

# 3 Kidderpore Avenue. London. 3 Kidderpore Avenue.

## SUSTAINABILITY

ENERGY AND SUSTAINABILITY DOCUMENT

REVISION 01 - 13 APRIL 2018



## Audit sheet.

| Rev. | Date       | Description                   | Prepared | Verified |
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Document reference: 180413 3KA Energy and Sustainabililty Document Rev 01

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#### **3 KIDDERPORE AVENUE** 3 KIDDERPORE AVENUE

**SUSTAINABILITY** ENERGY AND SUSTAINABILITY DOCUMENT – REV. 01

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## **Executive Summary.**

This report describes the Energy Strategy and Sustainability Statement for the proposed development at 3 Kidderpore Avenue in London. The site image is shown in Figure 1.



Figure 1 Proposed Site Image (SIAW)

The development includes the demolition of the existing building on site and erection of a 3 storey dwelling.

## **Carbon Dioxide Emissions.**

The London Borough of Camden's (LBC) Local Plan aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable technologies.

Policy CC1 Climate Change Mitigation requires all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. New developments in Camden will be expected to be designed to minimise energy use and  $CO_2$  emissions in operation through the application of the energy hierarchy.

In order to demonstrate compliance with Part L 2013 a SAP calculation was carried out on the proposed development. A Part L 2013 compliant baseline calculation was carried out to establish the regulated carbon dioxide emissions for the development.

These calculations included a number of the following passive and active energy efficiency measures.

The passive measures include the specification of a high performance building fabric including U-values and an air permeability that are significantly beyond the minimum requirements of the Building Regulations.

The active measures include:

- Low energy lighting;
- Variable speed pumping;
- Efficient mechanical ventilation systems with heat recovery; and •
- Insulated pipework to reduce circulation losses.

As the building is one single dwelling there will not be a constant base heat load throughout the day and due to this reason CHP is not considered an appropriate technology.

A number of alternative renewable technologies were investigated with the view to be incorporated in the development, with Photo-Voltaic (PV) panels deemed the most appropriate for the site.

The assessment showed that a reduction in carbon emissions of 22% over a Part L 2013 compliant development can be achieved which is in line with the requirements of Camden's Local Plan.

## Sustainability.

The wider sustainability measures include the following:

- The contractors will be selected with consideration of their ability to comply with the Considerate Constructors Scheme;
- Internal and external lighting will be designed to promote a healthy, and safe internal and external • environment;
- Energy efficient light fittings will be installed for all external areas of the development. In addition, they will be automatically controlled for the prevention of operation during daylight hours;
- The proposed development will reduce potable water consumption through the specification of efficient sanitary ware;
- Materials with a low environmental impact will be implemented where feasible; and
- The design for the new landscape conserves the existing natural environment whilst enhancing the ecology of the overall site.

## 1. Introduction.

The proposed 3 Kidderpore Avenue is situated in a residential area of Camden, with the street consisting predominantly of large detached properties of late 19<sup>th</sup>/ early 20<sup>th</sup> century architectural characteristics.

The development includes the demolition of the existing building on site and erection of a 3 storey dwelling. The site is highlighted in Figure 2.



#### Figure 2 Proposed Site

This Energy and Sustainability Document has been prepared in support of the planning appeal for the proposed development of 3 Kidderpore Avenue, hereafter referred to as the Proposed Development.

The document has been commissioned to address the fourth reason for refusal in the decision notice, as detailed below:

The applicant has failed to demonstrate that the proposed replacement dwelling would achieve a reduction in CO2 emissions through renewable technologies contrary to policies CC1 (Climate change mitigation) and CC2 (Adapting to climate change) of the Camden Local Plan 2017.

The purpose of this document is to set out the energy strategy and overall sustainability proposals for the Proposed Development. This document provides a summary of the key policies that are applicable to the Proposed Development and an energy strategy commensurate with the current building regulations as well as regional and local planning policies.

## 2. Policy Requirements & Building Regulations.

The policies and regulations that are required to be satisfied are summarised as follows.

#### 2.1 The Building Regulations

Part L Conservation of Fuel and Power deals with energy efficiency requirements in the Building Regulations. New buildings will be assessed under Approved Document Part L1A (Domestic) of the Building Regulations.





#### The National Planning Policy Framework, March 2012

The National Planning Policy Framework (NPPF) was published in March 2012 and has superseded all Planning Policy Statements (PPS) and Planning Policy Guidelines (PPD) documents, with the exception of PPS10 (Waste). The NPPF sets out the Government's strategy on the delivery of sustainable development through the planning system.

The NPPF places responsibility for policy making with the Local Planning Authority, who shall communicate their policies through local core strategy documents and other supplementary planning guidance. The NPPF stated that there is a presumption in favour of sustainable development. The following is extracted from paragraph 14 of the NPPF:

"For decision-taking this means:

- plan without delay; and
- out-of-date, granting permission unless:

o Any adverse impacts of doing so would significantly and demonstrably outweigh the benefits, when assessed against the policies in this Framework taken as a whole; or o Specific policies in this Framework indicate development should be restricted."

In respect of energy policy contained within the NPPF, paragraph 96 sets out that:

#### Part L1A 2013 of Building Regulations - New Domestic Elements

On a national level, Part L1A of the Building Regulations sets the energy

Under Building Regulations Approved Document Part L1A, compliance is achieved by demonstrating that the Dwelling Emission Rate (DER) does not exceed the Target Emission Rate (TER) and that the Dwelling Fabric Efficiency (DFEE) does not exceed the Target Fabric Efficiency (TFEE).

In addition, Part L1A also requires that the fabric elements and the fixed building services all meet minimum energy efficiency standards (Criterion 2), and reasonable provision for limiting solar gain through the building fabric

• Approving development proposals that accord with the development

Where the development plan is absent, silent or relevant policies are

"In determining planning applications, local planning authorities should expect new developments to:

- Comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- Take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption."

At the heart of NPPF is a presumption in favour of sustainable development, which should be seen as a golden thread running through both plan-making and decision-taking.

The following NPPF objectives have been identified as being relevant to this development:

- Promoting Sustainable Transport
- Requiring Good Design
- Promoting Healthy Communities
- Meeting the Challenge of Climate Change, Flooding and Coastal Change
- Conserving and Enhancing the Natural Environment

#### 2.3 Local Planning Guidance

|                   | Camden Local Plan 2017  |  |  |  |  |
|-------------------|---|--|--|--|--|
|                   | The Local Plan sets out the Council's planning policies ensuring that Camden<br>continues to have robust, effective and up-to-date planning policies that<br>respond to changing circumstances and the borough's unique characteristics<br>and contribute to delivering the Camden Plan and other local priorities. |  |  |  |  |
| Camden Local Plan | The Council aims to tackle the causes of climate change in the borough by<br>ensuring developments use less energy and assess the feasibility of<br>decentralised energy and renewable energy technologies.   |  |  |  |  |
|                   | Green Action for Change: Camden's environmental sustainability plan (2011-2020) commits Camden to a 27% borough wide Carbon Dioxide (CO <sub>2</sub> )  |  |  |  |  |
|                   | reduction by 2017 and a 40% borough wide CO <sub>2</sub> reduction by 2020 (London carbon reduction target). Over 90% of Camden's carbon dioxide emissions are produced by the operation of buildings.  |  |  |  |  |
| Camden            | Any new development in Camden has the potential to increase carbon dioxide emissions in the borough. If we are to achieve local, and support  |  |  |  |  |

national, carbon dioxide reduction targets, it is crucial that planning policy limits carbon dioxide emissions from new development wherever possible and supports sensitive energy efficiency improvements to existing buildings.

Policy CC1 Climate Change Mitigation requires all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

New developments in Camden will be expected to be designed to minimise energy use and  $CO_2$  emissions in operation through the application of the energy hierarchy – Be Lean, Be Clean and Be Green.

All developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floor space will be required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction. All new residential development will also be required to demonstrate a 19% CO<sub>2</sub> reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floor space to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated  $CO_2$  emissions of the development after all proposed energy efficiency measures and any CO<sub>2</sub> reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

Policy CC2 Adapting to Climate Change requires development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

- the protection of existing green spaces and promoting new appropriate green infrastructure;
- not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems:
- incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate: and
- measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floor space is required to demonstrate the above in a Sustainability Statement.

## 3. Carbon Dioxide Emissions.

Local policy requires a 19% reduction over Part L 2013 as a minimum with a 20% reduction being achieved from on-site renewable energy sources.

Policy CC1 Climate Change Mitigation refers to the approach taken to reduce the building's carbon dioxide emissions in line with the following energy hierarchy:

- 1. Be Lean: Use Less Energy
- 2. Be Clean: Supply Energy Efficiently
- 3. Be Green: Use Renewable Energy

The energy assessment comprised the following stages:

- 1. Estimating a target for total regulated  $CO_2$  emissions of the proposed development. The estimates are based primarily on Part L approved software modelling results.
- 2. Estimating savings in regulated  $CO_2$  emissions of the proposed development through the incorporation of passive and active energy efficiency measures. The estimates are based primarily on Part L approved software modelling results.
- 3. Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of energy networks including CHP.
- 4. Estimating the potential contribution to carbon dioxide reductions that could be achieved by the use of renewable technologies.

The regulated CO<sub>2</sub> emissions assuming the development complied with Part L 2013 of the Building Regulations using approved compliance software are established. The Building Regulations approved compliance software. NHER v6.3.4 was used to assess the site. The Target Emission Rate (TER) output from this assessment was then used to calculate the baseline CO<sub>2</sub> emissions.

The TER Report is located in Appendix A.

## 4. Be Lean.

#### **4.1 Passive Measures**

In order to reduce the energy demand of the development, the fabric of the development will be improved significantly beyond the minimum requirements of Criterion 2 of Part L1A 2013. Table 1 shows the typical envelope performance characteristics that will be incorporated into the scheme design to limit the buildings energy consumption.

#### Table 1 Element U-Values

|               | Element                           |         |
|---------------|-----------------------------------|---------|
|               | Floor U - Value (W/m²K)           | 0.10    |
|               | Roof U - Value (W/m²K)            | 0.10    |
|               | External Walls U - Value (W/m²K)  | 0.15    |
| S             | U-value (W/m²K)                   | 1.40    |
| zing<br>I doo | Frame type                        | u-PVC   |
| Gla:<br>lazec | G-value                           | 0.60    |
| U             | Fraction Glazed                   | 0.70    |
|               | Opaque Door (W/m²K)               | 1.0     |
|               | Air permeability (m³/hm² (@ 50Pa) | 3       |
|               | Thermal Bridge Specification      | Default |

#### **4.2 Active Measures**

The energy consumption will be further reduced by the incorporation of active energy efficiency measures in the design of the mechanical and electrical engineering systems. The following energy efficiency measures will be incorporated:

- Windows carefully designed to balance daylight, heat loss and heat gain;
- Solar control measures;
- High energy efficient heat recovery ventilation; and
- Low energy lighting.

#### 4.3 Be Lean Results

The dwelling has been assessed to gain SAP results. The measurements were taken from drawings issued by SIAW Architects.

Figure 3Figure 1 below shows that the regulated carbon dioxide emissions of the Energy Efficient Scheme are approximately 7% below that of the Baseline Scheme.

The Be Lean DER Worksheet is located within Appendix B.

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- 5. Mechanical Ventilation
  - Background ventilation will be provided by MVHR units. These units will incorporate a summer bypass, which will allow the unit to supply fresh air without heat being transferred from the extract air into the supply air.
- 6. Active Cooling Systems
  - The current strategy is for cooling to be provided to all living areas and bedrooms within the dwelling.

Figure 3 Be Lean Regulated Carbon Dioxide Emissions

#### 4.4 Overheating and Cooling

Policy CC2 Adapting to Climate Change requires developments to be resilient to climate change. All development should adopt appropriate climate change adaptation including: measures to reduce the impact of urban and dwelling overheating.

Below are the steps and proposals to demonstrate mitigation against overheating

- 1. Minimise internal heat generation through energy efficient design.
  - Heat generation will be minimised through the specification of energy efficient ventilation systems, insulation on pipework and low energy lighting.
- 2. Reduce the amount of heat entering a building in summer through orientation, shading, fenestration, albedo and insulation.
  - The amount of heat entering the building will be reduced by:
    - o Energy efficient facades with appropriate proportions of glazing; and
    - o A glazing shading coefficient carefully selected to minimise solar gain in the summer, but also to maximise solar gain in winter.
- 3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
  - Ceiling heights in the development have been maximised within the constraints of the overall building height and massing.
- 4. Passive Ventilation
  - Passive ventilation (openable windows) has been incorporated within the development. In addition, there will be a small amount of natural ventilation through infiltration

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## 5. Be Clean.

These measures are those which serve to reduce the overall emissions of the development through the inclusion of low-carbon technologies such as Combined Heat and Power (CHP) engines.

#### 5.1 Area Wide Heat Networks

The first step in selecting energy systems is to consider a connection to an existing heating and cooling network.

An investigation has been carried out to determine if there are any area wide heat networks currently existing in the area or if any are planned in the future. The London Heat Map for the area, shown in Figure 4, reveals that there are no existing or potential area wide heat networks in the vicinity of the Proposed Development site. As a result it has been assumed that no connection is possible

The London Heat Map has identified that the Proposed Development is not located within an area that has the potential for decentralised energy.



Figure 4 London Heat Map

#### 5.2 Site Wide Heat Networks

Due to the development consisting of a single dwelling a central energy centre is not appropriate and therefore no site wide heat network can be established.

#### 5.3 Gas-fired Combined Heat and Power (CHP)

A CHP uses a gas-fired reciprocating engine or turbine, connected to a generator to simultaneously generate both heat and power (electricity). Useable heat is generated by recovering the heat from the engine that, in a conventional generator, is rejected to atmosphere. In order to optimise the performance of the CHP engine it is important to provide consistent heating and electrical loads.



#### 5.4 Be Clean Results

Figure 5 below shows the revised estimated reduction in regulated carbon dioxide emissions for the "Be Clean" case. As identified throughout this section there are no heat networks or CHP to add to the calculations therefore the results remain as the "Be Lean" case - approximately 7% below the baseline schemes.



Figure 5 Be Clean Regulated Carbon Dioxide Emissions

## 6. Be Green.

These measures are those which serve to reduce the overall emissions of the development through the inclusion of renewable technologies such as Ground Source Heat Pump (GSHP), Solar Photovoltaics array (PV panels), besides others.

This section addresses the requirements of Policy CC1 (Climate Change Mitigation) of The Local Plan. The supporting text states the following:

The Council will expect developments of five or more dwellings and/or more than 500 sqm of any gross internal floor space to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation (which can include sources of site related decentralised renewable energy), unless it can be demonstrated that such provision is not feasible. This is in line with stage three of the energy hierarchy 'Be green'. The 20% reduction should be calculated from the regulated CO2 emissions of the development after all proposed energy efficiency measures and any CO<sub>2</sub> reduction from non-renewable decentralised energy (e.g. CHP) have been incorporated.

#### 6.1 Solar Water Heating Panels

Solar water heating systems use heat from the sun to heat domestic hot water. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders.

This technology is compatible with the design however compared to the carbon emission savings achieved through the installation of PV it does not perform as well and therefore is not proposed.



Ground source heat pumps utilise either water extracted from an aquifer (open loop) or water circulated within underground pipework (closed loop) as the heat source in a refrigeration process. This enables them to produce hot water, typically at around 45°C that can be used as means of space heating in buildings. Due to the relatively constant temperature of the ground at depth (typically 10-14°C in the UK) this produces heat more efficiently in winter than an air source heat pump, and usually with lower carbon emissions than a gas-fired boiler.



Open loop systems require the water extracted to be re-injected into the aquifer at another borehole on another part of the site. A licence from the Environment Agency (EA) is required for both abstraction and discharge although these licences cannot be obtained until a test borehole has been constructed and the appropriate EA tests undertaken.

Installing a GSHP is not practically and financially viable and therefore is not proposed for this development.

### 6.3 Biomass Boilers

A biomass boiler uses a natural fuel such as wood chips or wood pellets for combustion. Since it uses a natural resource that can be replanted it is considered as a renewable energy source subject to the distance the fuel is transported. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a carbon neutral process.

The primary disadvantage of a biomass boiler are that large storage volumes are required for fuel, regular deliveries are required and biomass exhaust gases would require significant treatment to avoid degrading local air quality.

Biomass boilers are therefore not proposed for the development.

#### 6.4 Wind Turbines

Wind turbines use the wind's lift forces to turn aerodynamic blades that turn a rotor thus generating electricity. There are three basic types to consider: horizontal axis (propeller type), vertical access (helical type) and building integrated (where the building design is adapted to suit the wind turbine).

Wind turbines have a significant visual impact and the roof space will be sensitive in townscape terms, which is likely to preclude wind turbines. They can create noise and vibration problems. Additionally, there is limited roof area across the site where clean air flows and good wind speeds can be realised and which are vital to delivering a useful electrical output. Even if a suitable location could be found, the output of a wind turbine and the consequential carbon dioxide emissions will be very limited when compared to the emissions of the whole development.

Wind turbines are therefore not proposed for the development.

#### **6.5 Solar Photovoltaics**

Solar photovoltaic (PV) cells generate electricity from the sun's energy. Solid PV panels can be either roof or façade mounted (although solar modules fitted on a south facing façade have only 75% the output of roof mounted modules).



Suitable roof area has been identified to locate a PV array to offset the electrical load. It has been estimated the array will be installed with south facing orientation and 30° angle to maximise the capacity to generate approximately 4.4kW (peak) of energy (approximately 20m<sup>2</sup> of PV).

Appendix C contains a roof plan showing the proposed layout for the PV array.

#### 6.6 "Be Green" Results

Figure 6 below shows the revised estimated reduction in regulated carbon dioxide emissions taking into account the contribution of PV is approximately 23% below the "Be Clean", energy efficient and baseline schemes and 22% below the baseline.

The Be Green DER Worksheet is located within Appendix D.







Figure 6 Be Green Regulated Carbon Dioxide Emissions

## 7. Sustainability.

Sustainability has been a key design consideration for this development from the onset of the project and consideration of the impact of design proposals and measures on the sustainable credentials of the development has been made throughout the design development to date and will continue throughout the design and construction process.

The following is a summary of the key sustainability issues that form the overall strategy for the project.

#### 7.1 Management

To encourage an integrated design process, the project delivery stakeholders will identify and define roles, responsibilities for each of the key phases of project delivery.

To ensure that the construction site is managed in an environmentally and socially considerate, responsible and accountable manner, the contractor will be selected with consideration of their ability to comply with the Considerate Constructors Scheme.

#### 7.2 Health and Wellbeing

The development will be designed to encourage a healthy and safe internal and external environment. All external lighting will be photocell and time controlled. Luminaires will be carefully selected to limit night sky

All external lighting will be photocell and time controlled. Lumina pollution.

#### 7.3 Energy

An Energy Strategy has been devised in line with the Local Plan. Please refer to Sections 4-6 of this report for further details on energy performance.

Energy efficient light fittings will be installed for all external areas of the development.

Heat recovery will be incorporated into the mechanical ventilation reducing the overall energy demand.

#### 7.4 Transport

The site is located in a residential area in West Hampstead. The PTAL rating for the site is 3 with rail and bus links approximately 12 minutes' walk from the site.



PTAL output for Base Year

3 NW3 7SX Kidderpore Ave, London NW3 7SX, UK Easting: 525456, Northing: 185718

Figure 7 PTAL Map

You can click anywhere on the map to change the selected location

#### 7.5 Water

Reducing the consumption of potable water will be a significant consideration in the design process. Water use will be reduced as much as possible mainly through the specification of efficient sanitary ware.

The dwelling will be designed to comply with the requirements of Building Regulations Part G.

A water meter will be specified on the mains water supply to the building, ensuring that water consumption can be monitored and managed and therefore encourage reductions.

#### 7.6 Materials

Materials with low environmental impact will be implemented were feasible. Recycled, sustainable and locally sourced materials will be used where possible.

Thermal insulation used in the building fabric and services will be selected with consideration of their embodied environmental impact relative to its thermal properties.

#### 7.7 Waste

Storage facilities for waste and recycling will be provided in accordance with, as a minimum, BS5906.

The refuse and recyclable storage will be located on hard, level surface and easily accessible to all users.

#### 7.8 Land Use and Ecology

An improvement in ecological value is being targeted for the site with external landscaped areas provided for the residents.

At least 75% of the proposed development's footprint is on an area of land which has previously been occupied by an existing building.

#### 7.9 Pollution

The site is located in Flood Zone 1. There will be no increase in surface water run-off from the development as it is being built on an existing brownfield site.



#### Figure 8 Environment Agency Flood Mapping

The materials used for the landscaping will be selected with consideration of reducing the flood risk. Such materials include permeable paving and other porous finishes. The types of materials and finishes will help promote infiltration into the ground.

External lighting will be designed to ensure upward lighting is minimised, reducing unnecessary light pollution, energy consumption and nuisance to neighbouring properties.



## 8. Conclusion.

An energy assessment has been undertaken to address the London Borough of Camden's Local Plan.

A range of passive and active energy efficiency measures will be employed on the Proposed Development.

No area wide low carbon heating distribution network exists in close proximity to the Proposed Development. Due to the site being a single dwelling a site wide energy centre and provision of CHP is not appropriate.

A number of renewable technologies have been appraised in terms of their technical, physical and financial feasibility, as potential renewable systems for use on the project. A PV array will be incorporated to maximise the on-site carbon savings.

#### 8.1 Energy

Table 2 below shows the site wide regulated carbon dioxide emissions and savings.

