



# Energy Report

## Elm Court, Highgate

Client: Red Cannon Developments Ltd

Author: Ruth Ferguson

## Revision History

| <i>Version</i> | <i>Date Issued</i> | <i>Issued by</i>              | <i>QA Check</i>                 |
|----------------|--------------------|-------------------------------|---------------------------------|
| <b>1</b>       | 17/12/2025         | <i>Ruth Ferguson, BSc MSc</i> | <i>Robert Holbrook, BSc MSc</i> |
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### About Environmental Economics

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  - *Part L (SAP) & Future Homes Standard*
  - *Part F (ventilation)*
  - *Part G (water)*
  - *Part O (overheating)*
- *Overheating - TM59 dynamic modelling*
- *Overheating – simple method*
- *Life cycle carbon assessments*
- *Net zero carbon assessments*
- *BREEAM*
- *SBEM (existing and new build)*
- *Minimum Energy Efficiency Standards (MEES)*
- *Thermal Bridging (Psi value calculations)*

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## 1. Executive Summary

- 1.1.1. Red Cannon Developments Ltd. have proposed a development comprising of 4 residential units. This application addresses a planning condition from Haringey Council.
- 1.1.2. The proposed development of 4 residential units at Elm Court, Highgate is designed to achieve and exceed the requirements set out in the London Plan 2021 through the use of good fabric, Exhaust Air Heat Pumps (EAHP) with heat recovery, and Waste Water Heat Recovery Systems (WWHRS) to reduce the site's carbon emissions.
- 1.1.3. Using the "Part\_L\_2021\_gla\_carbon\_emission\_reporting\_spreadsheet\_v2.0\_0", it has been confirmed that the proposed development will deliver the following reductions to regulated Carbon emissions:
- Building fabric specifications ("Be Lean") deliver 11% reduction in carbon emissions;
  - Total Carbon emissions reduced by 62% over Part L 2021 notional level.

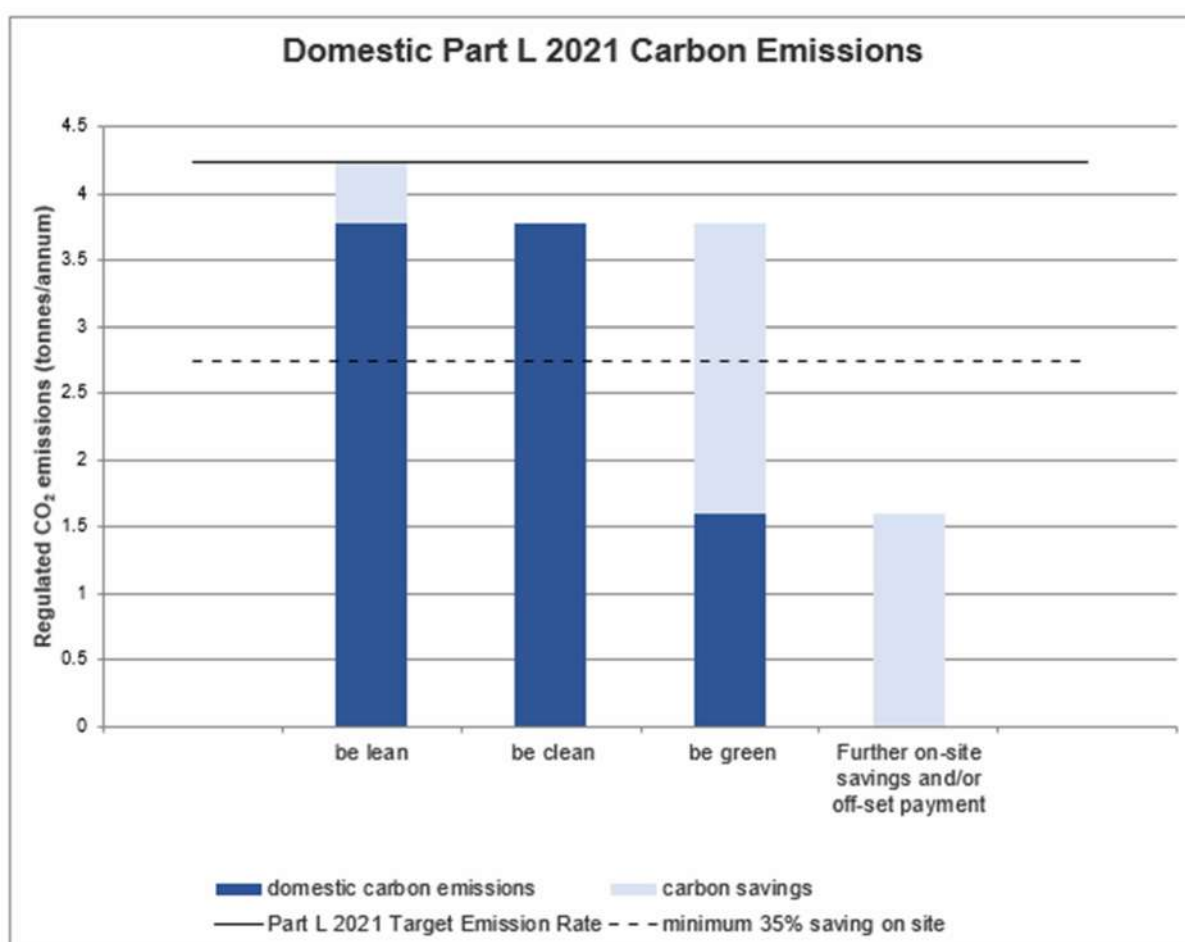


**Figure 1 – Carbon Emissions from the Energy Hierarchy**

1.1.4. The following tables summarise the reductions achieved at each stage of the energy hierarchy.

**Table 1 – Carbon emissions after each stage of the Energy Hierarchy**

|                                                                         | Carbon Dioxide Emissions for residential buildings<br>(Tonnes CO <sub>2</sub> per annum) |             |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------|
|                                                                         | Regulated                                                                                | Unregulated |
| Baseline: Part L 2021 of the Building Regulations Compliant Development | 4.2                                                                                      | 1.6         |
| After energy demand reduction (be lean)                                 | 3.8                                                                                      | 1.6         |
| After heat network connection (be clean)                                | 3.8                                                                                      | 1.6         |
| After renewable energy (be green)                                       | 1.6                                                                                      | 1.6         |

**Table 2 – Regulated carbon dioxide savings from each stage of the Energy Hierarchy**

|                                               | Regulated residential carbon dioxide savings |            |
|-----------------------------------------------|----------------------------------------------|------------|
|                                               | (Tonnes CO <sub>2</sub> per annum)           | (%)        |
| Be lean: savings from energy demand reduction | 0.5                                          | 11%        |
| Be clean: savings from heat network           | 0.0                                          | 0%         |
| Be green: savings from renewable energy       | 2.2                                          | 51%        |
| <b>Cumulative on site savings</b>             | <b>2.6</b>                                   | <b>62%</b> |
| Annual savings from off-set payment           | 1.6                                          | -          |
|                                               | (Tonnes CO <sub>2</sub> )                    |            |
| <b>Cumulative savings for off-set payment</b> | <b>48</b>                                    | -          |
| <b>Cash in-lieu contribution (£)</b>          | <b>4,577</b>                                 |            |

- 1.1.5. The use of smart meters will provide occupiers with real time data which will allow occupiers to manage their energy consumption, save money and reduce carbon emissions. This is particularly important as the UK migrates towards half-hourly pricing levels and the proposed smart grid system.
- 1.1.6. Overheating risk will be addressed at detailed design stage in accordance with Approved Document O of the Building Regulations. No active cooling is proposed.
- 1.1.7. The proposed development complies with the condition set out by Haringey Council by addressing the energy hierarchy and delivering a reduction in Carbon emissions of 62% over and above Approved Document L 2021.

## 2. Planning Policy

2.1.1. This report addresses the following condition from Haringey Council.

### 2.2. Planning Policy – Haringey Council

#### *Energy & Sustainability*

*Local Plan Policy SP4 outlines that the Council will promote measures to reduce carbon emissions and energy use from new buildings during design, construction and occupation. This policy requires all new residential development from 2016 onwards to be zero carbon. DM DPD Policy DM21 notes that all new development should implement sustainable design, layout and construction techniques. The energy hierarchy and cooling hierarchy should be applied to new developments. Building materials used should have high environmental performance ratings. Adverse impacts on the urban heat island should be minimised through design, layout, orientation, materials and the incorporation of green infrastructure, in line with London Plan Policy SI4.*

*Considering the main part of the application is for a new building on site such a planning application would need to be supported by an Energy & Sustainability Report to demonstrate compliance with the above policies. The report should clearly outline:*

- o the baseline regulated and unregulated emissions*
- o the assumptions included in that baseline model*
- o the Target Emission Rate (TER), Dwelling Emissions Rate (DER) for the residential home*
- o the reduction in carbon emissions following the energy hierarchy (Be Lean, Be Clean, Be Green).*
- o SAP output for a sample of the proposed residential dwellings for each stage of the energy hierarchy.*

2.2.1. The policies referenced above are given in full in Appendix E.

2.2.2. Haringey's Policy SP4 sets a zero-carbon target from 2016. However, the UK Government withdrew the aspiration for zero carbon homes and has replaced this with incremental reduction in carbon emissions via Building Regulations. The 2023 Ministerial statement (Appendix F) states that plan makers are not expected to set targets beyond building regulations. The next set of building regulations, called the Future Homes Standard (FHS), are due to be published in early 2026 and will improve standards on the current regulations by approximately 49%.

2.2.3. Therefore, the zero carbon ambition given in Policy SP4 is not applicable.

## 2.3. Building regulations

- 2.3.1. The 4 residential units for this development fall under Part L1A 2021 of the building regulations, and therefore will be required to follow SAP 10 methodology. Part L1A 2021 regulations will have a higher standard in carbon requirements than Part L1A 2013. Specifically, any plots on site which are to be built to the part L 2021 (using SAP 10) will exceed current Part L1A 2013 regulations by 31%.
- 2.3.2. In addition to the higher standards, some of the carbon content for different types of fuel has changed, meaning that the resultant carbon emissions will be calculated differently.

## 3. Energy Efficiency Assessment

### 3.1. Assessment Methodology

3.1.1. Environmental Economics have modelled a sample of the proposed dwellings using the software Design SAP 10, provided by Elmhurst Energy and approved by the BRE. The software provides several outputs, and based on the provided specification for this proposed development, we can assess the following areas for our calculations:

- *Building regulations compliance, including:*
  - *Carbon emissions (kg CO<sub>2</sub>/m<sup>2</sup>/year)*
  - *Primary Energy Demand (kWh/m<sup>2</sup>/annum)*
  - *Fabric Energy Efficiency (kWh/m<sup>2</sup>/annum)*
- *Energy usage per year (kWh/annum)*
- *Energy costs per year (£/annum)*
- *More detailed breakdowns by end use (space heating, water heating, cooking, lighting, appliances)*

3.1.2. Each of these outputs can be used in different ways to analyse the performance of the dwelling. The total regulated carbon emissions for each property are based upon:

- *Space heating*
- *Water heating*
- *Electricity for pumps and fans*
- *Electricity for lighting*

3.1.3. SAP software is issued by independent software suppliers and checked and approved on behalf of government by the Building Research Establishment (BRE).

3.1.4. The draft SAP reports used in this energy report are shown in Appendix G.

## 4. Energy Performance

### 4.1. Be Lean

- 4.1.1. To mitigate the residual carbon emissions by 11%, a number of improvements were made to the standard material and product specification.
- 4.1.2. The proposed standard U-Values of the external elements, as well as their notional and backstop U values, are shown in Table 3 below:

**Table 3 – Fabric Specification**

| <i>Element</i> | <i>Part L 2021<br/>Backstop</i> | <i>Notional U-Value<br/>Performance</i> | <i>Proposed U Value<br/>Performance</i> |
|----------------|---------------------------------|-----------------------------------------|-----------------------------------------|
| -              | <i>W/m<sup>2</sup>k</i>         | <i>W/m<sup>2</sup>k</i>                 | <i>W/m<sup>2</sup>k</i>                 |
| <b>Walls</b>   | 0.26                            | 0.18                                    | 0.14                                    |
| <b>Roof</b>    | 0.16                            | 0.11                                    | 0.09 – 0.12                             |
| <b>Floors</b>  | 0.18                            | 0.13                                    | 0.10                                    |
| <b>Doors</b>   | 1.60                            | 1.00                                    | 1.0                                     |
| <b>Glazing</b> | 1.60                            | 1.20                                    | 1.20                                    |

- 4.1.3. As the development is still at an early design stage, these U-values are subject to change.
- 4.1.4. As improvements are made to the thermal conductivity of main elements, thermal bridging and air permeability becomes increasingly significant in the overall fabric performance.
- 4.1.5. The design is at an early stage, and so it is not feasible to accurately model psi values (thermal losses at junctions of building elements). Therefore, the design SAP assessments have included psi values as per the schedule used within the Notional Building (TER) calculation, set out in The Government's Standard Assessment Procedure for Energy Rating of Dwellings v10.2 Table R2. During the detailed design process, the actual psi values must be modelled and should achieve the Notional values.

## 4.2. Be Green

- 4.2.1. The systems used in a property to supply hot water and heating, as well as to control it, are important to the overall energy demand of a property. ADL 2021 includes requirements for efficiency and controls of such equipment, including space heating, water heating, ventilation, and lighting.
- 4.2.2. The design of building services which provide space heating and domestic hot water, ventilation, and lighting, must be considered in a holistic way to avoid unintended consequences and to maximise the benefits from such systems.
- 4.2.3. After due consideration of the potential LZCT available (shown in Appendix B), individual Exhaust Air Heat Pumps are proposed for the development.
- ***Exhaust air heat pump (EAHP):***
    - No connection to the gas grid;
    - Uses grid electricity as the fuel;
    - Provides 100% space heating and domestic hot water;
    - Minimum co-efficient of performance over 2.5 (250% efficient);
    - Better than MEV alone as provides heat recovery via the heat pump;
    - Delivers very good performance within Building Regulations assessments;
    - Significant reduction in primary energy demand due to the Coefficient of Performance (COP).
- 4.2.4. In addition to the above, the design team proposes Elm Court, Highgate adopt the following technology which provide benefits as listed:
- ***Waste Water Heat Recovery (WWHR):***
    - Passive technology, no maintenance required;
    - Recovers waste heat from shower, pre-heats incoming cold. This mitigates the amount of hot water required from the hot water cylinder;
    - Typical systems recover ~60% waste heat.
- 4.2.5. The client is fully committed to adopting suitable renewable energy technologies where technically feasible.
- 4.2.6. Lighting provision will be from LED low energy fittings achieving a minimum efficacy of 100 lamp lumens per circuit watt, an improvement of over 50% from AD-L 2013 performance levels.

4.2.7. Smart meters will be installed on all properties, providing:

- Real time information on energy use both in terms of consumption and cost;
- Occupier can manage their energy, save money, and reduce carbon emissions;
- Smart meters will also allow for easier switching between suppliers;
- Facilitate a more reactive, price driven, demand-response;
- End estimated billing and eliminate the need for meter readers to visit premises.

## 5. Results

5.1.1. The on-site carbon reductions from the energy hierarchy can be viewed in detail in Appendix C.

5.1.2. In accordance with the London Plan 2021, the following results are presented:

- *Target Emissions Rate (regulatory maximum): 4.2 Tonnes CO<sub>2</sub> per annum*
- *Be Lean (after fabric improvements): 3.8 Tonnes CO<sub>2</sub> per annum (11% reduction)*
- *Be Green (proposed development): 1.6 Tonnes CO<sub>2</sub> per annum (62% reduction)*

5.1.3. As required by the planning condition, the energy hierarchy has been applied in order to minimise carbon dioxide emissions on site.

5.1.4. A reduction in carbon emissions of 62% has been achieved, thereby exceeding the 25% reduction target set out by the council.

5.1.5. Figure 2 demonstrates the carbon savings from each stage of the energy hierarchy.

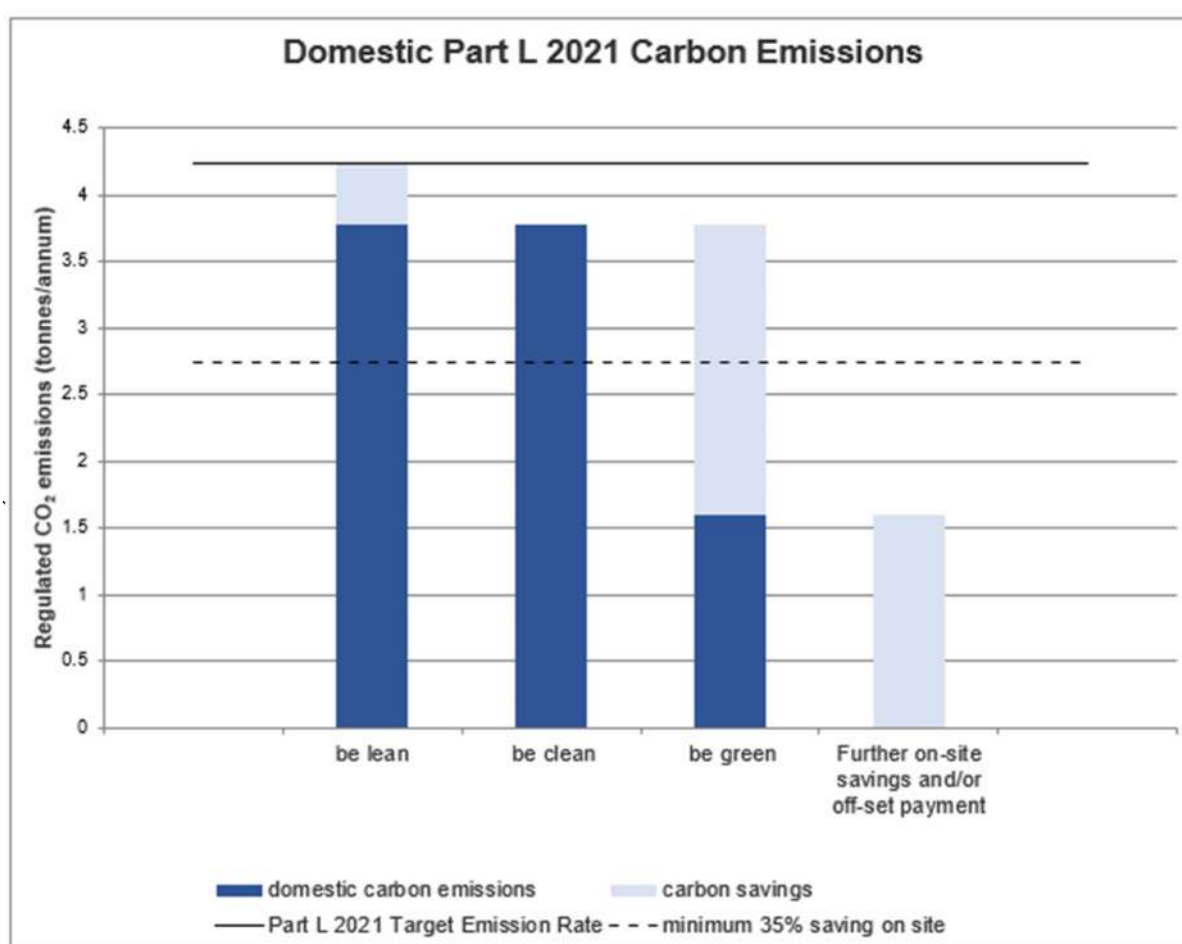
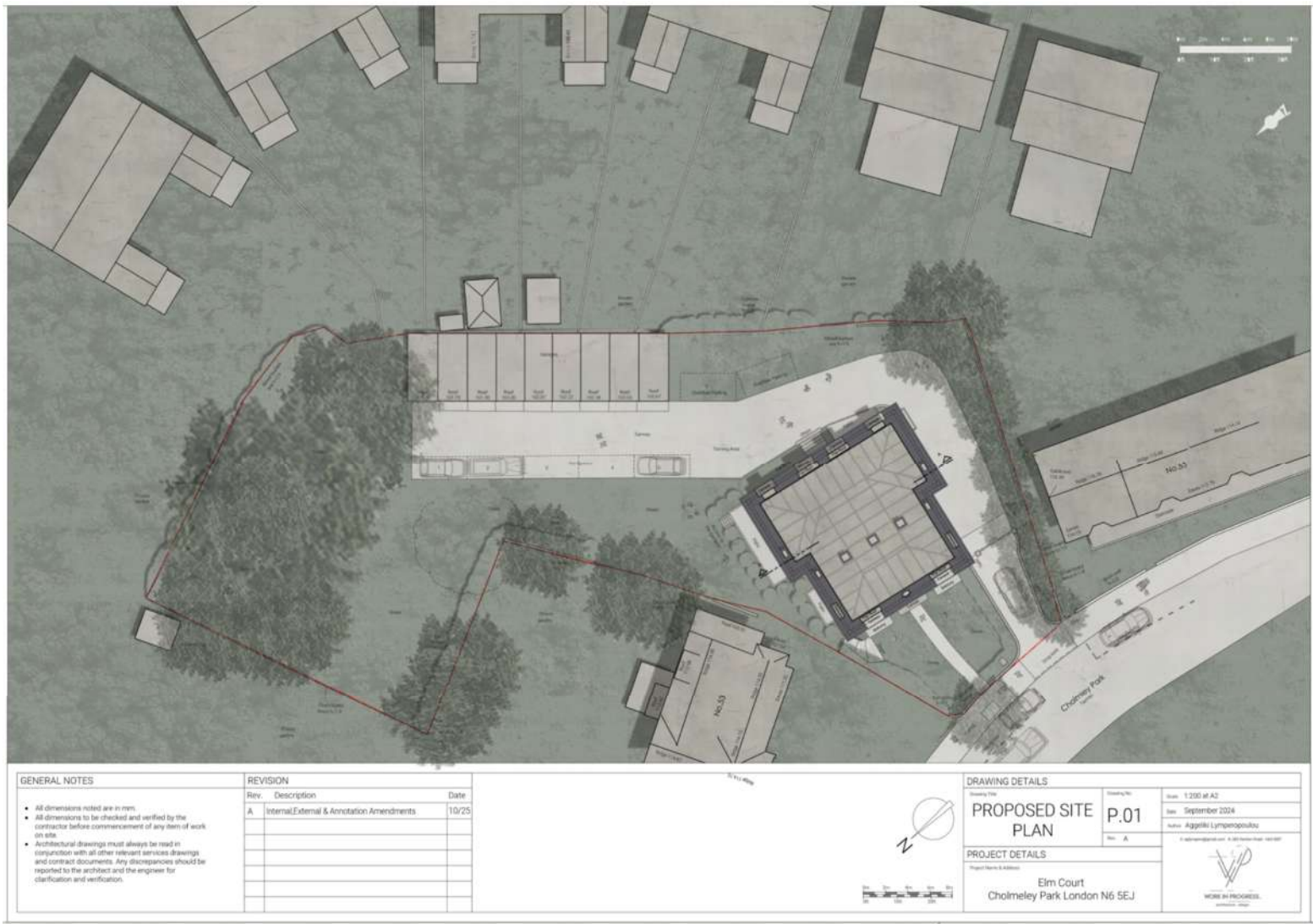


Figure 2 – CO<sub>2</sub> Savings at each stage of the energy hierarchy

## 6. Conclusion

- 6.1.1. This Energy Report has been produced to accompany the planning application for the proposed development of 4 residential units at Elm Court, Highgate.
- 6.1.2. The proposals set forth are in line with the sustainability policy requirements by utilising good design practice, whereby each relevant criterion has been appropriately addressed.
- 6.1.3. The development conforms to the requirements set out by Haringey Council.
- 6.1.4. The following LZCT are proposed for the development:
- Exhaust Air Heat Pumps (EAHPs)
  - Waste Water Heat Recovery (WWHR)
- 6.1.5. It is therefore considered that the proposal achieves the required levels of sustainability across the site.
- 6.1.6. This report demonstrates a detailed energy strategy to help reduce CO<sub>2</sub> emissions from the proposed Elm Court, Highgate site using the energy hierarchy described in the London Plan.
- 6.1.7. It has been demonstrated that the development will reduce carbon emissions by 62% against the target emission rate set out in Part L1A 2021. This is through the use of good fabric design and LZC Technologies recommended through this report. The proposed site therefore meets the planning condition of reducing carbon emissions by at least 25%.

Appendix A – Site Plan



## Appendix B – LZC Technologies

|                                                              | Description                                                                                                                                                                                                       | Advantages                                                                                                                                                                                                                                                                         | Disadvantages                                                                                                                                                   | Adopted? |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| Solar Hot Water (SHW)                                        | SHW systems generate energy which is used to heat stored water (in a special solar hot water cylinder) which offsets the energy required for the boiler, thereby reducing fuel use and reducing carbon emissions. | <ul style="list-style-type: none"> <li>Meets approximately 50% hot water demand for a dwelling</li> </ul>                                                                                                                                                                          | <ul style="list-style-type: none"> <li>PV cells provide more efficient use of roof area compared to SHW</li> </ul>                                              |          |
| Air Source Heat Pumps (ASHP) & Exhaust Air Heat Pumps (EAHP) | ASHP/EAHP provide heating and hot water to a home through thermal energy gathered from air outside the dwelling.                                                                                                  | <ul style="list-style-type: none"> <li>Net zero ready complying with UK Government policy to reach net zero carbon by 2050.</li> <li>This is achieved by utilizing low carbon grid electricity.</li> <li>Typical CoP of 3.5 leading to large energy and carbon savings.</li> </ul> | <ul style="list-style-type: none"> <li>Requires professional commissioning to ensure optimal performance. This ensures cost parity with gas systems.</li> </ul> | ✓        |
| Ground Source Heat Pumps (GSHP)                              | GSHP provide heating and hot water to a dwelling through geothermal effects.                                                                                                                                      | <ul style="list-style-type: none"> <li>CoP can be greater than that of ASHPs</li> </ul>                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>Rely on having appropriate ground conditions</li> <li>Expensive to install</li> </ul>                                    |          |
| Biomass Heating Systems                                      | Biomass heating systems burn fuels, considered carbon neutral, to heat the water required for a dwelling.                                                                                                         | <ul style="list-style-type: none"> <li>Large variety of systems available</li> <li>Good carbon savings when replacing electrical hot water system</li> </ul>                                                                                                                       | <ul style="list-style-type: none"> <li>High maintenance</li> </ul>                                                                                              |          |
| Wind Turbines                                                | Wind turbines provide electricity directly to a dwelling. They can be added to a property in two ways: pole mounted or building mounted.                                                                          | <ul style="list-style-type: none"> <li>Large-scale pole mounted turbines provide great financial return</li> </ul>                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Pole mounted requires a lot of space</li> <li>Building mounted have lower power output</li> </ul>                        |          |
| Waste Water Heat Recovery (WWHR)                             | Recovers the energy that is lost from the waste water that is generated from showers.                                                                                                                             | <ul style="list-style-type: none"> <li>Reduces load on the main DHW system, leading to greater energy/carbon savings</li> <li>Passive design requiring very low maintenance</li> </ul>                                                                                             | <ul style="list-style-type: none"> <li>Additional capital cost</li> </ul>                                                                                       | ✓        |

**Subject to final SAP calculations, the following technologies could be considered for the scheme:**

| Description             |                                                       | Advantages                                                                                                                                                   | Disadvantages                                                             | Adopted? |
|-------------------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------|
| Photovoltaic (PV) Cells | Generates electricity from solar energy from the sun. | <ul style="list-style-type: none"><li>• Provides carbon savings</li><li>• Excess electricity can be exported to the grid</li><li>• Low maintenance</li></ul> | <ul style="list-style-type: none"><li>• Additional capital cost</li></ul> |          |

## Appendix C – GLA Carbon Emission Report

### Input Data

| The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the TER/DER/BER and the TFE/DFEE. |                        |                 |                                 |                   |                                              |                                       |                          |                                       |                                       |                                       |                                          |                                       |                          |                                       |                                                                         |                          |                                       |                          |                          |                          |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-----------------|---------------------------------|-------------------|----------------------------------------------|---------------------------------------|--------------------------|---------------------------------------|---------------------------------------|---------------------------------------|------------------------------------------|---------------------------------------|--------------------------|---------------------------------------|-------------------------------------------------------------------------|--------------------------|---------------------------------------|--------------------------|--------------------------|--------------------------|
| RESIDENTIAL CO <sub>2</sub> ANALYSIS (PART L1)                                                                                                                                |                        |                 |                                 |                   |                                              |                                       |                          |                                       |                                       |                                       |                                          |                                       |                          |                                       |                                                                         |                          |                                       |                          |                          |                          |
| Unit identifier<br>(e.g. plot number, dwelling type etc.)                                                                                                                     | Model total floor area | Number of units | Total area represented by model | Baseline          |                                              | 'Be Lean'                             | 'Be Clean'               | 'Be Green'                            | Fabric Energy Efficiency (FEE)        |                                       | Baseline                                 |                                       | 'Be Lean'                |                                       | 'Be Clean'                                                              |                          | 'Be Green'                            |                          |                          |                          |
|                                                                                                                                                                               |                        |                 |                                 | TER               | Energy saving/generation on technologies (-) | DER                                   | DER                      | Target Fabric Energy Efficiency       | Dwelling Fabric Energy Efficiency     | Part L 2021 CO <sub>2</sub> emissions | Energy saving/generation on technologies | Part L 2021 CO <sub>2</sub> emissions | 'Be Lean' savings        | Part L 2021 CO <sub>2</sub> emissions | Part L 2021 CO <sub>2</sub> emissions with Notional PV savings included | 'Be Clean' savings       | Part L 2021 CO <sub>2</sub> emissions | 'Be Green' savings       |                          |                          |
|                                                                                                                                                                               |                        |                 |                                 | (m <sup>2</sup> ) | (m <sup>2</sup> )                            | (kgCO <sub>2</sub> / m <sup>2</sup> ) | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> / m <sup>2</sup> ) | (kgCO <sub>2</sub> / m <sup>2</sup> ) | (kgCO <sub>2</sub> / m <sup>2</sup> ) | (kWh/m <sup>2</sup> )                    | (kWh/m <sup>2</sup> )                 | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.)              | (kgCO <sub>2</sub> p.a.)                                                | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.)              | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.) |
|                                                                                                                                                                               |                        |                 |                                 | (Row 4)           | (m <sup>2</sup> )                            | (Row 273)                             | (Row 269)                | (Row 273 or 384)                      | (Row 273 or 384)                      | (Row 273 or 384)                      | (Row 273 or 384)                         | (Row 273 or 384)                      | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.)              | (kgCO <sub>2</sub> p.a.)                                                | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.)              | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.) | (kgCO <sub>2</sub> p.a.) |
| Top floor flat 1                                                                                                                                                              | 78.78                  | 2               | 157.56                          | 16.54             | -84.28                                       | 16.16                                 | 16.16                    | 6.43                                  | 50.97                                 | 47.90                                 | 2,606                                    | -169                                  | 2,546                    | 2,378                                 | 228                                                                     | 2,546                    | 2,378                                 | 0                        | 1,023                    |                          |
| Garden floor fl                                                                                                                                                               | 54.72                  | 2               | 109.44                          | 14.85             | -58.57                                       | 13.88                                 | 13.88                    | 5.33                                  | 35.36                                 | 31.44                                 | 1,625                                    | -117                                  | 1,519                    | 1,482                                 | 223                                                                     | 1,519                    | 1,482                                 | 0                        | 583                      |                          |

### EUI and Space Heating Demand

| Applicants can use the 'be seen' methodology or an alternative predictive energy modelling methodology to fill in this tab.<br>Where 'be seen' reporting is used the reported EUI and space heating demand should align with energy consumption data reported in the planning stage submission for the 'be seen' policy, submitted via the online webform. |                       |                                       |                        |                |                |                    |                         |                         |                        |                          |           |                                             |                                                             |                                                                              |                                                                                                |                                                                                                           |                    |                                   |                                                                                                        |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------------------------------------|------------------------|----------------|----------------|--------------------|-------------------------|-------------------------|------------------------|--------------------------|-----------|---------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------|--------------------------------------------------------------------------------------------------------|--|
| Residential predicted energy use                                                                                                                                                                                                                                                                                                                           |                       |                                       |                        |                |                |                    |                         |                         |                        |                          |           |                                             |                                                             |                                                                              |                                                                                                |                                                                                                           |                    |                                   |                                                                                                        |  |
| Building type                                                                                                                                                                                                                                                                                                                                              | GIA (m <sup>2</sup> ) | EUI & space heating demand (kWh/year) |                        |                |                |                    |                         |                         |                        |                          |           | Has the following energy use been included? |                                                             | Results                                                                      |                                                                                                | Table 4 of the guidance comparison                                                                        |                    | Methodology used                  |                                                                                                        |  |
|                                                                                                                                                                                                                                                                                                                                                            |                       | Space heating demand                  | Annual Electricity Use | Annual Gas Use | Annual Oil Use | Annual Biomass Use | Annual District Htg Use | Annual District Ctg Use | Elec Generation, Gross | Solar Thermal Generation | Regulated | Unregulated                                 | EUI (kWh/m <sup>2</sup> /year) (excluding renewable energy) | Space heating demand (kWh/m <sup>2</sup> /year) (excluding renewable energy) | EUI value from Table 4 of the guidance (kWh/m <sup>2</sup> /year) (excluding renewable energy) | Space heating demand from Table 4 of the guidance (kWh/m <sup>2</sup> /year) (excluding renewable energy) | Software           | Operational energy use assessment | notes (if expected performance differs from the Table 4 values in the guidance or other software used) |  |
|                                                                                                                                                                                                                                                                                                                                                            |                       |                                       |                        |                |                |                    |                         |                         |                        |                          |           |                                             |                                                             |                                                                              |                                                                                                |                                                                                                           |                    |                                   |                                                                                                        |  |
| Residential use (total)                                                                                                                                                                                                                                                                                                                                    | 267                   | 11104.12                              | 22510.64               | 0              | 0              | 0                  | 0                       | 0                       | 0                      | 0                        | Yes       | Yes                                         | 84.30951311                                                 | 4158846442                                                                   | 35                                                                                             | 15                                                                                                        | Part L1 - SAP 10.2 | none                              |                                                                                                        |  |
| Landlord Circulation (in Residential Blocks)                                                                                                                                                                                                                                                                                                               |                       |                                       |                        |                |                |                    |                         |                         |                        |                          |           |                                             |                                                             |                                                                              |                                                                                                |                                                                                                           |                    |                                   |                                                                                                        |  |
| Total                                                                                                                                                                                                                                                                                                                                                      | 267                   | 11104.12                              | 22510.64               | 0              | 0              | 0                  | 0                       | 0                       | 0                      | 0                        |           |                                             |                                                             |                                                                              |                                                                                                |                                                                                                           |                    |                                   |                                                                                                        |  |

