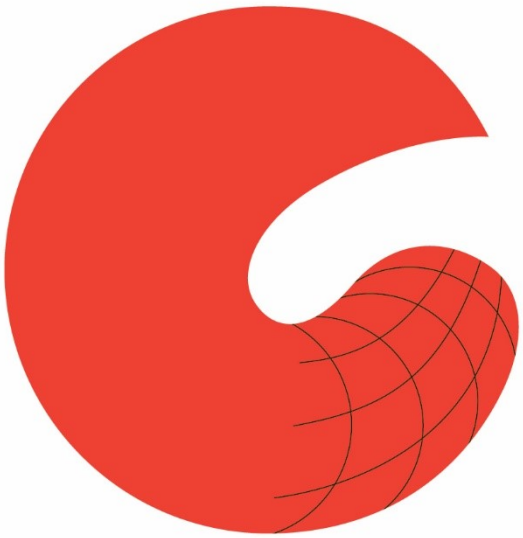

create
CONSULTING
ENGINEERS LTD

19 HERTFORD COURT, ENFIELD

Energy Statement

19 HERTFORD COURT, ENFIELD, N13 4DD

Energy Statement

19 HERTFORD COURT, ENFIELD
Energy Statement

Client: Ms G Theodorou

Engineer: Create Consulting Engineers Limited
109-112 Temple Chambers
3-7 Temple Avenue
London
EC4Y 0HP

Tel: 020 7822 2300
Email: enquiries@createconsultingengineers.co.uk
Web: www.createconsultingengineers.co.uk

Report By: Mirza Baig, Energy and Sustainability Engineer

Checked By: Sunanda Swain, MSc, BREEAM AP

Reference: MB/VL/P23-3009/01

Date: October 2023

19 HERTFORD COURT, ENFIELD, N13 4DD
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 located at 19 Hertford Court, Enfield, N13 4DD.

The strategy has been prepared in the context of the London Plan (2021) and Enfield Local Plan, specifically Policy DMD 51, which states that all residential developments are required to incorporate measures to improve energy conservation and efficiency and should achieve zero carbon emission reduction on-site over the Part L compliant case.

The policy requires all developments to integrate the principles of sustainable design and construction into the design of the new proposal. This energy strategy demonstrates the carbon reductions that can be achieved through addressing the fabric energy efficiency measures and 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 10% from 'Be Lean' measures only.

'Be Clean': Since the proposed development is a small development, connecting it to a future heat network would not be economically feasible.

'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 (ASHPs) serving each dwellings.
- PV panels on the roof – estimated system size 2.4 kWp

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 over 71%, exceeding the Building Regulations Part L 2021 targets for compliance and London Plan carbon emissions reduction target of 35%.

'Net Zero Carbon': The on-site 'net zero carbon' target for the development will be met through payment towards Enfield Council's carbon offsetting fund. The funds secured by the council will be ring-fenced to deliver carbon emissions savings off site through a variety of projects and will be secured through Section 106 legal agreements. Please refer to Appendix A for carbon offset calculation.

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd has been commissioned by Ms G Theodorou to prepare an Energy Statement analysis in support of the planning application for the proposed development at 19 Hertford Court, Enfield, N13 4DD.

1.2 The objective of the Energy Statement is to assess the proposed development against the policy requirements of the Enfield Local Plan and specifically Policy DMD51: Energy Efficiency Standards.

Site Location and Description

1.3 The proposed project involves the demolition of the existing structure and the construction of two residential dwellings, along with related infrastructure and activities. The existing site situation has been shown in the following figure:

Figure 1.1: Site location plan (Source-Google Earth)

Objectives

1.4 The objectives of this report are to:

- Demonstrate how the proposed development has been assessed against the policy requirements of the Publication London Plan (2021) Enfield Local Plan, specifically Policy DMD 51.
- 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.

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.

'Be Seen' Energy Monitoring Guidance (September 2021)

2.10 Major developments are required to monitor and report on energy performance to the Mayor for at least five years via an online portal to enable the GLA to identify good practice and report on the operational performance of new development in London.

2.11 The document is aimed at those involved in the planning, design, construction, delivery and operation of development. It includes a reporting template which applicants will be expected to use. It applies to major developments and sets out what each responsible party needs to do to comply with the policy from the inception stage of a development to full occupancy.

2.12 The 'Be Seen' policy is designed help verify the London Plan policies and to ensure compliance with London's net zero-carbon standard is achieved.

Energy Hierarchy

2.13 In line with the London Plan, developments are expected to achieve net zero-carbon by following the energy hierarchy:

- Be lean: Use less energy and manage demand during operation through fabric and servicing improvements and the incorporation of flexibility measures.
- Be clean: Exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks.
- Be green: Maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.
- Be seen: Monitor, verify and report on energy performance through the Mayor's post construction monitoring platform. This is only required for major development projects. Note that the major developments are also known as 'referable applications' as these proposals need to be referred to the Mayor of London. The criteria for that is either the development of for 150 residential units or more development over 30 metres in height (outside the City of London) or development on Green Belt or Metropolitan Open Land. For this project the Be Seen requirements will not be applicable since it is not a referrable application.

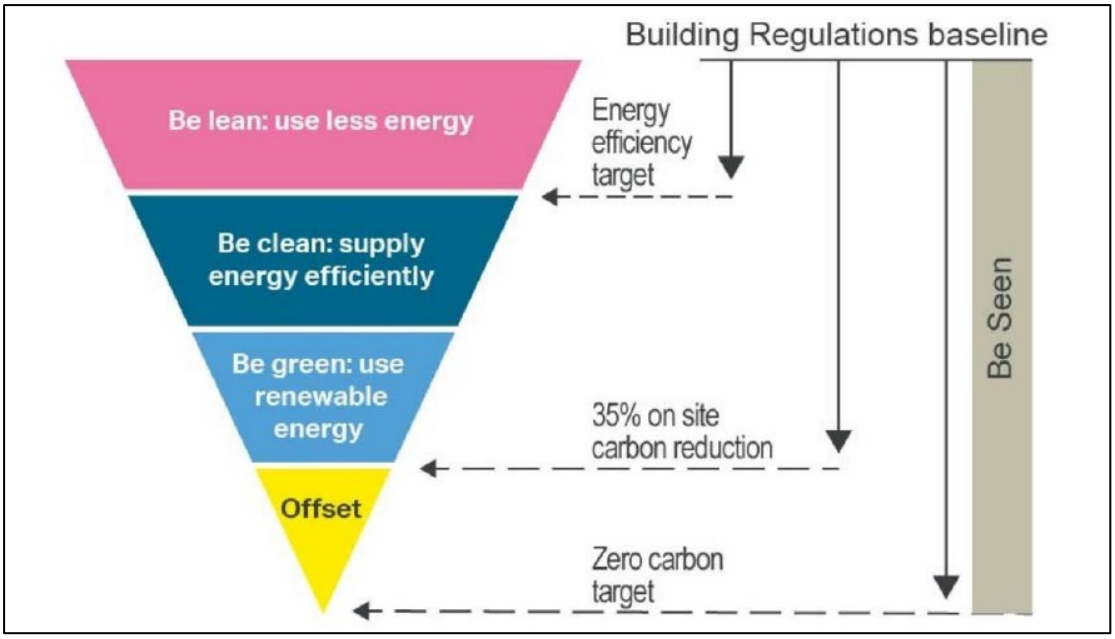


Figure 2.1: London Plan Energy Hierarchy

2.14 The remaining regulated carbon dioxide emissions, to 100 per cent, are to be offset through a cash in lieu contribution to the relevant borough.

Local Planning Policy

Enfield's Development Management Document Adopted (November 2014)

2.15 The Enfield's Development Management Document Adopted (November 2014) is the key strategic document in Enfield's development plan. It sets out the vision for shaping the future of the borough and contains policies for guiding planning decisions. The following policies have been identified as appropriate for assessing the sustainable performance of new developments:

Policy DMD51: Environmental Assessment Methods

"All developments will be required to demonstrate how the proposal minimises energy-related CO2 emissions in accordance with the following energy hierarchy:
a. Maximising fabric energy efficiency and the benefits of passive design;
b. Utilising the potential for connection to an existing or proposed decentralised energy network in accordance with DMD 52 'Decentralised Energy Networks';
c. Demonstrating the feasibility and use of low or zero carbon technology in accordance with DMD 53 'Low and Zero Carbon Technology'; and, where applicable,
d. Financial contributions to on, near or off-site carbon reduction strategies in accordance with DMD 54 'Allowable Solutions'.

Measures to secure energy efficiencies and reduce the emissions of CO2 must adhere strictly to the principles of the energy hierarchy with each tier utilised fully before a lower tier is employed. Developers must submit detailed Energy Statements in accordance with DMD 49 'Sustainable Design and Construction Statements' to demonstrate how they have engaged with the energy hierarchy to maximise the energy efficiency of the proposal.

Specific targets for energy efficiency will apply to the following types of development:

Residential Development
The Council will require all major residential developments to achieve as a minimum:
a. 25% reduction in carbon dioxide emissions over Part L1A of Building Regulations (2010) in line with best practice to 2013;
b. 40% improvement from 2013 to 2016; and
c. Moving towards zero carbon from 2016.

Non-residential proposals
The Council will require major non-residential development involving the replacement or creation of new non-residential floorspace or a combination thereof to achieve as a minimum:

a. 25% reduction in Carbon Dioxide emissions over Part L2A of Building Regulation (2010) in line with best practice to 2013;
b. 40% improvement from 2013 to 2016;
c. As per Building Regulations; and
d. Moving towards zero carbon from 2019.

All of the reductions specified for residential and non-residential development above should be provided on-site. Where site constraints preclude attainment of the required reductions and/or the reductions are not technically feasible and this has been evidenced through the Energy Statement, in accordance with DMD 49 'Sustainable Design and Construction Statements' provisions for providing near-site or off-site reductions through a set of agreed allowable solutions or financial contribution will be required to fully off-set the shortfall.

For minor development, the Council will seek to encourage all residential or non-residential developments to achieve the above targets where it is demonstrated that this is technically feasible and economically viable.

Developers will be required to take account of unregulated CO2 emissions within their energy statements and will be required to reduce energy consumption for these uses so far as practicable.

This Policy should be read in conjunction with Core Strategy Policy 20".

Policy DMD52- Decentralised Energy Networks

"Decentralised Energy Networks

Proposals for the development of decentralised energy network infrastructure and related apparatus in the borough will be supported. The Council will support, and in some cases facilitate, the provision of infrastructure to support new and expanding networks including safeguarding routes and land for such use where necessary.

Proposals for major developments which produce heat and/or energy should contribute to the supply of decentralised energy networks unless it can be demonstrated that this is not technically feasible or economically viable.

Connection to a decentralised energy network

All major developments should connect to or contribute towards existing or planned DE networks supplied by low or zero carbon energy.

1. Where the proposed development is adjacent to an existing DE network, it should:

a. Secure the direct connection of all units to that network; and

b. Contribute as necessary to the increased capacity of the DE network to support such connection.

2. Where there is an existing DE network that requires extension in order to supply the proposed development, proposed developments should:

a. Contribute to such extension:

b. Secure the direct connection of all units to the extended network; and

c. Contribute as necessary to the increased capacity of the DE network to support such connection.

3. Where there is a planned DE network within feasible and viable range of future connection, proposed developments should:

a. Commit to connect to the DE network:

b. Incorporate site-wide and/or communal heating systems:

c. Provide sufficient space for on-site energy centres or plant rooms to accommodate DE connection equipment such as pipes, heat exchangers and pumps etc:

d. Locate the energy centre or plant room to ensure the shortest connection distance to the future network, having regard to the requirements of the network as a whole:

e. Maximise the layout, density and mix of development to support identified DE opportunities;

f. Provide pipe connections as appropriate to the site boundary or safeguard an identified route within the site for future DE connection infrastructure; and

g. Where the planned DE network requires extension to supply the proposed development, proposed developments should contribute to such extension.

4. Where there is no connection available to a decentralised energy network and no DE network is planned within range, on-site CCHP or CHP will be expected where the heating demand makes it feasible.

5. Where CCHP or CHP would not be technically feasible or financially viable, developments will be required to be designed to enable its connection to a decentralised energy network in the future or provide a contribution for the expansion of decentralised energy networks, or other carbon reduction measures within the borough, where reasonable and appropriate.
6. Where technically feasible, buildings with high cooling loads that are connected to a DE network should be designed to meet their cooling demand through heat-fed absorption chilling.

This policy should be read in conjunction with Core Strategy Policy 20".

Policy DMD53- Low and Zero Carbon Technology

"Where major developments have secured all possible savings through energy efficiency and decentralised energy networks and still fail to achieve the specified carbon dioxide reductions targets (DMD 51 'Energy Efficiency Standards'), developments will be required to provide on site renewable energy generation through the use of low and zero carbon technologies. Developments will be required to make-up the identified shortfall or provide a 20% carbon dioxide reduction, whichever is the greater unless it can be demonstrated that this is not technically feasible or economically viable.

For minor applications, the Council will seek to encourage further carbon dioxide reductions through the provision and use of on-site renewable energy generation and the use of low and zero carbon technologies.

Local opportunities to contribute towards decentralised energy supply from low and zero carbon technologies will be encouraged, where there is no overriding adverse local impact including identified impacts to historic assets.

Where proposals are located within the Green Belt, elements of many low and zero carbon energy projects would constitute inappropriate development, which may impact on the openness of the Green Belt, the established character of the landscape or its biodiversity. In evaluating the development, the Council will give significant weight to the visual impacts of the project, the potential for disturbance to neighbouring properties and specific ecological considerations. Developers will need to demonstrate very special circumstances that clearly outweigh any harm by reason of inappropriateness and that there are no overriding local impacts for an application to be approved.
This Policy should be read in conjunction with Core Strategy Policy 20."

Building Regulations Approved Document Part L

2.16 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 L1A of the Regulations.

2.17 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.

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

Unregulated CO2 Emissions:

2.19 Unregulated emissions refer to emissions that are not evaluated under Part L of the Building Regulations, nor measured through SAP (Standard Assessment Procedure) or SBEM (Simplified Building Energy Model). In residential settings, these emissions commonly arise from cooking activities and the use of various appliances.

2.20 Unregulated emissions are not taken into account when calculating baseline emissions, setting targets, or determining emission reductions. However, they will be presented separately as shown in the table below:

Unit	Area m^2 (TFA)	Number of Units (U)	Total Energy (kWh/year)	Total CO_2 emission tonnes/year
Unit 1	91.29	2	8,548.03	
SAP 10	0.136		1,162.5	**1.16**

Table 2.1: Unregulated CO_2 Emissions

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 (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 The development is a new built and the orientation of the building is fixed. The facades of the building have been optimised in order to provide a balance of thermal control and access to daylight, both from within and outside the building.

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, west or east. This will enable daylight penetration into the new building, reducing its 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 mitigation includes the incorporation of openable windows, facilitating efficient purge ventilation. The proposed development design ensures that all areas are dual-aspect, allowing for cross-ventilation throughout the building. Moreover, both the dwellings will be equipped with a mechanical ventilation unit featuring a boost mode and a summer by-pass facility. This system will provide ventilation and free cooling during spring and summer nights while maintaining the security of the premises.

3.8 All south facing windows in the development are assumed to be fitted with low g-value glazing (g- 0.4) limiting solar thermal gains.

3.9 A detailed overheating analysis needs to be carried out.

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 Table 3.1 below detail the U-values for the development in relation to Building Regulations notional values for new builds.

Building Element/Characteristic	Part L1, 2021 Reference Values for Notional Building	Proposed values
External Wall – U value (W/m²K)	0.18	**0.14**
Party walls	0.00	**0.00**
Heat Loss Floor – U value (W/m²K)	0.13	**0.10**
Roof – U value (W/m²K)	0.11	**0.10**
Windows - U value (W/m²K)	1.20	**1.20** (G-value South= 0.60, North=0.40)
Doors - U value (W/m²K)	1.0 solid 1.2 semi-glazed	**0.98**
Design Air Permeability(m³/hr/m² @50Pa)	5	**3**

Building Element/Characteristic	Part L1, 2021 Reference Values for Notional Building	Proposed values
Thermal Bridges	**ACD equivalent psi values where available**	**LABC equivalent psi values where available**

Table 3.1: Proposed building fabric for the development

Air Tightness and Ventilation Strategy/Scope for Natural Ventilation

3.13 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.

3.14 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 m^3/m^2@50PA/hr.

3.15 The ventilation system proposed for the proposed dwellings 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).

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

- MVHR for dwellings – efficiency 88%, SFP = 1.07 W/l/s (based on Vent Axia Sentinel Kinetic Plus B);

Lighting and Appliances

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

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

3.19 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.

3.20 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

3.21 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.

3.22 Space and water heating for both the dwellings 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 137% (SCOP 3.50) and the heating system will be controlled by a programmer and at least 2 thermostats.

3.23 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

3.24 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 CO_2 emissions of the dwellings.

3.25 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').

3.26 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.

3.27 The selected dwelling unit 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.

3.28 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 2010 and adjusted for the revised carbon factors.

Space modelled

3.29 A sample of representative dwellings have been modelled for the scheme based on the latest set of architectural drawings from Urban and Rural Ltd, June 2023.

3.30 The provided example of dwelling has been modelled in various configurations to ensure that the dwelling types exhibiting the worst configurations in terms of orientation and area of exposed thermal elements are represented:

Dwelling Type	Floor Area of dwellings of this type	Number of dwellings	Total Floor Area of dwellings of this type
Unit 1	91.29	2	182.58

Table 3.2: Dwelling Types Modelled

Results of the Energy Simulation

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

3.32 The regulated CO_2 emissions of the residential units of the scheme before the use of any low and zero carbon systems has been estimated as approximately 3.1 tonnes of CO_2 per year as summarised in the table below. Please refer to DER/TER 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	3.1	1.16
Be Lean - After energy demand reduction	2.5	1.16
Improvement over Part LA: 2021	**0.6**	**Tonnes CO_2 per annum**
	20	**%**

Table 3.3: CO_2 emissions from the Baseline development and Be Lean case

3.33 The optimised building fabric specified for the dwellings has led to an overall projected improvement over Part L Target Emission Rate (TER) standard of over 20% for both the 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 the GLA spreadsheet for the calculation methodology (Appendix A).

3.34 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.

3.35 To reduce the development's total energy demand and maximise the carbon emission reduction, the proposed scheme will utilise low carbon and renewable energy technology. The study of feasible systems for the development at 19 Hertford Court, Enfield 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 Local Plan Policy DMD 51 Energy Efficiency Standards and Policy DMD 52 Decentralised Energy networks requires 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, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken, including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system.

Decentralised Energy Networks

4.2 The London Heat Map tool is an interactive tool that allows users to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study with all information being frequently updated. This tool details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.

4.3 The proposed development at 19 Herford Court, Enfield is not categorized a major project. Being a small development, it is considered as economically not viable to connect it to the proposed 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 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;
- Planning constraints;
- 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 emission factors comparing with 0.519 kg/kWh for SAP 2012);
- The development is proposed on a site 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 not feasible;
- 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 air source heat pumps (ASHPs).

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 provide all space and water heating demand for both the units. The heat distribution will be via low temperature radiators or underfloor distribution pipes. For the purpose of the modelling the ASHP- PUZH-W85VAA(-BS) Ecodan has been used with a minimum efficiency of 137%.

5.9 ASHPs extract energy from the air and therefore require space for external units. A roof space above the ground floor will be used for the location of the external units serving each flat.

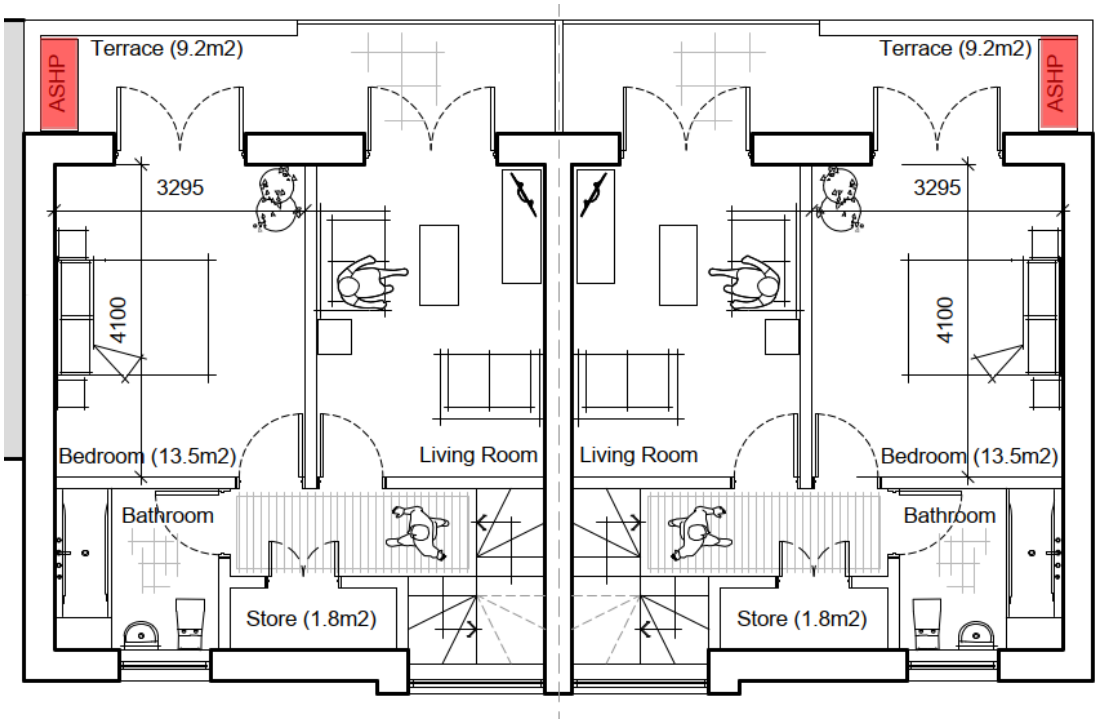


Figure 5.1: Proposed First Floor- Roof area for ASHP location

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 and PV, 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 71% for the development, exceeding the requirements of Part L of the Building Regulations.

5.13 These 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 a part of the roof in the development could be used for installing PV panels as shown in below figure.