Table 2 Site Wide Regulated CO<sub>2</sub> Emissions and Savings

|                                      | Regulated Carbor                         | n Dioxide Savings |
|--------------------------------------|--|-------------------|
|                                      | (Tonnes of CO <sub>2</sub> per<br>annum) | (%)               |
| Savings from energy demand reduction | 1  | 7%                |
| Savings from heat network / CHP      | 0  | 0%                |
| Savings from renewable energy        | 2  | 15%               |
| Cumulative on site savings           | 3  | 22%               |

The overall predicted reduction in CO<sub>2</sub> emissions from the Baseline development model (which is Part L 2013 compliant) is approximately 22% which represents an annual saving of approximately 3 tonnes of  $CO_2$ , which more than meets the requirements of Camden's Local Plan.

Figure 9 below sets out how the proposed development energy efficiency measures and LZC systems reduce CO<sub>2</sub> emissions in line with the London Plan Energy Hierarchy.



Figure 9 Energy Hierarchy and targets

#### 8.2 Sustainability

The sustainability measures include the following:

- The project design team will identify and define roles, responsibilities of each of the key phases of project delivery;
- The contractors will be selected with consideration of their ability to comply with the Considerate Constructors Scheme:
- Internal and external lighting will be designed to promote a healthy, and safe internal and external environment:
- An energy assessment has been carried out in line with the Energy Hierarchy described in Policy 5.2 of the London Plan:
- Energy efficient light fittings will be installed for all external areas of the development. In addition, they will be automatically controlled for the prevention of operation during daylight hours;
- The proposed development will reduce potable water consumption through the specification of efficient sanitary ware;
- Materials with a low environmental impact will be implemented where feasible;
- The design for the new landscape conserves the existing natural environment whilst enhancing the ecology of the overall site; and
- External lighting will be designed to reduce night time light pollution.

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Appendix A: TER Worksheet.

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# TER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

| Assessor name                  | Mr Robert          | Coffey       |               |             |                |                       |           | Assessor num                | nber          | 99     |                       |            |
|--------------------------------|--------------------|--------------|---------------|-------------|----------------|-----------------------|-----------|-----------------------------|---------------|--------|-----------------------|------------|
| Client                         | Last modified 02/0 |              |               |             |                |                       |           | 02/03                       | /2018         |        |                       |            |
| Address                        | 3 Kidderpo         | ore Avenu    | e. London.    | NW3 75      | x              |                       |           |                             |               |        |                       |            |
|                                | onducipe           |              | c, 20110011,  | 11110 7.0   |                |                       |           |                             |               |        |                       |            |
| 1. Overall dwelling dimen      | nsions             |              |               |             |                |                       |           |                             |               |        |                       |            |
|                                |                    |              |               |             | Area (m²)      |                       | Av        | verage storey<br>height (m) |               | Va     | lume (m³)             |            |
| Lowest occupied                |                    |              |               |             | 355.42         | ] <mark>(1a)</mark> x |           | 3.70                        | ] (2a) =      |        | 1315.05               | (3a)       |
| +1                             |                    |              |               |             | 295.45         | ] (1b) x              |           | 3.50                        | (2b) =        |        | 1034.08               | (3b)       |
| +2                             |                    |              |               |             | 273.01         | (1c) x                |           | 3.60                        | ] (2c) =      |        | 982.84                | (3c)       |
| Total floor area               | (1a) +             | · (1b) + (10 | c) + (1d)(    | 1n) = 🗌     | 923.88         | (4)                   |           |                             |               |        |                       |            |
| Dwelling volume                |                    |              |               |             |                |                       | (3        | 3a) + (3b) + (3             | c) + (3d)(    | 3n) =  | 3331.97               | <b>(5)</b> |
| 2. Ventilation rate            |                    |              |               |             |                |                       |           | ·                           |               |        |                       |            |
|                                |                    |              |               |             |                |                       |           |                             |               | m      | <sup>3</sup> per hour |            |
| Number of chimneys             |                    |              |               |             |                |                       |           | 0                           | ] x 40 =      | =      | 0                     | (6a)       |
| Number of open flues           |                    |              |               |             |                |                       |           | 0                           | _<br>] x 20 = | =      | 0                     | (6b)       |
| Number of intermittent fai     | ns                 |              |               |             |                |                       |           | 4                           | ] x 10 =      | =      | 40                    | (7a)       |
| Number of passive vents        |                    |              |               |             |                |                       |           | 0                           | x 10 =        | =      | 0                     | (7b)       |
| Number of flueless gas fire    | S                  |              |               |             |                |                       |           | 0                           | ] x 40 =      | =      | 0                     | (7c)       |
|                                |                    |              |               |             |                |                       |           |                             |               | Air    | changes pe<br>hour    | r          |
| Infiltration due to chimney    | s, flues, fans,    | PSVs         |               | (6          | a) + (6b) + (7 | a) + (7b) + (         | 7c) =     | 40                          | ÷ (5)         | =      | 0.01                  | (8)        |
| If a pressurisation test has   | been carried       | out or is ii | ntended, pi   | roceed to   | o (17), otherw | ise continu/          | e from (9 | ) to (16)                   | _             |        |                       | _          |
| Air permeability value, q50    | ), expressed ir    | n cubic me   | etres per h   | our per s   | quare metre    | of envelope           | e area    |                             |               |        | 5.00                  | (17)       |
| If based on air permeabilit    | y value, then      | (18) = [(17  | 7) ÷ 20] + (8 | B), other   | wise (18) = (1 | 6)                    |           |                             |               |        | 0.26                  | (18)       |
| Number of sides on which       | the dwelling i     | is sheltere  | ed            |             |                |                       |           |                             |               |        | 0                     | (19)       |
| Shelter factor                 |                    |              |               |             |                |                       |           | 1 -                         | [0.075 x (1   | .9)] = | 1.00                  | (20)       |
| Infiltration rate incorporat   | ing shelter fac    | ctor         |               |             |                |                       |           |                             | (18) x (      | 20) =  | 0.26                  | (21)       |
| Infiltration rate modified for | or monthly wi      | ind speed    | :             |             |                |                       |           |                             |               |        |                       | _          |
| Jan                            | Feb                | Mar          | Apr           | May         | Jun            | Jul                   | Aug       | Sep                         | Oct           | Nov    | Dec                   |            |
| Monthly average wind spe       | ed from Table      | e U2         |               |             |                |                       |           |                             |               |        |                       |            |
| 5.10                           | 5.00               | 4.90         | 4.40          | 4.30        | 3.80           | 3.80                  | 3.70      | 4.00                        | 4.30          | 4.50   | 4.70                  | (22)       |
| Wind factor (22)m ÷ 4          |                    |              |               |             |                |                       |           |                             |               |        |                       |            |
| 1.28                           | 1.25               | 1.23         | 1.10          | 1.08        | 0.95           | 0.95                  | 0.93      | 1.00                        | 1.08          | 1.13   | 1.18                  | (22a)      |
| Adjusted infiltration rate (a  | allowing for sl    | helter and   | wind facto    | or) (21) x  | (22a)m         |                       |           |                             |               |        |                       |            |
| 0.33                           | 0.33               | 0.32         | 0.29          | 0.28        | 0.25           | 0.25                  | 0.24      | 0.26                        | 0.28          | 0.29   | 0.31                  | (22b)      |
| Calculate effective air char   | nge rate for th    | e applical   | ble case:     |             |                |                       |           |                             |               |        |                       |            |
| If mechanical ventilatio       | n: air change      | rate throu   | ugh system    |             |                |                       |           |                             |               |        | N/A                   | (23a)      |
| If balanced with heat re       | covery: effici     | ency in %    | allowing fo   | or in-use   | factor from T  | able 4h               |           |                             |               |        | N/A                   | (23c)      |
| d) natural ventilation o       | r whole house      | e positive   | input venti   | ilation fro | om loft        |                       |           |                             |               |        |                       |            |
| 0.56                           | 0.55               | 0.55         | 0.54          | 0.54        | 0.53           | 0.53                  | 0.53      | 0.53                        | 0.54          | 0.54   | 0.55                  | (24d)      |



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

| Effective air ch | 0.56                       | 0.55           | 0.55         | (24c) or (24                 | 0.54                      | 0.53         | 0.53       | 0.53             | 0.53          | 0.54             | 0.54            | 0.55         | (25)  |
|------------------|----------------------------|----------------|--------------|------------------------------|---------------------------|--------------|------------|------------------|---------------|------------------|-----------------|--------------|-------|
|                  |                            |                |              |                              |                           |              |            | 1                |               |                  | 1               |              |       |
| 3. Heat losses   | and heat lo                | ss paramet     | er           | -                            | - ·                       | <b>.</b> .   |            |                  |               |                  |                 |              |       |
| Element          |                            |                | а            | Gross<br>rea, m <sup>2</sup> | Opening<br>m <sup>2</sup> | s Net<br>A,  | area<br>m² | U-value<br>W/m²K | AxUW          | /К к-\<br>kJ     | /alue,<br>/m².K | Ахк,<br>kJ/K |       |
| Window           |                            |                |              |                              |                           | 183          | 3.02 x     | 1.33             | = 242.64      | 4                |                 |              | (27)  |
| Roof window      |                            |                |              |                              |                           | 24           | .55 x      | 1.59             | = 39.08       |                  |                 |              | (27a) |
| Door             |                            |                |              |                              |                           | 4.           | 81 x       | 1.00             | = 4.81        |                  |                 |              | (26)  |
| Ground floor     |                            |                |              |                              |                           | 355          | 5.42 x     | 0.13             | = 46.20       | <br>             |                 |              | (28a) |
| External wall    |                            |                |              |                              |                           | 611          | 1.35 x     | 0.18             | = 110.04      | 4                |                 |              | (29a) |
| Roof             |                            |                |              |                              |                           | 327          | 7.01 x     | 0.13             | = 42.51       |                  |                 |              | (30)  |
| Total area of e  | xternal elem               | ents ∑A, m²    |              |                              |                           | 150          | 6.16       |                  |               |                  |                 |              | (31)  |
| Fabric heat los  | s, W/K = ∑(A               | × U)           |              |                              |                           |              |            |                  | (26           | 5)(30) + (       | 32) =           | 485.29       | (33)  |
| Heat capacity (  | Cm = ∑(А x к)              |                |              |                              |                           |              |            | (28)             | (30) + (32) - | + (32a)(3        | 2e) =           | N/A          | (34)  |
| Thermal mass     | parameter (T               | MP) in kJ/n    | n²K          |                              |                           |              |            |                  |               |                  |                 | 250.00       | (35)  |
| Thermal bridge   | es: ∑(L x Ψ) ca            | alculated us   | sing Appen   | dix K                        |                           |              |            |                  |               |                  |                 | 75.31        | (36)  |
| Total fabric hea | at loss                    |                |              |                              |                           |              |            |                  |               | (33) + (         | 36) =           | 560.59       | (37)  |
|                  | Jan                        | Feb            | Mar          | Apr                          | May                       | Jun          | Jul        | Aug              | Sep           | Oct              | Nov             | Dec          |       |
| Ventilation hea  | at loss calcula            | ated month     | ly 0.33 x (2 | 25)m x (5)                   |                           |              |            |                  |               |                  |                 |              |       |
|                  | 611.13                     | 608.74         | 606.41       | 595.44                       | 593.39                    | 583.83       | 583.83     | 582.07           | 587.51        | 593.39           | 597.54          | 601.88       | (38)  |
| Heat transfer o  | oefficient, W              | //K (37)m +    | - (38)m      |                              |                           |              |            |                  |               |                  |                 |              |       |
|                  | 1171.72                    | 1169.34        | 1167.00      | 1156.03                      | 1153.98                   | 1144.43      | 1144.43    | 1142.66          | 1148.11       | 1153.98          | 1158.13         | 3 1162.47    |       |
|                  |                            |                |              |                              |                           |              |            |                  | Average = 2   | <u>(</u> 39)112, | /12 =           | 1156.02      | (39)  |
| Heat loss parar  | meter (HLP),               | W/m²K (39      | 9)m ÷ (4)    | ·                            |                           |              |            |                  |               |                  |                 |              | -     |
|                  | 1.27                       | 1.27           | 1.26         | 1.25                         | 1.25                      | 1.24         | 1.24       | 1.24             | 1.24          | 1.25             | 1.25            | 1.26         |       |
|                  |                            |                |              |                              |                           |              |            |                  | Average = 2   | <u>(</u> 40)112, | /12 =           | 1.25         | (40)  |
| Number of day    | 's in month ( <sup>-</sup> | Table 1a)      |              |                              |                           |              |            |                  |               |                  |                 |              | ٦     |
|                  | 31.00                      | 28.00          | 31.00        | 30.00                        | 31.00                     | 30.00        | 31.00      | 31.00            | 30.00         | 31.00            | 30.00           | 31.00        | (40)  |
| 4. Water heat    | ting energy r              | equiremen      | t            |                              |                           |              |            |                  |               |                  |                 |              |       |
| Assumed occu     | pancy, N                   |                |              |                              |                           |              |            |                  |               |                  |                 | 3.94         | (42)  |
| Annual average   | e hot water u              | usage in litre | es per day ' | Vd,average                   | = (25 x N)                | + 36         |            |                  |               |                  |                 | 127.85       | (43)  |
|                  | Jan                        | Feb            | Mar          | Apr                          | May                       | Jun          | Jul        | Aug              | Sep           | Oct              | Nov             | Dec          |       |
| Hot water usag   | ge in litres pe            | er day for ea  | ach month    | Vd,m = fact                  | or from Ta                | ble 1c x (43 | 3)         |                  |               |                  |                 |              |       |
|                  | 140.63                     | 135.52         | 130.40       | 125.29                       | 120.17                    | 115.06       | 115.06     | 120.17           | 125.29        | 130.40           | 135.52          | 140.63       |       |
|                  |                            |                |              |                              |                           |              |            |                  |               | ∑(44)1           | .12 =           | 1534.15      | (44)  |
| Energy content   | t of hot wate              | r used = 4.1   | L8 x Vd,m x  | nm x Tm/3                    | 8600 kWh/i                | month (see   | Tables 1b, | 1c 1d)           |               |                  |                 |              |       |
|                  | 208.55                     | 182.40         | 188.22       | 164.09                       | 157.45                    | 135.87       | 125.90     | 144.48           | 146.20        | 170.38           | 185.99          | 201.97       |       |
|                  |                            |                |              |                              |                           |              |            |                  |               | ∑(45)1           | .12 =           | 2011.51      | (45)  |
| Distribution los | ss 0.15 x (45              | )m             |              |                              |                           |              |            |                  |               |                  |                 |              |       |
|                  | 31.28                      | 27.36          | 28.23        | 24.61                        | 23.62                     | 20.38        | 18.89      | 21.67            | 21.93         | 25.56            | 27.90           | 30.30        | (46)  |
| Storage volum    | e (litres) inclu           | uding any so   | olar or WW   | /HRS storag                  | e within sa               | me vessel    |            |                  |               |                  |                 | 1000.00      | (47)  |
| Water storage    | loss:                      |                |              |                              |                           |              |            |                  |               |                  |                 |              | _     |
| a) If manufactu  | irer's declare             | ed loss facto  | or is known  | (kWh/day)                    |                           |              |            |                  |               |                  |                 | 4.51         | (48)  |
| Temperatu        | re factor from             | n Table 2b     |              |                              |                           |              |            |                  |               |                  |                 | 0.54         | (49)  |
| Energy lost      | from water s               | storage (kW    | /h/day) (48  | 3) x (49)                    |                           |              |            |                  |               |                  |                 | 2.43         | (50)  |
| Enter (50) or (5 | 54) in (55)                |                |              |                              |                           |              |            |                  |               |                  |                 | 2.43         | (55)  |
| Water storage    | loss calculate             | ed for each    | month (55    | 5) x (41)m                   |                           |              |            |                  |               |                  |                 |              |       |

|                    | 75.41        | 68.12         | 75.41        | 72.98       | 75.41         | 72.98           | 75.41          | 75.41               | 72.98     | 75.41      | 72.98    | 75.41                                   | (56)          |
|--------------------|--------------|---------------|--------------|-------------|---------------|-----------------|----------------|---------------------|-----------|------------|----------|---|---------------|
| If the vessel con  | tains dedica | ated solar st | torage or d  | edicated W  | WHRS (56)     | m x [(47) -     | Vs] ÷ (47).    | else (56)           | 72.50     | , 5.11     | 72.50    | , | ] (30)        |
|                    | 75.41        | 68.12         | 75.41        | 72.98       | 75.41         | 72.98           | 75.41          | 75.41               | 72.98     | 75.41      | 72.98    | 75.41                                   | ] (57)        |
| Primary circuit lo | oss for each | month fro     | m Table 3    | /2.00       | ,             | / 1.00          | /0/12          | /0/12               | 12100     | /0112      | / 1.00   |   | ] (0.)        |
| ,                  | 23.26        | 21.01         | 23.26        | 22 51       | 23.26         | 22 51           | 23.26          | 23.26               | 22 51     | 23.26      | 22 51    | 23.26                                   | ] (59)        |
| Combi loss for e   | ach month    | from Table    | 3a 3h or 3   | c 22.31     | 23.20         | 22.51           | 23.20          | 23.20               | 22.51     | 23.20      | 22.51    | 25.20                                   | ] (33)        |
|                    |              |               | 0.00         |             | 0.00          | 0.00            | 0.00           | 0.00                | 0.00      | 0.00       | 0.00     | 0.00                                    | ] (61)        |
| Total heat requi   | red for wat  | o.00          | o.oo         | or each mo  | 0.00          | $(45)m \pm (4)$ | $6m \pm (57)r$ | 0.00<br>n ± (59)m ± | (61)m     | 0.00       | 0.00     | 0.00                                    | ] (01)        |
| iotal field requi  |              | 271 52        | 286.00       | 250 50      | 256 12        | 221.26          | 224 58         | 242.15              | 241.60    | 260.06     | 201 / 0  | 200.65                                  | ] (62)        |
| Solar DHW input    |              | 271.55        | 200.90       | 239.39      | 250.15        | 251.50          | 224.56         | 245.15              | 241.09    | 209.00     | 201.40   | 500.05                                  | ] (02)        |
|                    |              |               |              |             | 0.00          | 0.00            | 0.00           | 0.00                | 0.00      | 0.00       | 0.00     | 0.00                                    |               |
| Output from wo     | U.UU         | 0.00          | 0.00         | 0.00        | 0.00          | 0.00            | 0.00           | 0.00                | 0.00      | 0.00       | 0.00     | 0.00                                    | ] (63)        |
| Output from wa     | ter neater i | or each mo    |              | month) (62  | 2)m + (63)m   |                 |                |                     |           |            | 001.10   |   | ٦             |
|                    | 307.23       | 271.53        | 286.90       | 259.59      | 256.13        | 231.36          | 224.58         | 243.15              | 241.69    | 269.06     | 281.48   | 300.65                                  | ]             |
|                    |              |               |              | - 10.0-     | (1-) (01      |                 |                |                     | ,         | ∑(64)1     | 12 = 3   | 173.34                                  | <b>_</b> (64) |
| Heat gains from    | water heat   | ing (kwh/m    | ionth) 0.25  | 5 × [0.85 × | (45)m + (61   | .)m] + 0.8 ×    | [(46)m + (     | 57)m + (59)         | mj        |            |          |   | ٦             |
|                    | 148.28       | 131.95        | 141.52       | 130.96      | 131.29        | 121.57          | 120.80         | 126.98              | 125.01    | 135.59     | 138.24   | 146.10                                  | ] (65)        |
| 5. Internal gain   | S            |               |              |             |               |                 |                |                     |           |            |          |   |               |
|                    | Jan          | Feb           | Mar          | Apr         | May           | Jun             | Jul            | Aug                 | Sep       | Oct        | Nov      | Dec                                     |               |
| Metabolic gains    | (Table 5)    |               |              |             |               |                 |                |                     |           |            |          |   |               |
| _                  | 197.15       | 197.15        | 197.15       | 197.15      | 197.15        | 197.15          | 197.15         | 197.15              | 197.15    | 197.15     | 197.15   | 197.15                                  | (66)          |
| Lighting gains (c  | alculated in | Appendix I    | , equation   | L9 or L9a), | also see Ta   | able 5          |                |                     |           |            |          | <u> </u>                                | ], ,          |
| 0 00 1             | 77.39        | 68.73         | 55.90        | 42.32       | 31.63         | 26.71           | 28.86          | 37.51               | 50.35     | 63.92      | 74.61    | 79.54                                   | ] (67)        |
| Appliance gains    | (calculated  | in Appendi    | x L. equatio | on L13 or L | 13a). also se | ee Table 5      | 10.00          | 07.01               | 50.00     | 00102      | /        |   | ] (0.)        |
|                    | 868.04       | 877.04        | 854 35       | 806.02      | 745.02        | 687.69          | 6/9 39         | 640.39              | 663.08    | 711 / 1    | 772 / 1  | 829 74                                  | 68)           |
| Cooking gains (c   | alculated in | Annendix I    | equation     | 115 or 115  |               | Table 5         | 045.55         | 040.55              | 005.00    | /11.41     | ,,,,,,,, | 025.74                                  | ] (00)        |
| cooking gains (c   | 42.71        | 12 71         | 12 71        | 42 71       | 42 71         | 12 71           | 42.71          | 12 71               | 12 71     | 12 71      | 12 71    | 42.71                                   |               |
| Rump and fap g     | 42.71        | 42.71         | 42.71        | 42.71       | 42.71         | 42.71           | 42.71          | 42.71               | 42.71     | 42.71      | 42.71    | 42.71                                   | ] (09)        |
|                    |              |               | 2.00         | 2.00        | 2.00          | 2.00            | 2.00           | 2.00                | 2.00      | 2.00       | 2.00     | 2.00                                    | 7 (70)        |
|                    | 3.00         | 3.00          | 3.00         | 3.00        | 3.00          | 3.00            | 3.00           | 3.00                | 3.00      | 3.00       | 3.00     | 3.00                                    | ] (70)        |
| Losses e.g. evap   |              |               |              | 1           |               |                 |                |                     |           |            |          |   | 7             |
|                    | -157.72      | -157.72       | -157.72      | -157.72     | -157.72       | -157.72         | -157.72        | -157.72             | -157.72   | -157.72    | -157.72  | -157.72                                 | ] (/1)        |
| water neating g    | ains (Table  | 5)            |              |             |               |                 |                |                     |           |            |          |   | 7 ()          |
|                    | 199.31       | 196.35        | 190.22       | 181.88      | 176.47        | 168.85          | 162.37         | 170.67              | 173.62    | 182.25     | 191.99   | 196.37                                  | ] (72)        |
| lotal internal ga  | ins (66)m +  | + (67)m + (6  | 8)m + (69)i  | m + (70)m   | + (71)m + (7  | /2)m            |                |                     |           |            |          |   | 7             |
|                    | 1229.87      | 1227.28       | 1185.61      | 1115.37     | 1038.27       | 968.39          | 925.77         | 933.71              | 972.19    | 1042.73    | 1124.15  | 1190.78                                 | ] (73)        |
| 6. Solar gains     |              |               |              |             |               |                 |                |                     |           |            |          |   |               |
| Ŭ                  |              |               | Access f     | actor       | Area          | Sol             | ar flux        |                     | g         | FF         |          | Gains                                   |               |
|                    |              |               | Table        | 6d          | m²            | W               | //m²           | spec                | ific data | specific d | lata     | W                                       |               |
|                    |              |               |              |             |               |                 |                | or T                | able 6b   | or Table   | 6c       |   |               |
| North              |              |               | 0.7          | 7 X         | 55.57         | x 1             | 0.63 x         | 0.9 x 🛛 🕻           | ).63 x    | 0.70       | =        | 180.59                                  | (74)          |
| East               |              |               | 0.7          | 7 X         | 35.82         | x 1             | 9.64 x         | 0.9 x 🛛 🤇           | D.63 x    | 0.70       | =        | 215.00                                  | (76)          |
| South              |              |               | 0.7          | 7 X         | 74.66         | x 4             | 6.75 x         | 0.9 x 🚺             | ).63 x    | 0.70       | =        | 1066.74                                 | (78)          |
| West               |              |               | 0.7          | 7 x [       | 16.97         | x 1             | 9.64 x         | 0.9 x 🚺 🤇           | 0.63 x    | 0.70       | =        | 101.86                                  | (80)          |
| Horizontal         |              |               | 1.00         | 0 x [       | 24.55         | x 2             | 6.00 x         | 0.9 x 🚺             | 0.63 x    | 0.70       | =        | 253.34                                  | ]             |
| Solar gains in wa  | atts ∑(74)m  | (82)m         |              |             |               |                 |                |                     |           |            |          |   |               |
|                    | 1817.53      | 3238.18       | 4768.08      | 6407.54     | 7585.30       | 7697.30         | 7352.52        | 6456.79             | 5337.59   | 3673.77    | 2203.87  | 1537.51                                 | (83)          |
| Total gains - inte | ernal and so | lar (73)m +   | (83)m        |             |               |                 |                |                     |           |            |          |   |               |
|                    | 3047.41      | 4465.46       | 5953.69      | 7522.91     | 8623.57       | 8665.70         | 8278.29        | 7390.50             | 6309.78   | 4716.50    | 3328.03  | 2728.29                                 | (84)          |

