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35 TWICKENHAM ROAD, TEDDINGTON

Energy Statement

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Energy Statement

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Revision	Amendment Details	Revision Prepared By	Revision Approved By

EXECUTIVE SUMMARY

This Energy Statement is submitted to support the planning application for the proposed development at 35 Twickenham Road, Teddington, TW11 8AH.

The strategy has been prepared in the context of the adopted Richmond Local Plan Policy LP20: Climate Change Adaption and Policy LP 22: Sustainable Design and Construction, as well as the London Plan 2021.

The adopted policies require all developments to integrate the principles of sustainable design and construction into the design of the new proposal. Accordingly, this energy strategy demonstrates the carbon reductions that can be achieved through addressing the fabric energy efficiency measures primarily for the new build elements of the scheme, and very efficient servicing solutions throughout.

'Be Lean': The strategy aims to reduce energy demands by specifying a highly efficient building fabric and efficient heating and ventilation system. This is to ensure that the highest possible standards are achieved for the site. The proposal will ensure the development achieves an overall reduction of 5% from 'Be Lean' measures only. The following features will lead to a significant reduction in anticipated energy consumption and CO_2 emissions compared to the baseline development, through the specification of energy saving features within the services design:

- Good air tightness of $3m^3/m^2/hr@50Pa$
- Limitation of thermal bridges;
- Fabric improvements where feasible and very energy efficient building fabric,
- Highly efficient heating system and control system;
- Mechanical ventilation with heat recovery;
- 100% dedicated energy efficient lighting;

'Be Clean': The opportunity for the proposed development to link into an existing or planned decentralised energy network has been considered. The proposal is a minor development and heavily constrained by the surrounding existing infrastructure, the connection to district heating is therefore concluded to be impractical and unfeasible.

'Be Green': A feasibility study has been undertaken to establish suitability of the new building for integration of renewable technology on site. It has been concluded that the most feasible technologies for the development will be:

- Individual air source heat pumps (ASHP) serving each dwelling;
- PV panels on the flat roof and suitable sloping roof areas – estimated system size 2kWp

A highly optimised energy strategy based on passive design, building fabric performance and building services systems and controls, and suitable Low and Zero Carbon systems will allow the scheme to achieve an improvement on total carbon dioxide emissions over the existing scenario of 59%,

exceeding the Building Regulations Part L 2021 targets for compliance and London Plan carbon emissions reduction target of 35%.

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd has been commissioned by Foster Kennedy Developments to prepare an Energy Statement in support of the planning application for the proposed development at 35 Twickenham Road, Teddington, TW11 8AH.

1.2 The objective of the Energy Statement is to demonstrate how the proposed development will meet the policy requirements relating to carbon emissions reduction within the London Plan and Richmond Local Plan Policy LP 20: Climate Change Adaption and Policy LP 22: Sustainable Design and Construction.

Site Location and Description

1.3 The proposed development includes the erection of two new residential buildings in a detached configuration.

1.4 The site is located to the rear of 35 Twickenham Road, on the north side of Manor Road. Please refer to the Site Location plan below for details.

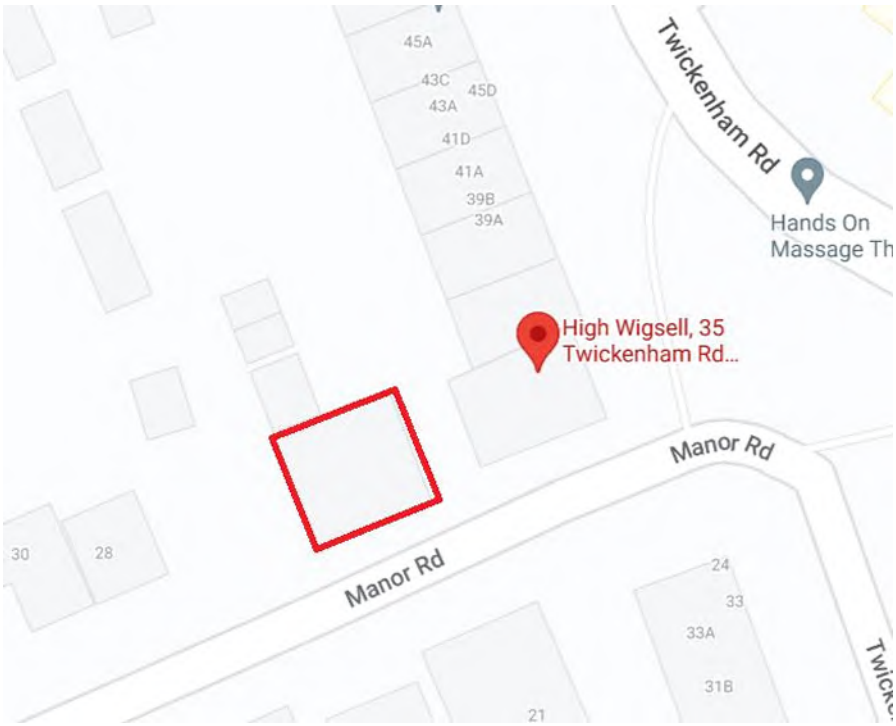


Figure 1.1: Site location plan (extracted from Google maps)

Objectives

1.5 The objectives of this report are to:

- Demonstrate how the proposed development will meet the policy requirements of adopted Richmond Local Plan, and the relevant London Plan policies.
- Identify the most suitable passive and energy efficient design approach for the scheme, the feasibility of Low and Zero Carbon technologies and operational Best Practice.
- Identify the drivers relating to an energy efficient design over and above minimum compliance with current Building Regulations and energy targets.

Report Structure

1.6 This introductory section is followed by a comprehensive review of national, regional and local policies on energy, sustainability and best practice standards. Sections 3-5 address measures taken to mitigate the effects of climate change, and measures to enhance the energy efficiency of the scheme, as well as reducing CO_2 emissions.

2.0 CURRENT AND FUTURE PLANNING POLICIES/GOOD PRACTICE REVIEW AND PROJECT REQUIREMENTS

National Planning Policy Framework (July 2021)

2.1 The National Planning Policy Framework sets out the Government's planning policies for England and how these are expected to be applied. Taken together, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations. The ministerial foreword of this NPPF highlights that 'the purpose of planning is to contribute to the achievement of sustainable development' and that at the heart of the framework is a presumption in favour of sustainable development.

2.2 Sustainable development is defined in the NPPF as comprising developments "meeting the needs of the present without compromising the ability of future generations to meet their own needs" in line with the definition of the Brundtland Commission ('Our Common Future', 1987). The NPPF also refers to the three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways – an economic objective, a social objective and an environmental objective.

New London Plan (March 2021)

2.3 The London Plan 2021 is the Spatial Development Strategy for Greater London. It sets out a framework for how London will develop over the next 20-25 years and the Mayor's vision for Good Growth.

2.4 Policy SI 2 within the Chapter 9: Sustainable Infrastructure confirms the London principles for minimising greenhouse gas emissions.

> *"Major* development *should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:*
> *1) Be lean: use less energy and manage demand during operation.*
> *2) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly*
> *3) Be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site*
> *4) Be seen: monitor, verify and report on energy performance. "*
>
> *"Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy.*

"A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. "

"Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
1) Through a cash in lieu contribution to the borough's carbon offset fund, or
2) Off-site provided that an alternative proposal is identified and delivery is certain."

"Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported on annually."

"Boroughs should ensure that all developments maximise opportunities for on-site electricity and heat production from solar technologies (photovoltaic and thermal) and use innovative building materials and smart technologies."

"To meet the zero-carbon target, an on-site reduction of at least 35 per cent beyond the baseline of Part L of the current Building Regulations is required."

Greater London Authority (GLA) guidance on preparing energy assessments as part of planning applications (June 2022)

2.5 The June 2022 revision to the GLA guidance on preparing energy statements explains how London Plan policies apply after Part L 2021 has taken effect. It introduces a percentage improvement benchmark for residential developments and the requirement to report the Energy Use Intensity (EUI) and space heating demand of the development.

2.6 It also further clarifies how to demonstrate carbon improvements from the 'be lean' stage of the energy hierarchy. The guidance has been updated considering the new Part O of building regulations and confirms that applicants should continue to report the results of dynamic overheating modelling as part of the energy strategy. This should use Chartered Institution of Building Services Engineers (CIBSE) guidance and account for the limits that Part O 2021 places on choices when undertaking a CIBSE assessment.

2.7 More guidance is also given on design and reporting process for proposals involving ambient loop systems with heat pumps in individual units where there is potential to connect to a district heat network and where heat network is utilised.

2.8 The guidance confirms the London Plan energy efficiency targets which require <u>new major</u> developments to achieve:

- Residential – 10% improvement on 2021 Building Regulations from energy efficiency;
- Residential – minimum 35% improvement on 2021 Building regulations on-site with a strong encouragement to reach 50% on-site CO2 emissions reduction;
- Non-residential – 15% improvement on 2021 Building Regulations from energy efficiency and minimum 35% improvement on-site.

2.9 The documents clarify how the results should be presented in the report and requires the refurbishment and the new extension to separately demonstrate the carbon reductions achieved, as well as site wide.

Local Planning Policy

Richmond Local Plan 2033 (adopted 2018)

2.10 The London Borough of Richmond Local Plan, adopted in July 2018, sets out the planning framework to guide the future development of the borough to 2033. This document replaces previous policies within the Core Strategy and Development Management Plan. The following policies has been identified as appropriate for assessing the energy performance of new developments:

- Policy LP 20: Climate Change Adaption

> *A. The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.*
> *B. New development, in their layout, design, construction, materials, landscaping and operation, should minimise the effects of overheating as well as minimise energy consumption in accordance with the following cooling hierarchy:*
> *1. minimise internal heat generation through energy efficient design*
> *2. reduce the amount of heat entering a building in summer through shading, reducing solar reflectance, fenestration, insulation and green roofs and walls*
> *3. manage the heat within the building through exposed internal thermal mass and high ceilings*
> *4. passive ventilation*
> *5. mechanical ventilation*
> *6. active cooling systems (ensuring they are the lowest carbon options).*
> *C. Opportunities to adapt existing buildings, places and spaces to the likely effects of climate change should be maximised and will be supported.*

- Policy LP 22: Sustainable Design and Construction

A. Developments will be required to achieve the highest standards of sustainable design and construction to mitigate the likely effects of climate change. Applicants will be required to complete the following:
1. Development of 1 dwelling unit or more, or 100sqm or more of non-residential floor space (including extensions) will be required to complete the Sustainable Construction Checklist SPD. A completed Checklist has to be submitted as part of the planning application.
2. Development that results in a new residential dwelling, including conversions, change of use, and extensions that result in a new dwelling unit, will be required to incorporate water conservation measures to achieve maximum water consumption of 110 litres per person per day for homes (including an allowance of 5 litres or less per person per day for external water consumption).
3. New non-residential buildings over 100sqm will be required to meet BREEAM 'Excellent' standard.
4. Proposals for change of use to residential will be required to meet BREEAM Domestic Refurbishment 'Excellent' standard (where feasible).
Reducing Carbon Dioxide Emissions
B. Developers are required to incorporate measures to improve energy conservation and efficiency as well as contributions to renewable and low carbon energy generation. Proposed developments are required to meet the following minimum reductions in carbon dioxide emissions:
1. All new major residential developments (10 units or more) should achieve zero carbon standards in line with London Plan policy.
2. All other new residential buildings should achieve a 35% reduction.
3. All non-residential buildings over 100sqm should achieve a 35% reduction. From 2019 all major non-residential buildings should achieve zero carbon standards in line with London Plan policy.
Targets are expressed as a percentage improvement over the target emission rate (TER) based on Part L of the 2013 Building Regulations.
C. This should be achieved by following the Energy Hierarchy:
1. Be lean: use less energy
2. Be clean: supply energy efficiently
3. Be green: use renewable energy
Decentralised Energy Networks
D. The Council requires developments to contribute towards the Mayor of London target of 25% of heat and power to be generated through localised decentralised energy (DE) systems by 2025. The following will be required:
1. All new development will be required to connect to existing DE networks where feasible. This also applies where a DE network is planned and expected to be operational within 5 years of the development being completed.

2. Development proposals of 50 units or more, or new non-residential development of 1000sqm or more, will need to provide an assessment of the provision of on-site decentralised energy (DE) networks and combined heat and power (CHP).
3. Where feasible, new development of 50 units or more, or new non-residential development of 1000sqm or more, as well as schemes for the Proposal Sites identified in this Plan, will need to provide on-site DE and CHP; this is particularly necessary within the clusters identified for DE opportunities in the borough-wide Heat Mapping Study. Where on-site provision is not feasible, provision should be made for future connection to a local DE network should one become available.
Applicants are required to consider the installation of low, or preferably ultra-low, NOx boilers to reduce the amount of NOx emitted in the borough.
Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged where appropriate.
Retrofitting
E. High standards of energy and water efficiency in existing developments will be supported wherever possible through retrofitting. Householder extensions and other development proposals that do not meet the thresholds set out in this policy are encouraged to complete and submit the Sustainable Construction Checklist SPD as far as possible, and opportunities for micro-generation of renewable energy will be supported in line with other policies in this Plan.

Sustainable Construction Checklist Guidance Document

2.11 The document confirms standards applicable to minor residential development within the borough. These are as follows:

- 35% reduction in CO2 emissions over Building Regulations (2013). This is equivalent to Part L 2021 compliant development.
- Submit energy statement.
- National water standards - 110 litres/person/day
- Submit Sustainable Construction Checklist.

Building Regulations Approved Document Part L

2.12 Part L of the current Building Regulations (2021) considers the reduction of carbon emissions in new and existing buildings. As the proposals consist of the creation of new domestic spaces they fall under Part L1 of the Regulations.

2.13 The overall structure of compliance with the 2021 Building Regulations for new buildings includes five criteria to comply with:

- **Criterion 1** – The Dwelling/Building Emission Rate (DER/BER) should be better than the Target Emission Rate (TER) and Dwelling/Building Primary Energy Rate should not exceed the Target Primary Energy Rate.
- **Criterion 2** – Limit on design flexibility;
- **Criterion 3** – Limiting effects of heat gain in summer;
- **Criterion 4** – Commissioning and air-tightness;
- **Criterion 5** – Efficient operation of buildings.

2.14 The detailed energy strategy for the scheme will be developed to ensure the scheme meets the relevant requirements of the Building Regulations.

Summary of the requirements for 35 Twickenham Road development

2.15 The proposed development does not classify as major and therefore most of the above quoted policies will not apply. However, the development will be designed to meet the new Part L 2021 of the Building Regulations and to maximise on renewable energy generation and to minimise carbon emissions in line with the principles of the energy hierarchy.

3.0 ENERGY EFFICIENCY STRATEGY – 'BE LEAN'

Introduction

3.1 The proposed energy strategy has, as its first priority, minimised energy consumption through the performance of the building envelope and services. The following section details the energy efficiency features of the development. The cooling hierarchy set out within the London Plan has been followed.

3.2 This analysis includes:

- Building Regulations Approved Document L1 and L2 (2021) initial compliance assessment, identifying the potential for the design to comply with and exceed Building Regulations requirements.
- An energy demand assessment of the proposed scheme contained within this document provides carbon dioxide emissions estimates from the analysis of passive energy efficiency enhancements and Low and Zero Carbon potential. This will utilise SAP 10 carbon dioxide fuel factors.

3.3 In further detail, the energy efficiency strategy of the scheme has been achieved by incorporating the following design and technology features:

Energy Efficiency Features Proposed

Physical Form and Orientation of the Building

3.4 While the orientation of the development is limited due to it being proposed on a small site, the facades of the new extension have been optimised in order to provide a balance of thermal control and access to daylight, both from within and outside the buildings.

3.5 Passive solar design involves adapting the internal layout and glazing to best respond to the local climate and annual sun path, with the aim of reducing energy demands and improving occupant comfort through the use of heat and light from the sun. The new building will utilise the passive solar design principles through orientation of its main living area windows towards south and west. The dual aspect design of the units will enable daylight penetration into the new maisonettes, reducing their heating load.

3.6 Good levels of natural daylight will be achieved for the majority of the scheme. This will reduce reliance on artificial lighting and thus limit energy consumption.

Overheating

3.7 Overheating is reduced through the inclusion of openable windows to enable effective purge ventilation. Both dwellings are dual aspect allowing cross-ventilation to the dwellings. Additionally, mechanical ventilation units with a boost mode and a summer by-pass facility will be fitted to each dwelling, providing ventilation and free cooling during spring and summer nights without compromising the security of the dwellings and providing a quiet internal environment.

3.8 All windows in the dwellings are proposed to be fitted with medium to low g-value glazing (g=0.63) limiting solar thermal gains.

3.9 Shading control systems in the form of individually controlled interior opaque blinds will offer efficient solar control as they provide both solar shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the building.

Building Envelope Specification and Thermal Performance

3.10 The heat losses of the spaces will be reduced by optimising the thermal performance of the building fabric and limiting the air permeability through a very high standard of construction. This strategy will lead to a steady but extremely low space heating load for all of the spaces of the scheme.

3.11 The building fabric U-Values and air tightness for the development has met and exceeded the building fabric elements standards of Part L1:2021 and will allow the Dwellings' Fabric Energy Efficiency (DFEE) rate to be lower or equal to the Part L1:2021 Target Fabric Energy Efficiency (TFEE) rate.

3.12 Building fabric thermal transmittance is measured by the U-value of each building element in Watts/m²/K. The U-Value is essentially a measure of the rate at which energy is lost through a building element; the greater the U-Value, the higher the rate of energy loss.

3.13 Tables 3.1 below detail the U-values for the development in relation to Building Regulations notional values for new builds and minimum values for extensions.

Building Element/Characteristic	Part L1, 2021 Reference Values for Notional Building	Proposed values
External Wall to Lower Ground Floor – U value (W/m²K)	0.18	**0.18**
External Wall to all other storeys (W/m²K)	0.18	**0.15**
Roof – U value (W/m²K)	0.13	**0.11**

Building Element/Characteristic	Part L1, 2021 Reference Values for Notional Building	Proposed values
Windows – U value (W/m²K)	1.4	**1.4** **g-value = 0.63**
Doors – U value (W/m²K) French Door – U value (W/m²K)	1.0 solid 1.2 semi-glazed	**1.1** **1.5**
Design Air Permeability(m³/hr/m² @50Pa)	5	**3**
Thermal Bridges	**ACD equivalent psi values where available**	**LABC equivalent psi values where available**

Table 3.1: Proposed building fabric for the residential part of the development

Air Tightness and Ventilation Strategy/Scope for Natural Ventilation

3.14 Air permeability is a measure of infiltration. It indicates how often the entire air quantity in a building is exchanged with outside air within 1 hour without any ventilation in place. Any air exchange with outside air is carrying heat energy away from the building, resulting in a higher heating load. Lower air permeability levels are desirable for conserving heat energy and in the case of mechanical ventilation systems for reducing fan power consumption. Infiltration is different from ventilation. Infiltration is essentially unwanted air exchanges through imperfections in the building fabric while ventilation is the air exchanges intended by the designer.

3.15 As detailed in Tables 3.1 it is envisaged that the air permeability of the proposed new dwellings will be in the region of 3 m³/m²@50PA/hr.

3.16 The ventilation system proposed for all flats is via mechanical ventilation with heat recovery (MVHR). The MVHR units will be specified at detailed design stage, however they are expected to have a high heat recovery efficiency and low SFP (specific fan power) to limit energy use. The system will supply fresh air to living spaces and extract air from wet rooms (kitchens, bathrooms, WCs).

3.17 For the purpose of the energy modelling the following specification has been assumed:

- MVHR for dwellings – efficiency 90%, SFP = 0.52 W/l/s (based on Vent Axia Sentinel Kinetic Plus B);

Lighting and Appliances

3.18 High efficiency low energy lighting and controls have been specified throughout. All new spaces will utilise 100% low energy lighting.

3.19 Lighting will be designed in accordance with CIBSE (Chartered Institute of Building Service Engineers) Guide A: Environmental Design and relevant CIBSE Lighting Guides.

3.20 Unnecessary light spill will be reduced by avoiding the use of external decorative lighting; providing fittings only where they are required for security and maintenance purposes. External luminaires have been chosen to minimise sky glow and overspill and located to ensure that only the level of lighting that is required is achieved.

3.21 All appliances, if fitted, will be very energy efficient (A to A+++ rated). Information on the EU Energy Efficiency Labelling Scheme will be provided.

The Choice and Design of Building Systems and Plant

3.22 The building systems and plant have been chosen to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be serviced regularly to maintain their performance.

3.23 Space and water heating in all spaces will be provided by individual ASHPs and heat will be emitted via underfloor heat distribution pipes or via low temperature radiators. The efficiency of the proposed ASHP system will be in the region of 280% (CoP 2.8) and the heating system will be controlled by a programmer and at least 2 thermostats.

3.24 Please refer to Section 4 of this report for a feasibility study of community and district heating for the site and to Section 5 for detailed calculation for the site with ASHP proposed ('Be Green' stage).

Energy requirement and CO_2 emissions of the development

Standard Assessment Procedure (SAP) for dwellings

3.25 The Standard Assessment Procedure (SAP 10) forms the basis for demonstrating compliance with Part L1 of the Building Regulations 2021 and as such it has been used to estimate the energy efficiency features required for Part L compliance, as well as predict the annual building regulated energy demand, consumption and CO2 emissions of the dwellings.

3.26 The SAP methodology determines a Dwelling Emission Rate or 'DER'. This value is compared to the energy requirements and emissions of a notional dwelling of the same shape and dimensions which determines a compliant building (the Target Emissions Rate or 'TER').

3.27 The DER calculation determines the regulated energy use and emissions, which are described as the energy used for space and water heating as well as lighting, pumps and fans.

Unregulated energy is the energy used for cooking and appliances and is not included in Approved Document Part L. For the purpose of this study, the unregulated energy, as defined above, has been excluded from the calculations.

3.28 Both dwellings have been modelled using Standard Assessment Procedure (SAP) to establish the energy efficiency strategy for the development and to inform the base case energy demand of the development.

3.29 The energy consumption and CO_2 emissions of the unregulated elements (cooking and appliances) have been estimated based on the methodology developed in Appendix L of SAP 2012 and adjusted for the revised carbon factors.

Results of the Energy Simulation

3.30 The total CO_2 emissions have been estimated based on the results from the energy modelling for the dwellings.

3.31 The regulated CO2 emissions of the residential units of the scheme before the use of any low and zero carbon systems has been estimated as approximately 3.4 tonnes of CO_2 per year as summarised in the table below. Please refer to DER worksheets appended to this report (Appendix B).

Carbon Dioxide Emissions	Carbon Dioxide Emissions [tonnes/year]	
	Regulated	**Unregulated**
Baseline: Part L 2021 of the Building Regulations Compliant Development	3.4	1.52
Be Lean - After energy demand reduction	3.2	1.52
Improvement over Part LA: 2013	**0.2**	**Tonnes CO_2 per annum**
	5	**%**

Table 3.2: CO_2 emissions from the Baseline development and Be Lean case

3.32 The optimised building fabric specified for the dwellings has led to an overall projected improvement over Part L Target Emission Rate (TER) standard of approximately 5% for all dwellings, demonstrating the development's high standard of building fabric. Please refer to DER/TER Worksheets found in Appendix B for detailed SAP calculations and GLA spreadsheet for calculation methodology (Appendix A).

3.33 It is worth noting that due to the current calculation methodology used for Part L compliance and the GLA Energy Assessment methodology, the CO_2 savings achieved through the provision of energy efficient appliances (unregulated loads) are not included hence the CO_2 savings presented in this report are considered to be conservative. The unregulated CO_2 emissions

have been considered similar for all the different stages of the London Plan energy hierarchy. It is however expected that this scheme will lead to unregulated CO_2 emissions significantly lower than those of a standard Part L 2021 compliant scheme.

3.34 To reduce the development's total energy demand and maximise the carbon emission reduction for the proposed scheme will utilise low carbon and renewable energy technology. The study of feasible systems for the development at 35 Twickenham Road has been summarised in section 4 of this report.

4.0 'BE CLEAN': SUPPLY ENERGY EFFICIENTLY

4.1 Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The Richmond upon Thames Local Plan Policy LP 20: Climate Change Adaption and Policy LP 22: Sustainable Design and Construction requires major development proposals to explore the opportunities to link into an existing or planned decentralised energy network. Where an existing decentralised energy network is not present, major developments should undertake a detailed investigation into the feasibility of establishing a District Heating Network with the proposed development as an anchor heat load or contribute towards such feasibility work.

4.2 The proposal is very small and constrained by the surrounding streets and buildings. To maximise the development's potential, no allocation has been made for a central plant room to serve a communal heating system. Each dwelling is proposed to be fitted with an individual heat pump.

4.3 Additionally, the nearest existing district heat network is located nearly 14km away from the site and the nearest proposed decentralised heat network is proposed to be developed 3km away from the development (see Figure 4.1 below).

4.4 For this reason, it is concluded that a connection to any future district heat network is not feasible and technically impractical.

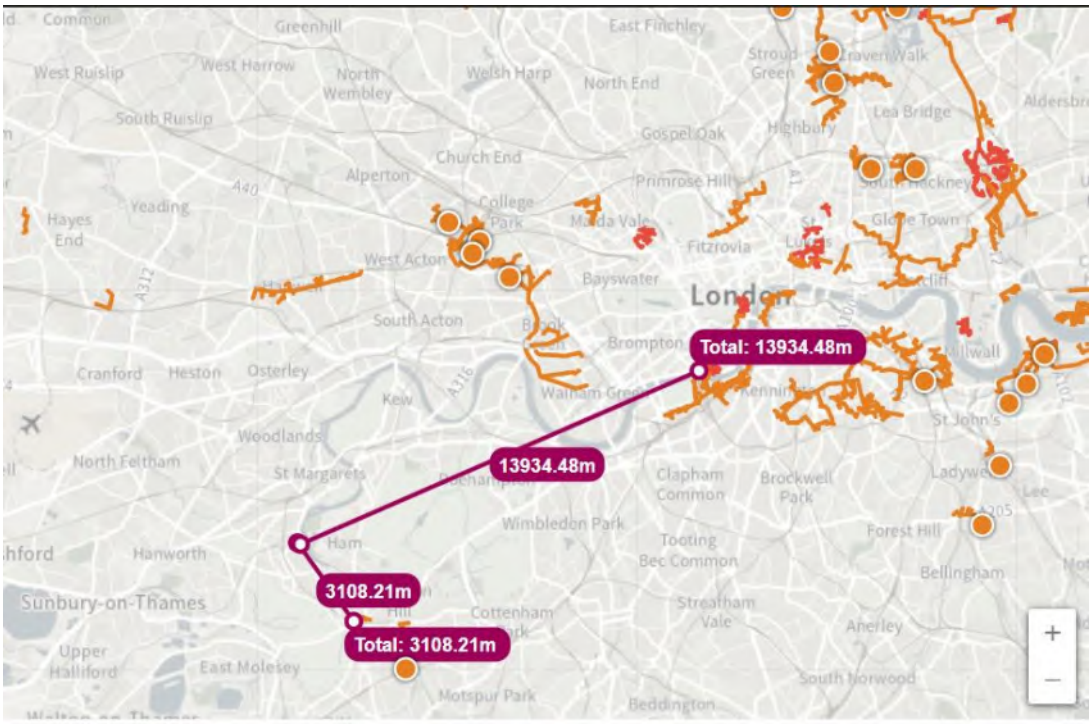


Figure 4.1: Location of existing and proposed district heat network.

5.0 LOW AND ZERO CARBON TECHNOLOGIES – 'BE GREEN'

Overview

5.1 The final step in the energy hierarchy requires that the clean generation of energy by renewable energy technologies be examined.

5.2 A feasibility study has been undertaken to establish the most technically and economically viable renewable technology which provides the highest overall reduction in carbon dioxide emissions for the proposed mixed-use development to help achieve the planning policy target. The renewable technologies reviewed in this study and their feasibility for the proposed development are summarised in Table 5.1 below.

Low and Zero Carbon Technology	Suitability for the proposed development
Heat Pumps	**YES**
Photovoltaic Panels	**YES**
Solar thermal panels	**NO**
Biomass boilers	**NO**
Wind turbines	**NO**

Table 5.1: Review of suitability of LZC technology for the site.

5.3 Key parameters which have been considered when selecting appropriate combinations of technologies include:

- Opportunities of the site and energy demand of the development;
- Visual impact of the system;
- Practical implementation considerations;
- Maintenance requirements;
- Implications for internal arrangement and space allocation, infrastructure and site layout;
- Public acceptability;
- Deliverability;
- Management options;
- Interactions of the technologies with one another;
- Client's preference.

Proposed Renewable Technology – ASHP

5.4 ASHPs are considered the most suitable option for providing low carbon heating to the development. The choice of air source heat pumps was dictated by a number of restrictions and constraints posed by the development, such as:

- Limited roof areas to accommodate sufficient number of PV panels to offset carbon dioxide emissions; CO_2 emissions reduction smaller due to lower emissions factor for electricity (0.136 kg/kWh for SAP 10.2 carbon factors comparing with 0.519 kg/kWh for SAP 2012);
- The development is proposed on a site almost fully covered by a building footprint; horizontal loops not feasible and spacing required between the vertical boreholes under the building would be technically challenging and economically unfeasible;
- Location of the development in an urban area – no space for a wind turbine and a large biomass fuel store.

5.5 For these reasons the Client's preferred option for reducing carbon dioxide emissions is through the application of individual air source heat pumps (ASHP).

5.6 Heat Pumps utilize low grade heat to provide highly efficient, low carbon heating. They are a thermodynamic device based on the vapour compression cycle. The four elements of the refrigeration circuit are: the evaporator, compressor, heat exchanger and condenser. The heat, which is extracted from the medium, goes through a number of processes and is distributed throughout individual dwellings through a standard wet central heating system. Heat pumps utilise electricity to drive their pumps and compressor units. They are essentially a form of efficient electric heating. The efficiency of a heat pump is rated by its coefficient of performance (CoP).

5.7 The following characteristics of the system will give it an advantage over other renewable technologies:

- High efficiency heating;
- Low impact on air quality;
- Low levels of noise when suitable location is chosen;
- Lower emissions when calculated using SAP 10 fuel carbon factors;
- Use of fuel that is becoming 'green' due to the grid decarbonisation.

5.8 ASHPs will be used to provide all of the space and water heating demand for both dwellings. The heat distribution will be via low temperature radiators or underfloor distribution pipes. For the purpose of the modelling the Mitsubishi Ecodan PUZ-WM112VAA has been used with a minimum efficiency of 370%.

5.9 ASHPs extract energy from the air and therefore require space for external units. The rear gardens can be used for the location of the external units serving each dwelling.

5.10 Carbon emissions savings achieved by the proposed ASHPs have been calculated in line with the GLA guidance on preparing energy statements (June 2022).

5.11 Please refer to table 5.2 for a summary of the savings achieved by the proposed ASHPs, Appendix C for SAP worksheets and Appendix A for carbon emissions calculations for revised (SAP 10) carbon factors.

5.12 Total CO_2 emissions reduction over the GLA Base Case scenario, achieved through incorporation of ASHPs are estimated to be over 59% for the development, exceeding the requirements of Part L of the Building Regulations.

5.13 The above results provide a robust case for supporting the proposed heating strategy incorporating air source heat pumps for all dwellings. This aligns with the London Plan policy strategy supporting clean, low emission fuels.

Photovoltaic Panels –Supplementing Technology

5.14 Photovoltaic cells directly convert sunlight into electrical current using semiconductors. The output of a cell is directly proportional to the intensity of the light received by the active surface of the cell. The location and positioning of PV cells is therefore critical to achieving acceptable performance.

5.15 Photovoltaics are generally technically suitable for residential developments, however the carbon reduction achieved by the system is quite low due to decarbonisation of the grid and revised carbon factors for electricity. 1 kWp of PV in a horizontal position generates approximately 760 kWh of electricity per year, which translates to 177 kg of CO_2 savings per year, using SAP 10 carbon factors, and only 103 kg of CO_2 savings per year, when calculated using SAP 10.2 carbon factor for electricity.

5.16 Areas of PV modules vary between manufacturers, however on average 1 PV module covers an area of approximately 1.6m^2. PV panels are produced in various sizes with power outputs ranging from 0.165 kWp to 1kWp per module. The most commonly used generate approximately 0.3-0.4 kW of electricity.

5.17 Only part of the flat roof in the development could be used for PV panels. The location of PV collectors will have to take into account the proposed dormer windows and possible shading created by the existing trees.

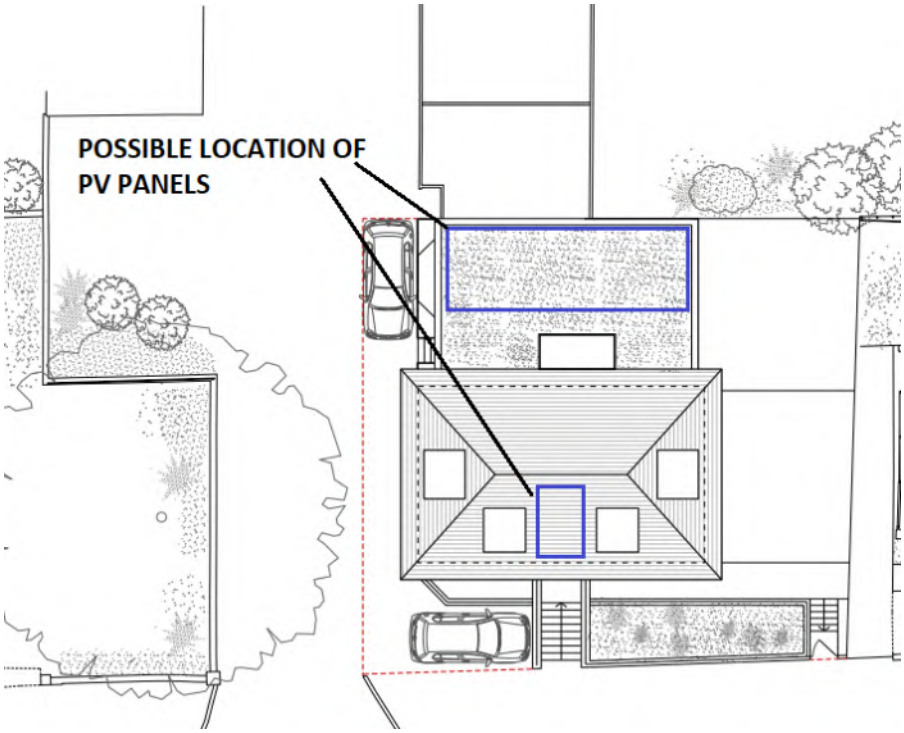


Figure 5.1: Location of the proposed PV system (source: Architect's plan)

5.18 The estimated PV system size is 2kWp (approximately 6-8 panels with a power output 0.385kWp each). A system of this size will generate approximately 1MWh per annum offsetting 0.55 tonnes of CO2 per year. This is based on the assumption that the panels will be fitted horizontally (at approx. 12 degrees inclination) and that 1kWp of PV system generates circa 760kWh of electricity per year. These are however fairly conservative assumptions, based on SAP default values. Detailed energy generation calculations will be provided by the selected PV supplier and will be confirmed at detailed design stage.

5.19 The estimated carbon emissions reduction from the development after incorporation of ASHPs and 2kWp is 59% as shown in the table below.

Carbon Dioxide Emissions	Carbon Dioxide Emissions [tonnes/year]	
	Regulated	**Unregulated**
Baseline: GLA Base Case	3.4	1.52
Be Lean - energy demand reduction	3.2	1.52
Be Green – ASHP + PVs	1.4	1.52
Improvement over Part LA: 2013	**2**	**Tonnes CO_2 per annum**
	59%	**%**

Table 5.2: Energy hierarchy reductions (SAP 10.2 fuel emission factors)

5.20 For a description of other renewable technologies considered for the development but concluded to be unfeasible, please refer to Appendix D.

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 This report has been developed to detail the energy efficient features of the development and assesses how they relate to the relevant planning policy including the Local Plan Policy LP 20: Climate Change Adaption and Policy LP 22: Sustainable Design and Construction, requiring reduction in predicted energy demand from the development to be achieved through incorporation of energy efficient building fabric, efficient services design and low and/or renewable energy technology, where feasible.

6.2 The energy assessment follows the principles of the energy hierarchy: 'Be Lean', 'Be Clean' and 'Be Green'. The overriding objective in the formulation of the energy strategy for the scheme has been to maximise the viable reductions in total carbon dioxide emissions within the framework of the energy hierarchy.

6.3 The energy strategy of the scheme has considered measures to adapt and mitigate the effects of climate change leading to significant CO2 emission reductions, in particular through the application of a 'fabric first' approach leading to an improvement in the thermal performance of the existing building envelope of approximately 5% for the development.

6.4 A highly optimised energy strategy based on passive design, building fabric performance and building services systems and controls as well as the installation of ASHPs and PV panels will allow the scheme to achieve an improvement over the baseline scenario of approximately 59%, exceeding the planning policy target of 35%.

7.0 DISCLAIMER

7.1 Create Consulting disclaims any responsibility to the Client, Foster Kennedy Developments and others in respect of any matters outside the scope of this report.

7.2 The copyright of this report is vested in Create Consulting Engineers Ltd and Foster Kennedy Developments. The Client, or his appointed representatives, may copy the report for purposes in connection with the development described herein. It shall not be copied by any other party or used for any other purposes without the written consent of Create Consulting Engineers Ltd or Foster Kennedy Developments.