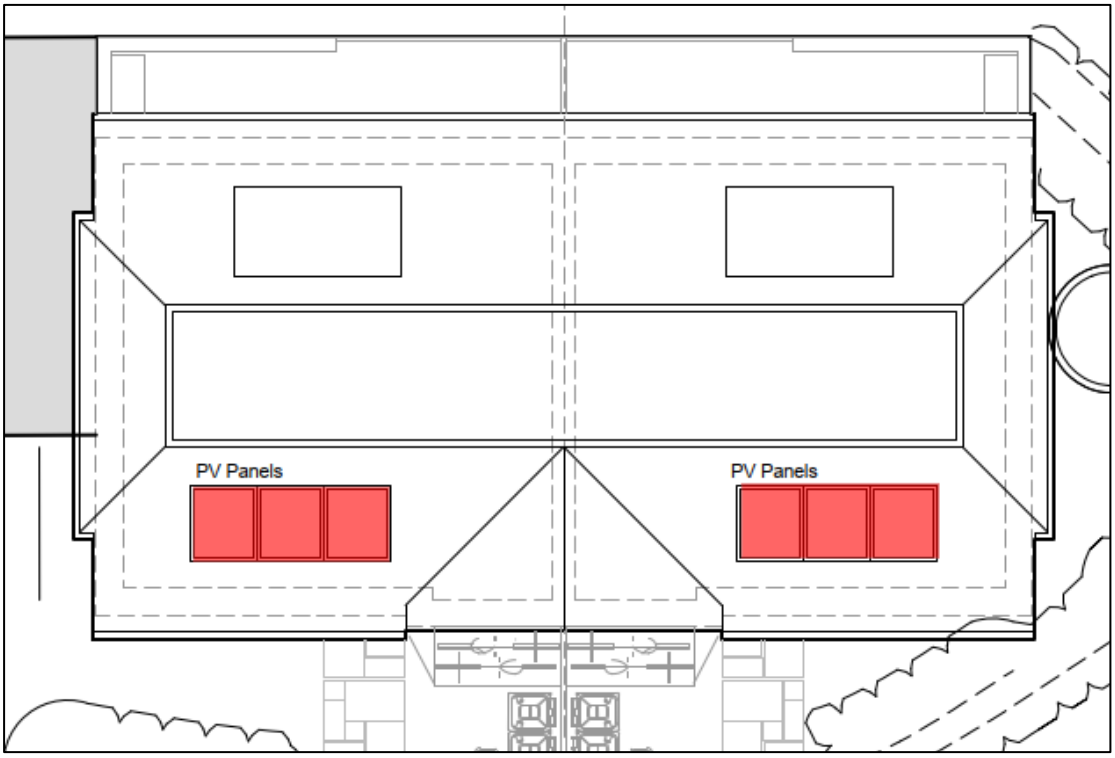


Figure 5.2: Proposed roof plan- PV location on roof

5.18 The estimated PV system size is 2.4kWp (6 panels with power output 0.40 kWp each).

5.19 The average space heating for overall development is 11.55 kWh/m^2/year. The average space heating is significantly lower than the required target of 15 kWh/m^2/year. The Energy usage intensity for overall development is 39.98 kWh/m^2/year.

5.20 The estimated carbon emissions reduction from the development after incorporation of PV panels and ASHP is 71%, as shown in the table 5.2 below.

	Total regulated emissions (Tonnes CO_2 / year)	CO_2 savings (Tonnes CO_2 / year)	Percentage savings (%)
Part L 2021 baseline	3.1		
Be lean	2.5	0.6	20%
Be clean	2.5	0.0	0%
Be green	0.9	1.6	51%
Total Savings	-	2.2	71%

Table 5.2: Energy hierarchy reductions (SAP 10 fuel emission factors)

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

'Net Zero Carbon' Offset Payment

5.22 The on-site 'net zero carbon' target shortfall for the development will be met through the payment towards Enfield Council's carbon offsetting fund. The funds secured by the council will be ring-fenced to deliver carbon emissions savings off site through a variety of projects and will be secured through Section 106 legal agreements.

5.23 The council's carbon offset cost is £95 for every tonne of CO_2 emitted per year over a period of 30 years (or £2,850 per tonne of annual residual CO_2 emissions).

5.24 The estimated offset payment will be in the region of £2,545. Please refer to Table 5.3 for detailed calculations of the carbon shortfall and the 'zero carbon' offset payment.

Energy hierarchy	Regulated carbon dioxide [tonnes/year]
Baseline emissions	3.1
Savings from 'Be Lean' measures - energy demand reduction	0.6
Savings from 'Be Clean'	0.0
Savings from 'Be Green' – ASHP	1.6
Cumulative savings	2.2
Shortfall to 'zero carbon'	0.9x30= 27
'Zero carbon' offset payment	**£2,545**

Table 5.3: 'Zero carbon' offset payment calculations.

Appendix A- SAP 10 Performance

6.0 BE SEEN – ENERGY MONITORING

6.1 The 'Be Seen' Energy monitoring will not be applicable to the proposed development at 19 Hertford Court, Enfield, as it does not meet the criteria of a major development.

7.0 CONCLUSION AND RECOMMENDATIONS

7.1 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 and its Policy CC1, 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.

7.2 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.

7.3 The energy strategy of the scheme has considered measures to adapt and mitigate the effects of climate change leading to significant CO_2 emission reductions, in particular through the application of a 'fabric first' approach leading to an improvement in the thermal performance of the building envelope of over 10% for the proposed development.

7.4 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 will allow the scheme to achieve an improvement over the baseline scenario of 71%, exceeding the planning policy target.

8.0 DISCLAIMER

8.1 Create Consulting disclaims any responsibility to the Client, Ms G Theodorou and others in respect of any matters outside the scope of this report.

8.2 The copyright of this report is vested in Create Consulting Engineers Ltd and Ms G Theodorou . 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 Ms G Theodorou .

8.3 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 Emissions Reporting Spreadsheet

BACKGROUND AND PURPOSE

From **January 2023** planning applicants for new and refurbishments schemes are required to use this spreadsheet to report the anticipated carbon performance of a development. It should be used for both domestic and non-domestic uses. This spreadsheet ensures a consistent and transparent process for presenting Part L 2021 CO_2 emission performance. The GLA will not accept the use of alternative methodologies or tools. This is to ensure consistency and to minimise the need for clarifications during the planning application determination period.

Planning applicants should use Part L 2021 BRUKL and SAP outputs to fill in this spreadsheet which serves as a the final step in reporting the carbon emission performance of the proposed energy strategy. **It is solely for the purpose of reporting compliance with the London Plan to the GLA and does not replace Part L calculations submitted for Building Regulations approval.**

The spreadsheet has been developed to fit as wide a range of policy compliant approaches for schemes as possible. Any planning applicants with a policy compliant approach that the spreadsheet does not serve should contact the GLA at: **ZeroCarbonPlanning@london.gov.uk**. Applicants must not amend or alter the spreadsheet to suit non-policy compliant strategies. Any unauthorised amendment to the spreadsheet will invalidate the CO_2 emission calculations.

Applicants should note that we will update the spreadsheet from time to time to ensure it remains fit for purpose. Applicants are expected to use the latest version at the time of the planning submission.

Any feedback on this spreadsheet should be sent to: ZeroCarbonPlanning@london.gov.uk.

METHODOLOGY

Applicants are required to complete **all** light blue input cells in the applicable tabs prior to submission ('Development Information', 'Part L Outputs', 'EUI & space heating demand' and 'GLA Summary Tables').

Input Data
For all applications, the input data required includes:
'Development information' tab
- Table 1. Application Completeness Check
- Table 2. Development Details
- Table 3. Bespoke District Heating Carbon Factors (if applicable)
- Table 4. Distribution loss factor (if applicable)
- Table 5. SCoP Calculation Methodology (if applicable)

'Part L Output' tab
- Type of units modelled
- Area of units modelled (m²)
- Number of units modelled
- Total area represented by model (m²)
- TER, DER and BER figures ($kgCO_2/m^2$ p.a.)
- Notional building Energy saving/generation technologies (-) for residential ($kgCO_2$ p.a.)
- Notional building Displaced electricity (-) for non-residential (kWh//m² p.a.)
- TFEE and DFEE figures for residential (kWh//m² p.a.)

'GLA Summary tables' tab
- Unregulated figures (tCO_2 p.a.)
- Actual and notional building cooling demand (MJ/m²)

Note: The total carbon emissions figures in the 'GLA Summary tables' tab are now calculated based on the area input for 'Total area represented by model (m²)'. This input requirement has been added to ensure that the carbon emission figures align with the development area schedule (included within the DAS) rather than the number of representative models.

'EUI & Space Heating Demand' tab
- Confirmation of building type
- Gross Internal Area (GIA) in m^2
- Energy Use Intensity (EUI) per fuel type (kWh p.a.)
- Space heating demand (kWh p.a.)
- Confirmation that both regulated and unregulated energy use has been included
- Confirmation of predicted energy use methodology, including modelling software
- Notes on the assessment, including justification if expected performance differs from Table 4

Note: Applicants can use the ‘be seen’ methodology or an alternative predictive energy modelling methodology to fill in the required EUI & space heating demand information.
Where ‘be seen’ reporting is used the reported EUI and space heating demand should align with energy consumption data reported in the planning stage submission for the ‘be seen’ policy, submitted via the online webform.

Required Part L Outputs for the GLA spreadsheet
Domestic Part L Outputs:
For the domestic conversion applicants are required to use the outputs from the SAP TER and DER worksheets. To assist in the process the required SAP worksheet rows have been referenced in each input cell. Note: The SAP worksheet rows are based on a communal heating system in line with GLA policy and guidance. Applicants proposing individual systems must first seek confirmation from the GLA as to whether the approach will be acceptable.

Non-domestic Part L Outputs:

Regarding the non-domestic uses, the applicant can determine whether each individual unit will be modelled independently and apportioned to the entire scheme or whether a single model will be generated for the entire development. The applicant should, however, include the results from all BRUKL outputs generated for the proposed development under the "NON-RESIDENTIAL CO_2 ANALYSIS" sections. Applicants are generally encouraged to model each individual typology independently.

Validation Check
Applicants must ensure that the calculated TER/DER/BER in this spreadsheet matches the actual values from the Part L 2021 BRUKL and SAP worksheets. The Part L 2021 BRUKL and SAP sheet must accompany the energy assessment so that results can be validated.

TABLE 1. APPLICATION COMPLETENESS CHECK	
Development information tab (Tables 1-4) completed and included in appendix of energy strategy?	yes
Part L outputs tab completed	yes
EUI & space heating demand completed	yes
Confirmation that the planning stage webform will be completed at planning application submission and that the Be Seen process and reporting responsibilities are fully understood, including the requirement for as-built and in-use stage reporting to be undertaken (or where the legal owner changes from one reporting stage to another that the responsible party will be notified).	no

TABLE 2. DEVELOPMENT DETAILS		Further notes	Response	Supporting comments (or signpost sections in the energy assessment)
Application details	Date of Application	Please provide the date the application was submitted to the Local Planning Authority.		
	Local Planning Authority	Please indicate the Local Planning Authority determining the application.	*Enfield*	
	Confirmed carbon offset price (£/tonne of carbon dioxide)	Please confirm the agreed carbon offset price for the Local Planning Authority. If no value is entered then the GLA's recommend price of £95 per tonne of carbon dioxide will be used.	*95.00*	
	Evidence of communication on the carbon offset price included in the energy assessment (Y/N).		*N*	
	Residential units number (Part L1)		*2*	
	Non-residential floor area in m^2 (Part L2)		*0.00*	
Heat risk	CIBSE TM59 undertaken for residential development (Y/N)		*N*	
	CIBSE TM52 undertaken for non-residential development (Y/N)			
	All sample units meet CIBSE criteria with DSY1 weather file (Y/N)			
	DSY2 and DSY3 included in overheating assessments (Y/N)			
	Residential g-value		*0.40*	
	% Glazing Ratio over façade			
	External shading proposed (Y/N)		*N*	
Energy efficiency measures	Target Fabric Energy Efficiency met (Y/N)			
	Mechanical Ventilation with Heat Recovery included (Y/N)			
	Waste Water Heat Recovery (Y/N)			
	Low energy lighting (Y/N)		*Y*	
District heating connection	Development in a Heat Network Priority Area (HNPA) (Y/N)		*N*	
	District Heating Network connection (Y/N)		*N*	
	Name of District Heating Network			
	Carbon factor ($kgCO_2$/ kWh)			
	Borough energy officer and Heat Network Operator contacted and evidence of correspondence included in the energy strategy (Y/N)	Applicable to all applications.	*N*	
Site heating distribution configuration	Development future proofed for DHN connection (Y/N)	Note that individual heating systems would not be appropriate for developments in HNPAs.		
	Drawings of communal system provided (Y/N)	Applicants should provide a drawings of the energy centre, on-site communal network with all building uses connected and future proofing arrangements detailed, including single point of connection.	*N*	
	Distribution type			
	Flow temperature (°C)			
	Return temperature (°C)			
	Distribution losses modelled (%)	See table 4 below for details.		
Heating system performance	Heat Pump (Y/N)		*Y*	
	Heat Pump source		*ELECTRIC*	
	Centralised Heat Pump capacity (kWth)			
	Heat Pump Seasonal Heating Efficiency (SCoP)			
	Heat Pump SCoP calculation includes heat source and heat distribution temperature and seasonal performance factor (Y/N)	See table 5 below for details.		
	Fraction of heat supplied by heat pump (only for hybrid systems with boilers) (%)			
	Low-emission on-site CHP enabling an area-wide heat network (Y/N)	Only low-emission CHP is suitable and only where it is facilitating an area-wide heat network. Therefore, new gas engine CHP is not suitable for any other purpose for new developments.		
	CHP (kWe)			
	Estimated end user cost (pence/kWh)			
	Energy assessment includes consideration of occupant running costs (Y/N)	Applicants should consider the estimated costs to occupants of the energy assessment and outline how they are committed to protecting the consumer from high prices.		
Solar technologies	Solar PV included (Y/N)		*Y*	
	Roof layout demonstrating solar PV technologies have been maximised included in energy strategy (Y/N)		*Y*	
	kWh generated			
	kWp			
	Total PV panel area (m^2) installed			
	Solar Thermal included (Y/N)		*N*	
	Solar Thermal panel area (m^2) installed			
Flexibility and peak energy demand	Site-wide peak demand, capacity and flexibility potential included in energy assessment (Y/N)	Table 9 in the energy assessment guidance to be completed.		
	Interventions for achieving flexibility included in energy assessment (Y/N)	Table 10 in the energy assessment guidance to be completed.		
	Estimated peak demand (MW)			
	Electrical energy storage (kWh) capacity			
	Heat energy storage (kWh) capacity			
Other technologies	System type (e.g. wind turbine)			
	Capacity (kW)			
Cooling	Cooling proposed - Residential (Y/N)	It is not expected that 'active cooling' will be proposed for any residential developments. It will be expected that applicants can fully demonstrate that all passive design measures have been thoroughly investigated before considering 'active cooling'.	*N*	
	Cooling proposed - Non-residential (Y/N)			
	Residential Cooling consumption (kWh p.a.)	See note in cell C60.		
	Commercial Cooling consumption (MJ p.a.)			

TABLE 3. BESPOKE DH CARBON FACTOR CALCULATION METHODOLOGY
Please provide below details of the calculation methodology followed to establish the bespoke carbon factor, if applicable.

TABLE 4. DISTRIBUTION LOSSES				COMMENTS
Primary network (buried pipe)	Total pipe length (m)			
	Average heat loss rate (W/m)			
Secondary network (buried pipe)	Total pipe length (m)			
	Average heat loss rate (W/m)			
Total losses (MWh/year)				
Total heat supplied (MWh/year)				
Distribution Loss Factor (DLF)				
Calculation included in energy statement (yes/no)				

TABLE 5. SEASONAL COEFFICIENT OF PERFORMANCE (SCOP) CALCULATION METHODOLOGY
Details of the Seasonal Coefficient of Performance (SCOP), the Seasonal Performance Factor (SFP) and Seasonal Energy Efficiency ratio (SEER), which should be used in the energy modelling. This should be based on a dynamic calculation of the system boundaries over the course of a year i.e. incorporating variations in source temperatures and the design sink temperatures (for space heat and hot water). Details of the assumptions should be included in the energy assessment, including manufacturer datasheets showing performance under test conditions for the specific source and sink temperatures of the proposed development and assumptions for hours spent under changing source temperatures.

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.)
Unit 1	91.29	2	182.58	16.87	-118.67	14.87	14.87	4.89	43.22	42.26	3,080	-237	2,715	2,478	602	2,715	2,478	0	893	1,585
Sum		2	183	16.9	-118.7	14.9	14.9	4.9	43.2	42.3	*3,080*	*-237*	*2,715*	*2,478*	*602*	*2,715*	*2,478*	*0*	*893*	*1,585*

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			183	-	-	-	-	-			*3,080*	*-237*	*2,715*	*2,478*	*602*	*2,715*	*2,478*	*0*	*893*	*1,585*

Applicants can use the 'be seen' methodology or an alternative predictive energy modelling methodology to fill in this tab.
Where 'be seen' reporting is used the reported EUI and space heating demand should align with energy consumption data reported in the planning stage submission for the 'be seen' policy, submitted via the online webform.

Residential predicted energy use

Building type	GIA (m^2)	EUI & space heating demand (kWh/year)									Has the following energy use been included?		Results		Table 4 of the guidance comparison		Methodology used		
		Space heating demand	Annual Electricity Use	Annual Gas Use	Annual Oil Use	Annual Biomass Use	Annual District Htg Use	Annual District Clg Use	Elec Generation, Gross	Solar Thermal Generation	Regulated	Unregulated	EUI (kWh/m^2/year) (excluding renewable energy)	Space heating demand (kWh/m^2/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m^2/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance (kWh/m^2/year) (excluding renewable energy)	Software	Operational energy use assessment	notes (if expected performance differs from the Table 4 values in the guidance or other software used)
					if applicable	if applicable	if applicable	if applicable	if applicable	if applicable									
Residential use (total)	182.58	2,110.27	7,300.14										39.98324132	11.55803812	35	15			
Landlord Circulation (in Residential Blocks)																			
Total	182.58	2110.2666	7300.1402	0	0	0	0	0	0	0									

Non-residential predicted energy use

Building type	GIA (m^2)	EUI & space heating demand (kWh/year)									Has the following energy use been included?		Results		Table 4 of the guidance comparison		Methodology used		
		Space heating demand	Annual Electricity Use	Annual Gas Use	Annual Oil Use	Annual Biomass Use	Annual District Htg Use	Annual District Clg Use	Elec Generation, Gross	Solar Thermal Generation	Regulated	Unregulated	EUI (kWh/m^2/year) (excluding renewable energy)	Space heating demand (kWh/m^2/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m^2/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance (kWh/m^2/year) (excluding renewable energy)	Software	Operational energy use assessment	notes (if expected performance differs from the Table 4 values in the guidance or other software used)
					if applicable	if applicable	if applicable	if applicable	if applicable	if applicable									
Total	0	0	0	0	0	0	0	0	0	0									

Part L 2021 Performance

Residential

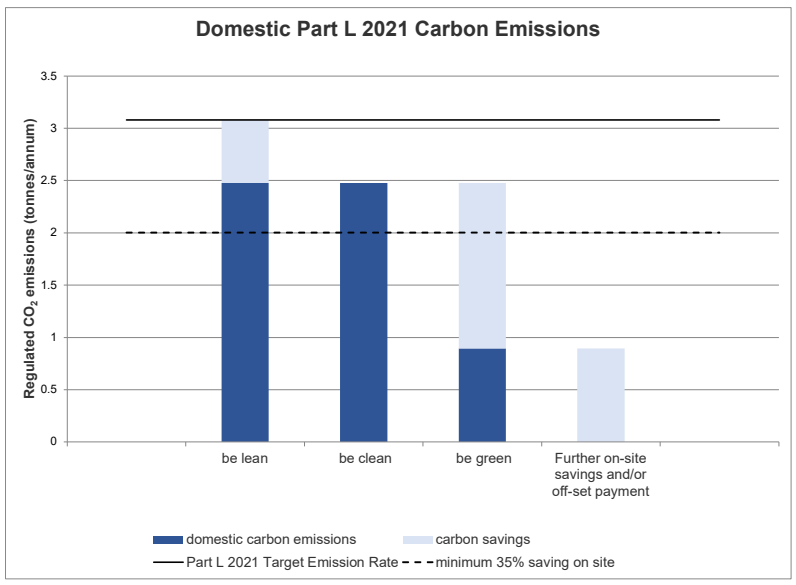
Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for residential buildings

	Carbon Dioxide Emissions for residential buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	3.1	1.2
After energy demand reduction (be lean)	2.5	1.2
After heat network connection (be clean)	2.5	1.2
After renewable energy (be green)	0.9	1.2

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	0.6	20%
Be clean: savings from heat network	0.0	0%
Be green: savings from renewable energy	1.6	51%
Cumulative on site savings	**2.2**	**71%**
Annual savings from off-set payment	0.9	-
	(Tonnes CO_2)	
Cumulative savings for off-set payment	**27**	-
Cash in-lieu contribution (£)	**2,545**	

*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

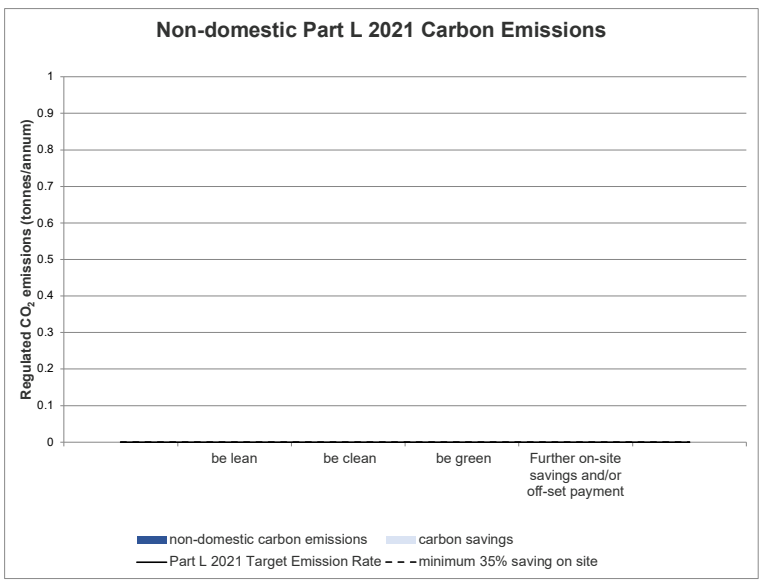
Table 3: Carbon Dioxide Emissions after each stage of the Energy Hierarchy for non-residential buildings

	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	3.1		
Be lean	2.5	0.6	20%
Be clean	2.5	0.0	0%
Be green	0.9	1.6	51%
Total Savings	-	2.2	71%
	-	**CO_2 savings off-set (Tonnes CO_2)**	-
Off-set	-	**26.8**	-

	Target Fabric Energy Efficiency (kWh/m²)	Dwelling Fabric Energy Efficiency (kWh/m²)	Improvement (%)
Development total	43.22	42.26	2%

	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/m^2/year) (excluding renewable energy)	Space heating demand (kWh/m^2/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m^2/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m^2/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)
Residential	39.98324132	11.55803812	35	15	& dwellings / & Landlord Circulation	

Non-residential

Building type	EUI (kWh/m^2/year) (excluding renewable energy)	Space heating demand (kWh/m^2/year) (excluding renewable energy)	EUI value from Table 4 of the guidance (kWh/m^2/year) (excluding renewable energy)	Space heating demand from Table 4 of the guidance(kWh/m^2/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

Full SAP Calculation Printout

Property Reference	Unit 1	Issued on Date	03/10/2023
Assessment Reference	Unit 1 BASELINE	Prop Type Ref	Enfield
Property	Hertford Court, 19, Green Lanes, London , N13 4DD		

SAP Rating	88 B	DER	16.87	TER	13.31
Environmental	85 B	% DER < TER			-26.75
CO_2 Emissions (t/year)	1.28	DFEE	49.96	TFEE	43.22
Compliance Check	See BREL	% DFEE < TFEE			-15.59
% DPER < TPER	-24.55	DPER	87.32	TPER	70.11