| 7. Mean interr                   | nal tempera    | ture (heati  | ing season)   |              |                           |              |         |         |         |               |          |          |                  |
|----------------------------------|----------------|--------------|---------------|--------------|---------------------------|--------------|---------|---------|---------|---------------|----------|----------|------------------|
| Temperature du                   | uring heatin   | g periods i  | n the living  | area from T  | able 9, Th1               | L(°C)        |         |         |         |               |          | 21.00    | (85)             |
|                                  | Jan            | Feb          | Mar           | Apr          | May                       | Jun          | Jul     | Aug     | Sep     | Oct           | Nov      | Dec      |                  |
| Utilisation facto                | or for gains f | or living ar | ea n1,m (se   | e Table 9a)  | )                         |              |         |         |         |               |          |          |                  |
|                                  | 1.00           | 1.00         | 1.00          | 0.97         | 0.90                      | 0.75         | 0.58    | 0.66    | 0.90    | 0.99          | 1.00     | 1.00     | (86)             |
| Mean internal t                  | emp of livin   | g area T1 (  | steps 3 to 7  | in Table 90  | c)                        |              |         |         |         |               |          |          |                  |
|                                  | 19.36          | 19.57        | 19.90         | 20.34        | 20.70                     | 20.92        | 20.98   | 20.96   | 20.78   | 20.27         | 19.73    | 19.33    | (87)             |
| Temperature du                   | uring heatin   | g periods i  | n the rest of | f dwelling f | rom Table 9               | 9, Th2(°C)   |         |         |         |               |          |          |                  |
|                                  | 19.87          | 19.87        | 19.87         | 19.88        | 19.88                     | 19.89        | 19.89   | 19.89   | 19.89   | 19.88         | 19.88    | 19.87    | (88)             |
| Utilisation facto                | or for gains f | or rest of c | lwelling n2,  | m            |                           |              |         |         |         |               |          |          |                  |
|                                  | 1.00           | 1.00         | 0.99          | 0.96         | 0.86                      | 0.65         | 0.45    | 0.53    | 0.85    | 0.99          | 1.00     | 1.00     | (89)             |
| Mean internal t                  | emperature     | in the rest  | t of dwelling | g T2 (follow | steps 3 to                | 7 in Table 9 | ∋c)     |         |         |               |          |          |                  |
|                                  | 17.65          | 17.97        | 18.46         | 19.08        | 19.58                     | 19.83        | 19.88   | 19.88   | 19.69   | 19.00         | 18.20    | 17.61    | (90)             |
| Living area fract                | ion            |              |               |              |                           |              |         |         | Li      | ving area ÷   | (4) =    | 0.20     | (91)             |
| Mean internal t                  | emperature     | for the wh   | nole dwellin  | g fLA x T1 - | +(1 - fLA) x <sup>-</sup> | Т2           |         |         |         |               |          |          |                  |
|                                  | 17.99          | 18.29        | 18.74         | 19.33        | 19.81                     | 20.05        | 20.10   | 20.09   | 19.91   | 19.25         | 18.50    | 17.95    | (92)             |
| Apply adjustme                   | nt to the me   | ean interna  | al temperati  | ure from Ta  | able 4e whe               | ere appropr  | riate   |         |         |               |          |          |                  |
|                                  | 17.99          | 18.29        | 18.74         | 19.33        | 19.81                     | 20.05        | 20.10   | 20.09   | 19.91   | 19.25         | 18.50    | 17.95    | (93)             |
| 0 Cuese heat                     |                |              |               |              |                           |              |         |         |         |               |          |          |                  |
| 8. Space neath                   | ng requirem    | ient         | <b>N</b> 4    | <b>A</b>     | <b>N</b> 4                |              | 1.1     | • • • • | 6       | 0.1           | N        | D        |                  |
| l ltiliaation footo              | Jan            | Feb          | iviar         | Apr          | iviay                     | Jun          | Jui     | Aug     | Sep     | Uct           | NOV      | Dec      |                  |
| Utilisation facto                | or for gains,  | ηm           |               |              |                           |              |         |         | 0.05    |               | 1.00     | 1.00     | ] (0.1)          |
|                                  | 1.00           | 1.00         | 0.99          | 0.96         | 0.86                      | 0.67         | 0.48    | 0.55    | 0.85    | 0.98          | 1.00     | 1.00     | ] (94)           |
| Useful gains, nn                 | nGm, W (94     | 4)m x (84)n  | 1             |              |                           |              |         |         |         |               |          | 0-0      | ] (0-1)          |
| No the base of the second second | 3046.32        | 4456.18      | 5894.81       | /192.51      | /387.02                   | 5802.41      | 3938.55 | 4087.20 | 5347.53 | 4642.43       | 3324.16  | 2/2/./1  | ] (95)           |
| wonthly averag                   | e external t   | emperatur    |               | eUI          |                           |              |         |         |         | 10.00         |          |          | ] (0.0)          |
|                                  | 4.30           | 4.90         | 6.50          | 8.90         | 11.70                     | 14.60        | 16.60   | 16.40   | 14.10   | 10.60         | /.10     | 4.20     | ] (96)           |
| Heat loss rate to                | or mean inte   | ernal temp   | erature, Lm   | , w [(39)m   | n x [(93)m -              | (96)mj       | 1007.00 |         |         |               |          |          | ] (0-1)          |
|                                  | 16041.73       | 15651.76     | 14289.27      | 12060.06     | 9356.05                   | 6235.88      | 4005.98 | 4219.29 | 6671.09 | 9981.34       | 13207.78 | 15987.07 | ] (97)           |
| Space neating re                 | equirement     | , kwn/mor    | 1th 0.024 x   | [(97)m - (9  | 5)m] x (41)               | m            |         |         |         | 0070 45       |          |          | ٦                |
|                                  | 9668.58        | /523.42      | 6245.48       | 3504.64      | 1464.95                   | 0.00         | 0.00    | 0.00    | 0.00    | 3972.15       | /116.20  | 9864.96  |                  |
|                                  |                | 1.1.1.1.21   |               |              |                           |              |         |         | ∑(98    | 3)15, 10      | .12 = 4  | 9360.39  | ] (98)<br>] (98) |
| Space heating re                 | equirement     | kWh/m²/y     | rear          |              |                           |              |         |         |         | (98)          | ÷ (4)    | 53.43    | ] (99)           |
| 9a. Energy req                   | uirements -    | individual   | heating sy    | stems inclu  | iding micro               | -СНР         |         |         |         |               |          |          |                  |
| Space heating                    |                |              |               |              |                           |              |         |         |         |               |          |          |                  |
| Fraction of space                | e heat from    | secondary    | //suppleme    | ntary syste  | m (table 11               | L)           |         |         |         |               |          | 0.00     | (201             |
| Fraction of space                | e heat from    | main syste   | em(s)         |              |                           |              |         |         |         | 1 - (2        | 01) =    | 1.00     | ]<br>(202        |
| Fraction of space                | e heat from    | main syste   | em 2          |              |                           |              |         |         |         |               |          | 0.00     | (202             |
| Fraction of tota                 | l space heat   | from mair    | n system 1    |              |                           |              |         |         | (20     | 02) x [1- (20 | 3)] =    | 1.00     | _<br>] (204      |
| Fraction of total                | l space heat   | from mair    | n system 2    |              |                           |              |         |         |         | (202) x (2    | 03) =    | 0.00     | _<br>] (205      |
| Efficiency of ma                 | in system 1    | (%)          |               |              |                           |              |         |         |         |               |          | 93.50    | (206             |
|                                  | Jan            | Feb          | Mar           | Apr          | May                       | Jun          | Jul     | Aug     | Sep     | Oct           | Nov      | Dec      | -                |
| Space heating for                | uel (main sy   | stem 1), k\  | Wh/month      |              |                           |              |         |         |         |               |          |          |                  |
|                                  | 10340.73       | 8046.44      | 6679.66       | 3748.27      | 1566.80                   | 0.00         | 0.00    | 0.00    | 0.00    | 4248.29       | 7610.91  | 10550.76 | ]                |
|                                  |                |              |               |              |                           |              |         |         | ∑(21:   | 1)15, 10      | .12 = 5  | 2791.86  | ] (211           |

#### Water heating

Efficiency of water heater

| 90.13 90.08 89.97 89.67 88  | .73 79.80          | 79.80  | 79.80 79.80          | 89.74 90               | .04 90.14   | ] (217)            |  |  |  |  |  |  |
|---|--------------------|--------|----------------------|------------------------|-------------|--------------------|--|--|--|--|--|--|
| Water heating fuel, kWh/month   |                    |        |                      |                        |             |                    |  |  |  |  |  |  |
| 340.88 301.43 318.88 289.49 288                                       | 3.66 289.93        | 281.43 | 304.70 302.88        | 299.83 312             | 2.61 333.52 |                    |  |  |  |  |  |  |
|   |                    |        |                      | ∑(219a)112 =           | 3664.24     | (219)              |  |  |  |  |  |  |
| Annual totals   |                    |        |                      |                        |             |                    |  |  |  |  |  |  |
| Space heating fuel - main system 1                                    |                    |        |                      |                        | 52791.86    | ]                  |  |  |  |  |  |  |
| Water heating fuel  |                    |        |                      |                        | 3664.24     | ]                  |  |  |  |  |  |  |
| Electricity for pumps, fans and electric keep-hot (Table 4f)          |                    |        |                      |                        |             |                    |  |  |  |  |  |  |
| central heating pump or water pump within warm air heating unit 30.00 |                    |        |                      |                        |             |                    |  |  |  |  |  |  |
| boiler flue fan   |                    | 45.00  | ]                    |                        | (230e)      |                    |  |  |  |  |  |  |
| Total electricity for the above, kWh/year                             |                    |        |                      |                        | 75.00       | (231)              |  |  |  |  |  |  |
| Electricity for lighting (Appendix L)                                 |                    |        |                      |                        | 1366.66     | (232)              |  |  |  |  |  |  |
| Total delivered energy for all uses                                   |                    |        | (211)(221) + (231) + | (232)(237b) =          | 57897.77    | (238)              |  |  |  |  |  |  |
| 10a. Fuel costs - individual heating systems including micro-CHP      |                    |        |                      |                        |             |                    |  |  |  |  |  |  |
|   | Fuel               |        | Fuel price           |                        | Fuel        |                    |  |  |  |  |  |  |
|   | kWh/year           |        |                      |                        | cost £/year |                    |  |  |  |  |  |  |
| Space heating - main system 1   | 52791.86           | x      | 3.48                 | x 0.01 =               | 1837.16     | (240)              |  |  |  |  |  |  |
| Water heating   | 3664.24            | ×      | 3.48                 | x 0.01 =               | 127.52      | (247)              |  |  |  |  |  |  |
| Pumps and fans  | 75.00              | x      | 13.19                | x 0.01 =               | 9.89        | (249)              |  |  |  |  |  |  |
| Electricity for lighting  | 1366.66            | x      | 13.19                | x 0.01 =               | 180.26      | (250)              |  |  |  |  |  |  |
| Additional standing charges   |                    |        |                      |                        | 120.00      | (251)              |  |  |  |  |  |  |
| Total energy cost   |                    |        | (240)(242)           | + (245)(254) =         | 2274.83     | (255)              |  |  |  |  |  |  |
| 11a. SAP rating - individual heating systems including micro-CH       | Р                  |        |                      |                        |             |                    |  |  |  |  |  |  |
| Energy cost deflator (Table 12)                                       |                    |        |                      |                        | 0.42        | (256)              |  |  |  |  |  |  |
| Energy cost factor (ECF)  |                    |        |                      |                        | 0.99        | (257)              |  |  |  |  |  |  |
| SAP value   |                    |        |                      |                        | 86.24       | ]                  |  |  |  |  |  |  |
| SAP rating (section 13)   |                    |        |                      |                        | 86          | (258)              |  |  |  |  |  |  |
| SAP band  |                    |        |                      |                        | В           | ]                  |  |  |  |  |  |  |
| 12a. CO₂ emissions - individual heating systems including micro       | -СНР               |        |                      |                        |             |                    |  |  |  |  |  |  |
|   | Energy<br>kWb/year |        | Emission factor      |                        | Emissions   |                    |  |  |  |  |  |  |
| Space heating main system 1   | E 2701 96          | X      | 0.216                | 1                      | 11402.04    | (261)              |  |  |  |  |  |  |
| Space heating - main system 1   | 2664.24            | X      | 0.216                | ] -                    | 701.49      |                    |  |  |  |  |  |  |
|   | 3004.24            | X      | (201) + (202)        | _ =                    | 12104 52    | ] (204)<br>] (205) |  |  |  |  |  |  |
| Space and water neating   | 75.00              |        | (261) + (262) -      | + (263) + (264) =<br>] | 12194.52    | ] (265)<br>] (267) |  |  |  |  |  |  |
| Pumps and rans  | 75.00              | x      | 0.519                | ] =                    | 38.93       | ] (267)            |  |  |  |  |  |  |
|   | 1366.66            | x      | 0.519                |                        | 709.30      | ] (268)<br>] (272) |  |  |  |  |  |  |
| $1 \text{ orall} (O_2, \text{ kg/year})$                              |                    |        |                      | (2b5)(2/1) =           | 12942.74    | ] (272)            |  |  |  |  |  |  |
| Dweiling CO <sub>2</sub> emission rate                                |                    |        |                      | (2/2) ÷ (4) =          | 14.01       | ן (273)<br>ר       |  |  |  |  |  |  |
| El value  |                    |        |                      |                        | 82.10       | ]                  |  |  |  |  |  |  |
| El rating (section 14)  |                    |        |                      |                        | 82          | ן (274)<br>ר       |  |  |  |  |  |  |
| El band   |                    |        |                      |                        | В           |                    |  |  |  |  |  |  |
|   |                    |        |                      |                        |             |                    |  |  |  |  |  |  |

|                               | Energy<br>kWh/year |     | Primary factor |   | Primary Energy<br>kWh/year | ,     |
|-------------------------------|--------------------|-----|----------------|---|----------------------------|-------|
| Space heating - main system 1 | 52791.86           | ] x | 1.22           | = | 64406.07                   | (261) |
| Water heating                 | 3664.24            | x   | 1.22           | = | 4470.38                    | (264) |

| Space and water heating                  |         |   | (261) + (262) + | - (263) + (264) = | 68876.45 | (265) |
|--|---------|---|-----------------|-------------------|----------|-------|
| Pumps and fans                           | 75.00   | х | 3.07            | ] = [             | 230.25   | (267) |
| Electricity for lighting                 | 1366.66 | х | 3.07            | ] = [             | 4195.65  | (268) |
| Primary energy kWh/year                  |         |   |                 |                   | 73302.35 | (272) |
| Dwelling primary energy rate kWh/m2/year |         |   |                 |                   | 79.34    | (273) |

**3 KIDDERPORE AVENUE** 3 KIDDERPORE AVENUE **SUSTAINABILITY** ENERGY AND SUSTAINABILITY DOCUMENT – REV. 01

Appendix B: Be Lean DER Worksheet.