7.3 Create Consulting Engineers Ltd accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

APPENDICES

APPENDIX A

GLA Carbon Reporting Spreadsheet

The applicant should complete all the light blue cells including information on the modelled units, the area per unit, the number of units, the TER/DER/BER and the TFEE/DFEE.

RESIDENTIAL CO_2 ANALYSIS (PART L1)

				Baseline		'Be Lean'	'Be Clean'	'Be Green'	Fabric Energy Efficiency (FEE)		Baseline		'Be Lean'			'Be Clean'			'Be Green'	
Unit identifier (e.g. plot number, dwelling type etc.)	Model total floor area	Number of units	Total area represented by model	TER	Energy saving/generation technologies (-)	DER	DER	DER	Target Fabric Energy Efficiency	Dwelling Fabric Energy Efficiency	Part L 2021 CO_2 emissions	Energy saving/generation technologies	Part L 2021 CO_2 emissions	Part L 2021 CO_2 emissions with Notional PV savings included	'Be Lean' savings	Part L 2021 CO_2 emissions	Part L 2021 CO_2 emissions with Notional PV savings included	'Be Clean' savings	Part L 2021 CO_2 emissions	'Be Green' savings
	(m^2) (Row 4)		(m^2)	($kgCO_2$ / m^2) (Row 273)	($kgCO_2$ p.a.) (Row 269)	($kgCO_2$ / m^2) (Row 273 or 384)	($kgCO_2$ / m^2) (Row 273 or 384)	($kgCO_2$ / m^2) (Row 273 or 384)	(kWh/m^2)	(kWh/m^2)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)
HOUSE 1	*188.97*	*1*	*188.97*	**10.18**	**-340.27**	**11.92**	**11.92**	**4.25**	42.32	41.49	**1,924**	**-340**	**2,253**	**1,912**	**11**	**2,253**	**1,912**	**0**	**803**	**1,109**
HOUSE 2	*93.37*	*1*	*93.37*	**15.85**	**-285.57**	**17.05**	**17.05**	**6.49**	60.13	50.99	**1,480**	**-286**	**1,592**	**1,306**	**174**	**1,592**	**1,306**	**0**	**606**	**700**
Sum		**2**	**282**	**12.1**	**-322.2**	**13.6**	**13.6**	**5.0**	**48.2**	**44.6**	***3,404***	***-626***	***3,844***	***3,219***	***185***	***3,844***	***3,219***	***0***	***1,409***	***1,810***

NON-RESIDENTIAL CO_2 ANALYSIS (PART L2)

				Baseline		'Be Lean'	'Be Clean'	'Be Green'			Baseline		'Be Lean'			'Be Clean'			'Be Green'	
Building Use	Model Area	Number of units	Total area represented by model	BRUKL TER	BRUKL Displaced electricity (-)	BRUKL BER	BRUKL BER	BRUKL BER			Part L 2021 CO_2 emissions	Energy saving/generation technologies	Part L 2021 CO_2 emissions	Part L 2021 CO_2 emissions with Notional PV savings included	'Be Lean' savings	Part L 2021 CO_2 emissions	Part L 2021 CO_2 emissions with Notional PV savings included	'Be Clean' savings	Part L 2021 CO_2 emissions	'Be Green' savings
	(m^2)		(m^2)	($kgCO_2$ / m^2)	(kWh / m^2)	($kgCO_2$ / m^2)	($kgCO_2$ / m^2)	($kgCO_2$ / m^2)			($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)	($kgCO_2$ p.a.)
Sum		**0**	**0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**			***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
SITE-WIDE ENERGY CONSUMPTION AND CO_2 ANALYSIS																				
Total Sum			**282**	-	-	-	-	-			***3,404***	***-626***	***3,844***	***3,219***	***185***	***3,844***	***3,219***	***0***	***1,409***	***1,810***

Part L 2021 Performance

Residential

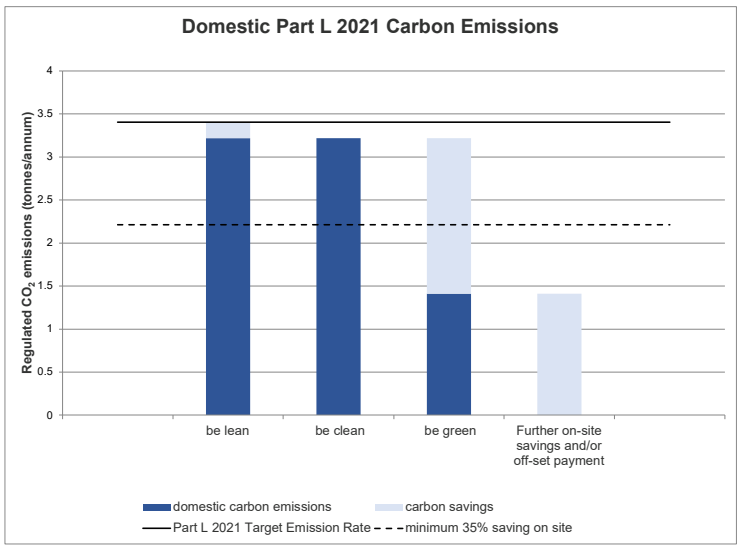
Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	3.4	1.5
After energy demand reduction (be lean)	3.2	1.5
After heat network connection (be clean)	3.2	1.5
After renewable energy (be green)	1.4	1.5

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

	Regulated residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.2	5%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1.8	53%
Cumulative on site savings	**2.0**	**59%**
Annual savings from off-set payment	1.4	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**42**	-
Cash in-lieu contribution (£)	**4,016**	

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



Non-residential

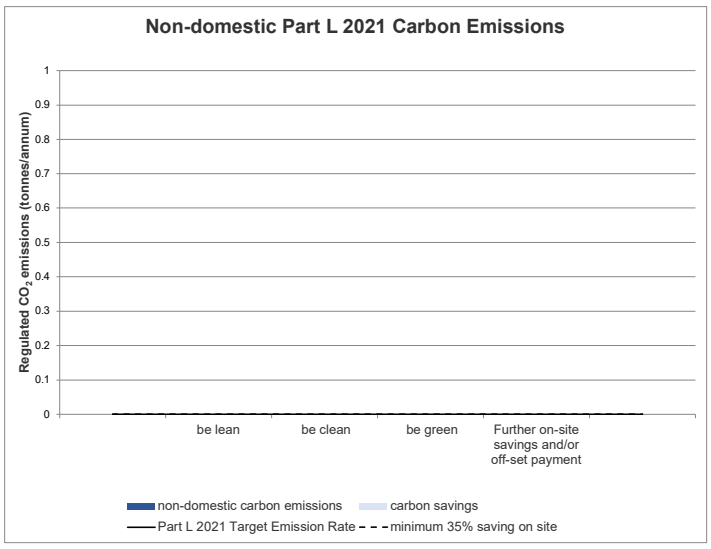
Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-residential buildings

	Carbon Dioxide Emissions for non-residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	0.0	
After energy demand reduction (be lean)	0.0	
After heat network connection (be clean)	0.0	
After renewable energy (be green)	0.0	

Table 4: Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-residential buildings

	Regulated non-residential carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	0.0	0%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	0.0	0%
Total Cumulative Savings	**0.0**	**0%**
Annual savings from off-set payment	0.0	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**0**	-
Cash in-lieu contribution (£)	**0**	

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



SITE-WIDE

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	3.4		
Be lean	3.2	0.2	5%
Be clean	3.2	0.0	0%
Be green	1.4	1.8	53%
Total Savings	-	2.0	59%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**42.3**	-

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	48.21	44.63	7%

	Area weighted non-residential cooling demand (MJ/m^2)	Total non-residential cooling demand (MJ/year)
Actual		
Notional		

EUI & space heating demand (predicted energy use)

Residential

Building type	EUI (kWh/m²/year) (excluding renewable energy)	Space heating demand (kWh/m²/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m²/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m²/year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)

Non-residential

Building type	EUI (kWh/m²/year) (excluding renewable energy)	Space heating demand (kWh/m²/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m²/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m²/year) (excluding renewable energy)	Methodology used (e.g. 'be seen' methodology or an alternative predictive energy modelling methodology)	Explanatory notes (if expected performance differs from the Table 4 values in the guidance)

APPENDIX B

SAP Worksheets – Baseline & Be Lean Case

Full SAP Calculation Printout

elmhurst energy

Property Reference	House 1	Issued on Date	23/01/2023
Assessment Reference	House 1 Be Lean	Prop Type Ref	
Property	House 1, 35, Twickenham Rd		

SAP Rating	85 B	DER	11.92	TER	10.18
Environmental	87 B	% DER < TER			-17.09
CO_2 Emissions (t/year)	1.96	DFEE	41.49	TFEE	42.32
Compliance Check	See BREL	% DFEE < TFEE			1.96
% DPER < TPER	-26.92	DPER	67.75	TPER	53.38

Assessor Details	Mrs. Deborah Elliott	Assessor ID	L377-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

---

2. Ventilation rate

---

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2764	0.2729	0.2695	0.2521	0.2487	0.2313	0.2313	0.2278	0.2382	0.2487	0.2556	0.2625	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K

Windows (Uw = 1.40)			36.9400	1.3258	48.9735		(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057		(27)
Entrance door			2.1600	1.1000	2.3760		(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000 (28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000 (28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993 (29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998 (29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600 (29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000 (30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100 (30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200 (30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600 (30)
Total net area of external elements Aum(A, m2)			406.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.0280		(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		183.5066 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		24.1532 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1139	46.5227	45.9314	42.9752	42.3839	39.4276	39.4276	38.8364	40.6101	42.3839	43.5664	44.7489	(38)
Heat transfer coeff	183.2952	182.7040	182.1127	179.1564	178.5652	175.6089	175.6089	175.0177	176.7914	178.5652	179.7477	180.9302	(39)

Average = Sum(39)m / 12 = 179.0086

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9668	0.9637	0.9481	0.9449	0.9293	0.9293	0.9262	0.9356	0.9449	0.9512	0.9575	(40)
HLP (average)												0.9473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9876	(42)
Hot water usage for mixer showers	102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)
Hot water usage for baths	32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)
Hot water usage for other uses	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)
Average daily hot water use (litres/day)												165.0615	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)
Energy content (annual)										Total = Sum(45)m =		2741.6891	
Distribution loss (46)m = 0.15 x (45)m	42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
									Total per year (kWh/year) = Sum(64)m =			3727.3117	(64)
12Total per year (kWh/year)												3727	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)

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

	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)

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

	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)

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

	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)

Total internal gains

	799.0747	819.1397	783.9973	756.0964	716.2443	652.6575	625.1500	625.8429	646.5437	707.3617	752.0590	781.3778	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787	(76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1243.5898	1593.0612	1875.5084	2143.7518	2288.6264	2217.8739	2132.7123	1997.4307	1842.2129	1572.6473	1287.8238	1159.4742	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5522	52.7223	52.8934	53.7662	53.9443	54.8524	54.8524	55.0377	54.4855	53.9443	53.5894	53.2391	
alpha	4.5035	4.5148	4.5262	4.5844	4.5963	4.6568	4.6568	4.6692	4.6324	4.5963	4.5726	4.5493	
util living area													
	0.9897	0.9702	0.9275	0.8255	0.6709	0.4960	0.3602	0.3996	0.6254	0.8822	0.9760	0.9922	(86)
MIT	19.9026	20.1463	20.4244	20.7075	20.8619	20.9200	20.9311	20.9298	20.8948	20.6671	20.2313	19.8670	(87)
Th 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(88)
util rest of house													
	0.9872	0.9637	0.9124	0.7938	0.6214	0.4335	0.2910	0.3270	0.5590	0.8521	0.9697	0.9904	(89)
MIT 2	19.1012	19.3429	19.6130	19.8844	20.0152	20.0695	20.0754	20.0777	20.0493	19.8577	19.4398	19.0746	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	19.1616	19.4035	19.6742	19.9465	20.0791	20.1336	20.1400	20.1420	20.1131	19.9188	19.4995	19.1344	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1616	19.4035	19.6742	19.9465	20.0791	20.1336	20.1400	20.1420	20.1131	19.9188	19.4995	19.1344	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9839	0.9573	0.9037	0.7866	0.6184	0.4328	0.2908	0.3267	0.5570	0.8437	0.9639	0.9877	(94)
Useful gains	1223.5412	1525.0864	1694.8976	1686.3577	1415.2617	959.9434	620.2359	652.4926	1026.1837	1326.8227	1241.3686	1145.2433	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2724.0666	2649.8495	2399.1984	1979.0537	1496.2133	971.7566	621.6521	654.9090	1063.0653	1664.0055	2228.7870	2702.0807	(97)
Space heating kWh													
	1116.3909	755.8408	523.9998	210.7411	60.2280	0.0000	0.0000	0.0000	0.0000	250.8640	710.9413	1158.2870	(98a)

Space heating requirement - total per year (kWh/year) 4787.2929

Solar heating kWh

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

	1116.3909	755.8408	523.9998	210.7411	60.2280	0.0000	0.0000	0.0000	0.0000	250.8640	710.9413	1158.2870	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 4787.2929

Space heating per m2 (98c) / (4) = 25.3336 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												84.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1116.3909	755.8408	523.9998	210.7411	60.2280	0.0000	0.0000	0.0000	0.0000	250.8640	710.9413	1158.2870	(98)
Space heating efficiency (main heating system 1)													
	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)													
	1329.0368	899.8105	623.8092	250.8823	71.7000	0.0000	0.0000	0.0000	0.0000	298.6476	846.3586	1378.9132	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
Efficiency of water heater												89.0000	(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)
Fuel for water heating, kWh/month													
	450.6288	399.4316	425.6094	376.0586	366.0493	294.9805	290.0450	301.8539	305.5618	379.5709	401.6346	445.8515	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	50.8694	45.9466	50.8694	49.2285	50.8694	49.2285	50.8694	50.8694	49.2285	50.8694	49.2285	50.8694	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	5699.1583	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	89.0000	
Water heating fuel used	4437.2759	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)		
mechanical ventilation fans (SFP = 0.8140)	512.9463	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	598.9463	(231)
Electricity for lighting (calculated in Appendix L)	288.1350	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	11023.5154	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5699.1583	0.2100	1196.8232	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4437.2759	0.2100	931.8279	(264)
Space and water heating			2128.6512	(265)
Pumps, fans and electric keep-hot	598.9463	0.1387	83.0812	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Total CO2, kg/year			2253.3192	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.9200	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5699.1583	1.1300	6440.0488	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	1.1300	5014.1217	(278)
Space and water heating			11454.1706	(279)
Pumps, fans and electric keep-hot	598.9463	1.5128	906.0859	(281)
Energy for lighting	288.1350	1.5338	441.9511	(282)
Total Primary energy kWh/year			12802.2075	(286)
Dwelling Primary energy Rate (DPER)			67.7500	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0774	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3274	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3029	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3862	0.3786	0.3710	0.3332	0.3256	0.2877	0.2877	0.2802	0.3029	0.3256	0.3407	0.3559	(22b)
Effective ac	0.5746	0.5717	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5459	0.5530	0.5581	0.5633	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			45.0000	1.1450	51.5267			(27)
LGF			53.1800	0.1300	6.9134			(28a)
Upper floor - above entrance			2.5900	0.1300	0.3367			(28a)
LGF wall	66.0900	14.7600	51.3300	0.1800	9.2394			(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1800	23.2020			(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1800	8.7156			(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849			(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159			(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718			(30)
Dormers	4.6400		4.6400	0.1100	0.5104			(30)

Total net area of external elements Aum(A, m2) 406.8800 (31)
Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 110.3768 (33)
Party Wall 1 47.4000 0.0000 0.0000 (32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0500	1.3740
E4 Jamb	106.2600	0.0500	5.3130
E5 Ground floor (normal)	23.1900	0.1600	3.7104
E6 Intermediate floor within a dwelling	84.2200	0.0000	0.0000
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.2400	1.1472
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.2946 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 133.6714 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	97.9358	97.4423	96.9585	94.6862	94.2611	92.2821	92.2821	91.9156	93.0444	94.2611	95.1212	96.0203	(38)
Heat transfer coeff	231.6072	231.1137	230.6299	228.3577	227.9325	225.9535	225.9535	225.5870	226.7158	227.9325	228.7926	229.6917	(39)

Average = Sum(39)m / 12 = 228.3556

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2256	1.2230	1.2205	1.2084	1.2062	1.1957	1.1957	1.1938	1.1997	1.2062	1.2107	1.2155	(40)
HLP (average)												1.2084	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)
Hot water usage for mixer showers

74.3113	73.1945	71.5672	68.4536	66.1558	63.5934	62.1369	63.7519	65.5223	68.2735	71.4540	74.0266	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 139.3694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.6163	148.3785	144.4357	138.4405	133.5719	128.3378	126.3266	130.2524	134.3927	139.8875	145.9751	151.2231	(44)
Energy conte	240.1231	211.2891	221.9923	189.5182	179.8135	157.8064	152.7810	161.2796	165.7196	189.8261	207.9683	236.7788	(45)

Energy content (annual) Total = Sum(45)m = 2314.8960

Distribution loss (46)m = 0.15 x (45)m

36.0185	31.6934	33.2989	28.4277	26.9720	23.6710	22.9172	24.1919	24.8579	28.4739	31.1952	35.5168	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)
Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

286.7180	253.3748	268.5872	234.6100	226.4084	202.8982	199.3759	207.8745	210.8114	236.4210	253.0601	283.3738	(62)
WWHRS -33.9720	-30.0451	-31.4615	-26.0514	-24.2790	-20.7757	-19.4739	-20.7085	-21.4953	-25.3406	-28.7078	-33.3429	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

252.7460	223.3297	237.1257	208.5586	202.1295	182.1225	179.9021	187.1660	189.3161	211.0804	224.3523	250.0309	(64)

Total per year (kWh/year) = Sum(64)m = 2547.8597 (64)
12Total per year (kWh/year) 2548 (64)
Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

117.1169	103.9222	111.0884	99.0883	97.0639	88.5441	88.0756	90.9014	91.1752	100.3931	105.2229	116.0049	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)

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

	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020 (71)
Water heating gains (Table 5)												
	157.4151	154.6461	149.3123	137.6226	130.4622	122.9779	118.3812	122.1793	126.6323	134.9369	146.1429	155.9206 (72)
Total internal gains												
	770.4662	790.9159	756.6784	730.9834	692.4344	664.2046	637.6444	637.7023	657.6405	682.9504	725.5451	753.0681 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	15.4800	19.6403	0.6300	0.7000	0.7700	92.9159	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1214.9813	1564.8374	1848.1894	2118.6389	2264.8164	2229.4209	2145.2067	2009.2901	1853.3097	1548.2360	1261.3098	1131.1645	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.5901	41.6789	41.7663	42.1819	42.2606	42.6308	42.6308	42.7000	42.4874	42.2606	42.1018	41.9370	
alpha	3.7727	3.7786	3.7844	3.8121	3.8174	3.8421	3.8421	3.8467	3.8325	3.8174	3.8068	3.7958	
util living area													
	0.9913	0.9777	0.9496	0.8825	0.7654	0.5994	0.4502	0.4960	0.7212	0.9217	0.9819	0.9933	(86)
MIT	19.1196	19.4523	19.8768	20.3668	20.7261	20.9219	20.9798	20.9707	20.8382	20.3310	19.6245	19.0645	(87)
Th 2	19.8996	19.9016	19.9037	19.9133	19.9151	19.9234	19.9234	19.9250	19.9202	19.9151	19.9114	19.9076	(88)
util rest of house													
	0.9891	0.9722	0.9372	0.8541	0.7113	0.5151	0.3460	0.3889	0.6428	0.8962	0.9766	0.9916	(89)
MIT 2	17.7151	18.1379	18.6710	19.2717	19.6771	19.8737	19.9155	19.9124	19.8034	19.2457	18.3667	17.6501	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	17.8211	18.2371	18.7620	19.3544	19.7563	19.9528	19.9958	19.9923	19.8815	19.3276	18.4617	17.7568	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8211	18.2371	18.7620	19.3544	19.7563	19.9528	19.9958	19.9923	19.8815	19.3276	18.4617	17.7568	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9605	0.9203	0.8366	0.7025	0.5175	0.3532	0.3959	0.6397	0.8785	0.9661	0.9863	(94)
Useful gains	1193.8565	1502.9509	1700.9170	1772.5584	1590.9628	1153.8177	757.7394	795.4895	1185.5236	1360.1724	1218.6004	1115.6201	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	3131.5916	3082.3921	2827.9831	2387.3373	1836.2851	1209.4923	767.2940	810.3776	1310.7492	1989.2989	2599.4615	3113.8861	(97)
Space heating kWh													
	1441.6749	1061.3845	838.5371	442.6408	182.5198	0.0000	0.0000	0.0000	0.0000	468.0701	994.2200	1486.7098	(98a)
Space heating requirement - total per year (kWh/year)												6915.7571	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1441.6749	1061.3845	838.5371	442.6408	182.5198	0.0000	0.0000	0.0000	0.0000	468.0701	994.2200	1486.7098	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6915.7571	
Space heating per m2											(98c) / (4) =	36.5971	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	92.3000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1441.6749	1061.3845	838.5371	442.6408	182.5198	0.0000	0.0000	0.0000	0.0000	468.0701	994.2200	1486.7098	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)

Space heating fuel (main heating system)

1561.9446	1149.9290	908.4909	479.5675	197.7462	0.0000	0.0000	0.0000	0.0000	507.1182	1077.1614	1610.7366 (211)

Space heating efficiency (main heating system 2)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)

Space heating fuel (main heating system 2)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)

Space heating fuel (secondary)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating

Water heating requirement

252.7460	223.3297	237.1257	208.5586	202.1295	182.1225	179.9021	187.1660	189.3161	211.0804	224.3523	250.0309 (64)

Efficiency of water heater 79.8000 (216)

(217)m 87.3308	87.0925	86.6458	85.7043	83.8316	79.8000	79.8000	79.8000	79.8000	85.7927	86.9936	87.3812 (217)

Fuel for water heating, kWh/month

289.4121	256.4281	273.6726	243.3467	241.1135	228.2237	225.4412	234.5439	237.2383	246.0352	257.8951	286.1380 (219)

Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa 7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting 37.7744	30.3040	27.2854	19.9905	15.4412	12.6156	14.0860	18.3095	23.7822	31.2036	35.2443	38.8242 (232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m -51.5448	-73.6172	-107.1456	-121.9592	-132.6621	-124.0990	-122.4254	-114.9328	-102.0238	-84.7073	-56.9493	-44.4417 (233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m -26.3212	-55.6658	-111.2323	-167.9797	-223.0773	-224.6199	-222.1219	-187.7561	-137.1046	-80.0803	-35.2838	-20.8038 (233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year

Space heating fuel - main system 1 7492.6946 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 79.8000
Water heating fuel used 3019.4883 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 86.0000 (231)
Electricity for lighting (calculated in Appendix L) 304.8608 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -2628.5548 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 8274.4890 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7492.6946	0.2100	1573.4659	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3019.4883	0.2100	634.0926	(264)
Space and water heating			2207.5584	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	304.8608	0.1443	44.0008	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1136.5081	0.1343	-152.6894	
PV Unit electricity exported	-1492.0467	0.1257	-187.5791	
Total			-340.2685	(269)
Total CO2, kg/year			1923.2200	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.1800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	7492.6946	1.1300	8466.7448	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3019.4883	1.1300	3412.0218	(278)
Space and water heating			11878.7667	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	304.8608	1.5338	467.6057	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1136.5081	1.4965	-1700.8075	

PV Unit electricity exported	-1492.0467		0.4615	-688.5299
Total				-2389.3374 (283)
Total Primary energy kWh/year				10087.1358 (286)
Target Primary Energy Rate (TPER)				53.3800 (287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0774	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2274	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2104	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2682	0.2630	0.2577	0.2314	0.2262	0.1999	0.1999	0.1946	0.2104	0.2262	0.2367	0.2472	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	0.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5360	0.5346	0.5332	0.5268	0.5256	0.5200	0.5200	0.5189	0.5221	0.5256	0.5280	0.5306	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	112.0280			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34677.2492 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	91.3581	91.1199	90.8865	89.7902	89.5851	88.6303	88.6303	88.4535	88.9981	89.5851	90.0001	90.4339	(38)
Heat transfer coeff	227.5393	227.3012	227.0678	225.9715	225.7664	224.8116	224.8116	224.6348	225.1794	225.7664	226.1814	226.6152	(39)

Average = Sum(39)m / 12 = 225.9705

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2041	1.2028	1.2016	1.1958	1.1947	1.1897	1.1897	1.1887	1.1916	1.1947	1.1969	1.1992	(40)
HLP (average)												1.1958	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)
Hot water usage for other uses	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 70.8569 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	77.3050	75.1840	72.8685	69.9870	67.4161	64.7445	64.1897	66.5005	68.8704	71.6140	74.5211	77.1966	(44)
Energy conte	122.4322	107.0610	111.9962	95.8086	90.7550	79.6109	77.6318	82.3415	84.9241	97.1795	106.1689	120.8712	(45)

Energy content (annual) Total = Sum(45)m = 1176.7810

Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(64)

Total per year (kWh/year) = Sum(64)m = 1000.2639 (64)
12Total per year (kWh/year) 1000 (64)

Electric shower(s)	59.5109	53.0247	57.9010	55.2542	56.2910	53.6962	55.4860	56.2910	55.2542	57.9010	56.8122	59.5109	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 676.9335 (64a)

Heat gains from water heating, kWh/month	40.8946	36.0067	38.2744	34.1729	33.3582	30.3414	30.3683	31.5703	31.8599	35.1259	36.7639	40.5629	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	54.9658	53.5813	51.4442	47.4623	44.8363	42.1408	40.8176	42.4332	44.2499	47.2122	51.0610	54.5200 (72)

Total internal gains

	665.0169	686.8511	655.8102	637.8232	603.8084	583.3674	560.0808	557.9562	575.2581	592.2256	627.4632	648.6675 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372 (76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898 (77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433 (78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898 (79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764 (80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787 (76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1109.5320	1460.7726	1747.3212	2025.4786	2176.1904	2148.5838	2067.6430	1929.5440	1770.9273	1457.5112	1163.2279	1026.7639	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.3336	42.3780	42.4216	42.6274	42.6661	42.8473	42.8473	42.8810	42.7773	42.6661	42.5878	42.5063	
alpha	3.8222	3.8252	3.8281	3.8418	3.8444	3.8565	3.8565	3.8587	3.8518	3.8444	3.8392	3.8338	
util living area													
	0.9936	0.9819	0.9564	0.8932	0.7791	0.6147	0.4635	0.5121	0.7390	0.9327	0.9860	0.9952	(86)
MIT	19.0863	19.4208	19.8491	20.3424	20.7127	20.9159	20.9780	20.9678	20.8257	20.2971	19.5809	19.0218	(87)
Th 2	19.9167	19.9177	19.9187	19.9234	19.9242	19.9283	19.9283	19.9290	19.9267	19.9242	19.9225	19.9206	(88)
util rest of house													
	0.9919	0.9774	0.9455	0.8666	0.7264	0.5300	0.3573	0.4029	0.6620	0.9100	0.9818	0.9939	(89)
MIT 2	18.1766	18.5085	18.9286	19.4004	19.7280	19.8862	19.9215	19.9181	19.8273	19.3705	18.6731	18.1152	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	18.2452	18.5773	18.9981	19.4715	19.8024	19.9639	20.0012	19.9973	19.9027	19.4405	18.7416	18.1836	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2452	18.5773	18.9981	19.4715	19.8024	19.9639	20.0012	19.9973	19.9027	19.4405	18.7416	18.1836	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9882	0.9697	0.9336	0.8533	0.7197	0.5330	0.3647	0.4102	0.6601	0.8970	0.9753	0.9910	(94)
Useful gains	1096.4471	1416.5421	1631.2684	1728.4056	1566.2994	1145.1592	754.1524	791.5089	1168.9426	1307.3518	1134.4720	1017.4977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	3173.0819	3108.8723	2837.9078	2388.8591	1829.2389	1205.8627	764.6312	808.0885	1306.6413	1995.8768	2633.1211	3168.8998	(97)
Space heating kWh													
	1545.0163	1137.2459	897.7397	475.5266	195.6270	0.0000	0.0000	0.0000	0.0000	512.2626	1079.0273	1600.6431	(98a)
Space heating requirement - total per year (kWh/year)												7443.0884	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1545.0163	1137.2459	897.7397	475.5266	195.6270	0.0000	0.0000	0.0000	0.0000	512.2626	1079.0273	1600.6431	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7443.0884	
Space heating per m2											(98c) / (4) =	39.3877	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2113.2289	1663.6057	1707.2242	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8455	0.9040	0.8786	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1786.6736	1503.8753	1499.9449	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2429.3847	2338.2181	2180.4737	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	462.7520	620.7511	506.3134	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	115.6880	155.1878	126.5784	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												397.4541	(107)
Energy for space heating												39.3877	(99)
Energy for space cooling												2.1033	(108)

Total 41.4909 (109)
Fabric Energy Efficiency (DFEE) 41.5 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

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2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0774	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3274	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3029	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3862	0.3786	0.3710	0.3332	0.3256	0.2877	0.2877	0.2802	0.3029	0.3256	0.3407	0.3559	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5746	0.5717	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5459	0.5530	0.5581	0.5633	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			45.0000	1.1450	51.5267			(27)
LGF			53.1800	0.1300	6.9134			(28a)
Upper floor - above entrance			2.5900	0.1300	0.3367			(28a)
LGF wall	66.0900	14.7600	51.3300	0.1800	9.2394			(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1800	23.2020			(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1800	8.7156			(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849			(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159			(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718			(30)
Dormers	4.6400		4.6400	0.1100	0.5104			(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.3768			(33)
Party Wall 1			47.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255

E3 Sill	27.4800	0.0500	1.3740	
E4 Jamb	106.2600	0.0500	5.3130	
E5 Ground floor (normal)	23.1900	0.1600	3.7104	
E6 Intermediate floor within a dwelling	84.2200	0.0000	0.0000	
E16 Corner (normal)	70.2700	0.0900	6.3243	
E18 Party wall between dwellings	12.1000	0.0600	0.7260	
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186	
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.2400	1.1472	
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296	
E20 Exposed floor (normal)	2.1000	0.3200	0.6720	
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588	
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420	
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.2946 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 133.6714 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	97.9358	97.4423	96.9585	94.6862	94.2611	92.2821	92.2821	91.9156	93.0444	94.2611	95.1212	96.0203	(38)
Heat transfer coeff	231.6072	231.1137	230.6299	228.3577	227.9325	225.9535	225.9535	225.5870	226.7158	227.9325	228.7926	229.6917	(39)

Average = Sum(39)m / 12 = 228.3556

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2256	1.2230	1.2205	1.2084	1.2062	1.1957	1.1957	1.1938	1.1997	1.2062	1.2107	1.2155	(40)
HLP (average)												1.2084	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 70.8569 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	77.3050	75.1840	72.8685	69.9870	67.4161	64.7445	64.1897	66.5005	68.8704	71.6140	74.5211	77.1966	(44)
Energy conte	122.4322	107.0610	111.9962	95.8086	90.7550	79.6109	77.6318	82.3415	84.9241	97.1795	106.1689	120.8712	(45)

Energy content (annual) Total = Sum(45)m = 1176.7810

Distribution loss (46)m = 0.15 x (45)m

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(64)

Total per year (kWh/year) = Sum(64)m = 1000.2639 (64)

12Total per year (kWh/year) 1000 (64)

Electric shower(s)

59.5109	53.0247	57.9010	55.2542	56.2910	53.6962	55.4860	56.2910	55.2542	57.9010	56.8122	59.5109	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 676.9335 (64a)

Heat gains from water heating, kWh/month

40.8946	36.0067	38.2744	34.1729	33.3582	30.3414	30.3683	31.5703	31.8599	35.1259	36.7639	40.5629	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)	54.9658	53.5813	51.4442	47.4623	44.8363	42.1408	40.8176	42.4332	44.2499	47.2122	51.0610	54.5200	(72)
Total internal gains	665.0169	686.8511	655.8102	637.8232	603.8084	583.3674	560.0808	557.9562	575.2581	592.2256	627.4632	648.6675	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	15.4800	19.6403	0.6300	0.7000	0.7700	92.9159	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1109.5320	1460.7726	1747.3212	2025.4786	2176.1904	2148.5838	2067.6430	1929.5440	1770.9273	1457.5112	1163.2279	1026.7639	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.5901	41.6789	41.7663	42.1819	42.2606	42.6308	42.6308	42.7000	42.4874	42.2606	42.1018	41.9370	
alpha	3.7727	3.7786	3.7844	3.8121	3.8174	3.8421	3.8421	3.8467	3.8325	3.8174	3.8068	3.7958	
util living area	0.9936	0.9820	0.9571	0.8946	0.7819	0.6167	0.4654	0.5137	0.7413	0.9335	0.9861	0.9952	(86)
MIT	19.0476	19.3849	19.8184	20.3260	20.7034	20.9139	20.9773	20.9670	20.8213	20.2838	19.5598	18.9925	(87)
Th 2	19.8996	19.9016	19.9037	19.9133	19.9151	19.9234	19.9234	19.9250	19.9202	19.9151	19.9114	19.9076	(88)
util rest of house	0.9919	0.9776	0.9463	0.8682	0.7291	0.5316	0.3584	0.4040	0.6641	0.9109	0.9819	0.9939	(89)
MIT 2	18.1258	18.4612	18.8874	19.3771	19.7124	19.8803	19.9164	19.9138	19.8183	19.3509	18.6441	18.0768	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	18.1954	18.5309	18.9577	19.4487	19.7872	19.9583	19.9965	19.9933	19.8940	19.4213	18.7132	18.1459	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1954	18.5309	18.9577	19.4487	19.7872	19.9583	19.9965	19.9933	19.8940	19.4213	18.7132	18.1459	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9881	0.9698	0.9342	0.8547	0.7222	0.5345	0.3659	0.4113	0.6619	0.8977	0.9753	0.9909	(94)
Useful gains	1096.3662	1416.7170	1632.4199	1731.2346	1571.5814	1148.5223	756.6495	793.6289	1172.2642	1308.4556	1134.5054	1017.4332	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3218.2704	3150.2888	2873.1127	2408.8872	1843.3397	1210.7307	767.4504	810.6065	1313.5825	2010.6579	2657.0223	3203.2472	(97)
Space heating kWh	1578.6967	1164.9602	923.0754	487.9099	202.1882	0.0000	0.0000	0.0000	0.0000	522.4385	1096.2122	1626.2456	(98a)
Space heating requirement - total per year (kWh/year)												7601.7268	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1578.6967	1164.9602	923.0754	487.9099	202.1882	0.0000	0.0000	0.0000	0.0000	522.4385	1096.2122	1626.2456	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7601.7268	
Space heating per m2										(98c) / (4) =		40.2272	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	2123.9628	1672.0558	1714.4612	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8431	0.9022	0.8768	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1790.7497	1508.4549	1503.3131	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2429.3847	2338.2181	2180.4737	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	459.8172	617.3439	503.8075	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	114.9543	154.3360	125.9519	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												395.2421	(107)
Energy for space heating												40.2272	(99)
Energy for space cooling												2.0916	(108)
Total												42.3187	(109)
Fabric Energy Efficiency (TFEE)												42.3	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2764	0.2729	0.2695	0.2521	0.2487	0.2313	0.2313	0.2278	0.2382	0.2487	0.2556	0.2625	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.0280			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		183.5066 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255

E3 Sill	27.4800	0.0320	0.8794	
E4 Jamb	106.2600	0.0340	3.6128	
E5 Ground floor (normal)	23.1900	0.0560	1.2986	
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954	
E16 Corner (normal)	70.2700	0.0900	6.3243	
E18 Party wall between dwellings	12.1000	0.0600	0.7260	
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186	
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170	
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296	
E20 Exposed floor (normal)	2.1000	0.3200	0.6720	
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588	
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420	
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1139	46.5227	45.9314	42.9752	42.3839	39.4276	39.4276	38.8364	40.6101	42.3839	43.5664	44.7489	(38)
Heat transfer coeff	183.2952	182.7040	182.1127	179.1564	178.5652	175.6089	175.6089	175.0177	176.7914	178.5652	179.7477	180.9302	(39)

Average = Sum(39)m / 12 = 179.0086

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9668	0.9637	0.9481	0.9449	0.9293	0.9293	0.9262	0.9356	0.9449	0.9512	0.9575	(40)
HLP (average)												0.9473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)

Energy content (annual) Total = Sum(45)m = 2741.6891

Distribution loss (46)m = 0.15 x (45)m

42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)

Water storage loss:

Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)

Total per year (kWh/year) = Sum(64)m = 3727.3117 (64)