## Summary Tables

### Residential

**Table 1:** Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

|                                                                         | Carbon Dioxide Emissions for residential buildings<br>(Tonnes CO <sub>2</sub> per annum) |             |
|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------|-------------|
|                                                                         | Regulated                                                                                | Unregulated |
| Baseline: Part L 2021 of the Building Regulations Compliant Development | 4.2                                                                                      | 1.6         |
| After energy demand reduction (be lean)                                 | 3.8                                                                                      | 1.6         |
| After heat network connection (be clean)                                | 3.8                                                                                      | 1.6         |
| After renewable energy (be green)                                       | 1.6                                                                                      | 1.6         |

**Table 2:** Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for residential buildings

|                                               | Regulated residential carbon dioxide savings |            |
|-----------------------------------------------|----------------------------------------------|------------|
|                                               | Tonnes CO <sub>2</sub> per annum             | (%)        |
| Be lean: savings from energy demand reduction | 0.5                                          | 11%        |
| Be clean: savings from heat network           | 0.0                                          | 0%         |
| Be green: savings from renewable energy       | 2.2                                          | 51%        |
| <b>Cumulative on site savings</b>             | <b>2.6</b>                                   | <b>62%</b> |
| Annual savings from off-set payment           | 1.6                                          | -          |
| <b>(Tonnes CO<sub>2</sub>)</b>                |                                              |            |
| <b>Cumulative savings for off-set payment</b> | <b>48</b>                                    | -          |
| <b>Cash in-lieu contribution (£)</b>          | <b>4,577</b>                                 |            |

\* carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide unless Local Planning Authority price is inputted in the 'Development'

**SITE-WIDE**

|                      | Total regulated emissions<br>(Tonnes CO <sub>2</sub> / year) | CO <sub>2</sub> savings<br>(Tonnes CO <sub>2</sub> / year)   | Percentage savings<br>(%) |
|----------------------|--------------------------------------------------------------|--------------------------------------------------------------|---------------------------|
| Part L 2021 baseline | 4.2                                                          |                                                              |                           |
| Be lean              | 3.8                                                          | 0.5                                                          | 11%                       |
| Be clean             | 3.8                                                          | 0.0                                                          | 0%                        |
| Be green             | 1.6                                                          | 2.2                                                          | 51%                       |
| Total Savings        | -                                                            | 2.6                                                          | 62%                       |
|                      | -                                                            | CO <sub>2</sub> savings off-set<br>(Tonnes CO <sub>2</sub> ) | -                         |
| Off-set              | -                                                            | 48.2                                                         | -                         |

|                   | Target Fabric Energy Efficiency (kWh/m <sup>2</sup> ) | Dwelling Fabric Energy Efficiency (kWh/m <sup>2</sup> ) | Improvement (%) |
|-------------------|-------------------------------------------------------|---------------------------------------------------------|-----------------|
| Development total | 44.57                                                 | 40.72                                                   | 9%              |

|          | Area weighted non-residential cooling demand (MJ/m <sup>2</sup> ) | Total non-residential cooling demand (MJ/year) |
|----------|-------------------------------------------------------------------|------------------------------------------------|
| Actual   |                                                                   |                                                |
| Notional |                                                                   |                                                |

**EUI & space heating demand (predicted energy use)****Residential**

| Building type | EUI<br>(kWh/m <sup>2</sup> /year)<br>(excluding renewable energy) | Space heating demand<br>(kWh/m <sup>2</sup> /year)<br>(excluding renewable energy) | EUI value from Table 4 of the guidance<br>(kWh/m <sup>2</sup> /year)<br>(excluding renewable energy) | Space heating demand from Table 4 of the guidance<br>(kWh/m <sup>2</sup> /year)<br>(excluding renewable energy) | Methodology used<br>(e.g. 'be seen' methodology or an alternative predictive energy modelling methodology) | Explanatory notes<br>(if expected performance differs from the Table 4 values in the guidance) |
|---------------|-------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Residential   | 84.30951311                                                       | 41.58846442                                                                        | 35                                                                                                   | 15                                                                                                              | Part L1 - SAP 10.2 & none dwellings / & Landlord Circulation                                               |                                                                                                |

## Appendix D – Modelled EAHP Product Information

[Home](#) / [Products](#) / [Exhaustair Heat Pump](#)

### Modul-Air Exhaust Air Heat Pump

Modul-AIR Exhaust Air Heat Pump (EAHP) provides mechanical ventilation with heat recovery, domestic hot water (DHW) & heating via radiators or underfloor heating (UFH).

This solution is best suited for new build flat developments. It uses the waste heat from the extract ventilation and this is recovered by the heat pump to provide the heating and hot water for the dwelling.

[Brochure](#) [Manual](#) [Service & Maintenance](#)





## MODUL-AIR

- ✓ Stand alone heating, hot water & ventilation system
- ✓ Decentralised solution for high density flat development
- ✓ cMEV or MVHR, ensuring Part F compliance
- ✓ Heat pump COP of up to 4.9 (A20/W35)
- ✓ Lower running costs
- ✓ Full compliance with Part L and SAP/DEAP using an all-electric solution
- ✓ Beneficial in an Overheating Risk Analysis
- ✓ Lower CAPEX and OPEX cost versus district heating
- ✓ No occupier standing charges or scheme management fees
- ✓ No gas connection, major plantroom maintenance, metering or billing

## Appendix E – Policies

### Development Management DPD (2017)

#### Policy DM21: Sustainable Design, Layout and Construction

*A. All new development, including building and landscape works, will be expected to consider and implement sustainable design, layout and construction techniques. Proposals should:*

- a) Apply the energy hierarchy to minimise energy use in order to meet, and if possible exceed, minimum carbon dioxide reduction requirements;*
- b) Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;*
- c) Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls*
- d) Wherever possible, use building materials with high environmental performance ratings; and*
- e) Seek opportunities for locally sourced labour.*

*B. The Council will support appropriate measures to sustainably retrofit existing homes and non-residential buildings.*

*C. Proposals that fail to demonstrate adequate consideration for sustainable design, layout and construction techniques will be resisted.*

*D. Consideration will be given to the use of carbon offset payments, to be secured by planning obligations, where it can be demonstrated that proposals are unable to meet carbon dioxide emission reduction targets on-site.*

## **Haringey Local Plan Strategic Policies (2013)**

### **SP4: Working towards a low carbon Haringey**

*Over the life time of the Local Plan, reducing energy use in buildings and working towards a low carbon borough will be one of the key challenges facing Haringey. The Council will promote the measures outlined below to reduce carbon emissions from new and existing buildings.*

*1. In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:*

*a. From 2011 onwards, all new residential development will achieve a minimum 25% reduction in total (regulated) CO2 emissions in line with Code for Sustainable Homes Level 4 energy standards, and should aim to achieve Level 6. All new residential development shall be zero carbon from 2016 onwards; and*

*b. From 2011 onwards all new non-residential development shall be built to at least BREEAM "very good" standard and should aim to achieve BREEAM "excellent" or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.*

*2. The Council will promote low- and zero-carbon energy generation through the following measures:*

*a. Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;*

*b. Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;*

*c. Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and*

*d. All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.*

## Appendix F – Written Ministerial Statement

### Baroness Penn, 13<sup>th</sup> December 2023:

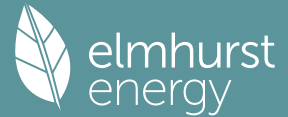
"In 2015, in reference to an uncommenced provision in the Deregulation Act 2015 which amended the Planning and Energy Act 2008, a written ministerial statement (WMS) (HC Deb, 25 March 2015, vol 584, cols 131-138WS) stated that until that amendment was commenced, local plan policies exceeding minimum energy efficiency standards should not go beyond level 4 of the Code for Sustainable Homes. Since then, the introduction of the 2021 Part L uplift to the Building Regulations set national minimum energy efficiency standards that are higher than those referenced in the 2015 WMS rendering it effectively moot.

"The improvement in standards already in force, alongside the ones which are due in 2025, demonstrates the Government's commitment to ensuring new properties have a much lower impact on the environment in the future. In this context, the Government does not expect plan-makers to set local energy efficiency standards for buildings that go beyond current or planned buildings regulations. The proliferation of multiple, local standards by local authority area can add further costs to building new homes by adding complexity and undermining economies of scale. Any planning policies that propose local energy efficiency standards for buildings that go beyond current or planned buildings regulation should be rejected at examination if they do not have a well-reasoned and robustly costed rationale."

## Appendix G – SAP Calculations

*SAP calculations from all three stages of the energy hierarchy can be found on the following pages:*

# Full SAP Calculation Printout



|                                    |                            |               |       |               |                |            |  |
|------------------------------------|----------------------------|---------------|-------|---------------|----------------|------------|--|
| Plot Reference                     | Garden floor flat A        |               |       |               | Issued on Date | 11/12/2025 |  |
| Assessment Reference               | Be Clean                   |               |       | Plot Type Ref |                |            |  |
| Plot Address                       |                            |               |       |               | SAP Version    | 10.2       |  |
|                                    |                            |               |       |               |                |            |  |
| SAP Rating                         | 85 B                       | DER           | 13.88 | TER           | 14.85          |            |  |
| Environmental                      | 90 B                       | % DER < TER   |       |               |                | 6.53       |  |
| CO <sub>2</sub> Emissions (t/year) | 0.67                       | DFEE          | 31.44 | TFEE          | 35.36          |            |  |
| Compliance Check                   | See BREL                   | % DFEE < TFEE |       |               |                | 11.09      |  |
| % DPER < TPER                      | 2.76                       | DPER          | 77.75 | TPER          | 79.96          |            |  |
|                                    |                            |               |       |               |                |            |  |
| Assessor Details                   | Ms. Ruth Ferguson          |               |       |               | Assessor ID    | AE69-0001  |  |
| Client                             | Red Cannon, Suite 1, 18-22 |               |       |               |                |            |  |

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> )                    |
|--------------------------------------------------------|---------------------------|----------------------|------------------------------------------------|
| Main dwelling                                          |                           |                      |                                                |
| Ground floor                                           | 54.7300 (1b)              | 2.4700 (2b)          | 135.1831 (1b) - (3b)                           |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.7300                   |                      | 135.1831 (4)                                   |
| Dwelling volume                                        |                           |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 135.1831 (5) |

## 2. Ventilation rate

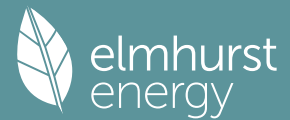
|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of 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                                                                | 2 * 10 = 20.0000 (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) = | 20.0000 / (5) = 0.1479 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0100 (17)                             |
| Infiltration rate                                                                                  | 0.3984 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3387 (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 | 0.4318 | 0.4234 | 0.4149 | 0.3725 | 0.3641 | 0.3217 | 0.3217 | 0.3133 | 0.3387 | 0.3641 | 0.3810 | 0.3979 (22b) |
| Effective ac    | 0.5932 | 0.5896 | 0.5861 | 0.5694 | 0.5663 | 0.5518 | 0.5518 | 0.5491 | 0.5574 | 0.5663 | 0.5726 | 0.5792 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Door                                                           |                         |                            | 1.6800                    | 1.0000                        | 1.6800       |                                      | (26)            |
| Windows                                                        |                         |                            | 7.5300                    | 1.1450                        | 8.6221       |                                      | (27)            |
| Heatloss Floor 1                                               |                         |                            | 54.7300                   | 0.1000                        | 5.4730       | 20.0000                              | 1094.6000 (28a) |
| External Wall 1                                                | 48.7300                 | 9.2100                     | 39.5200                   | 0.1400                        | 5.5328       | 70.0000                              | 2766.4000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 103.4600                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 21.3079      |                                      | (33)            |
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Party Wall 1                                                   |                         |                            | 28.0100                   | 0.0000                        | 0.0000       | 140.0000                             | 3921.4000 (32)  |
| Party Ceiling 1                                                |                         |                            | 54.7300                   |                               |              | 30.0000                              | 1641.9000 (32b) |
| Internal Wall 1                                                |                         |                            | 100.7800                  |                               |              | 9.0000                               | 907.0200 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 10331.3200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 188.7689 (35)   |
| List of Thermal Bridges                                        |                         |                            |                           |                               |              |                                      |                 |
| K1 Element                                                     |                         |                            |                           | Length                        | Psi-value    | Total                                |                 |
| E2 Other lintels (including other steel lintels)               |                         |                            |                           | 3.8000                        | 0.0500       | 0.1900                               |                 |
| E3 Sill                                                        |                         |                            |                           | 4.8000                        | 0.0500       | 0.2400                               |                 |
| E4 Jamb                                                        |                         |                            |                           | 13.4000                       | 0.0500       | 0.6700                               |                 |
| E5 Ground floor (normal)                                       |                         |                            |                           | 19.7300                       | 0.1600       | 3.1568                               |                 |
| E16 Corner (normal)                                            |                         |                            |                           | 4.9400                        | 0.0900       | 0.4446                               |                 |

# Full SAP Calculation Printout



|                                                                           |         |                       |              |
|---------------------------------------------------------------------------|---------|-----------------------|--------------|
| E18 Party wall between dwellings                                          | 7.4100  | 0.0600                | 0.4446       |
| E7 Party floor between dwellings (in blocks of flats)                     | 19.7300 | 0.0700                | 1.3811       |
| E17 Corner (inverted - internal area greater than external area)          | 2.4700  | -0.0900               | -0.2223      |
| E25 Staggered party wall between dwellings                                | 2.4700  | 0.0600                | 0.1482       |
| P1 Party wall - Ground floor                                              | 11.3400 | 0.0800                | 0.9072       |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.3400 | 0.0000                | 0.0000       |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |                       | 7.3602 (36)  |
| Point Thermal bridges                                                     |         |                       | 0.0000       |
| Total fabric heat loss                                                    |         | (33) + (36) + (36a) = | 28.6681 (37) |

|                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                |                |                |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>26.4644 | Feb<br>26.3029 | Mar<br>26.1446 | Apr<br>25.4010 | May<br>25.2619 | Jun<br>24.6143 | Jul<br>24.6143 | Aug<br>24.4943 | Sep<br>24.8637 | Oct<br>25.2619 | Nov<br>25.5433 | Dec<br>25.8375 (38) |
| Heat transfer coeff                                                 | 55.1325        | 54.9710        | 54.8127        | 54.0691        | 53.9300        | 53.2824        | 53.2824        | 53.1625        | 53.5319        | 53.9300        | 54.2115        | 54.5057 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                |                |                |                |                |                |                |                | 54.0685             |
| HLP                                                                 | Jan<br>1.0074  | Feb<br>1.0044  | Mar<br>1.0015  | Apr<br>0.9879  | May<br>0.9854  | Jun<br>0.9736  | Jul<br>0.9736  | Aug<br>0.9714  | Sep<br>0.9781  | Oct<br>0.9854  | Nov<br>0.9905  | Dec<br>0.9959 (40)  |
| HLP (average)                                                       |                |                |                |                |                |                |                |                |                |                |                | 0.9879              |
| Days in mont                                                        | 31             | 28             | 31             | 30             | 31             | 30             | 31             | 31             | 30             | 31             | 30             | 31                  |

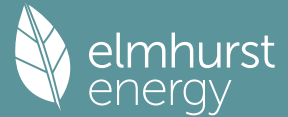
|                                                                                |          |          |          |          |          |          |          |          |          |                                        |          |               |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|---------------|----------------|
| 4. Water heating energy requirements (kWh/year)                                |          |          |          |          |          |          |          |          |          |                                        |          |               |                |
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |                                        |          | 1.8294 (42)   |                |
| Hot water usage for mixer showers                                              | 70.4615  | 69.4026  | 67.8596  | 64.9073  | 62.7286  | 60.2989  | 58.9179  | 60.4492  | 62.1279  | 64.7366                                | 67.7523  | 70.1916 (42a) |                |
| Hot water usage for baths                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000 (42b)  |                |
| Hot water usage for other uses                                                 | 33.3653  | 32.1520  | 30.9388  | 29.7255  | 28.5122  | 27.2989  | 27.2989  | 28.5122  | 29.7255  | 30.9388                                | 32.1520  | 33.3653 (42c) |                |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |                                        |          | 95.2953 (43)  |                |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct                                    | Nov      | Dec           |                |
|                                                                                | 103.8269 | 101.5547 | 98.7984  | 94.6328  | 91.2408  | 87.5978  | 86.2168  | 88.9614  | 91.8533  | 95.6754                                | 99.9044  | 103.5569 (44) |                |
| Energy content (annual)                                                        | 164.4364 | 144.6125 | 151.8494 | 129.5476 | 122.8276 | 107.7117 | 104.2717 | 110.1528 | 113.2643 | 129.8306                               | 142.3321 | 162.1451 (45) |                |
| Distribution loss (46)m = 0.15 x (45)m                                         | 24.6655  | 21.6919  | 22.7774  | 19.4321  | 18.4241  | 16.1568  | 15.6408  | 16.5229  | 16.9897  | 19.4746                                | 21.3498  | 24.3218 (46)  |                |
| Water storage loss (or HIU 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                                                                     | 5.3884   | 4.8591   | 5.3596   | 5.1415   | 5.2836   | 5.0850   | 5.2393   | 5.2555   | 5.1044   | 5.3079                                 | 5.1807   | 5.3838 (61)   |                |
| Total heat required for water heating calculated for each month                |          |          |          |          |          |          |          |          |          |                                        |          |               |                |
|                                                                                | 169.8248 | 149.4716 | 157.2090 | 134.6891 | 128.1113 | 112.7967 | 109.5110 | 115.4083 | 118.3687 | 135.1385                               | 147.5128 | 167.5289 (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                                                                | 169.8248 | 149.4716 | 157.2090 | 134.6891 | 128.1113 | 112.7967 | 109.5110 | 115.4083 | 118.3687 | 135.1385                               | 147.5128 | 167.5289 (64) |                |
| Total per year (kWh/year)                                                      |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = |          |               | 1645.5708 (64) |
| Electric shower(s)                                                             |          |          |          |          |          |          |          |          |          |                                        |          | 1646 (64)     |                |
|                                                                                | 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                                       |          |          |          |          |          |          |          |          |          |                                        |          |               |                |
|                                                                                | 56.0222  | 49.2984  | 51.8298  | 44.3599  | 42.1611  | 37.0854  | 35.9802  | 37.9397  | 38.9365  | 44.4957                                | 48.6206  | 55.2592 (65)  |                |

|                                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|-------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| 5. Internal gains (see Table 5 and 5a)                                              |                |                |                |                |                |                |                |                |                |                |                |                     |
| Metabolic gains (Table 5), Watts                                                    |                |                |                |                |                |                |                |                |                |                |                |                     |
| (66)m                                                                               | Jan<br>91.4722 | Feb<br>91.4722 | Mar<br>91.4722 | Apr<br>91.4722 | May<br>91.4722 | Jun<br>91.4722 | Jul<br>91.4722 | Aug<br>91.4722 | Sep<br>91.4722 | Oct<br>91.4722 | Nov<br>91.4722 | Dec<br>91.4722 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 86.6302        | 95.9120        | 86.6302        | 89.5178        | 86.6302        | 89.5178        | 86.6302        | 86.6302        | 89.5178        | 86.6302        | 89.5178        | 86.6302 (67)        |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 159.4895       | 161.1445       | 156.9740       | 148.0954       | 136.8877       | 126.3541       | 119.3170       | 117.6620       | 121.8325       | 130.7112       | 141.9188       | 152.4524 (68)       |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472 (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)                                 | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778 (71)       |
| Water heating gains (Table 5)                                                       | 75.2987        | 73.3608        | 69.6637        | 61.6110        | 56.6681        | 51.5075        | 48.3604        | 50.9942        | 54.0785        | 59.8060        | 67.5286        | 74.2731 (72)        |
| Total internal gains                                                                | 374.8600       | 383.8589       | 366.7096       | 352.6659       | 333.6277       | 317.8211       | 304.7493       | 305.7280       | 315.8705       | 330.5890       | 352.4069       | 366.7974 (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   |               |
| Northeast      | 6.0300     |          | 11.2829                        |          | 0.7600                            |          | 0.7000                             |          | 0.7700                       |          | 25.0833 (75) |               |
| Southeast      | 1.5000     |          | 36.7938                        |          | 0.7600                            |          | 0.7000                             |          | 0.7700                       |          | 20.3475 (77) |               |
| Solar gains    | 45.4308    | 85.7171  | 139.4123                       | 209.8324 | 268.8874                          | 281.8357 | 265.5220                           | 219.1875 | 163.4395                     | 100.7026 | 55.9329      | 37.8975 (83)  |
| Total gains    | 420.2908   | 469.5760 | 506.1218                       | 562.4983 | 602.5151                          | 599.6568 | 570.2713                           | 524.9155 | 479.3100                     | 431.2915 | 408.3398     | 404.6949 (84) |

|                                                                             |  |  |  |  |  |  |  |  |  |  |  |              |
|-----------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--------------|
| 7. Mean internal temperature (heating season)                               |  |  |  |  |  |  |  |  |  |  |  |              |
| Temperature during heating periods in the living area from Table 9, Th1 (C) |  |  |  |  |  |  |  |  |  |  |  | 21.0000 (85) |

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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                    | 52.0530 | 52.2059 | 52.3567 | 53.0767 | 53.2136 | 53.8604 | 53.8604 | 53.9819 | 53.6094             | 53.2136 | 52.9374 | 52.6516      |
| alpha                  | 4.4702  | 4.4804  | 4.4904  | 4.5384  | 4.5476  | 4.5907  | 4.5907  | 4.5988  | 4.5740              | 4.5476  | 4.5292  | 4.5101       |
| util living area       | 0.9835  | 0.9717  | 0.9477  | 0.8754  | 0.7375  | 0.5495  | 0.4070  | 0.4584  | 0.7005              | 0.9088  | 0.9704  | 0.9858 (86)  |
| MIT                    | 19.7266 | 19.9232 | 20.2081 | 20.5920 | 20.8558 | 20.9709 | 20.9941 | 20.9900 | 20.9151             | 20.5739 | 20.0998 | 19.6996 (87) |
| Th 2                   | 20.0772 | 20.0797 | 20.0821 | 20.0934 | 20.0955 | 20.1054 | 20.1054 | 20.1073 | 20.1016             | 20.0955 | 20.0912 | 20.0868 (88) |
| util rest of house     | 0.9796  | 0.9652  | 0.9357  | 0.8481  | 0.6874  | 0.4796  | 0.3262  | 0.3729  | 0.6306              | 0.8824  | 0.9626  | 0.9825 (89)  |
| MIT 2                  | 18.6018 | 18.8512 | 19.2084 | 19.6787 | 19.9706 | 20.0868 | 20.1030 | 20.1028 | 20.0399             | 19.6697 | 19.0850 | 18.5745 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | FLA = Living area / | (4) =   |         | 0.4603 (91)  |
| MIT                    | 19.1195 | 19.3446 | 19.6685 | 20.0991 | 20.3780 | 20.4937 | 20.5131 | 20.5112 | 20.4427             | 20.0859 | 19.5521 | 19.0923 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                     |         |         | -0.1500      |
| adjusted MIT           | 18.9695 | 19.1946 | 19.5185 | 19.9491 | 20.2280 | 20.3437 | 20.3631 | 20.3612 | 20.2927             | 19.9359 | 19.4021 | 18.9423 (93) |

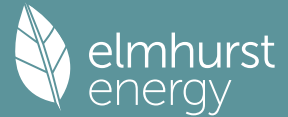
## 8. Space heating requirement

|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation                                                                    | 0.9735   | 0.9574   | 0.9267   | 0.8432   | 0.6952   | 0.4987   | 0.3497   | 0.3976   | 0.6463   | 0.8769        | 0.9550   | 0.9770 (94)    |
| Useful gains                                                                   | 409.1580 | 449.5676 | 469.0316 | 474.3045 | 418.8653 | 299.0438 | 199.4333 | 208.6832 | 309.7958 | 378.2017      | 389.9558 | 395.3733 (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                                                               | 808.7663 | 785.7872 | 713.5795 | 597.4139 | 459.9157 | 306.0394 | 200.5080 | 210.5851 | 331.5070 | 503.4835      | 666.9124 | 803.5408 (97)  |
| Space heating kWh                                                              | 297.3085 | 225.9396 | 181.9436 | 88.6388  | 30.5415  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.2097       | 199.4088 | 303.6765 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1420.6671      |
| 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                                                              | 297.3085 | 225.9396 | 181.9436 | 88.6388  | 30.5415  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.2097       | 199.4088 | 303.6765 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1420.6671      |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 25.9577 (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 %)                                                             |          |          |          |          |          |          |          |          |          |          |          | 89.0000 (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                                                                                    | 297.3085 | 225.9396 | 181.9436 | 88.6388  | 30.5415  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.2097  | 199.4088 | 303.6765 (98)   |
| Space heating efficiency (main heating system 1)                                                             | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)   |
| Space heating fuel (main heating system)                                                                     | 334.0545 | 253.8647 | 204.4311 | 99.5942  | 34.3163  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 104.7300 | 224.0548 | 341.2096 (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                                                                                    | 169.8248 | 149.4716 | 157.2090 | 134.6891 | 128.1113 | 112.7967 | 109.5110 | 115.4083 | 118.3687 | 135.1385 | 147.5128 | 167.5289 (64)   |
| Efficiency of water heater (217)m                                                                            | 88.3744  | 88.3153  | 88.2038  | 87.9669  | 87.6222  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 87.9860  | 88.2691  | 87.3000 (216)   |
| Fuel for water heating, kWh/month                                                                            | 192.1652 | 169.2478 | 178.2337 | 153.1133 | 146.2087 | 129.2059 | 125.4422 | 132.1974 | 135.5885 | 153.5909 | 167.1171 | 189.5379 (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                                                                                                     | 16.6874  | 13.3872  | 12.0537  | 8.8311   | 6.8214   | 5.5731   | 6.2227   | 8.0885   | 10.5061  | 13.7846  | 15.5697  | 17.1512 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)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 (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                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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                                                                           |          |          |          |          |          |          |          |          |          |          |          | 1596.2551 (211) |
| Space heating fuel - main system 2                                                                           |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                                   |          |          |          |          |          |          |          |          |          |          |          | 87.3000         |
| Water heating fuel used                                                                                      |          |          |          |          |          |          |          |          |          |          |          | 1871.6486 (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)                                                          |          |          |          |          |          |          |          |          |          |          |          | 134.6766 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| PV generation                                                                                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (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                                                                                |          |          |          |          |          |          |          |          |          |          |          |                 |

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|                                     |                 |
|-------------------------------------|-----------------|
| Energy saved or generated           | -0.0000 (236)   |
| Energy used                         | 0.0000 (237)    |
| Total delivered energy for all uses | 3688.5804 (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                   | 1596.2551          | 0.2100                        | 335.2136                 | (261) |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                      | 1871.6486          | 0.2100                        | 393.0462                 | (264) |
| Space and water heating                         |                    |                               | 728.2598                 | (265) |
| Pumps, fans and electric keep-hot               | 86.0000            | 0.1387                        | 11.9293                  | (267) |
| Energy for lighting                             | 134.6766           | 0.1443                        | 19.4380                  | (268) |
| Total CO2, kg/year                              |                    |                               | 759.6270                 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 13.8800                  | (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               | 1596.2551          | 1.1300                              | 1803.7683                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 1871.6486          | 1.1300                              | 2114.9629                  | (278) |
| Space and water heating                     |                    |                                     | 3918.7312                  | (279) |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008                   | (281) |
| Energy for lighting                         | 134.6766           | 1.5338                              | 206.5715                   | (282) |
| Total Primary energy kWh/year               |                    |                                     | 4255.4035                  | (286) |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 77.7500                    | (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) |             |
|--------------------------------------------------------|--------------|----------------------|----------------|-------------|
| Main dwelling                                          | 54.7300      | 2.4700               | 135.1831       | (1b) - (3b) |
| Ground floor                                           |              |                      |                | (4)         |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.7300      |                      |                | (5)         |
| Dwelling volume                                        |              |                      | 135.1831       | (5)         |

### 2. Ventilation rate

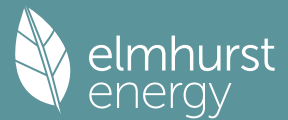
|                                                      |                                                       | m3 per hour     |             |
|------------------------------------------------------|-------------------------------------------------------|-----------------|-------------|
| Number of 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                  | 2 * 10 =                                              | 20.0000         | (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) = | 20.0000 / (5) = | 0.1479 (8)  |
| Pressure test                                        |                                                       | Yes             |             |
| Pressure Test Method                                 |                                                       | Blower Door     |             |
| Measured/design AP50                                 |                                                       | 5.0000          | (17)        |
| Infiltration rate                                    |                                                       | 0.3979          | (18)        |
| Number of sides sheltered                            |                                                       | 2               | (19)        |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =                           |                 | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =                                  |                 | 0.3383 (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 | 0.4313 | 0.4228 | 0.4144 | 0.3721 | 0.3636 | 0.3213 | 0.3213 | 0.3129 | 0.3383 | 0.3636 | 0.3805 | 0.3975 | (22b) |
| Effective ac    | 0.5930 | 0.5894 | 0.5858 | 0.5692 | 0.5661 | 0.5516 | 0.5516 | 0.5489 | 0.5572 | 0.5661 | 0.5724 | 0.5790 | (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 |       |
|------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-------------------|---------------|-------|
| Main dwelling                                  |             |                |               |                      |              |                   |               |       |
| TER Opaque door                                |             |                | 1.6800        | 1.0000               | 1.6800       |                   |               | (26)  |
| TER Opening Type                               |             |                | 7.5300        | 1.1450               | 8.6221       |                   |               | (27)  |
| Heatloss Floor 1                               |             |                | 54.7300       | 0.1300               | 7.1149       |                   |               | (28a) |
| External Wall 1                                | 48.7300     | 9.2100         | 39.5200       | 0.1800               | 7.1136       |                   |               | (29a) |
| Total net area of external elements Aum(A, m2) |             |                | 103.4600      |                      |              |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 24.5306      |                   |               | (33)  |
| Main dwelling                                  |             |                |               |                      |              |                   |               |       |
| Party Wall 1                                   |             |                | 28.0100       | 0.0000               | 0.0000       |                   |               | (32)  |

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

188.7689 (35)

List of Thermal Bridges

|                                                                           | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| K1 Element                                                                |         |           |         |
| E2 Other lintels (including other steel lintels)                          | 3.8000  | 0.0500    | 0.1900  |
| E3 Sill                                                                   | 4.8000  | 0.0500    | 0.2400  |
| E4 Jamb                                                                   | 13.4000 | 0.0500    | 0.6700  |
| E5 Ground floor (normal)                                                  | 19.7300 | 0.1600    | 3.1568  |
| E16 Corner (normal)                                                       | 4.9400  | 0.0900    | 0.4446  |
| E18 Party wall between dwellings                                          | 7.4100  | 0.0600    | 0.4446  |
| E7 Party floor between dwellings (in blocks of flats)                     | 19.7300 | 0.0700    | 1.3811  |
| E17 Corner (inverted - internal area greater than external area)          | 2.4700  | -0.0900   | -0.2223 |
| E25 Staggered party wall between dwellings                                | 2.4700  | 0.0600    | 0.1482  |
| P1 Party wall - Ground floor                                              | 11.3400 | 0.0800    | 0.9072  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.3400 | 0.0000    | 0.0000  |

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

7.3602 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 31.8908 (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                     | 26.4540 | 26.2928 | 26.1349 | 25.3932 | 25.2545 | 24.6085 | 24.6085 | 24.4888 | 24.8573 | 25.2545 | 25.5352 | 25.8287 | (38) |
| Heat transfer coeff       | 58.3448 | 58.1837 | 58.0258 | 57.2841 | 57.1453 | 56.4993 | 56.4993 | 56.3797 | 56.7481 | 57.1453 | 57.4260 | 57.7195 | (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 57.2834 |      |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| HLP           | 1.0660 | 1.0631 | 1.0602 | 1.0467 | 1.0441 | 1.0323 | 1.0323 | 1.0301 | 1.0369 | 1.0441 | 1.0493 | 1.0546 | (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0467 |      |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |      |