15

# DER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

| Client       Last modified $02/03/2018$ Address       3 Kidderpore Avenue, London, NW3 75X         I. Overall dwelling dimensions         Area (m <sup>2</sup> )       Average storey height (m)         Volume (m <sup>3</sup> )         Lowers occupied       355.42 (1a) x       3.70 (2a) = 1315.05 (3a)         +1       295.45 (1b) x       3.50 (2b) = 1034.08 (3b)         +2       273.01 (1c) x       3.60 (2c) = 982.84 (3c)         Otal floor area (1a) + (1b) + (1c) + (1d)(1n) = 923.88 (4)         Dwelling volume       (3a) + (3b) + (3c) + (3d)(3n) = 3331.97 (5)         2. Ventilation rate         m <sup>*</sup> per hour         Number of chimneys       0       x 40 = 66a         Number of pan flues       0       x 40 = 66a         Number of pan flues       0       x 40 = 66a         Number of flueless gas fires       0       x 40 = 66a         0       x 40 = 66a         0       x 40 = 66a         0        Air changes per hour                |
|---|
| Address       3 Kidderpore Avenue, London, NW3 75X         I. Overall dwelling dimensions       Area (m²)       Average storey<br>height (m)       Volume (m³)         Lowest occupied $355.42$ $(1a) \times$ $3.70$ $(2a) =$ $1315.05$ $(3a)$ +1 $295.45$ $(1b) \times$ $3.50$ $(2b) =$ $1034.08$ $(3b)$ +2 $273.01$ $(1c) \times$ $3.60$ $(2c) =$ $982.84$ $(3c)$ Total floor area $(1a) + (1b) + (1c) + (1d)(1n) =$ $923.88$ $(4)$ $(3a) + (3b) + (3c) + (3d)(3n) =$ $3331.97$ $(5)$ Ventilation rate         Number of chimneys $0 \times 40 =$ $0$ $(6a)$ Number of pan flues $0 \times 20 =$ $0$ $(6b)$ Number of passive vents $0 \times 10 =$ $0$ $(7a)$ Number of flueless gas fires $0 \times 40 =$ $0$ $(7c)$ Number of timenys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0 \times 40 =$ $0$ $(7c)$ Infiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0 \times (5) =$ $0.00 $ $(8)$ <i>If a pressurisation test has b</i> |
| Area (m²)       Average storey<br>height (m)       Volume (m³)         Lowest occupied $355.42$ $(1a) \times$ $3.70$ $(2a) =$ $1315.05$ $(3a)$ +1 $295.45$ $(1b) \times$ $3.50$ $(2b) =$ $1034.08$ $(3b)$ +2 $273.01$ $(1c) \times$ $3.60$ $(2c) =$ $982.84$ $(3c)$ Total floor area $(1a) + (1b) + (1c) + (1d)(1n) =$ $923.88$ $(4)$ $(3a) + (3b) + (3c) + (3d)(3n) =$ $3331.97$ $(5)$ Number of chimneys         Number of chimneys $0$ $x 40 =$ $0$ $(6a)$ Number of paen flues $0$ $x 10 =$ $0$ $(7a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7c)$ Number of flueless gas fires $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $x 40 =$ $0$ $(7c)$ Infiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $x 10 =$ $0$ $(7c)$ Infiltration tue to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $(5) =$ $0.00$ $(8)$ $0$   |
| Area (m²)       Average storey height (m)       Volume (m³)         Lowest occupied $355.42$ (1a) x $3.70$ (2a) = $1315.05$ (3a)         +1 $295.45$ (1b) x $3.50$ (2b) = $1034.08$ (3b)         +2 $273.01$ (1c) x $3.60$ (2c) = $982.84$ (3c)         Total floor area       (1a) + (1b) + (1c) + (1d)(1n) = $923.38$ (4)         Dwelling volume       (3a) + (3b) + (3c) + (3d)(3n) = $3331.97$ (5)         2       Ventilation rate $m^3 per hour$ Number of chimneys $0$ x 40 = $0$ (6a)         Number of intermittent fans $0$ x 10 = $0$ (7a)         Number of flueless gas fires $0$ x 40 = $0$ (7c)         Average start (ba) + (7a) + (7b) + (7c) = $0$ (c)       Average start (ba) (c)         Infiltration due to chimneys, flues, fans, PSVs       (6a) + (6b) + (7a) + (7b) + (7c) = $0$ (5) = $0.00$ (8)  |
| Area (m²)       Average storey<br>height (m)       Volume (m³)         Lowest occupied $355.42$ (1a) x $3.70$ (2a) = $1315.05$ (3a)         +1 $295.45$ (1b) x $3.50$ (2b) = $1034.08$ (3b)         +2 $273.01$ (1c) x $3.60$ (2c) = $982.84$ (3c)         Total floor area       (1a) + (1b) + (1c) + (1d)(1n) = $923.88$ (4) $(3a) + (3b) + (3c) + (3d)(3n) =$ $3331.97$ (5)         Vertilation rate $0$ $x40 =$ $0$ (6a)         Number of chinneys $0$ $x40 =$ $0$ (6a)         Number of pintermittent fans $0$ $x10 =$ $0$ Number of flueless gas fires $0$ $x40 =$ $0$ $(7e)$ Number of flueless gas fires $0$ $x40 =$ $0$ $(7e)$ Number of flueless gas fires $0$ $x40 =$ $0$ $(7e)$ Infiltration due to chinneys, flues, fans, PSVs $(6a) + (7e) + (7e) =$ $0$ $x40 =$ $0$ $(7e)$ Number of flueless gas fires $0$ $x40 =$ $0$ $(7e)$ $0$ $(7e)$ $0$ $(7e)$ Number of flueless gas fires $(6a) + (7e) + (7e) + (7e)$  |
| Lowest occupied $355.42$ $(1a) \times$ $3.70$ $(2a) =$ $1315.05$ $(3a)$ +1 $295.45$ $(1b) \times$ $3.50$ $(2b) =$ $1034.08$ $(3b)$ +2 $273.01$ $(1c) \times$ $3.60$ $(2c) =$ $982.84$ $(3c)$ Total floor area $(1a) + (1b) + (1c) + (1d)(1n) =$ $923.88$ $(4)$ $(3a) + (3b) + (3c) + (3d)(3n) =$ $3331.97$ $(5)$ <b>Ventilation rate Mumber of chimneys</b> Number of chimneys $0$ $x 40 =$ $0$ $(6a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7a)$ Number of flueless gas fires $0$ $x 10 =$ $0$ $(7c)$ Number of flueless gas fires $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $x 40 =$ $0$ $(7c)$ Number of flueless gas fires $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $x 10 =$ $0$ $(7c)$ Infiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $t 5) =$ $0.00$ $(8)$ If a pressurisation test has been carried out  |
| +1 $295.45$ $(1b) \times$ $3.50$ $(2b) =$ $1034.08$ $(3b)$ +2 $273.01$ $(1c) \times$ $3.60$ $(2c) =$ $982.84$ $(3c)$ Total floor area $(1a) + (1b) + (1c) + (1d)(1n) =$ $923.88$ $(4)$ $(3a) + (3b) + (3c) + (3d)(3n) =$ $3331.97$ $(5)$ <b>2. Ventilation rate ***********************************</b>   |
| +2 $273.01$ (1c) x $3.60$ (2c) = $982.84$ (3c)         Total floor area       (1a) + (1b) + (1c) + (1d)(1n) = $923.88$ (4) $(3a) + (3b) + (3c) + (3d)(3n) =$ $3331.97$ (5)         Dwelling volume <b>C. Ventilation rate</b> Mumber of chimneys         Number of open flues $0$ $x 40 =$ $0$ (6a)         Number of passive vents $0$ $x 10 =$ $0$ (7a)         Number of flueless gas fires $0$ $x 40 =$ $0$ (7b)         Number of flueless gas fires $0$ $x 40 =$ $0$ (7c)         Air changes per hour $0$ $x 40 =$ $0$ (7c)         Air changes per hour $0$ $x 40 =$ $0$ (7c)         Number of passive vents $0$ $x 10 =$ $0$ (7c)         Number of flueless gas fires $0$ $x 40 =$ $0$ (7c)         Air changes per hour $0$ $x 40 =$ $0$ (7c)         Air changes per hour $0$ $x 40 =$ $0$ (7c)         Infiltration due to chimneys, flues, fans, PSVs       (6a) + (6b) + (7a) + (7b) + (7c) = $0$ $\div$ (5) = $0.00$ (8)         If a pressurisation test has be       |
| Total floor area $(1a) + (1b) + (1c) + (1d)(1n) = 923.88$ (4)         Dwelling volume $(3a) + (3b) + (3c) + (3d)(3n) = 3331.97$ (5) <b>2. Ventilation rate</b> $m^3 per hour$ Number of chimneys $0 \times 40 = 0$ (6a)         Number of open flues $0 \times 10 = 0$ (7a)         Number of passive vents $0 \times 10 = 0$ (7b)         Number of flueless gas fires $0 \times 40 = 0$ (7c)         Air changes per hour $Air changes per hour$ Infiltration due to chimneys, flues, fans, PSVs $(6a) + (7a) + (7b) + (7c) = 0 + (5) = 0.000$ (8)         If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)   |
| Dwelling volume $(3a) + (3b) + (3c) + (3d)(3n) = 3331.97$ (5) <b>2. Ventilation rate</b> Number of chimneys0 $x 40 =$ 0(6a)Number of open flues0 $x 20 =$ 0(6b)Number of intermittent fans0 $x 10 =$ 0(7a)Number of passive vents0 $x 40 =$ 0(7a)Number of flueless gas fires0 $x 40 =$ 0(7c)Air changes per hourInfiltration due to chimneys, flues, fans, PSVs(6a) + (6b) + (7a) + (7b) + (7c) =0 $\div$ (5) =0.00(8)If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) $\bullet$ $\bullet$ $\bullet$ 0(a)  |
| 2. Ventilation rateNumber of chimneys $0$ $x 40 =$ $0$ $(6a)$ Number of open flues $0$ $x 20 =$ $0$ $(6b)$ Number of intermittent fans $0$ $x 10 =$ $0$ $(7a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7b)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Infiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $x (5) =$ $0.00$ $(8)$ If a pressurisation test has been carried out or is intended, proceed to $(17)$ , otherwise continue from $(9)$ to $(16)$ $(12)$ $(12)$ $(12)$  |
| Number of chimneys $0$ $x 40 =$ $0$ $(6a)$ Number of open flues $0$ $x 20 =$ $0$ $(6b)$ Number of intermittent fans $0$ $x 10 =$ $0$ $(7a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7b)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Infiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $\div (5) =$ $0.00$ $(8)$ If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16) $(7b)$ $(7b)$ $(7b)$  |
| Number of chimneys $0$ $x 40 =$ $0$ $(6a)$ Number of open flues $0$ $x 20 =$ $0$ $(6b)$ Number of intermittent fans $0$ $x 10 =$ $0$ $(7a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7b)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Air changes per hourInfiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $\div (5) =$ $0.00$ $(8)$ If a pressurisation test has been carried out or is intended, proceed to $(17)$ , otherwise continue from $(9)$ to $(16)$   |
| Number of open flues $0$ $x 20 =$ $0$ $(6b)$ Number of intermittent fans $0$ $x 10 =$ $0$ $(7a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7b)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Air changes per hourInfiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $\div (5) =$ $0.00$ $(8)$ If a pressurisation test has been carried out or is intended, proceed to $(17)$ , otherwise continue from $(9)$ to $(16)$  |
| Number of intermittent fans $0$ $x 10 =$ $0$ $(7a)$ Number of passive vents $0$ $x 10 =$ $0$ $(7b)$ Number of flueless gas fires $0$ $x 40 =$ $0$ $(7c)$ Air changes per hourInfiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $\div (5) =$ $0.00$ (8)If a pressurisation test has been carried out or is intended, proceed to $(17)$ , otherwise continue from $(9)$ to $(16)$  |
| Number of passive vents $0$ $x \ 10 =$ $0$ $(7b)$ Number of flueless gas fires $0$ $x \ 40 =$ $0$ $(7c)$ Air changes per hourInfiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) =$ $0$ $\div (5) =$ $0.00$ (8)If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)   |
| Number of flueless gas fires       0       x 40 =       0       (7c)         Air changes per hour       0       x 40 =       0       (7c)         Infiltration due to chimneys, flues, fans, PSVs       (6a) + (6b) + (7a) + (7b) + (7c) =       0 $\div$ (5) =       0.00       (8)         If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)       (6b)       (7c)       (7c)  |
| Air changes per<br>hourInfiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) = 0$ $\div (5) = 0.00$ (8)If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)(8)  |
| hourInfiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) = 0$ $\div (5) = 0.00$ (8)If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)(8)   |
| Infiltration due to chimneys, flues, fans, PSVs $(6a) + (6b) + (7a) + (7b) + (7c) = 0$ $\div (5) = 0.00$ $(8)$ If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)   |
| If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)  |
|   |
| Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area 3.00 (17)   |
| If based on air permeability value, then $(18) = [(17) \div 20] + (8)$ , otherwise $(18) = (16)$ 0.15(18)   |
| Number of sides on which the dwelling is sheltered 0 (19)   |
| Shelter factor       1 - [0.075 x (19)] = 1.00 (20)   |
| Infiltration rate incorporating shelter factor $(18) \times (20) = 0.15$ (21)   |
| Infiltration rate modified for monthly wind speed:  |
| Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec   |
|   |
| $\begin{array}{c c c c c c c c c c c c c c c c c c c $  |
|   |
| Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m   |
|   |
| Calculate effective air change rate for the applicable case:  |
| If mechanical ventilation: air change rate through system   |
| If halanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h 76.50 (22c)  |
| a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]  |
|   |



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

| Lifective all cli | 0.31                                   | 0.31                    | 0.30          | 0.28                         | 0.28                       | 0.26         | 0.26       | 0.26             | 0.27          | 0.28                 | 0.29            | 0.29         | (25)        |
|-------------------|--|-------------------------|---------------|------------------------------|----------------------------|--------------|------------|------------------|---------------|----------------------|-----------------|--------------|-------------|
|                   | 0.01                                   | 0.01                    | 0.00          | 0.20                         | 0.20                       | 0.20         | 0.20       | 0.20             | 0.27          | 0.20                 | 0.20            | 0.20         | ] (==)      |
| 3. Heat losses    | and heat lo                            | ss paramet              | ter           |                              |                            |              |            |                  |               |                      |                 |              |             |
| Element           |  |                         | а             | Gross<br>rea, m <sup>2</sup> | Openings<br>m <sup>2</sup> | s Net<br>A,  | area<br>m² | U-value<br>W/m²K | A x U W       | //К к-\<br>kJ,       | /alue,<br>/m².K | Ахк,<br>kJ/K |             |
| Window            |  |                         |               |                              |                            | 183          | 8.02 x     | 1.33             | = 242.64      | 4                    |                 |              | (27)        |
| Roof window       |  |                         |               |                              |                            | 24           | .55 x      | 1.33             | = 32.55       | <br>;                |                 |              | (27a)       |
| Door              |  |                         |               |                              |                            | 4.           | 81 x       | 1.40             | = 6.73        |                      |                 |              | (26)        |
| Ground floor      |  |                         |               |                              |                            | 355          | 5.42 x     | 0.10             | = 35.54       | ŀ                    |                 |              | (28a)       |
| External wall     |  |                         |               |                              |                            | 611          | .35 x      | 0.15             | = 91.70       | )                    |                 |              | (29a)       |
| Roof              |  |                         |               |                              |                            | 327          | 7.01 x     | 0.10             | = 32.70       | )                    |                 |              | (30)        |
| Total area of ex  | xternal elem                           | ents ∑A, m <sup>2</sup> | 2             |                              |                            | 150          | 6.16       |                  |               |                      |                 |              | (31)        |
| Fabric heat los   | s, W/K = ∑(A                           | × U)                    |               |                              |                            |              |            |                  | (26           | 5)(30) + (           | 32) =           | 441.87       | (33)        |
| Heat capacity (   | Cm = ∑(А x к)                          | )                       |               |                              |                            |              |            | (28)             | (30) + (32) - | + (32a)(3            | 2e) =           | N/A          | (34)        |
| Thermal mass      | parameter (1                           | ՐMP) in kJ/ı            | m²K           |                              |                            |              |            |                  |               |                      |                 | 100.00       | (35)        |
| Thermal bridge    | es: Σ(L x Ψ) c                         | alculated u             | sing Appen    | dix K                        |                            |              |            |                  |               |                      |                 | 225.92       | (36)        |
| Total fabric hea  | at loss                                |                         |               |                              |                            |              |            |                  |               | (33) + (             | 36) =           | 667.79       | (37)        |
|                   | Jan                                    | Feb                     | Mar           | Apr                          | May                        | Jun          | Jul        | Aug              | Sep           | Oct                  | Nov             | Dec          |             |
| Ventilation hea   | at loss calcula                        | ated month              | nly 0.33 x (2 | 25)m x (5)                   |                            |              |            |                  |               |                      |                 |              | -           |
|                   | 339.49                                 | 335.36                  | 331.24        | 310.62                       | 306.50                     | 285.88       | 285.88     | 281.76           | 294.13        | 306.50               | 314.75          | 322.99       | (38)        |
| Heat transfer c   | oefficient, W                          | V/K (37)m·              | + (38)m       | 1                            |                            |              |            | _                |               |                      | i               | 1            | ,           |
|                   | 1007.28                                | 1003.15                 | 999.03        | 978.41                       | 974.29                     | 953.67       | 953.67     | 949.55           | 961.92        | 974.29               | 982.54          | 990.78       | ]           |
|                   | . (                                    |                         |               |                              |                            |              |            |                  | Average = 2   | <u>s</u> (39)112,    | /12 =           | 977.38       | (39)        |
| Heat loss parar   | meter (HLP),                           | W/m²K (39               | 9)m ÷ (4)     |                              |                            |              |            |                  |               |                      |                 |              | 1           |
|                   | 1.09                                   | 1.09                    | 1.08          | 1.06                         | 1.05                       | 1.03         | 1.03       | 1.03             | 1.04          | 1.05                 | 1.06            | 1.07         | ]           |
| Number of dou     | ······································ |                         |               |                              |                            |              |            |                  | Average = 2   | <u>&gt;(</u> 40)112, | /12 =           | 1.06         | ] (40)      |
| Number of day     |  |                         | 21.00         | 20.00                        | 21.00                      | 20.00        | 21.00      | 21.00            | 20.00         | 21.00                | 20.00           | 21.00        |             |
|                   | 31.00                                  | 28.00                   | 31.00         | 30.00                        | 31.00                      | 30.00        | 31.00      | 31.00            | 30.00         | 31.00                | 30.00           | 31.00        | ] (40)      |
| 4. Water heat     | ting energy r                          | equiremen               | it            |                              |                            |              |            |                  |               |                      |                 |              |             |
| Assumed occup     | pancy, N                               |                         |               |                              |                            |              |            |                  |               |                      |                 | 3.94         | (42)        |
| Annual average    | e hot water ເ                          | usage in litr           | es per day    | Vd,average                   | = (25 x N) +               | - 36         |            |                  |               |                      |                 | 127.85       | (43)        |
|                   | Jan                                    | Feb                     | Mar           | Apr                          | May                        | Jun          | Jul        | Aug              | Sep           | Oct                  | Nov             | Dec          |             |
| Hot water usag    | ge in litres pe                        | er day for e            | ach month     | Vd,m = fact                  | or from Tak                | ole 1c x (43 | )          |                  |               |                      |                 |              |             |
|                   | 140.63                                 | 135.52                  | 130.40        | 125.29                       | 120.17                     | 115.06       | 115.06     | 120.17           | 125.29        | 130.40               | 135.52          | 140.63       | ]           |
|                   |  |                         |               |                              |                            |              |            |                  |               | ∑(44)1               | .12 =           | 1534.15      | (44)        |
| Energy content    | t of hot wate                          | er used = 4.            | 18 x Vd,m x   | x nm x Tm/3                  | 600 kWh/n                  | nonth (see   | Tables 1b, | 1c 1d)           |               |                      |                 |              |             |
|                   | 208.55                                 | 182.40                  | 188.22        | 164.09                       | 157.45                     | 135.87       | 125.90     | 144.48           | 146.20        | 170.38               | 185.99          | 201.97       | ]           |
|                   |  |                         |               |                              |                            |              |            |                  |               | ∑(45)1               | .12 =           | 2011.51      | (45)        |
| Distribution los  | s 0.15 x (45                           | )m                      |               |                              |                            |              |            |                  |               |                      |                 | _            | _           |
|                   | 31.28                                  | 27.36                   | 28.23         | 24.61                        | 23.62                      | 20.38        | 18.89      | 21.67            | 21.93         | 25.56                | 27.90           | 30.30        | (46)        |
| Storage volume    | e (litres) incl                        | uding any s             | olar or WW    | /HRS storag                  | e within sar               | me vessel    |            |                  |               |                      |                 | 1000.00      | (47)        |
| Water storage     | loss:                                  |                         |               |                              |                            |              |            |                  |               |                      |                 |              |             |
| b) Manufacture    | er's declared                          | l loss factor           | is not knov   | wn                           |                            |              |            |                  |               |                      |                 |              | 1           |
| Hot water s       | torage loss f                          | actor from              | Table 2 (kV   | Vh/litre/day                 | ()                         |              |            |                  |               |                      |                 | 0.01         | <b>(51)</b> |
| Volume fac        | tor from Tab                           | le 2a                   |               |                              |                            |              |            |                  |               |                      |                 | 0.49         | <b>(52)</b> |
| Temperatur        | re factor fror                         | m Table 2b              |               |                              |                            |              |            |                  |               |                      |                 | 0.54         | (53)        |
| Energy lost       | from water :                           | storage (kV             | /h/day) (47   | 7) x (51) x (5               | 52) x (53)                 |              |            |                  |               |                      |                 | 2.74         | (54)        |