Electric shower(s)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302 (72)
Total internal gains	883.4434	881.3115	854.2400	803.2387	751.3396	667.3707	639.2237	642.6349	668.6834	752.6018	809.3462	859.0470 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372 (76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898 (77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433 (78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898 (79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764 (80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787 (76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964 (83)
Total gains	1327.9585	1655.2331	1945.7510	2190.8942	2323.7216	2232.5870	2146.7860	2014.2227	1864.3526	1617.8874	1345.1110	1237.1434 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5522	52.7223	52.8934	53.7662	53.9443	54.8524	54.8524	55.0377	54.4855	53.9443	53.5894	53.2391	
alpha	4.5035	4.5148	4.5262	4.5844	4.5963	4.6568	4.6568	4.6692	4.6324	4.5963	4.5726	4.5493	
util living area	0.9867	0.9660	0.9189	0.8166	0.6633	0.4930	0.3579	0.3964	0.6194	0.8729	0.9719	0.9900	(86)
MIT	19.9473	20.1763	20.4517	20.7185	20.8652	20.9203	20.9311	20.9299	20.8963	20.6812	20.2598	19.9089	(87)
Th 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(88)
util rest of house	0.9836	0.9587	0.9026	0.7842	0.6138	0.4308	0.2891	0.3243	0.5532	0.8414	0.9646	0.9877	(89)
MIT 2	19.1453	19.3719	19.6384	19.8936	20.0175	20.0696	20.0754	20.0777	20.0502	19.8697	19.4673	19.1160	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	19.2058	19.4326	19.6997	19.9558	20.0814	20.1338	20.1400	20.1420	20.1140	19.9309	19.5271	19.1759	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2058	19.4326	19.6997	19.9558	20.0814	20.1338	20.1400	20.1420	20.1140	19.9309	19.5271	19.1759	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9797	0.9518	0.8938	0.7772	0.6109	0.4301	0.2889	0.3240	0.5513	0.8332	0.9584	0.9844	(94)
Useful gains	1300.9601	1575.5329	1739.0969	1702.8077	1419.5482	960.2774	620.2794	652.5852	1027.8517	1347.9772	1289.1713	1217.9018	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2732.1651	2655.1596	2403.8421	1980.7230	1496.6349	971.7891	621.6565	654.9184	1063.2291	1666.1786	2233.7505	2709.5871	(97)
Space heating kWh	1064.8165	725.5092	494.5705	200.0990	57.3525	0.0000	0.0000	0.0000	0.0000	236.7418	680.0970	1109.8139	(98a)
Space heating requirement - total per year (kWh/year)												4569.0004	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1064.8165	725.5092	494.5705	200.0990	57.3525	0.0000	0.0000	0.0000	0.0000	236.7418	680.0970	1109.8139	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4569.0004	
Space heating per m2											(98c) / (4) =	24.1784	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	84.0000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1064.8165	725.5092	494.5705	200.0990	57.3525	0.0000	0.0000	0.0000	0.0000	236.7418	680.0970	1109.8139	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	1267.6387	863.7014	588.7744	238.2131	68.2768	0.0000	0.0000	0.0000	0.0000	281.8355	809.6393	1321.2070	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)

Water heating
Water heating requirement

	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152 (64)
Efficiency of water heater												89.0000 (216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000 (217)
Fuel for water heating, kWh/month												
	450.6288	399.4316	425.6094	376.0586	366.0493	294.9805	290.0450	301.8539	305.5618	379.5709	401.6346	445.8515 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	50.8694	45.9466	50.8694	49.2285	50.8694	49.2285	50.8694	50.8694	49.2285	50.8694	49.2285	50.8694 (231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	5439.2861 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.0000
Water heating fuel used	4437.2759 (219)
Space cooling fuel	0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)

mechanical ventilation fans (SFP = 0.8140)	512.9463 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	598.9463 (231)
Electricity for lighting (calculated in Appendix L)	288.1350 (232)

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

PV generation	0.0000 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	10763.6433 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5439.2861	3.6400	197.9900	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	3.6400	161.5168	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	598.9463	16.4900	98.7662	(249)
Energy for lighting	288.1350	16.4900	47.5135	(250)
Additional standing charges			92.0000	(251)
Total energy cost			597.7866	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9198 (257)
SAP value		85.0902
SAP rating (Section 12)		85 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5439.2861	0.2100	1142.2501	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4437.2759	0.2100	931.8279	(264)
Space and water heating			2074.0780	(265)
Pumps, fans and electric keep-hot	598.9463	0.1387	83.0812	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)

Total CO2, kg/year	2198.7460 (272)
CO2 emissions per m2	11.6400 (273)
EI value	87.4073
EI rating	87 (274)
EI band	B

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
Infiltration rate			0.1500 (18)
Number of sides sheltered			1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2452	0.2382	0.2382	0.2278	0.2278	0.2140	0.2174	0.2105	0.2140	0.2209	0.2209	0.2313	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)

Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	112.0280		(33)
Party Wall 1	47.4000	0.0000	0.0000	70.0000	3318.0001	(32)
Heat capacity Cm = Sum(A x k)			(28)...(30) + (32) + (32a)...(32e) =		34677.2492	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					183.5066	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K)					24.1532	(36)
Point Thermal bridges				(36a) =	0.0000	
Total fabric heat loss			(33) + (36) + (36a) =		136.1813	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.7926	40.6101	40.6101	38.8364	38.8364	36.4714	37.0626	35.8801	36.4714	37.6539	37.6539	39.4276	(38)
Heat transfer coeff	177.9739	176.7914	176.7914	175.0177	175.0177	172.6526	173.2439	172.0614	172.6526	173.8352	173.8352	175.6089	(39)
Average = Sum(39)m / 12 =												174.6235	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9418	0.9356	0.9356	0.9262	0.9262	0.9137	0.9168	0.9105	0.9137	0.9199	0.9199	0.9293	(40)
HLP (average)												0.9241	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy											2.9876	(42)
Hot water usage for mixer showers	102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)
Hot water usage for baths	32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)
Hot water usage for other uses	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)
Average daily hot water use (litres/day)												165.0615	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)
Energy content (annual)										Total = Sum(45)m =		2741.6891	
Distribution loss (46)m = 0.15 x (45)m	42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)

Water storage loss:		
Store volume	150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6300	(48)
Temperature factor from Table 2b	0.7800	(49)
Enter (49) or (54) in (55)	1.2714	(55)

Total storage loss	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
								Total per year (kWh/year) = Sum(64)m =				3727.3117	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020 (71)
Water heating gains (Table 5)												
	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302 (72)
Total internal gains												
	883.4434	881.3115	854.2400	803.2387	751.3396	667.3707	639.2237	642.6349	668.6834	752.6018	809.3462	859.0470 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	22.3313	0.6300	0.7000	0.7700	50.6396	(76)
Southeast	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(77)
South	18.6200	50.9848	0.6300	0.7000	0.7700	290.1299	(78)
Southwest	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(79)
West	7.0600	22.3313	0.6300	0.7000	0.7700	48.1827	(80)
East	8.0600	22.3313	0.6300	0.7000	0.7700	55.0074	(76)

Solar gains	491.4531	769.8871	1073.7637	1411.2838	1563.6503	1668.8568	1588.6946	1473.3885	1276.2839	919.2490	606.7907	414.0311	(83)
Total gains	1374.8965	1651.1987	1928.0037	2214.5225	2314.9898	2336.2275	2227.9183	2116.0234	1944.9673	1671.8508	1416.1369	1273.0781	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1235	54.4855	54.4855	55.0377	55.0377	55.7916	55.6012	55.9833	55.7916	55.4121	55.4121	54.8524	
alpha	4.6082	4.6324	4.6324	4.6692	4.6692	4.7194	4.7067	4.7322	4.7194	4.6941	4.6941	4.6568	
util living area													
	0.9812	0.9587	0.8999	0.7658	0.5806	0.3674	0.2408	0.2599	0.5037	0.8148	0.9553	0.9858	(86)
MIT	20.0949	20.2874	20.5538	20.7935	20.9018	20.9316	20.9340	20.9342	20.9221	20.7794	20.4180	20.0610	(87)
Th 2	20.1321	20.1374	20.1374	20.1453	20.1453	20.1559	20.1533	20.1586	20.1559	20.1506	20.1506	20.1427	(88)
util rest of house													
	0.9768	0.9498	0.8798	0.7273	0.5258	0.3063	0.1752	0.1917	0.4348	0.7727	0.9438	0.9824	(89)
MIT 2	19.3110	19.5028	19.7557	19.9754	20.0600	20.0892	20.0875	20.0931	20.0846	19.9740	19.6434	19.2867	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	19.3702	19.5620	19.8160	20.0371	20.1236	20.1528	20.1513	20.1566	20.1478	20.0348	19.7018	19.3451	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3702	19.5620	19.8160	20.0371	20.1236	20.1528	20.1513	20.1566	20.1478	20.0348	19.7018	19.3451	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9720	0.9426	0.8713	0.7221	0.5243	0.3061	0.1750	0.1916	0.4341	0.7663	0.9364	0.9784	(94)
Useful gains	1336.3746	1556.4712	1679.9036	1599.0419	1213.7753	715.1073	389.9411	405.3400	844.2992	1281.2110	1326.0862	1245.5664	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2539.7198	2468.3658	2195.0338	1774.1721	1246.7489	716.9942	390.0293	405.4718	854.2521	1466.2608	2034.1900	2501.5712	(97)
Space heating kWh													
	895.2888	612.7932	383.2569	126.0937	24.5323	0.0000	0.0000	0.0000	0.0000	137.6770	509.8347	934.4675	(98a)
Space heating requirement - total per year (kWh/year)												3623.9443	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	895.2888	612.7932	383.2569	126.0937	24.5323	0.0000	0.0000	0.0000	0.0000	137.6770	509.8347	934.4675	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3623.9443	
Space heating per m2											(98c) / (4) =	19.1774	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	84.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	895.2888	612.7932	383.2569	126.0937	24.5323	0.0000	0.0000	0.0000	0.0000	137.6770	509.8347	934.4675	(98)
Space heating efficiency (main heating system 1)													
	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)

Space heating fuel (main heating system)
1065.8200 729.5157 456.2582 150.1116 29.2052 0.0000 0.0000 0.0000 0.0000 163.9012 606.9461 1112.4614 (211)
Space heating efficiency (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (212)
Space heating fuel (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (213)
Space heating fuel (secondary)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (215)

Water heating
Water heating requirement
378.5282 335.5226 357.5119 315.8893 307.4814 247.7837 243.6378 253.5572 256.6719 318.8395 337.3730 374.5152 (64)
Efficiency of water heater 89.0000 (216)
(217)m 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 (217)
Fuel for water heating, kWh/month
450.6288 399.4316 425.6094 376.0586 366.0493 294.9805 290.0450 301.8539 305.5618 379.5709 401.6346 445.8515 (219)
Space cooling fuel requirement
(221)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (221)
Pumps and Fa 50.8694 45.9466 50.8694 49.2285 50.8694 49.2285 50.8694 50.8694 49.2285 50.8694 49.2285 50.8694 (231)
Lighting 35.7019 28.6414 25.7884 18.8937 14.5940 11.9235 13.3132 17.3050 22.4774 29.4916 33.3107 36.6942 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1 4314.2194 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 89.0000
Water heating fuel used 4437.2759 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)
mechanical ventilation fans (SFP = 0.8140) 512.9463 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 598.9463 (231)
Electricity for lighting (calculated in Appendix L) 288.1350 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 9638.5765 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4314.2194	3.5000	150.9977	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	3.5000	155.3047	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	598.9463	18.3900	110.1462	(249)
Energy for lighting	288.1350	18.3900	52.9880	(250)
Additional standing charges			94.0000	(251)
Total energy cost			563.4366	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4314.2194	0.2100	905.9861	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4437.2759	0.2100	931.8279	(264)
Space and water heating			1837.8140	(265)
Pumps, fans and electric keep-hot	598.9463	0.1387	83.0812	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Total CO2, kg/year			1962.4820	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4314.2194	1.1300	4875.0679	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	1.1300	5014.1217	(278)
Space and water heating			9889.1896	(279)
Pumps, fans and electric keep-hot	598.9463	1.5128	906.0859	(281)
Energy for lighting	288.1350	1.5338	441.9511	(282)
Total Primary energy kWh/year			11237.2266	(286)

SAP 10 EPC IMPROVEMENTS

House 1 Be Lean

Current energy efficiency rating: B 85
Current environmental impact rating: B 87

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

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 3.7	-£ 173	-125 kg (6.4%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.6	-£ 25	-225 kg (11.5%)	

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	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£173	0.66 kg/m²	B 89	B 88
Total Savings	£173	0.66 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 88

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£163	£163	£0
Mains gas	£400	£400	£0
Space heating	£355	£355	£0
Water heating	£155	£155	£0
Lighting	£53	£53	£0
Generated (PV)	-£0	-£173	£173
Total cost of fuels	£563	£390	£173
Total cost of uses	£563	£390	£173
Delivered energy	51 kWh/m²	46 kWh/m²	5 kWh/m²
Carbon dioxide emissions	2.0 tonnes	1.8 tonnes	0.1 tonnes
CO2 emissions per m²	10 kg/m²	10 kg/m²	1 kg/m²
Primary energy	59 kWh/m²	52 kWh/m²	7 kWh/m²

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor		50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor		52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor		33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2764	0.2729	0.2695	0.2521	0.2487	0.2313	0.2313	0.2278	0.2382	0.2487	0.2556	0.2625	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.0280			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		183.5066 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3	Sill	27.4800	0.0320	0.8794
E4	Jamb	106.2600	0.0340	3.6128
E5	Ground floor (normal)	23.1900	0.0560	1.2986
E6	Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16	Corner (normal)	70.2700	0.0900	6.3243
E18	Party wall between dwellings	12.1000	0.0600	0.7260
E17	Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24	Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21	Exposed floor (inverted)	4.7800	0.3200	1.5296
E20	Exposed floor (normal)	2.1000	0.3200	0.6720
E10	Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11	Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8	Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		24.1532 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1139	46.5227	45.9314	42.9752	42.3839	39.4276	39.4276	38.8364	40.6101	42.3839	43.5664	44.7489	(38)
Heat transfer coeff	183.2952	182.7040	182.1127	179.1564	178.5652	175.6089	175.6089	175.0177	176.7914	178.5652	179.7477	180.9302	(39)

Average = Sum(39)m / 12 = 179.0086

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9668	0.9637	0.9481	0.9449	0.9293	0.9293	0.9262	0.9356	0.9449	0.9512	0.9575	(40)
HLP (average)												0.9473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9876 (42)
Hot water usage for mixer showers												
	102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865 (42a)
Hot water usage for baths												
	32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710 (42b)
Hot water usage for other uses												
	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255 (42c)
Average daily hot water use (litres/day)												165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)
Energy content (annual)										Total = Sum(45)m =		2741.6891	
Distribution loss (46)m = 0.15 x (45)m													
	42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
										Total per year (kWh/year) = Sum(64)m =		3727.3117	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)													
	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)
Total internal gains													
	883.4434	881.3115	854.2400	803.2387	751.3396	667.3707	639.2237	642.6349	668.6834	752.6018	809.3462	859.0470	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787	(76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1327.9585	1655.2331	1945.7510	2190.8942	2323.7216	2232.5870	2146.7860	2014.2227	1864.3526	1617.8874	1345.1110	1237.1434	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5522	52.7223	52.8934	53.7662	53.9443	54.8524	54.8524	55.0377	54.4855	53.9443	53.5894	53.2391	
alpha	4.5035	4.5148	4.5262	4.5844	4.5963	4.6568	4.6568	4.6692	4.6324	4.5963	4.5726	4.5493	
util living area	0.9867	0.9660	0.9189	0.8166	0.6633	0.4930	0.3579	0.3964	0.6194	0.8729	0.9719	0.9900	(86)
MIT	19.9473	20.1763	20.4517	20.7185	20.8652	20.9203	20.9311	20.9299	20.8963	20.6812	20.2598	19.9089	(87)
Th 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(88)
util rest of house	0.9836	0.9587	0.9026	0.7842	0.6138	0.4308	0.2891	0.3243	0.5532	0.8414	0.9646	0.9877	(89)
MIT 2	19.1453	19.3719	19.6384	19.8936	20.0175	20.0696	20.0754	20.0777	20.0502	19.8697	19.4673	19.1160	(90)
Living area fraction									fLA = Living area / (4) =			0.0755	(91)
MIT	19.2058	19.4326	19.6997	19.9558	20.0814	20.1338	20.1400	20.1420	20.1140	19.9309	19.5271	19.1759	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.2058	19.4326	19.6997	19.9558	20.0814	20.1338	20.1400	20.1420	20.1140	19.9309	19.5271	19.1759	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9797	0.9518	0.8938	0.7772	0.6109	0.4301	0.2889	0.3240	0.5513	0.8332	0.9584	0.9844	(94)
Useful gains	1300.9601	1575.5329	1739.0969	1702.8077	1419.5482	960.2774	620.2794	652.5852	1027.8517	1347.9772	1289.1713	1217.9018	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2732.1651	2655.1596	2403.8421	1980.7230	1496.6349	971.7891	621.6565	654.9184	1063.2291	1666.1786	2233.7505	2709.5871	(97)
Space heating kWh	1064.8165	725.5092	494.5705	200.0990	57.3525	0.0000	0.0000	0.0000	0.0000	236.7418	680.0970	1109.8139	(98a)
Space heating requirement - total per year (kWh/year)												4569.0004	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1064.8165	725.5092	494.5705	200.0990	57.3525	0.0000	0.0000	0.0000	0.0000	236.7418	680.0970	1109.8139	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4569.0004	
Space heating per m2										(98c) / (4) =		24.1784	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 84.0000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1064.8165	725.5092	494.5705	200.0990	57.3525	0.0000	0.0000	0.0000	0.0000	236.7418	680.0970	1109.8139	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	1267.6387	863.7014	588.7744	238.2131	68.2768	0.0000	0.0000	0.0000	0.0000	281.8355	809.6393	1321.2070	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
Efficiency of water heater												89.0000	(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)
Fuel for water heating, kWh/month	450.6288	399.4316	425.6094	376.0586	366.0493	294.9805	290.0450	301.8539	305.5618	379.5709	401.6346	445.8515	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	50.8694	45.9466	50.8694	49.2285	50.8694	49.2285	50.8694	50.8694	49.2285	50.8694	49.2285	50.8694	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-36.5465	-54.3034	-82.4154	-98.0553	-110.5059	-105.0413	-103.7970	-95.5754	-81.8709	-64.4226	-41.1631	-31.2775	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	5439.2861 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.0000
Water heating fuel used	4437.2759 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	512.9463 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	598.9463 (231)
Electricity for lighting (calculated in Appendix L)	288.1350 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-904.9743 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	9858.6690 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	5439.2861	3.6400	197.9900	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	3.6400	161.5168	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	598.9463	16.4900	98.7662	(249)
Energy for lighting	288.1350	16.4900	47.5135	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-904.9743	16.4900	-149.2303	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-149.2303	(252)
Total energy cost			448.5563	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.6902 (257)
SAP value		88.8123
SAP rating (Section 12)		89 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5439.2861	0.2100	1142.2501	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4437.2759	0.2100	931.8279	(264)
Space and water heating			2074.0780	(265)
Pumps, fans and electric keep-hot	598.9463	0.1387	83.0812	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-904.9743	0.1334	-120.7583	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-120.7583	(269)
Total CO2, kg/year			2077.9877	(272)
CO2 emissions per m2			11.0000	(273)
EI value			88.0989	
EI rating			88	(274)
EI band			B	

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2452	0.2382	0.2382	0.2278	0.2278	0.2140	0.2174	0.2105	0.2140	0.2209	0.2209	0.2313	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	112.0280			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	183.5066 (35)

List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E1	Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3	Sill	27.4800	0.0320	0.8794
E4	Jamb	106.2600	0.0340	3.6128
E5	Ground floor (normal)	23.1900	0.0560	1.2986
E6	Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16	Corner (normal)	70.2700	0.0900	6.3243
E18	Party wall between dwellings	12.1000	0.0600	0.7260

E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.7926	40.6101	40.6101	38.8364	38.8364	36.4714	37.0626	35.8801	36.4714	37.6539	37.6539	39.4276	(38)
Heat transfer coeff	177.9739	176.7914	176.7914	175.0177	175.0177	172.6526	173.2439	172.0614	172.6526	173.8352	173.8352	175.6089	(39)

Average = Sum(39)m / 12 = 174.6235

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9418	0.9356	0.9356	0.9262	0.9262	0.9137	0.9168	0.9105	0.9137	0.9199	0.9199	0.9293	(40)
HLP (average)												0.9241	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)

Hot water usage for mixer showers

102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)

Energy content (annual) Total = Sum(45)m = 2741.6891

Distribution loss (46)m = 0.15 x (45)m

42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)

Temperature factor from Table 2b 0.7800 (49)

Enter (49) or (54) in (55) 1.2714 (55)

Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)

Total per year (kWh/year) = Sum(64)m = 3727.3117 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans 3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)	
Losses e.g. evaporation (negative values) (Table 5)	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)
Total internal gains	883.4434	881.3115	854.2400	803.2387	751.3396	667.3707	639.2237	642.6349	668.6834	752.6018	809.3462	859.0470	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	22.3313	0.6300	0.7000	0.7700	50.6396	(76)
Southeast	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(77)
South	18.6200	50.9848	0.6300	0.7000	0.7700	290.1299	(78)
Southwest	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(79)
West	7.0600	22.3313	0.6300	0.7000	0.7700	48.1827	(80)
East	8.0600	22.3313	0.6300	0.7000	0.7700	55.0074	(76)

Solar gains	491.4531	769.8871	1073.7637	1411.2838	1563.6503	1668.8568	1588.6946	1473.3885	1276.2839	919.2490	606.7907	414.0311	(83)
Total gains	1374.8965	1651.1987	1928.0037	2214.5225	2314.9898	2336.2275	2227.9183	2116.0234	1944.9673	1671.8508	1416.1369	1273.0781	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1235	54.4855	54.4855	55.0377	55.0377	55.7916	55.6012	55.9833	55.7916	55.4121	55.4121	54.8524	
alpha	4.6082	4.6324	4.6324	4.6692	4.6692	4.7194	4.7067	4.7322	4.7194	4.6941	4.6941	4.6568	
util living area	0.9812	0.9587	0.8999	0.7658	0.5806	0.3674	0.2408	0.2599	0.5037	0.8148	0.9553	0.9858	(86)
MIT	20.0949	20.2874	20.5538	20.7935	20.9018	20.9316	20.9340	20.9342	20.9221	20.7794	20.4180	20.0610	(87)
Th 2	20.1321	20.1374	20.1374	20.1453	20.1453	20.1559	20.1533	20.1586	20.1559	20.1506	20.1506	20.1427	(88)
util rest of house	0.9768	0.9498	0.8798	0.7273	0.5258	0.3063	0.1752	0.1917	0.4348	0.7727	0.9438	0.9824	(89)
MIT 2	19.3110	19.5028	19.7557	19.9754	20.0600	20.0892	20.0875	20.0931	20.0846	19.9740	19.6434	19.2867	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	19.3702	19.5620	19.8160	20.0371	20.1236	20.1528	20.1513	20.1566	20.1478	20.0348	19.7018	19.3451	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.3702	19.5620	19.8160	20.0371	20.1236	20.1528	20.1513	20.1566	20.1478	20.0348	19.7018	19.3451	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9720	0.9426	0.8713	0.7221	0.5243	0.3061	0.1750	0.1916	0.4341	0.7663	0.9364	0.9784	(94)
Useful gains	1336.3746	1556.4712	1679.9036	1599.0419	1213.7753	715.1073	389.9411	405.3400	844.2992	1281.2110	1326.0862	1245.5664	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2539.7198	2468.3658	2195.0338	1774.1721	1246.7489	716.9942	390.0293	405.4718	854.2521	1466.2608	2034.1900	2501.5712	(97)
Space heating kWh	895.2888	612.7932	383.2569	126.0937	24.5323	0.0000	0.0000	0.0000	0.0000	137.6770	509.8347	934.4675	(98a)
Space heating requirement - total per year (kWh/year)												3623.9443	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	895.2888	612.7932	383.2569	126.0937	24.5323	0.0000	0.0000	0.0000	0.0000	137.6770	509.8347	934.4675	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3623.9443	
Space heating per m2											(98c) / (4) =	19.1774	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	84.0000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	895.2888	612.7932	383.2569	126.0937	24.5323	0.0000	0.0000	0.0000	0.0000	137.6770	509.8347	934.4675	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	1065.8200	729.5157	456.2582	150.1116	29.2052	0.0000	0.0000	0.0000	0.0000	163.9012	606.9461	1112.4614	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
Efficiency of water heater												89.0000	(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)

Fuel for water heating, kWh/month

	450.6288	399.4316	425.6094	376.0586	366.0493	294.9805	290.0450	301.8539	305.5618	379.5709	401.6346	445.8515 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	50.8694	45.9466	50.8694	49.2285	50.8694	49.2285	50.8694	50.8694	49.2285	50.8694	49.2285	50.8694 (231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-40.1997	-54.7122	-82.3213	-99.9655	-110.7683	-109.5843	-107.6000	-100.5717	-86.2900	-68.1093	-46.0295	-34.1618 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	4314.2194 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.0000
Water heating fuel used	4437.2759 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	512.9463 (230a)
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	598.9463 (231)
Electricity for lighting (calculated in Appendix L)	288.1350 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-940.3136 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	8698.2629 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4314.2194	3.5000	150.9977	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	3.5000	155.3047	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	598.9463	18.3900	110.1462	(249)
Energy for lighting	288.1350	18.3900	52.9880	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-940.3136	18.3900	-172.9237	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-172.9237	(252)
Total energy cost			390.5129	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	4314.2194	0.2100	905.9861	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4437.2759	0.2100	931.8279	(264)
Space and water heating			1837.8140	(265)
Pumps, fans and electric keep-hot	598.9463	0.1387	83.0812	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-940.3136	0.1335	-125.4850	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-125.4850	(269)
Total CO2, kg/year			1836.9970	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	4314.2194	1.1300	4875.0679	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4437.2759	1.1300	5014.1217	(278)
Space and water heating			9889.1896	(279)
Pumps, fans and electric keep-hot	598.9463	1.5128	906.0859	(281)
Energy for lighting	288.1350	1.5338	441.9511	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-940.3136	1.4931	-1404.0109	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1404.0109	(283)
Total Primary energy kWh/year			9833.2157	(286)

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Full SAP Calculation Printout

Property Reference	House 2	Issued on Date	23/01/2023
Assessment Reference	House 2 Be Lean	Prop Type Ref	
Property	House 1, 35, Twickenham Rd		

SAP Rating	81 B	DER	17.05	TER	15.85
Environmental	85 B	% DER < TER			-7.57
CO_2 Emissions (t/year)	1.41	DFEE	50.99	TFEE	60.13
Compliance Check	See BREL	% DFEE < TFEE			15.19
% DPER < TPER	-15.95	DPER	96.77	TPER	83.46

Assessor Details	Mrs. Deborah Elliott	Assessor ID	L377-0001
Client			

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

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1. Overall dwelling characteristics

			Area (m2)		Storey height (m)		Volume (m3)	
Ground floor			44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor			48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700							(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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		m3 per hour		
Number of open chimneys		0 * 80	=	0.0000 (6a)
Number of open flues		0 * 20	=	0.0000 (6b)
Number of chimneys / flues attached to closed fire		0 * 10	=	0.0000 (6c)
Number of flues attached to solid fuel boiler		0 * 20	=	0.0000 (6d)
Number of flues attached to other heater		0 * 35	=	0.0000 (6e)
Number of blocked chimneys		0 * 20	=	0.0000 (6f)
Number of intermittent extract fans		0 * 10	=	0.0000 (7a)
Number of passive vents		0 * 10	=	0.0000 (7b)
Number of flueless gas fires		0 * 40	=	0.0000 (7c)
		Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5)	=	0.0000 (8)
Pressure test				Yes
Pressure Test Method				Blower Door
Measured/design AP50				3.0000 (17)
Infiltration rate				0.1500 (18)
Number of sides sheltered				1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)]	=	0.9250 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20)	=	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2629	0.2594	0.2560	0.2386	0.2352	0.2178	0.2178	0.2143	0.2248	0.2352	0.2421	0.2490	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)

Entrance door			2.1600	1.1000	2.3760		(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000 (28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000 (28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001 (29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999 (29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m2)			237.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110		(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8697 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7366	27.3706	27.0047	25.1749	24.8089	22.9792	22.9792	22.6132	23.7111	24.8089	25.5409	26.2728	(38)
Heat transfer coeff	98.1173	97.7513	97.3853	95.5556	95.1896	93.3599	93.3599	92.9939	94.0918	95.1896	95.9215	96.6534	(39)

Average = Sum(39)m / 12 = 95.4641

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0508	1.0469	1.0430	1.0234	1.0195	0.9999	0.9999	0.9960	1.0077	1.0195	1.0273	1.0352	(40)
HLP (average)												1.0224	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)
Hot water usage for mixer showers

94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)

Energy content (annual) Total = Sum(45)m = 2544.6486

Distribution loss (46)m = 0.15 x (45)m												
39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)

Total per year (kWh/year) = Sum(64)m = 3530.2712 (64)
12Total per year (kWh/year) 3530 (64)
Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)

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

	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)

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

	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)

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

	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)

Water heating gains (Table 5)

	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)

Total internal gains

	612.1973	625.1132	599.6137	577.2072	547.9880	490.7308	470.6313	472.2019	487.5903	543.2053	576.9216	599.7164	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	730.7697	854.5735	973.3797	1119.0008	1211.0452	1169.5462	1116.8357	1027.5536	920.9361	814.2091	724.2699	697.5702	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.1654	72.4355	72.7077	74.1000	74.3849	75.8427	75.8427	76.1412	75.2528	74.3849	73.8173	73.2583	
alpha	5.8110	5.8290	5.8472	5.9400	5.9590	6.0562	6.0562	6.0761	6.0169	5.9590	5.9212	5.8839	
util living area	0.9949	0.9868	0.9617	0.8695	0.6967	0.5066	0.3673	0.4151	0.6772	0.9255	0.9875	0.9960	(86)
MIT	20.2024	20.3500	20.5578	20.7974	20.9138	20.9446	20.9482	20.9479	20.9274	20.7538	20.4409	20.1868	(87)
Th 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(88)
util rest of house	0.9931	0.9824	0.9494	0.8347	0.6381	0.4361	0.2911	0.3334	0.5980	0.8959	0.9826	0.9947	(89)
MIT 2	19.3194	19.4676	19.6715	19.9027	19.9956	20.0306	20.0321	20.0354	20.0157	19.8741	19.5724	19.3149	(90)
Living area fraction									fLA = Living area / (4) =			0.3237	(91)
MIT	19.6052	19.7532	19.9583	20.1923	20.2928	20.3264	20.3286	20.3307	20.3108	20.1588	19.8535	19.5971	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6052	19.7532	19.9583	20.1923	20.2928	20.3264	20.3286	20.3307	20.3108	20.1588	19.8535	19.5971	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9921	0.9808	0.9480	0.8399	0.6528	0.4549	0.3115	0.3553	0.6189	0.8993	0.9812	0.9938	(94)
Useful gains	725.0188	838.1288	922.7991	939.8388	790.5462	532.0710	347.8940	365.0903	569.9556	732.2001	710.6465	693.2545	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1501.7008	1451.9187	1310.6450	1079.0416	817.9424	534.6151	348.0998	365.5317	584.3847	909.9009	1223.3381	1488.1841	(97)
Space heating kWh	577.8514	412.4668	288.5573	100.2261	20.3828	0.0000	0.0000	0.0000	0.0000	132.2094	369.1379	591.4277	(98a)
Space heating requirement - total per year (kWh/year)												2492.2594	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	577.8514	412.4668	288.5573	100.2261	20.3828	0.0000	0.0000	0.0000	0.0000	132.2094	369.1379	591.4277	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2492.2594	
Space heating per m2											(98c) / (4) =	26.6923	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	84.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

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

Space heating requirement
577.8514 412.4668 288.5573 100.2261 20.3828 0.0000 0.0000 0.0000 0.0000 132.2094 369.1379 591.4277 (98)
Space heating efficiency (main heating system 1)
84.0000 84.0000 84.0000 84.0000 84.0000 0.0000 0.0000 0.0000 0.0000 84.0000 84.0000 84.0000 (210)
Space heating fuel (main heating system)
687.9183 491.0319 343.5206 119.3168 24.2653 0.0000 0.0000 0.0000 0.0000 157.3921 439.4499 704.0806 (211)
Space heating efficiency (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (212)
Space heating fuel (main heating system 2)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (213)
Space heating fuel (secondary)
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (215)

Water heating
Water heating requirement
358.0988 317.5286 338.5935 299.7436 292.1587 234.3354 230.6325 239.8389 242.5842 302.6999 319.6829 354.3742 (64)
Efficiency of water heater 89.0000 (216)
(217)m 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 84.0000 (217)
Fuel for water heating, kWh/month
426.3081 378.0103 403.0875 356.8377 347.8080 278.9707 274.5625 285.5225 288.7907 360.3570 380.5749 421.8740 (219)
Space cooling fuel requirement
(221)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (221)
Pumps and Fa 34.2685 30.9522 34.2685 33.1631 34.2685 33.1631 34.2685 34.2685 33.1631 34.2685 33.1631 34.2685 (231)
Lighting 26.1361 20.9673 18.8788 13.8314 10.6838 8.7287 9.7461 12.6683 16.4549 21.5897 24.3856 26.8625 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235a)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235c)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)
(233b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(234b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(235b)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)
(235d)m 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (235d)
Annual totals kWh/year
Space heating fuel - main system 1 2966.9754 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 89.0000
Water heating fuel used 4202.7038 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)
mechanical ventilation fans (SFP = 0.8140) 317.4842 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
Total electricity for the above, kWh/year 403.4842 (231)
Electricity for lighting (calculated in Appendix L) 210.9332 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation 0.0000 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 7784.0966 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2966.9754	0.2100	623.0648	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4202.7038	0.2100	882.5678	(264)
Space and water heating			1505.6326	(265)
Pumps, fans and electric keep-hot	403.4842	0.1387	55.9682	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Total CO2, kg/year			1592.0451	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			17.0500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2966.9754	1.1300	3352.6822	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4202.7038	1.1300	4749.0553	(278)
Space and water heating			8101.7375	(279)
Pumps, fans and electric keep-hot	403.4842	1.5128	610.3909	(281)
Energy for lighting	210.9332	1.5338	323.5363	(282)

Total Primary energy kWh/year 9035.6648 (286)
Dwelling Primary energy Rate (DPER) 96.7700 (287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0938	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3438	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3181	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4055	0.3976	0.3896	0.3499	0.3419	0.3021	0.3021	0.2942	0.3181	0.3419	0.3578	0.3737	(22b)
Effective ac	0.5822	0.5790	0.5759	0.5612	0.5584	0.5456	0.5456	0.5433	0.5506	0.5584	0.5640	0.5698	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			19.3200	1.1450	22.1221			(27)
LGF			44.6500	0.1300	5.8045			(28a)
Exposed upper			3.9600	0.1300	0.5148			(28a)
LGF wall	60.3600	8.6500	51.7100	0.1800	9.3078			(29a)
GF walls	79.7100	12.8300	66.8800	0.1800	12.0384			(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592			(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.3068			(33)
Party Wall 1			47.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.1600	2.9904
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0500	0.5390
E4 Jamb	47.2400	0.0500	2.3620

E15 Flat roof with parapet									20.1800	0.5600	11.3008		
E24 Eaves (insulation at ceiling level - inverted)									8.5600	0.2400	2.0544		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)												25.4067	(36)
Point Thermal bridges											(36a) =	0.0000	
Total fabric heat loss										(33) + (36) + (36a) =		82.7135	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	61.4243	61.0874	60.7573	59.2065	58.9163	57.5657	57.5657	57.3155	58.0859	58.9163	59.5033	60.1169	(38)
Heat transfer coeff	144.1378	143.8010	143.4708	141.9200	141.6299	140.2792	140.2792	140.0291	140.7995	141.6299	142.2168	142.8305	(39)
Average = Sum(39)m / 12 =												141.9186	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5437	1.5401	1.5366	1.5200	1.5169	1.5024	1.5024	1.4997	1.5080	1.5169	1.5232	1.5297	(40)
HLP (average)												1.5200	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers