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

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |          |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          |          | 1.8294 (42) |
| Hot water usage for mixer showers                                              | 70.4615  | 69.4026  | 67.8596  | 64.9073  | 62.7286  | 60.2989  | 58.9179  | 60.4492  | 62.1279  | 64.7366  | 67.7523  | 70.1916  | (42a)       |
| Hot water usage for baths                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (42b)       |
| Hot water usage for other uses                                                 | 33.3653  | 32.1520  | 30.9388  | 29.7255  | 28.5122  | 27.2989  | 27.2989  | 28.5122  | 29.7255  | 30.9388  | 32.1520  | 33.3653  | (42c)       |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 95.2953  | (43)        |
| Daily hot water use                                                            | 103.8269 | 101.5547 | 98.7984  | 94.6328  | 91.2408  | 87.5978  | 86.2168  | 88.9614  | 91.8533  | 95.6754  | 99.9044  | 103.5569 | (44)        |
| Energy conte                                                                   | 164.4364 | 144.6125 | 151.8494 | 129.5476 | 122.8276 | 107.7117 | 104.2717 | 110.1528 | 113.2643 | 129.8306 | 142.3321 | 162.1451 | (45)        |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          |          |          |          |             |
| Distribution loss (46)m = 0.15 x (45)m                                         | 24.6655  | 21.6919  | 22.7774  | 19.4321  | 18.4241  | 16.1568  | 15.6408  | 16.5229  | 16.9897  | 19.4746  | 21.3498  | 24.3218  | (46)        |
| Water storage loss (or HIU 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                                                                     | 50.9589  | 46.0274  | 50.3466  | 46.6682  | 46.4953  | 43.1989  | 43.9351  | 45.3338  | 45.2975  | 48.7551  | 49.2679  | 50.9589  | (61)        |
| Total heat required for water heating calculated for each month                | 215.3953 | 190.6399 | 202.1960 | 176.2158 | 169.3229 | 150.9107 | 148.2068 | 155.4866 | 158.5619 | 178.5857 | 191.6000 | 213.1040 | (62)        |
| WWHRS                                                                          | -32.2121 | -28.4886 | -29.8316 | -24.7018 | -23.0212 | -19.6994 | -18.4650 | -19.6357 | -20.3817 | -24.0278 | -27.2206 | -31.6156 | (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                                                                | 183.1832 | 162.1513 | 172.3644 | 151.5140 | 146.3018 | 131.2113 | 129.7418 | 135.8509 | 138.1801 | 154.5579 | 164.3794 | 181.4884 | (64)        |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |          |          |          |             |
| 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                                       | 67.4148  | 59.5905  | 63.0766  | 54.7416  | 52.4640  | 46.6139  | 45.6541  | 47.9592  | 48.9848  | 55.3574  | 59.6424  | 66.6530  | (65)        |

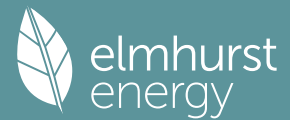
## 5. Internal gains (see Table 5 and 5a)

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |          |      |
| (66)m                                                                               | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 86.6302  | 95.9120  | 86.6302  | 89.5178  | 86.6302  | 89.5178  | 86.6302  | 86.6302  | 89.5178  | 86.6302  | 89.5178  | 86.6302  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 159.4895 | 161.1445 | 156.9740 | 148.0954 | 136.8877 | 126.3541 | 119.3170 | 117.6620 | 121.8325 | 130.7112 | 141.9188 | 152.4524 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | (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)                                 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | (71) |
| Water heating gains (Table 5)                                                       | 90.6113  | 88.6764  | 84.7803  | 76.0300  | 70.5162  | 64.7415  | 61.3631  | 64.4614  | 68.0344  | 74.4052  | 82.8367  | 89.5873  | (72) |
| Total internal gains                                                                | 390.1727 | 399.1745 | 381.8262 | 367.0849 | 347.4757 | 331.0551 | 317.7519 | 319.1952 | 329.8265 | 345.1882 | 367.7150 | 382.1116 | (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   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 6.0300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 20.7927 (75) |
| Southeast | 1.5000     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 16.8670 (77) |

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|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 37.6597  | 71.0550  | 115.5654 | 173.9400 | 222.8935 | 233.6270 | 220.1038 | 181.6949 | 135.4827 | 83.4771  | 46.3654  | 31.4150 (83)  |
| Total gains | 427.8324 | 470.2295 | 497.3916 | 541.0249 | 570.3692 | 564.6821 | 537.8557 | 500.8901 | 465.3092 | 428.6653 | 414.0804 | 413.5266 (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                                                                         | 49.1871 | 49.3233 | 49.4575 | 50.0979 | 50.2195 | 50.7937 | 50.7937 | 50.9015 | 50.5710 | 50.2195 | 49.9740 | 49.7199      |
| alpha                                                                       | 4.2791  | 4.2882  | 4.2972  | 4.3399  | 4.3480  | 4.3862  | 4.3862  | 4.3934  | 4.3714  | 4.3480  | 4.3316  | 4.3147       |
| util living area                                                            | 0.9832  | 0.9734  | 0.9545  | 0.8979  | 0.7832  | 0.6045  | 0.4536  | 0.5035  | 0.7377  | 0.9185  | 0.9711  | 0.9853 (86)  |
| MIT                                                                         | 19.6291 | 19.8131 | 20.0911 | 20.4844 | 20.7891 | 20.9495 | 20.9885 | 20.9822 | 20.8796 | 20.5008 | 20.0155 | 19.6043 (87) |
| Th 2                                                                        | 20.0287 | 20.0311 | 20.0335 | 20.0446 | 20.0467 | 20.0565 | 20.0565 | 20.0583 | 20.0527 | 20.0467 | 20.0425 | 20.0381 (88) |
| util rest of house                                                          | 0.9793  | 0.9672  | 0.9435  | 0.8733  | 0.7341  | 0.5278  | 0.3604  | 0.4068  | 0.6662  | 0.8934  | 0.9632  | 0.9819 (89)  |
| MIT 2                                                                       | 18.4442 | 18.6780 | 19.0281 | 19.5150 | 19.8606 | 20.0237 | 20.0518 | 20.0503 | 19.9638 | 19.5458 | 18.9441 | 18.4194 (90) |
| Living area fraction                                                        | 18.9895 | 19.2005 | 19.5173 | 19.9612 | 20.2880 | 20.4498 | 20.4829 | 20.4792 | 20.3853 | 19.9853 | 19.4372 | 0.4603 (91)  |
| MIT                                                                         | 18.9895 | 19.2005 | 19.5173 | 19.9612 | 20.2880 | 20.4498 | 20.4829 | 20.4792 | 20.3853 | 19.9853 | 19.4372 | 18.9648 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9895 | 19.2005 | 19.5173 | 19.9612 | 20.2880 | 20.4498 | 20.4829 | 20.4792 | 20.3853 | 19.9853 | 19.4372 | 18.9648 (93) |

## 8. Space heating requirement

|                                                                                |          |          |          |          |          |          |          |          |          |               |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
| Utilisation                                                                    | 0.9737   | 0.9604   | 0.9363   | 0.8708   | 0.7474   | 0.5608   | 0.4031   | 0.4509   | 0.6929   | 0.8915        | 0.9570   | 0.9768 (94)    |
| Useful gains                                                                   | 416.5861 | 451.6243 | 465.7185 | 471.1311 | 426.2662 | 316.6568 | 216.8192 | 225.8531 | 322.4173 | 382.1495      | 396.2605 | 403.9213 (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                                                               | 857.0578 | 832.0540 | 755.3403 | 633.6285 | 490.7614 | 330.5100 | 219.3825 | 229.9853 | 356.6781 | 536.3284      | 708.4775 | 852.2163 (97)  |
| Space heating kWh                                                              | 327.7109 | 255.6488 | 215.4786 | 116.9982 | 47.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 114.7092      | 224.7963 | 333.5315 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1636.8579      |
| 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                                                              | 327.7109 | 255.6488 | 215.4786 | 116.9982 | 47.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 114.7092      | 224.7963 | 333.5315 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1636.8579      |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 29.9079 (99)   |

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

|                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |                 |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 92.4000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
|                                                                                                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                                                            | 327.7109 | 255.6488 | 215.4786 | 116.9982 | 47.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 114.7092 | 224.7963 | 333.5315 (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)                                                             | 354.6655 | 276.6762 | 233.2020 | 126.6214 | 51.9312  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.1441 | 243.2860 | 360.9649 (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                                                                            | 183.1832 | 162.1513 | 172.3644 | 151.5140 | 146.3018 | 131.2113 | 129.7418 | 135.8509 | 138.1801 | 154.5579 | 164.3794 | 181.4884 (64)   |
| Efficiency of water heater                                                                           | 85.6124  | 85.3523  | 84.8609  | 83.8337  | 82.2655  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 83.7515  | 85.0526  | 80.3000 (216)   |
| Fuel for water heating, kWh/month                                                                    | 213.9680 | 189.9789 | 203.1139 | 180.7316 | 177.8410 | 163.4013 | 161.5714 | 169.1792 | 172.0799 | 184.5435 | 193.2680 | 211.8537 (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                                                                                             | 18.0000  | 14.4403  | 13.0019  | 9.5257   | 7.3580   | 6.0115   | 6.7122   | 8.7247   | 11.3326  | 14.8689  | 16.7944  | 18.5003 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -10.4404 | -15.8423 | -24.4894 | -29.6840 | -33.9447 | -32.4123 | -32.0328 | -29.2761 | -24.7649 | -19.0407 | -11.8742 | -8.9011 (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)                                        | -2.9155  | -6.3329  | -12.9677 | -20.0476 | -27.0733 | -27.4015 | -27.0655 | -22.6424 | -16.2515 | -9.2244  | -3.9460  | -2.2901 (233b)  |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system 1                                                                   |          |          |          |          |          |          |          |          |          |          |          | 1771.4912 (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                                                                              |          |          |          |          |          |          |          |          |          |          |          | 2221.5304 (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)                                                  |          |          |          |          |          |          |          |          |          |          |          | 145.2706 (232)  |

# Full SAP Calculation Printout



Energy saving/generation technologies (Appendices M ,N and Q)

|                                                |                 |
|------------------------------------------------|-----------------|
| PV generation                                  | -450.8612 (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            | 3773.4310 (238) |

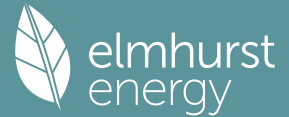
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 1771.4912          | 0.2100                        | 372.0132 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2221.5304          | 0.2100                        | 466.5214 (264)           |
| Space and water heating                       |                    |                               | 838.5345 (265)           |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 145.2706           | 0.1443                        | 20.9670 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -272.7029          | 0.1331                        | -36.2877                 |
| PV Unit electricity exported                  | -178.1583          | 0.1251                        | -22.2828                 |
| Total                                         |                    |                               | -58.5705 (269)           |
| Total CO2, kg/year                            |                    |                               | 812.8604 (272)           |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 14.8500 (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               | 1771.4912          | 1.1300                              | 2001.7851 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2221.5304          | 1.1300                              | 2510.3293 (278)            |
| Space and water heating                     |                    |                                     | 4512.1144 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 145.2706           | 1.5338                              | 222.8209 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -272.7029          | 1.4917                              | -406.7924                  |
| PV Unit electricity exported                | -178.1583          | 0.4591                              | -81.7861                   |
| Total                                       |                    |                                     | -488.5785 (283)            |
| Total Primary energy kWh/year               |                    |                                     | 4376.4576 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 79.9600 (287)              |

# Full SAP Calculation Printout



|                                    |                            |               |       |               |                |            |  |
|------------------------------------|----------------------------|---------------|-------|---------------|----------------|------------|--|
| Plot Reference                     | Garden floor flat A        |               |       |               | Issued on Date | 11/12/2025 |  |
| Assessment Reference               | Be Green                   |               |       | Plot Type Ref |                |            |  |
| Plot Address                       |                            |               |       |               | SAP Version    | 10.2       |  |
|                                    |                            |               |       |               |                |            |  |
| SAP Rating                         | 81 B                       | DER           | 5.33  | TER           | 14.36          |            |  |
| Environmental                      | 96 A                       | % DER < TER   |       |               |                | 62.88      |  |
| CO <sub>2</sub> Emissions (t/year) | 0.26                       | DFEE          | 31.44 | TFEE          | 35.36          |            |  |
| Compliance Check                   | See BREL                   | % DFEE < TFEE |       |               |                | 11.09      |  |
| % DPER < TPER                      | 27.61                      | DPER          | 55.96 | TPER          | 77.30          |            |  |
|                                    |                            |               |       |               |                |            |  |
| Assessor Details                   | Ms. Ruth Ferguson          |               |       |               | Assessor ID    | AE69-0001  |  |
| Client                             | Red Cannon, Suite 1, 18-22 |               |       |               |                |            |  |

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> ) |
|--------------------------------------------------------|---------------------------|----------------------|-----------------------------|
| Main dwelling                                          |                           |                      |                             |
| Ground floor                                           | 54.7300 (1b)              | 2.4700 (2b)          | 135.1831 (1b) - (3b)        |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.7300                   |                      | 135.1831 (4)                |
| Dwelling volume                                        |                           |                      | 135.1831 (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                                                                | 2 * 10 = 20.0000 (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) = | 20.0000 / (5) = 0.1479 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0100 (17)                             |
| Infiltration rate                                                                                  | 0.3984 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3387 (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 | 0.4318 | 0.4234 | 0.4149 | 0.3725 | 0.3641 | 0.3217 | 0.3217 | 0.3133 | 0.3387 | 0.3641 | 0.3810 | 0.3979 (22b) |
| Effective ac    | 0.5932 | 0.5896 | 0.5861 | 0.5694 | 0.5663 | 0.5518 | 0.5518 | 0.5491 | 0.5574 | 0.5663 | 0.5726 | 0.5792 (25)  |

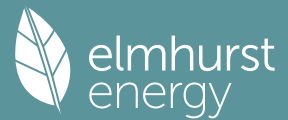
## 3. Heat losses and heat loss parameter

| 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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Door                                                           |                         |                            | 1.6800                    | 1.0000                        | 1.6800       |                                      | (26)            |
| Windows                                                        |                         |                            | 7.5300                    | 1.1450                        | 8.6221       |                                      | (27)            |
| Heatloss Floor 1                                               |                         |                            | 54.7300                   | 0.1000                        | 5.4730       | 20.0000                              | 1094.6000 (28a) |
| External Wall 1                                                | 48.7300                 | 9.2100                     | 39.5200                   | 0.1400                        | 5.5328       | 70.0000                              | 2766.4000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 103.4600                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 21.3079      |                                      | (33)            |
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Party Wall 1                                                   |                         |                            | 28.0100                   | 0.0000                        | 0.0000       | 140.0000                             | 3921.4000 (32)  |
| Party Ceiling 1                                                |                         |                            | 54.7300                   |                               |              | 30.0000                              | 1641.9000 (32b) |
| Internal Wall 1                                                |                         |                            | 100.7800                  |                               |              | 9.0000                               | 907.0200 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 10331.3200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 188.7689 (35)   |
| List of Thermal Bridges                                        |                         |                            |                           |                               |              |                                      |                 |
| K1 Element                                                     |                         |                            |                           | Length                        | Psi-value    | Total                                |                 |
| E2 Other lintels (including other steel lintels)               |                         |                            |                           | 3.8000                        | 0.0500       | 0.1900                               |                 |
| E3 Sill                                                        |                         |                            |                           | 4.8000                        | 0.0500       | 0.2400                               |                 |
| E4 Jamb                                                        |                         |                            |                           | 13.4000                       | 0.0500       | 0.6700                               |                 |
| E5 Ground floor (normal)                                       |                         |                            |                           | 19.7300                       | 0.1600       | 3.1568                               |                 |
| E16 Corner (normal)                                            |                         |                            |                           | 4.9400                        | 0.0900       | 0.4446                               |                 |



|                |  |          |          |            |          |               |          |             |          |          |          |              |               |
|----------------|--|----------|----------|------------|----------|---------------|----------|-------------|----------|----------|----------|--------------|---------------|
| 6. Solar gains |  |          |          |            |          |               |          |             |          |          |          |              |               |
| [Jan]          |  | Area     |          | Solar flux |          | g             |          | FF          |          | Access   |          | Gains        |               |
|                |  | m2       |          | Table 6a   |          | Specific data |          | or Table 6c |          | factor   |          | W            |               |
|                |  |          |          | W/m2       |          | or Table 6b   |          |             |          | Table 6d |          |              |               |
| Northeast      |  | 6.0300   |          | 11.2829    |          | 0.7600        |          | 0.7000      |          | 0.7700   |          | 25.0833 (75) |               |
| Southeast      |  | 1.5000   |          | 36.7938    |          | 0.7600        |          | 0.7000      |          | 0.7700   |          | 20.3475 (77) |               |
|                |  |          |          |            |          |               |          |             |          |          |          |              |               |
| Solar gains    |  | 45.4308  | 85.7171  | 139.4123   | 209.8324 | 268.8874      | 281.8357 | 265.5220    | 219.1875 | 163.4395 | 100.7026 | 55.9329      | 37.8975 (83)  |
| Total gains    |  | 415.4802 | 464.7683 | 501.3209   | 557.7131 | 597.7396      | 592.8912 | 568.5108    | 523.1496 | 477.5377 | 426.5080 | 403.5410     | 399.8858 (84) |

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## 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                    | 52.0530 | 52.2059 | 52.3567 | 53.0767 | 53.2136 | 53.8604 | 53.8604 | 53.9819 | 53.6094                   | 53.2136 | 52.9374 | 52.6516      |
| alpha                  | 4.4702  | 4.4804  | 4.4904  | 4.5384  | 4.5476  | 4.5907  | 4.5907  | 4.5988  | 4.5740                    | 4.5476  | 4.5292  | 4.5101       |
| util living area       | 0.9841  | 0.9727  | 0.9493  | 0.8782  | 0.7414  | 0.5509  | 0.4082  | 0.4598  | 0.7024                    | 0.9117  | 0.9717  | 0.9864 (86)  |
| Living                 | 19.7154 | 19.9126 | 20.1986 | 20.5853 | 20.8526 | 20.9706 | 20.9940 | 20.9899 | 20.9142                   | 20.5661 | 20.0893 | 19.6883      |
| Non living             | 18.5878 | 18.8380 | 19.1970 | 19.6713 | 19.9676 | 20.0866 | 20.1030 | 20.1028 | 20.0391                   | 19.6609 | 19.0720 | 18.5602      |
| 24 / 16                | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 24 / 9                 | 16      | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 0            |
| 16 / 9                 | 15      | 28      | 19      | 0       | 0       | 0       | 0       | 0       | 0                         | 0       | 0       | 31           |
| MIT                    | 20.6480 | 20.3841 | 20.4116 | 20.5853 | 20.8526 | 20.9706 | 20.9940 | 20.9899 | 20.9142                   | 20.5661 | 20.0893 | 20.2571 (87) |
| Th 2                   | 20.0772 | 20.0797 | 20.0821 | 20.0934 | 20.0955 | 20.1054 | 20.1054 | 20.1073 | 20.1016                   | 20.0955 | 20.0912 | 20.0868 (88) |
| util rest of house     | 0.9804  | 0.9665  | 0.9376  | 0.8512  | 0.6914  | 0.4809  | 0.3272  | 0.3741  | 0.6324                    | 0.8859  | 0.9641  | 0.9833 (89)  |
| MIT 2                  | 19.7591 | 19.5316 | 19.5000 | 19.6713 | 19.9676 | 20.0866 | 20.1030 | 20.1028 | 20.0391                   | 19.6609 | 19.0720 | 19.4130 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | FLA = Living area / (4) = |         |         | 0.4603 (91)  |
| MIT                    | 20.1682 | 19.9240 | 19.9196 | 20.0920 | 20.3750 | 20.4935 | 20.5131 | 20.5111 | 20.4419                   | 20.0775 | 19.5402 | 19.8015 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT           | 20.1682 | 19.9240 | 19.9196 | 20.0920 | 20.3750 | 20.4935 | 20.5131 | 20.5111 | 20.4419                   | 20.0775 | 19.5402 | 19.8015 (93) |

## 8. Space heating requirement

|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation                                                                    | 0.9809   | 0.9652   | 0.9352   | 0.8512   | 0.7076   | 0.5119   | 0.3644   | 0.4133   | 0.6602   | 0.8853        | 0.9583   | 0.9821 (94)    |
| Useful gains                                                                   | 407.5252 | 448.6139 | 468.8187 | 474.7250 | 422.9474 | 306.0454 | 207.1721 | 216.2388 | 315.2650 | 377.5735      | 386.7246 | 392.7240 (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                                                               | 874.8544 | 825.8850 | 735.5638 | 605.1422 | 467.8409 | 314.0184 | 208.4977 | 218.5546 | 339.4927 | 511.1216      | 674.4021 | 850.3695 (97)  |
| Space heating kWh                                                              | 347.6929 | 253.5262 | 198.4583 | 93.9004  | 33.4008  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3597       | 207.1278 | 340.4883 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1573.9544      |
| 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                                                              | 347.6929 | 253.5262 | 198.4583 | 93.9004  | 33.4008  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3597       | 207.1278 | 340.4883 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1573.9544      |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 28.7585 (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 %)

205.2557 (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                                                                            | 347.6929 | 253.5262 | 198.4583 | 93.9004  | 33.4008  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 99.3597  | 207.1278 | 340.4883 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 205.2557 | 205.2557 | 205.2557 | 205.2557 | 205.2557 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 205.2557 | 205.2557 | 205.2557 (210)  |
| Space heating fuel (main heating system)                                                             | 169.3950 | 123.5173 | 96.6884  | 45.7480  | 16.2728  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 48.4078  | 100.9121 | 165.8850 (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                                                                            | 136.6571 | 120.4526 | 127.7263 | 112.6035 | 109.1646 | 98.4508  | 97.6065  | 101.6895 | 102.9554 | 114.6215 | 121.5194 | 135.2820 (64)   |
| Efficiency of water heater                                                                           | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 | 127.3833 (216)  |
| Fuel for water heating, kWh/month                                                                    | 107.2803 | 94.5592  | 100.2693 | 88.3974  | 85.6978  | 77.2871  | 76.6242  | 79.8296  | 80.8233  | 89.9816  | 95.3966  | 106.2008 (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                                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (231)    |
| Lighting                                                                                             | 16.6874  | 13.3872  | 12.0537  | 8.8311   | 6.8214   | 5.5731   | 6.2227   | 8.0885   | 10.5061  | 13.7846  | 15.5697  | 17.1512 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |          |          |          |          |          |          |          |          |                 |
| (233a)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 (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                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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                                                                   |          |          |          |          |          |          |          |          |          |          |          | 766.8263 (211)  |
| Space heating fuel - main system 2                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                           |          |          |          |          |          |          |          |          |          |          |          | 127.3833        |
| Water heating fuel used                                                                              |          |          |          |          |          |          |          |          |          |          |          | 1082.3471 (219) |
| Space cooling fuel                                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (221)    |

Electricity for pumps and fans:

Total electricity for the above, kWh/year

0.0000 (231)

Electricity for lighting (calculated in Appendix L)

134.6766 (232)

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Energy saving/generation technologies (Appendices M ,N and Q)

|                                                |                 |
|------------------------------------------------|-----------------|
| PV generation                                  | 0.0000 (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            | 1983.8500 (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                   | 766.8263           | 0.1561                        | 119.7179 (261)           |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                      | 1082.3471          | 0.1408                        | 152.4445 (264)           |
| Space and water heating                         |                    |                               | 272.1624 (265)           |
| Pumps, fans and electric keep-hot               | 0.0000             | 0.0000                        | 0.0000 (267)             |
| Energy for lighting                             | 134.6766           | 0.1443                        | 19.4380 (268)            |
| Total CO2, kg/year                              |                    |                               | 291.6004 (272)           |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 5.3300 (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               | 766.8263           | 1.5780                              | 1210.0391 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 1082.3471          | 1.5208                              | 1646.0280 (278)            |
| Space and water heating                     |                    |                                     | 2856.0671 (279)            |
| Pumps, fans and electric keep-hot           | 0.0000             | 0.0000                              | 0.0000 (281)               |
| Energy for lighting                         | 134.6766           | 1.5338                              | 206.5715 (282)             |
| Total Primary energy kWh/year               |                    |                                     | 3062.6386 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 55.9600 (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)                                 |
|--------------------------------------------------------|--------------|----------------------|------------------------------------------------|
| Main dwelling                                          | 54.7300 (1b) | 2.4700 (2b)          | 135.1831 (1b) - (3b)                           |
| Ground floor                                           |              |                      |                                                |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.7300      |                      | 135.1831 (4)                                   |
| Dwelling volume                                        |              |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 135.1831 (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                | 2 * 10 = 20.0000 (7a) |
| Number of passive vents                            | 0 * 10 = 0.0000 (7b)  |
| Number of flueless gas fires                       | 0 * 40 = 0.0000 (7c)  |

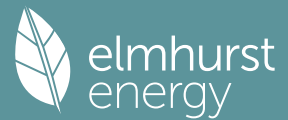
|                                                                                                    |                             |             |
|----------------------------------------------------------------------------------------------------|-----------------------------|-------------|
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 20.0000 / (5) =             | 0.1479 (8)  |
| Pressure test                                                                                      | Yes                         |             |
| Pressure Test Method                                                                               | Blower Door                 |             |
| Measured/design AP50                                                                               | 5.0000                      | (17)        |
| Infiltration rate                                                                                  | 0.3979                      | (18)        |
| Number of sides sheltered                                                                          | 2                           | (19)        |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) =        | 0.3383 (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 | 0.4313 | 0.4228 | 0.4144 | 0.3721 | 0.3636 | 0.3213 | 0.3213 | 0.3129 | 0.3383 | 0.3636 | 0.3805 | 0.3975 (22b) |
| Effective ac    | 0.5930 | 0.5894 | 0.5858 | 0.5692 | 0.5661 | 0.5516 | 0.5516 | 0.5489 | 0.5572 | 0.5661 | 0.5724 | 0.5790 (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 |
|-----------------|-------------|----------------|---------------|------------------|--------------|-------------------|---------------|
| Main dwelling   |             |                |               |                  |              |                   |               |
| TER Opaque door |             |                | 1.6800        | 1.0000           | 1.6800       |                   | (26)          |

# Full SAP Calculation Printout



|                                                |                      |        |         |       |
|------------------------------------------------|----------------------|--------|---------|-------|
| TER Opening Type                               | 7.5300               | 1.1450 | 8.6221  | (27)  |
| Heatloss Floor 1                               | 54.7300              | 0.1300 | 7.1149  | (28a) |
| External Wall 1                                | 48.7300              | 9.2100 | 39.5200 | (29a) |
| Total net area of external elements Aum(A, m2) | 103.4600             |        | 7.1136  | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            | (26)...(30) + (32) = |        | 24.5306 | (33)  |
| Main dwelling                                  |                      |        |         |       |
| Party Wall 1                                   | 28.0100              | 0.0000 | 0.0000  | (32)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 188.7689 (35)

|                                                                           |         |           |         |  |
|---------------------------------------------------------------------------|---------|-----------|---------|--|
| List of Thermal Bridges                                                   | Length  | Psi-value | Total   |  |
| K1 Element                                                                | 3.8000  | 0.0500    | 0.1900  |  |
| E2 Other lintels (including other steel lintels)                          | 4.8000  | 0.0500    | 0.2400  |  |
| E3 Sill                                                                   | 13.4000 | 0.0500    | 0.6700  |  |
| E4 Jamb                                                                   | 19.7300 | 0.1600    | 3.1568  |  |
| E5 Ground floor (normal)                                                  | 4.9400  | 0.0900    | 0.4446  |  |
| E16 Corner (normal)                                                       | 7.4100  | 0.0600    | 0.4446  |  |
| E18 Party wall between dwellings                                          | 19.7300 | 0.0700    | 1.3811  |  |
| E7 Party floor between dwellings (in blocks of flats)                     | 2.4700  | -0.0900   | -0.2223 |  |
| E17 Corner (inverted - internal area greater than external area)          | 2.4700  | 0.0600    | 0.1482  |  |
| E25 Staggered party wall between dwellings                                | 11.3400 | 0.0800    | 0.9072  |  |
| P1 Party wall - Ground floor                                              | 11.3400 | 0.0000    | 0.0000  |  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) |         |           |         |  |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 7.3602 (36)  
Point Thermal bridges (36a) = 0.0000  
Total fabric heat loss (33) + (36) + (36a) = 31.8908 (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                                                               | 26.4540 | 26.2928 | 26.1349 | 25.3932 | 25.2545 | 24.6085 | 24.6085 | 24.4888 | 24.8573 | 25.2545 | 25.5352 | 25.8287 | (38) |
| Heat transfer coeff                                                 | 58.3448 | 58.1837 | 58.0258 | 57.2841 | 57.1453 | 56.4993 | 56.4993 | 56.3797 | 56.7481 | 57.1453 | 57.4260 | 57.7195 | (39) |
| Average = Sum(39)m / 12 =                                           |         |         |         |         |         |         |         |         |         |         |         | 57.2834 |      |

|               |        |        |        |        |        |        |        |        |        |        |        |        |      |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
| HLP (average) | 1.0660 | 1.0631 | 1.0602 | 1.0467 | 1.0441 | 1.0323 | 1.0323 | 1.0301 | 1.0369 | 1.0441 | 1.0493 | 1.0546 | (40) |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |      |

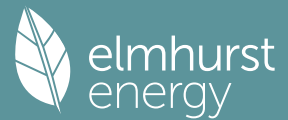
## 4. Water heating energy requirements (kWh/year)

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |           |             |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          |           | 1.8294 (42) |
| Hot water usage for mixer showers                                              | 70.4615  | 69.4026  | 67.8596  | 64.9073  | 62.7286  | 60.2989  | 58.9179  | 60.4492  | 62.1279  | 64.7366  | 67.7523  | 70.1916   | (42a)       |
| Hot water usage for baths                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (42b)       |
| Hot water usage for other uses                                                 | 33.3653  | 32.1520  | 30.9388  | 29.7255  | 28.5122  | 27.2989  | 27.2989  | 28.5122  | 29.7255  | 30.9388  | 32.1520  | 33.3653   | (42c)       |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 95.2953   | (43)        |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec       |             |
| Energy conte                                                                   | 103.8269 | 101.5547 | 98.7984  | 94.6328  | 91.2408  | 87.5978  | 86.2168  | 88.9614  | 91.8533  | 95.6754  | 99.9044  | 103.5569  | (44)        |
| Energy content (annual)                                                        | 164.4364 | 144.6125 | 151.8494 | 129.5476 | 122.8276 | 107.7117 | 104.2717 | 110.1528 | 113.2643 | 129.8306 | 142.3321 | 162.1451  | (45)        |
| Distribution loss (46)m = 0.15 x (45)m                                         | 24.6655  | 21.6919  | 22.7774  | 19.4321  | 18.4241  | 16.1568  | 15.6408  | 16.5229  | 16.9897  | 19.4746  | 21.3498  | 24.3218   | (46)        |
| Water storage loss (or HIU loss):                                              |          |          |          |          |          |          |          |          |          |          |          |           |             |
| Store volume                                                                   |          |          |          |          |          |          |          |          |          |          |          | 150.0000  | (47)        |
| a) If manufacturer declared loss factor is known (kWh/day):                    |          |          |          |          |          |          |          |          |          |          |          | 1.3938    | (48)        |
| Temperature factor from Table 2b                                               |          |          |          |          |          |          |          |          |          |          |          | 0.5400    | (49)        |
| Enter (49) or (54) in (55)                                                     |          |          |          |          |          |          |          |          |          |          |          | 0.7527    | (55)        |
| Total storage loss                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325   | (56)        |
| If cylinder contains dedicated solar storage                                   | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325   | (57)        |
| Primary loss                                                                   | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624   | (59)        |
| Combi loss                                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000    | (61)        |
| Total heat required for water heating calculated for each month                | 211.0313 | 186.6982 | 198.4443 | 174.6394 | 169.4225 | 152.8036 | 150.8666 | 156.7477 | 158.3562 | 176.4255 | 187.4239 | 208.7400  | (62)        |
| WWHRS                                                                          | -32.2121 | -28.4886 | -29.8316 | -24.7018 | -23.0212 | -19.6994 | -18.4650 | -19.6357 | -20.3817 | -24.0278 | -27.2206 | -31.6156  | (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                                                                | 178.8192 | 158.2096 | 168.6127 | 149.9376 | 146.4014 | 133.1042 | 132.4016 | 137.1120 | 137.9744 | 152.3977 | 160.2033 | 177.1244  | (64)        |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |          |          | 1832.2982 | (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                                       | 91.9510  | 81.7522  | 87.7659  | 79.1480  | 78.1161  | 71.8876  | 71.9463  | 73.9017  | 73.7339  | 80.4446  | 83.3989  | 91.1892   | (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                                                                               | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 86.6302  | 95.9120  | 86.6302  | 89.5178  | 86.6302  | 86.6302  | 86.6302  | 86.6302  | 89.5178  | 86.6302  | 89.5178  | 86.6302  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 159.4895 | 161.1445 | 156.9740 | 148.0954 | 136.8877 | 126.3541 | 119.3170 | 117.6620 | 121.8325 | 130.7112 | 141.9188 | 152.4524 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | (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)                                 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | (71) |
| Water heating gains (Table 5)                                                       | 123.5901 | 121.6551 | 117.9649 | 109.9278 | 104.9948 | 99.8439  | 96.7020  | 99.3303  | 102.4082 | 108.1244 | 115.8318 | 122.5661 | (72) |
| Total internal gains                                                                | 423.1514 | 432.1533 | 415.0107 | 400.9827 | 381.9543 | 366.1575 | 353.0908 | 354.0641 | 364.2002 | 378.9074 | 400.7101 | 415.0903 | (73) |