Assessor Details	Mirza Baig	Assessor ID	X001-7683
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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4284	(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) =	0.3963	(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	0.5052	0.4953	0.4854	0.4359	0.4260	0.3764	0.3764	0.3665	0.3963	0.4260	0.4458	0.4656	(22b)
Effective ac	0.6276	0.6227	0.6178	0.5950	0.5907	0.5709	0.5709	0.5672	0.5785	0.5907	0.5994	0.6084	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	1.2000	2.5080			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1300	3.5451	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1800	24.4044	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	9.0000	367.9200	(30)

Insulation at ceiling	10.2400	10.2400	0.1100	1.1264	9.0000	92.1600 (30)
flat roof	9.2000	9.2000	0.1100	1.0120	9.0000	82.8000 (30)
Total net area of external elements Aum(A, m2)		251.7000				(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		67.3675		(33)
Party Wall 1		27.0000	0.0000	0.0000	0.0000	0.0000 (32)
Internal Wall 1		91.2300			0.0000	0.0000 (32c)
Internal Floor 1		41.3900			18.0000	745.0200 (32d)
Internal Floor 2		22.6300			18.0000	407.3400 (32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.3393 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	90.7068 (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	46.4417	46.0750	45.7155	44.0272	43.7113	42.2408	42.2408	41.9684	42.8072	43.7113	44.3503	45.0184	(38)
Heat transfer coeff	137.1485	136.7818	136.4223	134.7340	134.4181	132.9476	132.9476	132.6752	133.5140	134.4181	135.0571	135.7252	(39)

Average = Sum(39)m / 12 = 134.7325

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5023	1.4983	1.4944	1.4759	1.4724	1.4563	1.4563	1.4533	1.4625	1.4724	1.4794	1.4867	(40)
HLP (average)												1.4759	
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												2.6430	(42)
Hot water usage for mixer showers	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)
Hot water usage for baths	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)
Hot water usage for other uses	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)
Average daily hot water use (litres/day)												128.5309	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
										Total per year (kWh/year) = Sum(64)m =		2730.0413	(64)
12Total per year (kWh/year)												2730	(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	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	121.7742	134.8215	121.7742	125.8334	121.7742	125.8334	121.7742	121.7742	125.8334	121.7742	125.8334	121.7742	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													
	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains													
	582.1706	595.1697	570.8903	550.7286	523.1001	501.3115	482.3604	483.3577	497.8367	517.8766	549.2361	570.1397	(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	
Northeast	9.9200	11.2829	0.6300	0.7000	0.7700	34.2063	(75)
Southwest	16.5200	36.7938	0.6300	0.7000	0.7700	185.7620	(79)

Solar gains	219.9683	386.0493	558.3889	742.4561	877.7845	891.7463	851.2867	747.2207	621.6436	434.8039	265.5404	186.9081	(83)
Total gains	802.1389	981.2190	1129.2792	1293.1846	1400.8846	1393.0577	1333.6471	1230.5784	1119.4804	952.6805	814.7766	757.0478	(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	39.7151	39.8216	39.9265	40.4269	40.5219	40.9701	40.9701	41.0542	40.7963	40.5219	40.3301	40.1316	
alpha	3.6477	3.6548	3.6618	3.6951	3.7015	3.7313	3.7313	3.7369	3.7198	3.7015	3.6887	3.6754	
util living area													
	0.9857	0.9704	0.9405	0.8675	0.7404	0.5690	0.4270	0.4771	0.7056	0.9078	0.9734	0.9883	(86)
MIT	19.1519	19.4584	19.8695	20.3702	20.7361	20.9276	20.9808	20.9711	20.8369	20.3392	19.6581	19.1064	(87)
Th 2	19.6857	19.6888	19.6917	19.7056	19.7082	19.7204	19.7204	19.7227	19.7157	19.7082	19.7030	19.6975	(88)
util rest of house													
	0.9816	0.9621	0.9237	0.8310	0.6739	0.4708	0.3083	0.3532	0.6111	0.8734	0.9644	0.9849	(89)
MIT 2	18.0557	18.3583	18.7580	19.2334	19.5441	19.6895	19.7158	19.7150	19.6342	19.2221	18.5688	18.0192	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.2674	18.5707	18.9726	19.4529	19.7743	19.9286	19.9601	19.9576	19.8665	19.4378	18.7791	18.2292	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2674	18.5707	18.9726	19.4529	19.7743	19.9286	19.9601	19.9576	19.8665	19.4378	18.7791	18.2292	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9753	0.9526	0.9120	0.8226	0.6776	0.4876	0.3312	0.3769	0.6234	0.8645	0.9557	0.9794	(94)
Useful gains	782.3118	934.7351	1029.9396	1063.8374	949.3076	679.3084	441.6747	463.8150	697.8621	823.5948	778.7002	741.4663	(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													
	1915.6023	1869.9075	1701.5459	1421.8383	1085.3369	708.4190	446.7206	472.0058	769.9033	1187.9650	1577.3518	1904.1123	(97)
Space heating kWh													
	843.1682	628.4359	499.6751	257.7606	101.2058	0.0000	0.0000	0.0000	0.0000	271.0915	575.0292	865.0086	(98a)
Space heating requirement - total per year (kWh/year)												4041.3749	
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													
	843.1682	628.4359	499.6751	257.7606	101.2058	0.0000	0.0000	0.0000	0.0000	271.0915	575.0292	865.0086	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4041.3749	
Space heating per m2											(98c) / (4) =	44.2696	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.5000	(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													
	843.1682	628.4359	499.6751	257.7606	101.2058	0.0000	0.0000	0.0000	0.0000	271.0915	575.0292	865.0086	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	942.0874	702.1630	558.2962	288.0007	113.0792	0.0000	0.0000	0.0000	0.0000	302.8955	642.4907	966.4901	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618	(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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.6964	-57.8035	-83.6245	-94.3877	-101.7952	-94.9553	-93.9250	-88.9086	-79.5960	-66.5784	-44.9556	-35.1355	(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	4515.5027 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-882.3615 (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	7169.2133 (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	4515.5027	0.2100	948.2556	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1588.8239	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	0.1345	-118.6698	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.6698	(269)
Total CO2, kg/year			1539.7791	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			16.8700	(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	4515.5027	1.1300	5102.5180 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3050.3255	1.1300	3446.8678 (278)
Space and water heating			8549.3858 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	399.7467	1.5338	613.1448 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-882.3615	1.4971	-1320.9415
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1320.9415 (283)
Total Primary energy kWh/year			7971.6899 (286)
Dwelling Primary energy Rate (DPER)			87.3200 (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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(22b)
Effective ac	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.20)			20.7300	1.1450	23.7366			(27)
G Floor			27.2700	0.1300	3.5451			(28a)
External Wall 1	164.1100	22.8200	141.2900	0.1800	25.4322			(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968			(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264			(30)
flat roof	9.2000		9.2000	0.1100	1.0120			(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4391			(33)
Party Wall 1			27.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.0500	0.7905
E3 Sill	7.2000	0.0500	0.3600
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0800	0.7720
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0800	0.6400
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.0400	0.3116
R1 Head of roof window	1.8000	0.0800	0.1440
R9 Roof to wall (flat ceiling)	2.9500	0.0400	0.1180
R3 Jamb of roof window	2.4000	0.0800	0.1920
R2 Sill of roof window	1.8000	0.0600	0.1080

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.1991 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 73.6382 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	118.2160	117.9216	117.6331	116.2780	116.0245	114.8442	114.8442	114.6256	115.2988	116.0245	116.5374	117.0736	(39)

Average = Sum(39)m / 12 = 116.2768

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2950	1.2917	1.2886	1.2737	1.2709	1.2580	1.2580	1.2556	1.2630	1.2709	1.2766	1.2824	(40)
HLP (average)												1.2737	
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 2.6430 (42)

Hot water usage for mixer showers	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711 (42a)
Hot water usage for baths	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949 (42b)
Hot water usage for other uses	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966 (42c)

Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)

Energy content (annual) Total = Sum(45)m = 2134.8723

Distribution loss (46)m = 0.15 x (45)m	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547 (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	268.0439	236.9434	251.3238	219.8719	212.4252	190.6264	187.4947	195.3322	197.9236	221.6583	236.8866	264.9596 (62)
WWHRS	-31.3307	-27.7092	-29.0154	-24.0259	-22.3913	-19.1604	-17.9598	-19.0985	-19.8241	-23.3704	-26.4758	-30.7505 (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	236.7132	209.2343	222.3084	195.8460	190.0339	171.4660	169.5349	176.2337	178.0995	198.2879	210.4108	234.2091 (64)

Total per year (kWh/year) = Sum(64)m = 2392.3777 (64)

12Total per year (kWh/year) 2392 (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	110.9077	98.4588	105.3483	94.1879	92.4145	84.4637	84.1251	86.7311	86.8900	95.4845	99.8452	109.8822 (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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)

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

	121.7495	134.7941	121.7495	125.8079	121.7495	125.8079	121.7495	121.7495	125.8079	121.7495	125.8079	121.7495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148 (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)												
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188 (71)
Water heating gains (Table 5)												
	149.0695	146.5160	141.5971	130.8165	124.2130	117.3107	113.0714	116.5740	120.6806	128.3394	138.6740	147.6911 (72)
Total internal gains												
	577.8946	590.8910	566.6143	546.4517	518.8241	497.0346	478.0844	479.0817	493.5599	513.6006	544.9593	565.8637 (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	
Northeast	7.7800	11.2829	0.6300	0.7000	0.7700	26.8271	(75)
Southwest	12.9500	36.7938	0.6300	0.7000	0.7700	145.6185	(79)

Solar gains	172.4456	302.6496	437.7672	582.0875	688.1979	699.1494	667.4260	585.8278	487.3629	340.8740	208.1729	146.5275 (83)
Total gains	750.3403	893.5406	1004.3816	1128.5392	1207.0220	1196.1840	1145.5104	1064.9095	980.9228	854.4746	753.1322	712.3912 (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	46.0756	46.1906	46.3039	46.8435	46.9459	47.4284	47.4284	47.5188	47.2414	46.9459	46.7393	46.5252	
alpha	4.0717	4.0794	4.0869	4.1229	4.1297	4.1619	4.1619	4.1679	4.1494	4.1297	4.1160	4.1017	
util living area													
	0.9878	0.9750	0.9494	0.8822	0.7575	0.5805	0.4328	0.4814	0.7136	0.9154	0.9767	0.9900	(86)
MIT	19.4178	19.6808	20.0336	20.4699	20.7876	20.9475	20.9877	20.9811	20.8766	20.4527	19.8611	19.3771	(87)
Th 2	19.8448	19.8473	19.8498	19.8615	19.8637	19.8739	19.8739	19.8758	19.8699	19.8637	19.8592	19.8546	(88)
util rest of house													
	0.9844	0.9681	0.9353	0.8504	0.6975	0.4912	0.3261	0.3702	0.6278	0.8851	0.9690	0.9872	(89)
MIT 2	18.0352	18.3685	18.8096	19.3409	19.6895	19.8438	19.8698	19.8688	19.7880	19.3367	18.6080	17.9902	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.3022	18.6219	19.0459	19.5589	19.9015	20.0569	20.0857	20.0836	19.9983	19.5522	18.8500	18.2581	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3022	18.6219	19.0459	19.5589	19.9015	20.0569	20.0857	20.0836	19.9983	19.5522	18.8500	18.2581	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9778	0.9582	0.9228	0.8406	0.6997	0.5064	0.3466	0.3914	0.6385	0.8748	0.9597	0.9815	(94)
Useful gains	733.6740	856.2196	926.8771	948.6076	844.5419	605.7040	397.0205	416.8024	626.2867	747.5104	722.7697	699.1818	(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													
	1655.2824	1618.1110	1475.8185	1239.3995	951.5798	626.6958	400.3110	422.2402	680.0615	1038.6739	1369.3113	1645.8264	(97)
Space heating kWh													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(98a)
Space heating requirement - total per year (kWh/year)												3281.5256	
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													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3281.5256	
Space heating per m2											(98c) / (4) =	35.9462	(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													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(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)													
	742.8782	554.7032	442.4836	226.8366	86.2797	0.0000	0.0000	0.0000	0.0000	234.6973	504.3444	763.0592	(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												
	236.7132	209.2343	222.3084	195.8460	190.0339	171.4660	169.5349	176.2337	178.0995	198.2879	210.4108	234.2091 (64)
Efficiency of water heater												79.8000 (216)
(217)m	86.3021	85.9866	85.4050	84.2098	82.2621	79.8000	79.8000	79.8000	79.8000	84.2586	85.7881	86.3691 (217)
Fuel for water heating, kWh/month												
	274.2843	243.3336	260.2991	232.5691	231.0102	214.8697	212.4498	220.8442	223.1823	235.3327	245.2680	271.1723 (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	25.2971	20.2943	18.2728	13.3874	10.3408	8.4485	9.4332	12.2617	15.9267	20.8967	23.6028	26.0002 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-27.9867	-40.8141	-60.6587	-70.5858	-78.1627	-73.6801	-72.7534	-67.6575	-59.0345	-47.7030	-31.2385	-24.0384 (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	-11.9419	-25.4805	-51.3225	-78.0911	-104.2557	-105.1383	-103.9259	-87.5574	-63.5874	-36.7979	-16.0574	-9.4187 (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	3555.2823 (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	2864.6152 (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)	204.1625 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1347.8881 (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	5362.1719 (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	3555.2823	0.2100	746.6093	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2864.6152	0.2100	601.5692	(264)
Space and water heating			1348.1785	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	204.1625	0.1443	29.4670	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-654.3134	0.1339	-87.6041	
PV Unit electricity exported	-693.5747	0.1255	-87.0509	
Total			-174.6549	(269)
Total CO2, kg/year			1214.9197	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.3100	(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	3555.2823	1.1300	4017.4690	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2864.6152	1.1300	3237.0152	(278)
Space and water heating			7254.4841	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	204.1625	1.5338	313.1512	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-654.3134	1.4948	-978.0574	
PV Unit electricity exported	-693.5747	0.4607	-319.5235	
Total			-1297.5809	(283)
Total Primary energy kWh/year			6400.1552	(286)

Target Primary Energy Rate (TPER) 70.1100 (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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286 (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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(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	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	1.2000	2.5080			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1300	3.5451	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1800	24.4044	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1100	1.0120	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.3675			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3	Sill	7.2000	0.0400	0.2880

E4 Jamb	33.9800	0.0500	1.6990	
E5 Ground floor (normal)	26.4300	0.1600	4.2288	
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155	
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772	
E14 Flat roof	9.6500	0.0600	0.5790	
P1 Party wall - Ground floor	2.5500	0.0800	0.2040	
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000	
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600	
E16 Corner (normal)	26.8600	0.0900	2.4174	
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178	
E18 Party wall between dwellings	9.2400	0.0600	0.5544	
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348	
R1 Head of roof window	1.8000	0.2400	0.4320	
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540	
R3 Jamb of roof window	2.4000	0.2400	0.5760	
R2 Sill of roof window	1.8000	0.2400	0.4320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 90.7068 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	135.2846	134.9902	134.7017	133.3466	133.0930	131.9127	131.9127	131.6942	132.3674	133.0930	133.6059	134.1422	(39)

Average = Sum(39)m / 12 = 133.3453

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4819	1.4787	1.4755	1.4607	1.4579	1.4450	1.4450	1.4426	1.4500	1.4579	1.4635	1.4694	(40)
HLP (average)												1.4607	
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 2.6430 (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

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 65.3452 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.2916	69.3358	67.2006	64.5432	62.1724	59.7086	59.1968	61.3276	63.5131	66.0432	68.7242	71.1915	(44)
Energy conte	112.9084	98.7333	103.2849	88.3564	83.6960	73.4187	71.5934	75.9364	78.3180	89.6200	97.9102	111.4687	(45)

Energy content (annual) Total = Sum(45)m = 1085.2444

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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(64)

Total per year (kWh/year) = Sum(64)m = 922.4577 (64)

12Total per year (kWh/year) 922 (64)

Electric shower(s)

54.8840	48.9021	53.3993	50.9583	51.9145	49.5214	51.1721	51.9145	50.9583	53.3993	52.3951	54.8840	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 624.3027 (64a)

Heat gains from water heating, kWh/month

37.7141	33.2064	35.2978	31.5153	30.7640	27.9818	28.0066	29.1151	29.3821	32.3941	33.9047	37.4081	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	121.7742	134.8215	121.7742	125.8334	121.7742	125.8334	121.7742	121.7742	125.8334	121.7742	125.8334	121.7742	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													

	50.6909	49.4142	47.4433	43.7712	41.3495	38.8636	37.6433	39.1332	40.8085	43.5404	47.0899	50.2797 (72)
Total internal gains	476.5408	490.8166	469.4852	456.4320	432.9853	418.6131	402.6810	401.6656	413.7134	425.8263	450.4008	465.4770 (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
Northeast	9.9200	11.2829	0.6300	0.7000	0.7700	34.2063 (75)
Southwest	16.5200	36.7938	0.6300	0.7000	0.7700	185.7620 (79)

Solar gains	219.9683	386.0493	558.3889	742.4561	877.7845	891.7463	851.2867	747.2207	621.6436	434.8039	265.5404	186.9081 (83)
Total gains	696.5091	876.8659	1027.8741	1198.8881	1310.7698	1310.3594	1253.9677	1148.8863	1035.3570	860.6302	715.9412	652.3851 (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	40.2623	40.3501	40.4366	40.8475	40.9253	41.2915	41.2915	41.3600	41.1497	40.9253	40.7682	40.6052	
alpha	3.6842	3.6900	3.6958	3.7232	3.7284	3.7528	3.7528	3.7573	3.7433	3.7284	3.7179	3.7070	
util living area	0.9909	0.9788	0.9535	0.8872	0.7654	0.5940	0.4487	0.5037	0.7371	0.9281	0.9820	0.9928	(86)
MIT	19.0588	19.3720	19.7947	20.3170	20.7085	20.9180	20.9779	20.9662	20.8131	20.2724	19.5672	19.0084	(87)
Th 2	19.7011	19.7035	19.7059	19.7171	19.7192	19.7290	19.7290	19.7308	19.7252	19.7192	19.7150	19.7105	(88)
util rest of house	0.9882	0.9726	0.9398	0.8544	0.7011	0.4945	0.3257	0.3754	0.6448	0.8995	0.9757	0.9906	(89)
MIT 2	17.9749	18.2854	18.6990	19.1977	19.5349	19.6933	19.7237	19.7217	19.6294	19.1728	18.4897	17.9317	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.1842	18.4953	18.9106	19.4139	19.7616	19.9298	19.9659	19.9620	19.8580	19.3852	18.6978	18.1397	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1842	18.4953	18.9106	19.4139	19.7616	19.9298	19.9659	19.9620	19.8580	19.3852	18.6978	18.1397	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9647	0.9289	0.8452	0.7035	0.5112	0.3494	0.3998	0.6556	0.8900	0.9687	0.9868	(94)
Useful gains	685.0646	845.8923	954.8295	1013.2700	922.1392	669.8524	438.1318	459.3703	678.7804	765.9296	693.5303	643.7562	(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	1878.3218	1835.2276	1671.7316	1401.9919	1072.9383	703.0746	444.0009	469.0947	762.1697	1169.2460	1549.5338	1869.8963	(97)
Space heating kWh	887.7834	664.8333	533.3752	279.8797	112.1945	0.0000	0.0000	0.0000	0.0000	300.0673	616.3225	912.2483	(98a)
Space heating requirement - total per year (kWh/year)												4306.7042	
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	887.7834	664.8333	533.3752	279.8797	112.1945	0.0000	0.0000	0.0000	0.0000	300.0673	616.3225	912.2483	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4306.7042	
Space heating per m2											(98c) / (4) =	47.1761	(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	1239.9798	976.1543	1000.8757	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8540	0.9079	0.8789	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1058.9440	886.2794	879.6738	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1483.6593	1420.1073	1299.6743	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	305.7950	397.1679	312.4804	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	76.4488	99.2920	78.1201	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												253.8608	(107)
Energy for space heating												47.1761	(99)
Energy for space cooling												2.7808	(108)
Total												49.9569	(109)
Fabric Energy Efficiency (DFEE)												50.0	(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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(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	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.20)			20.7300	1.1450	23.7366			(27)
G Floor			27.2700	0.1300	3.5451			(28a)
External Wall 1	164.1100	22.8200	141.2900	0.1800	25.4322			(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968			(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264			(30)
flat roof	9.2000		9.2000	0.1100	1.0120			(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4391			(33)
Party Wall 1			27.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	15.8100	0.0500	0.7905
E3	Sill	7.2000	0.0500	0.3600
E4	Jamb	33.9800	0.0500	1.6990
E5	Ground floor (normal)	26.4300	0.1600	4.2288
E6	Intermediate floor within a dwelling	41.6500	0.0000	0.0000
E11	Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14	Flat roof	9.6500	0.0800	0.7720
P1	Party wall - Ground floor	2.5500	0.0800	0.2040
P2	Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5	Party wall - Roof (insulation at rafter level)	8.0000	0.0800	0.6400
E16	Corner (normal)	26.8600	0.0900	2.4174

E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.0400	0.3116
R1 Head of roof window	1.8000	0.0800	0.1440
R9 Roof to wall (flat ceiling)	2.9500	0.0400	0.1180
R3 Jamb of roof window	2.4000	0.0800	0.1920
R2 Sill of roof window	1.8000	0.0600	0.1080

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.1991 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 73.6382 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	118.2160	117.9216	117.6331	116.2780	116.0245	114.8442	114.8442	114.6256	115.2988	116.0245	116.5374	117.0736	(39)

Average = Sum(39)m / 12 = 116.2768

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2950	1.2917	1.2886	1.2737	1.2709	1.2580	1.2580	1.2556	1.2630	1.2709	1.2766	1.2824	(40)
HLP (average)												1.2737	
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 2.6430 (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

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 65.3452 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.2916	69.3358	67.2006	64.5432	62.1724	59.7086	59.1968	61.3276	63.5131	66.0432	68.7242	71.1915	(44)
Energy conte	112.9084	98.7333	103.2849	88.3564	83.6960	73.4187	71.5934	75.9364	78.3180	89.6200	97.9102	111.4687	(45)

Energy content (annual) Total = Sum(45)m = 1085.2444

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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(64)

Total per year (kWh/year) = Sum(64)m = 922.4577 (64)

12Total per year (kWh/year) 922 (64)

Electric shower(s)

54.8840	48.9021	53.3993	50.9583	51.9145	49.5214	51.1721	51.9145	50.9583	53.3993	52.3951	54.8840	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 624.3027 (64a)

Heat gains from water heating, kWh/month

37.7141	33.2064	35.2978	31.5153	30.7640	27.9818	28.0066	29.1151	29.3821	32.3941	33.9047	37.4081	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.7495	134.7941	121.7495	125.8079	121.7495	125.8079	121.7495	121.7495	125.8079	121.7495	125.8079	121.7495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)	50.6909	49.4142	47.4433	43.7712	41.3495	38.8636	37.6433	39.1332	40.8085	43.5404	47.0899	50.2797	(72)
Total internal gains	476.5161	490.7892	469.4605	456.4065	432.9606	418.5875	402.6563	401.6409	413.6878	425.8016	450.3752	465.4523	(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
Northeast	7.7800	11.2829	0.6300	0.7000	0.7700	26.8271 (75)
Southwest	12.9500	36.7938	0.6300	0.7000	0.7700	145.6185 (79)