68.9717	67.9352	66.4248	63.5349	61.4023	59.0240	57.6721	59.1711	60.8142	63.3678	66.3198	68.7075	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day) 129.3527 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.7193	137.7145	134.0552	128.4909	123.9723	119.1144	117.2475	120.8910	124.7335	129.8335	135.4835	140.3543	(44)
Energy conte	222.8649	196.1036	206.0379	175.8976	166.8905	146.4650	141.8007	149.6883	153.8089	176.1828	193.0211	219.7609	(45)
Energy content (annual)										Total = Sum(45)m =		2148.5222	
Distribution loss (46)m = 0.15 x (45)m	33.4297	29.4155	30.9057	26.3846	25.0336	21.9698	21.2701	22.4532	23.0713	26.4274	28.9532	32.9641	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	269.4598	238.1893	252.6328	220.9894	213.4854	191.5569	188.3956	196.2832	198.9008	222.7777	238.1130	266.3558	(62)
WWHRS	-31.5310	-27.8863	-29.2009	-24.1795	-22.5344	-19.2829	-18.0746	-19.2205	-19.9508	-23.5198	-26.6451	-30.9471	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	237.9288	210.3030	223.4319	196.8099	190.9510	172.2740	170.3210	177.0626	178.9500	199.2579	211.4679	235.4088	(64)
										Total per year (kWh/year) = Sum(64)m =		2404.1667	(64)
12Total per year (kWh/year)												2404	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month	111.3785	98.8730	105.7835	94.5594	92.7670	84.7731	84.4246	87.0473	87.2149	95.8567	100.2530	110.3464	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)	149.7023	147.1325	142.1821	131.3325	124.6868	117.7404	113.4740	116.9990	121.1319	128.8396	139.2403	148.3151	(72)
Total internal gains	585.0060	598.2790	573.6193	553.2603	525.2505	503.2509	484.0306	485.0118	499.6925	519.9096	551.6744	572.8024	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	11.3200	19.6403	0.6300	0.7000	0.7700	67.9463	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	703.5784	827.7393	947.3854	1095.0539	1188.3076	1182.0663	1130.2350	1040.3635	933.0383	790.9134	699.0227	670.6563	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.1243	49.2394	49.3527	49.8920	49.9942	50.4755	50.4755	50.5657	50.2890	49.9942	49.7878	49.5739	
alpha	4.2750	4.2826	4.2902	4.3261	4.3329	4.3650	4.3650	4.3710	4.3526	4.3329	4.3192	4.3049	
util living area	0.9963	0.9921	0.9811	0.9431	0.8518	0.6882	0.5277	0.5877	0.8292	0.9675	0.9927	0.9970	(86)
MIT	19.2885	19.5004	19.8441	20.3107	20.6927	20.9149	20.9790	20.9670	20.8004	20.2870	19.7088	19.2597	(87)
Th 2	19.6549	19.6575	19.6602	19.6726	19.6749	19.6857	19.6857	19.6877	19.6815	19.6749	19.6702	19.6653	(88)
util rest of house	0.9949	0.9891	0.9735	0.9194	0.7913	0.5752	0.3794	0.4354	0.7376	0.9493	0.9894	0.9959	(89)
MIT 2	17.7070	17.9787	18.4154	18.9980	19.4303	19.6424	19.6804	19.6782	19.5550	18.9839	18.2546	17.6772	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	18.2188	18.4712	18.8779	19.4229	19.8389	20.0542	20.1007	20.0953	19.9581	19.4057	18.7253	18.1894	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2188	18.4712	18.8779	19.4229	19.8389	20.0542	20.1007	20.0953	19.9581	19.4057	18.7253	18.1894	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9926	0.9852	0.9673	0.9138	0.7999	0.6094	0.4280	0.4853	0.7599	0.9442	0.9858	0.9939	(94)
Useful gains	698.3773	815.5019	916.4389	1000.6533	950.5592	720.3633	483.6932	504.8718	709.0222	746.8103	689.1254	666.5902	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	2006.2286	1951.5569	1775.8607	1493.4040	1152.7120	765.1175	491.0784	517.4503	824.8191	1247.1439	1653.3081	1998.1083	(97)
Space heating kWh	973.0414	763.4290	639.4098	354.7805	150.4017	0.0000	0.0000	0.0000	0.0000	372.2482	694.2115	990.6495	(98a)
Space heating requirement - total per year (kWh/year)												4938.1716	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	973.0414	763.4290	639.4098	354.7805	150.4017	0.0000	0.0000	0.0000	0.0000	372.2482	694.2115	990.6495	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4938.1716	
Space heating per m2											(98c) / (4) =	52.8882	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	92.3000 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	973.0414	763.4290	639.4098	354.7805	150.4017	0.0000	0.0000	0.0000	0.0000	372.2482	694.2115	990.6495	(98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)	1054.2160	827.1170	692.7517	384.3776	162.9487	0.0000	0.0000	0.0000	0.0000	403.3025	752.1251	1073.2931	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	237.9288	210.3030	223.4319	196.8099	190.9510	172.2740	170.3210	177.0626	178.9500	199.2579	211.4679	235.4088	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.8749	86.6884	86.2802	85.3648	83.5301	79.8000	79.8000	79.8000	79.8000	85.4403	86.5216	86.9178	(217)
Fuel for water heating, kWh/month	273.8751	242.5964	258.9607	230.5515	228.6014	215.8822	213.4348	221.8830	224.2481	233.2129	244.4106	270.8406	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	25.7906	20.6902	18.6292	13.6486	10.5425	8.6133	9.6173	12.5009	16.2374	21.3043	24.0632	26.5074	(232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m	-41.5277	-58.4235	-83.8027	-94.0129	-101.1797	-94.3421	-93.1371	-87.9937	-78.9285	-66.6600	-45.5953	-35.9143 (233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m	-23.8487	-50.1227	-99.5477	-149.4202	-197.4995	-198.4428	-196.1452	-166.1444	-121.8440	-71.6959	-31.8438	-18.8659 (233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	5350.1317 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	79.8000
Water heating fuel used	2858.4974 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	208.1448 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2206.9382 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	6295.8358 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5350.1317	0.2100	1123.5277	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2858.4974	0.2100	600.2845	(264)
Space and water heating			1723.8121	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	208.1448	0.1443	30.0417	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-881.5175	0.1346	-118.6867	
PV Unit electricity exported	-1325.4207	0.1259	-166.8840	
Total			-285.5707	(269)
Total CO2, kg/year			1480.2124	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.8500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5350.1317	1.1300	6045.6488	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2858.4974	1.1300	3230.1021	(278)
Space and water heating			9275.7509	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	208.1448	1.5338	319.2595	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-881.5175	1.4976	-1320.1661	
PV Unit electricity exported	-1325.4207	0.4622	-612.5794	
Total			-1932.7455	(283)
Total Primary energy kWh/year			7792.3657	(286)
Target Primary Energy Rate (TPER)			83.4600	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF FABRIC ENERGY EFFICIENCY

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0938	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2438	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2256	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2876	0.2819	0.2763	0.2481	0.2425	0.2143	0.2143	0.2086	0.2256	0.2425	0.2537	0.2650	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5414	0.5397	0.5382	0.5308	0.5294	0.5230	0.5230	0.5218	0.5254	0.5294	0.5322	0.5351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	25490.4001	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		273.0042	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8697	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	70.3807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.1124	56.9430	56.7769	55.9970	55.8511	55.1718	55.1718	55.0460	55.4335	55.8511	56.1463	56.4549	(38)
Heat transfer coeff	127.4931	127.3237	127.1576	126.3777	126.2318	125.5525	125.5525	125.4267	125.8142	126.2318	126.5270	126.8356	(39)
Average = Sum(39)m / 12 =												126.3770	

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

HLP	1.3655	1.3636	1.3619	1.3535	1.3520	1.3447	1.3447	1.3433	1.3475	1.3520	1.3551	1.3584 (40)
HLP (average)												1.3535
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826 (42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642 (42c)

Average daily hot water use (litres/day) 65.7631 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	71.7475	69.7792	67.6304	64.9559	62.5700	60.0904	59.5754	61.7199	63.9193	66.4656	69.1637	71.6468	(44)
Energy conte	113.6306	99.3647	103.9454	88.9214	84.2312	73.8882	72.0512	76.4221	78.8189	90.1932	98.5364	112.1816	(45)
Energy content (annual)										Total = Sum(45)m =		1092.1850	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(64)
										Total per year (kWh/year) = Sum(64)m =		928.3572	(64)
12Total per year (kWh/year)												928	(64)
Electric shower(s)													
	55.2349	49.2147	53.7406	51.2840	52.2463	49.8379	51.4992	52.2463	51.2840	53.7406	52.7301	55.2349	(64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					628.2933	(64a)
Heat gains from water heating, kWh/month													
	37.9552	33.4187	35.5235	31.7168	30.9607	28.1607	28.1857	29.3013	29.5700	32.6012	34.1215	37.6473	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	51.0151	49.7302	47.7467	44.0511	41.6139	39.1121	37.8840	39.3834	41.0695	43.8188	47.3910	50.6012	(72)
Total internal gains													
	483.3188	497.8767	476.1839	462.9789	439.1775	424.6226	408.4406	407.3962	419.6301	431.8888	456.8251	472.0886	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	601.8912	727.3370	849.9499	1004.7724	1102.2346	1103.4380	1054.6450	962.7480	852.9758	702.8926	604.1734	569.9424	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5377	55.6115	55.6842	56.0278	56.0926	56.3961	56.3961	56.4526	56.2788	56.0926	55.9617	55.8255	
alpha	4.7025	4.7074	4.7123	4.7352	4.7395	4.7597	4.7597	4.7635	4.7519	4.7395	4.7308	4.7217	
util living area													
	0.9981	0.9951	0.9858	0.9484	0.8507	0.6761	0.5120	0.5772	0.8333	0.9753	0.9958	0.9986	(86)
MIT	19.4220	19.6304	19.9608	20.4039	20.7555	20.9404	20.9871	20.9779	20.8371	20.3509	19.8033	19.3857	(87)
Th 2	19.7899	19.7913	19.7927	19.7992	19.8004	19.8060	19.8060	19.8070	19.8038	19.8004	19.7979	19.7954	(88)
util rest of house													
	0.9974	0.9932	0.9801	0.9274	0.7934	0.5714	0.3792	0.4387	0.7481	0.9613	0.9939	0.9980	(89)
MIT 2	18.3708	18.5792	18.9071	19.3382	19.6472	19.7820	19.8034	19.8019	19.7215	19.2978	18.7573	18.3387	(90)
Living area fraction										fLA = Living area / (4) =			0.3237 (91)
MIT	18.7110	18.9194	19.2482	19.6831	20.0059	20.1569	20.1865	20.1825	20.0825	19.6386	19.0959	18.6776	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7110	18.9194	19.2482	19.6831	20.0059	20.1569	20.1865	20.1825	20.0825	19.6386	19.0959	18.6776	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9913	0.9767	0.9249	0.8045	0.6040	0.4227	0.4841	0.7708	0.9588	0.9923	0.9972	(94)
Useful gains	599.7593	721.0043	830.1621	929.2761	886.7486	666.5182	445.7685	466.0186	657.4766	673.9287	599.4920	568.3726	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1837.3024	1785.0063	1621.0272	1362.7423	1048.4726	697.6861	450.2941	474.4277	752.6895	1140.9631	1517.8014	1836.2701	(97)
Space heating kWh													
	920.7321	715.0093	588.4036	312.0957	120.3227	0.0000	0.0000	0.0000	0.0000	347.4736	661.1827	943.3157	(98a)
Space heating requirement - total per year (kWh/year)												4608.5354	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	920.7321	715.0093	588.4036	312.0957	120.3227	0.0000	0.0000	0.0000	0.0000	347.4736	661.1827	943.3157	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4608.5354	
Space heating per m2											(98c) / (4) =	49.3578	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1180.1937	929.0887	953.2431	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8463	0.9102	0.8740	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	998.7471	845.6229	833.1496	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1240.3276	1185.7136	1080.7434	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	173.9379	253.0274	184.2098	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	43.4845	63.2569	46.0524	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												152.7938	(107)
Energy for space heating												49.3578	(99)
Energy for space cooling												1.6364	(108)
Total												50.9942	(109)
Fabric Energy Efficiency (DFEE)												51.0	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0938	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3438	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3181	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4055	0.3976	0.3896	0.3499	0.3419	0.3021	0.3021	0.2942	0.3181	0.3419	0.3578	0.3737	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 0.0000 (23c)

Effective ac	0.5822	0.5790	0.5759	0.5612	0.5584	0.5456	0.5456	0.5433	0.5506	0.5584	0.5640	0.5698	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			19.3200	1.1450	22.1221			(27)
LGF			44.6500	0.1300	5.8045			(28a)
Exposed upper			3.9600	0.1300	0.5148			(28a)
LGF wall	60.3600	8.6500	51.7100	0.1800	9.3078			(29a)
GF walls	79.7100	12.8300	66.8800	0.1800	12.0384			(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592			(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.3068			(33)
Party Wall 1			47.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.1600	2.9904
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0500	0.5390
E4 Jamb	47.2400	0.0500	2.3620
E15 Flat roof with parapet	20.1800	0.5600	11.3008
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.2400	2.0544

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4067 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 82.7135 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	61.4243	61.0874	60.7573	59.2065	58.9163	57.5657	57.5657	57.3155	58.0859	58.9163	59.5033	60.1169	(38)
Heat transfer coeff	144.1378	143.8010	143.4708	141.9200	141.6299	140.2792	140.2792	140.0291	140.7995	141.6299	142.2168	142.8305	(39)

Average = Sum(39)m / 12 = 141.9186

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5437	1.5401	1.5366	1.5200	1.5169	1.5024	1.5024	1.4997	1.5080	1.5169	1.5232	1.5297	(40)
HLP (average)												1.5200	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

	29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826 (42b)
Hot water usage for other uses												
	41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642 (42c)
Average daily hot water use (litres/day)												65.7631 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	71.7475	69.7792	67.6304	64.9559	62.5700	60.0904	59.5754	61.7199	63.9193	66.4656	69.1637	71.6468	(44)
Energy conte	113.6306	99.3647	103.9454	88.9214	84.2312	73.8882	72.0512	76.4221	78.8189	90.1932	98.5364	112.1816	(45)
Energy content (annual)										Total = Sum(45)m =		1092.1850	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(64)
										Total per year (kWh/year) = Sum(64)m =		928.3572	(64)
12Total per year (kWh/year)												928	(64)
Electric shower(s)													
	55.2349	49.2147	53.7406	51.2840	52.2463	49.8379	51.4992	52.2463	51.2840	53.7406	52.7301	55.2349	(64a)
							Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =					628.2933	(64a)
Heat gains from water heating, kWh/month													
	37.9552	33.4187	35.5235	31.7168	30.9607	28.1607	28.1857	29.3013	29.5700	32.6012	34.1215	37.6473	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	51.0151	49.7302	47.7467	44.0511	41.6139	39.1121	37.8840	39.3834	41.0695	43.8188	47.3910	50.6012	(72)
Total internal gains													
	483.3188	497.8767	476.1839	462.9789	439.1775	424.6226	408.4406	407.3962	419.6301	431.8888	456.8251	472.0886	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	11.3200	19.6403	0.6300	0.7000	0.7700	67.9463	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	601.8912	727.3370	849.9499	1004.7724	1102.2346	1103.4380	1054.6450	962.7480	852.9758	702.8926	604.1734	569.9424	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.1243	49.2394	49.3527	49.8920	49.9942	50.4755	50.4755	50.5657	50.2890	49.9942	49.7878	49.5739	
alpha	4.2750	4.2826	4.2902	4.3261	4.3329	4.3650	4.3650	4.3710	4.3526	4.3329	4.3192	4.3049	
util living area													
	0.9980	0.9952	0.9872	0.9567	0.8770	0.7215	0.5604	0.6258	0.8620	0.9784	0.9958	0.9984	(86)
MIT	19.1879	19.4027	19.7534	20.2387	20.6469	20.8974	20.9736	20.9580	20.7616	20.2089	19.6160	19.1596	(87)
Th 2	19.6549	19.6575	19.6602	19.6726	19.6749	19.6857	19.6857	19.6877	19.6815	19.6749	19.6702	19.6653	(88)
util rest of house													
	0.9972	0.9933	0.9818	0.9376	0.8223	0.6089	0.4054	0.4681	0.7784	0.9655	0.9939	0.9978	(89)
MIT 2	18.0367	18.2526	18.6020	19.0816	19.4501	19.6437	19.6804	19.6779	19.5585	19.0637	18.4753	18.0162	(90)
Living area fraction											fLA = Living area / (4) =	0.3237	(91)

MIT	18.4093	18.6248	18.9747	19.4561	19.8374	20.0495	20.0989	20.0922	19.9479	19.4343	18.8445	18.3863 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4093	18.6248	18.9747	19.4561	19.8374	20.0495	20.0989	20.0922	19.9479	19.4343	18.8445	18.3863 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9912	0.9781	0.9336	0.8301	0.6430	0.4564	0.5200	0.7985	0.9622	0.9921	0.9969	(94)
Useful gains	599.5611	720.9151	831.2977	938.0512	915.0115	709.4572	481.3592	500.6257	681.1376	676.3478	599.3797	568.1986	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2033.6845	1973.6425	1789.7504	1498.1283	1152.5033	764.4478	490.8264	517.0134	823.3845	1251.2055	1670.2609	2026.2299	(97)
Space heating kWh													
	1066.9878	841.8329	713.0889	403.2555	176.6939	0.0000	0.0000	0.0000	0.0000	427.6942	771.0344	1084.7753	(98a)
Space heating requirement - total per year (kWh/year)												5485.3627	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1066.9878	841.8329	713.0889	403.2555	176.6939	0.0000	0.0000	0.0000	0.0000	427.6942	771.0344	1084.7753	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5485.3627	
Space heating per m2											(98c) / (4) =	58.7487	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1318.6245	1038.0661	1064.2210	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7879	0.8634	0.8200	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1038.9273	896.2423	872.6938	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1240.3276	1185.7136	1080.7434	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	145.0082	215.3666	154.7890	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction											fC = cooled area / (4) =	1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	36.2520	53.8416	38.6972	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												128.7909	(107)
Energy for space heating												58.7487	(99)
Energy for space cooling												1.3794	(108)
Total												60.1280	(109)
Fabric Energy Efficiency (TFEE)												60.1	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 93.3700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery	
If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2629	0.2594	0.2560	0.2386	0.2352	0.2178	0.2178	0.2143	0.2248	0.2352	0.2421	0.2490	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	273.0042 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E16	Corner (normal)	24.3500	0.0900	2.1915
E18	Party wall between dwellings	13.6000	0.0600	0.8160
E17	Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21	Exposed floor (inverted)	5.9600	0.3200	1.9072
E20	Exposed floor (normal)	5.0700	0.3200	1.6224
E5	Ground floor (normal)	18.6900	0.0560	1.0466
E1	Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3	Sill	10.7800	0.0320	0.3450
E4	Jamb	47.2400	0.0340	1.6062
E15	Flat roof with parapet	20.1800	0.1500	3.0270
E24	Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8697 (36)
Point Thermal bridges	(36a) = 0.0000
Total fabric heat loss	(33) + (36) + (36a) = 70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7366	27.3706	27.0047	25.1749	24.8089	22.9792	22.9792	22.6132	23.7111	24.8089	25.5409	26.2728	(38)
Heat transfer coeff	98.1173	97.7513	97.3853	95.5556	95.1896	93.3599	93.3599	92.9939	94.0918	95.1896	95.9215	96.6534	(39)
Average = Sum(39)m / 12 =												95.4641	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0508	1.0469	1.0430	1.0234	1.0195	0.9999	0.9999	0.9960	1.0077	1.0195	1.0273	1.0352	(40)
HLP (average)												1.0224	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6691 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day)	153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)
Energy content (annual)										Total = Sum(45)m =		2544.6486	

Distribution loss (46)m = 0.15 x (45)m

39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155 (46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)

Temperature factor from Table 2b 0.7800 (49)

Enter (49) or (54) in (55) 1.2714 (55)

Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Total heat required for water heating calculated for each month

358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742 (62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

Output from w/h

358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742 (64)

Total per year (kWh/year) = Sum(64)m = 3530.2712 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains													
	682.7039	680.2351	659.9246	621.4193	583.7300	512.4596	492.0000	495.6562	515.0173	586.7311	628.9175	665.7254	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	801.2763	909.6954	1033.6906	1163.2128	1246.7871	1191.2750	1138.2044	1051.0079	948.3630	857.7349	776.2657	763.5792	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.1654	72.4355	72.7077	74.1000	74.3849	75.8427	75.8427	76.1412	75.2528	74.3849	73.8173	73.2583	
alpha	5.8110	5.8290	5.8472	5.9400	5.9590	6.0562	6.0562	6.0761	6.0169	5.9590	5.9212	5.8839	
util living area													
	0.9919	0.9823	0.9510	0.8533	0.6806	0.4977	0.3604	0.4060	0.6608	0.9100	0.9826	0.9937	(86)
MIT	20.2577	20.3910	20.5961	20.8135	20.9177	20.9449	20.9483	20.9480	20.9299	20.7760	20.4799	20.2391	(87)
Th 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(88)
util rest of house													
	0.9893	0.9766	0.9360	0.8164	0.6221	0.4283	0.2856	0.3260	0.5823	0.8766	0.9760	0.9916	(89)
MIT 2	19.3740	19.5075	19.7069	19.9155	19.9979	20.0307	20.0321	20.0354	20.0170	19.8925	19.6101	19.3668	(90)
Living area fraction									fLA = Living area / (4) =			0.3237	(91)
MIT	19.6600	19.7935	19.9947	20.2062	20.2956	20.3266	20.3286	20.3308	20.3124	20.1784	19.8916	19.6491	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6600	19.7935	19.9947	20.2062	20.2956	20.3266	20.3286	20.3308	20.3124	20.1784	19.8916	19.6491	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9748	0.9350	0.8225	0.6369	0.4469	0.3057	0.3474	0.6031	0.8811	0.9745	0.9905	(94)
Useful gains	791.5943	886.7581	966.5105	956.6978	794.0687	532.3256	347.9170	365.1474	571.9205	755.7439	756.4765	756.2953	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1507.0827	1455.8586	1314.1890	1080.3674	818.2154	534.6357	348.1020	365.5370	584.5397	911.7662	1226.9935	1493.2110	(97)
Space heating kWh	532.3234	382.4355	258.6728	89.0421	17.9651	0.0000	0.0000	0.0000	0.0000	116.0806	338.7723	548.2653	(98a)
Space heating requirement - total per year (kWh/year)												2283.5572	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	532.3234	382.4355	258.6728	89.0421	17.9651	0.0000	0.0000	0.0000	0.0000	116.0806	338.7723	548.2653	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2283.5572	
Space heating per m2											(98c) / (4) =	24.4571	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												84.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	532.3234	382.4355	258.6728	89.0421	17.9651	0.0000	0.0000	0.0000	0.0000	116.0806	338.7723	548.2653	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	633.7183	455.2804	307.9439	106.0025	21.3871	0.0000	0.0000	0.0000	0.0000	138.1912	403.3003	652.6968	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
Efficiency of water heater												89.0000	(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)
Fuel for water heating, kWh/month	426.3081	378.0103	403.0875	356.8377	347.8080	278.9707	274.5625	285.5225	288.7907	360.3570	380.5749	421.8740	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	34.2685	30.9522	34.2685	33.1631	34.2685	33.1631	34.2685	34.2685	33.1631	34.2685	33.1631	34.2685	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2718.5205	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												89.0000	
Water heating fuel used												4202.7038	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)		
mechanical ventilation fans (SFP = 0.8140)	317.4842	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	403.4842	(231)
Electricity for lighting (calculated in Appendix L)	210.9332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		

Energy saved or generated		-0.0000 (236)
Energy used		0.0000 (237)
Total delivered energy for all uses		7535.6417 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2718.5205	3.6400	98.9541	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4202.7038	3.6400	152.9784	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	403.4842	16.4900	66.5345	(249)
Energy for lighting	210.9332	16.4900	34.7829	(250)
Additional standing charges			92.0000	(251)
Total energy cost			445.2500	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.1584	(257)
SAP value		81.2221	
SAP rating (Section 12)		81	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2718.5205	0.2100	570.8893	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4202.7038	0.2100	882.5678	(264)
Space and water heating			1453.4571	(265)
Pumps, fans and electric keep-hot	403.4842	0.1387	55.9682	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Total CO2, kg/year			1539.8695	(272)
CO2 emissions per m2			16.4900	(273)
EI value			85.0876	
EI rating			85	(274)
EI band			B	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		319.6965	(5)

2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)

Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												3.0000	(17)
Infiltration rate												0.1500	(18)
Number of sides sheltered												1	(19)
Shelter factor								(20) = 1 - [0.075 x (19)] =				0.9250	(20)
Infiltration rate adjusted to include shelter factor								(21) = (18) x (20) =				0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	82.8000	(23c)

Effective ac	0.2317	0.2248	0.2248	0.2143	0.2143	0.2005	0.2039	0.1970	0.2005	0.2074	0.2074	0.2178	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 25490.4001	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	273.0042	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8697	(36)
Point Thermal bridges (36a) =	0.0000	
Total fabric heat loss (33) + (36) + (36a) =	70.3807	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.4430	23.7111	23.7111	22.6132	22.6132	21.1494	21.5154	20.7835	21.1494	21.8813	21.8813	22.9792	(38)
Heat transfer coeff	94.8237	94.0918	94.0918	92.9939	92.9939	91.5301	91.8961	91.1642	91.5301	92.2620	92.2620	93.3599	(39)
Average = Sum(39)m / 12 =												92.7499	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0156	1.0077	1.0077	0.9960	0.9960	0.9803	0.9842	0.9764	0.9803	0.9881	0.9881	0.9999	(40)
HLP (average)												0.9934	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6691	(42)

Hot water usage for mixer showers

94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day)	153.1989	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)
Energy content (annual)										Total = Sum(45)m =		2544.6486	

Distribution loss (46)m = 0.15 x (45)m

39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)

Water storage loss:

Store volume													150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.6300 (48)
Temperature factor from Table 2b													0.7800 (49)
Enter (49) or (54) in (55)													1.2714 (55)
Total storage loss													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
									Total per year (kWh/year) = Sum(64)m =			3530.2712	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month													
	131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains													
	682.7039	680.2351	659.9246	621.4193	583.7300	512.4596	492.0000	495.6562	515.0173	586.7311	628.9175	665.7254	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	22.3313	0.6300	0.7000	0.7700	35.9664	(76)
Southwest	0.9700	40.4699	0.6300	0.7000	0.7700	11.9971	(79)
West	6.0600	22.3313	0.6300	0.7000	0.7700	41.3579	(80)
Northwest	0.9700	12.9236	0.6300	0.7000	0.7700	3.8311	(81)
East	6.0500	22.3313	0.6300	0.7000	0.7700	41.2897	(76)

Solar gains	134.4422	234.1564	376.4091	561.1789	668.0638	731.4984	688.9976	606.2365	472.6945	295.2148	171.1807	109.8590	(83)
Total gains	817.1461	914.3914	1036.3337	1182.5982	1251.7938	1243.9580	1180.9976	1101.8927	987.7118	881.9459	800.0982	775.5844	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.6719	75.2528	75.2528	76.1412	76.1412	77.3589	77.0508	77.6694	77.3589	76.7452	76.7452	75.8427	
alpha	5.9781	6.0169	6.0169	6.0761	6.0761	6.1573	6.1367	6.1780	6.1573	6.1163	6.1163	6.0562	
util living area													
	0.9881	0.9759	0.9308	0.7943	0.5838	0.3674	0.2412	0.2647	0.5320	0.8522	0.9704	0.9905	(86)
MIT	20.3728	20.4905	20.6893	20.8723	20.9381	20.9491	20.9494	20.9497	20.9451	20.8537	20.6001	20.3588	(87)
Th 2	20.0704	20.0769	20.0769	20.0867	20.0867	20.0998	20.0965	20.1031	20.0998	20.0932	20.0932	20.0834	(88)
util rest of house													
	0.9840	0.9682	0.9103	0.7488	0.5214	0.3015	0.1709	0.1905	0.4521	0.8040	0.9592	0.9873	(89)
MIT 2	19.5129	19.6331	19.8201	19.9846	20.0303	20.0492	20.0459	20.0528	20.0478	19.9810	19.7550	19.5107	(90)
Living area fraction									fLA = Living area / (4) =			0.3237	(91)
MIT	19.7912	19.9106	20.1014	20.2719	20.3241	20.3405	20.3383	20.3431	20.3382	20.2634	20.0285	19.7852	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7912	19.9106	20.1014	20.2719	20.3241	20.3405	20.3383	20.3431	20.3382	20.2634	20.0285	19.7852	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9825	0.9665	0.9109	0.7585	0.5379	0.3192	0.1897	0.2104	0.4736	0.8139	0.9582	0.9860	(94)
Useful gains	802.8789	883.7747	943.9623	897.0233	673.3023	397.0430	224.0653	231.8260	467.7324	717.8124	766.6578	764.6971	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1393.0763	1346.5091	1195.0985	964.5264	681.0994	397.2828	224.0721	231.8380	470.3000	799.3062	1109.7737	1371.0070	(97)
Space heating kWh	439.1069	310.9576	186.8454	48.6022	5.8010	0.0000	0.0000	0.0000	0.0000	60.6314	247.0434	451.0946	(98a)
Space heating requirement - total per year (kWh/year)												1750.0824	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	439.1069	310.9576	186.8454	48.6022	5.8010	0.0000	0.0000	0.0000	0.0000	60.6314	247.0434	451.0946	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1750.0824	
Space heating per m2											(98c) / (4) =	18.7435	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	84.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	439.1069	310.9576	186.8454	48.6022	5.8010	0.0000	0.0000	0.0000	0.0000	60.6314	247.0434	451.0946	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	522.7463	370.1876	222.4349	57.8598	6.9060	0.0000	0.0000	0.0000	0.0000	72.1802	294.0993	537.0173	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
Efficiency of water heater												89.0000	(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)
Fuel for water heating, kWh/month	426.3081	378.0103	403.0875	356.8377	347.8080	278.9707	274.5625	285.5225	288.7907	360.3570	380.5749	421.8740	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	34.2685	30.9522	34.2685	33.1631	34.2685	33.1631	34.2685	34.2685	33.1631	34.2685	33.1631	34.2685	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	2083.4314	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	89.0000	
Water heating fuel used	4202.7038	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)		
mechanical ventilation fans (SFP = 0.8140)	317.4842	(230a)
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	403.4842	(231)
Electricity for lighting (calculated in Appendix L)	210.9332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)

Total delivered energy for all uses 6900.5526 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2083.4314	3.5000	72.9201	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4202.7038	3.5000	147.0946	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	403.4842	18.3900	74.2007	(249)
Energy for lighting	210.9332	18.3900	38.7906	(250)
Additional standing charges			94.0000	(251)
Total energy cost			427.0061	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2083.4314	0.2100	437.5206	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	4202.7038	0.2100	882.5678	(264)
Space and water heating			1320.0884	(265)
Pumps, fans and electric keep-hot	403.4842	0.1387	55.9682	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Total CO2, kg/year			1406.5008	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2083.4314	1.1300	2354.2775	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	4202.7038	1.1300	4749.0553	(278)
Space and water heating			7103.3328	(279)
Pumps, fans and electric keep-hot	403.4842	1.5128	610.3909	(281)
Energy for lighting	210.9332	1.5338	323.5363	(282)
Total Primary energy kWh/year			8037.2600	(286)

SAP 10 EPC IMPROVEMENTS

House 2 Be Lean

Current energy efficiency rating: B 81
Current environmental impact rating: B 85

N Solar water heating Recommended
U Solar photovoltaic panels Recommended
V2 Wind turbine Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.0	-£ 24	-223 kg (15.9%)
U Solar photovoltaic panels	+ 5.6	-£ 153	-111 kg (9.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£24	2.39 kg/m²	B 82	B 87
Solar photovoltaic panels	£153	1.19 kg/m²	B 88	B 88
Total Savings	£177	3.58 kg/m²		

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

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£113	£128	-£15
Mains gas	£314	£275	£39
Space heating	£241	£256	-£15
Water heating	£147	£108	£39
Lighting	£39	£39	£0
Generated (PV)	-£0	-£153	£153

Total cost of fuels	£427	£250	£177
Total cost of uses	£427	£250	£177
Delivered energy	74 kWh/m²	54 kWh/m²	20 kWh/m²
Carbon dioxide emissions	1.4 tonnes	1.1 tonnes	0.3 tonnes
CO2 emissions per m²	15 kg/m²	11 kg/m²	4 kg/m²
Primary energy	86 kWh/m²	61 kWh/m²	25 kWh/m²

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	82.8000	(23c)

Effective ac	0.2629	0.2594	0.2560	0.2386	0.2352	0.2178	0.2178	0.2143	0.2248	0.2352	0.2421	0.2490	(25)

---

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 25490.4001	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E16	Corner (normal)	24.3500	0.0900	2.1915
E18	Party wall between dwellings	13.6000	0.0600	0.8160
E17	Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21	Exposed floor (inverted)	5.9600	0.3200	1.9072
E20	Exposed floor (normal)	5.0700	0.3200	1.6224
E5	Ground floor (normal)	18.6900	0.0560	1.0466
E1	Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3	Sill	10.7800	0.0320	0.3450
E4	Jamb	47.2400	0.0340	1.6062
E15	Flat roof with parapet	20.1800	0.1500	3.0270
E24	Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8697 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7366	27.3706	27.0047	25.1749	24.8089	22.9792	22.9792	22.6132	23.7111	24.8089	25.5409	26.2728	(38)
Heat transfer coeff	98.1173	97.7513	97.3853	95.5556	95.1896	93.3599	93.3599	92.9939	94.0918	95.1896	95.9215	96.6534	(39)

Average = Sum(39)m / 12 = 95.4641

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0508	1.0469	1.0430	1.0234	1.0195	0.9999	0.9999	0.9960	1.0077	1.0195	1.0273	1.0352	(40)
HLP (average)												1.0224	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers

94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)

Energy content (annual) Total = Sum(45)m = 2544.6486

Distribution loss (46)m = 0.15 x (45)m

39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)

Water storage loss:

Store volume 190.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)

Temperature factor from Table 2b 0.7800 (49)

Enter (49) or (54) in (55) 1.2714 (55)

Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)

If cylinder contains dedicated solar storage

23.8555	21.5469	23.8555	23.0859	23.8555	23.0859	23.8555	23.8555	23.0859	23.8555	23.0859	23.8555	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

342.5409	303.4763	323.0356	284.6876	276.6008	219.2793	215.0746	224.2810	227.5281	287.1419	304.6268	338.8163	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)

Aperture area of solar collector 3.0000 (H1)

Zero-loss collector efficiency 0.8000 (H2)

Collector linear heat loss coefficient 1.8000 (H3)

Collector 2nd order heat loss coefficient 0.0000 (H4)

Collector loop efficiency 0.9000 (H5)

Incidence angle modifier 1.0000 (H6)

Overshading factor 0.8000 (H8)

Overall heat loss coefficient of system 6.5000 (H10)

Heat loss coefficient of collector loop 3.9667 (H11)

Dedicated solar storage volume 75.0000 (H12)

If combined cylinder, total volume of cylinder 190.0000 (H13)

Effective solar volume 109.5000 (H14)

Reference volume 225.0000 (H15)

Storage tank correction coefficient 1.1973 (H16)

Heat delivered to hot water 687.9359 (H24)

Heat delivered to space heating 0.0000 (H29)

Solar input 687.9359

Solar input -0.0000	-19.8293	-63.9811	-88.2871	-116.9900	-105.5110	-105.0512	-91.4214	-63.2048	-33.3147	-0.3453	-0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

342.5409	283.6470	259.0545	196.4005	159.6108	113.7684	110.0234	132.8595	164.3233	253.8273	304.2815	338.8163	(64)

Total per year (kWh/year) = Sum(64)m = 2659.1533 (64)

Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains													
	682.7039	680.2351	659.9246	621.4193	583.7300	512.4596	492.0000	495.6562	515.0173	586.7311	628.9175	665.7254	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	801.2763	909.6954	1033.6906	1163.2128	1246.7871	1191.2750	1138.2044	1051.0079	948.3630	857.7349	776.2657	763.5792	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.1654	72.4355	72.7077	74.1000	74.3849	75.8427	75.8427	76.1412	75.2528	74.3849	73.8173	73.2583	
alpha	5.8110	5.8290	5.8472	5.9400	5.9590	6.0562	6.0562	6.0761	6.0169	5.9590	5.9212	5.8839	
util living area													
	0.9919	0.9823	0.9510	0.8533	0.6806	0.4977	0.3604	0.4060	0.6608	0.9100	0.9826	0.9937	(86)
MIT	20.2577	20.3910	20.5961	20.8135	20.9177	20.9449	20.9483	20.9480	20.9299	20.7760	20.4799	20.2391	(87)
Th 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(88)
util rest of house													
	0.9893	0.9766	0.9360	0.8164	0.6221	0.4283	0.2856	0.3260	0.5823	0.8766	0.9760	0.9916	(89)
MIT 2	19.3740	19.5075	19.7069	19.9155	19.9979	20.0307	20.0321	20.0354	20.0170	19.8925	19.6101	19.3668	(90)
Living area fraction									fLA = Living area / (4) =			0.3237	(91)
MIT	19.6600	19.7935	19.9947	20.2062	20.2956	20.3266	20.3286	20.3308	20.3124	20.1784	19.8916	19.6491	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6600	19.7935	19.9947	20.2062	20.2956	20.3266	20.3286	20.3308	20.3124	20.1784	19.8916	19.6491	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9879	0.9748	0.9350	0.8225	0.6369	0.4469	0.3057	0.3474	0.6031	0.8811	0.9745	0.9905	(94)
Useful gains	791.5943	886.7581	966.5105	956.6978	794.0687	532.3256	347.9170	365.1474	571.9205	755.7439	756.4765	756.2953	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1507.0827	1455.8586	1314.1890	1080.3674	818.2154	534.6357	348.1020	365.5370	584.5397	911.7662	1226.9935	1493.2110	(97)
Space heating kWh													
	532.3234	382.4355	258.6728	89.0421	17.9651	0.0000	0.0000	0.0000	0.0000	116.0806	338.7723	548.2653	(98a)
Space heating requirement - total per year (kWh/year)												2283.5572	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	532.3234	382.4355	258.6728	89.0421	17.9651	0.0000	0.0000	0.0000	0.0000	116.0806	338.7723	548.2653	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2283.5572	
Space heating per m2											(98c) / (4) =	24.4571	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 84.0000 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	532.3234	382.4355	258.6728	89.0421	17.9651	0.0000	0.0000	0.0000	0.0000	116.0806	338.7723	548.2653	(98)
Space heating efficiency (main heating system 1)													
	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000		(210)
Space heating fuel (main heating system)													
	633.7183	455.2804	307.9439	106.0025	21.3871	0.0000	0.0000	0.0000	0.0000	138.1912	403.3003	652.6968	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	342.5409	283.6470	259.0545	196.4005	159.6108	113.7684	110.0234	132.8595	164.3233	253.8273	304.2815	338.8163	(64)
Efficiency of water heater													(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)
Fuel for water heating, kWh/month													
	407.7868	337.6750	308.3982	233.8101	190.0129	135.4385	130.9802	158.1661	195.6230	302.1753	362.2399	403.3527	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	41.0630	37.0892	41.0630	39.7384	41.0630	39.7384	41.0630	41.0630	39.7384	41.0630	39.7384	41.0630	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-34.3805	-49.9409	-74.1255	-86.2256	-95.5604	-90.3594	-89.4021	-83.1706	-72.4353	-58.5105	-38.3673	-29.5598	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 2718.5205 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 89.0000
Water heating fuel used 3165.6587 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)
mechanical ventilation fans (SFP = 0.8140) 317.4842 (230a)
central heating pump 41.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 80.0000 (230g)
Total electricity for the above, kWh/year 483.4842 (231)
Electricity for lighting (calculated in Appendix L) 210.9332 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -802.0379 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 5776.5586 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2718.5205	3.6400	98.9541	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3165.6587	3.6400	115.2300	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	403.4842	16.4900	66.5345	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	210.9332	16.4900	34.7829	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-802.0379	16.4900	-132.2561	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-132.2561	(252)
Total energy cost			288.4375	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.7504 (257)
SAP value		87.8355
SAP rating (Section 12)		88 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2718.5205	0.2100	570.8893	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3165.6587	0.2100	664.7883	(264)
Space and water heating			1235.6776	(265)
Pumps, fans and electric keep-hot	483.4842	0.1387	67.0652	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-802.0379	0.1339	-107.3681	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-107.3681	(269)
Total CO2, kg/year			1225.8189	(272)
CO2 emissions per m2			13.1300	(273)
EI value			88.1289	
EI rating			88	(274)
EI band			B	