# Full SAP Calculation Printout



## 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    |
|-------------|----------|----------|------------|--------------------------------|------------------------------|------------------------------|------------------------------|---------------|
| Northeast   |          |          | 6.0300     | 11.2829                        | 0.6300                       | 0.7000                       |                              | 20.7927 (75)  |
| Southeast   |          |          | 1.5000     | 36.7938                        | 0.6300                       | 0.7000                       |                              | 16.8670 (77)  |
| Solar gains | 37.6597  | 71.0550  | 115.5654   | 173.9400                       | 222.8935                     | 233.6270                     | 181.6949                     | 31.4150 (83)  |
| Total gains | 460.8112 | 503.2082 | 530.5761   | 574.9227                       | 604.8478                     | 599.7845                     | 462.3846                     | 446.5054 (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                                                                         | 49.1871 | 49.3233 | 49.4575 | 50.0979 | 50.2195 | 50.7937 | 50.7937 | 50.9015 | 50.5710                   | 50.2195 | 49.9740 | 49.7199      |
| alpha                                                                       | 4.2791  | 4.2882  | 4.2972  | 4.3399  | 4.3480  | 4.3862  | 4.3862  | 4.3934  | 4.3714                    | 4.3480  | 4.3316  | 4.3147       |
| util living area                                                            | 0.9782  | 0.9665  | 0.9442  | 0.8801  | 0.7570  | 0.5750  | 0.4273  | 0.4736  | 0.7036                    | 0.8991  | 0.9626  | 0.9807 (86)  |
| MIT                                                                         | 19.7036 | 19.8841 | 20.1561 | 20.5345 | 20.8169 | 20.9583 | 20.9909 | 20.9859 | 20.9004                   | 20.5556 | 20.0856 | 19.6798 (87) |
| Th 2                                                                        | 20.0287 | 20.0311 | 20.0335 | 20.0446 | 20.0467 | 20.0565 | 20.0565 | 20.0583 | 20.0527                   | 20.0467 | 20.0425 | 20.0381 (88) |
| util rest of house                                                          | 0.9732  | 0.9589  | 0.9312  | 0.8527  | 0.7061  | 0.5001  | 0.3387  | 0.3814  | 0.6310                    | 0.8701  | 0.9528  | 0.9762 (89)  |
| MIT 2                                                                       | 18.5379 | 18.7663 | 19.1070 | 19.5717 | 19.8873 | 20.0298 | 20.0528 | 20.0521 | 19.9807                   | 19.6076 | 19.0306 | 18.5146 (90) |
| Living area fraction                                                        | 19.0744 | 19.2808 | 19.5899 | 20.0148 | 20.3152 | 20.4572 | 20.4846 | 20.4819 | fLA = Living area / (4) = | 20.0439 | 19.5162 | 0.4603 (91)  |
| MIT                                                                         | 19.0744 | 19.2808 | 19.5899 | 20.0148 | 20.3152 | 20.4572 | 20.4846 | 20.4819 | 20.4040                   | 20.0439 | 19.5162 | 19.0509 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 19.0744 | 19.2808 | 19.5899 | 20.0148 | 20.3152 | 20.4572 | 20.4846 | 20.4819 | 20.4040                   | 20.0439 | 19.5162 | 19.0509 (93) |

## 8. Space heating requirement

|                                                                                |          |          |          |          |          |          |          |          |          |               |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
| Utilisation                                                                    | 0.9669   | 0.9517   | 0.9241   | 0.8517   | 0.7212   | 0.5328   | 0.3794   | 0.4235   | 0.6593   | 0.8700        | 0.9461   | 0.9703 (94)    |
| Useful gains                                                                   | 445.5458 | 478.8946 | 490.3258 | 489.6680 | 436.2436 | 319.5388 | 217.4548 | 226.8978 | 329.4595 | 402.2656      | 422.9977 | 433.2645 (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                                                               | 862.0106 | 836.7271 | 759.5500 | 636.7030 | 492.3158 | 330.9275 | 219.4756 | 230.1372 | 357.7397 | 539.6761      | 713.0124 | 857.1862 (97)  |
| Space heating kWh                                                              | 309.8498 | 240.4634 | 200.3028 | 105.8652 | 41.7177  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 102.2334      | 208.8106 | 315.3977 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1524.6407      |
| 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                                                              | 309.8498 | 240.4634 | 200.3028 | 105.8652 | 41.7177  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 102.2334      | 208.8106 | 315.3977 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1524.6407      |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 27.8575 (99)   |

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

|                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |                |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)   |
| Fraction of space heat from main system(s)                                                           |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)   |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 92.3000 (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                                                                            | 309.8498 | 240.4634 | 200.3028 | 105.8652 | 41.7177  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 102.2334 | 208.8106 | 315.3977 (98)  |
| Space heating efficiency (main heating system 1)                                                     | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 92.3000  | 92.3000  | 92.3000 (210)  |
| Space heating fuel (main heating system)                                                             | 335.6986 | 260.5237 | 217.0128 | 114.6969 | 45.1979  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 110.7621 | 226.2303 | 341.7094 (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                                                                            | 178.8192 | 158.2096 | 168.6127 | 149.9376 | 146.4014 | 133.1042 | 132.4016 | 137.1120 | 137.9744 | 152.3977 | 160.2033 | 177.1244 (64)  |
| Efficiency of water heater (217)m                                                                    | 85.2804  | 84.9959  | 84.4470  | 83.2937  | 81.6348  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 83.1850  | 84.6550  | 79.8000 (216)  |
| Fuel for water heating, kWh/month                                                                    | 209.6837 | 186.1380 | 199.6669 | 180.0107 | 179.3369 | 166.7972 | 165.9168 | 171.8196 | 172.9003 | 183.2033 | 189.2425 | 207.5546 (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                                                                                             | 18.0000  | 14.4403  | 13.0019  | 9.5257   | 7.3580   | 6.0115   | 6.7122   | 8.7247   | 11.3326  | 14.8689  | 16.7944  | 18.5003 (232)  |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |          |          |          |          |          |          |          |          |                |
| (233a)m                                                                                              | -10.4404 | -15.8423 | -24.4894 | -29.6840 | -33.9447 | -32.4123 | -32.0328 | -29.2761 | -24.7649 | -19.0407 | -11.8742 | -8.9011 (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                                                                                              | -2.9155  | -6.3329  | -12.9677 | -20.0476 | -27.0733 | -27.4015 | -27.0655 | -22.6424 | -16.2515 | -9.2244  | -3.9460  | -2.2901 (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)  |

# Full SAP Calculation Printout



|                                                               |                 |
|---------------------------------------------------------------|-----------------|
| Annual totals kWh/year                                        |                 |
| Space heating fuel - main system 1                            | 1651.8317 (211) |
| Space heating fuel - main system 2                            | 0.0000 (213)    |
| Space heating fuel - secondary                                | 0.0000 (215)    |
| Efficiency of water heater                                    | 79.8000         |
| Water heating fuel used                                       | 2212.2706 (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)           | 145.2706 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q) |                 |
| PV generation                                                 | -450.8612 (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                           | 3644.5117 (238) |

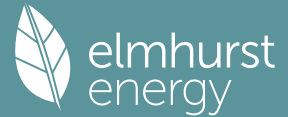
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 1651.8317          | 0.2100                        | 346.8847 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2212.2706          | 0.2100                        | 464.5768 (264)           |
| Space and water heating                       |                    |                               | 811.4615 (265)           |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 145.2706           | 0.1443                        | 20.9670 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -272.7029          | 0.1331                        | -36.2877                 |
| PV Unit electricity exported                  | -178.1583          | 0.1251                        | -22.2828                 |
| Total                                         |                    |                               | -58.5705 (269)           |
| Total CO2, kg/year                            |                    |                               | 785.7873 (272)           |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 14.3600 (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               | 1651.8317          | 1.1300                              | 1866.5698 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2212.2706          | 1.1300                              | 2499.8658 (278)            |
| Space and water heating                     |                    |                                     | 4366.4356 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 145.2706           | 1.5338                              | 222.8209 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -272.7029          | 1.4917                              | -406.7924                  |
| PV Unit electricity exported                | -178.1583          | 0.4591                              | -81.7861                   |
| Total                                       |                    |                                     | -488.5785 (283)            |
| Total Primary energy kWh/year               |                    |                                     | 4230.7789 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 77.3000 (287)              |

# Full SAP Calculation Printout



|                                    |                            |               |       |               |                |            |  |
|------------------------------------|----------------------------|---------------|-------|---------------|----------------|------------|--|
| Plot Reference                     | Garden floor flat A        |               |       |               | Issued on Date | 11/12/2025 |  |
| Assessment Reference               | Be Lean                    |               |       | Plot Type Ref |                |            |  |
| Plot Address                       |                            |               |       |               | SAP Version    | 10.2       |  |
|                                    |                            |               |       |               |                |            |  |
| SAP Rating                         | 85 B                       | DER           | 13.88 | TER           | 14.85          |            |  |
| Environmental                      | 90 B                       | % DER < TER   |       |               |                | 6.53       |  |
| CO <sub>2</sub> Emissions (t/year) | 0.67                       | DFEE          | 31.44 | TFEE          | 35.36          |            |  |
| Compliance Check                   | See BREL                   | % DFEE < TFEE |       |               |                | 11.09      |  |
| % DPER < TPER                      | 2.76                       | DPER          | 77.75 | TPER          | 79.96          |            |  |
|                                    |                            |               |       |               |                |            |  |
| Assessor Details                   | Ms. Ruth Ferguson          |               |       |               | Assessor ID    | AE69-0001  |  |
| Client                             | Red Cannon, Suite 1, 18-22 |               |       |               |                |            |  |

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> )                    |
|--------------------------------------------------------|---------------------------|----------------------|------------------------------------------------|
| Main dwelling                                          |                           |                      |                                                |
| Ground floor                                           | 54.7300 (1b)              | 2.4700 (2b)          | 135.1831 (1b) - (3b)                           |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.7300                   |                      | 135.1831 (4)                                   |
| Dwelling volume                                        |                           |                      | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 135.1831 (5) |

## 2. Ventilation rate

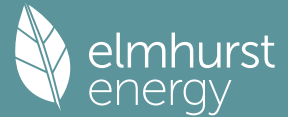
|                                                                                                    | m <sup>3</sup> per hour                 |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of 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                                                                | 2 * 10 = 20.0000 (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) = | 20.0000 / (5) = 0.1479 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0100 (17)                             |
| Infiltration rate                                                                                  | 0.3984 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3387 (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 | 0.4318 | 0.4234 | 0.4149 | 0.3725 | 0.3641 | 0.3217 | 0.3217 | 0.3133 | 0.3387 | 0.3641 | 0.3810 | 0.3979 (22b) |
| Effective ac    | 0.5932 | 0.5896 | 0.5861 | 0.5694 | 0.5663 | 0.5518 | 0.5518 | 0.5491 | 0.5574 | 0.5663 | 0.5726 | 0.5792 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Door                                                           |                         |                            | 1.6800                    | 1.0000                        | 1.6800       |                                      | (26)            |
| Windows                                                        |                         |                            | 7.5300                    | 1.1450                        | 8.6221       |                                      | (27)            |
| Heatloss Floor 1                                               |                         |                            | 54.7300                   | 0.1000                        | 5.4730       | 20.0000                              | 1094.6000 (28a) |
| External Wall 1                                                | 48.7300                 | 9.2100                     | 39.5200                   | 0.1400                        | 5.5328       | 70.0000                              | 2766.4000 (29a) |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 103.4600                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 21.3079      |                                      | (33)            |
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Party Wall 1                                                   |                         |                            | 28.0100                   | 0.0000                        | 0.0000       | 140.0000                             | 3921.4000 (32)  |
| Party Ceiling 1                                                |                         |                            | 54.7300                   |                               |              | 30.0000                              | 1641.9000 (32b) |
| Internal Wall 1                                                |                         |                            | 100.7800                  |                               |              | 9.0000                               | 907.0200 (32c)  |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 10331.3200 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 188.7689 (35)   |
| List of Thermal Bridges                                        |                         |                            |                           |                               |              |                                      |                 |
| K1 Element                                                     |                         |                            |                           | Length                        | Psi-value    | Total                                |                 |
| E2 Other lintels (including other steel lintels)               |                         |                            |                           | 3.8000                        | 0.0500       | 0.1900                               |                 |
| E3 Sill                                                        |                         |                            |                           | 4.8000                        | 0.0500       | 0.2400                               |                 |
| E4 Jamb                                                        |                         |                            |                           | 13.4000                       | 0.0500       | 0.6700                               |                 |
| E5 Ground floor (normal)                                       |                         |                            |                           | 19.7300                       | 0.1600       | 3.1568                               |                 |
| E16 Corner (normal)                                            |                         |                            |                           | 4.9400                        | 0.0900       | 0.4446                               |                 |

# Full SAP Calculation Printout



|                                                                           |         |                       |              |
|---------------------------------------------------------------------------|---------|-----------------------|--------------|
| E18 Party wall between dwellings                                          | 7.4100  | 0.0600                | 0.4446       |
| E7 Party floor between dwellings (in blocks of flats)                     | 19.7300 | 0.0700                | 1.3811       |
| E17 Corner (inverted - internal area greater than external area)          | 2.4700  | -0.0900               | -0.2223      |
| E25 Staggered party wall between dwellings                                | 2.4700  | 0.0600                | 0.1482       |
| P1 Party wall - Ground floor                                              | 11.3400 | 0.0800                | 0.9072       |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.3400 | 0.0000                | 0.0000       |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |                       | 7.3602 (36)  |
| Point Thermal bridges                                                     |         |                       | 0.0000       |
| Total fabric heat loss                                                    |         | (33) + (36) + (36a) = | 28.6681 (37) |

|                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|---------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5) |                |                |                |                |                |                |                |                |                |                |                |                     |
| (38)m                                                               | Jan<br>26.4644 | Feb<br>26.3029 | Mar<br>26.1446 | Apr<br>25.4010 | May<br>25.2619 | Jun<br>24.6143 | Jul<br>24.6143 | Aug<br>24.4943 | Sep<br>24.8637 | Oct<br>25.2619 | Nov<br>25.5433 | Dec<br>25.8375 (38) |
| Heat transfer coeff                                                 | 55.1325        | 54.9710        | 54.8127        | 54.0691        | 53.9300        | 53.2824        | 53.2824        | 53.1625        | 53.5319        | 53.9300        | 54.2115        | 54.5057 (39)        |
| Average = Sum(39)m / 12 =                                           |                |                |                |                |                |                |                |                |                |                |                | 54.0685             |
| HLP                                                                 | Jan<br>1.0074  | Feb<br>1.0044  | Mar<br>1.0015  | Apr<br>0.9879  | May<br>0.9854  | Jun<br>0.9736  | Jul<br>0.9736  | Aug<br>0.9714  | Sep<br>0.9781  | Oct<br>0.9854  | Nov<br>0.9905  | Dec<br>0.9959 (40)  |
| HLP (average)                                                       |                |                |                |                |                |                |                |                |                |                |                | 0.9879              |
| Days in mont                                                        | 31             | 28             | 31             | 30             | 31             | 30             | 31             | 31             | 30             | 31             | 30             | 31                  |

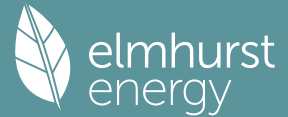
|                                                                 |                                                                                |          |          |          |          |          |          |          |          |          |          |                |
|-----------------------------------------------------------------|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| 4. Water heating energy requirements (kWh/year)                 |                                                                                |          |          |          |          |          |          |          |          |          |          |                |
| Assumed occupancy                                               |                                                                                |          |          |          |          |          |          |          |          |          |          | 1.8294 (42)    |
| Hot water usage for mixer showers                               | 70.4615                                                                        | 69.4026  | 67.8596  | 64.9073  | 62.7286  | 60.2989  | 58.9179  | 60.4492  | 62.1279  | 64.7366  | 67.7523  | 70.1916 (42a)  |
| Hot water usage for baths                                       | 0.0000                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (42b)   |
| Hot water usage for other uses                                  | 33.3653                                                                        | 32.1520  | 30.9388  | 29.7255  | 28.5122  | 27.2989  | 27.2989  | 28.5122  | 29.7255  | 30.9388  | 32.1520  | 33.3653 (42c)  |
| Average daily hot water use (litres/day)                        |                                                                                |          |          |          |          |          |          |          |          |          |          | 95.2953 (43)   |
| Daily hot water use                                             | Jan                                                                            | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
|                                                                 | 103.8269                                                                       | 101.5547 | 98.7984  | 94.6328  | 91.2408  | 87.5978  | 86.2168  | 88.9614  | 91.8533  | 95.6754  | 99.9044  | 103.5569 (44)  |
| Energy content (annual)                                         | 164.4364                                                                       | 144.6125 | 151.8494 | 129.5476 | 122.8276 | 107.7117 | 104.2717 | 110.1528 | 113.2643 | 129.8306 | 142.3321 | 162.1451 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                          | Total = Sum(45)m =                                                             |          |          |          |          |          |          |          |          |          |          | 1582.9819      |
|                                                                 | 24.6655                                                                        | 21.6919  | 22.7774  | 19.4321  | 18.4241  | 16.1568  | 15.6408  | 16.5229  | 16.9897  | 19.4746  | 21.3498  | 24.3218 (46)   |
| Water storage loss (or HIU 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                                                      | 5.3884                                                                         | 4.8591   | 5.3596   | 5.1415   | 5.2836   | 5.0850   | 5.2393   | 5.2555   | 5.1044   | 5.3079   | 5.1807   | 5.3838 (61)    |
| Total heat required for water heating calculated for each month | 169.8248                                                                       | 149.4716 | 157.2090 | 134.6891 | 128.1113 | 112.7967 | 109.5110 | 115.4083 | 118.3687 | 135.1385 | 147.5128 | 167.5289 (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                                                 | 169.8248                                                                       | 149.4716 | 157.2090 | 134.6891 | 128.1113 | 112.7967 | 109.5110 | 115.4083 | 118.3687 | 135.1385 | 147.5128 | 167.5289 (64)  |
| 12Total per year (kWh/year)                                     | Total per year (kWh/year) = Sum(64)m =                                         |          |          |          |          |          |          |          |          |          |          | 1645.5708 (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                        | 56.0222                                                                        | 49.2984  | 51.8298  | 44.3599  | 42.1611  | 37.0854  | 35.9802  | 37.9397  | 38.9365  | 44.4957  | 48.6206  | 55.2592 (65)   |

|                                                                                     |                |                |                |                |                |                |                |                |                |                |                |                     |
|-------------------------------------------------------------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|---------------------|
| 5. Internal gains (see Table 5 and 5a)                                              |                |                |                |                |                |                |                |                |                |                |                |                     |
| Metabolic gains (Table 5), Watts                                                    |                |                |                |                |                |                |                |                |                |                |                |                     |
| (66)m                                                                               | Jan<br>91.4722 | Feb<br>91.4722 | Mar<br>91.4722 | Apr<br>91.4722 | May<br>91.4722 | Jun<br>91.4722 | Jul<br>91.4722 | Aug<br>91.4722 | Sep<br>91.4722 | Oct<br>91.4722 | Nov<br>91.4722 | Dec<br>91.4722 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 86.6302        | 95.9120        | 86.6302        | 89.5178        | 86.6302        | 89.5178        | 86.6302        | 86.6302        | 89.5178        | 86.6302        | 89.5178        | 86.6302 (67)        |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 159.4895       | 161.1445       | 156.9740       | 148.0954       | 136.8877       | 126.3541       | 119.3170       | 117.6620       | 121.8325       | 130.7112       | 141.9188       | 152.4524 (68)       |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472        | 32.1472 (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)                                 | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778       | -73.1778 (71)       |
| Water heating gains (Table 5)                                                       | 75.2987        | 73.3608        | 69.6637        | 61.6110        | 56.6681        | 51.5075        | 48.3604        | 50.9942        | 54.0785        | 59.8060        | 67.5286        | 74.2731 (72)        |
| Total internal gains                                                                | 374.8600       | 383.8589       | 366.7096       | 352.6659       | 333.6277       | 317.8211       | 304.7493       | 305.7280       | 315.8705       | 330.5890       | 352.4069       | 366.7974 (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   |               |
| Northeast      | 6.0300     |          | 11.2829                        |          | 0.7600                            |          | 0.7000                             |          | 0.7700                       |          | 25.0833 (75) |               |
| Southeast      | 1.5000     |          | 36.7938                        |          | 0.7600                            |          | 0.7000                             |          | 0.7700                       |          | 20.3475 (77) |               |
| Solar gains    | 45.4308    | 85.7171  | 139.4123                       | 209.8324 | 268.8874                          | 281.8357 | 265.5220                           | 219.1875 | 163.4395                     | 100.7026 | 55.9329      | 37.8975 (83)  |
| Total gains    | 420.2908   | 469.5760 | 506.1218                       | 562.4983 | 602.5151                          | 599.6568 | 570.2713                           | 524.9155 | 479.3100                     | 431.2915 | 408.3398     | 404.6949 (84) |

|                                                                             |  |  |  |  |  |  |  |  |  |  |  |              |
|-----------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--------------|
| 7. Mean internal temperature (heating season)                               |  |  |  |  |  |  |  |  |  |  |  |              |
| Temperature during heating periods in the living area from Table 9, Th1 (C) |  |  |  |  |  |  |  |  |  |  |  | 21.0000 (85) |

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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                    | 52.0530 | 52.2059 | 52.3567 | 53.0767 | 53.2136 | 53.8604 | 53.8604 | 53.9819 | 53.6094             | 53.2136 | 52.9374 | 52.6516      |
| alpha                  | 4.4702  | 4.4804  | 4.4904  | 4.5384  | 4.5476  | 4.5907  | 4.5907  | 4.5988  | 4.5740              | 4.5476  | 4.5292  | 4.5101       |
| util living area       | 0.9835  | 0.9717  | 0.9477  | 0.8754  | 0.7375  | 0.5495  | 0.4070  | 0.4584  | 0.7005              | 0.9088  | 0.9704  | 0.9858 (86)  |
| MIT                    | 19.7266 | 19.9232 | 20.2081 | 20.5920 | 20.8558 | 20.9709 | 20.9941 | 20.9900 | 20.9151             | 20.5739 | 20.0998 | 19.6996 (87) |
| Th 2                   | 20.0772 | 20.0797 | 20.0821 | 20.0934 | 20.0955 | 20.1054 | 20.1054 | 20.1073 | 20.1016             | 20.0955 | 20.0912 | 20.0868 (88) |
| util rest of house     | 0.9796  | 0.9652  | 0.9357  | 0.8481  | 0.6874  | 0.4796  | 0.3262  | 0.3729  | 0.6306              | 0.8824  | 0.9626  | 0.9825 (89)  |
| MIT 2                  | 18.6018 | 18.8512 | 19.2084 | 19.6787 | 19.9706 | 20.0868 | 20.1030 | 20.1028 | 20.0399             | 19.6697 | 19.0850 | 18.5745 (90) |
| Living area fraction   |         |         |         |         |         |         |         |         | FLA = Living area / | (4) =   |         | 0.4603 (91)  |
| MIT                    | 19.1195 | 19.3446 | 19.6685 | 20.0991 | 20.3780 | 20.4937 | 20.5131 | 20.5112 | 20.4427             | 20.0859 | 19.5521 | 19.0923 (92) |
| Temperature adjustment |         |         |         |         |         |         |         |         |                     |         |         | -0.1500      |
| adjusted MIT           | 18.9695 | 19.1946 | 19.5185 | 19.9491 | 20.2280 | 20.3437 | 20.3631 | 20.3612 | 20.2927             | 19.9359 | 19.4021 | 18.9423 (93) |

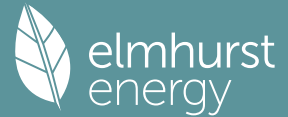
## 8. Space heating requirement

|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
| Utilisation                                                                    | 0.9735   | 0.9574   | 0.9267   | 0.8432   | 0.6952   | 0.4987   | 0.3497   | 0.3976   | 0.6463   | 0.8769        | 0.9550   | 0.9770 (94)    |
| Useful gains                                                                   | 409.1580 | 449.5676 | 469.0316 | 474.3045 | 418.8653 | 299.0438 | 199.4333 | 208.6832 | 309.7958 | 378.2017      | 389.9558 | 395.3733 (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                                                               | 808.7663 | 785.7872 | 713.5795 | 597.4139 | 459.9157 | 306.0394 | 200.5080 | 210.5851 | 331.5070 | 503.4835      | 666.9124 | 803.5408 (97)  |
| Space heating kWh                                                              | 297.3085 | 225.9396 | 181.9436 | 88.6388  | 30.5415  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.2097       | 199.4088 | 303.6765 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1420.6671      |
| 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                                                              | 297.3085 | 225.9396 | 181.9436 | 88.6388  | 30.5415  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.2097       | 199.4088 | 303.6765 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1420.6671      |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 25.9577 (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 %)                                                             |          |          |          |          |          |          |          |          |          |          |          | 89.0000 (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                                                                                    | 297.3085 | 225.9396 | 181.9436 | 88.6388  | 30.5415  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 93.2097  | 199.4088 | 303.6765 (98)   |
| Space heating efficiency (main heating system 1)                                                             | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)   |
| Space heating fuel (main heating system)                                                                     | 334.0545 | 253.8647 | 204.4311 | 99.5942  | 34.3163  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 104.7300 | 224.0548 | 341.2096 (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                                                                                    | 169.8248 | 149.4716 | 157.2090 | 134.6891 | 128.1113 | 112.7967 | 109.5110 | 115.4083 | 118.3687 | 135.1385 | 147.5128 | 167.5289 (64)   |
| Efficiency of water heater (217)m                                                                            | 88.3744  | 88.3153  | 88.2038  | 87.9669  | 87.6222  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 87.9860  | 88.2691  | 87.3000 (216)   |
| Fuel for water heating, kWh/month                                                                            | 192.1652 | 169.2478 | 178.2337 | 153.1133 | 146.2087 | 129.2059 | 125.4422 | 132.1974 | 135.5885 | 153.5909 | 167.1171 | 189.5379 (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                                                                                                     | 16.6874  | 13.3872  | 12.0537  | 8.8311   | 6.8214   | 5.5731   | 6.2227   | 8.0885   | 10.5061  | 13.7846  | 15.5697  | 17.1512 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity) (233a)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 (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                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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                                                                           |          |          |          |          |          |          |          |          |          |          |          | 1596.2551 (211) |
| Space heating fuel - main system 2                                                                           |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                                   |          |          |          |          |          |          |          |          |          |          |          | 87.3000         |
| Water heating fuel used                                                                                      |          |          |          |          |          |          |          |          |          |          |          | 1871.6486 (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)                                                          |          |          |          |          |          |          |          |          |          |          |          | 134.6766 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                                |          |          |          |          |          |          |          |          |          |          |          |                 |
| PV generation                                                                                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (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                                                                                |          |          |          |          |          |          |          |          |          |          |          |                 |

# Full SAP Calculation Printout



|                                     |                 |
|-------------------------------------|-----------------|
| Energy saved or generated           | -0.0000 (236)   |
| Energy used                         | 0.0000 (237)    |
| Total delivered energy for all uses | 3688.5804 (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                   | 1596.2551          | 0.2100                        | 335.2136                 | (261) |
| Total CO2 associated with community systems     |                    |                               | 0.0000                   | (373) |
| Water heating (other fuel)                      | 1871.6486          | 0.2100                        | 393.0462                 | (264) |
| Space and water heating                         |                    |                               | 728.2598                 | (265) |
| Pumps, fans and electric keep-hot               | 86.0000            | 0.1387                        | 11.9293                  | (267) |
| Energy for lighting                             | 134.6766           | 0.1443                        | 19.4380                  | (268) |
| Total CO2, kg/year                              |                    |                               | 759.6270                 | (272) |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 13.8800                  | (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               | 1596.2551          | 1.1300                              | 1803.7683                  | (275) |
| Total CO2 associated with community systems |                    |                                     | 0.0000                     | (473) |
| Water heating (other fuel)                  | 1871.6486          | 1.1300                              | 2114.9629                  | (278) |
| Space and water heating                     |                    |                                     | 3918.7312                  | (279) |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008                   | (281) |
| Energy for lighting                         | 134.6766           | 1.5338                              | 206.5715                   | (282) |
| Total Primary energy kWh/year               |                    |                                     | 4255.4035                  | (286) |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 77.7500                    | (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) |             |
|--------------------------------------------------------|--------------|----------------------|----------------|-------------|
| Main dwelling                                          | 54.7300      | 2.4700               | 135.1831       | (1b) - (3b) |
| Ground floor                                           |              |                      |                | (4)         |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 54.7300      |                      |                |             |
| Dwelling volume                                        |              |                      | 135.1831       | (5)         |

### 2. Ventilation rate

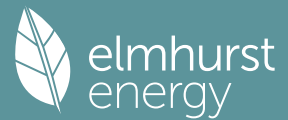
|                                                      |                                                       | m3 per hour     |             |
|------------------------------------------------------|-------------------------------------------------------|-----------------|-------------|
| Number of 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                  | 2 * 10 =                                              | 20.0000         | (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) = | 20.0000 / (5) = | 0.1479 (8)  |
| Pressure test                                        |                                                       | Yes             |             |
| Pressure Test Method                                 |                                                       | Blower Door     |             |
| Measured/design AP50                                 |                                                       | 5.0000          | (17)        |
| Infiltration rate                                    |                                                       | 0.3979          | (18)        |
| Number of sides sheltered                            |                                                       | 2               | (19)        |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] =                           |                 | 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) =                                  |                 | 0.3383 (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 | 0.4313 | 0.4228 | 0.4144 | 0.3721 | 0.3636 | 0.3213 | 0.3213 | 0.3129 | 0.3383 | 0.3636 | 0.3805 | 0.3975 | (22b) |
| Effective ac    | 0.5930 | 0.5894 | 0.5858 | 0.5692 | 0.5661 | 0.5516 | 0.5516 | 0.5489 | 0.5572 | 0.5661 | 0.5724 | 0.5790 | (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 |       |
|------------------------------------------------|-------------|----------------|---------------|----------------------|--------------|-------------------|---------------|-------|
| Main dwelling                                  |             |                |               |                      |              |                   |               |       |
| TER Opaque door                                |             |                | 1.6800        | 1.0000               | 1.6800       |                   |               | (26)  |
| TER Opening Type                               |             |                | 7.5300        | 1.1450               | 8.6221       |                   |               | (27)  |
| Heatloss Floor 1                               |             |                | 54.7300       | 0.1300               | 7.1149       |                   |               | (28a) |
| External Wall 1                                | 48.7300     | 9.2100         | 39.5200       | 0.1800               | 7.1136       |                   |               | (29a) |
| Total net area of external elements Aum(A, m2) |             |                | 103.4600      |                      |              |                   |               | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |             |                |               | (26)...(30) + (32) = | 24.5306      |                   |               | (33)  |
| Main dwelling                                  |             |                |               |                      |              |                   |               |       |
| Party Wall 1                                   |             |                | 28.0100       | 0.0000               | 0.0000       |                   |               | (32)  |

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

188.7689 (35)

List of Thermal Bridges

|                                                                           | Length  | Psi-value | Total   |
|---------------------------------------------------------------------------|---------|-----------|---------|
| K1 Element                                                                |         |           |         |
| E2 Other lintels (including other steel lintels)                          | 3.8000  | 0.0500    | 0.1900  |
| E3 Sill                                                                   | 4.8000  | 0.0500    | 0.2400  |
| E4 Jamb                                                                   | 13.4000 | 0.0500    | 0.6700  |
| E5 Ground floor (normal)                                                  | 19.7300 | 0.1600    | 3.1568  |
| E16 Corner (normal)                                                       | 4.9400  | 0.0900    | 0.4446  |
| E18 Party wall between dwellings                                          | 7.4100  | 0.0600    | 0.4446  |
| E7 Party floor between dwellings (in blocks of flats)                     | 19.7300 | 0.0700    | 1.3811  |
| E17 Corner (inverted - internal area greater than external area)          | 2.4700  | -0.0900   | -0.2223 |
| E25 Staggered party wall between dwellings                                | 2.4700  | 0.0600    | 0.1482  |
| P1 Party wall - Ground floor                                              | 11.3400 | 0.0800    | 0.9072  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 11.3400 | 0.0000    | 0.0000  |

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

7.3602 (36)

Point Thermal bridges

0.0000

Total fabric heat loss

(33) + (36) + (36a) = 31.8908 (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                     | 26.4540 | 26.2928 | 26.1349 | 25.3932 | 25.2545 | 24.6085 | 24.6085 | 24.4888 | 24.8573 | 25.2545 | 25.5352 | 25.8287 | (38) |
| Heat transfer coeff       | 58.3448 | 58.1837 | 58.0258 | 57.2841 | 57.1453 | 56.4993 | 56.4993 | 56.3797 | 56.7481 | 57.1453 | 57.4260 | 57.7195 | (39) |
| Average = Sum(39)m / 12 = |         |         |         |         |         |         |         |         |         |         |         | 57.2834 |      |

|               | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |      |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| HLP           | 1.0660 | 1.0631 | 1.0602 | 1.0467 | 1.0441 | 1.0323 | 1.0323 | 1.0301 | 1.0369 | 1.0441 | 1.0493 | 1.0546 | (40) |
| HLP (average) |        |        |        |        |        |        |        |        |        |        |        | 1.0467 |      |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |      |