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

South

West

```
(55)
2.74
```

| Water storage loss calculated for eac  | h month (55) x (41)m      |                                  |                                |   |                                  |                              |                           |
|--|---------------------------|----------------------------------|--------------------------------|---|----------------------------------|------------------------------|---------------------------|
| 84.95 76.73                            | 84.95 82.21               | 84.95 82.21                      | 84.95                          | 84.95 8                                 | 82.21 84.                        | .95 82.21                    | 84.95 <mark>(56)</mark>   |
| If the vessel contains dedicated solar | storage or dedicated W    | /WHRS (56)m x [(47               | ) - Vs] ÷ (47),                | else (56)                               |                                  |                              |                           |
| 84.95 76.73                            | 84.95 82.21               | 84.95 82.21                      | 84.95                          | 84.95 8                                 | 82.21 84.                        | .95 82.21                    | 84.95 <b>(57)</b>         |
| Primary circuit loss for each month fr | om Table 3                |                                  |                                |   |                                  |                              |                           |
| 23.26 21.01                            | 23.26 22.51               | 23.26 22.51                      | 23.26                          | 23.26                                   | 22.51 23.                        | .26 22.51                    | 23.26 <b>(59)</b>         |
| Combi loss for each month from Tabl    | e 3a, 3b or 3c            |                                  |                                |   |                                  |                              |                           |
| 0.00 0.00                              | 0.00 0.00                 | 0.00 0.00                        | 0.00                           | 0.00                                    | 0.00 0.0                         | 0.00                         | 0.00 (61)                 |
| Total heat required for water heating  | calculated for each mo    | onth  0.85 x (45)m +             | (46)m + (57)r                  | n + (59)m + (63                         | 1)m                              |                              |                           |
| 316.76 280.14                          | 296.43 268.82             | 265.67 240.59                    | 9 234.12                       | 252.69 2                                | 50.92 278                        | 3.60 290.71                  | 310.18 <mark>(62)</mark>  |
| Solar DHW input calculated using App   | oendix G or Appendix H    |                                  |                                |   |                                  |                              |                           |
| 0.00 0.00                              | 0.00 0.00                 | 0.00 0.00                        | 0.00                           | 0.00                                    | 0.00 0.0                         | 0.00                         | 0.00 (63)                 |
| Output from water heater for each m    | onth (kWh/month) (62      | 2)m + (63)m                      |                                |   |                                  |                              |                           |
| 316.76 280.14                          | 296.43 268.82             | 265.67 240.59                    | 9 234.12                       | 252.69 2                                | 50.92 278                        | .60 290.71                   | 310.18                    |
|  |                           |                                  |                                |   | Σ(6                              | 54)112 = 3                   | 285.63 <mark>(64)</mark>  |
| Heat gains from water heating (kWh/    | /month) 0.25 × [0.85 ×    | (45)m + (61)m] + 0.8             | 8 × [(46)m + (5                | 57)m + (59)m]                           |                                  |                              |                           |
| 155.91 138.84                          | 149.15 138.34             | 138.92 128.9                     | 5 128.43                       | 134.61 1                                | .32.39 143                       | .22 145.62                   | 153.73 <mark>(65)</mark>  |
|  |                           |                                  |                                |   |                                  |                              |                           |
| 5. Internal gains                      |                           |                                  |                                |   |                                  |                              | _                         |
| Jan Feb                                | Mar Apr                   | May Jun                          | Jul                            | Aug                                     | Sep O                            | ct Nov                       | Dec                       |
| Metabolic gains (Table 5)              |                           |                                  |                                |   |                                  |                              |                           |
| 197.15 197.15                          | 197.15 197.15             | 197.15 197.15                    | 5 197.15                       | 197.15 1                                | .97.15   197                     | 197.15 197.15                | 197.15 (66)               |
| Lighting gains (calculated in Appendix | ( L, equation L9 or L9a), | also see Table 5                 | _                              |   | ·                                |                              | ·                         |
| 77.39 68.73                            | 55.90 42.32               | 31.63 26.71                      | 28.86                          | 37.51                                   | 50.35 63.                        | .92 74.61                    | 79.54 <mark>(67)</mark>   |
| Appliance gains (calculated in Append  | dix L, equation L13 or L  | 13a), also see Table             | 5                              |   |                                  |                              |                           |
| 868.04 877.04                          | 854.35 806.02             | 745.02 687.69                    | 9 649.39                       | 640.39 6                                | 63.08 711                        | 41 772.41                    | 829.74 <mark>(68)</mark>  |
| Cooking gains (calculated in Appendix  | < L, equation L15 or L15  | a), also see Table 5             |                                | I I                                     |                                  |                              |                           |
| 42.71 42.71                            | 42.71 42.71               | 42.71 42.71                      | 42.71                          | 42.71                                   | 42.71 42.                        | .71 42.71                    | 42.71 (69)                |
| Pump and fan gains (Table 5a)          | _                         |                                  | _                              | i i                                     | i                                |                              |                           |
| 3.00 3.00                              | 3.00 3.00                 | 3.00 3.00                        | 3.00                           | 3.00                                    | 3.00 3.0                         | 00 3.00                      | 3.00 (70)                 |
| Losses e.g. evaporation (Table 5)      |                           |                                  |                                | 1                                       |                                  |                              |                           |
| -157.72 -157.72                        | -157.72 -157.72           | -157.72 -157.7                   | 2 -157.72                      | -157.72 -1                              | 157.72 -157                      | 7.72 -157.72                 | -157.72 <mark>(71)</mark> |
| Water heating gains (Table 5)          |                           |                                  |                                |   |                                  |                              |                           |
| 209.56 206.61                          | 200.48 192.14             | 186.73 179.10                    | ) 172.63                       | 180.93 1                                | .83.87 192                       | .50 202.25                   | 206.62 (72)               |
| Total internal gains (66)m + (67)m +   | (68)m + (69)m + (70)m     | + (71)m + (72)m                  |                                |   |                                  |                              |                           |
| 1240.13 1237.53                        | 1195.86 1125.62           | 1048.53 978.65                   | 5 936.02                       | 943.97 9                                | 82.45 1052                       | 2.98 1134.41                 | 1201.04 (73)              |
| 6. Solar gains                         |                           |                                  |                                |   |                                  |                              |                           |
|  |                           |                                  |                                |   |                                  |                              |                           |
|  | Access factor             | Area                             | Solar flux                     | σ                                       |                                  | FF                           | Gains                     |
|  | Access factor<br>Table 6d | Area S<br>m²                     | olar flux<br>W/m²              | g<br>specific                           | data spe                         | FF<br>cific data             | Gains<br>W                |
|  | Access factor<br>Table 6d | Area S<br>m²                     | olar flux<br>W/m²              | g<br>specific<br>or Table               | data spe<br>e 6b or <sup>-</sup> | FF<br>cific data<br>Table 6c | Gains<br>W                |
| North                                  | Access factor<br>Table 6d | Area 5<br>m <sup>2</sup> 55.57 x | Solar flux<br>W/m <sup>2</sup> | g<br>specific<br>or Table<br>0.9 x 0.60 | data spe<br>e 6b or<br>) x       | FF<br>cific data<br>Table 6c | Gains<br>W<br>171.99 (74) |

0.77 74.66 46.75 x 0.9 x 0.60 0.70 = 1015.95 (78) х х х 0.77 16.97 19.64 x 0.9 x 0.60 0.70 97.01 (80) х х х = 1.00 24.55 26.00 x 0.9 x 0.60 0.70 241.28 Horizontal х х х = Solar gains in watts ∑(74)m...(82)m 1730.99 3083.98 7330.76 7002.40 6149.32 5083.42 3498.83 4541.03 6102.42 7224.09 2098.93 1464.29 (83) Total gains - internal and solar (73)m + (83)m

|                   | 2971.11             | 4321.51          | 5736.89      | 7228.04      | 8272.62         | 8309.41      | 7938.42     | 7093.29  | 6065.87 | 4551.81     | 3233.33   | 2665.33 (8 | 84)  |
|-------------------|---------------------|------------------|--------------|--------------|-----------------|--------------|-------------|----------|---------|-------------|-----------|------------|------|
| 7. Mean intern    | al tempera          | ture (heati      | ng season)   |              |                 |              |             |          |         |             |           |            |      |
| Temperature du    | iring heating       | g periods ir     | the living a | area from T  | Table 9, Th1    | .(°C)        |             |          |         |             |           | 21.00 (8   | 85)  |
|                   | Jan                 | Feb              | Mar          | Apr          | May             | Jun          | Jul         | Aug      | Sep     | Oct         | Nov       | Dec        |      |
| Utilisation facto | r for gains f       | or living are    | ea n1,m (se  | e Table 9a)  | )               |              |             |          |         |             |           |            |      |
|                   | 0.99                | 0.98             | 0.95         | 0.88         | 0.77            | 0.62         | 0.48        | 0.54     | 0.77    | 0.94        | 0.99      | 0.99 (8    | 86)  |
| Mean internal te  | emp of livin        | g area T1 (s     | steps 3 to 7 | in Table 90  | c)              | •            |             |          |         |             | •         |            |      |
|                   | 18.85               | 19.13            | 19.56        | 20.08        | 20.49           | 20.75        | 20.85       | 20.83    | 20.60   | 20.02       | 19.34     | 18.82 (    | 87)  |
| Temperature du    | iring heating       | g periods ir     | the rest of  | f dwelling f | rom Table 9     | 9, Th2(°C)   |             |          |         |             | •         | · ·        |      |
|                   | 20.01               | 20.01            | 20.02        | 20.03        | 20.04           | 20.06        | 20.06       | 20.06    | 20.05   | 20.04       | 20.03     | 20.02 (    | 88)  |
| Utilisation facto | r for gains f       | or rest of d     | welling n2,  | m            | ł               |              | 1           |          |         |             | 1         | · · ·      |      |
|                   | 0.99                | 0.98             | 0.94         | 0.86         | 0.73            | 0.55         | 0.39        | 0.45     | 0.71    | 0.92        | 0.98      | 0.99 (     | 89)  |
| Mean internal te  | emperature          | in the rest      | of dwelling  | T2 (follow   | steps 3 to      | 7 in Table 9 | )<br>()     |          |         |             |           | (          | ,    |
|                   | 17.07               | 17 49            | 18 11        | 18 87        | 19.43           | 19 78        | 19.88       | 19.86    | 19.60   | 18 80       | 17.80     | 17.03 (    | 90)  |
| Living area fract | ion                 | 17.45            | 10.11        | 10.07        | 15.45           | 15.70        | 15.00       | 15.00    |         | ving area ÷ | (4) =     |            | 91)  |
| Mean internal te  | emnerature          | for the wh       | ole dwellin  | σ flΔ x T1 - | ⊧(1 - fl Δ) x ī | г2           |             |          |         | and area .  | (+) -     | 0.20       | 51)  |
|                   | 17.42               | 17.02            |              | 10.11        | 10.64           | 10.07        | 20.07       | 20.05    | 10.90   | 10.04       | 10 11     | 17.20 (    | 02)  |
| Apply adjustma    | 17.42               | 17.02            | 10.40        | 19.11        | 19.04           | 19.97        | 20.07       | 20.05    | 19.00   | 19.04       | 10.11     | 17.59 (:   | 92)  |
|                   |                     |                  |              |              |                 |              | 10.02       | 10.00    | 10.05   | 10.00       | 17.00     | 17.24      | 02)  |
|                   | 17.27               | 17.67            | 18.25        | 18.96        | 19.49           | 19.82        | 19.92       | 19.90    | 19.65   | 18.89       | 17.96     | 17.24      | 93)  |
| 8. Space heatir   | ng requirem         | nent             |              |              |                 |              |             |          |         |             |           |            |      |
|                   | Jan                 | Feb              | Mar          | Apr          | May             | Jun          | Jul         | Aug      | Sep     | Oct         | Nov       | Dec        |      |
| Utilisation facto | r for gains,        | ηm               |              |              |                 |              |             |          |         |             |           |            |      |
|                   | 0.99                | 0.96             | 0.92         | 0.83         | 0.70            | 0.53         | 0.38        | 0.44     | 0.69    | 0.90        | 0.97      | 0.99 (     | 94)  |
| Useful gains. nm  | 1Gm. W (94          | 1)m x (84)m      |              |              | 1               |              |             |          |         |             |           |            | /    |
|                   | 2928 77             | 4167.27          | 5284 28      | 6029 49      | 5803 92         | 4421 69      | 3016 41     | 3103 17  | 4166.01 | 4089 24     | 3146 88   | 2636.66    | 95)  |
| Monthly average   | e external t        | emperature       | e from Tabl  | e []1        | 5005.52         | 1121.05      | 5010.11     | 5105.17  | 1100.01 | 1005121     | 5110.00   | 2000.00 (. | 551  |
| wontiny average   |                     | 1 90             | 6 50         | 8 90         | 11 70           | 14.60        | 16.60       | 16.40    | 14.10   | 10.60       | 7 10      | 4 20 (     | 96)  |
| Heat loss rate fo | r mean inte         | rnal tempe       | arature Im   | W [(39)m     | v [(93)m -      | (96)ml       | 10.00       | 10.40    | 14.10   | 10.00       | 7.10      | 4.20 (.    | 50)  |
|                   |                     | 12806.01         | 11725 00     | , w [(35)]   | 7502.08         | 4079.25      | 2167.00     | 2227 72  | 5220 47 | 0077 57     | 10666 70  | 12010 12 ( | 07)  |
| Chase besting r   | 13067.50            | 12806.91         | 11/35.00     | 9842.03      | 7593.08         | 4978.35      | 3167.09     | 3327.73  | 5338.47 | 8077.57     | 10666.70  | 12919.12   | 97)  |
| space neating re  |                     |                  | un 0.024 x   | [(97)11 - (9 | 5)mj x (41)     |              | 0.00        | 0.00     | 0.00    | 2067.22     | E 44 4 27 | 7650.45    |      |
|                   | /543.22             | 5805.84          | 4799.33      | 2745.03      | 1331.14         | 0.00         | 0.00        | 0.00     | 0.00    | 2967.32     | 5414.27   | 7650.15    |      |
|                   |                     |                  |              |              |                 |              |             |          | ∑(98    | 3)15, 10    | .12 = 38  | 8256.29 (  | 98)  |
| Space heating re  | equirement          | kWh/m²/y         | ear          |              |                 |              |             |          |         | (98)        | ÷ (4)     | 41.41 (9   | 99)  |
| 8c. Space cooli   | ng requirer         | nent             |              |              |                 |              |             |          |         |             |           |            |      |
|                   | Jan                 | Feb              | Mar          | Apr          | May             | Jun          | Jul         | Aug      | Sep     | Oct         | Nov       | Dec        |      |
| Heat loss rate Lr | n                   |                  |              |              |                 |              |             |          | •       |             |           |            |      |
|                   | 0.00                | 0.00             | 0.00         | 0.00         | 0.00            | 8964 53      | 7057 18     | 7216 58  | 0.00    | 0.00        | 0.00      | 0.00 (     | 100) |
| Utilisation facto | r for loss nr       | n <u>1 0.000</u> | 0.00         | 0.00         | 0.00            | 000.000      | /00/120     | / 120.00 | 0.00    | 0.00        | 0.00      | (          | ,    |
|                   |                     | 0.00             | 0.00         | 0.00         | 0.00            | 0.76         | 0.83        | 0.79     | 0.00    | 0.00        | 0.00      |            | 101) |
| Useful loss nm    | 0.00<br>m (watts) / | 100 m v (10      | 1 0.00       | 0.00         | 0.00            | 5.70         | 0.05        | 0.79     | 0.00    | 0.00        | 0.00      | 0.00 (     | -01) |
|                   |                     |                  |              | 0.00         | 0.00            | 6845 20      | 5021 01     | 5677 02  | 0.00    | 0.00        | 0.00      | 0.00 /     | 1021 |
| Gains             | 0.00                | 0.00             | 0.00         | 0.00         | 0.00            | 0045.59      | 10.1205     | 5077.03  | 0.00    | 0.00        | 0.00      | 0.00 (.    | 102) |
| Jailis            | 0.00                | 0.00             | 0.00         | 0.00         | 0.00            | 0669.00      | 0242.00     | 0212 50  | 0.00    | 0.00        | 0.00      |            | 1021 |
| Choose and the -  |                     |                  |              |              |                 | (102) (1     | 02)1(11     | 8313.50  | 0.00    | 0.00        | 0.00      | 0.00 (     | 103) |
| space cooling re  | quirement,          | whole dwe        | ening, conti | nuous (kW    | n) 0.024 x [    | (103)m - (1  | 02)mj x (41 | L)M      |         |             |           |            |      |
|                   | 0.00                | 0.00             | 0.00         | 0.00         | 0.00            | 2032.87      | 2538.66     | 1961.53  | 0.00    | 0.00        | 0.00      | 0.00       |      |