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation 0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 82.8000 (23c)

Effective ac	0.2317	0.2248	0.2248	0.2143	0.2143	0.2005	0.2039	0.1970	0.2005	0.2074	0.2074	0.2178	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8697 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.4430	23.7111	23.7111	22.6132	22.6132	21.1494	21.5154	20.7835	21.1494	21.8813	21.8813	22.9792	(38)
Heat transfer coeff	94.8237	94.0918	94.0918	92.9939	92.9939	91.5301	91.8961	91.1642	91.5301	92.2620	92.2620	93.3599	(39)

Average = Sum(39)m / 12 = 92.7499

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0156	1.0077	1.0077	0.9960	0.9960	0.9803	0.9842	0.9764	0.9803	0.9881	0.9881	0.9999	(40)
HLP (average)												0.9934	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)
Hot water usage for mixer showers
94.8361 93.4109 91.3341 87.3605 84.4281 81.1580 79.2992 81.3603 83.6196 87.1308 91.1897 94.4728 (42a)
Hot water usage for baths
29.7833 29.3410 28.7181 27.5696 26.7097 25.7561 25.2410 25.8595 26.5330 27.5534 28.7255 29.6826 (42b)
Hot water usage for other uses
41.9642 40.4382 38.9123 37.3863 35.8603 34.3344 34.3344 35.8603 37.3863 38.9123 40.4382 41.9642 (42c)
Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)

Energy content (annual) Total = Sum(45)m = 2544.6486
Distribution loss (46)m = 0.15 x (45)m
39.5742 34.8571 36.6484 31.2770 29.6832 26.0522 25.1935 26.5745 27.2895 31.2643 34.2679 39.0155 (46)
Water storage loss:
Store volume 190.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss
39.4134 35.5992 39.4134 38.1420 39.4134 38.1420 39.4134 39.4134 38.1420 39.4134 38.1420 39.4134 (56)
If cylinder contains dedicated solar storage
23.8555 21.5469 23.8555 23.0859 23.8555 23.0859 23.8555 23.8555 23.0859 23.8555 23.0859 23.8555 (57)
Primary loss 54.8576 49.5488 54.8576 53.0880 54.8576 22.5120 23.2624 23.2624 22.5120 54.8576 53.0880 54.8576 (59)
Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)
Total heat required for water heating calculated for each month
342.5409 303.4763 323.0356 284.6876 276.6008 219.2793 215.0746 224.2810 227.5281 287.1419 304.6268 338.8163 (62)
WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63a)
PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)
Aperture area of solar collector 3.0000 (H1)

Zero-loss collector efficiency													0.8000 (H2)
Collector linear heat loss coefficient													1.8000 (H3)
Collector 2nd order heat loss coefficient													0.0000 (H4)
Collector loop efficiency													0.9000 (H5)
Incidence angle modifier													1.0000 (H6)
Overshading factor													0.8000 (H8)
Overall heat loss coefficient of system													6.5000 (H10)
Heat loss coefficient of collector loop													3.9667 (H11)
Dedicated solar storage volume													75.0000 (H12)
If combined cylinder, total volume of cylinder													190.0000 (H13)
Effective solar volume													109.5000 (H14)
Reference volume													225.0000 (H15)
Storage tank correction coefficient													1.1973 (H16)
Heat delivered to hot water													753.2387 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													753.2387
Solar input	-1.6890	-21.1799	-64.9611	-92.9553	-119.0961	-115.9304	-114.0049	-102.7323	-72.2454	-40.4802	-7.9642	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	340.8519	282.2964	258.0745	191.7323	157.5047	103.3489	101.0697	121.5487	155.2828	246.6617	296.6626	338.8163	(64)
Total per year (kWh/year) = Sum(64)m =												2593.8505	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000	(64a)
Heat gains from water heating, kWh/month	131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains	682.7039	680.2351	659.9246	621.4193	583.7300	512.4596	492.0000	495.6562	515.0173	586.7311	628.9175	665.7254	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	22.3313	0.6300	0.7000	0.7700	35.9664	(76)
Southwest	0.9700	40.4699	0.6300	0.7000	0.7700	11.9971	(79)
West	6.0600	22.3313	0.6300	0.7000	0.7700	41.3579	(80)
Northwest	0.9700	12.9236	0.6300	0.7000	0.7700	3.8311	(81)
East	6.0500	22.3313	0.6300	0.7000	0.7700	41.2897	(76)

Solar gains	134.4422	234.1564	376.4091	561.1789	668.0638	731.4984	688.9976	606.2365	472.6945	295.2148	171.1807	109.8590	(83)
Total gains	817.1461	914.3914	1036.3337	1182.5982	1251.7938	1243.9580	1180.9976	1101.8927	987.7118	881.9459	800.0982	775.5844	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.6719	75.2528	75.2528	76.1412	76.1412	77.3589	77.0508	77.6694	77.3589	76.7452	76.7452	75.8427	
alpha	5.9781	6.0169	6.0169	6.0761	6.0761	6.1573	6.1367	6.1780	6.1573	6.1163	6.1163	6.0562	
util living area	0.9881	0.9759	0.9308	0.7943	0.5838	0.3674	0.2412	0.2647	0.5320	0.8522	0.9704	0.9905	(86)
MIT	20.3728	20.4905	20.6893	20.8723	20.9381	20.9491	20.9494	20.9497	20.9451	20.8537	20.6001	20.3588	(87)
Th 2	20.0704	20.0769	20.0769	20.0867	20.0867	20.0998	20.0965	20.1031	20.0998	20.0932	20.0932	20.0834	(88)
util rest of house	0.9840	0.9682	0.9103	0.7488	0.5214	0.3015	0.1709	0.1905	0.4521	0.8040	0.9592	0.9873	(89)
MIT 2	19.5129	19.6331	19.8201	19.9846	20.0303	20.0492	20.0459	20.0528	20.0478	19.9810	19.7550	19.5107	(90)
Living area fraction									fLA = Living area / (4) =			0.3237	(91)
MIT	19.7912	19.9106	20.1014	20.2719	20.3241	20.3405	20.3383	20.3431	20.3382	20.2634	20.0285	19.7852	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7912	19.9106	20.1014	20.2719	20.3241	20.3405	20.3383	20.3431	20.3382	20.2634	20.0285	19.7852	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9825	0.9665	0.9109	0.7585	0.5379	0.3192	0.1897	0.2104	0.4736	0.8139	0.9582	0.9860	(94)
Useful gains	802.8789	883.7747	943.9623	897.0233	673.3023	397.0430	224.0653	231.8260	467.7324	717.8124	766.6578	764.6971	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1393.0763	1346.5091	1195.0985	964.5264	681.0994	397.2828	224.0721	231.8380	470.3000	799.3062	1109.7737	1371.0070	(97)
Space heating kWh	439.1069	310.9576	186.8454	48.6022	5.8010	0.0000	0.0000	0.0000	0.0000	60.6314	247.0434	451.0946	(98a)
Space heating requirement - total per year (kWh/year)												1750.0824	
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	439.1069	310.9576	186.8454	48.6022	5.8010	0.0000	0.0000	0.0000	0.0000	60.6314	247.0434	451.0946	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1750.0824	
Space heating per m2											(98c) / (4) =	18.7435	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												84.0000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	439.1069	310.9576	186.8454	48.6022	5.8010	0.0000	0.0000	0.0000	0.0000	60.6314	247.0434	451.0946	(98)
Space heating efficiency (main heating system 1)	84.0000	84.0000	84.0000	84.0000	84.0000	0.0000	0.0000	0.0000	0.0000	84.0000	84.0000	84.0000	(210)
Space heating fuel (main heating system)	522.7463	370.1876	222.4349	57.8598	6.9060	0.0000	0.0000	0.0000	0.0000	72.1802	294.0993	537.0173	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	340.8519	282.2964	258.0745	191.7323	157.5047	103.3489	101.0697	121.5487	155.2828	246.6617	296.6626	338.8163	(64)
Efficiency of water heater												89.0000	(216)
(217)m	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	84.0000	(217)
Fuel for water heating, kWh/month	405.7761	336.0671	307.2316	228.2528	187.5055	123.0344	120.3211	144.7008	184.8604	293.6449	353.1698	403.3527	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	41.0630	37.0892	41.0630	39.7384	41.0630	39.7384	41.0630	41.0630	39.7384	41.0630	39.7384	41.0630	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-37.6786	-50.2961	-74.0472	-87.7347	-95.7598	-93.7371	-92.2408	-86.9940	-75.9590	-61.6249	-42.6821	-32.1861	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2083.4314	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												89.0000	
Water heating fuel used												3087.9173	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)													
mechanical ventilation fans (SFP = 0.8140)												317.4842	(230a)
central heating pump												41.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												483.4842	(231)
Electricity for lighting (calculated in Appendix L)												210.9332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-830.9405	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													

Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	5034.8256 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2083.4314	3.5000	72.9201	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3087.9173	3.5000	108.0771	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	403.4842	18.3900	74.2007	(249)
Pump for solar water heating	80.0000	18.3900	14.7120	(249)
Energy for lighting	210.9332	18.3900	38.7906	(250)
Additional standing charges			94.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-830.9405	18.3900	-152.8100	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-152.8100	(252)
Total energy cost			249.8906	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2083.4314	0.2100	437.5206	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3087.9173	0.2100	648.4626	(264)
Space and water heating			1085.9832	(265)
Pumps, fans and electric keep-hot	483.4842	0.1387	67.0652	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-830.9405	0.1339	-111.2744	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-111.2744	(269)
Total CO2, kg/year			1072.2182	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	2083.4314	1.1300	2354.2775	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3087.9173	1.1300	3489.3465	(278)
Space and water heating			5843.6240	(279)
Pumps, fans and electric keep-hot	483.4842	1.5128	731.4149	(281)
Energy for lighting	210.9332	1.5338	323.5363	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-830.9405	1.4949	-1242.1487	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1242.1487	(283)
Total Primary energy kWh/year			5656.4266	(286)

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APPENDIX C

SAP Worksheets – Be Green Case

Full SAP Calculation Printout

elmhurst energy

Property Reference	House 1	Issued on Date	23/01/2023
Assessment Reference	House 1 Be Green	Prop Type Ref	
Property	House 1, 35, Twickenham Rd		

SAP Rating	78 C	DER	4.25	TER	10.18
Environmental	95 A	% DER < TER			58.25
CO_2 Emissions (t/year)	0.73	DFEE	41.49	TFEE	42.32
Compliance Check	See BREL	% DFEE < TFEE			1.96
% DPER < TPER	16.57	DPER	44.54	TPER	53.38

Assessor Details	Mrs. Deborah Elliott	Assessor ID	L377-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000	(23c)

Effective ac	0.2764	0.2729	0.2695	0.2521	0.2487	0.2313	0.2313	0.2278	0.2382	0.2487	0.2556	0.2625	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K

Windows (Uw = 1.40)			36.9400	1.3258	48.9735		(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057		(27)
Entrance door			2.1600	1.1000	2.3760		(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000 (28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000 (28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993 (29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998 (29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600 (29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000 (30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100 (30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200 (30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600 (30)
Total net area of external elements Aum(A, m2)			406.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.0280		(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		183.5066 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		24.1532 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1139	46.5227	45.9314	42.9752	42.3839	39.4276	39.4276	38.8364	40.6101	42.3839	43.5664	44.7489	(38)
Heat transfer coeff	183.2952	182.7040	182.1127	179.1564	178.5652	175.6089	175.6089	175.0177	176.7914	178.5652	179.7477	180.9302	(39)

Average = Sum(39)m / 12 = 179.0086

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9668	0.9637	0.9481	0.9449	0.9293	0.9293	0.9262	0.9356	0.9449	0.9512	0.9575	(40)
HLP (average)												0.9473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.9876	(42)
Hot water usage for mixer showers	102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)
Hot water usage for baths	32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)
Hot water usage for other uses	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)
Average daily hot water use (litres/day)												165.0615	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)
Energy content (annual)										Total = Sum(45)m =		2741.6891	
Distribution loss (46)m = 0.15 x (45)m	42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
									Total per year (kWh/year) = Sum(64)m =			3727.3117	(64)
12Total per year (kWh/year)												3727	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)

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

	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)

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

	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)

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

	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)

Total internal gains

	796.0747	816.1397	780.9973	753.0964	713.2443	652.6575	625.1500	625.8429	646.5437	704.3617	749.0590	778.3778	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787	(76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1240.5898	1590.0612	1872.5084	2140.7518	2285.6264	2217.8739	2132.7123	1997.4307	1842.2129	1569.6473	1284.8238	1156.4742	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5522	52.7223	52.8934	53.7662	53.9443	54.8524	54.8524	55.0377	54.4855	53.9443	53.5894	53.2391	
alpha	4.5035	4.5148	4.5262	4.5844	4.5963	4.6568	4.6568	4.6692	4.6324	4.5963	4.5726	4.5493	
util living area													
	0.9897	0.9704	0.9278	0.8260	0.6716	0.4960	0.3602	0.3996	0.6254	0.8828	0.9762	0.9923	(86)
Living	19.9010	20.1449	20.4232	20.7068	20.8617	20.9200	20.9311	20.9298	20.8948	20.6661	20.2298	19.8653	
Non living	19.0996	19.3415	19.6119	19.8838	20.0150	20.0695	20.0754	20.0777	20.0493	19.8569	19.4383	19.0730	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(88)
util rest of house													
	0.9873	0.9639	0.9128	0.7944	0.6221	0.4335	0.2910	0.3270	0.5590	0.8528	0.9699	0.9905	(89)
MIT 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(90)
Living area fraction									fLA = Living area / (4) =			0.0755	(91)
MIT	20.1757	20.1781	20.1806	20.1927	20.1952	20.2074	20.2074	20.2098	20.2025	20.1952	20.1903	20.1854	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1757	20.1781	20.1806	20.1927	20.1952	20.2074	20.2074	20.2098	20.2025	20.1952	20.1903	20.1854	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9875	0.9645	0.9141	0.7970	0.6260	0.4383	0.2963	0.3325	0.5642	0.8553	0.9704	0.9907	(94)
Useful gains	1225.1426	1533.5991	1711.5807	1706.1552	1430.7277	972.0949	631.9223	664.1319	1039.4397	1342.5234	1246.8503	1145.6842	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2909.9423	2791.3766	2491.4050	2023.1645	1516.9401	984.7035	633.4857	666.7843	1078.8661	1713.3618	2352.9495	2892.2463	(97)
Space heating kWh													
	1253.4910	845.2264	580.1893	228.2466	64.1421	0.0000	0.0000	0.0000	0.0000	275.9038	796.3915	1299.4422	(98a)
Space heating requirement - total per year (kWh/year)												5343.0329	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1253.4910	845.2264	580.1893	228.2466	64.1421	0.0000	0.0000	0.0000	0.0000	275.9038	796.3915	1299.4422	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 5343.0329
Space heating per m2 (98c) / (4) = 28.2745 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)
Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 290.9151 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1253.4910	845.2264	580.1893	228.2466	64.1421	0.0000	0.0000	0.0000	0.0000	275.9038	796.3915	1299.4422	(98)
Space heating efficiency (main heating system 1)													
	290.9151	290.9151	290.9151	290.9151	290.9151	0.0000	0.0000	0.0000	0.0000	290.9151	290.9151	290.9151	(210)
Space heating fuel (main heating system)													
	430.8787	290.5406	199.4360	78.4582	22.0484	0.0000	0.0000	0.0000	0.0000	94.8400	273.7539	446.6741	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	336.4695	298.2423	317.7883	280.7904	273.3168	220.2521	216.5669	225.3842	228.1528	283.4129	299.8871	332.9024	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	43.5653	39.3493	43.5653	42.1600	43.5653	42.1600	43.5653	43.5653	42.1600	43.5653	42.1600	43.5653	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.7075	-27.9970	-44.8980	-55.9961	-65.4746	-62.3963	-61.5761	-55.3882	-45.3682	-33.9517	-20.4325	-14.9752	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 1836.6298 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 112.5000
Water heating fuel used 3313.1660 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)
mechanical ventilation fans (SFP = 0.8140) 512.9463 (230a)
Total electricity for the above, kWh/year 512.9463 (231)
Electricity for lighting (calculated in Appendix L) 288.1350 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -506.1613 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 5444.7157 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1836.6298	0.1570	288.4063	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3313.1660	0.1416	469.0528	(264)
Space and water heating			757.4591	(265)
Pumps, fans and electric keep-hot	512.9463	0.1387	71.1520	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-506.1613	0.1325	-67.0899	

PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-67.0899	(269)
Total CO2, kg/year			803.1080	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.2500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1836.6298	1.5813	2904.2545	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3313.1660	1.5235	5047.7044	(278)
Space and water heating			7951.9590	(279)
Pumps, fans and electric keep-hot	512.9463	1.5128	775.9851	(281)
Energy for lighting	288.1350	1.5338	441.9511	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-506.1613	1.4898	-754.0562	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-754.0562	(283)
Total Primary energy kWh/year			8415.8390	(286)
Dwelling Primary energy Rate (DPER)			44.5400	(287)

SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)

CALCULATION OF TARGET EMISSIONS

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0774	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3274	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3029	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3862	0.3786	0.3710	0.3332	0.3256	0.2877	0.2877	0.2802	0.3029	0.3256	0.3407	0.3559	(22b)
Effective ac	0.5746	0.5717	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5459	0.5530	0.5581	0.5633	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			45.0000	1.1450	51.5267			(27)
LGF			53.1800	0.1300	6.9134			(28a)
Upper floor - above entrance			2.5900	0.1300	0.3367			(28a)
LGF wall	66.0900	14.7600	51.3300	0.1800	9.2394			(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1800	23.2020			(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1800	8.7156			(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849			(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159			(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718			(30)
Dormers	4.6400		4.6400	0.1100	0.5104			(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.3768			(33)
Party Wall 1			47.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3	Sill	27.4800	0.0500	1.3740
E4	Jamb	106.2600	0.0500	5.3130
E5	Ground floor (normal)	23.1900	0.1600	3.7104
E6	Intermediate floor within a dwelling	84.2200	0.0000	0.0000
E16	Corner (normal)	70.2700	0.0900	6.3243
E18	Party wall between dwellings	12.1000	0.0600	0.7260
E17	Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24	Eaves (insulation at ceiling level - inverted)	4.7800	0.2400	1.1472
E21	Exposed floor (inverted)	4.7800	0.3200	1.5296
E20	Exposed floor (normal)	2.1000	0.3200	0.6720
E10	Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11	Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8	Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.2946 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 133.6714 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	97.9358	97.4423	96.9585	94.6862	94.2611	92.2821	92.2821	91.9156	93.0444	94.2611	95.1212	96.0203	(38)
Heat transfer coeff	231.6072	231.1137	230.6299	228.3577	227.9325	225.9535	225.9535	225.5870	226.7158	227.9325	228.7926	229.6917	(39)

Average = Sum(39)m / 12 = 228.3556

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2256	1.2230	1.2205	1.2084	1.2062	1.1957	1.1957	1.1938	1.1997	1.2062	1.2107	1.2155	(40)
HLP (average)												1.2084	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)

Hot water usage for mixer showers												
	74.3113	73.1945	71.5672	68.4536	66.1558	63.5934	62.1369	63.7519	65.5223	68.2735	71.4540	74.0266 (42a)
Hot water usage for baths												
	32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710 (42b)
Hot water usage for other uses												
	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255 (42c)

Average daily hot water use (litres/day) 139.3694 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.6163	148.3785	144.4357	138.4405	133.5719	128.3378	126.3266	130.2524	134.3927	139.8875	145.9751	151.2231	(44)
Energy conte	240.1231	211.2891	221.9923	189.5182	179.8135	157.8064	152.7810	161.2796	165.7196	189.8261	207.9683	236.7788	(45)

Energy content (annual) Total = Sum(45)m = 2314.8960

Distribution loss (46)m = 0.15 x (45)m												
	36.0185	31.6934	33.2989	28.4277	26.9720	23.6710	22.9172	24.1919	24.8579	28.4739	31.1952	35.5168 (46)

Water storage loss:

Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss												
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage												
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
	286.7180	253.3748	268.5872	234.6100	226.4084	202.8982	199.3759	207.8745	210.8114	236.4210	253.0601	283.3738 (62)
WWHRS	-33.9720	-30.0451	-31.4615	-26.0514	-24.2790	-20.7757	-19.4739	-20.7085	-21.4953	-25.3406	-28.7078	-33.3429 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	252.7460	223.3297	237.1257	208.5586	202.1295	182.1225	179.9021	187.1660	189.3161	211.0804	224.3523	250.0309 (64)

Total per year (kWh/year) = Sum(64)m = 2547.8597 (64)

12Total per year (kWh/year) 2548 (64)

Electric shower(s)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	117.1169	103.9222	111.0884	99.0883	97.0639	88.5441	88.0756	90.9014	91.1752	100.3931	105.2229	116.0049 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)

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

	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)

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

	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)

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

	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	157.4151	154.6461	149.3123	137.6226	130.4622	122.9779	118.3812	122.1793	126.6323	134.9369	146.1429	155.9206	(72)

Total internal gains

	770.4662	790.9159	756.6784	730.9834	692.4344	664.2046	637.6444	637.7023	657.6405	682.9504	725.5451	753.0681	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	15.4800	19.6403	0.6300	0.7000	0.7700	92.9159	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1214.9813	1564.8374	1848.1894	2118.6389	2264.8164	2229.4209	2145.2067	2009.2901	1853.3097	1548.2360	1261.3098	1131.1645	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.5901	41.6789	41.7663	42.1819	42.2606	42.6308	42.6308	42.7000	42.4874	42.2606	42.1018	41.9370	
alpha	3.7727	3.7786	3.7844	3.8121	3.8174	3.8421	3.8421	3.8467	3.8325	3.8174	3.8068	3.7958	
util living area	0.9913	0.9777	0.9496	0.8825	0.7654	0.5994	0.4502	0.4960	0.7212	0.9217	0.9819	0.9933	(86)
MIT	19.1196	19.4523	19.8768	20.3668	20.7261	20.9219	20.9798	20.9707	20.8382	20.3310	19.6245	19.0645	(87)
Th 2	19.8996	19.9016	19.9037	19.9133	19.9151	19.9234	19.9234	19.9250	19.9202	19.9151	19.9114	19.9076	(88)
util rest of house	0.9891	0.9722	0.9372	0.8541	0.7113	0.5151	0.3460	0.3889	0.6428	0.8962	0.9766	0.9916	(89)
MIT 2	17.7151	18.1379	18.6710	19.2717	19.6771	19.8737	19.9155	19.9124	19.8034	19.2457	18.3667	17.6501	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	17.8211	18.2371	18.7620	19.3544	19.7563	19.9528	19.9958	19.9923	19.8815	19.3276	18.4617	17.7568	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8211	18.2371	18.7620	19.3544	19.7563	19.9528	19.9958	19.9923	19.8815	19.3276	18.4617	17.7568	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9826	0.9605	0.9203	0.8366	0.7025	0.5175	0.3532	0.3959	0.6397	0.8785	0.9661	0.9863	(94)
Useful gains	1193.8565	1502.9509	1700.9170	1772.5584	1590.9628	1153.8177	757.7394	795.4895	1185.5236	1360.1724	1218.6004	1115.6201	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	3131.5916	3082.3921	2827.9831	2387.3373	1836.2851	1209.4923	767.2940	810.3776	1310.7492	1989.2989	2599.4615	3113.8861	(97)
Space heating kWh	1441.6749	1061.3845	838.5371	442.6408	182.5198	0.0000	0.0000	0.0000	0.0000	468.0701	994.2200	1486.7098	(98a)
Space heating requirement - total per year (kWh/year)												6915.7571	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1441.6749	1061.3845	838.5371	442.6408	182.5198	0.0000	0.0000	0.0000	0.0000	468.0701	994.2200	1486.7098	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												6915.7571	
Space heating per m2											(98c) / (4) =	36.5971	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												92.3000	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1441.6749	1061.3845	838.5371	442.6408	182.5198	0.0000	0.0000	0.0000	0.0000	468.0701	994.2200	1486.7098	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	1561.9446	1149.9290	908.4909	479.5675	197.7462	0.0000	0.0000	0.0000	0.0000	507.1182	1077.1614	1610.7366	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	252.7460	223.3297	237.1257	208.5586	202.1295	182.1225	179.9021	187.1660	189.3161	211.0804	224.3523	250.0309	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.3308	87.0925	86.6458	85.7043	83.8316	79.8000	79.8000	79.8000	79.8000	85.7927	86.9936	87.3812	(217)
Fuel for water heating, kWh/month													
	289.4121	256.4281	273.6726	243.3467	241.1135	228.2237	225.4412	234.5439	237.2383	246.0352	257.8951	286.1380	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)
Lighting	37.7744	30.3040	27.2854	19.9905	15.4412	12.6156	14.0860	18.3095	23.7822	31.2036	35.2443	38.8242	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-51.5448	-73.6172	-107.1456	-121.9592	-132.6621	-124.0990	-122.4254	-114.9328	-102.0238	-84.7073	-56.9493	-44.4417	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-26.3212	-55.6658	-111.2323	-167.9797	-223.0773	-224.6199	-222.1219	-187.7561	-137.1046	-80.0803	-35.2838	-20.8038	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												7492.6946	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												79.8000	
Water heating fuel used												3019.4883	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												86.0000	(231)
Electricity for lighting (calculated in Appendix L)												304.8608	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-2628.5548	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												8274.4890	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	7492.6946	0.2100	1573.4659	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3019.4883	0.2100	634.0926	(264)
Space and water heating			2207.5584	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	304.8608	0.1443	44.0008	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1136.5081	0.1343	-152.6894	
PV Unit electricity exported	-1492.0467	0.1257	-187.5791	
Total			-340.2685	(269)
Total CO2, kg/year			1923.2200	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.1800	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	7492.6946	1.1300	8466.7448	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3019.4883	1.1300	3412.0218	(278)
Space and water heating			11878.7667	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	304.8608	1.5338	467.6057	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1136.5081	1.4965	-1700.8075	
PV Unit electricity exported	-1492.0467	0.4615	-688.5299	
Total			-2389.3374	(283)
Total Primary energy kWh/year			10087.1358	(286)
Target Primary Energy Rate (TPER)			53.3800	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0774	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2274	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2104	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2682	0.2630	0.2577	0.2314	0.2262	0.1999	0.1999	0.1946	0.2104	0.2262	0.2367	0.2472	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5360	0.5346	0.5332	0.5268	0.5256	0.5200	0.5200	0.5189	0.5221	0.5256	0.5280	0.5306	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)

Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000 (28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993 (29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998 (29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600 (29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000 (30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100 (30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200 (30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600 (30)
Total net area of external elements Aum(A, m2)			406.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.0280		(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	91.3581	91.1199	90.8865	89.7902	89.5851	88.6303	88.6303	88.4535	88.9981	89.5851	90.0001	90.4339	(38)
Heat transfer coeff	227.5393	227.3012	227.0678	225.9715	225.7664	224.8116	224.8116	224.6348	225.1794	225.7664	226.1814	226.6152	(39)
Average = Sum(39)m / 12 =												225.9705	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2041	1.2028	1.2016	1.1958	1.1947	1.1897	1.1897	1.1887	1.1916	1.1947	1.1969	1.1992	(40)
HLP (average)												1.1958	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)
Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 70.8569 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	77.3050	75.1840	72.8685	69.9870	67.4161	64.7445	64.1897	66.5005	68.8704	71.6140	74.5211	77.1966	(44)
Energy conte	122.4322	107.0610	111.9962	95.8086	90.7550	79.6109	77.6318	82.3415	84.9241	97.1795	106.1689	120.8712	(45)
Energy content (annual)										Total = Sum(45)m =		1176.7810	

Distribution loss (46)m = 0.15 x (45)m

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(64)

Total per year (kWh/year) = Sum(64)m = 1000.2639 (64)
12Total per year (kWh/year) 1000 (64)
Electric shower(s)

59.5109	53.0247	57.9010	55.2542	56.2910	53.6962	55.4860	56.2910	55.2542	57.9010	56.8122	59.5109	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 676.9335 (64a)
Heat gains from water heating, kWh/month

40.8946	36.0067	38.2744	34.1729	33.3582	30.3414	30.3683	31.5703	31.8599	35.1259	36.7639	40.5629	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)

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

	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)

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

	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)

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

	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	54.9658	53.5813	51.4442	47.4623	44.8363	42.1408	40.8176	42.4332	44.2499	47.2122	51.0610	54.5200	(72)

Total internal gains

	665.0169	686.8511	655.8102	637.8232	603.8084	583.3674	560.0808	557.9562	575.2581	592.2256	627.4632	648.6675	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787	(76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1109.5320	1460.7726	1747.3212	2025.4786	2176.1904	2148.5838	2067.6430	1929.5440	1770.9273	1457.5112	1163.2279	1026.7639	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	42.3336	42.3780	42.4216	42.6274	42.6661	42.8473	42.8473	42.8810	42.7773	42.6661	42.5878	42.5063	
alpha	3.8222	3.8252	3.8281	3.8418	3.8444	3.8565	3.8565	3.8587	3.8518	3.8444	3.8392	3.8338	
util living area													
	0.9936	0.9819	0.9564	0.8932	0.7791	0.6147	0.4635	0.5121	0.7390	0.9327	0.9860	0.9952	(86)
MIT	19.0863	19.4208	19.8491	20.3424	20.7127	20.9159	20.9780	20.9678	20.8257	20.2971	19.5809	19.0218	(87)
Th 2	19.9167	19.9177	19.9187	19.9234	19.9242	19.9283	19.9283	19.9290	19.9267	19.9242	19.9225	19.9206	(88)
util rest of house													
	0.9919	0.9774	0.9455	0.8666	0.7264	0.5300	0.3573	0.4029	0.6620	0.9100	0.9818	0.9939	(89)
MIT 2	18.1766	18.5085	18.9286	19.4004	19.7280	19.8862	19.9215	19.9181	19.8273	19.3705	18.6731	18.1152	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	18.2452	18.5773	18.9981	19.4715	19.8024	19.9639	20.0012	19.9973	19.9027	19.4405	18.7416	18.1836	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2452	18.5773	18.9981	19.4715	19.8024	19.9639	20.0012	19.9973	19.9027	19.4405	18.7416	18.1836	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9882	0.9697	0.9336	0.8533	0.7197	0.5330	0.3647	0.4102	0.6601	0.8970	0.9753	0.9910	(94)
Useful gains	1096.4471	1416.5421	1631.2684	1728.4056	1566.2994	1145.1592	754.1524	791.5089	1168.9426	1307.3518	1134.4720	1017.4977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	3173.0819	3108.8723	2837.9078	2388.8591	1829.2389	1205.8627	764.6312	808.0885	1306.6413	1995.8768	2633.1211	3168.8998	(97)
Space heating kWh													
	1545.0163	1137.2459	897.7397	475.5266	195.6270	0.0000	0.0000	0.0000	0.0000	512.2626	1079.0273	1600.6431	(98a)
Space heating requirement - total per year (kWh/year)												7443.0884	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1545.0163	1137.2459	897.7397	475.5266	195.6270	0.0000	0.0000	0.0000	0.0000	512.2626	1079.0273	1600.6431	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7443.0884	
Space heating per m2											(98c) / (4) =	39.3877	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2113.2289	1663.6057	1707.2242	0.0000	0.0000	0.0000	0.0000	(100)

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8455	0.9040	0.8786	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1786.6736	1503.8753	1499.9449	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2429.3847	2338.2181	2180.4737	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	462.7520	620.7511	506.3134	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	115.6880	155.1878	126.5784	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												397.4541	(107)
Energy for space heating												39.3877	(99)
Energy for space cooling												2.1033	(108)
Total												41.4909	(109)
Fabric Energy Efficiency (DFEE)												41.5	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0774	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3274	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3029	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.3862	0.3786	0.3710	0.3332	0.3256	0.2877	0.2877	0.2802	0.3029	0.3256	0.3407	0.3559	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5746	0.5717	0.5688	0.5555	0.5530	0.5414	0.5414	0.5392	0.5459	0.5530	0.5581	0.5633	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			45.0000	1.1450	51.5267			(27)
LGF			53.1800	0.1300	6.9134			(28a)
Upper floor - above entrance			2.5900	0.1300	0.3367			(28a)
LGF wall	66.0900	14.7600	51.3300	0.1800	9.2394			(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1800	23.2020			(29a)

Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1800	8.7156	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	(30)
Total net area of external elements Aum(A, m2)			406.8800			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		110.3768	(33)
Party Wall 1			47.4000	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0500	1.3740
E4 Jamb	106.2600	0.0500	5.3130
E5 Ground floor (normal)	23.1900	0.1600	3.7104
E6 Intermediate floor within a dwelling	84.2200	0.0000	0.0000
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.2400	1.1472
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.2946 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 133.6714 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	97.9358	97.4423	96.9585	94.6862	94.2611	92.2821	92.2821	91.9156	93.0444	94.2611	95.1212	96.0203	(38)
Heat transfer coeff	231.6072	231.1137	230.6299	228.3577	227.9325	225.9535	225.9535	225.5870	226.7158	227.9325	228.7926	229.6917	(39)

Average = Sum(39)m / 12 = 228.3556

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2256	1.2230	1.2205	1.2084	1.2062	1.1957	1.1957	1.1938	1.1997	1.2062	1.2107	1.2155	(40)
HLP (average)												1.2084	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)

Hot water usage for mixer showers

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 70.8569 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	77.3050	75.1840	72.8685	69.9870	67.4161	64.7445	64.1897	66.5005	68.8704	71.6140	74.5211	77.1966	(44)
Energy conte	122.4322	107.0610	111.9962	95.8086	90.7550	79.6109	77.6318	82.3415	84.9241	97.1795	106.1689	120.8712	(45)

Energy content (annual) Total = Sum(45)m = 1176.7810

Distribution loss (46)m = 0.15 x (45)m

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:

Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

104.0674	91.0019	95.1968	81.4373	77.1418	67.6692	65.9871	69.9902	72.1855	82.6026	90.2436	102.7405	(64)

Total per year (kWh/year) = Sum(64)m = 1000.2639 (64)

12Total per year (kWh/year) 1000 (64)

Electric shower(s)

59.5109	53.0247	57.9010	55.2542	56.2910	53.6962	55.4860	56.2910	55.2542	57.9010	56.8122	59.5109	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 676.9335 (64a)