Solar gains	172.4456	302.6496	437.7672	582.0875	688.1979	699.1494	667.4260	585.8278	487.3629	340.8740	208.1729	146.5275 (83)
Total gains	648.9617	793.4388	907.2277	1038.4940	1121.1585	1117.7369	1070.0823	987.4687	901.0507	766.6756	658.5481	611.9798 (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	46.0756	46.1906	46.3039	46.8435	46.9459	47.4284	47.4284	47.5188	47.2414	46.9459	46.7393	46.5252	
alpha	4.0717	4.0794	4.0869	4.1229	4.1297	4.1619	4.1619	4.1679	4.1494	4.1297	4.1160	4.1017	
util living area	0.9927	0.9832	0.9630	0.9051	0.7893	0.6131	0.4610	0.5150	0.7527	0.9379	0.9852	0.9943	(86)
MIT	19.2934	19.5639	19.9310	20.3981	20.7498	20.9358	20.9845	20.9758	20.8484	20.3713	19.7494	19.2526	(87)
Th 2	19.8448	19.8473	19.8498	19.8615	19.8637	19.8739	19.8739	19.8758	19.8699	19.8637	19.8592	19.8546	(88)
util rest of house	0.9906	0.9784	0.9522	0.8775	0.7320	0.5216	0.3484	0.3979	0.6689	0.9137	0.9802	0.9926	(89)
MIT 2	18.3116	18.5809	18.9421	19.3933	19.7005	19.8446	19.8698	19.8687	19.7892	19.3811	18.7755	18.2783	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.5012	18.7707	19.1330	19.5874	19.9032	20.0554	20.0851	20.0825	19.9937	19.5723	18.9636	18.4665	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5012	18.7707	19.1330	19.5874	19.9032	20.0554	20.0851	20.0825	19.9937	19.5723	18.9636	18.4665	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9871	0.9724	0.9436	0.8696	0.7342	0.5372	0.3701	0.4203	0.6791	0.9059	0.9747	0.9896	(94)
Useful gains	640.5907	771.5235	856.0459	903.1146	823.1395	600.4544	396.0316	415.0258	611.9112	694.5254	641.8831	605.6315	(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	1678.8128	1635.6599	1486.0652	1242.7059	951.7670	626.5152	400.2395	422.1095	679.5384	1041.0062	1382.5535	1670.2292	(97)
Space heating kWh	772.4372	580.6996	468.7343	244.5058	95.6989	0.0000	0.0000	0.0000	0.0000	257.7817	533.2827	792.0607	(98a)
Space heating requirement - total per year (kWh/year)												3745.2009	
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	772.4372	580.6996	468.7343	244.5058	95.6989	0.0000	0.0000	0.0000	0.0000	257.7817	533.2827	792.0607	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3745.2009	
Space heating per m2											(98c) / (4) =	41.0253	(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	1079.5352	849.8469	871.1546	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8627	0.9175	0.8905	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	931.3154	779.7513	775.7660	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1258.5439	1205.2028	1111.0302	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	235.6045	316.5360	249.4366	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	58.9011	79.1340	62.3591	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												200.3943	(107)
Energy for space heating												41.0253	(99)
Energy for space cooling												2.1951	(108)
Total												43.2205	(109)
Fabric Energy Efficiency (TFEE)												43.2	(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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.4284 (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) =	0.3963 (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	0.5052	0.4953	0.4854	0.4359	0.4260	0.3764	0.3764	0.3665	0.3963	0.4260	0.4458	0.4656	(22b)
Effective ac	0.6276	0.6227	0.6178	0.5950	0.5907	0.5709	0.5709	0.5672	0.5785	0.5907	0.5994	0.6084	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	1.2000	2.5080			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1300	3.5451	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1800	24.4044	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1100	1.0120	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	67.3675			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			19608.7400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							214.7961	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760

R2 Sill of roof window 1.8000 0.2400 0.4320
Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 90.7068 (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	46.4417	46.0750	45.7155	44.0272	43.7113	42.2408	42.2408	41.9684	42.8072	43.7113	44.3503	45.0184	(38)
Heat transfer coeff	137.1485	136.7818	136.4223	134.7340	134.4181	132.9476	132.9476	132.6752	133.5140	134.4181	135.0571	135.7252	(39)

Average = Sum(39)m / 12 = 134.7325

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5023	1.4983	1.4944	1.4759	1.4724	1.4563	1.4563	1.4533	1.4625	1.4724	1.4794	1.4867	(40)
HLP (average)												1.4759	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6430 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)
Hot water usage for baths	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)
Hot water usage for other uses	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)

Energy content (annual) Total = Sum(45)m = 2134.8723

Distribution loss (46)m = 0.15 x (45)m	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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 0.5400 (49)
Enter (49) or (54) in (55) 0.8802 (55)

Total storage loss	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)

Total per year (kWh/year) = Sum(64)m = 2730.0413 (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	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains	679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a	g Specific data	FF Specific data	Access factor	Gains W

					W/m2	or Table 6b		or Table 6c		Table 6d			
Northeast					9.9200	11.2829		0.6300		0.7000		0.7700	34.2063 (75)
Southwest					16.5200	36.7938		0.6300		0.7000		0.7700	185.7620 (79)
Solar gains	219.9683	386.0493	558.3889	742.4561	877.7845	891.7463	851.2867	747.2207	621.6436	434.8039	265.5404	186.9081 (83)	
Total gains	899.5824	1060.5221	1209.1340	1352.4304	1448.0200	1424.6772	1365.6517	1267.6761	1165.0145	1018.8236	893.0301	850.8173 (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	39.7151	39.8216	39.9265	40.4269	40.5219	40.9701	40.9701	41.0542	40.7963	40.5219	40.3301	40.1316	
alpha	3.6477	3.6548	3.6618	3.6951	3.7015	3.7313	3.7313	3.7369	3.7198	3.7015	3.6887	3.6754	
util living area													
	0.9796	0.9629	0.9287	0.8537	0.7260	0.5587	0.4178	0.4647	0.6876	0.8914	0.9651	0.9831 (86)	
MIT	19.2635	19.5434	19.9445	20.4108	20.7536	20.9318	20.9821	20.9735	20.8508	20.3929	19.7431	19.2155 (87)	
Th 2	19.6857	19.6888	19.6917	19.7056	19.7082	19.7204	19.7204	19.7227	19.7157	19.7082	19.7030	19.6975 (88)	
util rest of house													
	0.9739	0.9527	0.9093	0.8150	0.6587	0.4615	0.3013	0.3433	0.5927	0.8530	0.9537	0.9783 (89)	
MIT 2	18.1650	18.4401	18.8275	19.2676	19.5563	19.6914	19.7162	19.7157	19.6421	19.2679	18.6503	18.1264 (90)	
Living area fraction										fLA = Living area / (4) =		0.1931 (91)	
MIT	18.3772	18.6532	19.0433	19.4884	19.7875	19.9310	19.9607	19.9586	19.8755	19.4852	18.8614	18.3367 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.3772	18.6532	19.0433	19.4884	19.7875	19.9310	19.9607	19.9586	19.8755	19.4852	18.8614	18.3367 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9661	0.9423	0.8974	0.8075	0.6633	0.4783	0.3237	0.3666	0.6057	0.8450	0.9439	0.9713 (94)	
Useful gains	869.0693	999.3192	1085.1017	1092.0946	960.4275	681.4222	442.1187	464.6804	705.5942	860.8741	842.9372	826.4340 (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													
	1930.6606	1881.1888	1711.1801	1426.6152	1087.1124	708.7408	446.7922	472.1426	771.1136	1194.3311	1588.4589	1918.7109 (97)	
Space heating kWh													
	789.8239	592.6164	465.8023	240.8548	94.2536	0.0000	0.0000	0.0000	0.0000	248.0920	536.7756	812.6540 (98a)	
Space heating requirement - total per year (kWh/year)												3780.8727	
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													
	789.8239	592.6164	465.8023	240.8548	94.2536	0.0000	0.0000	0.0000	0.0000	248.0920	536.7756	812.6540 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												3780.8727	
Space heating per m2											(98c) / (4) =	41.4161 (99)	

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)	
Fraction of space heat from main system(s)												1.0000 (202)	
Efficiency of main space heating system 1 (in %)												89.5000 (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													
	789.8239	592.6164	465.8023	240.8548	94.2536	0.0000	0.0000	0.0000	0.0000	248.0920	536.7756	812.6540 (98)	
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000 (210)	
Space heating fuel (main heating system)													
	882.4848	662.1413	520.4495	269.1115	105.3113	0.0000	0.0000	0.0000	0.0000	277.1977	599.7493	907.9933 (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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133 (64)	
Efficiency of water heater												89.5000 (216)	
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000 (217)	
Fuel for water heating, kWh/month													
	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618 (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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.6964	-57.8035	-83.6245	-94.3877	-101.7952	-94.9553	-93.9250	-88.9086	-79.5960	-66.5784	-44.9556	-35.1355 (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	(235a)

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

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

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

(233b)m	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	(234b)

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

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

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

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

Annual totals kWh/year		
Space heating fuel - main system 1	4224.4388	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	89.5000	
Water heating fuel used	3050.3255	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
central heating pump	41.0000	(230c)
main heating flue fan	45.0000	(230e)
Total electricity for the above, kWh/year	86.0000	(231)
Electricity for lighting (calculated in Appendix L)	399.7467	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-882.3615	(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	6878.1495	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4224.4388	3.6400	153.7696	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	3.6400	111.0318	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	399.7467	16.4900	65.9182	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	16.4900	-145.5014	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-145.5014	(252)
Total energy cost			291.3996	(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] =	0.7697 (257)
SAP value		87.5230
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	4224.4388	0.2100	887.1322	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1527.7005	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	0.1345	-118.6698	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.6698	(269)
Total CO2, kg/year			1478.6557	(272)
CO2 emissions per m2			16.2000	(273)
EI value			85.4619	
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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4284	(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) =	0.3963	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.1000	3.7000	3.8000	3.2000	3.4000	3.7000	3.5000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0500	1.0000	1.0250	0.9250	0.9500	0.8000	0.8500	0.9250	0.8750	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.4161	0.3963	0.4062	0.3665	0.3764	0.3170	0.3368	0.3665	0.3467	0.3665	0.3566	0.3963	(22b)
Effective ac	0.5866	0.5785	0.5825	0.5672	0.5709	0.5502	0.5567	0.5672	0.5601	0.5672	0.5636	0.5785	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	1.2000	2.5080			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1300	3.5451	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1800	24.4044	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1100	1.0120	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.3675			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		19608.7400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							214.7961	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040

P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 90.7068 (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	43.4026	42.8072	43.1013	41.9684	42.2408	40.7158	41.1951	41.9684	41.4456	41.9684	41.7034	42.8072	(38)
Heat transfer coeff	134.1095	133.5140	133.8081	132.6752	132.9476	131.4226	131.9019	132.6752	132.1524	132.6752	132.4102	133.5140	(39)

Average = Sum(39)m / 12 = 132.8172

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4690	1.4625	1.4657	1.4533	1.4563	1.4396	1.4449	1.4533	1.4476	1.4533	1.4504	1.4625	(40)
HLP (average)												1.4549	
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 2.6430 (42)

Hot water usage for mixer showers

68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)

Energy content (annual) Total = Sum(45)m = 2134.8723

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

33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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 0.5400 (49)

Enter (49) or (54) in (55) 0.8802 (55)

Total storage loss

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)

If cylinder contains dedicated solar storage

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(57)
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)
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

271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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

271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)

Total per year (kWh/year) = Sum(64)m = 2730.0413 (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

114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)

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

56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)

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

360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)

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

53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(69)
3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	3.0000	(70)

Pumps, fans

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

-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)

Total internal gains

679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(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
Northeast	9.9200	12.9236	0.6300	0.7000	0.7700	39.1801 (75)
Southwest	16.5200	40.4699	0.6300	0.7000	0.7700	204.3215 (79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	243.5016	371.4738	547.0662	751.9747	867.3164	950.2477	914.0400	814.6596	673.7299	463.8752	301.2685	204.8389	(83)
Total gains	923.1158	1045.9465	1197.8113	1361.9491	1437.5518	1483.1786	1428.4049	1335.1151	1217.1007	1047.8949	928.7582	868.7480	(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	40.6151	40.7963	40.7066	41.0542	40.9701	41.4455	41.2949	41.0542	41.2166	41.0542	41.1364	40.7963	
alpha	3.7077	3.7198	3.7138	3.7369	3.7313	3.7630	3.7530	3.7369	3.7478	3.7369	3.7424	3.7198	
util living area	0.9720	0.9561	0.9077	0.8014	0.6277	0.3911	0.2301	0.2669	0.5423	0.8332	0.9472	0.9771	(86)
MIT	19.5347	19.7383	20.1739	20.6082	20.8821	20.9859	20.9987	20.9976	20.9497	20.6173	20.0184	19.4677	(87)
Th 2	19.7108	19.7157	19.7133	19.7227	19.7204	19.7331	19.7291	19.7227	19.7270	19.7227	19.7249	19.7157	(88)
util rest of house	0.9637	0.9437	0.8815	0.7493	0.5418	0.2846	0.1135	0.1413	0.4259	0.7747	0.9293	0.9702	(89)
MIT 2	18.4505	18.6508	19.0619	19.4536	19.6606	19.7297	19.7291	19.7225	19.7099	19.4744	18.9328	18.3889	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.6599	18.8608	19.2766	19.6766	19.8965	19.9723	19.9742	19.9688	19.9493	19.6951	19.1424	18.5972	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6599	18.8608	19.2766	19.6766	19.8965	19.9723	19.9742	19.9688	19.9493	19.6951	19.1424	18.5972	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9547	0.9330	0.8707	0.7472	0.5544	0.3051	0.1361	0.1657	0.4473	0.7732	0.9188	0.9621	(94)
Useful gains	881.3102	975.8412	1042.9733	1017.6993	796.9601	452.5764	194.3619	221.1823	544.4627	810.2236	853.3871	835.8494	(95)
Ext temp.	5.5000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.7000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	1764.8645	1730.4491	1522.2871	1230.7709	850.3947	456.3334	194.4563	221.4064	561.5569	1007.6847	1422.4056	1762.0170	(97)
Space heating kWh	657.3644	507.0965	356.6095	153.4115	39.7553	0.0000	0.0000	0.0000	0.0000	146.9110	409.6934	689.0687	(98a)
Space heating requirement - total per year (kWh/year)												2959.9103	
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	657.3644	507.0965	356.6095	153.4115	39.7553	0.0000	0.0000	0.0000	0.0000	146.9110	409.6934	689.0687	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2959.9103	
Space heating per m2										(98c) / (4) =		32.4232	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	89.5000 (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	657.3644	507.0965	356.6095	153.4115	39.7553	0.0000	0.0000	0.0000	0.0000	146.9110	409.6934	689.0687	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	734.4853	566.5883	398.4464	171.4095	44.4193	0.0000	0.0000	0.0000	0.0000	164.1464	457.7580	769.9092	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													

	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618 (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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-44.4545	-56.7321	-83.0173	-95.2094	-101.2536	-97.4954	-96.7657	-92.6080	-83.3637	-69.8633	-49.7743	-38.1520 (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	3307.1624 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-908.6894 (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	5934.5451 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3307.1624	4.8000	158.7438	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	4.8000	146.4156	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	21.5100	18.4986	(249)
Energy for lighting	399.7467	21.5100	85.9855	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	21.5100	-195.4591	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-195.4591	(252)
Total energy cost			312.1844	(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	3307.1624	0.2100	694.5041	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1335.0724	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	0.1345	-122.2243	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-122.2243	(269)
Total CO2, kg/year			1282.4732	(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	3307.1624	1.1300	3737.0935	(275)

Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3050.3255	1.1300	3446.8678 (278)
Space and water heating			7183.9613 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	399.7467	1.5338	613.1448 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-908.6894	1.4971	-1360.3943
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1360.3943 (283)
Total Primary energy kWh/year			6566.8125 (286)

SAP 10 EPC IMPROVEMENTS

Unit 1 BASELINE

Current energy efficiency rating: B 88
Current environmental impact rating: B 85

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

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

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.9	-£ 31	-194 kg (15.1%)

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

Potential energy efficiency rating: B 88
Potential environmental impact rating: B 85

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
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	£104	£104	£0
Mains gas	£403	£403	£0
Space heating	£275	£275	£0
Water heating	£146	£146	£0
Lighting	£86	£86	£0
Generated (PV)	-£195	-£195	£0
Total cost of fuels	£312	£312	£0
Total cost of uses	£312	£312	£0
Delivered energy	65 kWh/m²	65 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.3 tonnes	1.3 tonnes	0.0 tonnes
CO2 emissions per m²	14 kg/m²	14 kg/m²	0 kg/m²
Primary energy	72 kWh/m²	72 kWh/m²	0 kWh/m²

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.4284	(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) =	0.3963	(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	0.5052	0.4953	0.4854	0.4359	0.4260	0.3764	0.3764	0.3665	0.3963	0.4260	0.4458	0.4656	(22b)
Effective ac	0.6276	0.6227	0.6178	0.5950	0.5907	0.5709	0.5709	0.5672	0.5785	0.5907	0.5994	0.6084	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	1.2000	2.5080			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1300	3.5451	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1800	24.4044	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1100	1.0120	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.3675			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.3393 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	90.7068 (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	46.4417	46.0750	45.7155	44.0272	43.7113	42.2408	42.2408	41.9684	42.8072	43.7113	44.3503	45.0184	(38)
Heat transfer coeff	137.1485	136.7818	136.4223	134.7340	134.4181	132.9476	132.9476	132.6752	133.5140	134.4181	135.0571	135.7252	(39)
Average = Sum(39)m / 12 =												134.7325	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5023	1.4983	1.4944	1.4759	1.4724	1.4563	1.4563	1.4533	1.4625	1.4724	1.4794	1.4867	(40)
HLP (average)												1.4759	
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 2.6430 (42)
Hot water usage for mixer showers
68.5337 67.5037 66.0029 63.1314 61.0123 58.6491 57.3058 58.7953 60.4280 62.9654 65.8986 68.2711 (42a)
Hot water usage for baths
29.5949 29.1554 28.5365 27.3952 26.5407 25.5932 25.0813 25.6960 26.3652 27.3791 28.5438 29.4949 (42b)
Hot water usage for other uses
41.6966 40.1804 38.6642 37.1479 35.6317 34.1154 34.1154 35.6317 37.1479 38.6642 40.1804 41.6966 (42c)
Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m													
	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
										Total per year (kWh/year) = Sum(64)m =		2730.0413	(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													
	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													
	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains													
	679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(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	
Northeast	9.9200	11.2829	0.6300	0.7000	0.7700	34.2063	(75)
Southwest	16.5200	36.7938	0.6300	0.7000	0.7700	185.7620	(79)

Solar gains	219.9683	386.0493	558.3889	742.4561	877.7845	891.7463	851.2867	747.2207	621.6436	434.8039	265.5404	186.9081	(83)
Total gains	899.5824	1060.5221	1209.1340	1352.4304	1448.0200	1424.6772	1365.6517	1267.6761	1165.0145	1018.8236	893.0301	850.8173	(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	39.7151	39.8216	39.9265	40.4269	40.5219	40.9701	40.9701	41.0542	40.7963	40.5219	40.3301	40.1316
alpha	3.6477	3.6548	3.6618	3.6951	3.7015	3.7313	3.7313	3.7369	3.7198	3.7015	3.6887	3.6754
util living area												
	0.9796	0.9629	0.9287	0.8537	0.7260	0.5587	0.4178	0.4647	0.6876	0.8914	0.9651	0.9831 (86)
MIT	19.2635	19.5434	19.9445	20.4108	20.7536	20.9318	20.9821	20.9735	20.8508	20.3929	19.7431	19.2155 (87)
Th 2	19.6857	19.6888	19.6917	19.7056	19.7082	19.7204	19.7204	19.7227	19.7157	19.7082	19.7030	19.6975 (88)
util rest of house												
	0.9739	0.9527	0.9093	0.8150	0.6587	0.4615	0.3013	0.3433	0.5927	0.8530	0.9537	0.9783 (89)
MIT 2	18.1650	18.4401	18.8275	19.2676	19.5563	19.6914	19.7162	19.7157	19.6421	19.2679	18.6503	18.1264 (90)
Living area fraction										fLA = Living area / (4) =		0.1931 (91)
MIT	18.3772	18.6532	19.0433	19.4884	19.7875	19.9310	19.9607	19.9586	19.8755	19.4852	18.8614	18.3367 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3772	18.6532	19.0433	19.4884	19.7875	19.9310	19.9607	19.9586	19.8755	19.4852	18.8614	18.3367 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9661	0.9423	0.8974	0.8075	0.6633	0.4783	0.3237	0.3666	0.6057	0.8450	0.9439	0.9713	(94)
Useful gains	869.0693	999.3192	1085.1017	1092.0946	960.4275	681.4222	442.1187	464.6804	705.5942	860.8741	842.9372	826.4340	(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													
	1930.6606	1881.1888	1711.1801	1426.6152	1087.1124	708.7408	446.7922	472.1426	771.1136	1194.3311	1588.4589	1918.7109	(97)
Space heating kWh													
	789.8239	592.6164	465.8023	240.8548	94.2536	0.0000	0.0000	0.0000	0.0000	248.0920	536.7756	812.6540	(98a)
Space heating requirement - total per year (kWh/year)												3780.8727	
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													
	789.8239	592.6164	465.8023	240.8548	94.2536	0.0000	0.0000	0.0000	0.0000	248.0920	536.7756	812.6540	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3780.8727	
Space heating per m2											(98c) / (4) =	41.4161	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.5000	(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													
	789.8239	592.6164	465.8023	240.8548	94.2536	0.0000	0.0000	0.0000	0.0000	248.0920	536.7756	812.6540	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	882.4848	662.1413	520.4495	269.1115	105.3113	0.0000	0.0000	0.0000	0.0000	277.1977	599.7493	907.9933	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618	(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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.6964	-57.8035	-83.6245	-94.3877	-101.7952	-94.9553	-93.9250	-88.9086	-79.5960	-66.5784	-44.9556	-35.1355	(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												4224.4388	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												89.5000	

Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-882.3615 (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	6878.1495 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4224.4388	3.6400	153.7696	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	3.6400	111.0318	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	399.7467	16.4900	65.9182	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	16.4900	-145.5014	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-145.5014	(252)
Total energy cost			291.3996	(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] =	0.7697 (257)
SAP value		87.5230
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	4224.4388	0.2100	887.1322	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1527.7005	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	0.1345	-118.6698	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.6698	(269)
Total CO2, kg/year			1478.6557	(272)
CO2 emissions per m2			16.2000	(273)
EI value			85.4619	
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 FOR IMPROVED DWELLING

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)

Ground floor	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b) -
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c) -
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286 (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)	=	0.1784 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.4284 (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)	=	0.3963 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.1000	3.7000	3.8000	3.2000	3.4000	3.7000	3.5000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0500	1.0000	1.0250	0.9250	0.9500	0.8000	0.8500	0.9250	0.8750	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.4161	0.3963	0.4062	0.3665	0.3764	0.3170	0.3368	0.3665	0.3467	0.3665	0.3566	0.3963	(22b)
Effective ac	0.5866	0.5785	0.5825	0.5672	0.5709	0.5502	0.5567	0.5672	0.5601	0.5672	0.5636	0.5785	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	1.2000	2.5080			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1300	3.5451	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1800	24.4044	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1100	1.0120	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		67.3675			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e)	=	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K			214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)			23.3393 (36)
Point Thermal bridges	(36a)	=	0.0000
Total fabric heat loss	(33) + (36) + (36a)	=	90.7068 (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	43.4026	42.8072	43.1013	41.9684	42.2408	40.7158	41.1951	41.9684	41.4456	41.9684	41.7034	42.8072	(38)