| Cooled area + [4] 0.57 (18)<br>intermittency factor (Table 10)<br>0.00 0.00 0.00 0.00 0.05 0.25 0.25 0.20 0.00 0.0  |                     |               |              |                       |              |               |            |        |           |              | ∑(104)6.      | 8 =     | 6533.06   | (104)              |
|---|---------------------|---------------|--------------|-----------------------|--------------|---------------|------------|--------|-----------|--------------|---------------|---------|-----------|--------------------|
| <ul> <li></li></ul>   | Cooled fraction     |               |              |                       |              |               |            |        |           | coo          | oled area ÷   | (4) =   | 0.67      | (105)              |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$   | Intermittency fa    | ctor (Table   | 10)          |                       |              |               |            |        |           |              |               |         |           |                    |
| Space cooling requirement (104)m x (105) x (106)m         0.00 <t< td=""><td></td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.25</td><td>0.25</td><td>0.25</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>7</td></t<>   |                     | 0.00          | 0.00         | 0.00                  | 0.00         | 0.00          | 0.25       | 0.25   | 0.25      | 0.00         | 0.00          | 0.00    | 0.00      | 7                  |
| Space cooling requirement (104)m x (105) x (106)m         0.00 <t< td=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>•</td><td>•</td><td>-<br/>Σ(106)6.</td><td>8 =</td><td>0.75</td><td>(106)</td></t<>  |                     |               |              |                       |              |               |            |        | •         | •            | -<br>Σ(106)6. | 8 =     | 0.75      | (106)              |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$   | Space cooling re    | quirement     | (104)m x (1  | .05) x (106)          | m            |               |            |        |           |              |               | L       |           |                    |
| $ \begin{array}{ c c c c c c c c c c c c c c c c c c c$   |                     | 0.00          | 0.00         | 0.00                  | 0.00         | 0.00          | 340.02     | 424.61 | 328.08    | 0.00         | 0.00          | 0.00    | 0.00      | 7                  |
| Space cooling requirement KWh/m <sup>2</sup> /year       (107) + (4) = 1.18 (100)         Space cooling requirements - individual heating systems including micro-CHP         Space heat from main system (2)       0.00 (202)         Fraction of space heat from main system 1       0.00 (202)         Fraction of space heat from main system 2       0.00 (202)         Fraction of total space heat from main system 1       (202) x [203] = 1.00 (202)         Fraction of total space heat from main system 1       (202) x [203] = 0.00 (202)         Fraction of total space heat from main system 1       (202) x [203] = 0.00 (202)         Fraction of total space heat from main system 1       (202) x [203] = 0.00 (202)         Cooling system energy efficiency rate (Table 10c)       0.00 0.00 0.00 0.00 0.00 3160.06 5765.99 8147.12         Cooling system energy efficiency rate (Table 10c)       0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0  |                     |               |              |                       |              |               |            |        |           |              | Σ(107)6.      | 8 =     | 1092.71   | _<br>] (107)       |
| $ \begin{array}{ c c c c c c } \hline \begin{tabular}{ c c c c c c c } \hline \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$   | Space cooling re    | auirement     | kWh/m²/ve    | ar                    |              |               |            |        |           |              | (107) ÷       | (4) =   | 1 18      | (108)              |
| 92. Energy requirements - individual heating systems including micro-CHP           Space heats           Fraction of space heat from main system(s)           1 - (201)           Fraction of space heat from main system 1           (202) x (203)           Fraction of space heat from main system 1           (202) x (203)           Fraction of total space heat from main system 1           (202) x (203)           Fraction of total space heat from main system 1           (202) x (203)           Fraction of total space heat from main system 2           (202) x (203)           Fraction of total space heat from main system 1           (202) x (203)           Fraction of total space heat from main system 1           (202) x (203)           Fraction of total space heat from main system 1           (202) x (203)           Fraction of space heat from main system 1           (202) x (203)           Space heating fuel (main system 1), kWh/month           8033 25 6183.00 511111 2923.35 1417.61 0.00 0.00 0.00 0.00 3160.08 5765.99 8147.22 (211)           Water heating fuel, kWh/month           30.35 310.08 328.64 299.25 298.75 299.99 291.92 315.07 312.87 310.00 321.99 343.01 (219)           Space cooling fuel, kWh/month           0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0  | opuce coomig re     | quirement     | ,,,,,,       |                       |              |               |            |        |           |              | (10))         | (.,     | 1.10      | ] (100)            |
| Space heating <ul> <li></li></ul>   | 9a. Energy req      | uirements -   | individual   | heating sys           | tems inclu   | ding micro    | -CHP       |        |           |              |               |         |           |                    |
| Fraction of space heat from main system(s) <ul> <li></li></ul>  | Space heating       |               |              |                       |              |               |            |        |           |              |               |         |           |                    |
| Fraction of space heat from main system 1          1 - (201)         1.00         (202)         (1-(203))         1.00         (202)         (1-(203))         (1-(2  | Fraction of space   | e heat from   | secondary    | /supplemer            | ntary system | m (table 11   | L)         |        |           |              |               |         | 0.00      | (201)              |
| Fraction of space heat from main system 1   | Fraction of space   | e heat from   | main syste   | em(s)                 |              |               |            |        |           |              | 1 - (20       | 01) =   | 1.00      | (202)              |
| Fraction of total space heat from main system 1       (202) x [1-(203)] =       1.00       (204)         Fraction of total space heat from main system 2       (202) x (203) =       0.00       (205)         Efficiency of main system 1 (%)       93.90       (206)       4.05       (202) x (203) =       0.00       (205)         Space heating fuel (main system 1), kWh/month       10       Aug       Sep       Oct       Nov       Dec         Space heating fuel (main system 1), kWh/month       117.61       0.00       0.00       0.00       3160.08       5765.99       8147.12       (211)         Water heating       90.41       90.35       90.20       89.83       88.93       80.20       80.20       80.20       89.87       90.29       90.43       (217)         Water heating fuel, kWh/month       350.35       310.08       328.64       299.25       298.75       299.99       291.92       315.07       312.87       310.00       321.99       343.01       (219)         Space cooling fuel, kWh/month       2(219, 1   | Fraction of space   | e heat from   | main syste   | em 2                  |              |               |            |        |           |              |               |         | 0.00      | (202)              |
| Fraction of total space heat from main system 2 (202) $k$ (203) $=$ 0.00 (205)<br>Efficiency of main system 1 (%)<br>Cooling system energy efficiency ratio (Table 10c)<br>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec<br>Space heating fuel (main system 1), kWh/month<br>8033.25 6183.00 5111.11 2923.35 1417.61 0.00 0.00 0.00 0.00 3160.08 5765.99 8147.12<br>$\chi$ (211)15, 1012 = 40741.52 (211)<br>Water heating<br>Efficiency of water heater<br>Fficiency of water heater<br>0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0   | Fraction of total   | space heat    | from main    | svstem 1              |              |               |            |        |           | (20          | )2) x [1- (20 | 3)] =   | 1.00      | (204)              |
| Efficiency of main system 1 (%)<br>Cooling system energy efficiency ratio (Table 10c)<br>Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec<br>Space heating fuel (main system 1), kWh/month<br>8033.25 6 183.00 5 111.11 2923.35 1417.61 0.00 0.00 0.00 0.00 3160.08 5765.99 8147.12<br>(211)15, 1012 = 40741.52 (211)<br>Water heating<br>Efficiency of water heater<br>90.41 90.35 90.20 89.83 88.93 80.20 80.20 80.20 80.20 89.87 90.29 90.43 (217)<br>Water heating fuel, kWh/month<br>350.35 310.08 328.64 299.25 298.75 299.99 291.92 315.07 312.87 310.00 321.99 343.01<br>(219)<br>Space heating fuel, kWh/month<br>0.00 0.00 0.00 0.00 83.95 104.84 81.01 0.00 0.00 0.00 0.00 (221)<br>Space cooling fuel, kWh/month<br>0.00 0.00 0.00 0.00 0.00 83.95 104.84 81.01 0.00 0.00 0.00 (221)<br>Space cooling fuel, kWh/month<br>2(221)68 = 269.81 (221)<br>Annal totals<br>Space heating fuel - main system 1 40741.52<br>Space heating fuel - main system 1 40741.52<br>Space cooling fuel - main system 1 (30.00 (230c) (230 | Fraction of total   | space heat    | from main    | system 2              |              |               |            |        |           | <b>,</b>     | (202) x (20   | )3) =   | 0.00      | (205)              |
| Ansension 4 rule         2003 <td>Efficiency of ma</td> <td>in system 1</td> <td>(%)</td> <td>-,</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>(, (</td> <td></td> <td>93.90</td> <td>(206)</td>   | Efficiency of ma    | in system 1   | (%)          | -,                    |              |               |            |        |           |              | (, (          |         | 93.90     | (206)              |
| Cooling System Entropy Integrity  | Cooling system      | energy effic  | iency ratio  | (Table 10c)           |              |               |            |        |           |              |               |         | 4.05      | (200)              |
| Lin       Loi       May       Juit       <   | cooling system      | lan           | Eeb          | (Table 100)<br>Mar    | Apr          | May           | lun        | 1.1    | Δυσ       | Son          | Oct           | Nov     | 4.05      | ] (203)            |
| Space heating fuel (main system 1, kwn/monto)<br>8033.25 6183.00 5111.11 2923.35 1417.61 0.00 0.00 0.00 3160.08 5765.99 8147.12<br>[2(211)15, 1012 = 40741.52 (211)<br>Water heating<br>Efficiency of water heater<br>90.41 90.35 90.20 89.83 88.93 80.20 80.20 80.20 80.20 89.87 90.29 90.43 (217)<br>Water heating fuel, kWh/month<br>350.35 310.08 328.64 299.25 298.75 299.99 291.92 315.07 312.87 310.00 321.99 343.01<br>[2(219)]<br>Space cooling fuel, kWh/month<br>0.00 0.00 0.00 0.00 83.95 104.84 81.01 0.00 0.00 0.00 0.00<br>[2(221)68 = 269.81 (221)<br>Annual totals<br>Space heating fuel 269.81<br>Electricity for pumps, fans and electric keep-hot (Table 4f)<br>mechanical ventilation fans - balanced, extract or positive input from outside 2947.12 (230e)<br>central heating pump or water pump within warm air heating unit 30.00 (230c)<br>total electricity for the above, kWh/year<br>Electricity for the above, kWh/year<br>Electricity for fughting (Appendix L)<br>Total electricity for fughting (Appendix L)<br>Total electricity for aluses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>104. Fuel work (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel work (240)<br>105. Fuel price Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all uses (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all use (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all use (211)(221) + (231) + (232)(237b) = 49182.02 (238)<br>105. Fuel energy for all use (211)(221) + (231) + (232)(237b) = 49182.02   | Space beating fu    | Jan<br>Jan cu | reu          | iviai                 | дрі          | ividy         | Jun        | Jui    | Aug       | зер          | 001           | NOV     | Dec       |                    |
| $\begin{bmatrix} 833.25 & 6183.00 & 5111.11 & 292.35 & 141.761 & 0.00 & 0.00 & 0.00 & 0.00 & 3160.08 & 5765.99 & 814.712 \\ & & & & & & \\ & & & & & & \\ & & & & $   | space neating it    |               |              |                       | 2022.25      | 4447.64       | 0.00       | 0.00   | 0.00      | 0.00         | 24.62.02      |         | 0117.10   | Т                  |
| $ \sum_{(211)15, 1012 = 40741.52 (211) } Xuter heating Efficiency of water heater = 90.41 90.35 90.20 89.83 88.93 80.20 80.20 80.20 89.87 90.29 90.43 (217) Water heating fuel, kWh/month = 350.35 310.08 328.64 299.25 298.75 299.99 291.92 315.07 312.87 310.00 321.99 343.01 (219) = 3781.91 (230) (230$                                     |                     | 8033.25       | 6183.00      | 5111.11               | 2923.35      | 1417.61       | 0.00       | 0.00   | 0.00      | 0.00         | 3160.08       | 5765.99 | 8147.12   | ]                  |
| Water heating         Efficiency of water heater         90.41       90.35       90.20       89.83       88.93       80.20       80.20       80.20       89.87       90.29       90.43       (217)         Water heating fuel, kWh/month       350.35       310.08       328.64       299.25       298.75       299.99       291.92       315.07       312.87       310.00       321.99       343.01         Space cooling fuel, kWh/month       0.00       0   |                     |               |              |                       |              |               |            |        |           | Σ(21:        | 1)15, 10      | 12 = 4  | 0741.52   | ] (211)            |
| Efficiency of water heater         90.41       90.35       90.20       89.83       88.93       80.20       80.20       80.20       89.87       90.29       90.43       (217)         Water heating fuel, kWh/month         Space cooling fuel, kWh/month $\chi(219)$ Space cooling fuel, kWh/month $\chi(219)$ Space cooling fuel, kWh/month $\chi(219)$ $\chi(219)$ Annual totals         Space heating fuel - main system 1 $40741.52$ Month Cols         Space cooling fuel $40741.52$ Generating fuel $3781.91$ Space cooling fuel $40741.52$ Cool 0.00 0.00 0.00 $40741.52$ Month Colspan="4"> $2947.12$ $(230e)$ Generating fuel $3022.12       (230e)         Generating fuel       3022.12       (230e)         Generating fuel       3022.12       (230e) $  | Water heating       |               |              |                       |              |               |            |        |           |              |               |         |           |                    |
| $\begin{array}{ c c c c c c c c c c c c c c c c c c c$  | Efficiency of wat   | ter heater    |              |                       |              |               |            |        |           |              |               |         |           | -                  |
| Water heating fuel, kWh/month       310.08       328.64       299.25       298.75       299.99       291.92       315.07       312.87       310.00       321.99       343.01 $\Sigma$ (219)         Space cooling fuel, kWh/month       0.00 <td< td=""><td></td><td>90.41</td><td>90.35</td><td>90.20</td><td>89.83</td><td>88.93</td><td>80.20</td><td>80.20</td><td>80.20</td><td>80.20</td><td>89.87</td><td>90.29</td><td>90.43</td><td>(217)</td></td<>  |                     | 90.41         | 90.35        | 90.20                 | 89.83        | 88.93         | 80.20      | 80.20  | 80.20     | 80.20        | 89.87         | 90.29   | 90.43     | (217)              |
| 350.35       310.08       328.64       299.25       299.99       291.92       315.07       312.87       310.00       321.99       343.01         Σ(219a)112 =       3781.91       (219)         Space cooling fuel, kWh/month       0.00  | Water heating for   | uel, kWh/m    | onth         |                       |              |               |            |        |           |              |               |         |           | _                  |
| $\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$  |                     | 350.35        | 310.08       | 328.64                | 299.25       | 298.75        | 299.99     | 291.92 | 315.07    | 312.87       | 310.00        | 321.99  | 343.01    |                    |
| Space cooling fuel, kWh/month         0.00   |                     |               |              |                       |              |               |            |        |           |              | ∑(219a)1      | 12 =    | 3781.91   | (219)              |
| $\begin{array}{ c c c c c c c c c c c c c c c c c c c$  | Space cooling fu    | el, kWh/mo    | onth         |                       |              |               |            |        |           |              |               |         |           |                    |
| $ \sum \sum 269.81 (221) $ Annual totals $ \sum 269.81 (221) $ Annual totals $ \sum 269.81 (221) $ Water heating fuel - main system 1 $ 40741.52 $ Water heating fuel $ 3781.91 $ Space cooling fuel $ 269.81 $ Electricity for pumps, fans and electric keep-hot (Table 4f) mechanical ventilation fans - balanced, extract or positive input from outside $ 2947.12 $ (230a) (230c)  (230c)  boiler flue fan $ 30.00 $ (230c)  102a electricity for the above, kWh/year $ 3022.12 $ (231) Electricity for lighting (Appendix L) $ 1366.66 $ (232) $ 10a. Fuel costs - individual heating systems including micro-CHP  $ $ Fuel kWh/year     Fuel kWh/year     Fuel cost f/year     Space heating - main system 1     Autor     Autor $                            |                     | 0.00          | 0.00         | 0.00                  | 0.00         | 0.00          | 83.95      | 104.84 | 81.01     | 0.00         | 0.00          | 0.00    | 0.00      |                    |
| Annual totalsSpace heating fuel - main system 1 $40741.52$ Water heating fuel $3781.91$ Space cooling fuel $269.81$ Electricity for pumps, fans and electric keep-hot (Table 4f) $2947.12$ mechanical ventilation fans - balanced, extract or positive input from outside $2947.12$ central heating pump or water pump within warm air heating unit $30.00$ boiler flue fan $45.00$ Total electricity for the above, kWh/year $3022.12$ Electricity for lighting (Appendix L) $1366.66$ Total delivered energy for all uses $(211)(221) + (231) + (232)(237b) =$ 10a. Fuel costs - individual heating systems including micro-CHPFuel priceFuel kWh/year $5026 \text{ f.year}$ Space heating - main system 1 $40741.52$ X $3.48$ $X 0.01 =$ 1417.81(240)  |                     |               |              |                       |              |               |            |        |           |              | ∑(221)6.      | 8 =     | 269.81    | (221)              |
| Space heating fuel - main system 1 $40741.52$ Water heating fuel $3781.91$ Space cooling fuel $269.81$ Electricity for pumps, fans and electric keep-hot (Table 4f)(230a)mechanical ventilation fans - balanced, extract or positive input from outside $2947.12$ (230a)central heating pump or water pump within warm air heating unit $30.00$ (230c)boiler flue fan $45.00$ (230e)Total electricity for the above, kWh/year $3022.12$ (231)Electricity for lighting (Appendix L) $1366.66$ (232)Total delivered energy for all uses $(211)(221) + (231) + (232)(237b) =$ $49182.02$ (238)Ioa. Fuel costs - individual heating systems including micro-CHPFuel kWh/yearFuel kWh/yearFuel kWh/yearFuel costs f/yearSpace heating - main system 1 $40741.52$ x $3.48$ x 0.01 = $1417.81$ (240)   | Annual totals       |               |              |                       |              |               |            |        |           |              |               |         |           |                    |
| Water heating fuel       3781.91         Space cooling fuel       269.81         Electricity for pumps, fans and electric keep-hot (Table 4f)       (230a)         mechanical ventilation fans - balanced, extract or positive input from outside       2947.12       (230a)         central heating pump or water pump within warm air heating unit       30.00       (230c)         boiler flue fan       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel price       Fuel cost £/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)  | Space heating fu    | iel - main sy | vstem 1      |                       |              |               |            |        |           |              |               | 4       | 0741.52   | ]                  |
| Space cooling fuel       269.81         Electricity for pumps, fans and electric keep-hot (Table 4f)       (230c)         mechanical ventilation fans - balanced, extract or positive input from outside       2947.12       (230a)         central heating pump or water pump within warm air heating unit       30.00       (230c)         boiler flue fan       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel price       Fuel cost f/year       Cost f/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)   | Water heating f     | uel           |              |                       |              |               |            |        |           |              |               |         | 3781.91   | ]                  |
| Electricity for pumps, fans and electric keep-hot (Table 4f)       (230a)         mechanical ventilation fans - balanced, extract or positive input from outside       2947.12       (230a)         central heating pump or water pump within warm air heating unit       30.00       (230c)         boiler flue fan       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel kWh/year       Fuel price       Fuel cost f./year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)  | Space cooling fu    | el            |              |                       |              |               |            |        |           |              |               |         | 269.81    | ]                  |
| mechanical ventilation fans - balanced, extract or positive input from outside       2947.12       (230a)         central heating pump or water pump within warm air heating unit       30.00       (230c)         boiler flue fan       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel price       Fuel cost f/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)   | Electricity for pu  | imps. fans a  | nd electric  | keep-hot (1           | Table 4f)    |               |            |        |           |              |               | L       |           |                    |
| Internation rules buildneed, extract of positive input from buildneed       2347.12       (2004)         central heating pump or water pump within warm air heating unit       30.00       (230c)         boiler flue fan       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel price       Fuel costs f/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)   | mechanical v        | entilation f  | ans - halan  | ed extract            | or positive  | a input from  | n outside  |        | 2         | 9/7 12       | ]             |         |           | (230a)             |
| central nearing pump of water pump within warm an nearing unit       30.00       (230e)         boiler flue fan       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel kWh/year       Cost £/year       Cost £/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)  | central heati       |               | water num    | n within w            | arm air hea  | ting unit     | in outside |        |           | 30.00        | ]             |         |           | (230c)             |
| bolier rule ran       45.00       (230e)         Total electricity for the above, kWh/year       3022.12       (231)         Electricity for lighting (Appendix L)       1366.66       (232)         Total delivered energy for all uses       (211)(221) + (231) + (232)(237b) =       49182.02       (238)         10a. Fuel costs - individual heating systems including micro-CHP       Fuel price       Fuel cost £/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)  | beiler flue fe      | ng punip or   | water pun    |                       |              | iting unit    |            |        |           | 45.00        | ]             |         |           | (2300)             |
| Total electricity for the above, kWh/yearElectricity for lighting (Appendix L) $3022.12$ (231)Total delivered energy for all uses $(211)(221) + (231) + (232)(237b) = 49182.02$ (238)10a. Fuel costs - individual heating systems including micro-CHPFuel kWh/yearFuel kWh/yearFuel costs - individual heating systems including micro-CHPFuel kWh/yearFuel costs - individual heating systems including micro-CHPSpace heating - main system 140741.52x3.48x 0.01 =1417.81(240)  |                     | n<br>c.u.u    |              |                       |              |               |            |        |           | 45.00        |               |         |           | (230e)             |
| Liectricity for lighting (Appendix L)1366.66(232)Total delivered energy for all uses $(211)(221) + (231) + (232)(237b) =$ 49182.02(238)10a. Fuel costs - individual heating systems including micro-CHPFuel kWh/yearFuel price Fuel cost £/yearSpace heating - main system 140741.52x3.48x 0.01 =1417.81(240)   |                     | ior the abov  | ve, kvvn/ye  | ar                    |              |               |            |        |           |              |               |         | 3022.12   | _ (231)<br>] (232) |
| Total delivered energy for all uses $(211)(221) + (232)(237b) = 49182.02$ (238)         10a. Fuel costs - individual heating systems including micro-CHP         Fuel kWh/year         Fuel costs - fuel cost f/year         Space heating - main system 1  | Electricity for lig | hting (Appe   | endix L)     |                       |              |               |            |        |           |              |               |         | 1366.66   | ] (232)<br>] .     |
| 10a. Fuel costs - individual heating systems including micro-CHP         Fuel       Fuel price       Fuel cost £/year         Space heating - main system 1       40741.52       x       3.48       x 0.01 =       1417.81       (240)  | Total delivered e   | energy for a  | ll uses      |                       |              |               |            |        | (211)(221 | L) + (231) + | (232)(237     | /b) =4  | 9182.02   | J (238)            |
| Fuel     Fuel price     Fuel       kWh/year     cost £/year       Space heating - main system 1     40741.52     x     3.48     x 0.01 =     1417.81     (240)  | 10a. Fuel costs     | - individua   | l heating sv | /ste <u>ms incl</u> ı | uding micro  | о-С <u>НР</u> |            |        |           |              |               |         |           |                    |
| kWh/year     cost £/year       Space heating - main system 1     40741.52     x     3.48     x 0.01 =     1417.81     (240)   |                     |               |              |                       |              |               | Fuel       |        | Fu        | el price     |               |         | Fuel      |                    |
| Space heating - main system 1 $40741.52$ x $3.48$ x $0.01 = 1417.81$ (240)  |                     |               |              |                       |              | k\            | Wh/year    |        |           |              |               | cc      | st £/year |                    |
|   | Space heating -     | main systen   | n 1          |                       |              | 4             | 0741.52    | ] x    |           | 3.48         | ) x 0.01      | =       | 1417.81   | (240)              |

NHER Plan Assessor version 6.3.4

131.61

(247)

х

3.48

x 0.01 =

3781.91

Water heating

| Space cooling   | 269.81  | ] x | 13.19        | x 0.01 =       | 35.59   | (248) |
|---|---------|-----|--------------|----------------|---------|-------|
| Pumps and fans  | 3022.12 | x   | 13.19        | x 0.01 =       | 398.62  | (249) |
| Electricity for lighting  | 1366.66 | x   | 13.19        | x 0.01 =       | 180.26  | (250) |
| Additional standing charges                                     |         |     |              |                | 120.00  | (251) |
| Total energy cost   |         |     | (240)(242) - | + (245)(254) = | 2283.88 | (255) |
|   |         |     |              |                |         |       |
| 11a. SAP rating - individual heating systems including micro-CH | Р       |     |              |                |         |       |
| Energy cost deflator (Table 12)                                 |         |     |              |                | 0.42    | (256) |
| Energy cost factor (ECF)  |         |     |              |                | 0.99    | (257) |
| SAP value   |         |     |              |                | 86.19   |       |
| SAP rating (section 13)   |         |     |              |                | 86      | (258) |
| SAP band  |         |     |              |                | D       | 7     |
|   |         |     |              |                | D       |       |

| 12a. CO2 emissions - individual heating systems | s including micro-CHP |   |                               |                  |                                       |       |
|---|-----------------------|---|-------------------------------|------------------|---------------------------------------|-------|
|   | Energy<br>kWh/year    |   | Emission factor<br>kg CO₂/kWh |                  | Emissions<br>kg CO <sub>2</sub> /year |       |
| Space heating - main system 1                   | 40741.52              | x | 0.216                         | = [              | 8800.17                               | (261) |
| Water heating                                   | 3781.91               | x | 0.216                         | = [              | 816.89                                | (264) |
| Space and water heating                         |                       |   | (261) + (262) + (             | 263) + (264) = [ | 9617.06                               | (265) |
| Space cooling                                   | 269.81                | x | 0.519                         | = [              | 140.03                                | (266) |
| Pumps and fans                                  | 3022.12               | x | 0.519                         | = [              | 1568.48                               | (267) |
| Electricity for lighting                        | 1366.66               | x | 0.519                         | = [              | 709.30                                | (268) |
| Total CO <sub>2</sub> , kg/year                 |                       |   |                               | (265)(271) = [   | 12034.87                              | (272) |
| Dwelling CO <sub>2</sub> emission rate          |                       |   |                               | (272) ÷ (4) = [  | 13.03                                 | (273) |
| El value  |                       |   |                               | [                | 83.36                                 |       |
| El rating (section 14)                          |                       |   |                               | [                | 83                                    | (274) |
| EI band   |                       |   |                               | [                | В                                     |       |
|   |                       |   |                               |                  |                                       |       |

|  | Energy<br>kWh/year |   | Primary factor  |                 | Primary Energy<br>kWh/year | ,     |
|--|--------------------|---|-----------------|-----------------|----------------------------|-------|
| Space heating - main system 1            | 40741.52           | x | 1.22            | ] =             | 49704.66                   | (261) |
| Water heating                            | 3781.91            | x | 1.22            | =               | 4613.93                    | (264) |
| Space and water heating                  |                    |   | (261) + (262) + | (263) + (264) = | 54318.58                   | (265) |
| Space cooling                            | 269.81             | x | 3.07            | =               | 828.30                     | (266) |
| Pumps and fans                           | 3022.12            | x | 3.07            | =               | 9277.92                    | (267) |
| Electricity for lighting                 | 1366.66            | x | 3.07            | =               | 4195.65                    | (268) |
| Primary energy kWh/year                  |                    |   |                 |                 | 68620.46                   | (272) |
| Dwelling primary energy rate kWh/m2/year |                    |   |                 |                 | 74.27                      | (273) |
|  |                    |   |                 |                 |                            |       |
|  |                    |   |                 |                 |                            |       |
|  |                    |   |                 |                 |                            |       |
|  |                    |   |                 |                 |                            |       |

**3 KIDDERPORE AVENUE** 3 KIDDERPORE AVENUE **SUSTAINABILITY** ENERGY AND SUSTAINABILITY DOCUMENT – REV. 01

Appendix C: Roof Layout.

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| General Notes: |
|----------------|
|----------------|

Report all errors, omissions and discrepancies.

Verify all dimensions on site before commencing any work on site or preparing any shop drawings.

All materials, components and workmanship are to comply with the relevant British Standarts, Codes of Practice and appropriate manufacturers' recommendations that from time to time shall apply.

this drawing and design remains the property of SIAW and may not be

NOTES NB: BASEMENT AND LANDSCAPING AS PER PLANNING CONSENT 2013/3641/P

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| scale<br>1:50      | DATE<br>02.06.2016                      | DRAWN<br>AW      | CHECKED<br>IS                  | PROJECT TITLE 3 KIDDERPORE AVENUE  |
|                    |   |                  |                                |  |

**3 KIDDERPORE AVENUE** 3 KIDDERPORE AVENUE **SUSTAINABILITY** ENERGY AND SUSTAINABILITY DOCUMENT – REV. 01

Appendix D: Be Green DER Worksheet.