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

|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------------|-----------|-------------|
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |          |            |           | 1.8294 (42) |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 70.4615                                                         | 69.4026  | 67.8596  | 64.9073  | 62.7286  | 60.2989  | 58.9179  | 60.4492  | 62.1279  | 64.7366  | 67.7523  | 70.1916    | (42a)     |             |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 0.0000                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | (42b)     |             |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 33.3653                                                         | 32.1520  | 30.9388  | 29.7255  | 28.5122  | 27.2989  | 27.2989  | 28.5122  | 29.7255  | 30.9388  | 32.1520  | 33.3653    | (42c)     |             |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |            | 95.2953   | (43)        |
|                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov        | Dec       |             |
| Daily hot water use                                             | 103.8269 | 101.5547 | 98.7984  | 94.6328  | 91.2408  | 87.5978  | 86.2168  | 88.9614  | 91.8533  | 95.6754  | 99.9044    | 103.5569  | (44)        |
| Energy conte                                                    | 164.4364 | 144.6125 | 151.8494 | 129.5476 | 122.8276 | 107.7117 | 104.2717 | 110.1528 | 113.2643 | 129.8306 | 142.3321   | 162.1451  | (45)        |
| Energy content (annual)                                         |          |          |          |          |          |          |          |          |          | Total =  | Sum(45)m = | 1582.9819 |             |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 24.6655                                                         | 21.6919  | 22.7774  | 19.4321  | 18.4241  | 16.1568  | 15.6408  | 16.5229  | 16.9897  | 19.4746  | 21.3498  | 24.3218    | (46)      |             |
| Water storage loss (or HIU loss):                               |          |          |          |          |          |          |          |          |          |          |            |           |             |
| Total storage loss                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000    | (56)        |
| If cylinder contains dedicated solar storage                    |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 0.0000                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000    | (57)        |
| Primary loss                                                    | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000    | (59)        |
| Combi loss                                                      | 50.9589  | 46.0274  | 50.3466  | 46.6682  | 46.4953  | 43.1989  | 43.9351  | 45.3338  | 45.2975  | 48.7551  | 49.2679    | 50.9589   | (61)        |
| Total heat required for water heating calculated for each month |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 215.3953                                                        | 190.6399 | 202.1960 | 176.2158 | 169.3229 | 150.9107 | 148.2068 | 155.4866 | 158.5619 | 178.5857 | 191.6000 | 213.1040   | (62)      |             |
| WWHRS                                                           | -32.2121 | -28.4886 | -29.8316 | -24.7018 | -23.0212 | -19.6994 | -18.4650 | -19.6357 | -20.3817 | -24.0278 | -27.2206   | -31.6156  | (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                                                 | 183.1832 | 162.1513 | 172.3644 | 151.5140 | 146.3018 | 131.2113 | 129.7418 | 135.8509 | 138.1801 | 154.5579 | 164.3794   | 181.4884  | (64)        |
| 12Total per year (kWh/year)                                     |          |          |          |          |          |          |          |          |          |          |            |           |             |
| 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)       |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            | 1850.9245 | (64)        |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            | 1851      | (64)        |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |
|                                                                 |          |          |          |          |          |          |          |          |          |          |            |           |             |

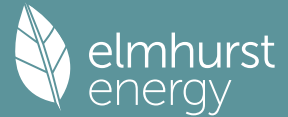
## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |      |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|------|
| (66)m                                                                               | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | 91.4722  | (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 86.6302  | 95.9120  | 86.6302  | 89.5178  | 86.6302  | 89.5178  | 86.6302  | 86.6302  | 89.5178  | 86.6302  | 89.5178  | 86.6302  | (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 159.4895 | 161.1445 | 156.9740 | 148.0954 | 136.8877 | 126.3541 | 119.3170 | 117.6620 | 121.8325 | 130.7112 | 141.9188 | 152.4524 | (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | 32.1472  | (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)                                 |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | -73.1778 | (71) |
| Water heating gains (Table 5)                                                       |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 90.6113  | 88.6764  | 84.7803  | 76.0300  | 70.5162  | 64.7415  | 61.3631  | 64.4614  | 68.0344  | 74.4052  | 82.8367  | 89.5873  | (72) |
| Total internal gains                                                                |          |          |          |          |          |          |          |          |          |          |          |          |      |
|                                                                                     | 390.1727 | 399.1745 | 381.8262 | 367.0849 | 347.4757 | 331.0551 | 317.7519 | 319.1952 | 329.8265 | 345.1882 | 367.7150 | 382.1116 | (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   |
|-----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|--------------|
| Northeast | 6.0300     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 20.7927 (75) |
| Southeast | 1.5000     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 16.8670 (77) |

# Full SAP Calculation Printout



|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 37.6597  | 71.0550  | 115.5654 | 173.9400 | 222.8935 | 233.6270 | 220.1038 | 181.6949 | 135.4827 | 83.4771  | 46.3654  | 31.4150 (83)  |
| Total gains | 427.8324 | 470.2295 | 497.3916 | 541.0249 | 570.3692 | 564.6821 | 537.8557 | 500.8901 | 465.3092 | 428.6653 | 414.0804 | 413.5266 (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                                                                         | 49.1871 | 49.3233 | 49.4575 | 50.0979 | 50.2195 | 50.7937 | 50.7937 | 50.9015 | 50.5710 | 50.2195 | 49.9740 | 49.7199      |
| alpha                                                                       | 4.2791  | 4.2882  | 4.2972  | 4.3399  | 4.3480  | 4.3862  | 4.3862  | 4.3934  | 4.3714  | 4.3480  | 4.3316  | 4.3147       |
| util living area                                                            | 0.9832  | 0.9734  | 0.9545  | 0.8979  | 0.7832  | 0.6045  | 0.4536  | 0.5035  | 0.7377  | 0.9185  | 0.9711  | 0.9853 (86)  |
| MIT                                                                         | 19.6291 | 19.8131 | 20.0911 | 20.4844 | 20.7891 | 20.9495 | 20.9885 | 20.9822 | 20.8796 | 20.5008 | 20.0155 | 19.6043 (87) |
| Th 2                                                                        | 20.0287 | 20.0311 | 20.0335 | 20.0446 | 20.0467 | 20.0565 | 20.0565 | 20.0583 | 20.0527 | 20.0467 | 20.0425 | 20.0381 (88) |
| util rest of house                                                          | 0.9793  | 0.9672  | 0.9435  | 0.8733  | 0.7341  | 0.5278  | 0.3604  | 0.4068  | 0.6662  | 0.8934  | 0.9632  | 0.9819 (89)  |
| MIT 2                                                                       | 18.4442 | 18.6780 | 19.0281 | 19.5150 | 19.8606 | 20.0237 | 20.0518 | 20.0503 | 19.9638 | 19.5458 | 18.9441 | 18.4194 (90) |
| Living area fraction                                                        | 18.9895 | 19.2005 | 19.5173 | 19.9612 | 20.2880 | 20.4498 | 20.4829 | 20.4792 | 20.3853 | 19.9853 | 19.4372 | 0.4603 (91)  |
| MIT                                                                         | 18.9895 | 19.2005 | 19.5173 | 19.9612 | 20.2880 | 20.4498 | 20.4829 | 20.4792 | 20.3853 | 19.9853 | 19.4372 | 18.9648 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |         |         | 0.0000       |
| adjusted MIT                                                                | 18.9895 | 19.2005 | 19.5173 | 19.9612 | 20.2880 | 20.4498 | 20.4829 | 20.4792 | 20.3853 | 19.9853 | 19.4372 | 18.9648 (93) |

## 8. Space heating requirement

|                                                                                |          |          |          |          |          |          |          |          |          |               |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|----------|----------------|
|                                                                                | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov      | Dec            |
| Utilisation                                                                    | 0.9737   | 0.9604   | 0.9363   | 0.8708   | 0.7474   | 0.5608   | 0.4031   | 0.4509   | 0.6929   | 0.8915        | 0.9570   | 0.9768 (94)    |
| Useful gains                                                                   | 416.5861 | 451.6243 | 465.7185 | 471.1311 | 426.2662 | 316.6568 | 216.8192 | 225.8531 | 322.4173 | 382.1495      | 396.2605 | 403.9213 (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                                                               | 857.0578 | 832.0540 | 755.3403 | 633.6285 | 490.7614 | 330.5100 | 219.3825 | 229.9853 | 356.6781 | 536.3284      | 708.4775 | 852.2163 (97)  |
| Space heating kWh                                                              | 327.7109 | 255.6488 | 215.4786 | 116.9982 | 47.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 114.7092      | 224.7963 | 333.5315 (98a) |
| Space heating requirement - total per year (kWh/year)                          |          |          |          |          |          |          |          |          |          |               |          | 1636.8579      |
| 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                                                              | 327.7109 | 255.6488 | 215.4786 | 116.9982 | 47.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 114.7092      | 224.7963 | 333.5315 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |          |          |          |          |          |          |          |          |          |               |          | 1636.8579      |
| Space heating per m2                                                           |          |          |          |          |          |          |          |          |          | (98c) / (4) = |          | 29.9079 (99)   |

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

|                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |                 |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 92.4000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
|                                                                                                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                                                            | 327.7109 | 255.6488 | 215.4786 | 116.9982 | 47.9844  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 114.7092 | 224.7963 | 333.5315 (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)                                                             | 354.6655 | 276.6762 | 233.2020 | 126.6214 | 51.9312  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 124.1441 | 243.2860 | 360.9649 (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                                                                            | 183.1832 | 162.1513 | 172.3644 | 151.5140 | 146.3018 | 131.2113 | 129.7418 | 135.8509 | 138.1801 | 154.5579 | 164.3794 | 181.4884 (64)   |
| Efficiency of water heater                                                                           | 85.6124  | 85.3523  | 84.8609  | 83.8337  | 82.2655  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 83.7515  | 85.0526  | 80.3000 (216)   |
| Fuel for water heating, kWh/month                                                                    | 213.9680 | 189.9789 | 203.1139 | 180.7316 | 177.8410 | 163.4013 | 161.5714 | 169.1792 | 172.0799 | 184.5435 | 193.2680 | 211.8537 (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                                                                                             | 18.0000  | 14.4403  | 13.0019  | 9.5257   | 7.3580   | 6.0115   | 6.7122   | 8.7247   | 11.3326  | 14.8689  | 16.7944  | 18.5003 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -10.4404 | -15.8423 | -24.4894 | -29.6840 | -33.9447 | -32.4123 | -32.0328 | -29.2761 | -24.7649 | -19.0407 | -11.8742 | -8.9011 (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)                                        | -2.9155  | -6.3329  | -12.9677 | -20.0476 | -27.0733 | -27.4015 | -27.0655 | -22.6424 | -16.2515 | -9.2244  | -3.9460  | -2.2901 (233b)  |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system 1                                                                   |          |          |          |          |          |          |          |          |          |          |          | 1771.4912 (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                                                                              |          |          |          |          |          |          |          |          |          |          |          | 2221.5304 (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)                                                  |          |          |          |          |          |          |          |          |          |          |          | 145.2706 (232)  |

# Full SAP Calculation Printout



Energy saving/generation technologies (Appendices M ,N and Q)

|                                                |                 |
|------------------------------------------------|-----------------|
| PV generation                                  | -450.8612 (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            | 3773.4310 (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                 | 1771.4912          | 0.2100                        | 372.0132 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2221.5304          | 0.2100                        | 466.5214 (264)           |
| Space and water heating                       |                    |                               | 838.5345 (265)           |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 145.2706           | 0.1443                        | 20.9670 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -272.7029          | 0.1331                        | -36.2877                 |
| PV Unit electricity exported                  | -178.1583          | 0.1251                        | -22.2828                 |
| Total                                         |                    |                               | -58.5705 (269)           |
| Total CO2, kg/year                            |                    |                               | 812.8604 (272)           |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 14.8500 (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               | 1771.4912          | 1.1300                              | 2001.7851 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2221.5304          | 1.1300                              | 2510.3293 (278)            |
| Space and water heating                     |                    |                                     | 4512.1144 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 145.2706           | 1.5338                              | 222.8209 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -272.7029          | 1.4917                              | -406.7924                  |
| PV Unit electricity exported                | -178.1583          | 0.4591                              | -81.7861                   |
| Total                                       |                    |                                     | -488.5785 (283)            |
| Total Primary energy kWh/year               |                    |                                     | 4376.4576 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 79.9600 (287)              |

# Full SAP Calculation Printout



|                                    |                            |               |       |                |            |
|------------------------------------|----------------------------|---------------|-------|----------------|------------|
| Plot Reference                     | Top floor flat 9           |               |       | Issued on Date | 11/12/2025 |
| Assessment Reference               | Be Clean                   | Plot Type Ref |       |                |            |
| Plot Address                       |                            |               |       | SAP Version    | 10.2       |
|                                    |                            |               |       |                |            |
| SAP Rating                         | 84 B                       | DER           | 16.16 | TER            | 16.54      |
| Environmental                      | 87 B                       | % DER < TER   |       |                | 2.30       |
| CO <sub>2</sub> Emissions (t/year) | 1.12                       | DFEE          | 47.16 | TFEE           | 50.97      |
| Compliance Check                   | See BREL                   | % DFEE < TFEE |       |                | 7.47       |
| % DPER < TPER                      | -1.00                      | DPER          | 89.57 | TPER           | 88.68      |
|                                    |                            |               |       |                |            |
| Assessor Details                   | Ms. Ruth Ferguson          |               |       | Assessor ID    | AE69-0001  |
| Client                             | Red Cannon, Suite 1, 18-22 |               |       |                |            |

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> ) |
|--------------------------------------------------------|---------------------------|---------------------------------|-----------------------------|
| Main dwelling                                          | 78.7800 (1b)              | x 2.6500 (2b)                   | = 208.7670 (1b) - (3b)      |
| Ground floor                                           |                           |                                 |                             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.7800                   |                                 | (4)                         |
| Dwelling volume                                        |                           | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 208.7670 (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                                                                | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1437 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0100 (17)                             |
| Infiltration rate                                                                                  | 0.3942 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3351 (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 | 0.4272 | 0.4188 | 0.4105 | 0.3686 | 0.3602 | 0.3183 | 0.3183 | 0.3099 | 0.3351 | 0.3602 | 0.3770 | 0.3937 (22b) |
| Effective ac    | 0.5913 | 0.5877 | 0.5842 | 0.5679 | 0.5649 | 0.5507 | 0.5507 | 0.5480 | 0.5561 | 0.5649 | 0.5710 | 0.5775 (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   |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------------|-----------------|
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Door                                                           |                         |                            | 1.6800                    | 1.0000                        | 1.6800       |                                      | (26)            |
| Windows                                                        |                         |                            | 11.3400                   | 1.1450                        | 12.9847      |                                      | (27)            |
| External Wall 1                                                | 98.5000                 | 13.0200                    | 85.4800                   | 0.1400                        | 11.9672      | 70.0000                              | 5983.6000 (29a) |
| External Roof 1                                                | 101.4700                |                            | 101.4700                  | 0.0900                        | 9.1323       | 9.0000                               | 913.2300 (30)   |
| Sloping ceiling                                                | 150.0500                |                            | 150.0500                  | 0.1200                        | 18.0060      | 9.0000                               | 1350.4500 (30)  |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 350.0200                  |                               |              |                                      | (31)            |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           | (26)...(30) + (32) =          | 53.7702      |                                      | (33)            |
| Main dwelling                                                  |                         |                            |                           |                               |              |                                      |                 |
| Party Wall 1                                                   |                         |                            | 22.2100                   | 0.0000                        | 0.0000       | 140.0000                             | 3109.4000 (32)  |
| Party Floor 1                                                  |                         |                            | 78.7800                   |                               |              | 40.0000                              | 3151.2000 (32d) |
| Internal Wall 1                                                |                         |                            | 161.3900                  |                               |              | 9.0000                               | 1452.5100 (32c) |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              | (28)...(30) + (32) + (32a)...(32e) = | 15960.3900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                      | 202.5944 (35)   |
| List of Thermal Bridges                                        |                         |                            |                           |                               |              |                                      |                 |
| K1 Element                                                     |                         |                            |                           | Length                        | Psi-value    | Total                                |                 |
| E2 Other lintels (including other steel lintels)               |                         |                            |                           | 2.2000                        | 0.0500       | 0.1100                               |                 |
| E3 Sill                                                        |                         |                            |                           | 5.9600                        | 0.0500       | 0.2980                               |                 |
| E4 Jamb                                                        |                         |                            |                           | 21.8000                       | 0.0500       | 1.0900                               |                 |
| E16 Corner (normal)                                            |                         |                            |                           | 7.9500                        | 0.0900       | 0.7155                               |                 |

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|                                                                           |         |                       |              |
|---------------------------------------------------------------------------|---------|-----------------------|--------------|
| E18 Party wall between dwellings                                          | 7.9500  | 0.0600                | 0.4770       |
| E7 Party floor between dwellings (in blocks of flats)                     | 34.3200 | 0.0700                | 2.4024       |
| E17 Corner (inverted - internal area greater than external area)          | 2.6500  | -0.0900               | -0.2385      |
| E25 Staggered party wall between dwellings                                | 2.6500  | 0.0600                | 0.1590       |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.7400  | 0.1200                | 0.9288       |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.7400  | 0.0000                | 0.0000       |
| E10 Eaves (insulation at ceiling level)                                   | 34.3200 | 0.0600                | 2.0592       |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |                       | 8.0014 (36)  |
| Point Thermal bridges                                                     |         |                       | 0.0000       |
| Total fabric heat loss                                                    |         | (33) + (36) + (36a) = | 61.7716 (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                                                 | 40.7335  | 40.4894  | 40.2501  | 39.1261  | 38.9158  | 37.9369 | 37.9369 | 37.7556 | 38.3140  | 38.9158  | 39.3412  | 39.7860  |
| Average = Sum(39)m / 12 =                                           | 102.5051 | 102.2610 | 102.0217 | 100.8977 | 100.6874 | 99.7085 | 99.7085 | 99.5272 | 100.0856 | 100.6874 | 101.1129 | 101.5576 |
|                                                                     |          |          |          |          |          |         |         |         |          |          |          | 100.8967 |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep      | Oct      | Nov      | Dec      |
| HLP (average)                                                       | 1.3012   | 1.2981   | 1.2950   | 1.2808   | 1.2781   | 1.2657  | 1.2657  | 1.2634  | 1.2704   | 1.2781   | 1.2835   | 1.2891   |
| Days in month                                                       | 31       | 28       | 31       | 30       | 31       | 30      | 31      | 31      | 30       | 31       | 30       | 31       |

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

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          | 2.4393 (42)    |
| Hot water usage for mixer showers                                              | 83.6411  | 82.3842  | 80.5525  | 77.0480  | 74.4618  | 71.5776  | 69.9383  | 71.7560  | 73.7487  | 76.8454  | 80.4252  | 83.3207 (42a)  |
| Hot water usage for baths                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (42b)   |
| Hot water usage for other uses                                                 | 39.6109  | 38.1705  | 36.7301  | 35.2897  | 33.8493  | 32.4089  | 32.4089  | 33.8493  | 35.2897  | 36.7301  | 38.1705  | 39.6109 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 113.1242 (43)  |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Energy conte                                                                   | 123.2521 | 120.5547 | 117.2827 | 112.3377 | 108.3111 | 103.9865 | 102.3472 | 105.6054 | 109.0384 | 113.5755 | 118.5957 | 122.9316 (44)  |
| Energy content (annual)                                                        | 195.2011 | 171.6683 | 180.2591 | 153.7847 | 145.8076 | 127.8636 | 123.7801 | 130.7615 | 134.4552 | 154.1209 | 168.9613 | 192.4812 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                                         | 29.2802  | 25.7502  | 27.0389  | 23.0677  | 21.8711  | 19.1795  | 18.5670  | 19.6142  | 20.1683  | 23.1181  | 25.3442  | 28.8722 (46)   |
| Water storage loss (or HIU 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                                                                     | 5.4499   | 4.9132   | 5.4200   | 5.2039   | 5.3511   | 5.1520   | 5.3071   | 5.3210   | 5.1652   | 5.3678   | 5.2342   | 5.4445 (61)    |
| Total heat required for water heating calculated for each month                | 200.6510 | 176.5815 | 185.6791 | 158.9886 | 151.1587 | 133.0156 | 129.0871 | 136.0825 | 139.6204 | 159.4886 | 174.1955 | 197.9256 (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                                                                | 200.6510 | 176.5815 | 185.6791 | 158.9886 | 151.1587 | 133.0156 | 129.0871 | 136.0825 | 139.6204 | 159.4886 | 174.1955 | 197.9256 (64)  |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |          |          | 1942.4744 (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                                       | 66.2669  | 58.3080  | 61.2911  | 52.4344  | 49.8188  | 43.8026  | 42.4836  | 44.8085  | 45.9977  | 52.5871  | 57.4882  | 65.3611 (65)   |
| Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (64a)   |

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

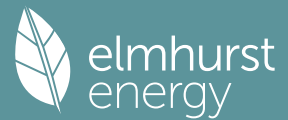
|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 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     | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 116.6488 | 129.1469 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 (67) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 216.8719 | 219.1223 | 213.4512 | 201.3782 | 186.1382 | 171.8147 | 162.2458 | 159.9953 | 165.6664 | 177.7394 | 192.9794 | 207.3029 (68) |
| Pumps, fans                                                                         | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 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)   |
| Water heating gains (Table 5)                                                       | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 (71) |
| Total internal gains                                                                | 89.0683  | 86.7679  | 82.3806  | 72.8256  | 66.9607  | 60.8370  | 57.1017  | 60.2264  | 63.8856  | 70.6816  | 79.8447  | 87.8509 (72)  |
|                                                                                     | 485.1786 | 497.6267 | 475.0702 | 457.3305 | 432.3373 | 412.7784 | 395.5858 | 396.4601 | 409.6787 | 427.6594 | 455.9508 | 474.3922 (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    |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|
| Northeast   | 5.8000     | 11.2829                        | 0.7600                            | 0.7000                             | 0.7700                       | 24.1265 (75)  |
| Southwest   | 3.7800     | 36.7938                        | 0.7600                            | 0.7000                             | 0.7700                       | 51.2757 (79)  |
| Northwest   | 1.7600     | 11.2829                        | 0.7600                            | 0.7000                             | 0.7700                       | 7.3212 (81)   |
| Solar gains | 82.7234    | 151.3542                       | 234.8350                          | 337.4777                           | 420.4515                     | 436.0826      |
| Total gains | 567.9020   | 648.9809                       | 709.9052                          | 794.8082                           | 852.7888                     | 848.8610      |
|             |            |                                |                                   |                                    |                              | 808.2457      |
|             |            |                                |                                   |                                    |                              | 744.3633      |
|             |            |                                |                                   |                                    |                              | 679.6089      |
|             |            |                                |                                   |                                    |                              | 602.4190      |
|             |            |                                |                                   |                                    |                              | 556.9367      |
|             |            |                                |                                   |                                    |                              | 69.5631 (83)  |
|             |            |                                |                                   |                                    |                              | 543.9553 (84) |

## 7. Mean internal temperature (heating season)

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|                                                                             |         |         |         |         |         |         |         |         |                     |         |         |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------|---------|---------|--------------|
| 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                                                                         | 43.2509 | 43.3542 | 43.4559 | 43.9400 | 44.0317 | 44.4640 | 44.4640 | 44.5450 | 44.2965             | 44.0317 | 43.8465 | 43.6544      |
| alpha                                                                       | 3.8834  | 3.8903  | 3.8971  | 3.9293  | 3.9354  | 3.9643  | 3.9643  | 3.9697  | 3.9531              | 3.9354  | 3.9231  | 3.9103       |
| util living area                                                            | 0.9908  | 0.9836  | 0.9694  | 0.9265  | 0.8329  | 0.6723  | 0.5197  | 0.5773  | 0.8045              | 0.9484  | 0.9838  | 0.9922 (86)  |
| MIT                                                                         | 19.2183 | 19.4361 | 19.7718 | 20.2457 | 20.6477 | 20.8946 | 20.9708 | 20.9561 | 20.7755             | 20.2587 | 19.6656 | 19.1869 (87) |
| Th 2                                                                        | 19.8399 | 19.8424 | 19.8447 | 19.8559 | 19.8580 | 19.8678 | 19.8678 | 19.8696 | 19.8641             | 19.8580 | 19.8538 | 19.8494 (88) |
| util rest of house                                                          | 0.9882  | 0.9791  | 0.9605  | 0.9043  | 0.7822  | 0.5800  | 0.3965  | 0.4519  | 0.7281              | 0.9282  | 0.9786  | 0.9900 (89)  |
| MIT 2                                                                       | 17.7873 | 18.0654 | 18.4910 | 19.0834 | 19.5494 | 19.8019 | 19.8571 | 19.8517 | 19.6997             | 19.1124 | 18.3670 | 17.7536 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / | (4) =   |         | 0.3227 (91)  |
| MIT                                                                         | 18.2490 | 18.5077 | 18.9043 | 19.4584 | 19.9038 | 20.1545 | 20.2164 | 20.2080 | 20.0468             | 19.4823 | 18.7860 | 18.2161 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                     |         |         | -0.1500      |
| adjusted MIT                                                                | 18.0990 | 18.3577 | 18.7543 | 19.3084 | 19.7538 | 20.0045 | 20.0664 | 20.0580 | 19.8968             | 19.3323 | 18.6360 | 18.0661 (93) |

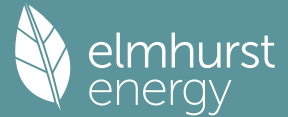
## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9825    | 0.9709    | 0.9492    | 0.8910    | 0.7768   | 0.5921   | 0.4191   | 0.4741   | 0.7307   | 0.9159        | 0.9705    | 0.9850 (94)    |
| Useful gains                                                                   | 557.9631  | 630.0844  | 673.8395  | 708.2050  | 662.4756 | 502.5885 | 338.7122 | 352.8741 | 496.5612 | 551.7470      | 540.4951  | 535.7845 (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                                                               | 1414.4714 | 1376.1951 | 1250.2051 | 1050.1858 | 810.9165 | 538.8728 | 345.6340 | 364.0725 | 580.1805 | 879.2314      | 1166.4395 | 1408.2053 (97) |
| Space heating kWh                                                              | 637.2422  | 501.3864  | 428.8160  | 246.2262  | 110.4401 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.6483      | 450.6800  | 649.0811 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 3267.5203      |
| 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                                                              | 637.2422  | 501.3864  | 428.8160  | 246.2262  | 110.4401 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.6483      | 450.6800  | 649.0811 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 3267.5203      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 41.4765 (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 %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 89.0000 (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                                                                            | 637.2422 | 501.3864 | 428.8160 | 246.2262 | 110.4401 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.6483 | 450.6800 | 649.0811 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)   |
| Space heating fuel (main heating system)                                                             | 716.0024 | 563.3555 | 481.8158 | 276.6587 | 124.0900 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 273.7622 | 506.3820 | 729.3046 (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                                                                            | 200.6510 | 176.5815 | 185.6791 | 158.9886 | 151.1587 | 133.0156 | 129.0871 | 136.0825 | 139.6204 | 159.4886 | 174.1955 | 197.9256 (64)   |
| Efficiency of water heater (217)m                                                                    | 88.5869  | 88.5509  | 88.4794  | 88.3252  | 88.0097  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 88.3196  | 88.5195  | 87.3000 (216)   |
| Fuel for water heating, kWh/month                                                                    | 226.5019 | 199.4125 | 209.8558 | 180.0038 | 171.7523 | 152.3661 | 147.8661 | 155.8792 | 159.9318 | 180.5812 | 196.7878 | 223.4003 (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                                                                                             | 23.1582  | 18.5784  | 16.7278  | 12.2555  | 9.4665   | 7.7342   | 8.6356   | 11.2249  | 14.5801  | 19.1298  | 21.6071  | 23.8018 (232)   |
| Electricity generated by PVs (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 (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)                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (233b)   |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system 1                                                                   |          |          |          |          |          |          |          |          |          |          |          | 3671.3711 (211) |
| Space heating fuel - main system 2                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                           |          |          |          |          |          |          |          |          |          |          |          | 87.3000         |
| Water heating fuel used                                                                              |          |          |          |          |          |          |          |          |          |          |          | 2204.3388 (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)                                                  |          |          |          |          |          |          |          |          |          |          |          | 186.8999 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |          |          |          |          |          |          |          |          |                 |
| PV generation                                                                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (233)    |
| Wind generation                                                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (234)    |
| Hydro-electric generation (Appendix N)                                                               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (235a)   |

# Full SAP Calculation Printout



|                                                |                 |
|------------------------------------------------|-----------------|
| 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            | 6148.6098 (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                   | 3671.3711          | 0.2100                        | 770.9879 (261)           |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                      | 2204.3388          | 0.2100                        | 462.9111 (264)           |
| Space and water heating                         |                    |                               | 1233.8991 (265)          |
| Pumps, fans and electric keep-hot               | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                             | 186.8999           | 0.1443                        | 26.9754 (268)            |
| Total CO2, kg/year                              |                    |                               | 1272.8038 (272)          |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 16.1600 (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               | 3671.3711          | 1.1300                              | 4148.6493 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2204.3388          | 1.1300                              | 2490.9028 (278)            |
| Space and water heating                     |                    |                                     | 6639.5521 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 186.8999           | 1.5338                              | 286.6733 (282)             |
| Total Primary energy kWh/year               |                    |                                     | 7056.3263 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 89.5700 (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)         |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|
| Main dwelling                                          | 78.7800 (1b) | x 2.6500 (2b)                   | = 208.7670 (1b) - (3b) |
| Ground floor                                           |              |                                 | (4)                    |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.7800      |                                 |                        |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 208.7670 (5)         |

### 2. Ventilation rate

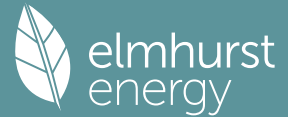
|                                                      | m3 per hour                                                                      |
|------------------------------------------------------|----------------------------------------------------------------------------------|
| Number of open chimneys                              | 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                  | 3 * 10 = 30.0000 (7a)                                                            |
| Number of passive vents                              | 0 * 10 = 0.0000 (7b)                                                             |
| Number of flueless gas fires                         | 0 * 40 = 0.0000 (7c)                                                             |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 30.0000 / (5) = 0.1437 (8) |
| Pressure test                                        | Yes                                                                              |
| Pressure Test Method                                 | Blower Door                                                                      |
| Measured/design AP50                                 | 5.0000 (17)                                                                      |
| Infiltration rate                                    | 0.3937 (18)                                                                      |
| Number of sides sheltered                            | 2 (19)                                                                           |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] = 0.8500 (20)                                          |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = 0.3346 (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 | 0.4267 | 0.4183 | 0.4099 | 0.3681 | 0.3597 | 0.3179 | 0.3179 | 0.3095 | 0.3346 | 0.3597 | 0.3765 | 0.3932 (22b) |
| Effective ac    | 0.5910 | 0.5875 | 0.5840 | 0.5678 | 0.5647 | 0.5505 | 0.5505 | 0.5479 | 0.5560 | 0.5647 | 0.5709 | 0.5773 (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 |
|------------------------------------------------|-------------|----------------|---------------|------------------|--------------|-------------------|---------------|
| Main dwelling                                  |             |                |               |                  |              |                   |               |
| TER Opaque door                                |             |                | 1.6800        | 1.0000           | 1.6800       |                   | (26)          |
| TER Opening Type                               |             |                | 11.3400       | 1.1450           | 12.9847      |                   | (27)          |
| External Wall 1                                | 98.5000     | 13.0200        | 85.4800       | 0.1800           | 15.3864      |                   | (29a)         |
| External Roof 1                                | 101.4700    |                | 101.4700      | 0.1100           | 11.1617      |                   | (30)          |
| Sloping ceiling                                | 150.0500    |                | 150.0500      | 0.1100           | 16.5055      |                   | (30)          |
| Total net area of external elements Aum(A, m2) |             |                | 350.0200      |                  |              |                   | (31)          |