Heat gains from water heating, kWh/month

40.8946	36.0067	38.2744	34.1729	33.3582	30.3414	30.3683	31.5703	31.8599	35.1259	36.7639	40.5629	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	149.3776	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	181.7996	201.2782	181.7996	187.8596	181.7996	187.8596	181.7996	181.7996	187.8596	181.7996	187.8596	181.7996	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	360.4381	364.1783	354.7531	334.6879	309.3592	285.5538	269.6503	265.9101	275.3353	295.4005	320.7292	344.5346	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	37.9378	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)													
	54.9658	53.5813	51.4442	47.4623	44.8363	42.1408	40.8176	42.4332	44.2499	47.2122	51.0610	54.5200	(72)
Total internal gains													
	665.0169	686.8511	655.8102	637.8232	603.8084	583.3674	560.0808	557.9562	575.2581	592.2256	627.4632	648.6675	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	15.4800	19.6403	0.6300	0.7000	0.7700	92.9159	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1109.5320	1460.7726	1747.3212	2025.4786	2176.1904	2148.5838	2067.6430	1929.5440	1770.9273	1457.5112	1163.2279	1026.7639	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.5901	41.6789	41.7663	42.1819	42.2606	42.6308	42.6308	42.7000	42.4874	42.2606	42.1018	41.9370	
alpha	3.7727	3.7786	3.7844	3.8121	3.8174	3.8421	3.8421	3.8467	3.8325	3.8174	3.8068	3.7958	
util living area													
	0.9936	0.9820	0.9571	0.8946	0.7819	0.6167	0.4654	0.5137	0.7413	0.9335	0.9861	0.9952	(86)
MIT	19.0476	19.3849	19.8184	20.3260	20.7034	20.9139	20.9773	20.9670	20.8213	20.2838	19.5598	18.9925	(87)
Th 2	19.8996	19.9016	19.9037	19.9133	19.9151	19.9234	19.9234	19.9250	19.9202	19.9151	19.9114	19.9076	(88)
util rest of house													
	0.9919	0.9776	0.9463	0.8682	0.7291	0.5316	0.3584	0.4040	0.6641	0.9109	0.9819	0.9939	(89)
MIT 2	18.1258	18.4612	18.8874	19.3771	19.7124	19.8803	19.9164	19.9138	19.8183	19.3509	18.6441	18.0768	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	18.1954	18.5309	18.9577	19.4487	19.7872	19.9583	19.9965	19.9933	19.8940	19.4213	18.7132	18.1459	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1954	18.5309	18.9577	19.4487	19.7872	19.9583	19.9965	19.9933	19.8940	19.4213	18.7132	18.1459	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9881	0.9698	0.9342	0.8547	0.7222	0.5345	0.3659	0.4113	0.6619	0.8977	0.9753	0.9909	(94)
Useful gains	1096.3662	1416.7170	1632.4199	1731.2346	1571.5814	1148.5223	756.6495	793.6289	1172.2642	1308.4556	1134.5054	1017.4332	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	3218.2704	3150.2888	2873.1127	2408.8872	1843.3397	1210.7307	767.4504	810.6065	1313.5825	2010.6579	2657.0223	3203.2472	(97)
Space heating kWh													
	1578.6967	1164.9602	923.0754	487.9099	202.1882	0.0000	0.0000	0.0000	0.0000	522.4385	1096.2122	1626.2456	(98a)
Space heating requirement - total per year (kWh/year)												7601.7268	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1578.6967	1164.9602	923.0754	487.9099	202.1882	0.0000	0.0000	0.0000	0.0000	522.4385	1096.2122	1626.2456	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												7601.7268	
Space heating per m2											(98c) / (4) =	40.2272	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	2123.9628	1672.0558	1714.4612	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8431	0.9022	0.8768	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1790.7497	1508.4549	1503.3131	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2429.3847	2338.2181	2180.4737	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	459.8172	617.3439	503.8075	0.0000	0.0000	0.0000	0.0000	(104)

Cooled fraction fC = cooled area / (4) = 1.0000 (105)

Intermittency factor (Table 10b)

0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)

Space cooling kWh

0.0000	0.0000	0.0000	0.0000	0.0000	114.9543	154.3360	125.9519	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling requirement 395.2421 (107)
Energy for space heating 40.2272 (99)
Energy for space cooling 2.0916 (108)
Total 42.3187 (109)
Fabric Energy Efficiency (TFEE) 42.3 (109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		516.5206	(5)

2. Ventilation rate

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

	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	80.1000 (23c)

Effective ac	0.2764	0.2729	0.2695	0.2521	0.2487	0.2313	0.2313	0.2278	0.2382	0.2487	0.2556	0.2625	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)

Exposed from LGF	2.5900	2.5900	0.1100	0.2849	0.0000	0.0000 (30)
Insulation between joists	34.6900	34.6900	0.1100	3.8159	9.0000	312.2100 (30)
insulation between rafters	33.3800	33.3800	0.1100	3.6718	9.0000	300.4200 (30)
Dormers	4.6400	4.6400	0.1100	0.5104	9.0000	41.7600 (30)
Total net area of external elements Aum(A, m2)		406.8800				(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		112.0280		(33)
Party Wall 1		47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1139	46.5227	45.9314	42.9752	42.3839	39.4276	39.4276	38.8364	40.6101	42.3839	43.5664	44.7489	(38)
Heat transfer coeff	183.2952	182.7040	182.1127	179.1564	178.5652	175.6089	175.6089	175.0177	176.7914	178.5652	179.7477	180.9302	(39)

Average = Sum(39)m / 12 = 179.0086

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9668	0.9637	0.9481	0.9449	0.9293	0.9293	0.9262	0.9356	0.9449	0.9512	0.9575	(40)
HLP (average)												0.9473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)
Hot water usage for mixer showers

102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865 (42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710 (42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255 (42c)

Average daily hot water use (litres/day) 165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)

Energy content (annual) Total = Sum(45)m = 2741.6891
Distribution loss (46)m = 0.15 x (45)m

42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366 (46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (57)
54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152 (62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

WWHRS
PV diverter
Solar input
FGHRS
Output from w/h

378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152 (64)

Total per year (kWh/year) = Sum(64)m = 3727.3117 (64)
Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)

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

	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)

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

	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)

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

	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)

Water heating gains (Table 5)

	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)

Total internal gains

	880.4434	878.3115	851.2400	800.2387	748.3396	667.3707	639.2237	642.6349	668.6834	749.6018	806.3462	856.0470	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787	(76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1324.9585	1652.2331	1942.7510	2187.8942	2320.7216	2232.5870	2146.7860	2014.2227	1864.3526	1614.8874	1342.1110	1234.1434	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5522	52.7223	52.8934	53.7662	53.9443	54.8524	54.8524	55.0377	54.4855	53.9443	53.5894	53.2391	
alpha	4.5035	4.5148	4.5262	4.5844	4.5963	4.6568	4.6568	4.6692	4.6324	4.5963	4.5726	4.5493	
util living area													
	0.9868	0.9662	0.9193	0.8171	0.6639	0.4930	0.3579	0.3964	0.6194	0.8735	0.9721	0.9901	(86)
Living	19.9457	20.1748	20.4506	20.7178	20.8649	20.9203	20.9311	20.9299	20.8963	20.6802	20.2583	19.9072	
Non living	19.1437	19.3705	19.6373	19.8930	20.0173	20.0696	20.0754	20.0777	20.0502	19.8689	19.4659	19.1145	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(88)
util rest of house													
	0.9838	0.9589	0.9030	0.7848	0.6144	0.4308	0.2891	0.3243	0.5532	0.8421	0.9649	0.9878	(89)
MIT 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(90)
Living area fraction									fLA = Living area / (4) =			0.0755	(91)
MIT	20.1757	20.1781	20.1806	20.1927	20.1952	20.2074	20.2074	20.2098	20.2025	20.1952	20.1903	20.1854	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1757	20.1781	20.1806	20.1927	20.1952	20.2074	20.2074	20.2098	20.2025	20.1952	20.1903	20.1854	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9840	0.9595	0.9044	0.7874	0.6183	0.4356	0.2944	0.3298	0.5584	0.8447	0.9655	0.9880	(94)
Useful gains	1303.8070	1585.3407	1756.9878	1722.7035	1434.9124	972.4175	631.9653	664.2232	1041.0632	1364.1356	1295.8322	1219.3193	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2909.9423	2791.3766	2491.4050	2023.1645	1516.9401	984.7035	633.4857	666.7843	1078.8661	1713.3618	2352.9495	2892.2463	(97)
Space heating kWh													
	1194.9647	810.4561	546.4064	216.3319	61.0286	0.0000	0.0000	0.0000	0.0000	259.8243	761.1245	1244.6576	(98a)
Space heating requirement - total per year (kWh/year)												5094.7942	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1194.9647	810.4561	546.4064	216.3319	61.0286	0.0000	0.0000	0.0000	0.0000	259.8243	761.1245	1244.6576	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5094.7942	
Space heating per m2											(98c) / (4) =	26.9609	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)
Efficiency of main space heating system 1 (in %) 290.9151 (206)
Efficiency of main space heating system 2 (in %) 0.0000 (207)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1194.9647	810.4561	546.4064	216.3319	61.0286	0.0000	0.0000	0.0000	0.0000	259.8243	761.1245	1244.6576	(98)
Space heating efficiency (main heating system 1)													
	290.9151	290.9151	290.9151	290.9151	290.9151	0.0000	0.0000	0.0000	0.0000	290.9151	290.9151	290.9151	(210)
Space heating fuel (main heating system)													
	410.7607	278.5885	187.8233	74.3626	20.9781	0.0000	0.0000	0.0000	0.0000	89.3128	261.6312	427.8423	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	336.4695	298.2423	317.7883	280.7904	273.3168	220.2521	216.5669	225.3842	228.1528	283.4129	299.8871	332.9024	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	43.5653	39.3493	43.5653	42.1600	43.5653	42.1600	43.5653	43.5653	42.1600	43.5653	42.1600	43.5653	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.6895	-27.9675	-44.8341	-55.9505	-65.4563	-62.3963	-61.5761	-55.3882	-45.3682	-33.9239	-20.4134	-14.9621	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year
Space heating fuel - main system 1 1751.2995 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 112.5000
Water heating fuel used 3313.1660 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)
mechanical ventilation fans (SFP = 0.8140) 512.9463 (230a)
Total electricity for the above, kWh/year 512.9463 (231)
Electricity for lighting (calculated in Appendix L) 288.1350 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -505.9263 (233)
Wind generation 0.0000 (234)
Hydro-electric generation (Appendix N) 0.0000 (235a)
Electricity generated - Micro CHP (Appendix N) 0.0000 (235)
Appendix Q - special features
Energy saved or generated -0.0000 (236)
Energy used 0.0000 (237)
Total delivered energy for all uses 5359.6204 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1751.2995	16.4900	288.7893	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3313.1660	16.4900	546.3411	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	512.9463	16.4900	84.5848	(249)
Energy for lighting	288.1350	16.4900	47.5135	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-505.9263	16.4900	-83.4272	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-83.4272	(252)
Total energy cost			883.8014	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.3599 (257)
SAP value		77.9565
SAP rating (Section 12)		78 (258)
SAP band		C

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1751.2995	0.1571	275.0592	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3313.1660	0.1416	469.0528	(264)
Space and water heating			744.1121	(265)
Pumps, fans and electric keep-hot	512.9463	0.1387	71.1520	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-505.9263	0.1325	-67.0548	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-67.0548	(269)
Total CO2, kg/year			789.7960	(272)
CO2 emissions per m2			4.1800	(273)
EI value			95.4767	
EI rating			95	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000	(23a)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 80.1000 (23c)

Effective ac	0.2452	0.2382	0.2382	0.2278	0.2278	0.2140	0.2174	0.2105	0.2140	0.2209	0.2209	0.2313 (25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	112.0280			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.7926	40.6101	40.6101	38.8364	38.8364	36.4714	37.0626	35.8801	36.4714	37.6539	37.6539	39.4276	(38)
Heat transfer coeff	177.9739	176.7914	176.7914	175.0177	175.0177	172.6526	173.2439	172.0614	172.6526	173.8352	173.8352	175.6089	(39)

Average = Sum(39)m / 12 = 174.6235

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9418	0.9356	0.9356	0.9262	0.9262	0.9137	0.9168	0.9105	0.9137	0.9199	0.9199	0.9293	(40)
HLP (average)												0.9241	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)
Hot water usage for mixer showers

102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255	(42c)

Average daily hot water use (litres/day) 165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)

Energy content (annual) Total = Sum(45)m = 2741.6891
Distribution loss (46)m = 0.15 x (45)m

42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)

Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
									Total per year (kWh/year) = Sum(64)m =			3727.3117	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
									Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =			0.0000	(64a)
Heat gains from water heating, kWh/month													
	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)													
	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)
Total internal gains													
	880.4434	878.3115	851.2400	800.2387	748.3396	667.3707	639.2237	642.6349	668.6834	749.6018	806.3462	856.0470	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	22.3313	0.6300	0.7000	0.7700	50.6396	(76)
Southeast	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(77)
South	18.6200	50.9848	0.6300	0.7000	0.7700	290.1299	(78)
Southwest	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(79)
West	7.0600	22.3313	0.6300	0.7000	0.7700	48.1827	(80)
East	8.0600	22.3313	0.6300	0.7000	0.7700	55.0074	(76)

Solar gains	491.4531	769.8871	1073.7637	1411.2838	1563.6503	1668.8568	1588.6946	1473.3885	1276.2839	919.2490	606.7907	414.0311	(83)
Total gains	1371.8965	1648.1987	1925.0037	2211.5225	2311.9898	2336.2275	2227.9183	2116.0234	1944.9673	1668.8508	1413.1369	1270.0781	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1235	54.4855	54.4855	55.0377	55.0377	55.7916	55.6012	55.9833	55.7916	55.4121	55.4121	54.8524	
alpha	4.6082	4.6324	4.6324	4.6692	4.6692	4.7194	4.7067	4.7322	4.7194	4.6941	4.6941	4.6568	
util living area													
	0.9814	0.9590	0.9003	0.7664	0.5812	0.3674	0.2408	0.2599	0.5037	0.8156	0.9556	0.9859	(86)
Living	20.0934	20.2860	20.5528	20.7930	20.9017	20.9316	20.9340	20.9342	20.9221	20.7788	20.4166	20.0594	
Non living	19.3095	19.5015	19.7548	19.9750	20.0599	20.0892	20.0875	20.0931	20.0846	19.9735	19.6421	19.2851	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1321	20.1374	20.1374	20.1453	20.1453	20.1559	20.1533	20.1586	20.1559	20.1506	20.1506	20.1427	(88)
util rest of house													
	0.9770	0.9501	0.8803	0.7280	0.5264	0.3063	0.1752	0.1917	0.4348	0.7735	0.9442	0.9826	(89)
MIT 2	20.1321	20.1374	20.1374	20.1453	20.1453	20.1559	20.1533	20.1586	20.1559	20.1506	20.1506	20.1427	(90)
Living area fraction									fLA = Living area / (4) =			0.0755	(91)
MIT	20.1976	20.2025	20.2025	20.2098	20.2098	20.2196	20.2172	20.2221	20.2196	20.2147	20.2147	20.2074	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1976	20.2025	20.2025	20.2098	20.2098	20.2196	20.2172	20.2221	20.2196	20.2147	20.2147	20.2074	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9508	0.8820	0.7310	0.5306	0.3110	0.1801	0.1969	0.4401	0.7770	0.9451	0.9829	(94)

Useful gains	1340.8654	1567.1792	1697.8167	1616.6978	1226.7995	726.4739	401.3300	416.5900	855.9553	1296.6777	1335.6106	1248.3044	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2686.9792	2581.5932	2263.3686	1804.3991	1261.8444	728.5265	401.4333	416.7432	866.6487	1497.5389	2123.3454	2652.9882	(97)
Space heating kWh													
	1001.5087	681.6862	420.7706	135.1449	26.0734	0.0000	0.0000	0.0000	0.0000	149.4408	567.1691	1045.0847	(98a)
Space heating requirement - total per year (kWh/year)												4026.8784	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1001.5087	681.6862	420.7706	135.1449	26.0734	0.0000	0.0000	0.0000	0.0000	149.4408	567.1691	1045.0847	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4026.8784	
Space heating per m2											(98c) / (4) =	21.3096	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	290.6864 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1001.5087	681.6862	420.7706	135.1449	26.0734	0.0000	0.0000	0.0000	0.0000	149.4408	567.1691	1045.0847	(98)
Space heating efficiency (main heating system 1)													
	290.6864	290.6864	290.6864	290.6864	290.6864	0.0000	0.0000	0.0000	0.0000	290.6864	290.6864	290.6864	(210)
Space heating fuel (main heating system)													
	344.5323	234.5091	144.7507	46.4917	8.9696	0.0000	0.0000	0.0000	0.0000	51.4096	195.1137	359.5231	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	336.4695	298.2423	317.7883	280.7904	273.3168	220.2521	216.5669	225.3842	228.1528	283.4129	299.8871	332.9024	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	43.5653	39.3493	43.5653	42.1600	43.5653	42.1600	43.5653	43.5653	42.1600	43.5653	42.1600	43.5653	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.6087	-28.0987	-44.5260	-57.0156	-65.4544	-66.0666	-64.6335	-59.2255	-48.4666	-36.0355	-23.0549	-16.4446	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year	
Space heating fuel - main system 1	1385.2998 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	112.5000
Water heating fuel used	3313.1660 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	512.9463 (230a)
Total electricity for the above, kWh/year	512.9463 (231)
Electricity for lighting (calculated in Appendix L)	288.1350 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-528.6308 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4970.9162 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1385.2998	18.3900	254.7566 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3313.1660	18.3900	609.2912 (247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000 (247a)
Pumps, fans and electric keep-hot	512.9463	18.3900	94.3308 (249)
Energy for lighting	288.1350	18.3900	52.9880 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-528.6308	18.3900	-97.2152
PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-97.2152 (252)
Total energy cost			914.1515 (255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1385.2998	0.1579	218.7155 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3313.1660	0.1416	469.0528 (264)
Space and water heating			687.7683 (265)
Pumps, fans and electric keep-hot	512.9463	0.1387	71.1520 (267)
Energy for lighting	288.1350	0.1443	41.5868 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-528.6308	0.1324	-70.0088
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-70.0088 (269)
Total CO2, kg/year			730.4983 (272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1385.2998	1.5844	2194.9351 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3313.1660	1.5235	5047.7044 (278)
Space and water heating			7242.6395 (279)
Pumps, fans and electric keep-hot	512.9463	1.5128	775.9851 (281)
Energy for lighting	288.1350	1.5338	441.9511 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-528.6308	1.4893	-787.2990
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-787.2990 (283)
Total Primary energy kWh/year			7673.2767 (286)

SAP 10 EPC IMPROVEMENTS

House 1 Be Green

Current energy efficiency rating: C 78
Current environmental impact rating: A 95

N Solar water heating — Recommended
U Solar photovoltaic panels — Already installed
V2 Wind turbine — Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.1	-£ 102	-70 kg (9.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£102	0.37 kg/m²	C 80	A 96
Total Savings	£102	0.37 kg/m²		

Potential energy efficiency rating: C 80
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£1011	£907	£104

Space heating	£349	£364	-£15
Water heating	£609	£491	£119
Lighting	£53	£53	£0
Generated (PV)	-£97	-£95	-£2
Total cost of fuels	£914	£812	£102
Total cost of uses	£914	£813	£102
Delivered energy	26 kWh/m²	23 kWh/m²	3 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.7 tonnes	0.1 tonnes
CO2 emissions per m²	4 kg/m²	3 kg/m²	0 kg/m²
Primary energy	41 kWh/m²	36 kWh/m²	4 kWh/m²

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	188.9700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	516.5206	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation												0.5000	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												80.1000	(23c)
Effective ac	0.2764	0.2729	0.2695	0.2521	0.2487	0.2313	0.2313	0.2278	0.2382	0.2487	0.2556	0.2625	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)

LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993 (29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998 (29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600 (29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000 (30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100 (30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200 (30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600 (30)
Total net area of external elements Aum(A, m2)			406.8800				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		112.0280		(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3 Sill	27.4800	0.0320	0.8794
E4 Jamb	106.2600	0.0340	3.6128
E5 Ground floor (normal)	23.1900	0.0560	1.2986
E6 Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16 Corner (normal)	70.2700	0.0900	6.3243
E18 Party wall between dwellings	12.1000	0.0600	0.7260
E17 Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24 Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21 Exposed floor (inverted)	4.7800	0.3200	1.5296
E20 Exposed floor (normal)	2.1000	0.3200	0.6720
E10 Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11 Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8 Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.1139	46.5227	45.9314	42.9752	42.3839	39.4276	39.4276	38.8364	40.6101	42.3839	43.5664	44.7489	(38)
Heat transfer coeff	183.2952	182.7040	182.1127	179.1564	178.5652	175.6089	175.6089	175.0177	176.7914	178.5652	179.7477	180.9302	(39)

Average = Sum(39)m / 12 = 179.0086

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9668	0.9637	0.9481	0.9449	0.9293	0.9293	0.9262	0.9356	0.9449	0.9512	0.9575	(40)
HLP (average)												0.9473	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)
Hot water usage for mixer showers

102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865 (42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710 (42b)

Hot water usage for other uses

45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255 (42c)

Average daily hot water use (litres/day) 165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)
Energy content (annual)										Total = Sum(45)m =		2741.6891	
Distribution loss (46)m = 0.15 x (45)m	42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (57)
54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Primary loss
Combi loss
Total heat required for water heating calculated for each month

378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152 (62)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)

WWHRS
PV diverter
Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.8000 (H2)
Collector linear heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0000 (H4)
Collector loop efficiency 0.9000 (H5)
Incidence angle modifier 1.0000 (H6)
Overshading factor 0.8000 (H8)
Overall heat loss coefficient of system 6.5000 (H10)
Heat loss coefficient of collector loop 3.9667 (H11)
Dedicated solar storage volume 75.0000 (H12)
Effective solar volume 75.0000 (H14)
Reference volume 225.0000 (H15)
Storage tank correction coefficient 1.3161 (H16)

Heat delivered to hot water												663.8046 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												663.8046
Solar input	-0.0000	-16.1513	-60.4836	-85.3636	-114.9996	-104.3751	-103.9268	-89.4254	-60.0693	-29.0098	-0.0000	-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	378.5282	319.3713	297.0283	230.5256	192.4818	143.4086	139.7109	164.1318	196.6026	289.8297	337.3730	374.5152 (64)
										Total per year (kWh/year) = Sum(64)m =		3063.5071 (64)
Electric shower(s)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000 (64a)
Heat gains from water heating, kWh/month												
	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673 (65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)													
	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)
Total internal gains													
	880.4434	878.3115	851.2400	800.2387	748.3396	667.3707	639.2237	642.6349	668.6834	749.6018	806.3462	856.0470	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	19.6403	0.6300	0.7000	0.7700	44.5372	(76)
Southeast	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(77)
South	18.6200	46.7521	0.6300	0.7000	0.7700	266.0433	(78)
Southwest	1.9200	36.7938	0.6300	0.7000	0.7700	21.5898	(79)
West	7.0600	19.6403	0.6300	0.7000	0.7700	42.3764	(80)
East	8.0600	19.6403	0.6300	0.7000	0.7700	48.3787	(76)

Solar gains	444.5151	773.9215	1091.5110	1387.6555	1572.3820	1565.2163	1507.5623	1371.5878	1195.6692	865.2856	535.7647	378.0964	(83)
Total gains	1324.9585	1652.2331	1942.7510	2187.8942	2320.7216	2232.5870	2146.7860	2014.2227	1864.3526	1614.8874	1342.1110	1234.1434	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5522	52.7223	52.8934	53.7662	53.9443	54.8524	54.8524	55.0377	54.4855	53.9443	53.5894	53.2391	
alpha	4.5035	4.5148	4.5262	4.5844	4.5963	4.6568	4.6568	4.6692	4.6324	4.5963	4.5726	4.5493	
util living area													
	0.9868	0.9662	0.9193	0.8171	0.6639	0.4930	0.3579	0.3964	0.6194	0.8735	0.9721	0.9901	(86)
Living	19.9457	20.1748	20.4506	20.7178	20.8649	20.9203	20.9311	20.9299	20.8963	20.6802	20.2583	19.9072	
Non living	19.1437	19.3705	19.6373	19.8930	20.0173	20.0696	20.0754	20.0777	20.0502	19.8689	19.4659	19.1145	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(88)
util rest of house													
	0.9838	0.9589	0.9030	0.7848	0.6144	0.4308	0.2891	0.3243	0.5532	0.8421	0.9649	0.9878	(89)
MIT 2	20.1084	20.1111	20.1137	20.1268	20.1295	20.1427	20.1427	20.1453	20.1374	20.1295	20.1242	20.1189	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	20.1757	20.1781	20.1806	20.1927	20.1952	20.2074	20.2074	20.2098	20.2025	20.1952	20.1903	20.1854	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1757	20.1781	20.1806	20.1927	20.1952	20.2074	20.2074	20.2098	20.2025	20.1952	20.1903	20.1854	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9840	0.9595	0.9044	0.7874	0.6183	0.4356	0.2944	0.3298	0.5584	0.8447	0.9655	0.9880	(94)
Useful gains	1303.8070	1585.3407	1756.9878	1722.7035	1434.9124	972.4175	631.9653	664.2232	1041.0632	1364.1356	1295.8322	1219.3193	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)

Heat loss rate W

2909.9423	2791.3766	2491.4050	2023.1645	1516.9401	984.7035	633.4857	666.7843	1078.8661	1713.3618	2352.9495	2892.2463	(97)

Space heating kWh

1194.9647	810.4561	546.4064	216.3319	61.0286	0.0000	0.0000	0.0000	0.0000	259.8243	761.1245	1244.6576	(98a)

Space heating requirement - total per year (kWh/year) 5094.7942

Solar heating kWh

-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)

Solar heating contribution - total per year (kWh/year) 0.0000

Space heating kWh

1194.9647	810.4561	546.4064	216.3319	61.0286	0.0000	0.0000	0.0000	0.0000	259.8243	761.1245	1244.6576	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 5094.7942

Space heating per m2 (98c) / (4) = 26.9609 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 290.9151 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1194.9647	810.4561	546.4064	216.3319	61.0286	0.0000	0.0000	0.0000	0.0000	259.8243	761.1245	1244.6576	(98)
Space heating efficiency (main heating system 1)													
	290.9151	290.9151	290.9151	290.9151	290.9151	0.0000	0.0000	0.0000	0.0000	290.9151	290.9151	290.9151	(210)
Space heating fuel (main heating system)													
	410.7607	278.5885	187.8233	74.3626	20.9781	0.0000	0.0000	0.0000	0.0000	89.3128	261.6312	427.8423	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	378.5282	319.3713	297.0283	230.5256	192.4818	143.4086	139.7109	164.1318	196.6026	289.8297	337.3730	374.5152	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	336.4695	283.8856	264.0251	204.9117	171.0950	127.4743	124.1875	145.8949	174.7579	257.6264	299.8871	332.9024	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	50.3598	45.4863	50.3598	48.7353	50.3598	48.7353	50.3598	50.3598	48.7353	50.3598	48.7353	50.3598	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.6957	-27.9470	-44.5648	-55.1272	-63.6671	-60.3905	-59.5844	-54.0213	-44.7610	-33.8263	-20.4238	-14.9669	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)

Annual totals kWh/year

Space heating fuel - main system 1 1751.2995 (211)

Space heating fuel - main system 2 0.0000 (213)

Space heating fuel - secondary 0.0000 (215)

Efficiency of water heater 112.5000

Water heating fuel used 2723.1174 (219)

Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)

mechanical ventilation fans (SFP = 0.8140) 512.9463 (230a)

pump for solar water heating 80.0000 (230g)

Total electricity for the above, kWh/year 592.9463 (231)

Electricity for lighting (calculated in Appendix L) 288.1350 (232)

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

PV generation -496.9760 (233)

Wind generation 0.0000 (234)

Hydro-electric generation (Appendix N) 0.0000 (235a)

Electricity generated - Micro CHP (Appendix N) 0.0000 (235)

Appendix Q - special features

Energy saved or generated -0.0000 (236)

Energy used 0.0000 (237)

Total delivered energy for all uses 4858.5222 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1751.2995	16.4900	288.7893	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2723.1174	16.4900	449.0421	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	512.9463	16.4900	84.5848	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	288.1350	16.4900	47.5135	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-496.9760	16.4900	-81.9513	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-81.9513	(252)
Total energy cost			801.1703	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.2327 (257)
SAP value		80.0175
SAP rating (Section 12)		80 (258)
SAP band		C

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1751.2995	0.1571	275.0592	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2723.1174	0.1446	393.8746	(264)
Space and water heating			668.9339	(265)
Pumps, fans and electric keep-hot	592.9463	0.1387	82.2490	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-496.9760	0.1327	-65.9575	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-65.9575	(269)
Total CO2, kg/year			726.8121	(272)
CO2 emissions per m2			3.8500	(273)
EI value			95.8374	
EI rating			96	(274)
EI band			A	

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	53.1800 (1b)	x	2.8500 (2b)	=	151.5630 (1b)	-
First floor	50.5900 (1c)	x	3.2000 (2c)	=	161.8880 (1c)	-
Second floor	52.1600 (1d)	x	2.6200 (2d)	=	136.6592 (1d)	-
Third floor	33.0400 (1e)	x	2.0100 (2e)	=	66.4104 (1e)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 188.9700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		516.5206	(5)

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2. Ventilation rate

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

Number of flueless gas fires 0 * 40 = 0.0000 (7c)

Air changes per hour
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) = 0.0000 / (5) = 0.0000 (8)
Pressure test Yes
Pressure Test Method Blower Door
Measured/design AP50 3.0000 (17)
Infiltration rate 0.1500 (18)
Number of sides sheltered 1 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation 0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 80.1000 (23c)

Effective ac	0.2452	0.2382	0.2382	0.2278	0.2278	0.2140	0.2174	0.2105	0.2140	0.2209	0.2209	0.2313	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			36.9400	1.3258	48.9735			(27)
French doors (Uw = 1.50)			8.0600	1.4151	11.4057			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			53.1800	0.1200	6.3816	110.0000	5849.8000	(28a)
Upper floor - above entrance			2.5900	0.1200	0.3108	20.0000	51.8000	(28a)
LGF wall	66.0900	14.7600	51.3300	0.1500	7.6995	190.0000	9752.6993	(29a)
GF+1st FL walls	156.6700	27.7700	128.9000	0.1500	19.3350	110.0000	14178.9998	(29a)
Walls in loft+ dormers	53.0500	4.6300	48.4200	0.1500	7.2630	18.0000	871.5600	(29a)
Exposed from LGF	2.5900		2.5900	0.1100	0.2849	0.0000	0.0000	(30)
Insulation between joists	34.6900		34.6900	0.1100	3.8159	9.0000	312.2100	(30)
insulation between rafters	33.3800		33.3800	0.1100	3.6718	9.0000	300.4200	(30)
Dormers	4.6400		4.6400	0.1100	0.5104	9.0000	41.7600	(30)
Total net area of external elements Aum(A, m2)			406.8800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	112.0280			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 34677.2492 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 183.5066 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	28.5100	0.0500	1.4255
E3	Sill	27.4800	0.0320	0.8794
E4	Jamb	106.2600	0.0340	3.6128
E5	Ground floor (normal)	23.1900	0.0560	1.2986
E6	Intermediate floor within a dwelling	84.2200	0.0700	5.8954
E16	Corner (normal)	70.2700	0.0900	6.3243
E18	Party wall between dwellings	12.1000	0.0600	0.7260
E17	Corner (inverted – internal area greater than external area)	33.5400	-0.0900	-3.0186
E24	Eaves (insulation at ceiling level - inverted)	4.7800	0.1500	0.7170
E21	Exposed floor (inverted)	4.7800	0.3200	1.5296
E20	Exposed floor (normal)	2.1000	0.3200	0.6720
E10	Eaves (insulation at ceiling level)	25.9800	0.0600	1.5588
E11	Eaves (insulation at rafter level)	18.5500	0.0400	0.7420
R8	Roof to wall (rafter)	29.8400	0.0600	1.7904

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 24.1532 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 136.1813 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.7926	40.6101	40.6101	38.8364	38.8364	36.4714	37.0626	35.8801	36.4714	37.6539	37.6539	39.4276	(38)
Heat transfer coeff	177.9739	176.7914	176.7914	175.0177	175.0177	172.6526	173.2439	172.0614	172.6526	173.8352	173.8352	175.6089	(39)

Average = Sum(39)m / 12 = 174.6235

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9418	0.9356	0.9356	0.9262	0.9262	0.9137	0.9168	0.9105	0.9137	0.9199	0.9199	0.9293	(40)
HLP (average)												0.9241	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.9876 (42)
Hot water usage for mixer showers

102.1780	100.6425	98.4049	94.1237	90.9643	87.4409	85.4382	87.6589	90.0931	93.8761	98.2493	101.7865	(42a)

Hot water usage for baths

32.0795	31.6031	30.9322	29.6951	28.7689	27.7418	27.1870	27.8532	28.5786	29.6776	30.9401	31.9710	(42b)

Hot water usage for other uses

	45.2255	43.5809	41.9364	40.2918	38.6473	37.0027	37.0027	38.6473	40.2918	41.9364	43.5809	45.2255 (42c)
Average daily hot water use (litres/day)												165.0615 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	179.4830	175.8265	171.2734	164.1106	158.3804	152.1854	149.6279	154.1593	158.9635	165.4901	172.7703	178.9831	(44)
Energy conte	284.2572	250.3746	263.2409	224.6593	213.2104	187.1297	180.9620	190.8814	196.0179	224.5685	246.1430	280.2442	(45)
Energy content (annual)										Total = Sum(45)m =		2741.6891	
Distribution loss (46)m = 0.15 x (45)m													
	42.6386	37.5562	39.4861	33.6989	31.9816	28.0694	27.1443	28.6322	29.4027	33.6853	36.9215	42.0366	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	378.5282	335.5226	357.5119	315.8893	307.4814	247.7837	243.6378	253.5572	256.6719	318.8395	337.3730	374.5152	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												726.6982	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												726.6982	
Solar input	-0.0000	-17.5875	-61.5748	-90.2497	-117.2862	-115.4709	-113.4968	-101.3860	-69.5093	-36.3925	-3.7445	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	378.5282	317.9351	295.9371	225.6395	190.1952	132.3127	130.1410	152.1712	187.1626	282.4471	333.6285	374.5152	(64)
										Total per year (kWh/year) = Sum(64)m =		3000.6135	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	138.4016	122.8886	131.4137	117.1696	114.7785	80.2302	78.7798	82.0780	83.1856	118.5551	124.3130	137.0673	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	179.2531	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	40.7885	36.2280	29.4626	22.3051	16.6733	14.0763	15.2099	19.7705	26.5359	33.6934	39.3251	41.9221	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	537.9674	543.5498	529.4823	499.5342	461.7301	426.1997	402.4631	396.8807	410.9482	440.8963	478.7003	514.2308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	55.9129	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	-119.5020	(71)
Water heating gains (Table 5)													
	186.0237	182.8699	176.6313	162.7356	154.2722	111.4309	105.8868	110.3199	115.5355	159.3483	172.6569	184.2302	(72)
Total internal gains													
	880.4434	878.3115	851.2400	800.2387	748.3396	667.3707	639.2237	642.6349	668.6834	749.6018	806.3462	856.0470	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	7.4200	22.3313	0.6300	0.7000	0.7700	50.6396	(76)
Southeast	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(77)
South	18.6200	50.9848	0.6300	0.7000	0.7700	290.1299	(78)
Southwest	1.9200	40.4699	0.6300	0.7000	0.7700	23.7468	(79)
West	7.0600	22.3313	0.6300	0.7000	0.7700	48.1827	(80)
East	8.0600	22.3313	0.6300	0.7000	0.7700	55.0074	(76)

Solar gains	491.4531	769.8871	1073.7637	1411.2838	1563.6503	1668.8568	1588.6946	1473.3885	1276.2839	919.2490	606.7907	414.0311	(83)
Total gains	1371.8965	1648.1987	1925.0037	2211.5225	2311.9898	2336.2275	2227.9183	2116.0234	1944.9673	1668.8508	1413.1369	1270.0781	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	54.1235	54.4855	54.4855	55.0377	55.0377	55.7916	55.6012	55.9833	55.7916	55.4121	55.4121	54.8524	
alpha	4.6082	4.6324	4.6324	4.6692	4.6692	4.7194	4.7067	4.7322	4.7194	4.6941	4.6941	4.6568	
util living area	0.9814	0.9590	0.9003	0.7664	0.5812	0.3674	0.2408	0.2599	0.5037	0.8156	0.9556	0.9859	(86)
Living	20.0934	20.2860	20.5528	20.7930	20.9017	20.9316	20.9340	20.9342	20.9221	20.7788	20.4166	20.0594	
Non living	19.3095	19.5015	19.7548	19.9750	20.0599	20.0892	20.0875	20.0931	20.0846	19.9735	19.6421	19.2851	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.1321	20.1374	20.1374	20.1453	20.1453	20.1559	20.1533	20.1586	20.1559	20.1506	20.1506	20.1427	(88)
util rest of house	0.9770	0.9501	0.8803	0.7280	0.5264	0.3063	0.1752	0.1917	0.4348	0.7735	0.9442	0.9826	(89)
MIT 2	20.1321	20.1374	20.1374	20.1453	20.1453	20.1559	20.1533	20.1586	20.1559	20.1506	20.1506	20.1427	(90)
Living area fraction										fLA = Living area / (4) =		0.0755	(91)
MIT	20.1976	20.2025	20.2025	20.2098	20.2098	20.2196	20.2172	20.2221	20.2196	20.2147	20.2147	20.2074	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1976	20.2025	20.2025	20.2098	20.2098	20.2196	20.2172	20.2221	20.2196	20.2147	20.2147	20.2074	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9774	0.9508	0.8820	0.7310	0.5306	0.3110	0.1801	0.1969	0.4401	0.7770	0.9451	0.9829	(94)
Useful gains	1340.8654	1567.1792	1697.8167	1616.6978	1226.7995	726.4739	401.3300	416.5900	855.9553	1296.6777	1335.6106	1248.3044	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2686.9792	2581.5932	2263.3686	1804.3991	1261.8444	728.5265	401.4333	416.7432	866.6487	1497.5389	2123.3454	2652.9882	(97)
Space heating kWh	1001.5087	681.6862	420.7706	135.1449	26.0734	0.0000	0.0000	0.0000	0.0000	149.4408	567.1691	1045.0847	(98a)
Space heating requirement - total per year (kWh/year)												4026.8784	
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	1001.5087	681.6862	420.7706	135.1449	26.0734	0.0000	0.0000	0.0000	0.0000	149.4408	567.1691	1045.0847	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4026.8784	
Space heating per m2										(98c) / (4) =		21.3096	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 290.6864 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1001.5087	681.6862	420.7706	135.1449	26.0734	0.0000	0.0000	0.0000	0.0000	149.4408	567.1691	1045.0847	(98)
Space heating efficiency (main heating system 1)	290.6864	290.6864	290.6864	290.6864	290.6864	0.0000	0.0000	0.0000	0.0000	290.6864	290.6864	290.6864	(210)
Space heating fuel (main heating system)	344.5323	234.5091	144.7507	46.4917	8.9696	0.0000	0.0000	0.0000	0.0000	51.4096	195.1137	359.5231	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	378.5282	317.9351	295.9371	225.6395	190.1952	132.3127	130.1410	152.1712	187.1626	282.4471	333.6285	374.5152	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month	336.4695	282.6089	263.0552	200.5685	169.0624	117.6113	115.6809	135.2633	166.3668	251.0640	296.5587	332.9024	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	50.3598	45.4863	50.3598	48.7353	50.3598	48.7353	50.3598	50.3598	48.7353	50.3598	48.7353	50.3598	(231)
Lighting	35.7019	28.6414	25.7884	18.8937	14.5940	11.9235	13.3132	17.3050	22.4774	29.4916	33.3107	36.6942	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.6165	-28.0731	-44.2336	-56.0545	-63.5691	-63.5824	-62.2380	-57.4556	-47.6623	-35.8784	-23.0618	-16.4506	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													