17

# DER Worksheet Design - Draft



This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

| Assessor name                | Mr Robe          | rt Coffey                |                      |               |                    |                                | As             | ssessor num              | ıber             | 99      |                       |                  |
|------------------------------|------------------|--------------------------|----------------------|---------------|--------------------|--------------------------------|----------------|--------------------------|------------------|---------|-----------------------|------------------|
| Client                       |                  |                          |                      |               |                    |                                | La             | ist modified             |                  | 13/04   | /2018                 |                  |
| Address                      | 3 Kidder         | pore Avenu               | e. London.           | NW3 7SX       |                    |                                |                |                          |                  |         |                       |                  |
|                              |                  |                          | -,,                  |               |                    |                                |                |                          |                  |         |                       |                  |
| 1. Overall dwelling dim      | ensions          |                          |                      |               |                    |                                |                |                          |                  |         |                       |                  |
|                              |                  |                          |                      | A             | rea (m²)           |                                | Ave<br>he      | rage storey<br>eight (m) |                  | Vo      | lume (m³)             |                  |
| Lowest occupied              |                  |                          |                      |               | 355.42             | ](1a) x                        |                | 3.70                     | ] (2a) =         |         | 1315.05               | (3a)             |
| +1                           |                  |                          |                      |               | 295.45             | ](1b) x                        |                | 3.50                     | (2b) =           |         | 1034.08               | (3b)             |
| +2                           |                  |                          |                      |               | 273.01             | ] (1c) x                       |                | 3.60                     | ] (2c) =         |         | 982.84                | (3c)             |
| Total floor area             | (1a)             | + (1b) + (1              | c) + (1d)(           | 1n) =         | 923.88             | (4)                            |                |                          |                  |         |                       |                  |
| Dwelling volume              |                  |                          |                      |               |                    |                                | (3a)           | ) + (3b) + (3            | c) + (3d)(3      | 3n) =   | 3331.97               | <b>(5)</b>       |
| 2. Ventilation rate          |                  |                          |                      |               |                    |                                |                |                          |                  |         |                       |                  |
|                              |                  |                          |                      |               |                    |                                |                |                          |                  | m       | <sup>3</sup> per hour |                  |
| Number of chimneys           |                  |                          |                      |               |                    |                                |                | 0                        | ] x 40 =         | -       | 0                     | (6a)             |
| Number of open flues         |                  |                          |                      |               |                    |                                |                | 0                        | ] x 20 =         | -       | 0                     | (6b)             |
| Number of intermittent       | ans              |                          |                      |               |                    |                                |                | 0                        | ] x 10 =         | -       | 0                     | (7a)             |
| Number of passive vents      |                  |                          |                      |               |                    |                                |                | 0                        | ] x 10 =         | -       | 0                     | (7b)             |
| Number of flueless gas fi    | res              |                          |                      |               |                    |                                |                | 0                        | ] x 40 =         | -       | 0                     | (7c)             |
|                              |                  |                          |                      |               |                    |                                |                |                          |                  | Air     | changes pe            | r                |
| Infiltration due to chimp    | ove fluos for    | c DSV/c                  |                      | (62)          | $\pm (6b) \pm (7)$ | (7b) + (7b) + (7b)             | 7c) -          | 0                        | ) <u>+ (5)</u> - |         | <b>nour</b>           | (٥)              |
| If a prossurisation tost b   | eys, nues, ian   | s, PSVs<br>d out or is i | ntandad n            | (ba)          | + (00) + (76       | a) + (70) + (<br>viso continuu | f(r) =         | to (16)                  | ] ÷(5)·          | - [     | 0.00                  | _ (0)            |
| Air pormobility value a      | 50 ovprossod     | in cubic m               | ntenueu, pi          |               | aro motro          | of onvolong                    | - 110111 (7) 1 | 10 (10)                  |                  |         | 2 00                  | (17)             |
| If based on air permeability | ity value the    | (18) = [(1)]             | $7) \pm 201 \pm (9)$ | a) otherwis   | (18) - (16)        |                                |                |                          |                  |         | 0.15                  | (12)             |
| Number of sides on which     | h the dwellin    | n (10) – [(1             | , , , , 20] , (t     | s), otherwis  | 50 (10) - (10      | 0)                             |                |                          |                  |         |                       | (10)<br>(10)     |
| Shelter factor               | in the dwelling  | g is sheller             | u                    |               |                    |                                |                | 1 -                      | [0 075 v (1      | a)1 – [ | 1.00                  | (20)             |
| Infiltration rate incorpor   | ating shalter f  | actor                    |                      |               |                    |                                |                | 1-                       | (18) v (1        | 20) - [ | 0.15                  | _ (20)<br>_ (21) |
| Infiltration rate modified   | for monthly      | wind speed               |                      |               |                    |                                |                |                          | (10) × (         | 20) =   | 0.15                  | _ (21)           |
| Jan                          | Feb              | Mar                      | Apr                  | May           | Jun                | Jul                            | Aug            | Sep                      | Oct              | Nov     | Dec                   |                  |
| Monthly average wind sp      | beed from Tak    | ole U2                   |                      |               |                    |                                | Ū              |                          |                  |         |                       |                  |
| 5.10                         | 5.00             | 4.90                     | 4.40                 | 4.30          | 3.80               | 3.80                           | 3.70           | 4.00                     | 4.30             | 4.50    | 4.70                  | (22)             |
| Wind factor (22)m ÷ 4        | !                |                          |                      |               |                    |                                |                | 4                        |                  |         |                       |                  |
| 1.28                         | 1.25             | 1.23                     | 1.10                 | 1.08          | 0.95               | 0.95                           | 0.93           | 1.00                     | 1.08             | 1.13    | 1.18                  | (22a)            |
| Adjusted infiltration rate   | (allowing for    | shelter and              | wind facto           | or) (21) x (2 | 2a)m               |                                |                | •                        |                  |         | -                     |                  |
| 0.19                         | 0.19             | 0.18                     | 0.17                 | 0.16          | 0.14               | 0.14                           | 0.14           | 0.15                     | 0.16             | 0.17    | 0.18                  | (22b)            |
| Calculate effective air ch   | ange rate for    | the applica              | ble case:            | •             |                    |                                |                |                          |                  |         |                       |                  |
| If mechanical ventilat       | ion: air chang   | e rate thro              | ugh system           | I             |                    |                                |                |                          |                  |         | 0.50                  | (23a)            |
| If balanced with heat        | recovery: effi   | ciency in %              | allowing fo          | or in-use fa  | ctor from T        | able 4h                        |                |                          |                  |         | 76.50                 | (23c)            |
| a) If balanced mechar        | nical ventilatio | on with hea              | t recovery           | (MVHR) (22    | 2b)m + (23t        | o) x [1 - (23d                 | c) ÷ 100]      |                          |                  |         |                       | _                |
| 0.31                         | 0.31             | 0.30                     | 0.28                 | 0.28          | 0.26               | 0.26                           | 0.26           | 0.27                     | 0.28             | 0.29    | 0.29                  | (24a)            |



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

| Lifective all cli | 0.31                                   | 0.31                    | 0.30          | 0.28                         | 0.28                       | 0.26         | 0.26       | 0.26             | 0.27          | 0.28                 | 0.29            | 0.29         | (25)        |
|-------------------|--|-------------------------|---------------|------------------------------|----------------------------|--------------|------------|------------------|---------------|----------------------|-----------------|--------------|-------------|
|                   |  | 0.01                    | 0.00          | 0.20                         | 0.20                       | 0.20         | 0.20       | 0.20             | 0.27          | 0.20                 | 0.20            | 0.20         | ] (==)      |
| 3. Heat losses    | and heat lo                            | ss paramet              | ter           |                              |                            |              |            |                  |               |                      |                 |              |             |
| Element           |  |                         | а             | Gross<br>rea, m <sup>2</sup> | Openings<br>m <sup>2</sup> | s Net<br>A,  | area<br>m² | U-value<br>W/m²K | A x U W       | //К к-\<br>kJ,       | /alue,<br>/m².K | Ахк,<br>kJ/K |             |
| Window            |  |                         |               |                              |                            | 183          | 8.02 x     | 1.33             | = 242.64      | 4                    |                 |              | (27)        |
| Roof window       |  |                         |               |                              |                            | 24           | .55 x      | 1.33             | = 32.55       | <br>;                |                 |              | (27a)       |
| Door              |  |                         |               |                              |                            | 4.           | 81 x       | 1.40             | = 6.73        |                      |                 |              | (26)        |
| Ground floor      |  |                         |               |                              |                            | 355          | 5.42 x     | 0.10             | = 35.54       | ŀ                    |                 |              | (28a)       |
| External wall     |  |                         |               |                              |                            | 611          | .35 x      | 0.15             | = 91.70       | )                    |                 |              | (29a)       |
| Roof              |  |                         |               |                              |                            | 327          | 7.01 x     | 0.10             | = 32.70       | )                    |                 |              | (30)        |
| Total area of ex  | xternal elem                           | ents ∑A, m <sup>2</sup> | 2             |                              |                            | 150          | 6.16       |                  |               |                      |                 |              | (31)        |
| Fabric heat los   | s, W/K = ∑(A                           | × U)                    |               |                              |                            |              |            |                  | (26           | 5)(30) + (           | 32) =           | 441.87       | (33)        |
| Heat capacity (   | Cm = ∑(А x к)                          | )                       |               |                              |                            |              |            | (28)             | (30) + (32) - | + (32a)(3            | 2e) =           | N/A          | (34)        |
| Thermal mass      | parameter (1                           | ՐMP) in kJ/ı            | m²K           |                              |                            |              |            |                  |               |                      |                 | 100.00       | (35)        |
| Thermal bridge    | es: Σ(L x Ψ) c                         | alculated u             | sing Appen    | dix K                        |                            |              |            |                  |               |                      |                 | 225.92       | (36)        |
| Total fabric hea  | at loss                                |                         |               |                              |                            |              |            |                  |               | (33) + (             | 36) =           | 667.79       | (37)        |
|                   | Jan                                    | Feb                     | Mar           | Apr                          | May                        | Jun          | Jul        | Aug              | Sep           | Oct                  | Nov             | Dec          |             |
| Ventilation hea   | at loss calcula                        | ated month              | nly 0.33 x (2 | 25)m x (5)                   |                            |              |            |                  |               |                      |                 |              | -           |
|                   | 339.49                                 | 335.36                  | 331.24        | 310.62                       | 306.50                     | 285.88       | 285.88     | 281.76           | 294.13        | 306.50               | 314.75          | 322.99       | (38)        |
| Heat transfer c   | oefficient, W                          | V/K (37)m·              | + (38)m       | 1                            |                            |              |            | _                |               |                      | i               | 1            | ,           |
|                   | 1007.28                                | 1003.15                 | 999.03        | 978.41                       | 974.29                     | 953.67       | 953.67     | 949.55           | 961.92        | 974.29               | 982.54          | 990.78       | ]           |
|                   | . (                                    |                         |               |                              |                            |              |            |                  | Average = 2   | <u>s</u> (39)112,    | /12 =           | 977.38       | (39)        |
| Heat loss parar   | meter (HLP),                           | W/m²K (39               | 9)m ÷ (4)     |                              |                            |              |            |                  |               |                      |                 |              | 1           |
|                   | 1.09                                   | 1.09                    | 1.08          | 1.06                         | 1.05                       | 1.03         | 1.03       | 1.03             | 1.04          | 1.05                 | 1.06            | 1.07         | ]           |
| Number of dou     | ······································ |                         |               |                              |                            |              |            |                  | Average = 2   | <u>&gt;(</u> 40)112, | /12 =           | 1.06         | ] (40)      |
| Number of day     |  |                         | 21.00         | 20.00                        | 21.00                      | 20.00        | 21.00      | 21.00            | 20.00         | 21.00                | 20.00           | 21.00        |             |
|                   | 31.00                                  | 28.00                   | 31.00         | 30.00                        | 31.00                      | 30.00        | 31.00      | 31.00            | 30.00         | 31.00                | 30.00           | 31.00        | ] (40)      |
| 4. Water heat     | ting energy r                          | equiremen               | it            |                              |                            |              |            |                  |               |                      |                 |              |             |
| Assumed occup     | pancy, N                               |                         |               |                              |                            |              |            |                  |               |                      |                 | 3.94         | (42)        |
| Annual average    | e hot water ເ                          | usage in litr           | es per day    | Vd,average                   | = (25 x N) +               | - 36         |            |                  |               |                      |                 | 127.85       | (43)        |
|                   | Jan                                    | Feb                     | Mar           | Apr                          | May                        | Jun          | Jul        | Aug              | Sep           | Oct                  | Nov             | Dec          |             |
| Hot water usag    | ge in litres pe                        | er day for e            | ach month     | Vd,m = fact                  | or from Tak                | ole 1c x (43 | )          |                  |               |                      |                 |              |             |
|                   | 140.63                                 | 135.52                  | 130.40        | 125.29                       | 120.17                     | 115.06       | 115.06     | 120.17           | 125.29        | 130.40               | 135.52          | 140.63       | ]           |
|                   |  |                         |               |                              |                            |              |            |                  |               | ∑(44)1               | .12 =           | 1534.15      | (44)        |
| Energy content    | t of hot wate                          | er used = 4.            | 18 x Vd,m x   | x nm x Tm/3                  | 600 kWh/n                  | nonth (see   | Tables 1b, | 1c 1d)           |               |                      |                 |              |             |
|                   | 208.55                                 | 182.40                  | 188.22        | 164.09                       | 157.45                     | 135.87       | 125.90     | 144.48           | 146.20        | 170.38               | 185.99          | 201.97       | ]           |
|                   |  |                         |               |                              |                            |              |            |                  |               | ∑(45)1               | .12 =           | 2011.51      | (45)        |
| Distribution los  | s 0.15 x (45                           | )m                      |               |                              |                            |              |            |                  |               |                      |                 | _            | _           |
|                   | 31.28                                  | 27.36                   | 28.23         | 24.61                        | 23.62                      | 20.38        | 18.89      | 21.67            | 21.93         | 25.56                | 27.90           | 30.30        | (46)        |
| Storage volume    | e (litres) incl                        | uding any s             | olar or WW    | /HRS storag                  | e within sar               | me vessel    |            |                  |               |                      |                 | 1000.00      | (47)        |
| Water storage     | loss:                                  |                         |               |                              |                            |              |            |                  |               |                      |                 |              |             |
| b) Manufacture    | er's declared                          | l loss factor           | is not know   | wn                           |                            |              |            |                  |               |                      |                 |              | 1           |
| Hot water s       | torage loss f                          | actor from              | Table 2 (kV   | Vh/litre/day                 | ()                         |              |            |                  |               |                      |                 | 0.01         | <b>(51)</b> |
| Volume fac        | tor from Tab                           | le 2a                   |               |                              |                            |              |            |                  |               |                      |                 | 0.49         | <b>(52)</b> |
| Temperatur        | re factor fror                         | m Table 2b              |               |                              |                            |              |            |                  |               |                      |                 | 0.54         | (53)        |
| Energy lost       | from water :                           | storage (kV             | /h/day) (47   | 7) x (51) x (5               | 52) x (53)                 |              |            |                  |               |                      |                 | 2.74         | (54)        |

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

South

West

Horizontal

```
(55)
2.74
```

| Water storage loss calculated for eac  | h month (55) x (41)m      |                                  |                                |   |                                  |                              |                           |
|--|---------------------------|----------------------------------|--------------------------------|---|----------------------------------|------------------------------|---------------------------|
| 84.95 76.73                            | 84.95 82.21               | 84.95 82.21                      | 84.95                          | 84.95 8                                 | 82.21 84.                        | .95 82.21                    | 84.95 <mark>(56)</mark>   |
| If the vessel contains dedicated solar | storage or dedicated W    | /WHRS (56)m x [(47               | ) - Vs] ÷ (47),                | else (56)                               |                                  |                              |                           |
| 84.95 76.73                            | 84.95 82.21               | 84.95 82.21                      | 84.95                          | 84.95 8                                 | 82.21 84.                        | .95 82.21                    | 84.95 <b>(57)</b>         |
| Primary circuit loss for each month fr | om Table 3                |                                  |                                |   |                                  |                              |                           |
| 23.26 21.01                            | 23.26 22.51               | 23.26 22.51                      | 23.26                          | 23.26                                   | 22.51 23.                        | .26 22.51                    | 23.26 <b>(59)</b>         |
| Combi loss for each month from Tabl    | e 3a, 3b or 3c            |                                  |                                |   |                                  |                              |                           |
| 0.00 0.00                              | 0.00 0.00                 | 0.00 0.00                        | 0.00                           | 0.00                                    | 0.00 0.0                         | 0.00                         | 0.00 (61)                 |
| Total heat required for water heating  | calculated for each mo    | onth  0.85 x (45)m +             | (46)m + (57)r                  | n + (59)m + (63                         | 1)m                              |                              |                           |
| 316.76 280.14                          | 296.43 268.82             | 265.67 240.59                    | 9 234.12                       | 252.69 2                                | 50.92 278                        | 3.60 290.71                  | 310.18 <mark>(62)</mark>  |
| Solar DHW input calculated using App   | oendix G or Appendix H    |                                  |                                |   |                                  |                              |                           |
| 0.00 0.00                              | 0.00 0.00                 | 0.00 0.00                        | 0.00                           | 0.00                                    | 0.00 0.0                         | 0.00                         | 0.00 (63)                 |
| Output from water heater for each m    | onth (kWh/month) (62      | 2)m + (63)m                      |                                |   |                                  |                              |                           |
| 316.76 280.14                          | 296.43 268.82             | 265.67 240.59                    | 9 234.12                       | 252.69 2                                | 50.92 278                        | .60 290.71                   | 310.18                    |
|  |                           |                                  |                                |   | Σ(6                              | 54)112 = 3                   | 285.63 <mark>(64)</mark>  |
| Heat gains from water heating (kWh/    | /month) 0.25 × [0.85 ×    | (45)m + (61)m] + 0.8             | 8 × [(46)m + (5                | 57)m + (59)m]                           |                                  |                              |                           |
| 155.91 138.84                          | 149.15 138.34             | 138.92 128.9                     | 5 128.43                       | 134.61 1                                | .32.39 143                       | .22 145.62                   | 153.73 <mark>(65)</mark>  |
|  |                           |                                  |                                |   |                                  |                              |                           |
| 5. Internal gains                      |                           |                                  |                                |   |                                  |                              | _                         |
| Jan Feb                                | Mar Apr                   | May Jun                          | Jul                            | Aug                                     | Sep O                            | ct Nov                       | Dec                       |
| Metabolic gains (Table 5)              |                           |                                  |                                |   |                                  |                              |                           |
| 197.15 197.15                          | 197.15 197.15             | 197.15 197.15                    | 5 197.15                       | 197.15 1                                | .97.15   197                     | 197.15 197.15                | 197.15 (66)               |
| Lighting gains (calculated in Appendix | ( L, equation L9 or L9a), | also see Table 5                 | _                              |   | ·                                |                              | ·                         |
| 77.39 68.73                            | 55.90 42.32               | 31.63 26.71                      | 28.86                          | 37.51                                   | 50.35 63.                        | .92 74.61                    | 79.54 <mark>(67)</mark>   |
| Appliance gains (calculated in Append  | dix L, equation L13 or L  | 13a), also see Table             | 5                              |   |                                  |                              |                           |
| 868.04 877.04                          | 854.35 806.02             | 745.02 687.69                    | 9 649.39                       | 640.39 6                                | 63.08 711                        | 41 772.41                    | 829.74 <mark>(68)</mark>  |
| Cooking gains (calculated in Appendix  | < L, equation L15 or L15  | a), also see Table 5             |                                | I I                                     |                                  |                              |                           |
| 42.71 42.71                            | 42.71 42.71               | 42.71 42.71                      | 42.71                          | 42.71                                   | 42.71 42.                        | .71 42.71                    | 42.71 (69)                |
| Pump and fan gains (Table 5a)          | _                         |                                  | _                              | i i                                     | i                                |                              |                           |
| 3.00 3.00                              | 3.00 3.00                 | 3.00 3.00                        | 3.00                           | 3.00                                    | 3.00 3.0                         | 00 3.00                      | 3.00 (70)                 |
| Losses e.g. evaporation (Table 5)      |                           |                                  |                                | 1                                       |                                  |                              |                           |
| -157.72 -157.72                        | -157.72 -157.72           | -157.72 -157.7                   | 2 -157.72                      | -157.72 -1                              | 157.72 -157                      | 7.72 -157.72                 | -157.72 <mark>(71)</mark> |
| Water heating gains (Table 5)          |                           |                                  |                                |   |                                  |                              |                           |
| 209.56 206.61                          | 200.48 192.14             | 186.73 179.10                    | ) 172.63                       | 180.93 1                                | .83.87 192                       | .50 202.25                   | 206.62 (72)               |
| Total internal gains (66)m + (67)m +   | (68)m + (69)m + (70)m     | + (71)m + (72)m                  |                                |   |                                  |                              |                           |
| 1240.13 1237.53                        | 1195.86 1125.62           | 1048.53 978.65                   | 5 936.02                       | 943.97 9                                | 82.45 1052                       | 2.98 1134.41                 | 1201.04 (73)              |
| 6. Solar gains                         |                           |                                  |                                |   |                                  |                              |                           |
|  |                           |                                  |                                |   |                                  |                              |                           |
|  | Access factor             | Area                             | Solar flux                     | σ                                       |                                  | FF                           | Gains                     |
|  | Access factor<br>Table 6d | Area S<br>m²                     | olar flux<br>W/m²              | g<br>specific                           | data spe                         | FF<br>cific data             | Gains<br>W                |
|  | Access factor<br>Table 6d | Area S<br>m²                     | olar flux<br>W/m²              | g<br>specific<br>or Table               | data spe<br>e 6b or <sup>-</sup> | FF<br>cific data<br>Table 6c | Gains<br>W                |
| North                                  | Access factor<br>Table 6d | Area 5<br>m <sup>2</sup> 55.57 x | Solar flux<br>W/m <sup>2</sup> | g<br>specific<br>or Table<br>0.9 x 0.60 | data spe<br>e 6b or<br>) x       | FF<br>cific data<br>Table 6c | Gains<br>W<br>171.99 (74) |