# Full SAP Calculation Printout



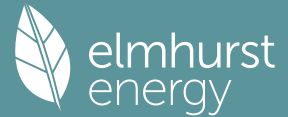
|                                                                           |                      |          |          |          |          |          |          |          |           |          |          |                            |               |
|---------------------------------------------------------------------------|----------------------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|----------|----------------------------|---------------|
| Fabric heat loss, W/K = Sum (A x U)                                       | (26)...(30) + (32) = |          |          |          | 57.7183  |          |          |          |           |          |          |                            | (33)          |
| Main dwelling                                                             |                      |          |          |          |          |          |          |          |           |          |          |                            |               |
| Party Wall 1                                                              | 22.2100              | 0.0000   | 0.0000   |          |          |          |          |          |           |          |          |                            | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                         |                      |          |          |          |          |          |          |          |           |          |          |                            | 202.5944 (35) |
| List of Thermal Bridges                                                   |                      |          |          |          |          |          |          |          |           |          |          |                            |               |
| K1 Element                                                                |                      |          |          |          |          |          |          | Length   | Psi-value | Total    |          |                            |               |
| E2 Other lintels (including other steel lintels)                          |                      |          |          |          |          |          |          | 2.2000   | 0.0500    | 0.1100   |          |                            |               |
| E3 Sill                                                                   |                      |          |          |          |          |          |          | 5.9600   | 0.0500    | 0.2980   |          |                            |               |
| E4 Jamb                                                                   |                      |          |          |          |          |          |          | 21.8000  | 0.0500    | 1.0900   |          |                            |               |
| E16 Corner (normal)                                                       |                      |          |          |          |          |          |          | 7.9500   | 0.0900    | 0.7155   |          |                            |               |
| E18 Party wall between dwellings                                          |                      |          |          |          |          |          |          | 7.9500   | 0.0600    | 0.4770   |          |                            |               |
| E7 Party floor between dwellings (in blocks of flats)                     |                      |          |          |          |          |          |          | 34.3200  | 0.0700    | 2.4024   |          |                            |               |
| E17 Corner (inverted - internal area greater than external area)          |                      |          |          |          |          |          |          | 2.6500   | -0.0900   | -0.2385  |          |                            |               |
| E25 Staggered party wall between dwellings                                |                      |          |          |          |          |          |          | 2.6500   | 0.0600    | 0.1590   |          |                            |               |
| P4 Party wall - Roof (insulation at ceiling level)                        |                      |          |          |          |          |          |          | 7.7400   | 0.1200    | 0.9288   |          |                            |               |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) |                      |          |          |          |          |          |          | 7.7400   | 0.0000    | 0.0000   |          |                            |               |
| E10 Eaves (insulation at ceiling level)                                   |                      |          |          |          |          |          |          | 34.3200  | 0.0600    | 2.0592   |          |                            |               |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |                      |          |          |          |          |          |          |          |           |          | 8.0014   | (36)                       |               |
| Point Thermal bridges                                                     |                      |          |          |          |          |          |          |          |           |          | 0.0000   | (36a) =                    |               |
| Total fabric heat loss                                                    |                      |          |          |          |          |          |          |          |           |          | 65.7197  | (33) + (36) + (36a) = (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                        | (38)          |
| Heat transfer coeff                                                       | 40.7176              | 40.4740  | 40.2354  | 39.1142  | 38.9045  | 37.9280  | 37.9280  | 37.7472  | 38.3041   | 38.9045  | 39.3288  | 39.7724                    | (38)          |
| Average = Sum(39)m / 12 =                                                 | 106.4373             | 106.1938 | 105.9551 | 104.8340 | 104.6242 | 103.6478 | 103.6478 | 103.4669 | 104.0239  | 104.6242 | 105.0486 | 105.4922                   | (39)          |
|                                                                           |                      |          |          |          |          |          |          |          |           |          |          | 104.8330                   | (39)          |
| HLP                                                                       | Jan                  | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep       | Oct      | Nov      | Dec                        | (40)          |
| HLP (average)                                                             | 1.3511               | 1.3480   | 1.3449   | 1.3307   | 1.3281   | 1.3157   | 1.3157   | 1.3134   | 1.3204    | 1.3281   | 1.3334   | 1.3391                     | (40)          |
| Days in mont                                                              | 31                   | 28       | 31       | 30       | 31       | 30       | 31       | 31       | 30        | 31       | 30       | 31                         | (40)          |

|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 4. Water heating energy requirements (kWh/year)                 |          |          |          |          |          |          |          |          |          |          |          |          |
| Assumed occupancy                                               |          |          |          |          |          |          |          |          |          |          |          |          |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |          |          |
| Hot water usage for baths                                       | 83.6411  | 82.3842  | 80.5525  | 77.0480  | 74.4618  | 71.5776  | 69.9383  | 71.7560  | 73.7487  | 76.8454  | 80.4252  | 83.3207  |
| Hot water usage for other uses                                  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   |
| Average daily hot water use (litres/day)                        | 39.6109  | 38.1705  | 36.7301  | 35.2897  | 33.8493  | 32.4089  | 32.4089  | 33.8493  | 35.2897  | 36.7301  | 38.1705  | 39.6109  |
|                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec      |
| Energy conte                                                    | 123.2521 | 120.5547 | 117.2827 | 112.3377 | 108.3111 | 103.9865 | 102.3472 | 105.6054 | 109.0384 | 113.5755 | 118.5957 | 122.9316 |
| Energy content (annual)                                         | 195.2011 | 171.6683 | 180.2591 | 153.7847 | 145.8076 | 127.8636 | 123.7801 | 130.7615 | 134.4552 | 154.1209 | 168.9613 | 192.4812 |
| Distribution loss (46)m = 0.15 x (45)m                          | 29.2802  | 25.7502  | 27.0389  | 23.0677  | 21.8711  | 19.1795  | 18.5670  | 19.6142  | 20.1683  | 23.1181  | 25.3442  | 28.8722  |
| Water storage loss (or HIU 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   |
| 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   |
| 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   |
| 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  |
| Total heat required for water heating calculated for each month | 246.1600 | 217.6957 | 231.2180 | 203.0998 | 196.7665 | 177.1787 | 174.7390 | 181.7204 | 183.7703 | 205.0798 | 218.2764 | 243.4401 |
| WWHRS                                                           | -38.2372 | -33.8173 | -35.4115 | -29.3222 | -27.3272 | -23.3841 | -21.9188 | -23.3085 | -24.1941 | -28.5221 | -32.3121 | -37.5291 |
| 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  |
| 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   |
| 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   |
| Output from w/h                                                 | 207.9228 | 183.8784 | 195.8064 | 173.7777 | 169.4393 | 153.7946 | 152.8201 | 158.4119 | 159.5762 | 176.5576 | 185.9642 | 205.9109 |
| 12Total per year (kWh/year)                                     |          |          |          |          |          |          |          |          |          |          |          |          |
| 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   |
| Heat gains from water heating, kWh/month                        | 77.6441  | 68.5866  | 72.6759  | 63.4622  | 61.2207  | 54.8434  | 53.8966  | 56.2179  | 57.0351  | 63.9849  | 68.5084  | 76.7397  |

|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |          |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 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     | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 116.6488 | 129.1469 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 216.8719 | 219.1223 | 213.4512 | 201.3782 | 186.1382 | 171.8147 | 162.2458 | 159.9953 | 165.6664 | 177.7394 | 192.9794 | 207.3029 |
| Pumps, fans                                                                         | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 3.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 3.0000   | 3.0000   | 3.0000   |
| Water heating gains (Table 5)                                                       | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 |
| Total internal gains                                                                | 104.3603 | 102.0633 | 97.6826  | 88.1419  | 82.2859  | 76.1714  | 72.4417  | 75.5617  | 79.2155  | 86.0012  | 95.1505  | 103.1448 |
|                                                                                     | 500.4706 | 512.9221 | 490.3723 | 472.6469 | 447.6625 | 428.1128 | 410.9258 | 411.7954 | 425.0085 | 442.9790 | 471.2567 | 489.6861 |

|                |                |            |                  |               |               |         |  |  |  |  |  |  |
|----------------|----------------|------------|------------------|---------------|---------------|---------|--|--|--|--|--|--|
| 6. Solar gains |                |            |                  |               |               |         |  |  |  |  |  |  |
| [Jan]          | Area           | Solar flux | g                | FF            | Access        | Gains   |  |  |  |  |  |  |
|                | m <sup>2</sup> | Table 6a   | W/m <sup>2</sup> | Specific data | Specific data | factor  |  |  |  |  |  |  |
| Northeast      | 5.8000         | 11.2829    | 0.6300           | 0.7000        | 0.7700        | 19.9996 |  |  |  |  |  |  |

# Full SAP Calculation Printout



|           |        |         |        |        |        |              |
|-----------|--------|---------|--------|--------|--------|--------------|
| Southwest | 3.7800 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 42.5049 (79) |
| Northwest | 1.7600 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.0689 (81)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 68.5734  | 125.4647 | 194.6659 | 279.7513 | 348.5321 | 361.4895 | 342.0733 | 288.3934 | 223.7579 | 144.8665 | 83.7119  | 57.6642 (83)  |
| Total gains | 569.0440 | 638.3868 | 685.0381 | 752.3981 | 796.1947 | 789.6023 | 752.9991 | 700.1889 | 648.7664 | 587.8455 | 554.9686 | 547.3502 (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                                                                         | 41.6531 | 41.7486 | 41.8426 | 42.2901 | 42.3749 | 42.7741 | 42.7741 | 42.8489 | 42.6195                   | 42.3749 | 42.2037 | 42.0263      |
| alpha                                                                       | 3.7769  | 3.7832  | 3.7895  | 3.8193  | 3.8250  | 3.8516  | 3.8516  | 3.8566  | 3.8413                    | 3.8250  | 3.8136  | 3.8018       |
| util living area                                                            | 0.9908  | 0.9848  | 0.9735  | 0.9398  | 0.8639  | 0.7198  | 0.5677  | 0.6217  | 0.8315                    | 0.9540  | 0.9844  | 0.9920 (86)  |
| MIT                                                                         | 19.1375 | 19.3400 | 19.6641 | 20.1349 | 20.5603 | 20.8531 | 20.9558 | 20.9372 | 20.7246                   | 20.1870 | 19.5925 | 19.1090 (87) |
| Th 2                                                                        | 19.8010 | 19.8034 | 19.8058 | 19.8168 | 19.8189 | 19.8286 | 19.8286 | 19.8304 | 19.8249                   | 19.8189 | 19.8147 | 19.8104 (88) |
| util rest of house                                                          | 0.9882  | 0.9805  | 0.9656  | 0.9204  | 0.8176  | 0.6261  | 0.4333  | 0.4880  | 0.7582                    | 0.9353  | 0.9792  | 0.9898 (89)  |
| MIT 2                                                                       | 17.6595 | 17.9184 | 18.3303 | 18.9232 | 19.4262 | 19.7343 | 19.8120 | 19.8041 | 19.6195                   | 18.9984 | 18.2490 | 17.6291 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3227 (91)  |
| MIT                                                                         | 18.1364 | 18.3771 | 18.7607 | 19.3142 | 19.7922 | 20.0953 | 20.1811 | 20.1697 | 19.9761                   | 19.3820 | 18.6825 | 18.1066 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.1364 | 18.3771 | 18.7607 | 19.3142 | 19.7922 | 20.0953 | 20.1811 | 20.1697 | 19.9761                   | 19.3820 | 18.6825 | 18.1066 (93) |

## 8. Space heating requirement

|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
| Utilisation                                                                    | 0.9829    | 0.9733    | 0.9561    | 0.9101    | 0.8164   | 0.6495   | 0.4760   | 0.5296   | 0.7692   | 0.9262        | 0.9721    | 0.9851 (94)    |
| Useful gains                                                                   | 559.3177  | 621.3521  | 654.9884  | 684.7201  | 649.9836 | 512.8372 | 358.4200 | 370.8296 | 499.0157 | 544.4521      | 539.4922  | 539.1942 (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                                                               | 1472.7082 | 1431.1852 | 1299.0803 | 1091.7610 | 846.6375 | 569.5755 | 371.1737 | 390.0425 | 611.2532 | 918.8058      | 1216.7277 | 1467.0392 (97) |
| Space heating kWh                                                              | 679.5626  | 544.2078  | 479.2044  | 293.0695  | 146.3105 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.5192      | 487.6096  | 690.3167 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 3598.8001      |
| 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                                                              | 679.5626  | 544.2078  | 479.2044  | 293.0695  | 146.3105 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.5192      | 487.6096  | 690.3167 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 3598.8001      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 45.6816 (99)   |

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

|                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |                 |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 92.4000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
|                                                                                                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                                                            | 679.5626 | 544.2078 | 479.2044 | 293.0695 | 146.3105 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.5192 | 487.6096 | 690.3167 (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)                                                             | 735.4573 | 588.9695 | 518.6195 | 317.1747 | 158.3447 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 301.4277 | 527.7160 | 747.0960 (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                                                                            | 207.9228 | 183.8784 | 195.8064 | 173.7777 | 169.4393 | 153.7946 | 152.8201 | 158.4119 | 159.5762 | 176.5576 | 185.9642 | 205.9109 (64)   |
| Efficiency of water heater (217)m                                                                    | 86.7240  | 86.5588  | 86.2214  | 85.4918  | 84.0684  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 85.3535  | 86.3469  | 86.7650 (216)   |
| Fuel for water heating, kWh/month                                                                    | 239.7524 | 212.4318 | 227.0973 | 203.2682 | 201.5492 | 191.5250 | 190.3115 | 197.2751 | 198.7251 | 206.8547 | 215.3688 | 237.3201 (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                                                                                             | 24.2373  | 19.4441  | 17.5072  | 12.8266  | 9.9076   | 8.0946   | 9.0380   | 11.7480  | 15.2595  | 20.0213  | 22.6140  | 24.9110 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |          |          |          |          |          |          |          |          |                 |
| (233a)m                                                                                              | -14.8717 | -22.4806 | -34.6145 | -41.7758 | -47.5945 | -45.3607 | -44.8089 | -41.0273 | -34.8285 | -26.9254 | -16.8785 | -12.6871 (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                                                                                              | -4.3532  | -9.4390  | -19.3024 | -29.8093 | -40.2366 | -40.7371 | -40.2589 | -33.7058 | -24.2116 | -13.7602 | -5.8936  | -3.4218 (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                                                                   |          |          |          |          |          |          |          |          |          |          |          | 3894.8053 (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                                                                              |          |          |          |          |          |          |          |          |          |          |          | 2521.4792 (219) |
| Space cooling fuel                                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (221)    |

# Full SAP Calculation Printout



|                                                               |                 |
|---------------------------------------------------------------|-----------------|
| Electricity for pumps and fans:                               |                 |
| Total electricity for the above, kWh/year                     | 86.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)           | 195.6091 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q) |                 |
| PV generation                                                 | -648.9831 (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                           | 6048.9105 (238) |

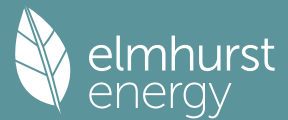
## ----- 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP -----

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 3894.8053          | 0.2100                        | 817.9091 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2521.4792          | 0.2100                        | 529.5106 (264)           |
| Space and water heating                       |                    |                               | 1347.4198 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 195.6091           | 0.1443                        | 28.2324 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -383.8535          | 0.1332                        | -51.1131                 |
| PV Unit electricity exported                  | -265.1296          | 0.1251                        | -33.1648                 |
| Total                                         |                    |                               | -84.2779 (269)           |
| Total CO2, kg/year                            |                    |                               | 1303.3035 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 16.5400 (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               | 3894.8053          | 1.1300                              | 4401.1300 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2521.4792          | 1.1300                              | 2849.2715 (278)            |
| Space and water heating                     |                    |                                     | 7250.4015 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 195.6091           | 1.5338                              | 300.0317 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -383.8535          | 1.4920                              | -572.7276                  |
| PV Unit electricity exported                | -265.1296          | 0.4591                              | -121.7272                  |
| Total                                       |                    |                                     | -694.4548 (283)            |
| Total Primary energy kWh/year               |                    |                                     | 6986.0792 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 88.6800 (287)              |

# Full SAP Calculation Printout



|                                    |                            |  |               |               |                |            |       |
|------------------------------------|----------------------------|--|---------------|---------------|----------------|------------|-------|
| Plot Reference                     | Top floor flat 9           |  |               |               | Issued on Date | 11/12/2025 |       |
| Assessment Reference               | Be Green                   |  |               | Plot Type Ref |                |            |       |
| Plot Address                       |                            |  |               |               | SAP Version    | 10.2       |       |
|                                    |                            |  |               |               |                |            |       |
| SAP Rating                         | 74 C                       |  | DER           | 6.49          |                | TER        | 16.07 |
| Environmental                      | 95 A                       |  | % DER < TER   |               |                |            | 59.61 |
| CO <sub>2</sub> Emissions (t/year) | 0.45                       |  | DFEE          | 47.16         |                | TFEE       | 50.97 |
| Compliance Check                   | See BREL                   |  | % DFEE < TFEE |               |                |            | 7.47  |
| % DPER < TPER                      | 21.63                      |  | DPER          | 67.49         |                | TPER       | 86.11 |
|                                    |                            |  |               |               |                |            |       |
| Assessor Details                   | Ms. Ruth Ferguson          |  |               |               | Assessor ID    | AE69-0001  |       |
| Client                             | Red Cannon, Suite 1, 18-22 |  |               |               |                |            |       |

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> ) |
|--------------------------------------------------------|---------------------------|----------------------|-----------------------------|
| Main dwelling                                          |                           |                      |                             |
| Ground floor                                           | 78.7800 (1b)              | 2.6500 (2b)          | 208.7670 (1b) - (3b)        |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.7800                   |                      | 208.7670 (4)                |
| Dwelling volume                                        |                           |                      | 208.7670 (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                                                                | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1437 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0100 (17)                             |
| Infiltration rate                                                                                  | 0.3942 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3351 (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 | 0.4272 | 0.4188 | 0.4105 | 0.3686 | 0.3602 | 0.3183 | 0.3183 | 0.3099 | 0.3351 | 0.3602 | 0.3770 | 0.3937 (22b) |
| Effective ac    | 0.5913 | 0.5877 | 0.5842 | 0.5679 | 0.5649 | 0.5507 | 0.5507 | 0.5480 | 0.5561 | 0.5649 | 0.5710 | 0.5775 (25)  |

## 3. Heat losses and heat loss parameter

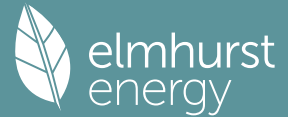
| Element                                                        | Gross<br>m <sup>2</sup> | Openings<br>m <sup>2</sup> | NetArea<br>m <sup>2</sup> | U-value<br>W/m <sup>2</sup> K | A x U<br>W/K | K-value<br>kJ/m <sup>2</sup> K | A x K<br>kJ/K                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| Main dwelling                                                  |                         |                            |                           |                               |              |                                |                                                      |
| Door                                                           |                         |                            | 1.6800                    | 1.0000                        | 1.6800       |                                | (26)                                                 |
| Windows                                                        |                         |                            | 11.3400                   | 1.1450                        | 12.9847      |                                | (27)                                                 |
| External Wall 1                                                | 98.5000                 | 13.0200                    | 85.4800                   | 0.1400                        | 11.9672      | 70.0000                        | 5983.6000 (29a)                                      |
| External Roof 1                                                | 101.4700                |                            | 101.4700                  | 0.0900                        | 9.1323       | 9.0000                         | 913.2300 (30)                                        |
| Sloping ceiling                                                | 150.0500                |                            | 150.0500                  | 0.1200                        | 18.0060      | 9.0000                         | 1350.4500 (30)                                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 350.0200                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | 53.7702      |                                | (33)                                                 |
| Main dwelling                                                  |                         |                            |                           |                               |              |                                |                                                      |
| Party Wall 1                                                   |                         |                            | 22.2100                   | 0.0000                        | 0.0000       | 140.0000                       | 3109.4000 (32)                                       |
| Party Floor 1                                                  |                         |                            | 78.7800                   |                               |              | 40.0000                        | 3151.2000 (32d)                                      |
| Internal Wall 1                                                |                         |                            | 161.3900                  |                               |              | 9.0000                         | 1452.5100 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 15960.3900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 202.5944 (35)                                        |
| List of Thermal Bridges                                        |                         |                            |                           |                               |              |                                |                                                      |
| K1 Element                                                     |                         |                            |                           | Length                        | Psi-value    |                                | Total                                                |
| E2 Other lintels (including other steel lintels)               |                         |                            |                           | 2.2000                        | 0.0500       |                                | 0.1100                                               |
| E3 Sill                                                        |                         |                            |                           | 5.9600                        | 0.0500       |                                | 0.2980                                               |
| E4 Jamb                                                        |                         |                            |                           | 21.8000                       | 0.0500       |                                | 1.0900                                               |
| E16 Corner (normal)                                            |                         |                            |                           | 7.9500                        | 0.0900       |                                | 0.7155                                               |

# Full SAP Calculation Printout



|                                                                                     |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|------------|----------|---------------|--------------------------------------------------------------------------------|---------------|-----------------------|----------|----------------|
| E18 Party wall between dwellings                                                    |          |          |          |          |            |          |               |                                                                                | 7.9500        | 0.0600                | 0.4770   |                |
| E7 Party floor between dwellings (in blocks of flats)                               |          |          |          |          |            |          |               |                                                                                | 34.3200       | 0.0700                | 2.4024   |                |
| E17 Corner (inverted - internal area greater than external area)                    |          |          |          |          |            |          |               |                                                                                | 2.6500        | -0.0900               | -0.2385  |                |
| E25 Staggered party wall between dwellings                                          |          |          |          |          |            |          |               |                                                                                | 2.6500        | 0.0600                | 0.1590   |                |
| P4 Party wall - Roof (insulation at ceiling level)                                  |          |          |          |          |            |          |               |                                                                                | 7.7400        | 0.1200                | 0.9288   |                |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats)           |          |          |          |          |            |          |               |                                                                                | 7.7400        | 0.0000                | 0.0000   |                |
| E10 Eaves (insulation at ceiling level)                                             |          |          |          |          |            |          |               |                                                                                | 34.3200       | 0.0600                | 2.0592   |                |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                          |          |          |          |          |            |          |               |                                                                                |               |                       |          | 8.0014 (36)    |
| Point Thermal Bridges                                                               |          |          |          |          |            |          |               |                                                                                |               |                       |          | 0.0000         |
| Total fabric heat loss                                                              |          |          |          |          |            |          |               |                                                                                |               | (33) + (36) + (36a) = |          | 61.7716 (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                                                                 | 40.7335  | 40.4894  | 40.2501  | 39.1261  | 38.9158    | 37.9369  | 37.9369       | 37.7556                                                                        | 38.3140       | 38.9158               | 39.3412  | 39.7860 (38)   |
| Average = Sum(39)m / 12 =                                                           | 102.5051 | 102.2610 | 102.0217 | 100.8977 | 100.6874   | 99.7085  | 99.7085       | 99.5272                                                                        | 100.0856      | 100.6874              | 101.1129 | 101.5576 (39)  |
|                                                                                     |          |          |          |          |            |          |               |                                                                                |               |                       |          | 100.8967       |
| HLP                                                                                 | Jan      | Feb      | Mar      | Apr      | May        | Jun      | Jul           | Aug                                                                            | Sep           | Oct                   | Nov      | Dec            |
| HLP (average)                                                                       | 1.3012   | 1.2981   | 1.2950   | 1.2808   | 1.2781     | 1.2657   | 1.2657        | 1.2634                                                                         | 1.2704        | 1.2781                | 1.2835   | 1.2891 (40)    |
| Days in mont                                                                        | 31       | 28       | 31       | 30       | 31         | 30       | 31            | 31                                                                             | 30            | 31                    | 30       | 31             |
|                                                                                     |          |          |          |          |            |          |               |                                                                                |               |                       |          | 1.2807         |
|                                                                                     |          |          |          |          |            |          |               |                                                                                |               |                       |          | 31             |
| -----                                                                               |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
| 4. Water heating energy requirements (kWh/year)                                     |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
| -----                                                                               |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
| Assumed occupancy                                                                   |          |          |          |          |            |          |               |                                                                                |               |                       |          | 2.4393 (42)    |
| Hot water usage for mixer showers                                                   |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 83.6411  | 82.3842  | 80.5525  | 77.0480  | 74.4618    | 71.5776  | 69.9383       | 71.7560                                                                        | 73.7487       | 76.8454               | 80.4252  | 83.3207 (42a)  |
| Hot water usage for baths                                                           |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000   | 0.0000        | 0.0000                                                                         | 0.0000        | 0.0000                | 0.0000   | 0.0000 (42b)   |
| Hot water usage for other uses                                                      |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 39.6109  | 38.1705  | 36.7301  | 35.2897  | 33.8493    | 32.4089  | 32.4089       | 33.8493                                                                        | 35.2897       | 36.7301               | 38.1705  | 39.6109 (42c)  |
| Average daily hot water use (litres/day)                                            |          |          |          |          |            |          |               |                                                                                |               |                       |          | 113.1242 (43)  |
|                                                                                     |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May        | Jun      | Jul           | Aug                                                                            | Sep           | Oct                   | Nov      | Dec            |
| Daily hot water use                                                                 | 123.2521 | 120.5547 | 117.2827 | 112.3377 | 108.3111   | 103.9865 | 102.3472      | 105.6054                                                                       | 109.0384      | 113.5755              | 118.5957 | 122.9316 (44)  |
| Energy conte                                                                        | 195.2011 | 171.6683 | 180.2591 | 153.7847 | 145.8076   | 127.8636 | 123.7801      | 130.7615                                                                       | 134.4552      | 154.1209              | 168.9613 | 192.4812 (45)  |
| Energy content (annual)                                                             |          |          |          |          |            |          |               |                                                                                |               | Total = Sum(45)m =    |          | 1879.1445      |
| Distribution loss (46)m = 0.15 x (45)m                                              |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 29.2802  | 25.7502  | 27.0389  | 23.0677  | 21.8711    | 19.1795  | 18.5670       | 19.6142                                                                        | 20.1683       | 23.1181               | 25.3442  | 28.8722 (46)   |
| Water storage loss (or HIU loss):                                                   |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
| Store volume                                                                        |          |          |          |          |            |          |               |                                                                                |               |                       |          | 150.0000 (47)  |
| a) If manufacturer declared loss factor is known (kWh/day):                         |          |          |          |          |            |          |               |                                                                                |               |                       |          | 1.2960 (48)    |
| Temperature factor from Table 2b                                                    |          |          |          |          |            |          |               |                                                                                |               |                       |          | 0.5400 (49)    |
| Enter (49) or (54) in (55)                                                          |          |          |          |          |            |          |               |                                                                                |               |                       |          | 0.6998 (55)    |
| Total storage loss                                                                  |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 21.6950  | 19.5955  | 21.6950  | 20.9952  | 21.6950    | 20.9952  | 21.6950       | 21.6950                                                                        | 20.9952       | 21.6950               | 20.9952  | 21.6950 (56)   |
| If cylinder contains dedicated solar storage                                        |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 21.6950  | 19.5955  | 21.6950  | 20.9952  | 21.6950    | 20.9952  | 21.6950       | 21.6950                                                                        | 20.9952       | 21.6950               | 20.9952  | 21.6950 (57)   |
| Primary loss                                                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000   | 0.0000        | 0.0000                                                                         | 0.0000        | 0.0000                | 0.0000   | 0.0000 (59)    |
| Combi loss                                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000   | 0.0000        | 0.0000                                                                         | 0.0000        | 0.0000                | 0.0000   | 0.0000 (61)    |
| Total heat required for water heating calculated for each month                     |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
|                                                                                     | 216.8962 | 191.2638 | 201.9541 | 174.7799 | 167.5026   | 148.8588 | 145.4751      | 152.4565                                                                       | 155.4504      | 175.8159              | 189.9565 | 214.1762 (62)  |
| WWHRS                                                                               | -58.7283 | -51.9398 | -54.3883 | -45.0357 | -41.9717   | -35.9154 | -33.6650      | -35.7994                                                                       | -37.1595      | -43.8070              | -49.6280 | -57.6407 (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                                                                     | 158.1679 | 139.3240 | 147.5658 | 129.7442 | 125.5309   | 112.9433 | 111.8101      | 116.6572                                                                       | 118.2909      | 132.0090              | 140.3285 | 156.5355 (64)  |
|                                                                                     |          |          |          |          |            |          |               | Total per year (kWh/year) = Sum(64)m =                                         |               |                       |          | 1588.9073 (64) |
| 12Total per year (kWh/year)                                                         |          |          |          |          |            |          |               |                                                                                |               |                       |          | 1589 (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                                            | 64.9044  | 57.0797  | 59.9361  | 51.1334  | 48.4810    | 42.5146  | 41.1569       | 43.4782                                                                        | 44.7064       | 51.2452               | 56.1796  | 64.0000 (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                                                                               | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652   | 121.9652 | 121.9652      | 121.9652                                                                       | 121.9652      | 121.9652              | 121.9652 | 121.9652 (66)  |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 116.6488 | 129.1469 | 116.6488 | 120.5371 | 116.6488   | 120.5371 | 116.6488      | 116.6488                                                                       | 120.5371      | 116.6488              | 120.5371 | 116.6488 (67)  |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 216.8719 | 219.1223 | 213.4512 | 201.3782 | 186.1382   | 171.8147 | 162.2458      | 159.9953                                                                       | 165.6664      | 177.7394              | 192.9794 | 207.3029 (68)  |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965    | 35.1965  | 35.1965       | 35.1965                                                                        | 35.1965       | 35.1965               | 35.1965  | 35.1965 (69)   |
| Pumps, fans                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000     | 0.0000   | 0.0000        | 0.0000                                                                         | 0.0000        | 0.0000                | 0.0000   | 0.0000 (70)    |
| Losses e.g. evaporation (negative values) (Table 5)                                 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722   | -97.5722 | -97.5722      | -97.5722                                                                       | -97.5722      | -97.5722              | -97.5722 | -97.5722 (71)  |
| Water heating gains (Table 5)                                                       | 87.2371  | 84.9400  | 80.5593  | 71.0187  | 65.1626    | 59.0481  | 55.3184       | 58.4384                                                                        | 62.0922       | 68.8779               | 78.0273  | 86.0215 (72)   |
| Total internal gains                                                                | 480.3473 | 492.7988 | 470.2490 | 452.5236 | 427.5392   | 410.9895 | 393.8025      | 394.6721                                                                       | 407.8852      | 422.8557              | 451.1334 | 469.5628 (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 |                |
| Northeast                                                                           |          |          |          | 5.8000   | 11.2829    |          | 0.7600        |                                                                                | 0.7000        |                       | 0.7700   | 24.1265 (75)   |
| Southwest                                                                           |          |          |          | 3.7800   | 36.7938    |          | 0.7600        |                                                                                | 0.7000        |                       | 0.7700   | 51.2757 (79)   |
| Northwest                                                                           |          |          |          | 1.7600   | 11.2829    |          | 0.7600        |                                                                                | 0.7000        |                       | 0.7700   | 7.3212 (81)    |
| -----                                                                               |          |          |          |          |            |          |               |                                                                                |               |                       |          |                |
| Solar gains                                                                         | 82.7234  | 151.3542 | 234.8350 | 337.4777 | 420.4515   | 436.0826 | 412.6599      | 347.9032                                                                       | 269.9301      | 174.7596              | 100.9858 | 69.5631 (83)   |
| Total gains                                                                         | 563.0707 | 644.1531 | 705.0840 | 790.0013 | 847.9907   | 847.0721 | 806.4624      | 742.5753                                                                       | 677.8154      | 597.6153              | 552.1192 | 539.1259 (84)  |