Heat transfer coeff

	134.1095	133.5140	133.8081	132.6752	132.9476	131.4226	131.9019	132.6752	132.1524	132.6752	132.4102	133.5140 (39)
Average = Sum(39)m / 12 =												132.8172

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4690	1.4625	1.4657	1.4533	1.4563	1.4396	1.4449	1.4533	1.4476	1.4533	1.4504	1.4625	(40)
HLP (average)												1.4549	
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												2.6430 (42)
Hot water usage for mixer showers												
	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711 (42a)
Hot water usage for baths												
	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949 (42b)
Hot water usage for other uses												
	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966 (42c)
Average daily hot water use (litres/day)												128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m													
	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
										Total per year (kWh/year) = Sum(64)m =		2730.0413	(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													
	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													
	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains													
	679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(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	
Northeast	9.9200	12.9236	0.6300	0.7000	0.7700	39.1801	(75)
Southwest	16.5200	40.4699	0.6300	0.7000	0.7700	204.3215	(79)

Solar gains	243.5016	371.4738	547.0662	751.9747	867.3164	950.2477	914.0400	814.6596	673.7299	463.8752	301.2685	204.8389	(83)
Total gains	923.1158	1045.9465	1197.8113	1361.9491	1437.5518	1483.1786	1428.4049	1335.1151	1217.1007	1047.8949	928.7582	868.7480	(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	40.6151	40.7963	40.7066	41.0542	40.9701	41.4455	41.2949	41.0542	41.2166	41.0542	41.1364	40.7963	
alpha	3.7077	3.7198	3.7138	3.7369	3.7313	3.7630	3.7530	3.7369	3.7478	3.7369	3.7424	3.7198	
util living area	0.9720	0.9561	0.9077	0.8014	0.6277	0.3911	0.2301	0.2669	0.5423	0.8332	0.9472	0.9771	(86)
MIT	19.5347	19.7383	20.1739	20.6082	20.8821	20.9859	20.9987	20.9976	20.9497	20.6173	20.0184	19.4677	(87)
Th 2	19.7108	19.7157	19.7133	19.7227	19.7204	19.7331	19.7291	19.7227	19.7270	19.7227	19.7249	19.7157	(88)
util rest of house	0.9637	0.9437	0.8815	0.7493	0.5418	0.2846	0.1135	0.1413	0.4259	0.7747	0.9293	0.9702	(89)
MIT 2	18.4505	18.6508	19.0619	19.4536	19.6606	19.7297	19.7291	19.7225	19.7099	19.4744	18.9328	18.3889	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.6599	18.8608	19.2766	19.6766	19.8965	19.9723	19.9742	19.9688	19.9493	19.6951	19.1424	18.5972	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6599	18.8608	19.2766	19.6766	19.8965	19.9723	19.9742	19.9688	19.9493	19.6951	19.1424	18.5972	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9547	0.9330	0.8707	0.7472	0.5544	0.3051	0.1361	0.1657	0.4473	0.7732	0.9188	0.9621	(94)
Useful gains	881.3102	975.8412	1042.9733	1017.6993	796.9601	452.5764	194.3619	221.1823	544.4627	810.2236	853.3871	835.8494	(95)
Ext temp.	5.5000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.7000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	1764.8645	1730.4491	1522.2871	1230.7709	850.3947	456.3334	194.4563	221.4064	561.5569	1007.6847	1422.4056	1762.0170	(97)
Space heating kWh	657.3644	507.0965	356.6095	153.4115	39.7553	0.0000	0.0000	0.0000	0.0000	146.9110	409.6934	689.0687	(98a)
Space heating requirement - total per year (kWh/year)												2959.9103	
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	657.3644	507.0965	356.6095	153.4115	39.7553	0.0000	0.0000	0.0000	0.0000	146.9110	409.6934	689.0687	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2959.9103	
Space heating per m2										(98c) / (4) =		32.4232	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.5000	(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	657.3644	507.0965	356.6095	153.4115	39.7553	0.0000	0.0000	0.0000	0.0000	146.9110	409.6934	689.0687	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	734.4853	566.5883	398.4464	171.4095	44.4193	0.0000	0.0000	0.0000	0.0000	164.1464	457.7580	769.9092	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618	(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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.4545	-56.7321	-83.0173	-95.2094	-101.2536	-97.4954	-96.7657	-92.6080	-83.3637	-69.8633	-49.7743	-38.1520	(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	3307.1624 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-908.6894 (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	5934.5451 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3307.1624	4.8000	158.7438	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	4.8000	146.4156	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	21.5100	18.4986	(249)
Energy for lighting	399.7467	21.5100	85.9855	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	21.5100	-195.4591	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-195.4591	(252)
Total energy cost			312.1844	(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	3307.1624	0.2100	694.5041	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1335.0724	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	0.1345	-122.2243	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-122.2243	(269)
Total CO2, kg/year			1282.4732	(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	3307.1624	1.1300	3737.0935	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	1.1300	3446.8678	(278)
Space and water heating			7183.9613	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	399.7467	1.5338	613.1448	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	1.4971	-1360.3943	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1360.3943	(283)
Total Primary energy kWh/year			6566.8125	(286)

Full SAP Calculation Printout

Property Reference	Unit 1	Issued on Date	03/10/2023
Assessment Reference	Unit 1 BeLEAN	Prop Type Ref	Enfield
Property	Hertford Court, 19, Green Lanes, London , N13 4DD		

SAP Rating	89 B	DER	14.87	TER	13.31
Environmental	87 B	% DER < TER			-11.72
CO_2 Emissions (t/year)	1.14	DFEE	42.26	TFEE	43.22
Compliance Check	See BREL	% DFEE < TFEE			2.21
% DPER < TPER	-9.24	DPER	76.59	TPER	70.11

Assessor Details	Mirza Baig	Assessor ID	X001-7683
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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.3284 (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) =	0.3038 (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	0.3873	0.3797	0.3721	0.3341	0.3265	0.2886	0.2886	0.2810	0.3038	0.3265	0.3417	0.3569	(22b)
Effective ac	0.5750	0.5721	0.5692	0.5558	0.5533	0.5416	0.5416	0.5395	0.5461	0.5533	0.5584	0.5637	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)

Insulation at ceiling	10.2400	10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000	9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)		251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)		(26)...(30) + (32) =		60.0632			(33)
Party Wall 1		27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1		91.2300			0.0000	0.0000	(32c)
Internal Floor 1		41.3900			18.0000	745.0200	(32d)
Internal Floor 2		22.6630			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.3393 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	83.4025 (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	42.5473	42.3318	42.1205	41.1284	40.9428	40.0787	40.0787	39.9186	40.4115	40.9428	41.3183	41.7109	(38)
Heat transfer coeff	125.9498	125.7343	125.5230	124.5309	124.3453	123.4812	123.4812	123.3212	123.8140	124.3453	124.7208	125.1134	(39)

Average = Sum(39)m / 12 = 124.5300

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3797	1.3773	1.3750	1.3641	1.3621	1.3526	1.3526	1.3509	1.3563	1.3621	1.3662	1.3705	(40)
HLP (average)												1.3641	
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											2.6430	(42)
Hot water usage for mixer showers	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)
Hot water usage for baths	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)
Hot water usage for other uses	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)
Average daily hot water use (litres/day)												128.5309	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
										Total per year (kWh/year) = Sum(64)m =		2730.0413	(64)
12Total per year (kWh/year)												2730	(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	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)

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

	121.7742	134.8215	121.7742	125.8334	121.7742	125.8334	121.7742	121.7742	125.8334	121.7742	125.8334	121.7742	(67)

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

	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)

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

	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)

	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)

Total internal gains

	582.1706	595.1697	570.8903	550.7286	523.1001	501.3115	482.3604	483.3577	497.8367	517.8766	549.2361	570.1397	(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	
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183	(75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374	(79)

Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268	(83)
Total gains	856.6263	1069.8832	1239.5755	1411.3796	1516.4164	1500.3395	1440.1638	1340.2155	1232.6920	1047.7026	879.2845	804.1665	(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	43.2464	43.3205	43.3934	43.7391	43.8044	44.1110	44.1110	44.1682	43.9924	43.8044	43.6725	43.5355	
alpha	3.8831	3.8880	3.8929	3.9159	3.9203	3.9407	3.9407	3.9445	3.9328	3.9203	3.9115	3.9024	
util living area													
	0.9817	0.9587	0.9156	0.8218	0.6776	0.5059	0.3722	0.4149	0.6329	0.8711	0.9641	0.9853	(86)
MIT	19.4069	19.7392	20.1346	20.5608	20.8369	20.9604	20.9907	20.9858	20.9060	20.5181	19.8791	19.3445	(87)
Th 2	19.7790	19.7808	19.7826	19.7909	19.7925	19.7998	19.7998	19.8012	19.7970	19.7925	19.7893	19.7860	(88)
util rest of house													
	0.9766	0.9479	0.8943	0.7804	0.6120	0.4192	0.2731	0.3108	0.5431	0.8299	0.9528	0.9812	(89)
MIT 2	18.3744	18.6989	19.0769	19.4684	19.6935	19.7832	19.7976	19.7974	19.7515	19.4461	18.8469	18.3183	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.5738	18.8998	19.2811	19.6794	19.9143	20.0105	20.0280	20.0269	19.9745	19.6531	19.0462	18.5165	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5738	18.8998	19.2811	19.6794	19.9143	20.0105	20.0280	20.0269	19.9745	19.6531	19.0462	18.5165	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9380	0.8838	0.7761	0.6191	0.4349	0.2923	0.3308	0.5572	0.8243	0.9437	0.9753	(94)
Useful gains	830.7225	1003.5146	1095.5565	1095.4325	938.7549	652.5222	420.8923	443.3328	686.9010	863.6488	829.7706	784.3074	(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													
	1797.7811	1760.2549	1604.3280	1342.3666	1021.4071	668.0951	423.2965	447.2790	727.3440	1125.7154	1489.9408	1791.1871	(97)
Space heating kWh													
	719.4916	508.5295	378.5261	177.7926	61.4933	0.0000	0.0000	0.0000	0.0000	194.9776	475.3226	749.1185	(98a)

Space heating requirement - total per year (kWh/year) 3265.2515

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													
	719.4916	508.5295	378.5261	177.7926	61.4933	0.0000	0.0000	0.0000	0.0000	194.9776	475.3226	749.1185	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 3265.2515

Space heating per m2 (98c) / (4) = 35.7679 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 89.5000 (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													
	719.4916	508.5295	378.5261	177.7926	61.4933	0.0000	0.0000	0.0000	0.0000	194.9776	475.3226	749.1185	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	803.9012	568.1894	422.9341	198.6509	68.7075	0.0000	0.0000	0.0000	0.0000	217.8521	531.0867	837.0039	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618	(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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.6964	-57.8035	-83.6245	-94.3877	-101.7952	-94.9553	-93.9250	-88.9086	-79.5960	-66.5784	-44.9556	-35.1355	(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	3648.3257 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-882.3615 (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	6302.0364 (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	3648.3257	0.2100	766.1484	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1406.7167	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	0.1345	-118.6698	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.6698	(269)
Total CO2, kg/year			1357.6720	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			14.8700	(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	3648.3257	1.1300	4122.6081 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3050.3255	1.1300	3446.8678 (278)
Space and water heating			7569.4758 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	399.7467	1.5338	613.1448 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-882.3615	1.4971	-1320.9415
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1320.9415 (283)
Total Primary energy kWh/year			6991.7799 (286)
Dwelling Primary energy Rate (DPER)			76.5900 (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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(22b)
Effective ac	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.20)			20.7300	1.1450	23.7366			(27)
G Floor			27.2700	0.1300	3.5451			(28a)
External Wall 1	164.1100	22.8200	141.2900	0.1800	25.4322			(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968			(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264			(30)
flat roof	9.2000		9.2000	0.1100	1.0120			(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4391			(33)
Party Wall 1			27.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.0500	0.7905
E3 Sill	7.2000	0.0500	0.3600
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0800	0.7720
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0800	0.6400
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.0400	0.3116
R1 Head of roof window	1.8000	0.0800	0.1440
R9 Roof to wall (flat ceiling)	2.9500	0.0400	0.1180
R3 Jamb of roof window	2.4000	0.0800	0.1920
R2 Sill of roof window	1.8000	0.0600	0.1080

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.1991 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 73.6382 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	118.2160	117.9216	117.6331	116.2780	116.0245	114.8442	114.8442	114.6256	115.2988	116.0245	116.5374	117.0736	(39)

Average = Sum(39)m / 12 = 116.2768

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2950	1.2917	1.2886	1.2737	1.2709	1.2580	1.2580	1.2556	1.2630	1.2709	1.2766	1.2824	(40)
HLP (average)												1.2737	
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 2.6430 (42)

Hot water usage for mixer showers	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711 (42a)
Hot water usage for baths	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949 (42b)
Hot water usage for other uses	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966 (42c)

Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)

Energy content (annual) Total = Sum(45)m = 2134.8723

Distribution loss (46)m = 0.15 x (45)m	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547 (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	268.0439	236.9434	251.3238	219.8719	212.4252	190.6264	187.4947	195.3322	197.9236	221.6583	236.8866	264.9596 (62)
WWHRS	-31.3307	-27.7092	-29.0154	-24.0259	-22.3913	-19.1604	-17.9598	-19.0985	-19.8241	-23.3704	-26.4758	-30.7505 (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	236.7132	209.2343	222.3084	195.8460	190.0339	171.4660	169.5349	176.2337	178.0995	198.2879	210.4108	234.2091 (64)

Total per year (kWh/year) = Sum(64)m = 2392.3777 (64)

12Total per year (kWh/year) 2392 (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	110.9077	98.4588	105.3483	94.1879	92.4145	84.4637	84.1251	86.7311	86.8900	95.4845	99.8452	109.8822 (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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)

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

	121.7495	134.7941	121.7495	125.8079	121.7495	125.8079	121.7495	121.7495	125.8079	121.7495	125.8079	121.7495 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148 (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)												
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188 (71)
Water heating gains (Table 5)												
	149.0695	146.5160	141.5971	130.8165	124.2130	117.3107	113.0714	116.5740	120.6806	128.3394	138.6740	147.6911 (72)
Total internal gains												
	577.8946	590.8910	566.6143	546.4517	518.8241	497.0346	478.0844	479.0817	493.5599	513.6006	544.9593	565.8637 (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	
Northeast	7.7800	11.2829	0.6300	0.7000	0.7700	26.8271	(75)
Southwest	12.9500	36.7938	0.6300	0.7000	0.7700	145.6185	(79)

Solar gains	172.4456	302.6496	437.7672	582.0875	688.1979	699.1494	667.4260	585.8278	487.3629	340.8740	208.1729	146.5275 (83)
Total gains	750.3403	893.5406	1004.3816	1128.5392	1207.0220	1196.1840	1145.5104	1064.9095	980.9228	854.4746	753.1322	712.3912 (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	46.0756	46.1906	46.3039	46.8435	46.9459	47.4284	47.4284	47.5188	47.2414	46.9459	46.7393	46.5252	
alpha	4.0717	4.0794	4.0869	4.1229	4.1297	4.1619	4.1619	4.1679	4.1494	4.1297	4.1160	4.1017	
util living area													
	0.9878	0.9750	0.9494	0.8822	0.7575	0.5805	0.4328	0.4814	0.7136	0.9154	0.9767	0.9900	(86)
MIT	19.4178	19.6808	20.0336	20.4699	20.7876	20.9475	20.9877	20.9811	20.8766	20.4527	19.8611	19.3771	(87)
Th 2	19.8448	19.8473	19.8498	19.8615	19.8637	19.8739	19.8739	19.8758	19.8699	19.8637	19.8592	19.8546	(88)
util rest of house													
	0.9844	0.9681	0.9353	0.8504	0.6975	0.4912	0.3261	0.3702	0.6278	0.8851	0.9690	0.9872	(89)
MIT 2	18.0352	18.3685	18.8096	19.3409	19.6895	19.8438	19.8698	19.8688	19.7880	19.3367	18.6080	17.9902	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.3022	18.6219	19.0459	19.5589	19.9015	20.0569	20.0857	20.0836	19.9983	19.5522	18.8500	18.2581	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3022	18.6219	19.0459	19.5589	19.9015	20.0569	20.0857	20.0836	19.9983	19.5522	18.8500	18.2581	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9778	0.9582	0.9228	0.8406	0.6997	0.5064	0.3466	0.3914	0.6385	0.8748	0.9597	0.9815	(94)
Useful gains	733.6740	856.2196	926.8771	948.6076	844.5419	605.7040	397.0205	416.8024	626.2867	747.5104	722.7697	699.1818	(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													
	1655.2824	1618.1110	1475.8185	1239.3995	951.5798	626.6958	400.3110	422.2402	680.0615	1038.6739	1369.3113	1645.8264	(97)
Space heating kWh													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(98a)
Space heating requirement - total per year (kWh/year)												3281.5256	
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													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3281.5256	
Space heating per m2											(98c) / (4) =	35.9462	(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													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(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)													
	742.8782	554.7032	442.4836	226.8366	86.2797	0.0000	0.0000	0.0000	0.0000	234.6973	504.3444	763.0592	(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												
	236.7132	209.2343	222.3084	195.8460	190.0339	171.4660	169.5349	176.2337	178.0995	198.2879	210.4108	234.2091 (64)
Efficiency of water heater												79.8000 (216)
(217)m	86.3021	85.9866	85.4050	84.2098	82.2621	79.8000	79.8000	79.8000	79.8000	84.2586	85.7881	86.3691 (217)
Fuel for water heating, kWh/month												
	274.2843	243.3336	260.2991	232.5691	231.0102	214.8697	212.4498	220.8442	223.1823	235.3327	245.2680	271.1723 (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	25.2971	20.2943	18.2728	13.3874	10.3408	8.4485	9.4332	12.2617	15.9267	20.8967	23.6028	26.0002 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-27.9867	-40.8141	-60.6587	-70.5858	-78.1627	-73.6801	-72.7534	-67.6575	-59.0345	-47.7030	-31.2385	-24.0384 (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	-11.9419	-25.4805	-51.3225	-78.0911	-104.2557	-105.1383	-103.9259	-87.5574	-63.5874	-36.7979	-16.0574	-9.4187 (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	3555.2823 (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	2864.6152 (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)	204.1625 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-1347.8881 (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	5362.1719 (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	3555.2823	0.2100	746.6093	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2864.6152	0.2100	601.5692	(264)
Space and water heating			1348.1785	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	204.1625	0.1443	29.4670	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-654.3134	0.1339	-87.6041	
PV Unit electricity exported	-693.5747	0.1255	-87.0509	
Total			-174.6549	(269)
Total CO2, kg/year			1214.9197	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.3100	(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	3555.2823	1.1300	4017.4690	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2864.6152	1.1300	3237.0152	(278)
Space and water heating			7254.4841	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	204.1625	1.5338	313.1512	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-654.3134	1.4948	-978.0574	
PV Unit electricity exported	-693.5747	0.4607	-319.5235	
Total			-1297.5809	(283)
Total Primary energy kWh/year			6400.1552	(286)

Target Primary Energy Rate (TPER) 70.1100 (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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286 (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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2838	(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) =	0.2625	(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	0.3347	0.3281	0.3216	0.2888	0.2822	0.2494	0.2494	0.2428	0.2625	0.2822	0.2953	0.3084	(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	0.5560	0.5538	0.5517	0.5417	0.5398	0.5311	0.5311	0.5295	0.5345	0.5398	0.5436	0.5476	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880

E4 Jamb	33.9800	0.0500	1.6990	
E5 Ground floor (normal)	26.4300	0.1600	4.2288	
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155	
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772	
E14 Flat roof	9.6500	0.0600	0.5790	
P1 Party wall - Ground floor	2.5500	0.0800	0.2040	
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000	
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600	
E16 Corner (normal)	26.8600	0.0900	2.4174	
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178	
E18 Party wall between dwellings	9.2400	0.0600	0.5544	
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348	
R1 Head of roof window	1.8000	0.2400	0.4320	
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540	
R3 Jamb of roof window	2.4000	0.2400	0.5760	
R2 Sill of roof window	1.8000	0.2400	0.4320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	41.1423	40.9813	40.8236	40.0826	39.9440	39.2987	39.2987	39.1792	39.5472	39.9440	40.2245	40.5177	(38)
Heat transfer coeff	124.5448	124.3839	124.2261	123.4852	123.3465	122.7012	122.7012	122.5817	122.9498	123.3465	123.6270	123.9202	(39)

Average = Sum(39)m / 12 = 123.4845

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3643	1.3625	1.3608	1.3527	1.3512	1.3441	1.3441	1.3428	1.3468	1.3512	1.3542	1.3574	(40)
HLP (average)												1.3527	
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 2.6430 (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

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 65.3452 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.2916	69.3358	67.2006	64.5432	62.1724	59.7086	59.1968	61.3276	63.5131	66.0432	68.7242	71.1915	(44)
Energy conte	112.9084	98.7333	103.2849	88.3564	83.6960	73.4187	71.5934	75.9364	78.3180	89.6200	97.9102	111.4687	(45)

Energy content (annual) Total = Sum(45)m = 1085.2444

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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(64)

Total per year (kWh/year) = Sum(64)m = 922.4577 (64)

12Total per year (kWh/year) 922 (64)

Electric shower(s)

54.8840	48.9021	53.3993	50.9583	51.9145	49.5214	51.1721	51.9145	50.9583	53.3993	52.3951	54.8840	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 624.3027 (64a)

Heat gains from water heating, kWh/month

37.7141	33.2064	35.2978	31.5153	30.7640	27.9818	28.0066	29.1151	29.3821	32.3941	33.9047	37.4081	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.7742	134.8215	121.7742	125.8334	121.7742	125.8334	121.7742	121.7742	125.8334	121.7742	125.8334	121.7742	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													

	50.6909	49.4142	47.4433	43.7712	41.3495	38.8636	37.6433	39.1332	40.8085	43.5404	47.0899	50.2797 (72)
Total internal gains	476.5408	490.8166	469.4852	456.4320	432.9853	418.6131	402.6810	401.6656	413.7134	425.8263	450.4008	465.4770 (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
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183 (75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374 (79)

Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268 (83)
Total gains	750.9965	965.5301	1138.1705	1317.0831	1426.3016	1417.6411	1360.4844	1258.5234	1148.5686	955.6523	780.4492	699.5038 (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	43.7342	43.7908	43.8464	44.1095	44.1591	44.3914	44.3914	44.4346	44.3016	44.1591	44.0589	43.9547	
alpha	3.9156	3.9194	3.9231	3.9406	3.9439	3.9594	3.9594	3.9623	3.9534	3.9439	3.9373	3.9303	
util living area	0.9881	0.9695	0.9321	0.8446	0.7031	0.5288	0.3906	0.4376	0.6636	0.8958	0.9751	0.9908	(86)
MIT	19.3066	19.6496	20.0622	20.5156	20.8170	20.9546	20.9892	20.9833	20.8906	20.4585	19.7858	19.2398	(87)
Th 2	19.7908	19.7922	19.7935	19.7998	19.8010	19.8065	19.8065	19.8075	19.8044	19.8010	19.7986	19.7961	(88)
util rest of house	0.9847	0.9612	0.9141	0.8062	0.6383	0.4399	0.2877	0.3291	0.5736	0.8600	0.9669	0.9882	(89)
MIT 2	18.2848	18.6218	19.0196	19.4393	19.6883	19.7871	19.8038	19.8030	19.7503	19.4037	18.7646	18.2226	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.4821	18.8203	19.2210	19.6471	19.9062	20.0126	20.0328	20.0309	19.9705	19.6074	18.9618	18.4191	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4821	18.8203	19.2210	19.6471	19.9062	20.0126	20.0328	20.0309	19.9705	19.6074	18.9618	18.4191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9795	0.9525	0.9036	0.8006	0.6444	0.4558	0.3075	0.3499	0.5871	0.8530	0.9591	0.9839	(94)
Useful gains	735.6032	919.6454	1028.4981	1054.4707	919.1462	646.1775	418.3945	440.3762	674.2820	815.1682	748.5602	688.2117	(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	1766.3122	1731.4639	1580.2754	1327.1115	1012.2123	664.1293	421.2048	445.0832	721.7798	1111.0301	1466.4381	1762.0302	(97)
Space heating kWh	766.8475	545.5420	410.5223	196.3014	69.2412	0.0000	0.0000	0.0000	0.0000	220.1213	516.8721	798.9210	(98a)
Space heating requirement - total per year (kWh/year)												3524.3688	
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	766.8475	545.5420	410.5223	196.3014	69.2412	0.0000	0.0000	0.0000	0.0000	220.1213	516.8721	798.9210	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3524.3688	
Space heating per m2										(98c) / (4) =		38.6063	(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	1153.3910	907.9887	931.6206	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9062	0.9458	0.9272	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1045.2393	858.7986	863.8446	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1609.0536	1544.6073	1427.8215	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	405.9463	510.2416	419.5988	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	101.4866	127.5604	104.8997	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												333.9467	(107)
Energy for space heating												38.6063	(99)
Energy for space cooling												3.6581	(108)
Total												42.2644	(109)
Fabric Energy Efficiency (DFEE)												42.3	(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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(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	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.20)			20.7300	1.1450	23.7366			(27)
G Floor			27.2700	0.1300	3.5451			(28a)
External Wall 1	164.1100	22.8200	141.2900	0.1800	25.4322			(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968			(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264			(30)
flat roof	9.2000		9.2000	0.1100	1.0120			(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4391			(33)
Party Wall 1			27.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	15.8100	0.0500	0.7905
E3	Sill	7.2000	0.0500	0.3600
E4	Jamb	33.9800	0.0500	1.6990
E5	Ground floor (normal)	26.4300	0.1600	4.2288
E6	Intermediate floor within a dwelling	41.6500	0.0000	0.0000
E11	Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14	Flat roof	9.6500	0.0800	0.7720
P1	Party wall - Ground floor	2.5500	0.0800	0.2040
P2	Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5	Party wall - Roof (insulation at rafter level)	8.0000	0.0800	0.6400
E16	Corner (normal)	26.8600	0.0900	2.4174

E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.0400	0.3116
R1 Head of roof window	1.8000	0.0800	0.1440
R9 Roof to wall (flat ceiling)	2.9500	0.0400	0.1180
R3 Jamb of roof window	2.4000	0.0800	0.1920
R2 Sill of roof window	1.8000	0.0600	0.1080

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.1991 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 73.6382 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	118.2160	117.9216	117.6331	116.2780	116.0245	114.8442	114.8442	114.6256	115.2988	116.0245	116.5374	117.0736	(39)

Average = Sum(39)m / 12 = 116.2768

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2950	1.2917	1.2886	1.2737	1.2709	1.2580	1.2580	1.2556	1.2630	1.2709	1.2766	1.2824	(40)
HLP (average)												1.2737	
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 2.6430 (42)

Hot water usage for mixer showers

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

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 65.3452 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.2916	69.3358	67.2006	64.5432	62.1724	59.7086	59.1968	61.3276	63.5131	66.0432	68.7242	71.1915	(44)
Energy conte	112.9084	98.7333	103.2849	88.3564	83.6960	73.4187	71.5934	75.9364	78.3180	89.6200	97.9102	111.4687	(45)

Energy content (annual) Total = Sum(45)m = 1085.2444

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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(64)

Total per year (kWh/year) = Sum(64)m = 922.4577 (64)

12Total per year (kWh/year) 922 (64)

Electric shower(s)

54.8840	48.9021	53.3993	50.9583	51.9145	49.5214	51.1721	51.9145	50.9583	53.3993	52.3951	54.8840	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 624.3027 (64a)

Heat gains from water heating, kWh/month

37.7141	33.2064	35.2978	31.5153	30.7640	27.9818	28.0066	29.1151	29.3821	32.3941	33.9047	37.4081	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.7495	134.7941	121.7495	125.8079	121.7495	125.8079	121.7495	121.7495	125.8079	121.7495	125.8079	121.7495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)	50.6909	49.4142	47.4433	43.7712	41.3495	38.8636	37.6433	39.1332	40.8085	43.5404	47.0899	50.2797	(72)
Total internal gains	476.5161	490.7892	469.4605	456.4065	432.9606	418.5875	402.6563	401.6409	413.6878	425.8016	450.3752	465.4523	(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
Northeast	7.7800	11.2829	0.6300	0.7000	0.7700	26.8271 (75)
Southwest	12.9500	36.7938	0.6300	0.7000	0.7700	145.6185 (79)

Solar gains	172.4456	302.6496	437.7672	582.0875	688.1979	699.1494	667.4260	585.8278	487.3629	340.8740	208.1729	146.5275 (83)
Total gains	648.9617	793.4388	907.2277	1038.4940	1121.1585	1117.7369	1070.0823	987.4687	901.0507	766.6756	658.5481	611.9798 (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	46.0756	46.1906	46.3039	46.8435	46.9459	47.4284	47.4284	47.5188	47.2414	46.9459	46.7393	46.5252	
alpha	4.0717	4.0794	4.0869	4.1229	4.1297	4.1619	4.1619	4.1679	4.1494	4.1297	4.1160	4.1017	
util living area	0.9927	0.9832	0.9630	0.9051	0.7893	0.6131	0.4610	0.5150	0.7527	0.9379	0.9852	0.9943	(86)
MIT	19.2934	19.5639	19.9310	20.3981	20.7498	20.9358	20.9845	20.9758	20.8484	20.3713	19.7494	19.2526	(87)
Th 2	19.8448	19.8473	19.8498	19.8615	19.8637	19.8739	19.8739	19.8758	19.8699	19.8637	19.8592	19.8546	(88)
util rest of house	0.9906	0.9784	0.9522	0.8775	0.7320	0.5216	0.3484	0.3979	0.6689	0.9137	0.9802	0.9926	(89)
MIT 2	18.3116	18.5809	18.9421	19.3933	19.7005	19.8446	19.8698	19.8687	19.7892	19.3811	18.7755	18.2783	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.5012	18.7707	19.1330	19.5874	19.9032	20.0554	20.0851	20.0825	19.9937	19.5723	18.9636	18.4665	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5012	18.7707	19.1330	19.5874	19.9032	20.0554	20.0851	20.0825	19.9937	19.5723	18.9636	18.4665	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9871	0.9724	0.9436	0.8696	0.7342	0.5372	0.3701	0.4203	0.6791	0.9059	0.9747	0.9896	(94)
Useful gains	640.5907	771.5235	856.0459	903.1146	823.1395	600.4544	396.0316	415.0258	611.9112	694.5254	641.8831	605.6315	(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	1678.8128	1635.6599	1486.0652	1242.7059	951.7670	626.5152	400.2395	422.1095	679.5384	1041.0062	1382.5535	1670.2292	(97)
Space heating kWh	772.4372	580.6996	468.7343	244.5058	95.6989	0.0000	0.0000	0.0000	0.0000	257.7817	533.2827	792.0607	(98a)
Space heating requirement - total per year (kWh/year)												3745.2009	
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	772.4372	580.6996	468.7343	244.5058	95.6989	0.0000	0.0000	0.0000	0.0000	257.7817	533.2827	792.0607	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3745.2009	
Space heating per m2											(98c) / (4) =	41.0253	(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	1079.5352	849.8469	871.1546	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8627	0.9175	0.8905	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	931.3154	779.7513	775.7660	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1258.5439	1205.2028	1111.0302	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	235.6045	316.5360	249.4366	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	58.9011	79.1340	62.3591	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												200.3943	(107)
Energy for space heating												41.0253	(99)
Energy for space cooling												2.1951	(108)
Total												43.2205	(109)
Fabric Energy Efficiency (TFEE)												43.2	(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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286 (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) =	0.1784 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		3.0000 (17)
Infiltration rate		0.3284 (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) =	0.3038 (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	0.3873	0.3797	0.3721	0.3341	0.3265	0.2886	0.2886	0.2810	0.3038	0.3265	0.3417	0.3569	(22b)
Effective ac	0.5750	0.5721	0.5692	0.5558	0.5533	0.5416	0.5416	0.5395	0.5461	0.5533	0.5584	0.5637	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =	19608.7400			(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K					214.7961			(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760

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       R2 Sill of roof window                                                          1.8000         0.2400         0.4320
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                  23.3393 (36)
Point Thermal bridges                                                                                          (36a) =      0.0000
Total fabric heat loss                                                                                 (33) + (36) + (36a) =     83.4025 (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         42.5473    42.3318    42.1205    41.1284    40.9428    40.0787    40.0787    39.9186    40.4115    40.9428    41.3183    41.7109 (38)
Heat transfer coeff
              125.9498   125.7343   125.5230   124.5309   124.3453   123.4812   123.4812   123.3212   123.8140   124.3453   124.7208   125.1134 (39)
Average = Sum(39)m / 12 =                                                                                                                124.5300

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP               1.3797     1.3773     1.3750     1.3641     1.3621     1.3526     1.3526     1.3509     1.3563     1.3621     1.3662     1.3705 (40)
HLP (average)                                                                                                                            1.3641
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)
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Assumed occupancy                                                                                                                        2.6430 (42)
Hot water usage for mixer showers
              68.5337    67.5037    66.0029    63.1314    61.0123    58.6491    57.3058    58.7953    60.4280    62.9654    65.8986    68.2711 (42a)
Hot water usage for baths
              29.5949    29.1554    28.5365    27.3952    26.5407    25.5932    25.0813    25.6960    26.3652    27.3791    28.5438    29.4949 (42b)
Hot water usage for other uses
              41.6966    40.1804    38.6642    37.1479    35.6317    34.1154    34.1154    35.6317    37.1479    38.6642    40.1804    41.6966 (42c)
Average daily hot water use (litres/day)                                                                                                 128.5309 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              139.8252   136.8395   133.2035   127.6746   123.1847   118.3577   116.5026   120.1229   123.9411   129.0086   134.6228   139.4626 (44)
Energy conte  221.4490   194.8577   204.7289   174.7801   165.8302   145.5346   140.8998   148.7373   152.8317   175.0634   191.7948   218.3647 (45)
Energy content (annual)                                                                                        Total = Sum(45)m =    2134.8723
Distribution loss  (46)m = 0.15 x (45)m
              33.2173    29.2287    30.7093    26.2170    24.8745    21.8302    21.1350    22.3106    22.9248    26.2595    28.7692    32.7547 (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                                                                                                         0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                 0.8802 (55)
Total storage loss
              27.2862    24.6456    27.2862    26.4060    27.2862    26.4060    27.2862    27.2862    26.4060    27.2862    26.4060    27.2862 (56)
If cylinder contains dedicated solar storage
              27.2862    24.6456    27.2862    26.4060    27.2862    26.4060    27.2862    27.2862    26.4060    27.2862    26.4060    27.2862 (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
              271.9976   240.5145   255.2775   223.6981   216.3788   194.4526   191.4484   199.2859   201.7497   225.6120   240.7128   268.9133 (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
              271.9976   240.5145   255.2775   223.6981   216.3788   194.4526   191.4484   199.2859   201.7497   225.6120   240.7128   268.9133 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   2730.0413 (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
              114.0707   101.3156   108.5112    97.2488    95.5774    87.5246    87.2881    89.8940    89.9510    98.6475   102.9062   113.0452 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         158.5781   158.5781   158.5781   158.5781   158.5781   158.5781   158.5781   158.5781   158.5781   158.5781   158.5781   158.5781 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               56.5883    50.2612    40.8752    30.9451    23.1318    19.5289    21.1016    27.4287    36.8148    46.7448    54.5581    58.1610 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              360.3449   364.0841   354.6613   334.6013   309.2792   285.4799   269.5805   265.8413   275.2641   295.3241   320.6462   344.4455 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               53.5008    53.5008    53.5008    53.5008    53.5008    53.5008    53.5008    53.5008    53.5008    53.5008    53.5008    53.5008 (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)
             -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188  -105.7188 (71)
Water heating gains (Table 5)
              153.3208   150.7673   145.8484   135.0678   128.4643   121.5620   117.3227   120.8253   124.9319   132.5907   142.9252   151.9424 (72)
Total internal gains
              679.6141   674.4728   650.7451   609.9744   570.2355   532.9309   514.3650   520.4554   543.3709   584.0197   627.4897   663.9091 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux                 g                FF             Access             Gains
                                          m2            Table 6a       Specific data      Specific data            factor                 W
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					W/m2	or Table 6b		or Table 6c		Table 6d			
Northeast					9.9200	11.2829		0.4000		0.7000		0.7700	21.7183 (75)
Southwest					16.5200	36.7938		0.6000		1.0000		0.7700	252.7374 (79)
Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268 (83)	
Total gains	954.0698	1149.1863	1319.4303	1470.6254	1563.5518	1531.9590	1472.1684	1377.3132	1278.2261	1113.8457	957.5381	897.9359 (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	43.2464	43.3205	43.3934	43.7391	43.8044	44.1110	44.1110	44.1682	43.9924	43.8044	43.6725	43.5355	
alpha	3.8831	3.8880	3.8929	3.9159	3.9203	3.9407	3.9407	3.9445	3.9328	3.9203	3.9115	3.9024	
util living area	0.9741	0.9490	0.9008	0.8061	0.6633	0.4967	0.3644	0.4045	0.6157	0.8515	0.9536	0.9789 (86)	
MIT	19.5185	19.8211	20.2023	20.5933	20.8489	20.9628	20.9914	20.9870	20.9147	20.5635	19.9618	19.4540 (87)	
Th 2	19.7790	19.7808	19.7826	19.7909	19.7925	19.7998	19.7998	19.8012	19.7970	19.7925	19.7893	19.7860 (88)	
util rest of house	0.9672	0.9361	0.8769	0.7631	0.5976	0.4111	0.2673	0.3026	0.5266	0.8069	0.9395	0.9732 (89)	
MIT 2	18.4832	18.7768	19.1381	19.4948	19.7014	19.7843	19.7978	19.7978	19.7562	19.4832	18.9252	18.4256 (90)	
Living area fraction										fLA = Living area / (4) =		0.1931 (91)	
MIT	18.6831	18.9784	19.3436	19.7069	19.9230	20.0119	20.0283	20.0275	19.9799	19.6919	19.1254	18.6242 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.6831	18.9784	19.3436	19.7069	19.9230	20.0119	20.0283	20.0275	19.9799	19.6919	19.1254	18.6242 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9590	0.9256	0.8668	0.7598	0.6051	0.4267	0.2860	0.3222	0.5410	0.8026	0.9297	0.9659 (94)	
Useful gains	914.9115	1063.6779	1143.6781	1117.4199	946.1001	653.6925	421.1042	443.7508	691.4943	894.0168	890.2639	867.3348 (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	1811.5476	1770.1418	1612.1707	1345.7986	1022.4909	668.2633	423.3292	447.3422	728.0134	1130.5295	1499.8148	1804.6610 (97)	
Space heating kWh	667.0973	474.7437	348.5585	164.4327	56.8347	0.0000	0.0000	0.0000	0.0000	175.9654	438.8767	697.3707 (98a)	
Space heating requirement - total per year (kWh/year)												3023.8797	
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	667.0973	474.7437	348.5585	164.4327	56.8347	0.0000	0.0000	0.0000	0.0000	175.9654	438.8767	697.3707 (98c)	
Space heating requirement after solar contribution - total per year (kWh/year)												3023.8797	
Space heating per m2											(98c) / (4) =	33.1239 (99)	

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)	
Fraction of space heat from main system(s)												1.0000 (202)	
Efficiency of main space heating system 1 (in %)												89.5000 (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	667.0973	474.7437	348.5585	164.4327	56.8347	0.0000	0.0000	0.0000	0.0000	175.9654	438.8767	697.3707 (98)	
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000 (210)	
Space heating fuel (main heating system)	745.3601	530.4399	389.4508	183.7237	63.5025	0.0000	0.0000	0.0000	0.0000	196.6094	490.3650	779.1851 (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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133 (64)	
Efficiency of water heater												89.5000 (216)	
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000 (217)	
Fuel for water heating, kWh/month	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618 (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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.6964	-57.8035	-83.6245	-94.3877	-101.7952	-94.9553	-93.9250	-88.9086	-79.5960	-66.5784	-44.9556	-35.1355 (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	(235a)

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

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

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

(233b)m	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	(234b)

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

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

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

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

Annual totals kWh/year	
Space heating fuel - main system 1	3378.6365 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-882.3615 (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	6032.3471 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3378.6365	3.6400	122.9824	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	3.6400	111.0318	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	399.7467	16.4900	65.9182	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	16.4900	-145.5014	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-145.5014	(252)
Total energy cost			260.6124	(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] =	0.6884 (257)
SAP value		88.8412
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	3378.6365	0.2100	709.5137	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1350.0820	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	0.1345	-118.6698	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.6698	(269)
Total CO2, kg/year			1301.0372	(272)
CO2 emissions per m2			14.2500	(273)
EI value			87.2082	
EI rating			87	(274)
EI band			B	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.3284	(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) =	0.3038	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.1000	3.7000	3.8000	3.2000	3.4000	3.7000	3.5000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0500	1.0000	1.0250	0.9250	0.9500	0.8000	0.8500	0.9250	0.8750	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3189	0.3038	0.3114	0.2810	0.2886	0.2430	0.2582	0.2810	0.2658	0.2810	0.2734	0.3038	(22b)
Effective ac	0.5509	0.5461	0.5485	0.5395	0.5416	0.5295	0.5333	0.5395	0.5353	0.5395	0.5374	0.5461	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		19608.7400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							214.7961	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040

P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000	
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600	
E16 Corner (normal)	26.8600	0.0900	2.4174	
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178	
E18 Party wall between dwellings	9.2400	0.0600	0.5544	
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348	
R1 Head of roof window	1.8000	0.2400	0.4320	
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540	
R3 Jamb of roof window	2.4000	0.2400	0.5760	
R2 Sill of roof window	1.8000	0.2400	0.4320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7614	40.4115	40.5843	39.9186	40.0787	39.1825	39.4642	39.9186	39.6114	39.9186	39.7629	40.4115	(38)
Heat transfer coeff	124.1639	123.8140	123.9868	123.3212	123.4812	122.5851	122.8667	123.3212	123.0139	123.3212	123.1654	123.8140	(39)

Average = Sum(39)m / 12 = 123.4045

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3601	1.3563	1.3582	1.3509	1.3526	1.3428	1.3459	1.3509	1.3475	1.3509	1.3492	1.3563	(40)
HLP (average)												1.3518	
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 2.6430 (42)

Hot water usage for mixer showers

68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)

Energy content (annual) Total = Sum(45)m = 2134.8723

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

33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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 0.5400 (49)
Enter (49) or (54) in (55) 0.8802 (55)
Total storage loss

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)

If cylinder contains dedicated solar storage

27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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

271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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

271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)

Total per year (kWh/year) = Sum(64)m = 2730.0413 (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

114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains	679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(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	
Northeast	9.9200	12.9236	0.4000	0.7000	0.7700	24.8763	(75)
Southwest	16.5200	40.4699	0.6000	1.0000	0.7700	277.9885	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	302.8647	454.9273	651.7562	867.0599	976.9804	1060.2739	1024.0038	929.4543	792.1572	562.6856	373.1787	255.7406	(83)
Total gains	982.4789	1129.4001	1302.5013	1477.0343	1547.2159	1593.2048	1538.3688	1449.9098	1335.5280	1146.7053	1000.6684	919.6497	(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	43.8684	43.9924	43.9311	44.1682	44.1110	44.4334	44.3316	44.1682	44.2785	44.1682	44.2240	43.9924	
alpha	3.9246	3.9328	3.9287	3.9445	3.9407	3.9622	3.9554	3.9445	3.9519	3.9445	3.9483	3.9328	
util living area	0.9637	0.9405	0.8745	0.7464	0.5640	0.3428	0.1994	0.2291	0.4731	0.7799	0.9291	0.9710	(86)
MIT	19.7614	19.9765	20.3851	20.7401	20.9322	20.9931	20.9995	20.9990	20.9744	20.7421	20.2102	19.6834	(87)
Th 2	19.7941	19.7970	19.7956	19.8012	19.7998	19.8075	19.8051	19.8012	19.8038	19.8012	19.8025	19.7970	(88)
util rest of house	0.9536	0.9250	0.8434	0.6919	0.4856	0.2536	0.1042	0.1277	0.3729	0.7166	0.9073	0.9627	(89)
MIT 2	18.7326	18.9401	19.3186	19.6268	19.7660	19.8058	19.8050	19.8011	19.7952	19.6388	19.1722	18.6596	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.9313	19.1402	19.5246	19.8418	19.9913	20.0351	20.0357	20.0325	20.0229	19.8519	19.3726	18.8573	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9313	19.1402	19.5246	19.8418	19.9913	20.0351	20.0357	20.0325	20.0229	19.8519	19.3726	18.8573	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9444	0.9145	0.8353	0.6939	0.4986	0.2709	0.1226	0.1473	0.3918	0.7196	0.8976	0.9543	(94)
Useful gains	927.8373	1032.8911	1088.0413	1024.8936	771.4493	431.5285	188.6458	213.5551	523.2818	825.1883	898.2147	877.6098	(95)
Ext temp.	5.5000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.7000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	1667.6865	1639.3240	1441.2975	1164.3727	801.5484	433.3450	188.6869	213.6506	531.7799	955.9704	1351.4476	1666.2053	(97)
Space heating kWh	550.4478	407.5230	262.8226	100.4249	22.3938	0.0000	0.0000	0.0000	0.0000	97.3019	326.3277	586.7151	(98a)
Space heating requirement - total per year (kWh/year)												2353.9566	
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	550.4478	407.5230	262.8226	100.4249	22.3938	0.0000	0.0000	0.0000	0.0000	97.3019	326.3277	586.7151	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2353.9566	
Space heating per m2											(98c) / (4) =	25.7855	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.5000	(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	550.4478	407.5230	262.8226	100.4249	22.3938	0.0000	0.0000	0.0000	0.0000	97.3019	326.3277	586.7151	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	615.0254	455.3329	293.6565	112.2066	25.0210	0.0000	0.0000	0.0000	0.0000	108.7172	364.6119	655.5476	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													