0.77 74.66 46.75 x 0.9 x 0.60 0.70 = 1015.95 (78) х х х 0.77 16.97 19.64 x 0.9 x 0.60 0.70 97.01 (80) х х х = 1.00 24.55 26.00 x 0.9 x 0.60 0.70 241.28 х х х = Solar gains in watts ∑(74)m...(82)m 1730.99 3083.98 7330.76 7002.40 6149.32 5083.42 3498.83 4541.03 6102.42 7224.09 2098.93 1464.29 (83) Total gains - internal and solar (73)m + (83)m

|                     | 2971.11        | 4321.51      | 5736.89        | 7228.04      | 8272.62                   | 8309.41     | 7938.42                 | 7093.29 | 6065.87 | 4551.81     | 3233.33  | 2665.33  | (84)  |
|---------------------|----------------|--------------|----------------|--------------|---------------------------|-------------|-------------------------|---------|---------|-------------|----------|----------|-------|
| 7. Mean intern      | al tempera     | ture (heati  | ing season)    |              |                           |             |                         |         |         |             |          |          |       |
| Temperature du      | ring heating   | g periods ir | n the living a | area from T  | able 9, Th1               | .(°C)       |                         |         |         |             |          | 21.00    | (85)  |
|                     | Jan            | Feb          | Mar            | Apr          | May                       | Jun         | Jul                     | Aug     | Sep     | Oct         | Nov      | Dec      |       |
| Utilisation facto   | r for gains f  | or living ar | ea n1,m (se    | e Table 9a)  |                           |             |                         |         |         |             |          |          |       |
|                     | 0.99           | 0.98         | 0.95           | 0.88         | 0.77                      | 0.62        | 0.48                    | 0.54    | 0.77    | 0.94        | 0.99     | 0.99     | (86)  |
| Mean internal te    | emp of livin   | g area T1 (s | steps 3 to 7   | in Table 90  | <br>;)                    |             | 1                       | 1       |         | 1           | 1        |          |       |
|                     | 18.85          | 19.13        | . 19.56        | 20.08        | 20.49                     | 20.75       | 20.85                   | 20.83   | 20.60   | 20.02       | 19.34    | 18.82    | (87)  |
| Temperature du      | ring heating   | g periods ir | the rest of    | f dwelling f | rom Table 9               | ). Th2(°C)  | 20.00                   |         |         |             |          | 10.02    | (0.7  |
|                     | 20.01          | 20.01        | 20.02          | 20.03        | 20.04                     | 20.06       | 20.06                   | 20.06   | 20.05   | 20.04       | 20.03    | 20.02    | (88)  |
| Litilisation factor | r for gains f  | or rest of d | welling n2     | m            | 20.04                     | 20.00       | 20.00                   | 20.00   | 20.05   | 20.04       | 20.05    | 20.02    | (00)  |
| othisation factor   |                |              |                | 0.96         | 0.72                      | 0.55        | 0.20                    | 0.45    | 0.71    | 0.02        | 0.08     | 0.00     | (20)  |
|                     | 0.99           | 0.98         |                |              | 0.73                      | U.55        | 0.39                    | 0.45    | 0.71    | 0.92        | 0.98     | 0.99     | (89)  |
| Mean Internal te    | emperature     | in the rest  | toraweiling    |              | steps 3 to                |             |                         |         |         |             |          |          | ()    |
|                     | 17.07          | 17.49        | 18.11          | 18.87        | 19.43                     | 19.78       | 19.88                   | 19.86   | 19.60   | 18.80       | 17.80    | 17.03    | (90)  |
| Living area fract   | ion            |              |                |              |                           |             |                         |         | Liv     | ving area ÷ | (4) =    | 0.20     | (91)  |
| Mean internal te    | emperature     | for the wh   | nole dwellin   | g fLA x T1 + | +(1 - fLA) x <sup>-</sup> | Г2          |                         |         |         | 1           | -        |          |       |
|                     | 17.42          | 17.82        | 18.40          | 19.11        | 19.64                     | 19.97       | 20.07                   | 20.05   | 19.80   | 19.04       | 18.11    | 17.39    | (92)  |
| Apply adjustmer     | nt to the me   | ean interna  | l temperatu    | ure from Ta  | ble 4e whe                | ere appropr | iate                    |         |         |             |          |          |       |
|                     | 17.27          | 17.67        | 18.25          | 18.96        | 19.49                     | 19.82       | 19.92                   | 19.90   | 19.65   | 18.89       | 17.96    | 17.24    | (93)  |
| 0 Correction        | · · · · ·      |              |                |              |                           |             |                         |         |         |             |          |          |       |
| 8. Space neating    | ig requirem    |              |                | -            |                           |             |                         |         |         | • •         |          | _        |       |
|                     | Jan            | Feb          | Mar            | Apr          | Мау                       | Jun         | Jul                     | Aug     | Sep     | Oct         | Nov      | Dec      |       |
| Utilisation factor  | r for gains, i | ηm           | 1              |              | 1                         |             |                         |         | V       |             | 1        | ,        |       |
|                     | 0.99           | 0.96         | 0.92           | 0.83         | 0.70                      | 0.53        | 0.38                    | 0.44    | 0.69    | 0.90        | 0.97     | 0.99     | (94)  |
| Useful gains, ηm    | 1Gm, W (94     | 4)m x (84)m  | ו              |              |                           |             |                         |         |         |             |          |          |       |
|                     | 2928.77        | 4167.27      | 5284.28        | 6029.49      | 5803.92                   | 4421.69     | 3016.41                 | 3103.17 | 4166.01 | 4089.24     | 3146.88  | 2636.66  | (95)  |
| Monthly average     | e external t   | emperatur    | e from Tabl    | e U1         |                           |             |                         |         |         |             |          |          |       |
|                     | 4.30           | 4.90         | 6.50           | 8.90         | 11.70                     | 14.60       | 16.60                   | 16.40   | 14.10   | 10.60       | 7.10     | 4.20     | (96)  |
| Heat loss rate fo   | or mean inte   | ernal tempe  | erature, Lm    | , W [(39)m   | n x [(93)m -              | (96)m]      |                         |         |         |             |          |          |       |
|                     | 13067.50       | 12806.91     | 11735.00       | 9842.03      | 7593.08                   | 4978.35     | 3167.09                 | 3327.73 | 5338.47 | 8077.57     | 10666.70 | 12919.12 | (97)  |
| Space heating re    | equirement,    | , kWh/mor    | nth 0.024 x    | [(97)m - (9  | 5)m] x (41)               | m           |                         |         |         |             |          |          |       |
|                     | 7543.22        | 5805.84      | 4799.33        | 2745.03      | 1331.14                   | 0.00        | 0.00                    | 0.00    | 0.00    | 2967.32     | 5414.27  | 7650.15  |       |
|                     |                |              |                |              |                           |             |                         |         | ∑(98    | 3)15, 10    | .12 = 3  | 8256.29  | (98)  |
| Space heating re    | equirement     | kWh/m²/y     | ear            |              |                           |             |                         |         |         | (98)        | ÷ (4)    | 41.41    | (99)  |
|                     |                |              |                | _            |                           |             |                         |         |         |             |          | ,        |       |
| 8c. Space cooli     | ng requiren    | nent         |                | -            |                           |             |                         |         |         |             |          |          |       |
|                     | Jan            | Feb          | Mar            | Apr          | May                       | Jun         | Jul                     | Aug     | Sep     | Oct         | Nov      | Dec      |       |
| Heat loss rate Lr   | n              |              |                |              |                           |             |                         |         |         |             |          |          |       |
|                     | 0.00           | 0.00         | 0.00           | 0.00         | 0.00                      | 8964.53     | 7057.18                 | 7216.58 | 0.00    | 0.00        | 0.00     | 0.00     | (100) |
| Utilisation factor  | r for loss ηn  | n            |                |              |                           |             |                         |         |         |             |          |          |       |
|                     | 0.00           | 0.00         | 0.00           | 0.00         | 0.00                      | 0.76        | 0.83                    | 0.79    | 0.00    | 0.00        | 0.00     | 0.00     | (101) |
| Useful loss ηmLr    | m (watts) (    | 100)m x (10  | 01)m           |              |                           |             |                         |         |         |             |          |          |       |
|                     | 0.00           | 0.00         | 0.00           | 0.00         | 0.00                      | 6845.39     | 5831.81                 | 5677.03 | 0.00    | 0.00        | 0.00     | 0.00     | (102) |
| Gains               |                | •            |                |              | •                         |             |                         | •       |         | •           | ,        |          |       |
|                     | 0.00           | 0.00         | 0.00           | 0.00         | 0.00                      | 9668,82     | 9243,99                 | 8313.50 | 0.00    | 0.00        | 0.00     | 0.00     | (103) |
| Space cooling re    | auirement      | whole dwg    | elling. conti  | nuous (kW    | h) 0.024 x [              | (103)m - (1 | 02)ml x (4 <sup>-</sup> | L)m     |         |             |          |          | 1     |
|                     |                | 0.00         |                | 0.00         | 0.00                      | 2022 07     | 2528 66                 | 1961 52 | 0.00    | 0.00        | 0.00     | 0.00     |       |
|                     | 0.00           | 0.00         | 0.00           | 0.00         | 0.00                      | 2052.07     | 200.00                  | 1301.33 | 0.00    | 0.00        | 0.00     | 0.00     |       |

|                     |               |              |              |             |              |                 |        |           |              | ∑(104)6       | 8 =    | 6533.06      | (104)   |
|---------------------|---------------|--------------|--------------|-------------|--------------|-----------------|--------|-----------|--------------|---------------|--------|--------------|---------|
| Cooled fraction     |               |              |              |             |              |                 |        |           | CO           | oled area ÷   | (4) =  | 0.67         | (105)   |
| Intermittency fa    | ctor (Table   | 10)          |              |             |              |                 |        |           |              |               |        |              |         |
|                     | 0.00          | 0.00         | 0.00         | 0.00        | 0.00         | 0.25            | 0.25   | 0.25      | 0.00         | 0.00          | 0.00   | 0.00         |         |
|                     |               |              |              |             |              |                 |        |           |              | ∑(106)6       | 8 =    | 0.75         | (106)   |
| Space cooling re    | quirement     | (104)m x (1  | L05) x (106) | m           |              |                 |        |           |              |               |        |              |         |
|                     | 0.00          | 0.00         | 0.00         | 0.00        | 0.00         | 340.02          | 424.61 | 328.08    | 0.00         | 0.00          | 0.00   | 0.00         | ]       |
|                     |               | •            | •            |             | •            |                 |        | •         |              | <br>Σ(107)6   | 8 =    | 1092.71      | (107)   |
| Space cooling re    | quirement     | kWh/m²/ye    | ear          |             |              |                 |        |           |              | (107) ÷       | (4) =  | 1.18         | (108)   |
|                     |               |              |              |             |              |                 |        |           |              |               |        |              |         |
| 9a. Energy req      | uirements -   | individual   | heating sys  | stems inclu | uding micro  | -CHP            |        |           |              |               |        |              |         |
| Space heating       |               |              |              |             |              |                 |        |           |              |               |        |              | _       |
| Fraction of spac    | e heat from   | secondary    | /suppleme    | ntary syste | em (table 11 | L)              |        |           |              |               |        | 0.00         | (201)   |
| Fraction of spac    | e heat from   | main syste   | em(s)        |             |              |                 |        |           |              | 1 - (2        | 01) =  | 1.00         | (202)   |
| Fraction of spac    | e heat from   | main syste   | em 2         |             |              |                 |        |           |              |               |        | 0.00         | (202)   |
| Fraction of total   | space heat    | from main    | system 1     |             |              |                 |        |           | (20          | 02) x [1- (20 | )3)] = | 1.00         | (204)   |
| Fraction of total   | space heat    | from main    | system 2     |             |              |                 |        |           |              | (202) x (2    | 03) =  | 0.00         | (205)   |
| Efficiency of ma    | in system 1   | (%)          |              |             |              |                 |        |           |              |               |        | 93.90        | (206)   |
| Cooling system      | energy effic  | iency ratio  | (Table 10c)  |             |              |                 |        |           |              |               |        | 4.05         | (209)   |
|                     | Jan           | Feb          | Mar          | Apr         | May          | Jun             | Jul    | Aug       | Sep          | Oct           | Nov    | Dec          |         |
| Space heating fu    | uel (main sy  | stem 1), kV  | Vh/month     |             |              |                 |        | _         | -            |               |        |              |         |
|                     | 8033.25       | 6183.00      | 5111.11      | 2923.35     | 1417.61      | 0.00            | 0.00   | 0.00      | 0.00         | 3160.08       | 5765.9 | 9 8147.12    | 7       |
|                     |               |              |              |             | 1            |                 |        |           | 5(21)        | 1)1 5 10      | 12 =   | 40741 52     | (211)   |
| Water heating       |               |              |              |             |              |                 |        |           | 2(           |               |        |              |         |
| Efficiency of wat   | ter heater    |              |              |             |              |                 |        |           |              |               |        |              |         |
| Efficiency of ma    | 90.41         | 00.25        | 00.20        | 00 02       | 00 02        | 80.20           | 80.20  | 80.20     | 80.20        | 00.07         | 00.20  | 00 42        | (217)   |
| Water beating f     | 10.41         | 0.55         | 30.20        | 89.85       | 08.95        | 80.20           | 80.20  | 00.20     | 80.20        | 85.87         | 50.23  | 50.45        |         |
| water neating i     |               | 210.09       | 228.64       | 200.25      | 208.75       | 200.00          | 201.02 | 215.07    | 212.07       | 210.00        | 221.0  | 0 242.01     | 7       |
|                     | 350.35        | 310.08       | 328.04       | 299.25      | 298.75       | 299.99          | 291.92 | 315.07    | 312.87       | 5(210-)1      | 321.9  | 343.01       |         |
| Cross sociars fu    | al kM/b/ma    | nth          |              |             |              |                 |        |           |              | 2(2198)1      | .12 =  | 3781.91      | ] (219) |
| Space cooling to    |               |              | 0.00         | 0.00        | 0.00         | 02.05           | 10101  | 04.04     | 0.00         | 0.00          | 0.00   | 0.00         | 7       |
|                     | 0.00          | 0.00         | 0.00         | 0.00        | 0.00         | 83.95           | 104.84 | 81.01     | 0.00         | 0.00          |        | 0.00         | ]       |
|                     |               |              |              |             |              |                 |        |           |              | ∑(221)6       | 8 =    | 269.81       | (221)   |
| Annual totals       |               |              |              |             |              |                 |        |           |              |               | _      |              | 7       |
| Space heating fu    | uel - main sy | /stem 1      |              |             |              |                 |        |           |              |               |        | 40741.52     |         |
| Water heating f     | uel           |              |              |             |              |                 |        |           |              |               |        | 3781.91      |         |
| Space cooling fu    | el            |              |              |             |              |                 |        |           |              |               |        | 269.81       |         |
| Electricity for pu  | imps, fans a  | and electric | keep-hot (   | Table 4f)   |              |                 |        |           |              | _             |        |              |         |
| mechanical v        | entilation f  | ans - balan  | ced, extract | or positive | e input fron | n outside       |        | 2         | 947.12       |               |        |              | (230a)  |
| central heati       | ng pump or    | water pum    | np within w  | arm air he  | ating unit   |                 |        |           | 30.00        |               |        |              | (230c)  |
| boiler flue fa      | n             |              |              |             |              |                 |        |           | 45.00        | ]             |        |              | (230e)  |
| Total electricity   | for the abo   | ve, kWh/ye   | ar           |             |              |                 |        |           |              |               |        | 3022.12      | (231)   |
| Electricity for lig | hting (Appe   | endix L)     |              |             |              |                 |        |           |              |               |        | 1366.66      | (232)   |
| Energy saving/g     | eneration te  | echnologies  | 5            |             |              |                 |        |           |              |               |        |              |         |
| electricity ge      | nerated by    | PV (Append   | dix M)       |             |              |                 |        |           |              |               |        | -3799.93     | (233)   |
| Total delivered     | energy for a  | II uses      |              |             |              |                 |        | (211)(221 | .) + (231) + | (232)(23      | 7b) =  | 45382.10     | (238)   |
|                     |               |              |              |             |              |                 |        |           |              |               |        |              |         |
| 10a. Fuel costs     | - individua   | I heating sy | stems inclu  | uding micr  | O-CHP        |                 |        |           |              |               |        |              |         |
|                     |               |              |              |             | L.           | Fuel<br>Nh/year |        | Fu        | el price     |               |        | Fuel         |         |
|                     |               |              |              |             | ĸv           | vii, yedi       |        |           |              |               |        | COSC L/ year |         |

|   |          |   |              |                |         | _     |
|---|----------|---|--------------|----------------|---------|-------|
| Space heating - main system 1                                   | 40741.52 | x | 3.48         | x 0.01 =       | 1417.81 | (240) |
| Water heating   | 3781.91  | x | 3.48         | x 0.01 =       | 131.61  | (247) |
| Space cooling   | 269.81   | x | 13.19        | x 0.01 =       | 35.59   | (248) |
| Pumps and fans  | 3022.12  | x | 13.19        | x 0.01 =       | 398.62  | (249) |
| Electricity for lighting  | 1366.66  | x | 13.19        | x 0.01 =       | 180.26  | (250) |
| Additional standing charges                                     |          |   |              |                | 120.00  | (251) |
| Energy saving/generation technologies                           |          |   |              |                |         |       |
| pv savings  | -3799.93 | x | 13.19        | x 0.01 =       | -501.21 | (252) |
| Total energy cost   |          |   | (240)(242) - | + (245)(254) = | 1782.67 | (255) |
|   |          |   |              |                |         |       |
| 11a. SAP rating - individual heating systems including micro-CH | IP       |   |              |                |         |       |
| Energy cost deflator (Table 12)                                 |          |   |              |                | 0.42    | (256) |
| Energy cost factor (ECF)  |          |   |              |                | 0.77    | (257) |
| SAP value   |          |   |              |                | 89.22   |       |
| SAP rating (section 13)   |          |   |              |                | 89      | (258) |

SAP band

#### 12a. CO<sub>2</sub> emissions - individual heating systems including micro-CHP

|                                       | Energy<br>kWh/year |   | Emission factor<br>kg CO <sub>2</sub> /kWh |                   | Emissions<br>kg CO <sub>2</sub> /year |       |
|---------------------------------------|--------------------|---|--|-------------------|---------------------------------------|-------|
| Space heating - main system 1         | 40741.52           | x | 0.216                                      | ] = [             | 8800.17                               | (261) |
| Water heating                         | 3781.91            | x | 0.216                                      | ] = [             | 816.89                                | (264) |
| Space and water heating               |                    |   | (261) + (262) +                            | - (263) + (264) = | 9617.06                               | (265) |
| Space cooling                         | 269.81             | x | 0.519                                      | ] = [             | 140.03                                | (266) |
| Pumps and fans                        | 3022.12            | x | 0.519                                      | ] = [             | 1568.48                               | (267) |
| Electricity for lighting              | 1366.66            | x | 0.519                                      | ] = [             | 709.30                                | (268) |
| Energy saving/generation technologies |                    |   |  |                   |                                       |       |
| pv savings                            | -3799.93           | x | 0.519                                      | ] = [             | -1972.16                              | (269) |
| Total CO <sub>2</sub> , kg/year       |                    |   |  | (265)(271) =      | 10062.71                              | (272) |
| Dwelling CO₂ emission rate            |                    |   |  | (272) ÷ (4) =     | 10.89                                 | (273) |
| El value                              |                    |   |  |                   | 86.08                                 | ]     |
| El rating (section 14)                |                    |   |  |                   | 86                                    | (274) |
| El band                               |                    |   |  | [                 | В                                     | ]     |

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

|  | Energy<br>kWh/year |   | Primary factor  |                 | Primary Energy<br>kWh/year | ,     |
|--|--------------------|---|-----------------|-----------------|----------------------------|-------|
| Space heating - main system 1            | 40741.52           | x | 1.22            | =               | 49704.66                   | (261) |
| Water heating                            | 3781.91            | x | 1.22            | =               | 4613.93                    | (264) |
| Space and water heating                  |                    |   | (261) + (262) + | (263) + (264) = | 54318.58                   | (265) |
| Space cooling                            | 269.81             | x | 3.07            | =               | 828.30                     | (266) |
| Pumps and fans                           | 3022.12            | x | 3.07            | =               | 9277.92                    | (267) |
| Electricity for lighting                 | 1366.66            | x | 3.07            | =               | 4195.65                    | (268) |
| Energy saving/generation technologies    |                    |   |                 |                 |                            |       |
| Electricity generated - PVs              | -3799.93           | x | 3.07            | =               | -11665.77                  | (269) |
| Primary energy kWh/year                  |                    |   |                 |                 | 56954.69                   | (272) |
| Dwelling primary energy rate kWh/m2/year |                    |   |                 |                 | 61.65                      | (273) |
|  |                    |   |                 |                 |                            |       |

В



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