# Full SAP Calculation Printout



## 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                                                                         | 43.2509 | 43.3542 | 43.4559 | 43.9400 | 44.0317 | 44.4640 | 44.4640 | 44.5450 | 44.2965 | 44.0317             | 43.8465 | 43.6544      |
| alpha                                                                       | 3.8834  | 3.8903  | 3.8971  | 3.9293  | 3.9354  | 3.9643  | 3.9643  | 3.9697  | 3.9531  | 3.9354              | 3.9231  | 3.9103       |
| util living area                                                            | 0.9910  | 0.9840  | 0.9701  | 0.9277  | 0.8349  | 0.6733  | 0.5207  | 0.5784  | 0.8055  | 0.9496              | 0.9843  | 0.9924 (86)  |
| Living                                                                      | 19.2111 | 19.4291 | 19.7653 | 20.2402 | 20.6441 | 20.8940 | 20.9706 | 20.9558 | 20.7743 | 20.2528             | 19.6586 | 19.1797      |
| Non living                                                                  | 17.7782 | 18.0566 | 18.4829 | 19.0770 | 19.5458 | 19.8015 | 19.8570 | 19.8515 | 19.6987 | 19.1054             | 18.3583 | 17.7444      |
| 24 / 16                                                                     | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0       | 0                   | 0       | 0            |
| 24 / 9                                                                      | 31      | 28      | 31      | 0       | 0       | 0       | 0       | 0       | 0       | 0                   | 17      | 31           |
| 16 / 9                                                                      | 0       | 0       | 0       | 30      | 0       | 0       | 0       | 0       | 0       | 6                   | 13      | 0            |
| MIT                                                                         | 21.0000 | 21.0000 | 21.0000 | 20.5697 | 20.6441 | 20.8940 | 20.9706 | 20.9558 | 20.7743 | 20.3155             | 20.6708 | 21.0000 (87) |
| Th 2                                                                        | 19.8399 | 19.8424 | 19.8447 | 19.8559 | 19.8580 | 19.8678 | 19.8678 | 19.8696 | 19.8641 | 19.8580             | 19.8538 | 19.8494 (88) |
| util rest of house                                                          | 0.9885  | 0.9796  | 0.9613  | 0.9058  | 0.7845  | 0.5810  | 0.3973  | 0.4529  | 0.7293  | 0.9298              | 0.9792  | 0.9903 (89)  |
| MIT 2                                                                       | 19.8399 | 19.8424 | 19.8447 | 19.5121 | 19.5458 | 19.8015 | 19.8570 | 19.8515 | 19.6987 | 19.1867             | 19.5678 | 19.8494 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA =   | Living area / (4) = |         | 0.3227 (91)  |
| MIT                                                                         | 20.2142 | 20.2159 | 20.2175 | 19.8534 | 19.9002 | 20.1540 | 20.2163 | 20.2078 | 20.0458 | 19.5509             | 19.9237 | 20.2206 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |                     |         | 0.0000       |
| adjusted MIT                                                                | 20.2142 | 20.2159 | 20.2175 | 19.8534 | 19.9002 | 20.1540 | 20.2163 | 20.2078 | 20.0458 | 19.5509             | 19.9237 | 20.2206 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9894    | 0.9812    | 0.9645    | 0.9057    | 0.7866   | 0.6060   | 0.4368   | 0.4924   | 0.7432   | 0.9230        | 0.9795    | 0.9911 (94)    |
| Useful gains                                                                   | 557.1127  | 632.0344  | 680.0216  | 715.5363  | 667.0367 | 513.3147 | 352.2254 | 365.6628 | 503.7232 | 551.5837      | 540.8212  | 534.3061 (95)  |
| Ext temp.                                                                      | 4.3000    | 4.9000    | 6.5000    | 8.9000    | 11.7000  | 14.6000  | 16.6000  |          | 14.1000  | 10.6000       | 7.1000    | 4.2000 (96)    |
| Heat loss rate W                                                               | 1631.2921 | 1566.2185 | 1399.4833 | 1105.1721 | 825.6610 | 553.7841 | 360.5785 | 378.9825 | 595.0883 | 901.2477      | 1296.6375 | 1627.0176 (97) |
| Space heating kWh                                                              | 799.1894  | 627.7717  | 535.2795  | 280.5378  | 118.0164 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 260.1500      | 544.1877  | 812.9774 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 3978.1099      |
| 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                                                              | 799.1894  | 627.7717  | 535.2795  | 280.5378  | 118.0164 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 260.1500      | 544.1877  | 812.9774 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 3978.1099      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 50.4964 (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 %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 203.4196 (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                                                                            | 799.1894 | 627.7717 | 535.2795 | 280.5378 | 118.0164 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 260.1500 | 544.1877 | 812.9774 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 203.4196 | 203.4196 | 203.4196 | 203.4196 | 203.4196 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 203.4196 | 203.4196 | 203.4196 (210)  |
| Space heating fuel (main heating system)                                                             | 392.8772 | 308.6092 | 263.1405 | 137.9109 | 58.0162  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 127.8883 | 267.5197 | 399.6553 (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                                                                            | 158.1679 | 139.3240 | 147.5658 | 129.7442 | 125.5309 | 112.9433 | 111.8101 | 116.6572 | 118.2909 | 132.0090 | 140.3285 | 156.5355 (64)   |
| Efficiency of water heater (217)m                                                                    | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 | 124.0169 (216)  |
| Fuel for water heating, kWh/month                                                                    | 127.5374 | 112.3428 | 118.9885 | 104.6182 | 101.2209 | 91.0710  | 90.1572  | 94.0656  | 95.3829  | 106.4444 | 113.1528 | 126.2211 (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                                                                                         | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (231)    |
| Lighting                                                                                             | 23.1582  | 18.5784  | 16.7278  | 12.2555  | 9.4665   | 7.7342   | 8.6356   | 11.2249  | 14.5801  | 19.1298  | 21.6071  | 23.8018 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |          |          |          |          |          |          |          |          |                 |
| (233a)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 (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                                                                                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (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                                                                   |          |          |          |          |          |          |          |          |          |          |          | 1955.6174 (211) |
| Space heating fuel - main system 2                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                           |          |          |          |          |          |          |          |          |          |          |          | 124.0169        |
| Water heating fuel used                                                                              |          |          |          |          |          |          |          |          |          |          |          | 1281.2027 (219) |
| Space cooling fuel                                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (221)    |

Electricity for pumps and fans:

# Full SAP Calculation Printout



|                                                               |                 |
|---------------------------------------------------------------|-----------------|
| Total electricity for the above, kWh/year                     | 0.0000 (231)    |
| Electricity for lighting (calculated in Appendix L)           | 186.8999 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q) |                 |
| PV generation                                                 | 0.0000 (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                           | 3423.7200 (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                   | 1955.6174          | 0.1554                        | 303.9885 (261)           |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (273)             |
| Water heating (other fuel)                      | 1281.2027          | 0.1409                        | 180.5348 (264)           |
| Space and water heating                         |                    |                               | 484.5233 (265)           |
| Pumps, fans and electric keep-hot               | 0.0000             | 0.0000                        | 0.0000 (267)             |
| Energy for lighting                             | 186.8999           | 0.1443                        | 26.9754 (268)            |
| Total CO2, kg/year                              |                    |                               | 511.4987 (272)           |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 6.4900 (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               | 1955.6174          | 1.5755                              | 3081.0687 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 1281.2027          | 1.5210                              | 1948.7547 (278)            |
| Space and water heating                     |                    |                                     | 5029.8234 (279)            |
| Pumps, fans and electric keep-hot           | 0.0000             | 0.0000                              | 0.0000 (281)               |
| Energy for lighting                         | 186.8999           | 1.5338                              | 286.6733 (282)             |
| Total Primary energy kWh/year               |                    |                                     | 5316.4967 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 67.4900 (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) |
|--------------------------------------------------------|--------------|----------------------|----------------|
| Main dwelling                                          | 78.7800      | 2.6500               | 208.7670       |
| Ground floor                                           |              |                      |                |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.7800      |                      |                |
| Dwelling volume                                        |              |                      |                |

### 2. Ventilation rate

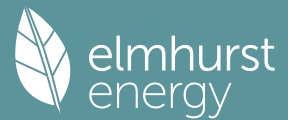
|                                                                                                    | m3 per hour                             |
|----------------------------------------------------------------------------------------------------|-----------------------------------------|
| Number of 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                                                                | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1437 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0000 (17)                             |
| Infiltration rate                                                                                  | 0.3937 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3346 (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 | 0.4267 | 0.4183 | 0.4099 | 0.3681 | 0.3597 | 0.3179 | 0.3179 | 0.3095 | 0.3346 | 0.3597 | 0.3765 | 0.3932 (22b) |
| Effective ac    | 0.5910 | 0.5875 | 0.5840 | 0.5678 | 0.5647 | 0.5505 | 0.5505 | 0.5479 | 0.5560 | 0.5647 | 0.5709 | 0.5773 (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



|                                                |          |         |                      |        |         |        |       |
|------------------------------------------------|----------|---------|----------------------|--------|---------|--------|-------|
| Main dwelling                                  | m2       | m2      | m2                   | W/m2K  | W/K     | kJ/m2K | kJ/K  |
| TER Opaque door                                |          |         | 1.6800               | 1.0000 | 1.6800  |        | (26)  |
| TER Opening Type                               |          |         | 11.3400              | 1.1450 | 12.9847 |        | (27)  |
| External Wall 1                                | 98.5000  | 13.0200 | 85.4800              | 0.1800 | 15.3864 |        | (29a) |
| External Roof 1                                | 101.4700 |         | 101.4700             | 0.1100 | 11.1617 |        | (30)  |
| Sloping ceiling                                | 150.0500 |         | 150.0500             | 0.1100 | 16.5055 |        | (30)  |
| Total net area of external elements Aum(A, m2) |          |         | 350.0200             |        |         |        | (31)  |
| Fabric heat loss, W/K = Sum (A x U)            |          |         | (26)...(30) + (32) = |        | 57.7183 |        | (33)  |
| Main dwelling                                  |          |         |                      |        |         |        |       |
| Party Wall 1                                   |          | 22.2100 | 0.0000               | 0.0000 |         |        | (32)  |

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 202.5944 (35)

|                                                                           |         |           |         |
|---------------------------------------------------------------------------|---------|-----------|---------|
| List of Thermal Bridges                                                   | Length  | Psi-value | Total   |
| K1 Element                                                                | 2.2000  | 0.0500    | 0.1100  |
| E2 Other lintels (including other steel lintels)                          | 5.9600  | 0.0500    | 0.2980  |
| E3 Sill                                                                   | 21.8000 | 0.0500    | 1.0900  |
| E4 Jamb                                                                   | 7.9500  | 0.0900    | 0.7155  |
| E16 Corner (normal)                                                       | 7.9500  | 0.0600    | 0.4770  |
| E18 Party wall between dwellings                                          | 34.3200 | 0.0700    | 2.4024  |
| E7 Party floor between dwellings (in blocks of flats)                     | 2.6500  | -0.0900   | -0.2385 |
| E17 Corner (inverted - internal area greater than external area)          | 2.6500  | 0.0600    | 0.1590  |
| E25 Staggered party wall between dwellings                                | 7.7400  | 0.1200    | 0.9288  |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.7400  | 0.0000    | 0.0000  |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 34.3200 | 0.0600    | 2.0592  |
| E10 Eaves (insulation at ceiling level)                                   |         |           |         |

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.0014 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 65.7197 (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                                                               | 40.7176  | 40.4740  | 40.2354  | 39.1142  | 38.9045  | 37.9280  | 37.9280  | 37.7472  | 38.3041  | 38.9045  | 39.3288  | 39.7724  |
| Heat transfer coeff                                                 | 106.4373 | 106.1938 | 105.9551 | 104.8340 | 104.6242 | 103.6478 | 103.6478 | 103.4669 | 104.0239 | 104.6242 | 105.0486 | 105.4922 |
| Average = Sum(39)m / 12 =                                           |          |          |          |          |          |          |          |          |          |          |          | 104.8330 |

|               |        |        |        |        |        |        |        |        |        |        |        |        |
|---------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| HLP           | Jan    | Feb    | Mar    | Apr    | May    | Jun    | Jul    | Aug    | Sep    | Oct    | Nov    | Dec    |
| HLP (average) | 1.3511 | 1.3480 | 1.3449 | 1.3307 | 1.3281 | 1.3157 | 1.3157 | 1.3134 | 1.3204 | 1.3281 | 1.3334 | 1.3391 |
| Days in mont  | 31     | 28     | 31     | 30     | 31     | 30     | 31     | 31     | 30     | 31     | 30     | 31     |

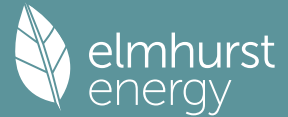
## 4. Water heating energy requirements (kWh/year)

|                                                                                |          |          |          |          |          |          |          |          |          |                                        |          |           |               |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------------------------------|----------|-----------|---------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |                                        |          |           | 2.4393 (42)   |
| Hot water usage for mixer showers                                              | 83.6411  | 82.3842  | 80.5525  | 77.0480  | 74.4618  | 71.5776  | 69.9383  | 71.7560  | 73.7487  | 76.8454                                | 80.4252  | 83.3207   | (42a)         |
| Hot water usage for baths                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000    | (42b)         |
| Hot water usage for other uses                                                 | 39.6109  | 38.1705  | 36.7301  | 35.2897  | 33.8493  | 32.4089  | 32.4089  | 33.8493  | 35.2897  | 36.7301                                | 38.1705  | 39.6109   | (42c)         |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |                                        |          |           | 113.1242 (43) |
| Daily hot water use                                                            | 123.2521 | 120.5547 | 117.2827 | 112.3377 | 108.3111 | 103.9865 | 102.3472 | 105.6054 | 109.0384 | 113.5755                               | 118.5957 | 122.9316  | (44)          |
| Energy conte                                                                   | 195.2011 | 171.6683 | 180.2591 | 153.7847 | 145.8076 | 127.8636 | 123.7801 | 130.7615 | 134.4552 | 154.1209                               | 168.9613 | 192.4812  | (45)          |
| Energy content (annual)                                                        |          |          |          |          |          |          |          |          |          | Total = Sum(45)m =                     |          | 1879.1445 | (45)          |
| Distribution loss (46)m = 0.15 x (45)m                                         | 29.2802  | 25.7502  | 27.0389  | 23.0677  | 21.8711  | 19.1795  | 18.5670  | 19.6142  | 20.1683  | 23.1181                                | 25.3442  | 28.8722   | (46)          |
| Water storage loss (or HIU loss):                                              |          |          |          |          |          |          |          |          |          |                                        |          |           | 150.0000 (47) |
| Store volume                                                                   |          |          |          |          |          |          |          |          |          |                                        |          |           | 1.3938 (48)   |
| a) If manufacturer declared loss factor is known (kWh/day):                    |          |          |          |          |          |          |          |          |          |                                        |          |           | 0.5400 (49)   |
| Temperature factor from Table 2b                                               |          |          |          |          |          |          |          |          |          |                                        |          |           | 0.7527 (55)   |
| Enter (49) or (54) in (55)                                                     |          |          |          |          |          |          |          |          |          |                                        |          |           |               |
| Total storage loss                                                             | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325                                | 22.5798  | 23.3325   | (56)          |
| If cylinder contains dedicated solar storage                                   | 23.3325  | 21.0745  | 23.3325  | 22.5798  | 23.3325  | 22.5798  | 23.3325  | 23.3325  | 22.5798  | 23.3325                                | 22.5798  | 23.3325   | (57)          |
| Primary loss                                                                   | 23.2624  | 21.0112  | 23.2624  | 22.5120  | 23.2624  | 22.5120  | 23.2624  | 23.2624  | 22.5120  | 23.2624                                | 22.5120  | 23.2624   | (59)          |
| Combi loss                                                                     | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000                                 | 0.0000   | 0.0000    | (61)          |
| Total heat required for water heating calculated for each month                | 241.7960 | 213.7540 | 226.8540 | 198.8766 | 192.4025 | 172.9554 | 170.3750 | 177.3564 | 179.5471 | 200.7158                               | 214.0531 | 239.0761  | (62)          |
| WWHRS                                                                          | -38.2372 | -33.8173 | -35.4115 | -29.3222 | -27.3272 | -23.3841 | -21.9188 | -23.3085 | -24.1941 | -28.5221                               | -32.3121 | -37.5291  | (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                                                                | 203.5588 | 179.9367 | 191.4424 | 169.5544 | 165.0753 | 149.5713 | 148.4561 | 154.0479 | 155.3530 | 172.1936                               | 181.7410 | 201.5469  | (64)          |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m = |          | 2072.4775 | (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                                       | 102.1803 | 90.7483  | 97.2121  | 87.2069  | 85.7569  | 78.5881  | 78.4328  | 80.7541  | 80.7798  | 88.5211                                | 92.2531  | 101.2759  | (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                                                                               | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 116.6488 | 129.1469 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 216.8719 | 219.1223 | 213.4512 | 201.3782 | 186.1382 | 171.8147 | 162.2458 | 159.9953 | 165.6664 | 177.7394 | 192.9794 | 207.3029 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965 (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)                                 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 (71) |
| Water heating gains (Table 5)                                                       | 137.3391 | 135.0421 | 130.6614 | 121.1207 | 115.2647 | 109.1502 | 105.4204 | 108.5405 | 112.1942 | 118.9800 | 128.1293 | 136.1235 (72) |
| Total internal gains                                                                | 533.4494 | 545.9009 | 523.3510 | 505.6256 | 480.6413 | 461.0916 | 443.9046 | 444.7742 | 457.9873 | 475.9578 | 504.2354 | 522.6648 (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    |
|-------------|----------|----------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|
| Northeast   |          |          | 5.8000     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 19.9996 (75)  |
| Southwest   |          |          | 3.7800     | 36.7938                        | 0.6300                            | 0.7000                             | 0.7700                       | 42.5049 (79)  |
| Northwest   |          |          | 1.7600     | 11.2829                        | 0.6300                            | 0.7000                             | 0.7700                       | 6.0689 (81)   |
| Solar gains | 68.5734  | 125.4647 | 194.6659   | 279.7513                       | 348.5321                          | 361.4895                           | 223.7579                     | 57.6642 (83)  |
| Total gains | 602.0227 | 671.3656 | 718.0169   | 785.3769                       | 829.1734                          | 822.5811                           | 681.7452                     | 580.3290 (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                                                                         | 41.6531 | 41.7486 | 41.8426 | 42.2901 | 42.3749 | 42.7741 | 42.7741 | 42.8489 | 42.6195 | 42.3749       | 42.2037 | 42.0263      |
| alpha                                                                       | 3.7769  | 3.7832  | 3.7895  | 3.8193  | 3.8250  | 3.8516  | 3.8516  | 3.8566  | 3.8413  | 3.8250        | 3.8136  | 3.8018       |
| util living area                                                            | 0.9889  | 0.9821  | 0.9694  | 0.9322  | 0.8509  | 0.7012  | 0.5480  | 0.6001  | 0.8134  | 0.9462        | 0.9812  | 0.9903 (86)  |
| MIT                                                                         | 19.1859 | 19.3871 | 19.7089 | 20.1735 | 20.5877 | 20.8662 | 20.9608 | 20.9444 | 20.7479 | 20.2281       | 19.6396 | 19.1577 (87) |
| Th 2                                                                        | 19.8010 | 19.8034 | 19.8058 | 19.8168 | 19.8189 | 19.8286 | 19.8286 | 19.8304 | 19.8249 | 19.8189       | 19.8147 | 19.8104 (88) |
| util rest of house                                                          | 0.9858  | 0.9772  | 0.9604  | 0.9110  | 0.8022  | 0.6069  | 0.4165  | 0.4684  | 0.7367  | 0.9250        | 0.9750  | 0.9876 (89)  |
| MIT 2                                                                       | 17.7208 | 17.9777 | 18.3858 | 18.9686 | 19.4544 | 19.7439 | 19.8141 | 19.8076 | 19.6400 | 19.0468       | 18.3080 | 17.6911 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA =   | Living area / | (4) =   | 0.3227 (91)  |
| MIT                                                                         | 18.1936 | 18.4325 | 18.8127 | 19.3574 | 19.8200 | 20.1060 | 20.1841 | 20.1744 | 19.9975 | 19.4279       | 18.7377 | 18.1643 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |         |               |         | 0.0000       |
| adjusted MIT                                                                | 18.1936 | 18.4325 | 18.8127 | 19.3574 | 19.8200 | 20.1060 | 20.1841 | 20.1744 | 19.9975 | 19.4279       | 18.7377 | 18.1643 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9798    | 0.9693    | 0.9504    | 0.9008    | 0.8023   | 0.6312   | 0.4584   | 0.5096   | 0.7497   | 0.9159        | 0.9672    | 0.9822 (94)    |
| Useful gains                                                                   | 589.8756  | 650.7276  | 682.3864  | 707.4472  | 665.2112 | 519.2085 | 360.2665 | 373.6515 | 511.0754 | 568.6066      | 568.6651  | 570.0224 (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                                                               | 1478.7925 | 1437.0638 | 1304.5920 | 1096.2927 | 849.5526 | 570.6888 | 371.4890 | 390.5236 | 613.4811 | 923.6169      | 1222.5219 | 1473.1258 (97) |
| Space heating kWh                                                              | 661.3542  | 528.4179  | 462.9210  | 279.9688  | 137.1500 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 264.1277      | 470.7769  | 671.9090 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 3476.6255      |
| 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                                                              | 661.3542  | 528.4179  | 462.9210  | 279.9688  | 137.1500 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 264.1277      | 470.7769  | 671.9090 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 3476.6255      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 44.1308 (99)   |

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

|                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |          |               |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)  |
| Fraction of space heat from main system(s)                                                           |          |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)  |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          |          | 92.3000 (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                                                                            | 661.3542 | 528.4179 | 462.9210 | 279.9688 | 137.1500 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 264.1277 | 470.7769 | 671.9090 | (98)          |
| Space heating efficiency (main heating system 1)                                                     | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 92.3000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 92.3000  | 92.3000  | 92.3000  | (210)         |
| Space heating fuel (main heating system)                                                             | 716.5267 | 572.5004 | 501.5395 | 303.3248 | 148.5916 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 286.1622 | 510.0508 | 727.9620 | (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                                                                            | 203.5588 | 179.9367 | 191.4424 | 169.5544 | 165.0753 | 149.5713 | 148.4561 | 154.0479 | 155.3530 | 172.1936 | 181.7410 | 201.5469 | (64)          |
| Efficiency of water heater                                                                           | 86.5039  | 86.3268  | 85.9636  | 85.1766  | 83.6472  | 79.8000  | 79.8000  | 79.8000  | 79.8000  | 85.0160  | 86.0955  | 79.8000  | (216)         |
| Fuel for water heating, kWh/month                                                                    | 235.3175 | 208.4366 | 222.7018 | 199.0622 | 197.3470 | 187.4328 | 186.0352 | 193.0425 | 194.6779 | 202.5426 | 211.0922 | 232.8739 | (219)         |
| Space cooling fuel requirement                                                                       | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (221)         |
| Pumps and Fa                                                                                         | 7.3041   | 6.5973   | 7.3041   | 7.0685   | 7.3041   | 7.0685   | 7.3041   | 7.3041   | 7.0685   | 7.3041   | 7.0685   | 7.3041   | (231)         |
| Lighting                                                                                             | 24.2373  | 19.4441  | 17.5072  | 12.8266  | 9.9076   | 8.0946   | 9.0380   | 11.7480  | 15.2595  | 20.0213  | 22.6140  | 24.9110  | (232)         |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        | -14.8717 | -22.4806 | -34.6145 | -41.7758 | -47.5945 | -45.3607 | -44.8089 | -41.0273 | -34.8285 | -26.9254 | -16.8785 | -12.6871 | (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)                                        | -4.3532  | -9.4390  | -19.3024 | -29.8093 | -40.2366 | -40.7371 | -40.2589 | -33.7058 | -24.2116 | -13.7602 | -5.8936  | -3.4218  | (233b)        |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (234b)        |

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|                                                                                                      |        |        |        |        |        |        |        |        |        |                 |
|------------------------------------------------------------------------------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-----------------|
| 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 | (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 | (235d)          |
| Annual totals kWh/year                                                                               |        |        |        |        |        |        |        |        |        |                 |
| Space heating fuel - main system 1                                                                   |        |        |        |        |        |        |        |        |        | 3766.6581 (211) |
| Space heating fuel - main system 2                                                                   |        |        |        |        |        |        |        |        |        | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |        |        |        |        |        |        |        |        |        | 0.0000 (215)    |
| Efficiency of water heater                                                                           |        |        |        |        |        |        |        |        |        | 79.8000         |
| Water heating fuel used                                                                              |        |        |        |        |        |        |        |        |        | 2470.5622 (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)                                                  |        |        |        |        |        |        |        |        |        | 195.6091 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |        |        |        |        |        |        |        |        |        |                 |
| PV generation                                                                                        |        |        |        |        |        |        |        |        |        | -648.9831 (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                                                                  |        |        |        |        |        |        |        |        |        | 5869.8463 (238) |

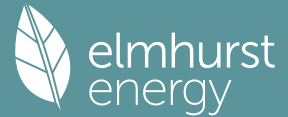
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

|                                               | Energy<br>kWh/year | Emission factor<br>kg CO2/kWh | Emissions<br>kg CO2/year |
|-----------------------------------------------|--------------------|-------------------------------|--------------------------|
| Space heating - main system 1                 | 3766.6581          | 0.2100                        | 790.9982 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2470.5622          | 0.2100                        | 518.8181 (264)           |
| Space and water heating                       |                    |                               | 1309.8163 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 195.6091           | 0.1443                        | 28.2324 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -383.8535          | 0.1332                        | -51.1131                 |
| PV Unit electricity exported                  | -265.1296          | 0.1251                        | -33.1648                 |
| Total                                         |                    |                               | -84.2779 (269)           |
| Total CO2, kg/year                            |                    |                               | 1265.7000 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 16.0700 (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               | 3766.6581          | 1.1300                              | 4256.3237 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2470.5622          | 1.1300                              | 2791.7353 (278)            |
| Space and water heating                     |                    |                                     | 7048.0590 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 195.6091           | 1.5338                              | 300.0317 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -383.8535          | 1.4920                              | -572.7276                  |
| PV Unit electricity exported                | -265.1296          | 0.4591                              | -121.7272                  |
| Total                                       |                    |                                     | -694.4548 (283)            |
| Total Primary energy kWh/year               |                    |                                     | 6783.7367 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 86.1100 (287)              |

# Full SAP Calculation Printout



|                                    |                            |               |       |               |                |            |  |
|------------------------------------|----------------------------|---------------|-------|---------------|----------------|------------|--|
| Plot Reference                     | Top floor flat 9           |               |       |               | Issued on Date | 11/12/2025 |  |
| Assessment Reference               | Be Lean                    |               |       | Plot Type Ref |                |            |  |
| Plot Address                       |                            |               |       |               | SAP Version    | 10.2       |  |
|                                    |                            |               |       |               |                |            |  |
| SAP Rating                         | 84 B                       | DER           | 16.16 | TER           | 16.54          |            |  |
| Environmental                      | 87 B                       | % DER < TER   |       |               |                | 2.30       |  |
| CO <sub>2</sub> Emissions (t/year) | 1.12                       | DFEE          | 47.16 | TFEE          | 50.97          |            |  |
| Compliance Check                   | See BREL                   | % DFEE < TFEE |       |               |                | 7.47       |  |
| % DPER < TPER                      | -1.00                      | DPER          | 89.57 | TPER          | 88.68          |            |  |
|                                    |                            |               |       |               |                |            |  |
| Assessor Details                   | Ms. Ruth Ferguson          |               |       |               | Assessor ID    | AE69-0001  |  |
| Client                             | Red Cannon, Suite 1, 18-22 |               |       |               |                |            |  |

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> ) |
|--------------------------------------------------------|---------------------------|----------------------|-----------------------------|
| Main dwelling                                          |                           |                      |                             |
| Ground floor                                           |                           |                      |                             |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.7800                   |                      |                             |
| Dwelling volume                                        |                           |                      |                             |

## 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                                                                | 3 * 10 = 30.0000 (7a)                   |
| Number of passive vents                                                                            | 0 * 10 = 0.0000 (7b)                    |
| Number of flueless gas fires                                                                       | 0 * 40 = 0.0000 (7c)                    |
| Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = | 30.0000 / (5) = 0.1437 (8)              |
| Pressure test                                                                                      | Yes                                     |
| Pressure Test Method                                                                               | Blower Door                             |
| Measured/design AP50                                                                               | 5.0100 (17)                             |
| Infiltration rate                                                                                  | 0.3942 (18)                             |
| Number of sides sheltered                                                                          | 2 (19)                                  |
| Shelter factor                                                                                     | (20) = 1 - [0.075 x (19)] = 0.8500 (20) |
| Infiltration rate adjusted to include shelter factor                                               | (21) = (18) x (20) = 0.3351 (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 | 0.4272 | 0.4188 | 0.4105 | 0.3686 | 0.3602 | 0.3183 | 0.3183 | 0.3099 | 0.3351 | 0.3602 | 0.3770 | 0.3937 (22b) |
| Effective ac    | 0.5913 | 0.5877 | 0.5842 | 0.5679 | 0.5649 | 0.5507 | 0.5507 | 0.5480 | 0.5561 | 0.5649 | 0.5710 | 0.5775 (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                                        |
|----------------------------------------------------------------|-------------------------|----------------------------|---------------------------|-------------------------------|--------------|--------------------------------|------------------------------------------------------|
| Main dwelling                                                  |                         |                            |                           |                               |              |                                |                                                      |
| Door                                                           |                         |                            | 1.6800                    | 1.0000                        | 1.6800       |                                | (26)                                                 |
| Windows                                                        |                         |                            | 11.3400                   | 1.1450                        | 12.9847      |                                | (27)                                                 |
| External Wall 1                                                | 98.5000                 | 13.0200                    | 85.4800                   | 0.1400                        | 11.9672      | 70.0000                        | 5983.6000 (29a)                                      |
| External Roof 1                                                | 101.4700                |                            | 101.4700                  | 0.0900                        | 9.1323       | 9.0000                         | 913.2300 (30)                                        |
| Sloping ceiling                                                | 150.0500                |                            | 150.0500                  | 0.1200                        | 18.0060      | 9.0000                         | 1350.4500 (30)                                       |
| Total net area of external elements Aum(A, m <sup>2</sup> )    |                         |                            | 350.0200                  |                               |              |                                | (31)                                                 |
| Fabric heat loss, W/K = Sum (A x U)                            |                         |                            |                           |                               | 53.7702      |                                | (33)                                                 |
| Main dwelling                                                  |                         |                            |                           |                               |              |                                |                                                      |
| Party Wall 1                                                   |                         |                            | 22.2100                   | 0.0000                        | 0.0000       | 140.0000                       | 3109.4000 (32)                                       |
| Party Floor 1                                                  |                         |                            | 78.7800                   |                               |              | 40.0000                        | 3151.2000 (32d)                                      |
| Internal Wall 1                                                |                         |                            | 161.3900                  |                               |              | 9.0000                         | 1452.5100 (32c)                                      |
| Heat capacity Cm = Sum(A x k)                                  |                         |                            |                           |                               |              |                                | (28)...(30) + (32) + (32a)...(32e) = 15960.3900 (34) |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K |                         |                            |                           |                               |              |                                | 202.5944 (35)                                        |
| List of Thermal Bridges                                        |                         |                            |                           |                               |              |                                |                                                      |
| K1 Element                                                     |                         |                            |                           |                               | Length       | Psi-value                      | Total                                                |
| E2 Other lintels (including other steel lintels)               |                         |                            |                           |                               | 2.2000       | 0.0500                         | 0.1100                                               |
| E3 Sill                                                        |                         |                            |                           |                               | 5.9600       | 0.0500                         | 0.2980                                               |
| E4 Jamb                                                        |                         |                            |                           |                               | 21.8000      | 0.0500                         | 1.0900                                               |
| E16 Corner (normal)                                            |                         |                            |                           |                               | 7.9500       | 0.0900                         | 0.7155                                               |

# Full SAP Calculation Printout



|                                                                           |         |                       |              |
|---------------------------------------------------------------------------|---------|-----------------------|--------------|
| E18 Party wall between dwellings                                          | 7.9500  | 0.0600                | 0.4770       |
| E7 Party floor between dwellings (in blocks of flats)                     | 34.3200 | 0.0700                | 2.4024       |
| E17 Corner (inverted - internal area greater than external area)          | 2.6500  | -0.0900               | -0.2385      |
| E25 Staggered party wall between dwellings                                | 2.6500  | 0.0600                | 0.1590       |
| P4 Party wall - Roof (insulation at ceiling level)                        | 7.7400  | 0.1200                | 0.9288       |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) | 7.7400  | 0.0000                | 0.0000       |
| E10 Eaves (insulation at ceiling level)                                   | 34.3200 | 0.0600                | 2.0592       |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |         |                       | 8.0014 (36)  |
| Point Thermal bridges                                                     |         |                       | 0.0000       |
| Total fabric heat loss                                                    |         | (33) + (36) + (36a) = | 61.7716 (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                                                 | 40.7335  | 40.4894  | 40.2501  | 39.1261  | 38.9158  | 37.9369 | 37.9369 | 37.7556 | 38.3140  | 38.9158  | 39.3412  | 39.7860  |
| Average = Sum(39)m / 12 =                                           | 102.5051 | 102.2610 | 102.0217 | 100.8977 | 100.6874 | 99.7085 | 99.7085 | 99.5272 | 100.0856 | 100.6874 | 101.1129 | 101.5576 |
|                                                                     |          |          |          |          |          |         |         |         |          |          |          | 100.8967 |
| HLP                                                                 | Jan      | Feb      | Mar      | Apr      | May      | Jun     | Jul     | Aug     | Sep      | Oct      | Nov      | Dec      |
| HLP (average)                                                       | 1.3012   | 1.2981   | 1.2950   | 1.2808   | 1.2781   | 1.2657  | 1.2657  | 1.2634  | 1.2704   | 1.2781   | 1.2835   | 1.2891   |
| Days in month                                                       | 31       | 28       | 31       | 30       | 31       | 30      | 31      | 31      | 30       | 31       | 30       | 31       |

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

|                                                                                |          |          |          |          |          |          |          |          |          |          |          |                |
|--------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------------|
| Assumed occupancy                                                              |          |          |          |          |          |          |          |          |          |          |          | 2.4393 (42)    |
| Hot water usage for mixer showers                                              | 83.6411  | 82.3842  | 80.5525  | 77.0480  | 74.4618  | 71.5776  | 69.9383  | 71.7560  | 73.7487  | 76.8454  | 80.4252  | 83.3207 (42a)  |
| Hot water usage for baths                                                      | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (42b)   |
| Hot water usage for other uses                                                 | 39.6109  | 38.1705  | 36.7301  | 35.2897  | 33.8493  | 32.4089  | 32.4089  | 33.8493  | 35.2897  | 36.7301  | 38.1705  | 39.6109 (42c)  |
| Average daily hot water use (litres/day)                                       |          |          |          |          |          |          |          |          |          |          |          | 113.1242 (43)  |
| Daily hot water use                                                            | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec            |
| Energy conte                                                                   | 123.2521 | 120.5547 | 117.2827 | 112.3377 | 108.3111 | 103.9865 | 102.3472 | 105.6054 | 109.0384 | 113.5755 | 118.5957 | 122.9316 (44)  |
| Energy content (annual)                                                        | 195.2011 | 171.6683 | 180.2591 | 153.7847 | 145.8076 | 127.8636 | 123.7801 | 130.7615 | 134.4552 | 154.1209 | 168.9613 | 192.4812 (45)  |
| Distribution loss (46)m = 0.15 x (45)m                                         | 29.2802  | 25.7502  | 27.0389  | 23.0677  | 21.8711  | 19.1795  | 18.5670  | 19.6142  | 20.1683  | 23.1181  | 25.3442  | 28.8722 (46)   |
| Water storage loss (or HIU 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                                                                     | 5.4499   | 4.9132   | 5.4200   | 5.2039   | 5.3511   | 5.1520   | 5.3071   | 5.3210   | 5.1652   | 5.3678   | 5.2342   | 5.4445 (61)    |
| Total heat required for water heating calculated for each month                | 200.6510 | 176.5815 | 185.6791 | 158.9886 | 151.1587 | 133.0156 | 129.0871 | 136.0825 | 139.6204 | 159.4886 | 174.1955 | 197.9256 (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                                                                | 200.6510 | 176.5815 | 185.6791 | 158.9886 | 151.1587 | 133.0156 | 129.0871 | 136.0825 | 139.6204 | 159.4886 | 174.1955 | 197.9256 (64)  |
| 12Total per year (kWh/year)                                                    |          |          |          |          |          |          |          |          |          |          |          | 1942.4744 (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                                       | 66.2669  | 58.3080  | 61.2911  | 52.4344  | 49.8188  | 43.8026  | 42.4836  | 44.8085  | 45.9977  | 52.5871  | 57.4882  | 65.3611 (65)   |