	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618 (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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-44.4545	-56.7321	-83.0173	-95.2094	-101.2536	-97.4954	-96.7657	-92.6080	-83.3637	-69.8633	-49.7743	-38.1520 (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	2630.1192 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-908.6894 (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	5257.5019 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2630.1192	4.8000	126.2457	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	4.8000	146.4156	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	21.5100	18.4986	(249)
Energy for lighting	399.7467	21.5100	85.9855	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	21.5100	-195.4591	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-195.4591	(252)
Total energy cost			279.6864	(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	2630.1192	0.2100	552.3250	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1192.8934	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	0.1345	-122.2243	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-122.2243	(269)
Total CO2, kg/year			1140.2941	(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	2630.1192	1.1300	2972.0346	(275)

Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3050.3255	1.1300	3446.8678 (278)
Space and water heating			6418.9024 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	399.7467	1.5338	613.1448 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-908.6894	1.4971	-1360.3943
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1360.3943 (283)
Total Primary energy kWh/year			5801.7537 (286)

SAP 10 EPC IMPROVEMENTS

Unit 1 BeLEAN

Current energy efficiency rating: B 89
Current environmental impact rating: B 87

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

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

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.9	-£ 32	-195 kg (17.1%)

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

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 87

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
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	£104	£104	£0
Mains gas	£371	£371	£0
Space heating	£243	£243	£0
Water heating	£146	£146	£0
Lighting	£86	£86	£0
Generated (PV)	-£195	-£195	£0
Total cost of fuels	£280	£280	£0
Total cost of uses	£280	£280	£0
Delivered energy	58 kWh/m²	58 kWh/m²	0 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.1 tonnes	0.0 tonnes
CO2 emissions per m²	12 kg/m²	12 kg/m²	0 kg/m²
Primary energy	64 kWh/m²	64 kWh/m²	0 kWh/m²

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1784	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.3284	(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) =	0.3038	(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	0.3873	0.3797	0.3721	0.3341	0.3265	0.2886	0.2886	0.2810	0.3038	0.3265	0.3417	0.3569	(22b)
Effective ac	0.5750	0.5721	0.5692	0.5558	0.5533	0.5416	0.5416	0.5395	0.5461	0.5533	0.5584	0.5637	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3	Sill	7.2000	0.0400	0.2880
E4	Jamb	33.9800	0.0500	1.6990
E5	Ground floor (normal)	26.4300	0.1600	4.2288
E6	Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11	Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14	Flat roof	9.6500	0.0600	0.5790
P1	Party wall - Ground floor	2.5500	0.0800	0.2040
P2	Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5	Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16	Corner (normal)	26.8600	0.0900	2.4174
E17	Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18	Party wall between dwellings	9.2400	0.0600	0.5544
R7	Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1	Head of roof window	1.8000	0.2400	0.4320
R9	Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3	Jamb of roof window	2.4000	0.2400	0.5760
R2	Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.3393 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	83.4025 (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	42.5473	42.3318	42.1205	41.1284	40.9428	40.0787	40.0787	39.9186	40.4115	40.9428	41.3183	41.7109	(38)
Heat transfer coeff	125.9498	125.7343	125.5230	124.5309	124.3453	123.4812	123.4812	123.3212	123.8140	124.3453	124.7208	125.1134	(39)
Average = Sum(39)m / 12 =												124.5300	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3797	1.3773	1.3750	1.3641	1.3621	1.3526	1.3526	1.3509	1.3563	1.3621	1.3662	1.3705	(40)
HLP (average)												1.3641	
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 2.6430 (42)
Hot water usage for mixer showers
68.5337 67.5037 66.0029 63.1314 61.0123 58.6491 57.3058 58.7953 60.4280 62.9654 65.8986 68.2711 (42a)
Hot water usage for baths
29.5949 29.1554 28.5365 27.3952 26.5407 25.5932 25.0813 25.6960 26.3652 27.3791 28.5438 29.4949 (42b)
Hot water usage for other uses
41.6966 40.1804 38.6642 37.1479 35.6317 34.1154 34.1154 35.6317 37.1479 38.6642 40.1804 41.6966 (42c)
Average daily hot water use (litres/day) 128.5309 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m													
	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
										Total per year (kWh/year) = Sum(64)m =		2730.0413	(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													
	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													
	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains													
	679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(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	
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183	(75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374	(79)

Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268	(83)
Total gains	954.0698	1149.1863	1319.4303	1470.6254	1563.5518	1531.9590	1472.1684	1377.3132	1278.2261	1113.8457	957.5381	897.9359	(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	43.2464	43.3205	43.3934	43.7391	43.8044	44.1110	44.1110	44.1682	43.9924	43.8044	43.6725	43.5355	
alpha	3.8831	3.8880	3.8929	3.9159	3.9203	3.9407	3.9407	3.9445	3.9328	3.9203	3.9115	3.9024	
util living area													
	0.9741	0.9490	0.9008	0.8061	0.6633	0.4967	0.3644	0.4045	0.6157	0.8515	0.9536	0.9789	(86)
MIT	19.5185	19.8211	20.2023	20.5933	20.8489	20.9628	20.9914	20.9870	20.9147	20.5635	19.9618	19.4540	(87)
Th 2	19.7790	19.7808	19.7826	19.7909	19.7925	19.7998	19.7998	19.8012	19.7970	19.7925	19.7893	19.7860	(88)
util rest of house													
	0.9672	0.9361	0.8769	0.7631	0.5976	0.4111	0.2673	0.3026	0.5266	0.8069	0.9395	0.9732	(89)
MIT 2	18.4832	18.7768	19.1381	19.4948	19.7014	19.7843	19.7978	19.7978	19.7562	19.4832	18.9252	18.4256	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.6831	18.9784	19.3436	19.7069	19.9230	20.0119	20.0283	20.0275	19.9799	19.6919	19.1254	18.6242	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6831	18.9784	19.3436	19.7069	19.9230	20.0119	20.0283	20.0275	19.9799	19.6919	19.1254	18.6242	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9590	0.9256	0.8668	0.7598	0.6051	0.4267	0.2860	0.3222	0.5410	0.8026	0.9297	0.9659	(94)
Useful gains	914.9115	1063.6779	1143.6781	1117.4199	946.1001	653.6925	421.1042	443.7508	691.4943	894.0168	890.2639	867.3348	(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													
	1811.5476	1770.1418	1612.1707	1345.7986	1022.4909	668.2633	423.3292	447.3422	728.0134	1130.5295	1499.8148	1804.6610	(97)
Space heating kWh													
	667.0973	474.7437	348.5585	164.4327	56.8347	0.0000	0.0000	0.0000	0.0000	175.9654	438.8767	697.3707	(98a)
Space heating requirement - total per year (kWh/year)												3023.8797	
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													
	667.0973	474.7437	348.5585	164.4327	56.8347	0.0000	0.0000	0.0000	0.0000	175.9654	438.8767	697.3707	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3023.8797	
Space heating per m2											(98c) / (4) =	33.1239	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												89.5000	(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													
	667.0973	474.7437	348.5585	164.4327	56.8347	0.0000	0.0000	0.0000	0.0000	175.9654	438.8767	697.3707	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	745.3601	530.4399	389.4508	183.7237	63.5025	0.0000	0.0000	0.0000	0.0000	196.6094	490.3650	779.1851	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618	(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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-40.6964	-57.8035	-83.6245	-94.3877	-101.7952	-94.9553	-93.9250	-88.9086	-79.5960	-66.5784	-44.9556	-35.1355	(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												3378.6365	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												89.5000	

Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-882.3615 (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	6032.3471 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3378.6365	3.6400	122.9824	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	3.6400	111.0318	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	16.4900	14.1814	(249)
Energy for lighting	399.7467	16.4900	65.9182	(250)
Additional standing charges			92.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	16.4900	-145.5014	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-145.5014	(252)
Total energy cost			260.6124	(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] =	0.6884 (257)
SAP value		88.8412
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	3378.6365	0.2100	709.5137	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1350.0820	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-882.3615	0.1345	-118.6698	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.6698	(269)
Total CO2, kg/year			1301.0372	(272)
CO2 emissions per m2			14.2500	(273)
EI value			87.2082	
EI rating			87	(274)
EI band			B	

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)

Ground floor	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b) -
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c) -
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286 (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)	=	0.1784 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
Infiltration rate			0.3284 (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)	=	0.3038 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.1000	3.7000	3.8000	3.2000	3.4000	3.7000	3.5000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0500	1.0000	1.0250	0.9250	0.9500	0.8000	0.8500	0.9250	0.8750	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.3189	0.3038	0.3114	0.2810	0.2886	0.2430	0.2582	0.2810	0.2658	0.2810	0.2734	0.3038	(22b)
Effective ac	0.5509	0.5461	0.5485	0.5395	0.5416	0.5295	0.5333	0.5395	0.5353	0.5395	0.5374	0.5461	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		23.3393	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	83.4025	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	40.7614	40.4115	40.5843	39.9186	40.0787	39.1825	39.4642	39.9186	39.6114	39.9186	39.7629	40.4115	(38)

Heat transfer coeff

	124.1639	123.8140	123.9868	123.3212	123.4812	122.5851	122.8667	123.3212	123.0139	123.3212	123.1654	123.8140 (39)
Average = Sum(39)m / 12 =												123.4045

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3601	1.3563	1.3582	1.3509	1.3526	1.3428	1.3459	1.3509	1.3475	1.3509	1.3492	1.3563	(40)
HLP (average)												1.3518	
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												2.6430	(42)
Hot water usage for mixer showers													
	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)
Hot water usage for baths													
	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)
Hot water usage for other uses													
	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)
Average daily hot water use (litres/day)												128.5309	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m													
	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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												0.5400	(49)
Enter (49) or (54) in (55)												0.8802	(55)
Total storage loss													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(56)
If cylinder contains dedicated solar storage													
	27.2862	24.6456	27.2862	26.4060	27.2862	26.4060	27.2862	27.2862	26.4060	27.2862	26.4060	27.2862	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(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													
	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
										Total per year (kWh/year) = Sum(64)m =		2730.0413	(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													
	114.0707	101.3156	108.5112	97.2488	95.5774	87.5246	87.2881	89.8940	89.9510	98.6475	102.9062	113.0452	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													
	153.3208	150.7673	145.8484	135.0678	128.4643	121.5620	117.3227	120.8253	124.9319	132.5907	142.9252	151.9424	(72)
Total internal gains													
	679.6141	674.4728	650.7451	609.9744	570.2355	532.9309	514.3650	520.4554	543.3709	584.0197	627.4897	663.9091	(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	
Northeast	9.9200	12.9236	0.4000	0.7000	0.7700	24.8763	(75)
Southwest	16.5200	40.4699	0.6000	1.0000	0.7700	277.9885	(79)

Solar gains	302.8647	454.9273	651.7562	867.0599	976.9804	1060.2739	1024.0038	929.4543	792.1572	562.6856	373.1787	255.7406	(83)
Total gains	982.4789	1129.4001	1302.5013	1477.0343	1547.2159	1593.2048	1538.3688	1449.9098	1335.5280	1146.7053	1000.6684	919.6497	(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	43.8684	43.9924	43.9311	44.1682	44.1110	44.4334	44.3316	44.1682	44.2785	44.1682	44.2240	43.9924	
alpha	3.9246	3.9328	3.9287	3.9445	3.9407	3.9622	3.9554	3.9445	3.9519	3.9445	3.9483	3.9328	
util living area	0.9637	0.9405	0.8745	0.7464	0.5640	0.3428	0.1994	0.2291	0.4731	0.7799	0.9291	0.9710	(86)
MIT	19.7614	19.9765	20.3851	20.7401	20.9322	20.9931	20.9995	20.9990	20.9744	20.7421	20.2102	19.6834	(87)
Th 2	19.7941	19.7970	19.7956	19.8012	19.7998	19.8075	19.8051	19.8012	19.8038	19.8012	19.8025	19.7970	(88)
util rest of house	0.9536	0.9250	0.8434	0.6919	0.4856	0.2536	0.1042	0.1277	0.3729	0.7166	0.9073	0.9627	(89)
MIT 2	18.7326	18.9401	19.3186	19.6268	19.7660	19.8058	19.8050	19.8011	19.7952	19.6388	19.1722	18.6596	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.9313	19.1402	19.5246	19.8418	19.9913	20.0351	20.0357	20.0325	20.0229	19.8519	19.3726	18.8573	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9313	19.1402	19.5246	19.8418	19.9913	20.0351	20.0357	20.0325	20.0229	19.8519	19.3726	18.8573	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9444	0.9145	0.8353	0.6939	0.4986	0.2709	0.1226	0.1473	0.3918	0.7196	0.8976	0.9543	(94)
Useful gains	927.8373	1032.8911	1088.0413	1024.8936	771.4493	431.5285	188.6458	213.5551	523.2818	825.1883	898.2147	877.6098	(95)
Ext temp.	5.5000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.7000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	1667.6865	1639.3240	1441.2975	1164.3727	801.5484	433.3450	188.6869	213.6506	531.7799	955.9704	1351.4476	1666.2053	(97)
Space heating kWh	550.4478	407.5230	262.8226	100.4249	22.3938	0.0000	0.0000	0.0000	0.0000	97.3019	326.3277	586.7151	(98a)
Space heating requirement - total per year (kWh/year)												2353.9566	
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	550.4478	407.5230	262.8226	100.4249	22.3938	0.0000	0.0000	0.0000	0.0000	97.3019	326.3277	586.7151	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2353.9566	
Space heating per m2										(98c) / (4) =		25.7855	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	89.5000	(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	550.4478	407.5230	262.8226	100.4249	22.3938	0.0000	0.0000	0.0000	0.0000	97.3019	326.3277	586.7151	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	615.0254	455.3329	293.6565	112.2066	25.0210	0.0000	0.0000	0.0000	0.0000	108.7172	364.6119	655.5476	(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	271.9976	240.5145	255.2775	223.6981	216.3788	194.4526	191.4484	199.2859	201.7497	225.6120	240.7128	268.9133	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	303.9079	268.7313	285.2263	249.9420	241.7641	217.2654	213.9088	222.6658	225.4187	252.0805	268.9529	300.4618	(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	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-44.4545	-56.7321	-83.0173	-95.2094	-101.2536	-97.4954	-96.7657	-92.6080	-83.3637	-69.8633	-49.7743	-38.1520	(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	2630.1192 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	89.5000
Water heating fuel used	3050.3255 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
central heating pump	41.0000 (230c)
main heating flue fan	45.0000 (230e)
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-908.6894 (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	5257.5019 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2630.1192	4.8000	126.2457	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	4.8000	146.4156	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	86.0000	21.5100	18.4986	(249)
Energy for lighting	399.7467	21.5100	85.9855	(250)
Additional standing charges			98.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	21.5100	-195.4591	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-195.4591	(252)
Total energy cost			279.6864	(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	2630.1192	0.2100	552.3250	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3050.3255	0.2100	640.5683	(264)
Space and water heating			1192.8934	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	0.1345	-122.2243	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-122.2243	(269)
Total CO2, kg/year			1140.2941	(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	2630.1192	1.1300	2972.0346	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3050.3255	1.1300	3446.8678	(278)
Space and water heating			6418.9024	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	399.7467	1.5338	613.1448	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-908.6894	1.4971	-1360.3943	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1360.3943	(283)
Total Primary energy kWh/year			5801.7537	(286)

APPENDIX C

Full SAP Calculation Printout

Property Reference	Unit 1	Issued on Date	03/10/2023
Assessment Reference	Unit 1 BeGreen	Prop Type Ref	Enfield
Property	Hertford Court, 19, Green Lanes, London , N13 4DD		

SAP Rating	80 C	DER	4.89	TER	13.31
Environmental	96 A	% DER < TER			63.26
CO_2 Emissions (t/year)	0.39	DFEE	42.26	TFEE	43.22
Compliance Check	See BREL	% DFEE < TFEE			2.21
% DPER < TPER	27.27	DPER	50.99	TPER	70.11

Assessor Details	Mirza Baig	Assessor ID	X001-7683
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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	70.4000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3249	0.3214	0.3180	0.3006	0.2972	0.2798	0.2798	0.2763	0.2867	0.2972	0.3041	0.3110	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)

Door			2.0900	0.9800	2.0482		(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160		(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000 (28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000 (29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200 (30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600 (30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000 (30)
Total net area of external elements Aum(A, m2)			251.7000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632		(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000 (32)
Internal Wall 1			91.2300			0.0000	0.0000 (32c)
Internal Floor 1			41.3900			18.0000	745.0200 (32d)
Internal Floor 2			22.6300			18.0000	407.3400 (32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	24.0416	23.7849	23.5282	22.2449	21.9882	20.7048	20.7048	20.4482	21.2182	21.9882	22.5016	23.0149	(38)
Heat transfer coeff	107.4441	107.1874	106.9307	105.6474	105.3907	104.1074	104.1074	103.8507	104.6207	105.3907	105.9041	106.4174	(39)

Average = Sum(39)m / 12 = 105.5832

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1770	1.1741	1.1713	1.1573	1.1545	1.1404	1.1404	1.1376	1.1460	1.1545	1.1601	1.1657	(40)
HLP (average)												1.1566	
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 2.6430 (42)
Hot water usage for mixer showers

94.2338	92.8176	90.7540	86.8057	83.8919	80.6425	78.7955	80.8435	83.0885	86.5774	90.6105	93.8727	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 152.2256 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5254	162.1534	157.9546	151.3488	146.0643	140.3511	137.9923	142.1711	146.6016	152.6206	159.3347	165.0643	(44)
Energy conte	262.1517	230.9043	242.7704	207.1890	196.6306	172.5780	166.8897	176.0376	180.7744	207.1047	227.0015	258.4507	(45)

Energy content (annual) Total = Sum(45)m = 2528.4827
Distribution loss (46)m = 0.15 x (45)m

39.3228	34.6357	36.4156	31.0783	29.4946	25.8867	25.0335	26.4056	27.1162	31.0657	34.0502	38.7676	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0260 (55)
Total storage loss

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)

If cylinder contains dedicated solar storage

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(57)
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)
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

317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(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

317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(64)

Total per year (kWh/year) = Sum(64)m = 3176.8687 (64)
12Total per year (kWh/year) 3177 (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

	105.7754	93.5847	99.3311	86.8999	83.9896	75.3918	74.1008	77.1424	78.1171	87.4722	93.4876	104.5448 (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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)

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

	121.7742	134.8215	121.7742	125.8334	121.7742	125.8334	121.7742	121.7742	125.8334	121.7742	125.8334	121.7742 (67)

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

	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785 (68)

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

	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148 (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)

	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188 (71)

Water heating gains (Table 5)

	142.1712	139.2629	133.5095	120.6944	112.8892	104.7108	99.5978	103.6860	108.4960	117.5702	129.8439	140.5172 (72)

Total internal gains

	568.0210	580.6653	555.5514	533.3552	504.5251	484.4603	464.6355	466.2185	481.4008	499.8561	533.1548	555.7145 (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	
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183	(75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374	(79)

Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268	(83)
Total gains	842.4767	1055.3788	1224.2366	1394.0062	1497.8414	1483.4883	1422.4389	1323.0762	1216.2560	1029.6821	863.2032	789.7413	(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	50.6949	50.8163	50.9383	51.5571	51.6827	52.3198	52.3198	52.4491	52.0630	51.6827	51.4321	51.1840	
alpha	4.3797	4.3878	4.3959	4.4371	4.4455	4.4880	4.4880	4.4966	4.4709	4.4455	4.4288	4.4123	
util living area	0.9803	0.9517	0.8966	0.7791	0.6162	0.4422	0.3207	0.3587	0.5687	0.8409	0.9588	0.9846	(86)
Living	19.9750	20.2182	20.4829	20.7400	20.8739	20.9209	20.9292	20.9281	20.9008	20.7025	20.2929	19.9320	
Non living	19.0216	19.2588	19.5096	19.7463	19.8530	19.8947	19.8986	19.9006	19.8798	19.7245	19.3445	18.9870	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.4756	20.2182	20.4829	20.7400	20.8739	20.9209	20.9292	20.9281	20.9008	20.7025	20.2929	20.0814	(87)
Th 2	19.9385	19.9407	19.9430	19.9543	19.9566	19.9680	19.9680	19.9703	19.9634	19.9566	19.9521	19.9475	(88)
util rest of house	0.9751	0.9401	0.8736	0.7375	0.5580	0.3738	0.2462	0.2796	0.4924	0.7983	0.9468	0.9805	(89)
MIT 2	19.4694	19.2588	19.5096	19.7463	19.8530	19.8947	19.8986	19.9006	19.8798	19.7245	19.3445	19.1214	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	19.6637	19.4441	19.6976	19.9382	20.0501	20.0929	20.0976	20.0990	20.0770	19.9134	19.5276	19.3068	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.6637	19.4441	19.6976	19.9382	20.0501	20.0929	20.0976	20.0990	20.0770	19.9134	19.5276	19.3068	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9736	0.9336	0.8676	0.7368	0.5634	0.3822	0.2556	0.2896	0.5010	0.7963	0.9409	0.9774	(94)
Useful gains	820.2003	985.2541	1062.0959	1027.1323	843.9044	566.9516	363.5272	383.0971	609.3761	819.9368	812.1626	771.9053	(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	1650.7432	1558.9452	1411.2272	1166.1613	880.0278	571.8507	364.1258	384.1465	625.3136	981.5472	1316.1364	1607.6220	(97)
Space heating kWh	617.9240	385.5204	259.7537	100.1009	26.8759	0.0000	0.0000	0.0000	0.0000	120.2381	362.8611	621.7732	(98a)

Space heating requirement - total per year (kWh/year) 2495.0473

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	617.9240	385.5204	259.7537	100.1009	26.8759	0.0000	0.0000	0.0000	0.0000	120.2381	362.8611	621.7732	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 2495.0473

Space heating per m2 (98c) / (4) = 27.3310 (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 %)												236.4675	(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													
	617.9240	385.5204	259.7537	100.1009	26.8759	0.0000	0.0000	0.0000	0.0000	120.2381	362.8611	621.7732	(98)
Space heating efficiency (main heating system 1)													
	236.4675	236.4675	236.4675	236.4675	236.4675	0.0000	0.0000	0.0000	0.0000	236.4675	236.4675	236.4675	(210)
Space heating fuel (main heating system)													
	261.3145	163.0331	109.8475	42.3318	11.3656	0.0000	0.0000	0.0000	0.0000	50.8476	153.4507	262.9423	(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													
	317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(64)
Efficiency of water heater												177.9361	(216)
(217)m	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	(217)
Fuel for water heating, kWh/month													
	178.2776	157.7216	167.3853	146.3902	141.4547	126.9389	124.7404	129.8815	131.5452	147.3412	157.5248	176.1976	(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	34.8042	31.4360	34.8042	33.6815	34.8042	33.6815	34.8042	34.8042	33.6815	34.8042	33.6815	34.8042	(231)
Lighting	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.8316	-38.0239	-58.9896	-70.8165	-80.3954	-76.4166	-75.5083	-69.0358	-57.9512	-44.9332	-28.1807	-21.1021	(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												1055.1333	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												177.9361	
Water heating fuel used												1785.3990	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.4980)													
mechanical ventilation fans (SFP = 1.4980)												409.7912	(230a)
Total electricity for the above, kWh/year												409.7912	(231)
Electricity for lighting (calculated in Appendix L)												399.7467	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-646.1847	(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												3003.8854	(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	1055.1333	0.1573	165.9859	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1785.3990	0.1410	251.7294	(264)
Space and water heating			417.7153	(265)
Pumps, fans and electric keep-hot	409.7912	0.1387	56.8431	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-646.1847	0.1332	-86.0550	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-86.0550	(269)