(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	1385.2998 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	112.5000
Water heating fuel used	2667.2120 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	512.9463 (230a)
pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	592.9463 (231)
Electricity for lighting (calculated in Appendix L)	288.1350 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-517.8758 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	4415.7173 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1385.2998	18.3900	254.7566	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2667.2120	18.3900	490.5003	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	512.9463	18.3900	94.3308	(249)
Pump for solar water heating	80.0000	18.3900	14.7120	(249)
Energy for lighting	288.1350	18.3900	52.9880	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8758	18.3900	-95.2374	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-95.2374	(252)
Total energy cost			812.0504	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1385.2998	0.1579	218.7155	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2667.2120	0.1451	386.8953	(264)
Space and water heating			605.6108	(265)
Pumps, fans and electric keep-hot	592.9463	0.1387	82.2490	(267)
Energy for lighting	288.1350	0.1443	41.5868	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8758	0.1326	-68.6952	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-68.6952	(269)
Total CO2, kg/year			660.7513	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1385.2998	1.5844	2194.9351	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2667.2120	1.5366	4098.3511	(278)
Space and water heating			6293.2862	(279)
Pumps, fans and electric keep-hot	592.9463	1.5128	897.0091	(281)
Energy for lighting	288.1350	1.5338	441.9511	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-517.8758	1.4901	-771.6982	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-771.6982	(283)

Total Primary energy kWh/year	6860.5482 (286)

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Full SAP Calculation Printout

Property Reference	House 2	Issued on Date	23/01/2023
Assessment Reference	House 2 Be Green	Prop Type Ref	
Property	House 1, 35, Twickenham Rd		

SAP Rating	72 C	DER	6.49	TER	15.85
Environmental	94 A	% DER < TER			59.05
CO_2 Emissions (t/year)	0.57	DFEE	50.99	TFEE	60.13
Compliance Check	See BREL	% DFEE < TFEE			15.19
% DPER < TPER	18.07	DPER	68.38	TPER	83.46

Assessor Details	Mrs. Deborah Elliott	Assessor ID	L377-0001
Client			

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

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1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)	
Ground floor		44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor		48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys		0 * 80 =	0.0000 (6a)
Number of open flues		0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire		0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler		0 * 20 =	0.0000 (6d)
Number of flues attached to other heater		0 * 35 =	0.0000 (6e)
Number of blocked chimneys		0 * 20 =	0.0000 (6f)
Number of intermittent extract fans		0 * 10 =	0.0000 (7a)
Number of passive vents		0 * 10 =	0.0000 (7b)
Number of flueless gas fires		0 * 40 =	0.0000 (7c)
		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		0.0000 / (5) =	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
Infiltration rate			0.1500 (18)
Number of sides sheltered			1 (19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery		
If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2629	0.2594	0.2560	0.2386	0.2352	0.2178	0.2178	0.2143	0.2248	0.2352	0.2421	0.2490	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)

Entrance door			2.1600	1.1000	2.3760		(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000 (28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000 (28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001 (29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999 (29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000 (30)
Total net area of external elements Aum(A, m2)			237.4000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110		(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001 (32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8697 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7366	27.3706	27.0047	25.1749	24.8089	22.9792	22.9792	22.6132	23.7111	24.8089	25.5409	26.2728	(38)
Heat transfer coeff	98.1173	97.7513	97.3853	95.5556	95.1896	93.3599	93.3599	92.9939	94.0918	95.1896	95.9215	96.6534	(39)

Average = Sum(39)m / 12 = 95.4641

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0508	1.0469	1.0430	1.0234	1.0195	0.9999	0.9999	0.9960	1.0077	1.0195	1.0273	1.0352	(40)
HLP (average)												1.0224	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)
Hot water usage for mixer showers

94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)

Energy content (annual) Total = Sum(45)m = 2544.6486

Distribution loss (46)m = 0.15 x (45)m												
	39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)

If cylinder contains dedicated solar storage

39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss 54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(62)
WWHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter -0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)

Output from w/h

358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)

Total per year (kWh/year) = Sum(64)m = 3530.2712 (64)
12Total per year (kWh/year) 3530 (64)
Electric shower(s)

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month

131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)

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

	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)

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

	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)

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

	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)

Water heating gains (Table 5)

	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)

Total internal gains

	609.1973	622.1132	596.6137	574.2072	544.9880	490.7308	470.6313	472.2019	487.5903	540.2053	573.9216	596.7164	(73)

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6. Solar gains

[Jan]

	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	727.7697	851.5735	970.3797	1116.0008	1208.0452	1169.5462	1116.8357	1027.5536	920.9361	811.2091	721.2699	694.5702	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	72.1654	72.4355	72.7077	74.1000	74.3849	75.8427	75.8427	76.1412	75.2528	74.3849	73.8173	73.2583	
alpha	5.8110	5.8290	5.8472	5.9400	5.9590	6.0562	6.0562	6.0761	6.0169	5.9590	5.9212	5.8839	
util living area	0.9950	0.9870	0.9622	0.8706	0.6981	0.5066	0.3673	0.4151	0.6772	0.9265	0.9878	0.9961	(86)
Living	20.2000	20.3477	20.5558	20.7963	20.9135	20.9446	20.9482	20.9479	20.9274	20.7522	20.4386	20.1844	
Non living	19.3170	19.4654	19.6696	19.9018	19.9953	20.0306	20.0321	20.0354	20.0157	19.8727	19.5702	19.3126	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(88)
util rest of house	0.9933	0.9827	0.9500	0.8359	0.6394	0.4361	0.2911	0.3334	0.5980	0.8972	0.9829	0.9948	(89)
MIT 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	20.3515	20.3537	20.3559	20.3669	20.3691	20.3801	20.3801	20.3823	20.3757	20.3691	20.3647	20.3603	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3515	20.3537	20.3559	20.3669	20.3691	20.3801	20.3801	20.3823	20.3757	20.3691	20.3647	20.3603	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9939	0.9842	0.9544	0.8479	0.6591	0.4591	0.3158	0.3599	0.6246	0.9078	0.9847	0.9953	(94)
Useful gains	723.3365	838.1552	926.1022	946.3049	796.1708	536.9311	352.6826	369.8483	575.2001	736.3940	710.2115	691.2812	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1574.9300	1510.6190	1349.3603	1095.7223	825.2044	539.6277	352.9079	370.3289	590.4886	929.9130	1272.3666	1561.9457	(97)
Space heating kWh	633.5856	451.8957	314.9040	107.5805	21.6010	0.0000	0.0000	0.0000	0.0000	143.9782	404.7517	647.7744	(98a)
Space heating requirement - total per year (kWh/year)												2726.0712	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	633.5856	451.8957	314.9040	107.5805	21.6010	0.0000	0.0000	0.0000	0.0000	143.9782	404.7517	647.7744	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2726.0712	
Space heating per m2										(98c) / (4) =		29.1964	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %)												283.3359	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	633.5856	451.8957	314.9040	107.5805	21.6010	0.0000	0.0000	0.0000	0.0000	143.9782	404.7517	647.7744	(98)
Space heating efficiency (main heating system 1)													
	283.3359	283.3359	283.3359	283.3359	283.3359	0.0000	0.0000	0.0000	0.0000	283.3359	283.3359	283.3359	(210)
Space heating fuel (main heating system)													
	223.6165	159.4912	111.1416	37.9693	7.6238	0.0000	0.0000	0.0000	0.0000	50.8154	142.8523	228.6242	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	318.3101	282.2477	300.9720	266.4388	259.6966	208.2981	205.0067	213.1901	215.6304	269.0665	284.1626	314.9993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	26.9644	24.3550	26.9644	26.0946	26.9644	26.0946	26.9644	26.9644	26.0946	26.9644	26.0946	26.9644	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.2748	-27.1179	-43.1949	-53.4439	-62.2815	-59.1930	-58.4201	-52.7889	-43.4948	-32.8173	-19.8780	-14.6326	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												962.1342	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												112.5000	
Water heating fuel used												3138.0189	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)													
mechanical ventilation fans (SFP = 0.8140)												317.4842	(230a)
Total electricity for the above, kWh/year												317.4842	(231)
Electricity for lighting (calculated in Appendix L)												210.9332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-484.5376	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												4144.0328	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	962.1342	0.1571	151.1560	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3138.0189	0.1416	444.2558	(264)
Space and water heating			595.4118	(265)
Pumps, fans and electric keep-hot	317.4842	0.1387	44.0390	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-484.5376	0.1327	-64.2835	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-64.2835	(269)
Total CO2, kg/year			605.6115	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			6.4900	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	962.1342	1.5816	1521.7060	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3138.0189	1.5235	4780.8609	(278)
Space and water heating			6302.5669	(279)
Pumps, fans and electric keep-hot	317.4842	1.5128	480.2901	(281)
Energy for lighting	210.9332	1.5338	323.5363	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-484.5376	1.4902	-722.0662	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-722.0662	(283)
Total Primary energy kWh/year			6384.3271	(286)
Dwelling Primary energy Rate (DPER)			68.3800	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0938	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3438	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3181	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4055	0.3976	0.3896	0.3499	0.3419	0.3021	0.3021	0.2942	0.3181	0.3419	0.3578	0.3737	(22b)
Effective ac	0.5822	0.5790	0.5759	0.5612	0.5584	0.5456	0.5456	0.5433	0.5506	0.5584	0.5640	0.5698	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			19.3200	1.1450	22.1221			(27)
LGF			44.6500	0.1300	5.8045			(28a)
Exposed upper			3.9600	0.1300	0.5148			(28a)
LGF wall	60.3600	8.6500	51.7100	0.1800	9.3078			(29a)
GF walls	79.7100	12.8300	66.8800	0.1800	12.0384			(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592			(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.3068			(33)
Party Wall 1			47.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.1600	2.9904
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0500	0.5390
E4 Jamb	47.2400	0.0500	2.3620
E15 Flat roof with parapet	20.1800	0.5600	11.3008
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.2400	2.0544

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 25.4067 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 82.7135 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	61.4243	61.0874	60.7573	59.2065	58.9163	57.5657	57.5657	57.3155	58.0859	58.9163	59.5033	60.1169	(38)
Heat transfer coeff	144.1378	143.8010	143.4708	141.9200	141.6299	140.2792	140.2792	140.0291	140.7995	141.6299	142.2168	142.8305	(39)

Average = Sum(39)m / 12 = 141.9186

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5437	1.5401	1.5366	1.5200	1.5169	1.5024	1.5024	1.4997	1.5080	1.5169	1.5232	1.5297	(40)
HLP (average)												1.5200	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers												
	68.9717	67.9352	66.4248	63.5349	61.4023	59.0240	57.6721	59.1711	60.8142	63.3678	66.3198	68.7075 (42a)
Hot water usage for baths												
	29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826 (42b)
Hot water usage for other uses												
	41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642 (42c)

Average daily hot water use (litres/day) 129.3527 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.7193	137.7145	134.0552	128.4909	123.9723	119.1144	117.2475	120.8910	124.7335	129.8335	135.4835	140.3543	(44)
Energy conte	222.8649	196.1036	206.0379	175.8976	166.8905	146.4650	141.8007	149.6883	153.8089	176.1828	193.0211	219.7609	(45)

Energy content (annual) Total = Sum(45)m = 2148.5222

Distribution loss (46)m = 0.15 x (45)m

	33.4297	29.4155	30.9057	26.3846	25.0336	21.9698	21.2701	22.4532	23.0713	26.4274	28.9532	32.9641 (46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (56)
If cylinder contains dedicated solar storage												
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
	269.4598	238.1893	252.6328	220.9894	213.4854	191.5569	188.3956	196.2832	198.9008	222.7777	238.1130	266.3558 (62)
WWHRS	-31.5310	-27.8863	-29.2009	-24.1795	-22.5344	-19.2829	-18.0746	-19.2205	-19.9508	-23.5198	-26.6451	-30.9471 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h												
	237.9288	210.3030	223.4319	196.8099	190.9510	172.2740	170.3210	177.0626	178.9500	199.2579	211.4679	235.4088 (64)

Total per year (kWh/year) = Sum(64)m = 2404.1667 (64)

12Total per year (kWh/year) 2404 (64)

Electric shower(s)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	111.3785	98.8730	105.7835	94.5594	92.7670	84.7731	84.4246	87.0473	87.2149	95.8567	100.2530	110.3464 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)

Water heating gains (Table 5)

149.7023	147.1325	142.1821	131.3325	124.6868	117.7404	113.4740	116.9990	121.1319	128.8396	139.2403	148.3151	(72)

Total internal gains

585.0060	598.2790	573.6193	553.2603	525.2505	503.2509	484.0306	485.0118	499.6925	519.9096	551.6744	572.8024	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	11.3200	19.6403	0.6300	0.7000	0.7700	67.9463	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	703.5784	827.7393	947.3854	1095.0539	1188.3076	1182.0663	1130.2350	1040.3635	933.0383	790.9134	699.0227	670.6563	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.1243	49.2394	49.3527	49.8920	49.9942	50.4755	50.4755	50.5657	50.2890	49.9942	49.7878	49.5739	
alpha	4.2750	4.2826	4.2902	4.3261	4.3329	4.3650	4.3650	4.3710	4.3526	4.3329	4.3192	4.3049	
util living area													
	0.9963	0.9921	0.9811	0.9431	0.8518	0.6882	0.5277	0.5877	0.8292	0.9675	0.9927	0.9970	(86)
MIT	19.2885	19.5004	19.8441	20.3107	20.6927	20.9149	20.9790	20.9670	20.8004	20.2870	19.7088	19.2597	(87)
Th 2	19.6549	19.6575	19.6602	19.6726	19.6749	19.6857	19.6857	19.6877	19.6815	19.6749	19.6702	19.6653	(88)
util rest of house													
	0.9949	0.9891	0.9735	0.9194	0.7913	0.5752	0.3794	0.4354	0.7376	0.9493	0.9894	0.9959	(89)
MIT 2	17.7070	17.9787	18.4154	18.9980	19.4303	19.6424	19.6804	19.6782	19.5550	18.9839	18.2546	17.6772	(90)
Living area fraction									fLA = Living area / (4) =			0.3237	(91)
MIT	18.2188	18.4712	18.8779	19.4229	19.8389	20.0542	20.1007	20.0953	19.9581	19.4057	18.7253	18.1894	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2188	18.4712	18.8779	19.4229	19.8389	20.0542	20.1007	20.0953	19.9581	19.4057	18.7253	18.1894	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9926	0.9852	0.9673	0.9138	0.7999	0.6094	0.4280	0.4853	0.7599	0.9442	0.9858	0.9939	(94)
Useful gains	698.3773	815.5019	916.4389	1000.6533	950.5592	720.3633	483.6932	504.8718	709.0222	746.8103	689.1254	666.5902	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2006.2286	1951.5569	1775.8607	1493.4040	1152.7120	765.1175	491.0784	517.4503	824.8191	1247.1439	1653.3081	1998.1083	(97)
Space heating kWh													
	973.0414	763.4290	639.4098	354.7805	150.4017	0.0000	0.0000	0.0000	0.0000	372.2482	694.2115	990.6495	(98a)
Space heating requirement - total per year (kWh/year)												4938.1716	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	973.0414	763.4290	639.4098	354.7805	150.4017	0.0000	0.0000	0.0000	0.0000	372.2482	694.2115	990.6495	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4938.1716	
Space heating per m2											(98c) / (4) =	52.8882	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 92.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	973.0414	763.4290	639.4098	354.7805	150.4017	0.0000	0.0000	0.0000	0.0000	372.2482	694.2115	990.6495	(98)
Space heating efficiency (main heating system 1)													
	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000	(210)
Space heating fuel (main heating system)													
	1054.2160	827.1170	692.7517	384.3776	162.9487	0.0000	0.0000	0.0000	0.0000	403.3025	752.1251	1073.2931	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)

Water heating
Water heating requirement

237.9288	210.3030	223.4319	196.8099	190.9510	172.2740	170.3210	177.0626	178.9500	199.2579	211.4679	235.4088 (64)

Efficiency of water heater 79.8000 (216)

(217)m 86.8749	86.6884	86.2802	85.3648	83.5301	79.8000	79.8000	79.8000	79.8000	85.4403	86.5216	86.9178 (217)

Fuel for water heating, kWh/month

273.8751	242.5964	258.9607	230.5515	228.6014	215.8822	213.4348	221.8830	224.2481	233.2129	244.4106	270.8406 (219)

Space cooling fuel requirement

(221)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa 7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting 25.7906	20.6902	18.6292	13.6486	10.5425	8.6133	9.6173	12.5009	16.2374	21.3043	24.0632	26.5074 (232)

Electricity generated by PVs (Appendix M) (negative quantity)

(233a)m -41.5277	-58.4235	-83.8027	-94.0129	-101.1797	-94.3421	-93.1371	-87.9937	-78.9285	-66.6600	-45.5953	-35.9143 (233a)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235a)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235c)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)

Electricity generated by PVs (Appendix M) (negative quantity)

(233b)m -23.8487	-50.1227	-99.5477	-149.4202	-197.4995	-198.4428	-196.1452	-166.1444	-121.8440	-71.6959	-31.8438	-18.8659 (233b)

Electricity generated by wind turbines (Appendix M) (negative quantity)

(234b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)

Electricity generated by hydro-electric generators (Appendix M) (negative quantity)

(235b)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)

Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)

(235d)m 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year

Space heating fuel - main system 1	5350.1317 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	79.8000
Water heating fuel used	2858.4974 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	208.1448 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2206.9382 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	6295.8358 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	5350.1317	0.2100	1123.5277	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2858.4974	0.2100	600.2845	(264)
Space and water heating			1723.8121	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	208.1448	0.1443	30.0417	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-881.5175	0.1346	-118.6867	
PV Unit electricity exported	-1325.4207	0.1259	-166.8840	
Total			-285.5707	(269)
Total CO2, kg/year			1480.2124	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			15.8500	(273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	5350.1317	1.1300	6045.6488	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2858.4974	1.1300	3230.1021	(278)
Space and water heating			9275.7509	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	208.1448	1.5338	319.2595	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-881.5175	1.4976	-1320.1661	
PV Unit electricity exported	-1325.4207	0.4622	-612.5794	
Total			-1932.7455	(283)
Total Primary energy kWh/year			7792.3657	(286)
Target Primary Energy Rate (TPER)			83.4600	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0938	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2438	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2256	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2876	0.2819	0.2763	0.2481	0.2425	0.2143	0.2143	0.2086	0.2256	0.2425	0.2537	0.2650	(22b)

If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.5414	0.5397	0.5382	0.5308	0.5294	0.5230	0.5230	0.5218	0.5254	0.5294	0.5322	0.5351	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		273.0042 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270

E24 Eaves (insulation at ceiling level - inverted)									8.5600	0.0800	0.6848		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)													12.8697 (36)
Point Thermal bridges											(36a) =		0.0000
Total fabric heat loss										(33) + (36) + (36a) =			70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	57.1124	56.9430	56.7769	55.9970	55.8511	55.1718	55.1718	55.0460	55.4335	55.8511	56.1463	56.4549	(38)
Heat transfer coeff	127.4931	127.3237	127.1576	126.3777	126.2318	125.5525	125.5525	125.4267	125.8142	126.2318	126.5270	126.8356	(39)
Average = Sum(39)m / 12 =												126.3770	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3655	1.3636	1.3619	1.3535	1.3520	1.3447	1.3447	1.3433	1.3475	1.3520	1.3551	1.3584	(40)
HLP (average)												1.3535	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6691	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)
Hot water usage for other uses	41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)
Average daily hot water use (litres/day)												65.7631	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.7475	69.7792	67.6304	64.9559	62.5700	60.0904	59.5754	61.7199	63.9193	66.4656	69.1637	71.6468	(44)
Energy conte	113.6306	99.3647	103.9454	88.9214	84.2312	73.8882	72.0512	76.4221	78.8189	90.1932	98.5364	112.1816	(45)
Energy content (annual)										Total = Sum(45)m =		1092.1850	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(64)
										Total per year (kWh/year) = Sum(64)m =		928.3572	(64)
12Total per year (kWh/year)												928	(64)
Electric shower(s)	55.2349	49.2147	53.7406	51.2840	52.2463	49.8379	51.4992	52.2463	51.2840	53.7406	52.7301	55.2349	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		628.2933	(64a)
Heat gains from water heating, kWh/month	37.9552	33.4187	35.5235	31.7168	30.9607	28.1607	28.1857	29.3013	29.5700	32.6012	34.1215	37.6473	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)	51.0151	49.7302	47.7467	44.0511	41.6139	39.1121	37.8840	39.3834	41.0695	43.8188	47.3910	50.6012	(72)
Total internal gains	483.3188	497.8767	476.1839	462.9789	439.1775	424.6226	408.4406	407.3962	419.6301	431.8888	456.8251	472.0886	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)

Southwest			0.9700	36.7938	0.6300	0.7000	0.7700	10.9073 (79)				
West			6.0600	19.6403	0.6300	0.7000	0.7700	36.3741 (80)				
Northwest			0.9700	11.2829	0.6300	0.7000	0.7700	3.3448 (81)				
East			6.0500	19.6403	0.6300	0.7000	0.7700	36.3140 (76)				
Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539 (83)
Total gains	601.8912	727.3370	849.9499	1004.7724	1102.2346	1103.4380	1054.6450	962.7480	852.9758	702.8926	604.1734	569.9424 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.5377	55.6115	55.6842	56.0278	56.0926	56.3961	56.3961	56.4526	56.2788	56.0926	55.9617	55.8255	
alpha	4.7025	4.7074	4.7123	4.7352	4.7395	4.7597	4.7597	4.7635	4.7519	4.7395	4.7308	4.7217	
util living area	0.9981	0.9951	0.9858	0.9484	0.8507	0.6761	0.5120	0.5772	0.8333	0.9753	0.9958	0.9986	(86)
MIT	19.4220	19.6304	19.9608	20.4039	20.7555	20.9404	20.9871	20.9779	20.8371	20.3509	19.8033	19.3857	(87)
Th 2	19.7899	19.7913	19.7927	19.7992	19.8004	19.8060	19.8060	19.8070	19.8038	19.8004	19.7979	19.7954	(88)
util rest of house	0.9974	0.9932	0.9801	0.9274	0.7934	0.5714	0.3792	0.4387	0.7481	0.9613	0.9939	0.9980	(89)
MIT 2	18.3708	18.5792	18.9071	19.3382	19.6472	19.7820	19.8034	19.8019	19.7215	19.2978	18.7573	18.3387	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	18.7110	18.9194	19.2482	19.6831	20.0059	20.1569	20.1865	20.1825	20.0825	19.6386	19.0959	18.6776	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7110	18.9194	19.2482	19.6831	20.0059	20.1569	20.1865	20.1825	20.0825	19.6386	19.0959	18.6776	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9913	0.9767	0.9249	0.8045	0.6040	0.4227	0.4841	0.7708	0.9588	0.9923	0.9972	(94)
Useful gains	599.7593	721.0043	830.1621	929.2761	886.7486	666.5182	445.7685	466.0186	657.4766	673.9287	599.4920	568.3726	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1837.3024	1785.0063	1621.0272	1362.7423	1048.4726	697.6861	450.2941	474.4277	752.6895	1140.9631	1517.8014	1836.2701	(97)
Space heating kWh	920.7321	715.0093	588.4036	312.0957	120.3227	0.0000	0.0000	0.0000	0.0000	347.4736	661.1827	943.3157	(98a)
Space heating requirement - total per year (kWh/year)												4608.5354	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	920.7321	715.0093	588.4036	312.0957	120.3227	0.0000	0.0000	0.0000	0.0000	347.4736	661.1827	943.3157	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4608.5354	
Space heating per m2											(98c) / (4) =	49.3578	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1180.1937	929.0887	953.2431	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8463	0.9102	0.8740	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	998.7471	845.6229	833.1496	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1240.3276	1185.7136	1080.7434	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	173.9379	253.0274	184.2098	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	43.4845	63.2569	46.0524	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												152.7938	(107)
Energy for space heating												49.3578	(99)
Energy for space cooling												1.6364	(108)
Total												50.9942	(109)
Fabric Energy Efficiency (DFEE)												51.0	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

2. Ventilation rate

	m3 per hour		
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.0938	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3438	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3181	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4055	0.3976	0.3896	0.3499	0.3419	0.3021	0.3021	0.2942	0.3181	0.3419	0.3578	0.3737	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000	(23c)
Effective ac	0.5822	0.5790	0.5759	0.5612	0.5584	0.5456	0.5456	0.5433	0.5506	0.5584	0.5640	0.5698	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1600	1.0000	2.1600			(26)
TER Opening Type (Uw = 1.20)			19.3200	1.1450	22.1221			(27)
LGF			44.6500	0.1300	5.8045			(28a)
Exposed upper			3.9600	0.1300	0.5148			(28a)
LGF wall	60.3600	8.6500	51.7100	0.1800	9.3078			(29a)
GF walls	79.7100	12.8300	66.8800	0.1800	12.0384			(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592			(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.3068			(33)
Party Wall 1			47.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.1600	2.9904
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0500	0.5390
E4 Jamb	47.2400	0.0500	2.3620
E15 Flat roof with parapet	20.1800	0.5600	11.3008
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.2400	2.0544

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		25.4067	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	82.7135	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	61.4243	61.0874	60.7573	59.2065	58.9163	57.5657	57.5657	57.3155	58.0859	58.9163	59.5033	60.1169	(38)
Heat transfer coeff	144.1378	143.8010	143.4708	141.9200	141.6299	140.2792	140.2792	140.0291	140.7995	141.6299	142.2168	142.8305	(39)
Average = Sum(39)m / 12 =												141.9186	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5437	1.5401	1.5366	1.5200	1.5169	1.5024	1.5024	1.4997	1.5080	1.5169	1.5232	1.5297	(40)

HLP (average)												1.5200
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)

Hot water usage for baths

	29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826 (42b)

Hot water usage for other uses

	41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642 (42c)

Average daily hot water use (litres/day) 65.7631 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	71.7475	69.7792	67.6304	64.9559	62.5700	60.0904	59.5754	61.7199	63.9193	66.4656	69.1637	71.6468	(44)
Energy conte	113.6306	99.3647	103.9454	88.9214	84.2312	73.8882	72.0512	76.4221	78.8189	90.1932	98.5364	112.1816	(45)
Energy content (annual)										Total = Sum(45)m =		1092.1850	
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	96.5860	84.4600	88.3536	75.5832	71.5965	62.8050	61.2435	64.9588	66.9960	76.6642	83.7560	95.3544	(64)
									Total per year (kWh/year) = Sum(64)m =			928.3572	(64)
12Total per year (kWh/year)												928	(64)
Electric shower(s)													
	55.2349	49.2147	53.7406	51.2840	52.2463	49.8379	51.4992	52.2463	51.2840	53.7406	52.7301	55.2349	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						628.2933	(64a)
Heat gains from water heating, kWh/month													
	37.9552	33.4187	35.5235	31.7168	30.9607	28.1607	28.1857	29.3013	29.5700	32.6012	34.1215	37.6473	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	133.4548	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	124.1244	137.4234	124.1244	128.2618	124.1244	128.2618	124.1244	124.1244	128.2618	124.1244	128.2618	124.1244	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	245.1429	247.6867	241.2764	227.6295	210.4028	194.2122	183.3958	180.8520	187.2623	200.9092	218.1359	234.3265	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	36.3455	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	51.0151	49.7302	47.7467	44.0511	41.6139	39.1121	37.8840	39.3834	41.0695	43.8188	47.3910	50.6012	(72)
Total internal gains													
	483.3188	497.8767	476.1839	462.9789	439.1775	424.6226	408.4406	407.3962	419.6301	431.8888	456.8251	472.0886	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	11.3200	19.6403	0.6300	0.7000	0.7700	67.9463	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	601.8912	727.3370	849.9499	1004.7724	1102.2346	1103.4380	1054.6450	962.7480	852.9758	702.8926	604.1734	569.9424	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.1243	49.2394	49.3527	49.8920	49.9942	50.4755	50.4755	50.5657	50.2890	49.9942	49.7878	49.5739	
alpha	4.2750	4.2826	4.2902	4.3261	4.3329	4.3650	4.3650	4.3710	4.3526	4.3329	4.3192	4.3049	
util living area													
	0.9980	0.9952	0.9872	0.9567	0.8770	0.7215	0.5604	0.6258	0.8620	0.9784	0.9958	0.9984	(86)
MIT	19.1879	19.4027	19.7534	20.2387	20.6469	20.8974	20.9736	20.9580	20.7616	20.2089	19.6160	19.1596	(87)
Th 2	19.6549	19.6575	19.6602	19.6726	19.6749	19.6857	19.6857	19.6877	19.6815	19.6749	19.6702	19.6653	(88)
util rest of house													
	0.9972	0.9933	0.9818	0.9376	0.8223	0.6089	0.4054	0.4681	0.7784	0.9655	0.9939	0.9978	(89)
MIT 2	18.0367	18.2526	18.6020	19.0816	19.4501	19.6437	19.6804	19.6779	19.5585	19.0637	18.4753	18.0162	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	18.4093	18.6248	18.9747	19.4561	19.8374	20.0495	20.0989	20.0922	19.9479	19.4343	18.8445	18.3863	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4093	18.6248	18.9747	19.4561	19.8374	20.0495	20.0989	20.0922	19.9479	19.4343	18.8445	18.3863	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9912	0.9781	0.9336	0.8301	0.6430	0.4564	0.5200	0.7985	0.9622	0.9921	0.9969	(94)
Useful gains	599.5611	720.9151	831.2977	938.0512	915.0115	709.4572	481.3592	500.6257	681.1376	676.3478	599.3797	568.1986	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	2033.6845	1973.6425	1789.7504	1498.1283	1152.5033	764.4478	490.8264	517.0134	823.3845	1251.2055	1670.2609	2026.2299	(97)
Space heating kWh													
	1066.9878	841.8329	713.0889	403.2555	176.6939	0.0000	0.0000	0.0000	0.0000	427.6942	771.0344	1084.7753	(98a)
Space heating requirement - total per year (kWh/year)												5485.3627	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	1066.9878	841.8329	713.0889	403.2555	176.6939	0.0000	0.0000	0.0000	0.0000	427.6942	771.0344	1084.7753	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5485.3627	
Space heating per m2											(98c) / (4) =	58.7487	(99)

8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1318.6245	1038.0661	1064.2210	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7879	0.8634	0.8200	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1038.9273	896.2423	872.6938	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1240.3276	1185.7136	1080.7434	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	145.0082	215.3666	154.7890	0.0000	0.0000	0.0000	0.0000	(104)
Cooled fraction										fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)													
	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	(106)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	36.2520	53.8416	38.6972	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												128.7909	(107)
Energy for space heating												58.7487	(99)
Energy for space cooling												1.3794	(108)
Total												60.1280	(109)
Fabric Energy Efficiency (TFEE)												60.1	(109)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2629	0.2594	0.2560	0.2386	0.2352	0.2178	0.2178	0.2143	0.2248	0.2352	0.2421	0.2490	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	273.0042 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8697 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7366	27.3706	27.0047	25.1749	24.8089	22.9792	22.9792	22.6132	23.7111	24.8089	25.5409	26.2728	(38)
Heat transfer coeff													
	98.1173	97.7513	97.3853	95.5556	95.1896	93.3599	93.3599	92.9939	94.0918	95.1896	95.9215	96.6534	(39)

Average = Sum(39)m / 12 =	95.4641

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0508	1.0469	1.0430	1.0234	1.0195	0.9999	0.9999	0.9960	1.0077	1.0195	1.0273	1.0352	(40)
HLP (average)												1.0224	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.6691 (42)

Hot water usage for mixer showers
94.8361 93.4109 91.3341 87.3605 84.4281 81.1580 79.2992 81.3603 83.6196 87.1308 91.1897 94.4728 (42a)
Hot water usage for baths
29.7833 29.3410 28.7181 27.5696 26.7097 25.7561 25.2410 25.8595 26.5330 27.5534 28.7255 29.6826 (42b)
Hot water usage for other uses
41.9642 40.4382 38.9123 37.3863 35.8603 34.3344 34.3344 35.8603 37.3863 38.9123 40.4382 41.9642 (42c)
Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)
Energy content (annual)										Total = Sum(45)m =		2544.6486	
Distribution loss (46)m = 0.15 x (45)m													
	39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
										Total per year (kWh/year) = Sum(64)m =		3530.2712	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains													
	679.7039	677.2351	656.9246	618.4193	580.7300	512.4596	492.0000	495.6562	515.0173	583.7311	625.9175	662.7254	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539	(83)
Total gains	798.2763	906.6954	1030.6906	1160.2128	1243.7871	1191.2750	1138.2044	1051.0079	948.3630	854.7349	773.2657	760.5792	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	72.1654	72.4355	72.7077	74.1000	74.3849	75.8427	75.8427	76.1412	75.2528	74.3849	73.8173	73.2583
alpha	5.8110	5.8290	5.8472	5.9400	5.9590	6.0562	6.0562	6.0761	6.0169	5.9590	5.9212	5.8839
util living area												
	0.9921	0.9826	0.9515	0.8544	0.6819	0.4977	0.3604	0.4060	0.6608	0.9111	0.9829	0.9938 (86)

Living	20.2554	20.3888	20.5943	20.8125	20.9174	20.9449	20.9483	20.9480	20.9299	20.7745	20.4777	20.2368	
Non living	19.3717	19.5054	19.7052	19.9147	19.9977	20.0307	20.0321	20.0354	20.0170	19.8913	19.6080	19.3644	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(88)
util rest of house													
	0.9894	0.9769	0.9367	0.8176	0.6234	0.4283	0.2856	0.3260	0.5823	0.8779	0.9764	0.9918	(89)
MIT 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	20.3515	20.3537	20.3559	20.3669	20.3691	20.3801	20.3801	20.3823	20.3757	20.3691	20.3647	20.3603	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3515	20.3537	20.3559	20.3669	20.3691	20.3801	20.3801	20.3823	20.3757	20.3691	20.3647	20.3603	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9904	0.9790	0.9419	0.8303	0.6429	0.4509	0.3099	0.3520	0.6086	0.8898	0.9788	0.9925	(94)
Useful gains	790.6114	887.6172	970.8559	963.3531	799.6458	537.1792	352.7053	369.9046	577.1276	760.5194	756.8480	754.8836	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1574.9300	1510.6190	1349.3603	1095.7223	825.2044	539.6277	352.9079	370.3289	590.4886	929.9130	1272.3666	1561.9457	(97)
Space heating kWh													
	583.5331	418.6572	281.6073	95.3059	19.0156	0.0000	0.0000	0.0000	0.0000	126.0288	371.1734	600.4542	(98a)
Space heating requirement - total per year (kWh/year)												2495.7755	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	583.5331	418.6572	281.6073	95.3059	19.0156	0.0000	0.0000	0.0000	0.0000	126.0288	371.1734	600.4542	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2495.7755	
Space heating per m2											(98c) / (4) =	26.7300	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	283.3359 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	583.5331	418.6572	281.6073	95.3059	19.0156	0.0000	0.0000	0.0000	0.0000	126.0288	371.1734	600.4542	(98)
Space heating efficiency (main heating system 1)													
	283.3359	283.3359	283.3359	283.3359	283.3359	0.0000	0.0000	0.0000	0.0000	283.3359	283.3359	283.3359	(210)
Space heating fuel (main heating system)													
	205.9510	147.7600	99.3899	33.6371	6.7113	0.0000	0.0000	0.0000	0.0000	44.4804	131.0012	211.9231	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	318.3101	282.2477	300.9720	266.4388	259.6966	208.2981	205.0067	213.1901	215.6304	269.0665	284.1626	314.9993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	26.9644	24.3550	26.9644	26.0946	26.9644	26.0946	26.9644	26.9644	26.0946	26.9644	26.0946	26.9644	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.2483	-27.0722	-43.0975	-53.3740	-62.2599	-59.1930	-58.4201	-52.7889	-43.4948	-32.7709	-19.8482	-14.6129	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												880.8541	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)