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

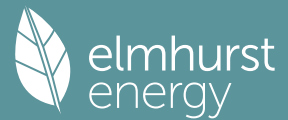
|                                                                                     |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| 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     | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 (66) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 116.6488 | 129.1469 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 (67) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 216.8719 | 219.1223 | 213.4512 | 201.3782 | 186.1382 | 171.8147 | 162.2458 | 159.9953 | 165.6664 | 177.7394 | 192.9794 | 207.3029 (68) |
| Pumps, fans                                                                         | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965 (69)  |
| Losses e.g. evaporation (negative values) (Table 5)                                 | 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)   |
| Water heating gains (Table 5)                                                       | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 (71) |
| Total internal gains                                                                | 89.0683  | 86.7679  | 82.3806  | 72.8256  | 66.9607  | 60.8370  | 57.1017  | 60.2264  | 63.8856  | 70.6816  | 79.8447  | 87.8509 (72)  |
|                                                                                     | 485.1786 | 497.6267 | 475.0702 | 457.3305 | 432.3373 | 412.7784 | 395.5858 | 396.4601 | 409.6787 | 427.6594 | 455.9508 | 474.3922 (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    |
|-------------|------------|--------------------------------|-----------------------------------|------------------------------------|------------------------------|---------------|
| Northeast   | 5.8000     | 11.2829                        | 0.7600                            | 0.7000                             | 0.7700                       | 24.1265 (75)  |
| Southwest   | 3.7800     | 36.7938                        | 0.7600                            | 0.7000                             | 0.7700                       | 51.2757 (79)  |
| Northwest   | 1.7600     | 11.2829                        | 0.7600                            | 0.7000                             | 0.7700                       | 7.3212 (81)   |
| Solar gains | 82.7234    | 151.3542                       | 234.8350                          | 337.4777                           | 420.4515                     | 436.0826      |
| Total gains | 567.9020   | 648.9809                       | 709.9052                          | 794.8082                           | 852.7888                     | 848.8610      |
|             |            |                                |                                   |                                    |                              | 808.2457      |
|             |            |                                |                                   |                                    |                              | 744.3633      |
|             |            |                                |                                   |                                    |                              | 679.6089      |
|             |            |                                |                                   |                                    |                              | 602.4190      |
|             |            |                                |                                   |                                    |                              | 556.9367      |
|             |            |                                |                                   |                                    |                              | 69.5631 (83)  |
|             |            |                                |                                   |                                    |                              | 543.9553 (84) |

## 7. Mean internal temperature (heating season)

# Full SAP Calculation Printout



|                                                                             |         |         |         |         |         |         |         |         |                     |         |             |              |
|-----------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------------------|---------|-------------|--------------|
| 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                                                                         | 43.2509 | 43.3542 | 43.4559 | 43.9400 | 44.0317 | 44.4640 | 44.4640 | 44.5450 | 44.2965             | 44.0317 | 43.8465     | 43.6544      |
| alpha                                                                       | 3.8834  | 3.8903  | 3.8971  | 3.9293  | 3.9354  | 3.9643  | 3.9643  | 3.9697  | 3.9531              | 3.9354  | 3.9231      | 3.9103       |
| util living area                                                            | 0.9908  | 0.9836  | 0.9694  | 0.9265  | 0.8329  | 0.6723  | 0.5197  | 0.5773  | 0.8045              | 0.9484  | 0.9838      | 0.9922 (86)  |
| MIT                                                                         | 19.2183 | 19.4361 | 19.7718 | 20.2457 | 20.6477 | 20.8946 | 20.9708 | 20.9561 | 20.7755             | 20.2587 | 19.6656     | 19.1869 (87) |
| Th 2                                                                        | 19.8399 | 19.8424 | 19.8447 | 19.8559 | 19.8580 | 19.8678 | 19.8678 | 19.8696 | 19.8641             | 19.8580 | 19.8538     | 19.8494 (88) |
| util rest of house                                                          | 0.9882  | 0.9791  | 0.9605  | 0.9043  | 0.7822  | 0.5800  | 0.3965  | 0.4519  | 0.7281              | 0.9282  | 0.9786      | 0.9900 (89)  |
| MIT 2                                                                       | 17.7873 | 18.0654 | 18.4910 | 19.0834 | 19.5494 | 19.8019 | 19.8571 | 19.8517 | 19.6997             | 19.1124 | 18.3670     | 17.7536 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / | (4) =   | 0.3227 (91) |              |
| MIT                                                                         | 18.2490 | 18.5077 | 18.9043 | 19.4584 | 19.9038 | 20.1545 | 20.2164 | 20.2080 | 20.0468             | 19.4823 | 18.7860     | 18.2161 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                     |         |             | -0.1500      |
| adjusted MIT                                                                | 18.0990 | 18.3577 | 18.7543 | 19.3084 | 19.7538 | 20.0045 | 20.0664 | 20.0580 | 19.8968             | 19.3323 | 18.6360     | 18.0661 (93) |

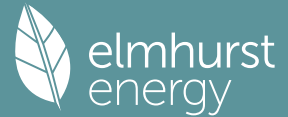
## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9825    | 0.9709    | 0.9492    | 0.8910    | 0.7768   | 0.5921   | 0.4191   | 0.4741   | 0.7307   | 0.9159        | 0.9705    | 0.9850 (94)    |
| Useful gains                                                                   | 557.9631  | 630.0844  | 673.8395  | 708.2050  | 662.4756 | 502.5885 | 338.7122 | 352.8741 | 496.5612 | 551.7470      | 540.4951  | 535.7845 (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                                                               | 1414.4714 | 1376.1951 | 1250.2051 | 1050.1858 | 810.9165 | 538.8728 | 345.6340 | 364.0725 | 580.1805 | 879.2314      | 1166.4395 | 1408.2053 (97) |
| Space heating kWh                                                              | 637.2422  | 501.3864  | 428.8160  | 246.2262  | 110.4401 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.6483      | 450.6800  | 649.0811 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 3267.5203      |
| 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                                                              | 637.2422  | 501.3864  | 428.8160  | 246.2262  | 110.4401 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.6483      | 450.6800  | 649.0811 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 3267.5203      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 41.4765 (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 %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 89.0000 (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                                                                            | 637.2422 | 501.3864 | 428.8160 | 246.2262 | 110.4401 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 243.6483 | 450.6800 | 649.0811 (98)   |
| Space heating efficiency (main heating system 1)                                                     | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 89.0000  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 89.0000  | 89.0000  | 89.0000 (210)   |
| Space heating fuel (main heating system)                                                             | 716.0024 | 563.3555 | 481.8158 | 276.6587 | 124.0900 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 273.7622 | 506.3820 | 729.3046 (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                                                                            | 200.6510 | 176.5815 | 185.6791 | 158.9886 | 151.1587 | 133.0156 | 129.0871 | 136.0825 | 139.6204 | 159.4886 | 174.1955 | 197.9256 (64)   |
| Efficiency of water heater (217)m                                                                    | 88.5869  | 88.5509  | 88.4794  | 88.3252  | 88.0097  | 87.3000  | 87.3000  | 87.3000  | 87.3000  | 88.3196  | 88.5195  | 87.3000 (216)   |
| Fuel for water heating, kWh/month                                                                    | 226.5019 | 199.4125 | 209.8558 | 180.0038 | 171.7523 | 152.3661 | 147.8661 | 155.8792 | 159.9318 | 180.5812 | 196.7878 | 223.4003 (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                                                                                             | 23.1582  | 18.5784  | 16.7278  | 12.2555  | 9.4665   | 7.7342   | 8.6356   | 11.2249  | 14.5801  | 19.1298  | 21.6071  | 23.8018 (232)   |
| Electricity generated by PVs (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 (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)                                        | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (233b)   |
| Electricity generated by wind turbines (Appendix M) (negative quantity)                              | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (234b)   |
| Electricity generated by hydro-electric generators (Appendix M) (negative quantity)                  | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235b)   |
| Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000 (235d)   |
| Annual totals kWh/year                                                                               |          |          |          |          |          |          |          |          |          |          |          |                 |
| Space heating fuel - main system 1                                                                   |          |          |          |          |          |          |          |          |          |          |          | 3671.3711 (211) |
| Space heating fuel - main system 2                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (213)    |
| Space heating fuel - secondary                                                                       |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (215)    |
| Efficiency of water heater                                                                           |          |          |          |          |          |          |          |          |          |          |          | 87.3000         |
| Water heating fuel used                                                                              |          |          |          |          |          |          |          |          |          |          |          | 2204.3388 (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)                                                  |          |          |          |          |          |          |          |          |          |          |          | 186.8999 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q)                                        |          |          |          |          |          |          |          |          |          |          |          |                 |
| PV generation                                                                                        |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (233)    |
| Wind generation                                                                                      |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (234)    |
| Hydro-electric generation (Appendix N)                                                               |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (235a)   |

# Full SAP Calculation Printout



|                                                |                 |
|------------------------------------------------|-----------------|
| 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            | 6148.6098 (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                   | 3671.3711          | 0.2100                        | 770.9879 (261)           |
| Total CO2 associated with community systems     |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                      | 2204.3388          | 0.2100                        | 462.9111 (264)           |
| Space and water heating                         |                    |                               | 1233.8991 (265)          |
| Pumps, fans and electric keep-hot               | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                             | 186.8999           | 0.1443                        | 26.9754 (268)            |
| Total CO2, kg/year                              |                    |                               | 1272.8038 (272)          |
| EPC Dwelling Carbon Dioxide Emission Rate (DER) |                    |                               | 16.1600 (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               | 3671.3711          | 1.1300                              | 4148.6493 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2204.3388          | 1.1300                              | 2490.9028 (278)            |
| Space and water heating                     |                    |                                     | 6639.5521 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 186.8999           | 1.5338                              | 286.6733 (282)             |
| Total Primary energy kWh/year               |                    |                                     | 7056.3263 (286)            |
| Dwelling Primary energy Rate (DPER)         |                    |                                     | 89.5700 (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)         |
|--------------------------------------------------------|--------------|---------------------------------|------------------------|
| Main dwelling                                          | 78.7800 (1b) | x 2.6500 (2b)                   | = 208.7670 (1b) - (3b) |
| Ground floor                                           |              |                                 | (4)                    |
| Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) | 78.7800      |                                 |                        |
| Dwelling volume                                        |              | (3a)+(3b)+(3c)+(3d)+(3e)...(3n) | = 208.7670 (5)         |

### 2. Ventilation rate

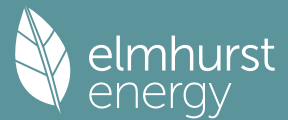
|                                                      | m3 per hour                                                                      |
|------------------------------------------------------|----------------------------------------------------------------------------------|
| Number of open chimneys                              | 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                  | 3 * 10 = 30.0000 (7a)                                                            |
| Number of passive vents                              | 0 * 10 = 0.0000 (7b)                                                             |
| Number of flueless gas fires                         | 0 * 40 = 0.0000 (7c)                                                             |
| Infiltration due to chimneys, flues and fans         | = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 30.0000 / (5) = 0.1437 (8) |
| Pressure test                                        | Yes                                                                              |
| Pressure Test Method                                 | Blower Door                                                                      |
| Measured/design AP50                                 | 5.0000 (17)                                                                      |
| Infiltration rate                                    | 0.3937 (18)                                                                      |
| Number of sides sheltered                            | 2 (19)                                                                           |
| Shelter factor                                       | (20) = 1 - [0.075 x (19)] = 0.8500 (20)                                          |
| Infiltration rate adjusted to include shelter factor | (21) = (18) x (20) = 0.3346 (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 | 0.4267 | 0.4183 | 0.4099 | 0.3681 | 0.3597 | 0.3179 | 0.3179 | 0.3095 | 0.3346 | 0.3597 | 0.3765 | 0.3932 (22b) |
| Effective ac    | 0.5910 | 0.5875 | 0.5840 | 0.5678 | 0.5647 | 0.5505 | 0.5505 | 0.5479 | 0.5560 | 0.5647 | 0.5709 | 0.5773 (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 |
|------------------------------------------------|-------------|----------------|---------------|------------------|--------------|-------------------|---------------|
| Main dwelling                                  |             |                |               |                  |              |                   |               |
| TER Opaque door                                |             |                | 1.6800        | 1.0000           | 1.6800       |                   | (26)          |
| TER Opening Type                               |             |                | 11.3400       | 1.1450           | 12.9847      |                   | (27)          |
| External Wall 1                                | 98.5000     | 13.0200        | 85.4800       | 0.1800           | 15.3864      |                   | (29a)         |
| External Roof 1                                | 101.4700    |                | 101.4700      | 0.1100           | 11.1617      |                   | (30)          |
| Sloping ceiling                                | 150.0500    |                | 150.0500      | 0.1100           | 16.5055      |                   | (30)          |
| Total net area of external elements Aum(A, m2) |             |                | 350.0200      |                  |              |                   | (31)          |

# Full SAP Calculation Printout



|                                                                           |                      |          |          |          |          |          |          |          |           |          |                       |              |               |
|---------------------------------------------------------------------------|----------------------|----------|----------|----------|----------|----------|----------|----------|-----------|----------|-----------------------|--------------|---------------|
| Fabric heat loss, W/K = Sum (A x U)                                       | (26)...(30) + (32) = |          |          |          | 57.7183  |          |          |          |           |          |                       |              | (33)          |
| Main dwelling                                                             |                      |          |          |          |          |          |          |          |           |          |                       |              |               |
| Party Wall 1                                                              | 22.2100              | 0.0000   | 0.0000   |          |          |          |          |          |           |          |                       |              | (32)          |
| Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                         |                      |          |          |          |          |          |          |          |           |          |                       |              | 202.5944 (35) |
| List of Thermal Bridges                                                   |                      |          |          |          |          |          |          |          |           |          |                       |              |               |
| K1 Element                                                                |                      |          |          |          |          |          |          | Length   | Psi-value | Total    |                       |              |               |
| E2 Other lintels (including other steel lintels)                          |                      |          |          |          |          |          |          | 2.2000   | 0.0500    | 0.1100   |                       |              |               |
| E3 Sill                                                                   |                      |          |          |          |          |          |          | 5.9600   | 0.0500    | 0.2980   |                       |              |               |
| E4 Jamb                                                                   |                      |          |          |          |          |          |          | 21.8000  | 0.0500    | 1.0900   |                       |              |               |
| E16 Corner (normal)                                                       |                      |          |          |          |          |          |          | 7.9500   | 0.0900    | 0.7155   |                       |              |               |
| E18 Party wall between dwellings                                          |                      |          |          |          |          |          |          | 7.9500   | 0.0600    | 0.4770   |                       |              |               |
| E7 Party floor between dwellings (in blocks of flats)                     |                      |          |          |          |          |          |          | 34.3200  | 0.0700    | 2.4024   |                       |              |               |
| E17 Corner (inverted - internal area greater than external area)          |                      |          |          |          |          |          |          | 2.6500   | -0.0900   | -0.2385  |                       |              |               |
| E25 Staggered party wall between dwellings                                |                      |          |          |          |          |          |          | 2.6500   | 0.0600    | 0.1590   |                       |              |               |
| P4 Party wall - Roof (insulation at ceiling level)                        |                      |          |          |          |          |          |          | 7.7400   | 0.1200    | 0.9288   |                       |              |               |
| P3 Party wall - Intermediate floor between dwellings (in blocks of flats) |                      |          |          |          |          |          |          | 7.7400   | 0.0000    | 0.0000   |                       |              |               |
| E10 Eaves (insulation at ceiling level)                                   |                      |          |          |          |          |          |          | 34.3200  | 0.0600    | 2.0592   |                       |              |               |
| Thermal bridges (Sum(L x Psi) calculated using Appendix K)                |                      |          |          |          |          |          |          |          |           |          | 8.0014                | (36)         |               |
| Point Thermal bridges                                                     |                      |          |          |          |          |          |          |          |           |          | (36a) =               | 0.0000       |               |
| Total fabric heat loss                                                    |                      |          |          |          |          |          |          |          |           |          | (33) + (36) + (36a) = | 65.7197 (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          | (38)          |
| Heat transfer coeff                                                       | 40.7176              | 40.4740  | 40.2354  | 39.1142  | 38.9045  | 37.9280  | 37.9280  | 37.7472  | 38.3041   | 38.9045  | 39.3288               | 39.7724      | (38)          |
| Average = Sum(39)m / 12 =                                                 | 106.4373             | 106.1938 | 105.9551 | 104.8340 | 104.6242 | 103.6478 | 103.6478 | 103.4669 | 104.0239  | 104.6242 | 105.0486              | 105.4922     | (39)          |
|                                                                           |                      |          |          |          |          |          |          |          |           |          |                       | 104.8330     |               |
| HLP                                                                       | Jan                  | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep       | Oct      | Nov                   | Dec          | (40)          |
| HLP (average)                                                             | 1.3511               | 1.3480   | 1.3449   | 1.3307   | 1.3281   | 1.3157   | 1.3157   | 1.3134   | 1.3204    | 1.3281   | 1.3334                | 1.3391       | (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                                               |          |          |          |          |          |          |          |          |          |          |          |                                                                                | 2.4393 (42)    |
| Hot water usage for mixer showers                               |          |          |          |          |          |          |          |          |          |          |          |                                                                                |                |
| 83.6411                                                         | 82.3842  | 80.5525  | 77.0480  | 74.4618  | 71.5776  | 69.9383  | 71.7560  | 73.7487  | 76.8454  | 80.4252  | 83.3207  | (42a)                                                                          |                |
| Hot water usage for baths                                       |          |          |          |          |          |          |          |          |          |          |          |                                                                                |                |
| 0.0000                                                          | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 0.0000   | (42b)                                                                          |                |
| Hot water usage for other uses                                  |          |          |          |          |          |          |          |          |          |          |          |                                                                                |                |
| 39.6109                                                         | 38.1705  | 36.7301  | 35.2897  | 33.8493  | 32.4089  | 32.4089  | 33.8493  | 35.2897  | 36.7301  | 38.1705  | 39.6109  | (42c)                                                                          |                |
| Average daily hot water use (litres/day)                        |          |          |          |          |          |          |          |          |          |          |          |                                                                                | 113.1242 (43)  |
| Daily hot water use                                             | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec                                                                            |                |
| 123.2521                                                        | 120.5547 | 117.2827 | 112.3377 | 108.3111 | 103.9865 | 102.3472 | 105.6054 | 109.0384 | 113.5755 | 118.5957 | 122.9316 | (44)                                                                           |                |
| Energy content (annual)                                         | 195.2011 | 171.6683 | 180.2591 | 153.7847 | 145.8076 | 127.8636 | 123.7801 | 130.7615 | 134.4552 | 154.1209 | 168.9613 | 192.4812                                                                       | (45)           |
| Distribution loss (46)m = 0.15 x (45)m                          |          |          |          |          |          |          |          |          |          |          |          |                                                                                |                |
| 29.2802                                                         | 25.7502  | 27.0389  | 23.0677  | 21.8711  | 19.1795  | 18.5670  | 19.6142  | 20.1683  | 23.1181  | 25.3442  | 28.8722  | (46)                                                                           |                |
| Water storage loss (or HIU 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                                                      | 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 |          |          |          |          |          |          |          |          |          |          |          |                                                                                |                |
| 246.1600                                                        | 217.6957 | 231.2180 | 203.0998 | 196.7665 | 177.1787 | 174.7390 | 181.7204 | 183.7703 | 205.0798 | 218.2764 | 243.4401 | (62)                                                                           |                |
| WWHRS                                                           | -38.2372 | -33.8173 | -35.4115 | -29.3222 | -27.3272 | -23.3841 | -21.9188 | -23.3085 | -24.1941 | -28.5221 | -32.3121 | -37.5291                                                                       | (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                                                 | 207.9228 | 183.8784 | 195.8064 | 173.7777 | 169.4393 | 153.7946 | 152.8201 | 158.4119 | 159.5762 | 176.5576 | 185.9642 | 205.9109                                                                       | (64)           |
| 12Total per year (kWh/year)                                     |          |          |          |          |          |          |          |          |          |          |          | Total per year (kWh/year) = Sum(64)m =                                         | 2123.8601 (64) |
| Electric shower(s)                                              |          |          |          |          |          |          |          |          |          |          |          | 2124 (64)                                                                      |                |
| 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                        |          |          |          |          |          |          |          |          |          |          |          | Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = | 0.0000 (64a)   |
| 77.6441                                                         | 68.5866  | 72.6759  | 63.4622  | 61.2207  | 54.8434  | 53.8966  | 56.2179  | 57.0351  | 63.9849  | 68.5084  | 76.7397  | (65)                                                                           |                |

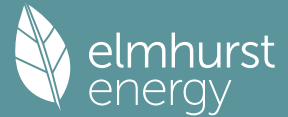
## 5. Internal gains (see Table 5 and 5a)

| Metabolic gains (Table 5), Watts                                                    |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
|                                                                                     | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec           |
| (66)m                                                                               | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 | 121.9652 (66) |
| Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5     | 116.6488 | 129.1469 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 | 116.6488 | 120.5371 | 116.6488 | 120.5371 | 116.6488 (67) |
| Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5 | 216.8719 | 219.1223 | 213.4512 | 201.3782 | 186.1382 | 171.8147 | 162.2458 | 159.9953 | 165.6664 | 177.7394 | 192.9794 | 207.3029 (68) |
| Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5    | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965  | 35.1965 (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)                                 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 | -97.5722 (71) |
| Water heating gains (Table 5)                                                       | 104.3603 | 102.0633 | 97.6826  | 88.1419  | 82.2859  | 76.1714  | 72.4417  | 75.5617  | 79.2155  | 86.0012  | 95.1505  | 103.1448 (72) |
| Total internal gains                                                                | 500.4706 | 512.9221 | 490.3723 | 472.6469 | 447.6625 | 428.1128 | 410.9258 | 411.7954 | 425.0085 | 442.9790 | 471.2567 | 489.6861 (73) |

## 6. Solar gains

|           |                |            |                  |               |          |         |      |
|-----------|----------------|------------|------------------|---------------|----------|---------|------|
| [Jan]     | Area           | Solar flux | g                | FF            | Access   | Gains   |      |
|           | m <sup>2</sup> | Table 6a   | W/m <sup>2</sup> | Specific data | factor   | W       |      |
|           |                |            | or Table 6b      | or Table 6c   | Table 6d |         |      |
| Northeast | 5.8000         | 11.2829    | 0.6300           | 0.7000        | 0.7700   | 19.9996 | (75) |

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|           |        |         |        |        |        |              |
|-----------|--------|---------|--------|--------|--------|--------------|
| Southwest | 3.7800 | 36.7938 | 0.6300 | 0.7000 | 0.7700 | 42.5049 (79) |
| Northwest | 1.7600 | 11.2829 | 0.6300 | 0.7000 | 0.7700 | 6.0689 (81)  |

|             |          |          |          |          |          |          |          |          |          |          |          |               |
|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|---------------|
| Solar gains | 68.5734  | 125.4647 | 194.6659 | 279.7513 | 348.5321 | 361.4895 | 342.0733 | 288.3934 | 223.7579 | 144.8665 | 83.7119  | 57.6642 (83)  |
| Total gains | 569.0440 | 638.3868 | 685.0381 | 752.3981 | 796.1947 | 789.6023 | 752.9991 | 700.1889 | 648.7664 | 587.8455 | 554.9686 | 547.3502 (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                                                                         | 41.6531 | 41.7486 | 41.8426 | 42.2901 | 42.3749 | 42.7741 | 42.7741 | 42.8489 | 42.6195                   | 42.3749 | 42.2037 | 42.0263      |
| alpha                                                                       | 3.7769  | 3.7832  | 3.7895  | 3.8193  | 3.8250  | 3.8516  | 3.8516  | 3.8566  | 3.8413                    | 3.8250  | 3.8136  | 3.8018       |
| util living area                                                            | 0.9908  | 0.9848  | 0.9735  | 0.9398  | 0.8639  | 0.7198  | 0.5677  | 0.6217  | 0.8315                    | 0.9540  | 0.9844  | 0.9920 (86)  |
| MIT                                                                         | 19.1375 | 19.3400 | 19.6641 | 20.1349 | 20.5603 | 20.8531 | 20.9558 | 20.9372 | 20.7246                   | 20.1870 | 19.5925 | 19.1090 (87) |
| Th 2                                                                        | 19.8010 | 19.8034 | 19.8058 | 19.8168 | 19.8189 | 19.8286 | 19.8286 | 19.8304 | 19.8249                   | 19.8189 | 19.8147 | 19.8104 (88) |
| util rest of house                                                          | 0.9882  | 0.9805  | 0.9656  | 0.9204  | 0.8176  | 0.6261  | 0.4333  | 0.4880  | 0.7582                    | 0.9353  | 0.9792  | 0.9898 (89)  |
| MIT 2                                                                       | 17.6595 | 17.9184 | 18.3303 | 18.9232 | 19.4262 | 19.7343 | 19.8120 | 19.8041 | 19.6195                   | 18.9984 | 18.2490 | 17.6291 (90) |
| Living area fraction                                                        |         |         |         |         |         |         |         |         | fLA = Living area / (4) = |         |         | 0.3227 (91)  |
| MIT                                                                         | 18.1364 | 18.3771 | 18.7607 | 19.3142 | 19.7922 | 20.0953 | 20.1811 | 20.1697 | 19.9761                   | 19.3820 | 18.6825 | 18.1066 (92) |
| Temperature adjustment                                                      |         |         |         |         |         |         |         |         |                           |         |         | 0.0000       |
| adjusted MIT                                                                | 18.1364 | 18.3771 | 18.7607 | 19.3142 | 19.7922 | 20.0953 | 20.1811 | 20.1697 | 19.9761                   | 19.3820 | 18.6825 | 18.1066 (93) |

## 8. Space heating requirement

|                                                                                |           |           |           |           |          |          |          |          |          |               |           |                |
|--------------------------------------------------------------------------------|-----------|-----------|-----------|-----------|----------|----------|----------|----------|----------|---------------|-----------|----------------|
|                                                                                | Jan       | Feb       | Mar       | Apr       | May      | Jun      | Jul      | Aug      | Sep      | Oct           | Nov       | Dec            |
| Utilisation                                                                    | 0.9829    | 0.9733    | 0.9561    | 0.9101    | 0.8164   | 0.6495   | 0.4760   | 0.5296   | 0.7692   | 0.9262        | 0.9721    | 0.9851 (94)    |
| Useful gains                                                                   | 559.3177  | 621.3521  | 654.9884  | 684.7201  | 649.9836 | 512.8372 | 358.4200 | 370.8296 | 499.0157 | 544.4521      | 539.4922  | 539.1942 (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                                                               | 1472.7082 | 1431.1852 | 1299.0803 | 1091.7610 | 846.6375 | 569.5755 | 371.1737 | 390.0425 | 611.2532 | 918.8058      | 1216.7277 | 1467.0392 (97) |
| Space heating kWh                                                              | 679.5626  | 544.2078  | 479.2044  | 293.0695  | 146.3105 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.5192      | 487.6096  | 690.3167 (98a) |
| Space heating requirement - total per year (kWh/year)                          |           |           |           |           |          |          |          |          |          |               |           | 3598.8001      |
| 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                                                              | 679.5626  | 544.2078  | 479.2044  | 293.0695  | 146.3105 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.5192      | 487.6096  | 690.3167 (98c) |
| Space heating requirement after solar contribution - total per year (kWh/year) |           |           |           |           |          |          |          |          |          |               |           | 3598.8001      |
| Space heating per m2                                                           |           |           |           |           |          |          |          |          |          | (98c) / (4) = |           | 45.6816 (99)   |

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

|                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |                 |
|------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|-----------------|
| Fraction of space heat from secondary/supplementary system (Table 11)                                |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (201)    |
| Fraction of space heat from main system(s)                                                           |          |          |          |          |          |          |          |          |          |          |          | 1.0000 (202)    |
| Efficiency of main space heating system 1 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 92.4000 (206)   |
| Efficiency of main space heating system 2 (in %)                                                     |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (207)    |
| Efficiency of secondary/supplementary heating system, %                                              |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (208)    |
|                                                                                                      | Jan      | Feb      | Mar      | Apr      | May      | Jun      | Jul      | Aug      | Sep      | Oct      | Nov      | Dec             |
| Space heating requirement                                                                            | 679.5626 | 544.2078 | 479.2044 | 293.0695 | 146.3105 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 278.5192 | 487.6096 | 690.3167 (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)                                                             | 735.4573 | 588.9695 | 518.6195 | 317.1747 | 158.3447 | 0.0000   | 0.0000   | 0.0000   | 0.0000   | 301.4277 | 527.7160 | 747.0960 (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                                                                            | 207.9228 | 183.8784 | 195.8064 | 173.7777 | 169.4393 | 153.7946 | 152.8201 | 158.4119 | 159.5762 | 176.5576 | 185.9642 | 205.9109 (64)   |
| Efficiency of water heater (217)m                                                                    | 86.7240  | 86.5588  | 86.2214  | 85.4918  | 84.0684  | 80.3000  | 80.3000  | 80.3000  | 80.3000  | 85.3535  | 86.3469  | 86.7650 (216)   |
| Fuel for water heating, kWh/month                                                                    | 239.7524 | 212.4318 | 227.0973 | 203.2682 | 201.5492 | 191.5250 | 190.3115 | 197.2751 | 198.7251 | 206.8547 | 215.3688 | 237.3201 (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                                                                                             | 24.2373  | 19.4441  | 17.5072  | 12.8266  | 9.9076   | 8.0946   | 9.0380   | 11.7480  | 15.2595  | 20.0213  | 22.6140  | 24.9110 (232)   |
| Electricity generated by PVs (Appendix M) (negative quantity)                                        |          |          |          |          |          |          |          |          |          |          |          |                 |
| (233a)m                                                                                              | -14.8717 | -22.4806 | -34.6145 | -41.7758 | -47.5945 | -45.3607 | -44.8089 | -41.0273 | -34.8285 | -26.9254 | -16.8785 | -12.6871 (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                                                                                              | -4.3532  | -9.4390  | -19.3024 | -29.8093 | -40.2366 | -40.7371 | -40.2589 | -33.7058 | -24.2116 | -13.7602 | -5.8936  | -3.4218 (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                                                                   |          |          |          |          |          |          |          |          |          |          |          | 3894.8053 (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                                                                              |          |          |          |          |          |          |          |          |          |          |          | 2521.4792 (219) |
| Space cooling fuel                                                                                   |          |          |          |          |          |          |          |          |          |          |          | 0.0000 (221)    |

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|                                                               |                 |
|---------------------------------------------------------------|-----------------|
| Electricity for pumps and fans:                               |                 |
| Total electricity for the above, kWh/year                     | 86.0000 (231)   |
| Electricity for lighting (calculated in Appendix L)           | 195.6091 (232)  |
| Energy saving/generation technologies (Appendices M ,N and Q) |                 |
| PV generation                                                 | -648.9831 (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                           | 6048.9105 (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                 | 3894.8053          | 0.2100                        | 817.9091 (261)           |
| Total CO2 associated with community systems   |                    |                               | 0.0000 (373)             |
| Water heating (other fuel)                    | 2521.4792          | 0.2100                        | 529.5106 (264)           |
| Space and water heating                       |                    |                               | 1347.4198 (265)          |
| Pumps, fans and electric keep-hot             | 86.0000            | 0.1387                        | 11.9293 (267)            |
| Energy for lighting                           | 195.6091           | 0.1443                        | 28.2324 (268)            |
| Energy saving/generation technologies         |                    |                               |                          |
| PV Unit electricity used in dwelling          | -383.8535          | 0.1332                        | -51.1131                 |
| PV Unit electricity exported                  | -265.1296          | 0.1251                        | -33.1648                 |
| Total                                         |                    |                               | -84.2779 (269)           |
| Total CO2, kg/year                            |                    |                               | 1303.3035 (272)          |
| EPC Target Carbon Dioxide Emission Rate (TER) |                    |                               | 16.5400 (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               | 3894.8053          | 1.1300                              | 4401.1300 (275)            |
| Total CO2 associated with community systems |                    |                                     | 0.0000 (473)               |
| Water heating (other fuel)                  | 2521.4792          | 1.1300                              | 2849.2715 (278)            |
| Space and water heating                     |                    |                                     | 7250.4015 (279)            |
| Pumps, fans and electric keep-hot           | 86.0000            | 1.5128                              | 130.1008 (281)             |
| Energy for lighting                         | 195.6091           | 1.5338                              | 300.0317 (282)             |
| Energy saving/generation technologies       |                    |                                     |                            |
| PV Unit electricity used in dwelling        | -383.8535          | 1.4920                              | -572.7276                  |
| PV Unit electricity exported                | -265.1296          | 0.4591                              | -121.7272                  |
| Total                                       |                    |                                     | -694.4548 (283)            |
| Total Primary energy kWh/year               |                    |                                     | 6986.0792 (286)            |
| Target Primary Energy Rate (TPER)           |                    |                                     | 88.6800 (287)              |