Efficiency of water heater		112.5000
Water heating fuel used		3138.0189 (219)
Space cooling fuel		0.0000 (221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)		
mechanical ventilation fans (SFP = 0.8140)		317.4842 (230a)
Total electricity for the above, kWh/year		317.4842 (231)
Electricity for lighting (calculated in Appendix L)		210.9332 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation		-484.1807 (233)
Wind generation		0.0000 (234)
Hydro-electric generation (Appendix N)		0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)		0.0000 (235)
Appendix Q - special features		
Energy saved or generated		-0.0000 (236)
Energy used		0.0000 (237)
Total delivered energy for all uses		4063.1096 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	880.8541	16.4900	145.2528	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3138.0189	16.4900	517.4593	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	317.4842	16.4900	52.3531	(249)
Energy for lighting	210.9332	16.4900	34.7829	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-484.1807	16.4900	-79.8414	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-79.8414	(252)
Total energy cost			670.0068	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.7432	(257)
SAP value		71.7432	
SAP rating (Section 12)		72	(258)
SAP band		C	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	880.8541	0.1572	138.4883	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3138.0189	0.1416	444.2558	(264)
Space and water heating			582.7440	(265)
Pumps, fans and electric keep-hot	317.4842	0.1387	44.0390	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-484.1807	0.1327	-64.2301	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-64.2301	(269)
Total CO2, kg/year			592.9971	(272)
CO2 emissions per m2			6.3500	(273)
EI value			94.2573	
EI rating			94	(274)
EI band			A	

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

1. Overall dwelling characteristics

Area	Storey height	Volume

	(m2)		(m)		(m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 93.3700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	= 0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	= 0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	= 0.1388	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2317	0.2248	0.2248	0.2143	0.2143	0.2005	0.2039	0.1970	0.2005	0.2074	0.2074	0.2178	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		273.0042 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8697 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.4430	23.7111	23.7111	22.6132	22.6132	21.1494	21.5154	20.7835	21.1494	21.8813	21.8813	22.9792	(38)
Heat transfer coeff	94.8237	94.0918	94.0918	92.9939	92.9939	91.5301	91.8961	91.1642	91.5301	92.2620	92.2620	93.3599	(39)

Average = Sum(39)m / 12 =	92.7499

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

HLP	1.0156	1.0077	1.0077	0.9960	0.9960	0.9803	0.9842	0.9764	0.9803	0.9881	0.9881	0.9999 (40)
HLP (average)												0.9934
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)

Hot water usage for mixer showers

94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728 (42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826 (42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642 (42c)

Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)
Energy content (annual)										Total = Sum(45)m =		2544.6486	
Distribution loss (46)m = 0.15 x (45)m													
	39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
										Total per year (kWh/year) = Sum(64)m =		3530.2712	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		0.0000	(64a)
Heat gains from water heating, kWh/month													
	131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains													
	679.7039	677.2351	656.9246	618.4193	580.7300	512.4596	492.0000	495.6562	515.0173	583.7311	625.9175	662.7254	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	22.3313	0.6300	0.7000	0.7700	35.9664	(76)
Southwest	0.9700	40.4699	0.6300	0.7000	0.7700	11.9971	(79)
West	6.0600	22.3313	0.6300	0.7000	0.7700	41.3579	(80)
Northwest	0.9700	12.9236	0.6300	0.7000	0.7700	3.8311	(81)
East	6.0500	22.3313	0.6300	0.7000	0.7700	41.2897	(76)

Solar gains	134.4422	234.1564	376.4091	561.1789	668.0638	731.4984	688.9976	606.2365	472.6945	295.2148	171.1807	109.8590	(83)
Total gains	814.1461	911.3914	1033.3337	1179.5982	1248.7938	1243.9580	1180.9976	1101.8927	987.7118	878.9459	797.0982	772.5844	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.6719	75.2528	75.2528	76.1412	76.1412	77.3589	77.0508	77.6694	77.3589	76.7452	76.7452	75.8427	
alpha	5.9781	6.0169	6.0169	6.0761	6.0761	6.1573	6.1367	6.1780	6.1573	6.1163	6.1163	6.0562	
util living area													
	0.9883	0.9763	0.9316	0.7956	0.5851	0.3674	0.2412	0.2647	0.5320	0.8537	0.9709	0.9907	(86)
Living	20.3705	20.4884	20.6876	20.8716	20.9380	20.9491	20.9494	20.9497	20.9451	20.8527	20.5980	20.3565	
Non living	19.5107	19.6310	19.8186	19.9841	20.0303	20.0492	20.0459	20.0528	20.0478	19.9802	19.7530	19.5084	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0704	20.0769	20.0769	20.0867	20.0867	20.0998	20.0965	20.1031	20.0998	20.0932	20.0932	20.0834	(88)
util rest of house													
	0.9843	0.9686	0.9112	0.7501	0.5225	0.3015	0.1709	0.1905	0.4521	0.8057	0.9598	0.9875	(89)
MIT 2	20.0704	20.0769	20.0769	20.0867	20.0867	20.0998	20.0965	20.1031	20.0998	20.0932	20.0932	20.0834	(90)
Living area fraction											fLA = Living area / (4) =	0.3237	(91)
MIT	20.3713	20.3757	20.3757	20.3823	20.3823	20.3911	20.3889	20.3934	20.3911	20.3867	20.3867	20.3801	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3713	20.3757	20.3757	20.3823	20.3823	20.3911	20.3889	20.3934	20.3911	20.3867	20.3867	20.3801	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9857	0.9714	0.9184	0.7656	0.5431	0.3229	0.1937	0.2145	0.4783	0.8225	0.9638	0.9887	(94)
Useful gains	802.5378	885.3051	948.9697	903.0614	678.2361	401.6631	228.7152	236.4083	472.4082	722.9081	768.2541	763.8350	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	1448.0770	1390.2687	1220.9035	974.7893	686.5082	401.9223	228.7230	236.4221	475.1464	810.6801	1142.8234	1426.5464	(97)
Space heating kWh													
	480.2812	339.3355	202.3188	51.6441	6.1544	0.0000	0.0000	0.0000	0.0000	65.3024	269.6899	493.0573	(98a)
Space heating requirement - total per year (kWh/year)												1907.7837	
Solar heating kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	480.2812	339.3355	202.3188	51.6441	6.1544	0.0000	0.0000	0.0000	0.0000	65.3024	269.6899	493.0573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1907.7837	
Space heating per m2											(98c) / (4) =	20.4325	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												269.2728	(206)
Efficiency of main space heating system 2 (in %)												0.0000	(207)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	480.2812	339.3355	202.3188	51.6441	6.1544	0.0000	0.0000	0.0000	0.0000	65.3024	269.6899	493.0573	(98)
Space heating efficiency (main heating system 1)													
	269.2728	269.2728	269.2728	269.2728	269.2728	0.0000	0.0000	0.0000	0.0000	269.2728	269.2728	269.2728	(210)
Space heating fuel (main heating system)													
	178.3623	126.0192	75.1352	19.1791	2.2856	0.0000	0.0000	0.0000	0.0000	24.2514	100.1549	183.1070	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(64)
Efficiency of water heater												109.9727	(216)
(217)m	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	(217)
Fuel for water heating, kWh/month													
	325.6252	288.7340	307.8887	272.5619	265.6648	213.0850	209.7180	218.0895	220.5858	275.2500	290.6929	322.2383	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	26.9644	24.3550	26.9644	26.0946	26.9644	26.0946	26.9644	26.9644	26.0946	26.9644	26.0946	26.9644	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-19.1250	-27.2437	-42.8916	-54.5261	-62.4869	-62.7019	-61.3649	-56.4573	-46.4769	-34.8590	-22.4242	-16.0661	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													

(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	708.4947 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	109.9727
Water heating fuel used	3210.1342 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	317.4842 (230a)
Total electricity for the above, kWh/year	317.4842 (231)
Electricity for lighting (calculated in Appendix L)	210.9332 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-506.6237 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3940.4225 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	708.4947	18.3900	130.2922	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3210.1342	18.3900	590.3437	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	317.4842	18.3900	58.3853	(249)
Energy for lighting	210.9332	18.3900	38.7906	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-506.6237	18.3900	-93.1681	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-93.1681	(252)
Total energy cost			724.6437	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	708.4947	0.1581	112.0441	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3210.1342	0.1416	454.4653	(264)
Space and water heating			566.5094	(265)
Pumps, fans and electric keep-hot	317.4842	0.1387	44.0390	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-506.6237	0.1326	-67.1591	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-67.1591	(269)
Total CO2, kg/year			573.8335	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	708.4947	1.5854	1123.2587	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3210.1342	1.5235	4890.7306	(278)
Space and water heating			6013.9893	(279)
Pumps, fans and electric keep-hot	317.4842	1.5128	480.2901	(281)
Energy for lighting	210.9332	1.5338	323.5363	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-506.6237	1.4898	-754.7667	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-754.7667	(283)
Total Primary energy kWh/year			6063.0491	(286)

SAP 10 EPC IMPROVEMENTS

House 2 Be Green

Current energy efficiency rating: C 72
Current environmental impact rating: A 94

N Solar water heating — Recommended
U Solar photovoltaic panels — Already installed
V2 Wind turbine — Not applicable

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.4	-£ 103	-70 kg (12.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£103	0.75 kg/m²	C 75	A 95
Total Savings	£103	0.75 kg/m²		

Potential energy efficiency rating: C 75
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 510 TEST (21 Dec 2022)
Recommendation texts revision number 6.1 (11 Jun 2019)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£818	£712	£106
Space heating	£189	£203	-£15
Water heating	£590	£470	£120
Lighting	£39	£39	£0
Generated (PV)	-£93	-£90	-£3
Total cost of fuels	£725	£622	£103
Total cost of uses	£725	£622	£102
Delivered energy	42 kWh/m²	36 kWh/m²	6 kWh/m²
Carbon dioxide emissions	0.6 tonnes	0.5 tonnes	0.1 tonnes
CO2 emissions per m²	6 kg/m²	5 kg/m²	1 kg/m²
Primary energy	65 kWh/m²	56 kWh/m²	9 kWh/m²

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

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2. Ventilation rate
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	m3 per hour		
Number of open chimneys	0 * 80	=	0.0000 (6a)
Number of open flues	0 * 20	=	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10	=	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20	=	0.0000 (6d)
Number of flues attached to other heater	0 * 35	=	0.0000 (6e)
Number of blocked chimneys	0 * 20	=	0.0000 (6f)
Number of intermittent extract fans	0 * 10	=	0.0000 (7a)
Number of passive vents	0 * 10	=	0.0000 (7b)
Number of flueless gas fires	0 * 40	=	0.0000 (7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5)	=	0.0000 (8)
Pressure test			Yes
Pressure Test Method			Blower Door

Measured/design AP50 3.0000 (17)
Infiltration rate 0.1500 (18)
Number of sides sheltered 1 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	0.1769	0.1734	0.1700	0.1526	0.1492	0.1318	0.1318	0.1283	0.1388	0.1492	0.1561	0.1630	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation 0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a) 0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2629	0.2594	0.2560	0.2386	0.2352	0.2178	0.2178	0.2143	0.2248	0.2352	0.2421	0.2490	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 273.0042 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.8697 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	27.7366	27.3706	27.0047	25.1749	24.8089	22.9792	22.9792	22.6132	23.7111	24.8089	25.5409	26.2728	(38)
Heat transfer coeff													
	98.1173	97.7513	97.3853	95.5556	95.1896	93.3599	93.3599	92.9939	94.0918	95.1896	95.9215	96.6534	(39)

Average = Sum(39)m / 12 = 95.4641

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0508	1.0469	1.0430	1.0234	1.0195	0.9999	0.9999	0.9960	1.0077	1.0195	1.0273	1.0352	(40)
HLP (average)												1.0224	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6691 (42)
Hot water usage for mixer showers

94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728	(42a)

Hot water usage for baths

29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826	(42b)

Hot water usage for other uses

41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642	(42c)

Average daily hot water use (litres/day) 153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)

Energy content (annual) Total = Sum(45)m = 2544.6486
Distribution loss (46)m = 0.15 x (45)m

39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)

Water storage loss:
Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.6300 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.2714 (55)
Total storage loss

	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (56)

If cylinder contains dedicated solar storage

	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134 (57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)

Total heat required for water heating calculated for each month

	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)

Aperture area of solar collector 3.0000 (H1)
Zero-loss collector efficiency 0.8000 (H2)
Collector linear heat loss coefficient 1.8000 (H3)
Collector 2nd order heat loss coefficient 0.0000 (H4)
Collector loop efficiency 0.9000 (H5)
Incidence angle modifier 1.0000 (H6)
Overshading factor 0.8000 (H8)
Overall heat loss coefficient of system 6.5000 (H10)
Heat loss coefficient of collector loop 3.9667 (H11)
Dedicated solar storage volume 75.0000 (H12)
Effective solar volume 75.0000 (H14)
Reference volume 225.0000 (H15)
Storage tank correction coefficient 1.3161 (H16)
Heat delivered to hot water 657.7926 (H24)
Heat delivered to space heating 0.0000 (H29)
Solar input 657.7926

Solar input	-0.0000	-16.1586	-60.1895	-84.7418	-113.9066	-103.0893	-102.6241	-88.4859	-59.6318	-28.9651	-0.0000	-0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)

Output from w/h

	358.0988	301.3700	278.4041	215.0018	178.2521	131.2461	128.0084	151.3530	182.9524	273.7348	319.6829	354.3742 (64)

Total per year (kWh/year) = Sum(64)m = 2872.4786 (64)

Electric shower(s)

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)

Heat gains from water heating, kWh/month

	131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)

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

	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897 (67)

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

	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411 (68)

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

	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)

Losses e.g. evaporation (negative values) (Table 5)

	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638 (71)

Water heating gains (Table 5)

	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290 (72)

Total internal gains

	679.7039	677.2351	656.9246	618.4193	580.7300	512.4596	492.0000	495.6562	515.0173	583.7311	625.9175	662.7254 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	5.2700	19.6403	0.6300	0.7000	0.7700	31.6322	(76)
Southwest	0.9700	36.7938	0.6300	0.7000	0.7700	10.9073	(79)
West	6.0600	19.6403	0.6300	0.7000	0.7700	36.3741	(80)
Northwest	0.9700	11.2829	0.6300	0.7000	0.7700	3.3448	(81)
East	6.0500	19.6403	0.6300	0.7000	0.7700	36.3140	(76)

Solar gains	118.5724	229.4603	373.7661	541.7935	663.0571	678.8154	646.2044	555.3517	433.3458	271.0038	147.3482	97.8539 (83)
Total gains	798.2763	906.6954	1030.6906	1160.2128	1243.7871	1191.2750	1138.2044	1051.0079	948.3630	854.7349	773.2657	760.5792 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	72.1654	72.4355	72.7077	74.1000	74.3849	75.8427	75.8427	76.1412	75.2528	74.3849	73.8173	73.2583
alpha	5.8110	5.8290	5.8472	5.9400	5.9590	6.0562	6.0562	6.0761	6.0169	5.9590	5.9212	5.8839
util living area												
	0.9921	0.9826	0.9515	0.8544	0.6819	0.4977	0.3604	0.4060	0.6608	0.9111	0.9829	0.9938 (86)

Living	20.2554	20.3888	20.5943	20.8125	20.9174	20.9449	20.9483	20.9480	20.9299	20.7745	20.4777	20.2368	
Non living	19.3717	19.5054	19.7052	19.9147	19.9977	20.0307	20.0321	20.0354	20.0170	19.8913	19.6080	19.3644	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(88)
util rest of house													
	0.9894	0.9769	0.9367	0.8176	0.6234	0.4283	0.2856	0.3260	0.5823	0.8779	0.9764	0.9918	(89)
MIT 2	20.0412	20.0444	20.0477	20.0639	20.0671	20.0834	20.0834	20.0867	20.0769	20.0671	20.0606	20.0541	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	20.3515	20.3537	20.3559	20.3669	20.3691	20.3801	20.3801	20.3823	20.3757	20.3691	20.3647	20.3603	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3515	20.3537	20.3559	20.3669	20.3691	20.3801	20.3801	20.3823	20.3757	20.3691	20.3647	20.3603	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9904	0.9790	0.9419	0.8303	0.6429	0.4509	0.3099	0.3520	0.6086	0.8898	0.9788	0.9925	(94)
Useful gains	790.6114	887.6172	970.8559	963.3531	799.6458	537.1792	352.7053	369.9046	577.1276	760.5194	756.8480	754.8836	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1574.9300	1510.6190	1349.3603	1095.7223	825.2044	539.6277	352.9079	370.3289	590.4886	929.9130	1272.3666	1561.9457	(97)
Space heating kWh													
	583.5331	418.6572	281.6073	95.3059	19.0156	0.0000	0.0000	0.0000	0.0000	126.0288	371.1734	600.4542	(98a)
Space heating requirement - total per year (kWh/year)												2495.7755	
Solar heating kWh													
	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh													
	583.5331	418.6572	281.6073	95.3059	19.0156	0.0000	0.0000	0.0000	0.0000	126.0288	371.1734	600.4542	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2495.7755	
Space heating per m2											(98c) / (4) =	26.7300	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	283.3359	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	583.5331	418.6572	281.6073	95.3059	19.0156	0.0000	0.0000	0.0000	0.0000	126.0288	371.1734	600.4542	(98)
Space heating efficiency (main heating system 1)													
	283.3359	283.3359	283.3359	283.3359	283.3359	0.0000	0.0000	0.0000	0.0000	283.3359	283.3359	283.3359	(210)
Space heating fuel (main heating system)													
	205.9510	147.7600	99.3899	33.6371	6.7113	0.0000	0.0000	0.0000	0.0000	44.4804	131.0012	211.9231	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	358.0988	301.3700	278.4041	215.0018	178.2521	131.2461	128.0084	151.3530	182.9524	273.7348	319.6829	354.3742	(64)
Efficiency of water heater												112.5000	(216)
(217)m	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	112.5000	(217)
Fuel for water heating, kWh/month													
	318.3101	267.8845	247.4703	191.1127	158.4463	116.6632	113.7853	134.5360	162.6243	243.3198	284.1626	314.9993	(219)
Space cooling fuel requirement													
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	33.7589	30.4919	33.7589	32.6699	33.7589	32.6699	33.7589	33.7589	32.6699	33.7589	32.6699	33.7589	(231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-17.2585	-27.0395	-42.6883	-52.1684	-59.7331	-56.4051	-55.6536	-50.8950	-42.6526	-32.6281	-19.8648	-14.6210	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												880.8541	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												112.5000	

Water heating fuel used	2553.3143 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	317.4842 (230a)
pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	397.4842 (231)
Electricity for lighting (calculated in Appendix L)	210.9332 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-471.6079 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3570.9778 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	880.8541	16.4900	145.2528	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2553.3143	16.4900	421.0415	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	317.4842	16.4900	52.3531	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	210.9332	16.4900	34.7829	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-471.6079	16.4900	-77.7681	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-77.7681	(252)
Total energy cost			588.8542	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5320 (257)
SAP value		75.1657
SAP rating (Section 12)		75 (258)
SAP band		C

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	880.8541	0.1572	138.4883	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2553.3143	0.1448	369.7359	(264)
Space and water heating			508.2242	(265)
Pumps, fans and electric keep-hot	397.4842	0.1387	55.1360	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-471.6079	0.1329	-62.6859	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-62.6859	(269)
Total CO2, kg/year			531.1185	(272)
CO2 emissions per m2			5.6900	(273)
EI value			94.8566	
EI rating			95	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	44.6500 (1b)	x	2.8500 (2b)	=	127.2525 (1b)	-
First floor	48.7200 (1c)	x	3.9500 (2c)	=	192.4440 (1c)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 93.3700						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	319.6965	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.1500 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1388 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1457	0.1388	0.1388	0.1283	0.1283	0.1145	0.1179	0.1110	0.1145	0.1214	0.1214	0.1318	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		82.8000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2317	0.2248	0.2248	0.2143	0.2143	0.2005	0.2039	0.1970	0.2005	0.2074	0.2074	0.2178	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows (Uw = 1.40)			13.2700	1.3258	17.5928			(27)
French doors (Uw = 1.50)			6.0500	1.4151	8.5613			(27)
Entrance door			2.1600	1.1000	2.3760			(26)
LGF			44.6500	0.1200	5.3580	110.0000	4911.5000	(28a)
Exposed upper			3.9600	0.1200	0.4752	20.0000	79.2000	(28a)
LGF wall	60.3600	8.6500	51.7100	0.1500	7.7565	190.0000	9824.9001	(29a)
GF walls	79.7100	12.8300	66.8800	0.1500	10.0320	110.0000	7356.7999	(29a)
Flat roof	48.7200		48.7200	0.1100	5.3592	0.0000	0.0000	(30)
Total net area of external elements Aum(A, m2)			237.4000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.5110			(33)
Party Wall 1			47.4000	0.0000	0.0000	70.0000	3318.0001	(32)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	25490.4001 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		273.0042 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E16 Corner (normal)	24.3500	0.0900	2.1915
E18 Party wall between dwellings	13.6000	0.0600	0.8160
E17 Corner (inverted – internal area greater than external area)	10.7500	-0.0900	-0.9675
E21 Exposed floor (inverted)	5.9600	0.3200	1.9072
E20 Exposed floor (normal)	5.0700	0.3200	1.6224
E5 Ground floor (normal)	18.6900	0.0560	1.0466
E1 Steel lintel with perforated steel base plate	11.8100	0.0500	0.5905
E3 Sill	10.7800	0.0320	0.3450
E4 Jamb	47.2400	0.0340	1.6062
E15 Flat roof with parapet	20.1800	0.1500	3.0270
E24 Eaves (insulation at ceiling level - inverted)	8.5600	0.0800	0.6848

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.8697 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	70.3807 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	24.4430	23.7111	23.7111	22.6132	22.6132	21.1494	21.5154	20.7835	21.1494	21.8813	21.8813	22.9792	(38)
Heat transfer coeff	94.8237	94.0918	94.0918	92.9939	92.9939	91.5301	91.8961	91.1642	91.5301	92.2620	92.2620	93.3599	(39)

Average = Sum(39)m / 12 = 92.7499

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0156	1.0077	1.0077	0.9960	0.9960	0.9803	0.9842	0.9764	0.9803	0.9881	0.9881	0.9999	(40)
HLP (average)												0.9934	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6691 (42)
Hot water usage for mixer showers												
	94.8361	93.4109	91.3341	87.3605	84.4281	81.1580	79.2992	81.3603	83.6196	87.1308	91.1897	94.4728 (42a)
Hot water usage for baths												
	29.7833	29.3410	28.7181	27.5696	26.7097	25.7561	25.2410	25.8595	26.5330	27.5534	28.7255	29.6826 (42b)
Hot water usage for other uses												
	41.9642	40.4382	38.9123	37.3863	35.8603	34.3344	34.3344	35.8603	37.3863	38.9123	40.4382	41.9642 (42c)
Average daily hot water use (litres/day)												153.1989 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	166.5837	163.1902	158.9645	152.3165	146.9981	141.2484	138.8745	143.0801	147.5389	153.5964	160.3534	166.1196	(44)
Energy conte	263.8278	232.3806	244.3225	208.5136	197.8877	173.6814	167.9567	177.1631	181.9302	208.4289	228.4529	260.1032	(45)
Energy content (annual)										Total = Sum(45)m =		2544.6486	
Distribution loss (46)m = 0.15 x (45)m													
	39.5742	34.8571	36.6484	31.2770	29.6832	26.0522	25.1935	26.5745	27.2895	31.2643	34.2679	39.0155	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6300	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.2714	(55)
Total storage loss													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(56)
If cylinder contains dedicated solar storage													
	39.4134	35.5992	39.4134	38.1420	39.4134	38.1420	39.4134	39.4134	38.1420	39.4134	38.1420	39.4134	(57)
Primary loss	54.8576	49.5488	54.8576	53.0880	54.8576	22.5120	23.2624	23.2624	22.5120	54.8576	53.0880	54.8576	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	358.0988	317.5286	338.5935	299.7436	292.1587	234.3354	230.6325	239.8389	242.5842	302.6999	319.6829	354.3742	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.8000	(H2)
Collector linear heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0000	(H4)
Collector loop efficiency												0.9000	(H5)
Incidence angle modifier												1.0000	(H6)
Overshading factor												0.8000	(H8)
Overall heat loss coefficient of system												6.5000	(H10)
Heat loss coefficient of collector loop												3.9667	(H11)
Dedicated solar storage volume												75.0000	(H12)
Effective solar volume												75.0000	(H14)
Reference volume												225.0000	(H15)
Storage tank correction coefficient												1.3161	(H16)
Heat delivered to hot water												719.7588	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												719.7588	
Solar input	-0.0000	-17.5854	-61.2724	-89.5675	-116.1666	-113.9347	-111.9743	-100.2116	-68.9313	-36.2892	-3.8257	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h													
	358.0988	299.9432	277.3212	210.1762	175.9921	120.4006	118.6582	139.6273	173.6529	266.4107	315.8572	354.3742	(64)
									Total per year (kWh/year) = Sum(64)m =			2810.5124	(64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						0.0000	(64a)
Heat gains from water heating, kWh/month													
	131.6088	116.9056	125.1233	111.8012	109.6837	75.7587	74.4555	77.5166	78.5014	113.1887	118.4310	130.3704	(65)

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	160.1458	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	29.8598	26.5212	21.5685	16.3287	12.2059	10.3047	11.1346	14.4732	19.4259	24.6657	28.7885	30.6897	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	365.8849	369.6817	360.1140	339.7456	314.0341	289.8689	273.7251	269.9284	279.4960	299.8645	325.5759	349.7411	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	53.6837	(69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	-106.7638	(71)
Water heating gains (Table 5)													
	176.8936	173.9667	168.1765	155.2794	147.4244	105.2204	100.0746	104.1890	109.0297	152.1353	164.4875	175.2290	(72)
Total internal gains													
	679.7039	677.2351	656.9246	618.4193	580.7300	512.4596	492.0000	495.6562	515.0173	583.7311	625.9175	662.7254	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
East	5.2700	22.3313	0.6300	0.7000	0.7700	35.9664 (76)
Southwest	0.9700	40.4699	0.6300	0.7000	0.7700	11.9971 (79)
West	6.0600	22.3313	0.6300	0.7000	0.7700	41.3579 (80)
Northwest	0.9700	12.9236	0.6300	0.7000	0.7700	3.8311 (81)
East	6.0500	22.3313	0.6300	0.7000	0.7700	41.2897 (76)

Solar gains	134.4422	234.1564	376.4091	561.1789	668.0638	731.4984	688.9976	606.2365	472.6945	295.2148	171.1807	109.8590 (83)
Total gains	814.1461	911.3914	1033.3337	1179.5982	1248.7938	1243.9580	1180.9976	1101.8927	987.7118	878.9459	797.0982	772.5844 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	74.6719	75.2528	75.2528	76.1412	76.1412	77.3589	77.0508	77.6694	77.3589	76.7452	76.7452	75.8427	
alpha	5.9781	6.0169	6.0169	6.0761	6.0761	6.1573	6.1367	6.1780	6.1573	6.1163	6.1163	6.0562	
util living area	0.9883	0.9763	0.9316	0.7956	0.5851	0.3674	0.2412	0.2647	0.5320	0.8537	0.9709	0.9907	(86)
Living	20.3705	20.4884	20.6876	20.8716	20.9380	20.9491	20.9494	20.9497	20.9451	20.8527	20.5980	20.3565	
Non living	19.5107	19.6310	19.8186	19.9841	20.0303	20.0492	20.0459	20.0528	20.0478	19.9802	19.7530	19.5084	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	31	28	31	30	31	30	31	31	30	31	30	31	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	21.0000	(87)
Th 2	20.0704	20.0769	20.0769	20.0867	20.0867	20.0998	20.0965	20.1031	20.0998	20.0932	20.0932	20.0834	(88)
util rest of house	0.9843	0.9686	0.9112	0.7501	0.5225	0.3015	0.1709	0.1905	0.4521	0.8057	0.9598	0.9875	(89)
MIT 2	20.0704	20.0769	20.0769	20.0867	20.0867	20.0998	20.0965	20.1031	20.0998	20.0932	20.0932	20.0834	(90)
Living area fraction										fLA = Living area / (4) =		0.3237	(91)
MIT	20.3713	20.3757	20.3757	20.3823	20.3823	20.3911	20.3889	20.3934	20.3911	20.3867	20.3867	20.3801	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.3713	20.3757	20.3757	20.3823	20.3823	20.3911	20.3889	20.3934	20.3911	20.3867	20.3867	20.3801	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9857	0.9714	0.9184	0.7656	0.5431	0.3229	0.1937	0.2145	0.4783	0.8225	0.9638	0.9887	(94)
Useful gains	802.5378	885.3051	948.9697	903.0614	678.2361	401.6631	228.7152	236.4083	472.4082	722.9081	768.2541	763.8350	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1448.0770	1390.2687	1220.9035	974.7893	686.5082	401.9223	228.7230	236.4221	475.1464	810.6801	1142.8234	1426.5464	(97)
Space heating kWh	480.2812	339.3355	202.3188	51.6441	6.1544	0.0000	0.0000	0.0000	0.0000	65.3024	269.6899	493.0573	(98a)
Space heating requirement - total per year (kWh/year)												1907.7837	
Solar heating kWh	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	480.2812	339.3355	202.3188	51.6441	6.1544	0.0000	0.0000	0.0000	0.0000	65.3024	269.6899	493.0573	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1907.7837	
Space heating per m2										(98c) / (4) =		20.4325	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	269.2728 (206)
Efficiency of main space heating system 2 (in %)	0.0000 (207)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	480.2812	339.3355	202.3188	51.6441	6.1544	0.0000	0.0000	0.0000	0.0000	65.3024	269.6899	493.0573	(98)
Space heating efficiency (main heating system 1)	269.2728	269.2728	269.2728	269.2728	269.2728	0.0000	0.0000	0.0000	0.0000	269.2728	269.2728	269.2728	(210)
Space heating fuel (main heating system)	178.3623	126.0192	75.1352	19.1791	2.2856	0.0000	0.0000	0.0000	0.0000	24.2514	100.1549	183.1070	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	358.0988	299.9432	277.3212	210.1762	175.9921	120.4006	118.6582	139.6273	173.6529	266.4107	315.8572	354.3742	(64)

Efficiency of water heater												109.9727 (216)
(217)m	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727	109.9727 (217)
Fuel for water heating, kWh/month												
	325.6252	272.7434	252.1727	191.1167	160.0325	109.4823	107.8979	126.9654	157.9054	242.2516	287.2142	322.2383 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	33.7589	30.4919	33.7589	32.6699	33.7589	32.6699	33.7589	33.7589	32.6699	33.7589	32.6699	33.7589 (231)
Lighting	26.1361	20.9673	18.8788	13.8314	10.6838	8.7287	9.7461	12.6683	16.4549	21.5897	24.3856	26.8625 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-19.1376	-27.2028	-42.4482	-53.1237	-59.8241	-59.2013	-57.9910	-53.9724	-45.3468	-34.6307	-22.4343	-16.0759 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)

Annual totals kWh/year	
Space heating fuel - main system 1	708.4947 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	109.9727
Water heating fuel used	2555.6456 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.8140)	
mechanical ventilation fans (SFP = 0.8140)	317.4842 (230a)
pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	397.4842 (231)
Electricity for lighting (calculated in Appendix L)	210.9332 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-491.3887 (233)
Wind generation	0.0000 (234)
Hydro-electric generation (Appendix N)	0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)	0.0000 (235)
Appendix Q - special features	
Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	3381.1689 (238)

10a. Fuel costs - using BEDF prices (510)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	708.4947	18.3900	130.2922	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.6456	18.3900	469.9832	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	317.4842	18.3900	58.3853	(249)
Pump for solar water heating	80.0000	18.3900	14.7120	(249)
Energy for lighting	210.9332	18.3900	38.7906	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-491.3887	18.3900	-90.3664	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-90.3664	(252)
Total energy cost			621.7970	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	708.4947	0.1581	112.0441	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2555.6456	0.1452	371.1918	(264)
Space and water heating			483.2359	(265)
Pumps, fans and electric keep-hot	397.4842	0.1387	55.1360	(267)
Energy for lighting	210.9332	0.1443	30.4442	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-491.3887	0.1329	-65.2960	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-65.2960	(269)
Total CO2, kg/year			503.5200	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	708.4947	1.5854	1123.2587	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2555.6456	1.5373	3928.7189	(278)
Space and water heating			5051.9776	(279)
Pumps, fans and electric keep-hot	397.4842	1.5128	601.3141	(281)
Energy for lighting	210.9332	1.5338	323.5363	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-491.3887	1.4910	-732.6587	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-732.6587	(283)
Total Primary energy kWh/year			5244.1694	(286)

;

APPENDIX D

Summary of LZC Technologies Not Feasible for the Development

Low and Zero Carbon Technologies Not Feasible for the Site

Solar Thermal Panels

Solar hot water systems (SHW) use the energy radiated by the sun and convert it into useful heat in the form of hot water.

Heat is transferred and stored in a central thermal store. The solar panel system would ideally supply approximately 45-55% of the development's hot water requirement; the remainder of energy required for hot water would be supplied by the gas boilers.

Solar thermal panels are ideal for buildings with a highly insulated building envelope as the energy demand for heating water is relatively high in comparison to space heating demand.

Solar thermal panels are most efficient when evacuated tube technology is used. This leads to bulky and visually less pleasing system that will be aesthetically more intrusive.

The roof of the proposed building is flat and therefore the collectors would have to be mounted on frames tilted at least 30 degrees facing south, south-west or south-east leading to an optimum hot water output.

Solar thermal panels could be specified to compliment the proposed ASHP strategy but would require a large hot water storage tank located in the cupboard with long circulation pipes providing hot water to the kitchen. This would lead to additional losses from the system.

A SHW system alone would not reduce CO_2 emissions by 35% as required by the London Plan Policy SI2 and therefore an additional technology would have to be incorporated into the design of the building, compromising on space and increasing the overall cost of the construction.

For these reasons a solar hot water system is not recommended for the site.

Gas CHP (Combined Heat and Power)

A conventionally fuelled CHP system would utilise a prime mover such as a diesel engine or gas turbine to drive an electrical generator. The heat generated by the prime mover during this process would be utilised in a community heating network.

Gas CHP systems are energy efficient and considered as low carbon technologies. For CHP to be viable, it must run almost continuously and thus requires a permanent heat demand (hence its suitability for swimming pools, hospitals etc).

The proposed development would not fully utilise the energy generated by CHP engine and therefore would result in inefficient running of the system.

Air quality issues resulting from operation of a gas CHP system would also have to be addressed and increase of associated NOx emissions would have to be mitigated.

It is therefore not recommended that gas fired-CHP be considered for this site.

Bio-fuels

Bio-fuels have the potential to contribute to the reduction of CO2 emissions of various developments by using this fuel within a boiler or CHP plant. Biofuels are considered to have low or zero CO2 intensities as theoretically the CO2 released when these fuels are combusted is no greater than the CO2 that has been absorbed from the atmosphere when the plants grew.

However, there are a number of issues which must be considered with this type of fuel in urban locations:

- Potential air quality impacts with combusting bio-fuels in urban areas, in particular elevated NOx emissions and particulates and must be addressed.
- Transporting this type of fuel increases lorry movements into and out of London, affecting congestion and transport emissions. The relatively rapid degradation of biodiesel would require appropriately sized on-site storage tanks with regular fuel deliveries.
- Importantly, the actual bio-diesel CO2 intensity cannot be guaranteed due to variations in fuel stock supply, demand, the energy input processing the fuel and CO2 emissions due to growing, harvesting and processing the base fuel.
- Biofuel availability is currently uncertain due to unknown future supply and demand. Whilst an increase in demand for larger developments may stimulate the supply chain, availability could change with variation in demand. Transport is likely to have the most significant impact on the biofuel industry over emerging building demand.

- Socio-economic issues from growing and harvesting feedstock, with potential impacts on food production, particularly for biodiesel that is imported. Solid biofuels have a lesser impact in this area.
- On-site fuel storage requirements requiring additional space, along with regular access to the on-site fuel storage area.
- Increased plant maintenance is generally required, adding to costs and plant down-time.

Consequently, biofuels for combustion within a boiler are not appropriate for the scheme.

Wind Turbines

Although a wind turbine could be sized to meet the requirements of this development, there are numerous factors that would discount its suitability in this setting. Typically wind turbines perform poorly in urban environments as surrounding buildings and features dissipate much of the useful energy of the wind before it can be extracted by the turbine. The tower would also require a large amount of free space for the erecting and periodic maintenance of the turbine. This is likely to be an issue with this site.

Environmental concerns such as noise and shadow flicker are also problematic in populated areas. While modern turbines have low levels of noise generation, even at high rotational speeds, the noise generated may still be an issue for local residents, particularly given the close proximity of the turbine. Given the dense urban setting of this development, shadow flicker is likely to be a problem for the residents of the proposed development. A wind turbine would not be a viable option for this development.