Total CO2, kg/year	446.1992 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)	4.8900 (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	1055.1333	1.5823	1669.5574	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1785.3990	1.5213	2716.2117	(278)
Space and water heating			4385.7691	(279)
Pumps, fans and electric keep-hot	409.7912	1.5128	619.9322	(281)
Energy for lighting	399.7467	1.5338	613.1448	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-646.1847	1.4921	-964.1797	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-964.1797	(283)
Total Primary energy kWh/year			4654.6663	(286)
Dwelling Primary energy Rate (DPER)			50.9900	(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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(22b)
Effective ac	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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			2.0900	1.0000	2.0900			(26)

TER Opening Type (Uw = 1.20)			20.7300	1.1450	23.7366	(27)
G Floor			27.2700	0.1300	3.5451	(28a)
External Wall 1	164.1100	22.8200	141.2900	0.1800	25.4322	(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968	(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264	(30)
flat roof	9.2000		9.2000	0.1100	1.0120	(30)
Total net area of external elements Aum(A, m2)			251.7000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4391	(33)
Party Wall 1			27.0000	0.0000	0.0000	(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.0500	0.7905
E3 Sill	7.2000	0.0500	0.3600
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0000	0.0000
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0800	0.7720
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0800	0.6400
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.0400	0.3116
R1 Head of roof window	1.8000	0.0800	0.1440
R9 Roof to wall (flat ceiling)	2.9500	0.0400	0.1180
R3 Jamb of roof window	2.4000	0.0800	0.1920
R2 Sill of roof window	1.8000	0.0600	0.1080

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		12.1991 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	73.6382 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	118.2160	117.9216	117.6331	116.2780	116.0245	114.8442	114.8442	114.6256	115.2988	116.0245	116.5374	117.0736	(39)

Average = Sum(39)m / 12 = 116.2768

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2950	1.2917	1.2886	1.2737	1.2709	1.2580	1.2580	1.2556	1.2630	1.2709	1.2766	1.2824	(40)
HLP (average)												1.2737	
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											2.6430	(42)
Hot water usage for mixer showers	68.5337	67.5037	66.0029	63.1314	61.0123	58.6491	57.3058	58.7953	60.4280	62.9654	65.8986	68.2711	(42a)
Hot water usage for baths	29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)
Hot water usage for other uses	41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)
Average daily hot water use (litres/day)												128.5309	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	139.8252	136.8395	133.2035	127.6746	123.1847	118.3577	116.5026	120.1229	123.9411	129.0086	134.6228	139.4626	(44)
Energy conte	221.4490	194.8577	204.7289	174.7801	165.8302	145.5346	140.8998	148.7373	152.8317	175.0634	191.7948	218.3647	(45)
Energy content (annual)										Total = Sum(45)m =		2134.8723	
Distribution loss (46)m = 0.15 x (45)m	33.2173	29.2287	30.7093	26.2170	24.8745	21.8302	21.1350	22.3106	22.9248	26.2595	28.7692	32.7547	(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	268.0439	236.9434	251.3238	219.8719	212.4252	190.6264	187.4947	195.3322	197.9236	221.6583	236.8866	264.9596	(62)
WWHRS	-31.3307	-27.7092	-29.0154	-24.0259	-22.3913	-19.1604	-17.9598	-19.0985	-19.8241	-23.3704	-26.4758	-30.7505	(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	236.7132	209.2343	222.3084	195.8460	190.0339	171.4660	169.5349	176.2337	178.0995	198.2879	210.4108	234.2091	(64)
										Total per year (kWh/year) = Sum(64)m =		2392.3777	(64)
12Total per year (kWh/year)												2392	(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	110.9077	98.4588	105.3483	94.1879	92.4145	84.4637	84.1251	86.7311	86.8900	95.4845	99.8452	109.8822	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	121.7495	134.7941	121.7495	125.8079	121.7495	125.8079	121.7495	121.7495	125.8079	121.7495	125.8079	121.7495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)													
	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)
Water heating gains (Table 5)													
	149.0695	146.5160	141.5971	130.8165	124.2130	117.3107	113.0714	116.5740	120.6806	128.3394	138.6740	147.6911	(72)
Total internal gains													
	577.8946	590.8910	566.6143	546.4517	518.8241	497.0346	478.0844	479.0817	493.5599	513.6006	544.9593	565.8637	(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	
Northeast	7.7800	11.2829	0.6300	0.7000	0.7700	26.8271	(75)
Southwest	12.9500	36.7938	0.6300	0.7000	0.7700	145.6185	(79)

Solar gains	172.4456	302.6496	437.7672	582.0875	688.1979	699.1494	667.4260	585.8278	487.3629	340.8740	208.1729	146.5275	(83)
Total gains	750.3403	893.5406	1004.3816	1128.5392	1207.0220	1196.1840	1145.5104	1064.9095	980.9228	854.4746	753.1322	712.3912	(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	46.0756	46.1906	46.3039	46.8435	46.9459	47.4284	47.4284	47.5188	47.2414	46.9459	46.7393	46.5252	
alpha	4.0717	4.0794	4.0869	4.1229	4.1297	4.1619	4.1619	4.1679	4.1494	4.1297	4.1160	4.1017	
util living area													
	0.9878	0.9750	0.9494	0.8822	0.7575	0.5805	0.4328	0.4814	0.7136	0.9154	0.9767	0.9900	(86)
MIT	19.4178	19.6808	20.0336	20.4699	20.7876	20.9475	20.9877	20.9811	20.8766	20.4527	19.8611	19.3771	(87)
Th 2	19.8448	19.8473	19.8498	19.8615	19.8637	19.8739	19.8739	19.8758	19.8699	19.8637	19.8592	19.8546	(88)
util rest of house													
	0.9844	0.9681	0.9353	0.8504	0.6975	0.4912	0.3261	0.3702	0.6278	0.8851	0.9690	0.9872	(89)
MIT 2	18.0352	18.3685	18.8096	19.3409	19.6895	19.8438	19.8698	19.8688	19.7880	19.3367	18.6080	17.9902	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.3022	18.6219	19.0459	19.5589	19.9015	20.0569	20.0857	20.0836	19.9983	19.5522	18.8500	18.2581	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3022	18.6219	19.0459	19.5589	19.9015	20.0569	20.0857	20.0836	19.9983	19.5522	18.8500	18.2581	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9778	0.9582	0.9228	0.8406	0.6997	0.5064	0.3466	0.3914	0.6385	0.8748	0.9597	0.9815	(94)
Useful gains	733.6740	856.2196	926.8771	948.6076	844.5419	605.7040	397.0205	416.8024	626.2867	747.5104	722.7697	699.1818	(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													
	1655.2824	1618.1110	1475.8185	1239.3995	951.5798	626.6958	400.3110	422.2402	680.0615	1038.6739	1369.3113	1645.8264	(97)
Space heating kWh													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(98a)
Space heating requirement - total per year (kWh/year)												3281.5256	
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													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3281.5256	
Space heating per m2											(98c) / (4) =	35.9462	(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													
	685.6766	511.9910	408.4124	209.3702	79.6362	0.0000	0.0000	0.0000	0.0000	216.6256	465.5099	704.3036	(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)													
	742.8782	554.7032	442.4836	226.8366	86.2797	0.0000	0.0000	0.0000	0.0000	234.6973	504.3444	763.0592	(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													
	236.7132	209.2343	222.3084	195.8460	190.0339	171.4660	169.5349	176.2337	178.0995	198.2879	210.4108	234.2091	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.3021	85.9866	85.4050	84.2098	82.2621	79.8000	79.8000	79.8000	79.8000	84.2586	85.7881	86.3691	(217)
Fuel for water heating, kWh/month													
	274.2843	243.3336	260.2991	232.5691	231.0102	214.8697	212.4498	220.8442	223.1823	235.3327	245.2680	271.1723	(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	25.2971	20.2943	18.2728	13.3874	10.3408	8.4485	9.4332	12.2617	15.9267	20.8967	23.6028	26.0002	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-27.9867	-40.8141	-60.6587	-70.5858	-78.1627	-73.6801	-72.7534	-67.6575	-59.0345	-47.7030	-31.2385	-24.0384	(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	-11.9419	-25.4805	-51.3225	-78.0911	-104.2557	-105.1383	-103.9259	-87.5574	-63.5874	-36.7979	-16.0574	-9.4187	(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	3555.2823	(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	2864.6152	(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)	204.1625	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1347.8881	(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	5362.1719	(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	3555.2823	0.2100	746.6093	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2864.6152	0.2100	601.5692	(264)
Space and water heating			1348.1785	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	204.1625	0.1443	29.4670	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-654.3134	0.1339	-87.6041	
PV Unit electricity exported	-693.5747	0.1255	-87.0509	
Total			-174.6549	(269)
Total CO2, kg/year			1214.9197	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.3100	(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	3555.2823	1.1300	4017.4690	(275)
Total CO2 associated with community systems			0.0000	(473)

Water heating (other fuel)	2864.6152	1.1300	3237.0152 (278)
Space and water heating			7254.4841 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	204.1625	1.5338	313.1512 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-654.3134	1.4948	-978.0574
PV Unit electricity exported	-693.5747	0.4607	-319.5235
Total			-1297.5809 (283)
Total Primary energy kWh/year			6400.1552 (286)
Target Primary Energy Rate (TPER)			70.1100 (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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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)	=	0.1338 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			3.0000 (17)
Infiltration rate			0.2838 (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)	=	0.2625 (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	0.3347	0.3281	0.3216	0.2888	0.2822	0.2494	0.2494	0.2428	0.2625	0.2822	0.2953	0.3084	(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	0.5560	0.5538	0.5517	0.5417	0.5398	0.5311	0.5311	0.5295	0.5345	0.5398	0.5436	0.5476	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)

Internal Wall 1	91.2300	0.0000	0.0000 (32c)
Internal Floor 1	41.3900	18.0000	745.0200 (32d)
Internal Floor 2	22.6300	18.0000	407.3400 (32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	41.1423	40.9813	40.8236	40.0826	39.9440	39.2987	39.2987	39.1792	39.5472	39.9440	40.2245	40.5177	(38)
Heat transfer coeff	124.5448	124.3839	124.2261	123.4852	123.3465	122.7012	122.7012	122.5817	122.9498	123.3465	123.6270	123.9202	(39)

Average = Sum(39)m / 12 = 123.4845

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3643	1.3625	1.3608	1.3527	1.3512	1.3441	1.3441	1.3428	1.3468	1.3512	1.3542	1.3574	(40)
HLP (average)												1.3527	
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 2.6430 (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

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 65.3452 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.2916	69.3358	67.2006	64.5432	62.1724	59.7086	59.1968	61.3276	63.5131	66.0432	68.7242	71.1915	(44)
Energy conte	112.9084	98.7333	103.2849	88.3564	83.6960	73.4187	71.5934	75.9364	78.3180	89.6200	97.9102	111.4687	(45)

Energy content (annual) Total = Sum(45)m = 1085.2444
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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(64)

Total per year (kWh/year) = Sum(64)m = 922.4577 (64)
12Total per year (kWh/year) 922 (64)
Electric shower(s)

54.8840	48.9021	53.3993	50.9583	51.9145	49.5214	51.1721	51.9145	50.9583	53.3993	52.3951	54.8840	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 624.3027 (64a)
Heat gains from water heating, kWh/month

37.7141	33.2064	35.2978	31.5153	30.7640	27.9818	28.0066	29.1151	29.3821	32.3941	33.9047	37.4081	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)

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

	121.7742	134.8215	121.7742	125.8334	121.7742	125.8334	121.7742	121.7742	125.8334	121.7742	125.8334	121.7742 (67)

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

	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785 (68)

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

	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148 (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)

	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188 (71)

Water heating gains (Table 5)

	50.6909	49.4142	47.4433	43.7712	41.3495	38.8636	37.6433	39.1332	40.8085	43.5404	47.0899	50.2797 (72)

Total internal gains

	476.5408	490.8166	469.4852	456.4320	432.9853	418.6131	402.6810	401.6656	413.7134	425.8263	450.4008	465.4770 (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	
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183	(75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374	(79)

Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268	(83)
Total gains	750.9965	965.5301	1138.1705	1317.0831	1426.3016	1417.6411	1360.4844	1258.5234	1148.5686	955.6523	780.4492	699.5038	(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	43.7342	43.7908	43.8464	44.1095	44.1591	44.3914	44.3914	44.4346	44.3016	44.1591	44.0589	43.9547	
alpha	3.9156	3.9194	3.9231	3.9406	3.9439	3.9594	3.9594	3.9623	3.9534	3.9439	3.9373	3.9303	
util living area	0.9881	0.9695	0.9321	0.8446	0.7031	0.5288	0.3906	0.4376	0.6636	0.8958	0.9751	0.9908	(86)
MIT	19.3066	19.6496	20.0622	20.5156	20.8170	20.9546	20.9892	20.9833	20.8906	20.4585	19.7858	19.2398	(87)
Th 2	19.7908	19.7922	19.7935	19.7998	19.8010	19.8065	19.8065	19.8075	19.8044	19.8010	19.7986	19.7961	(88)
util rest of house	0.9847	0.9612	0.9141	0.8062	0.6383	0.4399	0.2877	0.3291	0.5736	0.8600	0.9669	0.9882	(89)
MIT 2	18.2848	18.6218	19.0196	19.4393	19.6883	19.7871	19.8038	19.8030	19.7503	19.4037	18.7646	18.2226	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	18.4821	18.8203	19.2210	19.6471	19.9062	20.0126	20.0328	20.0309	19.9705	19.6074	18.9618	18.4191	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4821	18.8203	19.2210	19.6471	19.9062	20.0126	20.0328	20.0309	19.9705	19.6074	18.9618	18.4191	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9795	0.9525	0.9036	0.8006	0.6444	0.4558	0.3075	0.3499	0.5871	0.8530	0.9591	0.9839	(94)
Useful gains	735.6032	919.6454	1028.4981	1054.4707	919.1462	646.1775	418.3945	440.3762	674.2820	815.1682	748.5602	688.2117	(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	1766.3122	1731.4639	1580.2754	1327.1115	1012.2123	664.1293	421.2048	445.0832	721.7798	1111.0301	1466.4381	1762.0302	(97)
Space heating kWh	766.8475	545.5420	410.5223	196.3014	69.2412	0.0000	0.0000	0.0000	0.0000	220.1213	516.8721	798.9210	(98a)
Space heating requirement - total per year (kWh/year)												3524.3688	
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	766.8475	545.5420	410.5223	196.3014	69.2412	0.0000	0.0000	0.0000	0.0000	220.1213	516.8721	798.9210	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3524.3688	
Space heating per m2											(98c) / (4) =	38.6063	(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	1153.3910	907.9887	931.6206	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9062	0.9458	0.9272	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1045.2393	858.7986	863.8446	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1609.0536	1544.6073	1427.8215	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	405.9463	510.2416	419.5988	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	101.4866	127.5604	104.8997	0.0000	0.0000	0.0000	0.0000 (107)

Space cooling requirement 333.9467 (107)
Energy for space heating 38.6063 (99)
Energy for space cooling 3.6581 (108)
Total 42.2644 (109)
Fabric Energy Efficiency (DFEE) 42.3 (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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	0.1338	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3838	(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) =	0.3550	(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	0.4526	0.4438	0.4349	0.3905	0.3816	0.3373	0.3373	0.3284	0.3550	0.3816	0.3994	0.4171	(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	0.6024	0.5985	0.5946	0.5762	0.5728	0.5569	0.5569	0.5539	0.5630	0.5728	0.5798	0.5870	(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			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.20)			20.7300	1.1450	23.7366			(27)
G Floor			27.2700	0.1300	3.5451			(28a)
External Wall 1	164.1100	22.8200	141.2900	0.1800	25.4322			(29a)
Insulation at rafter	40.8800		40.8800	0.1100	4.4968			(30)
Insulation at ceiling	10.2400		10.2400	0.1100	1.1264			(30)
flat roof	9.2000		9.2000	0.1100	1.0120			(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.4391			(33)
Party Wall 1			27.0000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.0500	0.7905

E3 Sill	7.2000	0.0500	0.3600	
E4 Jamb	33.9800	0.0500	1.6990	
E5 Ground floor (normal)	26.4300	0.1600	4.2288	
E6 Intermediate floor within a dwelling	41.6500	0.0000	0.0000	
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772	
E14 Flat roof	9.6500	0.0800	0.7720	
P1 Party wall - Ground floor	2.5500	0.0800	0.2040	
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000	
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0800	0.6400	
E16 Corner (normal)	26.8600	0.0900	2.4174	
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178	
E18 Party wall between dwellings	9.2400	0.0600	0.5544	
R7 Flat ceiling (inverted)	7.7900	0.0400	0.3116	
R1 Head of roof window	1.8000	0.0800	0.1440	
R9 Roof to wall (flat ceiling)	2.9500	0.0400	0.1180	
R3 Jamb of roof window	2.4000	0.0800	0.1920	
R2 Sill of roof window	1.8000	0.0600	0.1080	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.1991 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 73.6382 (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	44.5777	44.2834	43.9949	42.6398	42.3862	41.2059	41.2059	40.9874	41.6606	42.3862	42.8991	43.4353	(38)
Heat transfer coeff	118.2160	117.9216	117.6331	116.2780	116.0245	114.8442	114.8442	114.6256	115.2988	116.0245	116.5374	117.0736	(39)

Average = Sum(39)m / 12 = 116.2768

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2950	1.2917	1.2886	1.2737	1.2709	1.2580	1.2580	1.2556	1.2630	1.2709	1.2766	1.2824	(40)
HLP (average)												1.2737	
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 2.6430 (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

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 65.3452 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.2916	69.3358	67.2006	64.5432	62.1724	59.7086	59.1968	61.3276	63.5131	66.0432	68.7242	71.1915	(44)
Energy conte	112.9084	98.7333	103.2849	88.3564	83.6960	73.4187	71.5934	75.9364	78.3180	89.6200	97.9102	111.4687	(45)

Energy content (annual) Total = Sum(45)m = 1085.2444

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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(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

95.9722	83.9233	87.7921	75.1029	71.1416	62.4059	60.8544	64.5460	66.5703	76.1770	83.2237	94.7484	(64)

Total per year (kWh/year) = Sum(64)m = 922.4577 (64)

12Total per year (kWh/year) 922 (64)

Electric shower(s)

54.8840	48.9021	53.3993	50.9583	51.9145	49.5214	51.1721	51.9145	50.9583	53.3993	52.3951	54.8840	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 624.3027 (64a)

Heat gains from water heating, kWh/month

37.7141	33.2064	35.2978	31.5153	30.7640	27.9818	28.0066	29.1151	29.3821	32.3941	33.9047	37.4081	(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	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	132.1484	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	121.7495	134.7941	121.7495	125.8079	121.7495	125.8079	121.7495	121.7495	125.8079	121.7495	125.8079	121.7495	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	241.4311	243.9364	237.6231	224.1829	207.2170	191.2715	180.6189	178.1136	184.4269	197.8671	214.8330	230.7785	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	36.2148	(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)	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

	50.6909	49.4142	47.4433	43.7712	41.3495	38.8636	37.6433	39.1332	40.8085	43.5404	47.0899	50.2797 (72)
Total internal gains												
	476.5161	490.7892	469.4605	456.4065	432.9606	418.5875	402.6563	401.6409	413.6878	425.8016	450.3752	465.4523 (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
Northeast	7.7800	11.2829	0.6300	0.7000	0.7700	26.8271 (75)
Southwest	12.9500	36.7938	0.6300	0.7000	0.7700	145.6185 (79)

Solar gains	172.4456	302.6496	437.7672	582.0875	688.1979	699.1494	667.4260	585.8278	487.3629	340.8740	208.1729	146.5275 (83)
Total gains	648.9617	793.4388	907.2277	1038.4940	1121.1585	1117.7369	1070.0823	987.4687	901.0507	766.6756	658.5481	611.9798 (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	46.0756	46.1906	46.3039	46.8435	46.9459	47.4284	47.4284	47.5188	47.2414	46.9459	46.7393	46.5252	
alpha	4.0717	4.0794	4.0869	4.1229	4.1297	4.1619	4.1619	4.1679	4.1494	4.1297	4.1160	4.1017	
util living area													
	0.9927	0.9832	0.9630	0.9051	0.7893	0.6131	0.4610	0.5150	0.7527	0.9379	0.9852	0.9943	(86)
MIT	19.2934	19.5639	19.9310	20.3981	20.7498	20.9358	20.9845	20.9758	20.8484	20.3713	19.7494	19.2526	(87)
Th 2	19.8448	19.8473	19.8498	19.8615	19.8637	19.8739	19.8739	19.8758	19.8699	19.8637	19.8592	19.8546	(88)
util rest of house													
	0.9906	0.9784	0.9522	0.8775	0.7320	0.5216	0.3484	0.3979	0.6689	0.9137	0.9802	0.9926	(89)
MIT 2	18.3116	18.5809	18.9421	19.3933	19.7005	19.8446	19.8698	19.8687	19.7892	19.3811	18.7755	18.2783	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	18.5012	18.7707	19.1330	19.5874	19.9032	20.0554	20.0851	20.0825	19.9937	19.5723	18.9636	18.4665	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5012	18.7707	19.1330	19.5874	19.9032	20.0554	20.0851	20.0825	19.9937	19.5723	18.9636	18.4665	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9871	0.9724	0.9436	0.8696	0.7342	0.5372	0.3701	0.4203	0.6791	0.9059	0.9747	0.9896	(94)
Useful gains	640.5907	771.5235	856.0459	903.1146	823.1395	600.4544	396.0316	415.0258	611.9112	694.5254	641.8831	605.6315	(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													
	1678.8128	1635.6599	1486.0652	1242.7059	951.7670	626.5152	400.2395	422.1095	679.5384	1041.0062	1382.5535	1670.2292	(97)
Space heating kWh													
	772.4372	580.6996	468.7343	244.5058	95.6989	0.0000	0.0000	0.0000	0.0000	257.7817	533.2827	792.0607	(98a)
Space heating requirement - total per year (kWh/year)												3745.2009	
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													
	772.4372	580.6996	468.7343	244.5058	95.6989	0.0000	0.0000	0.0000	0.0000	257.7817	533.2827	792.0607	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3745.2009	
Space heating per m2											(98c) / (4) =	41.0253	(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	1079.5352	849.8469	871.1546	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8627	0.9175	0.8905	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	931.3154	779.7513	775.7660	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1258.5439	1205.2028	1111.0302	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	235.6045	316.5360	249.4366	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	58.9011	79.1340	62.3591	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												200.3943	(107)
Energy for space heating												41.0253	(99)
Energy for space cooling												2.1951	(108)
Total												43.2205	(109)
Fabric Energy Efficiency (TFEE)												43.2	(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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =	70.4000 (23c)

Effective ac	0.3249	0.3214	0.3180	0.3006	0.2972	0.2798	0.2798	0.2763	0.2867	0.2972	0.3041	0.3110	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880

E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	24.0416	23.7849	23.5282	22.2449	21.9882	20.7048	20.7048	20.4482	21.2182	21.9882	22.5016	23.0149	(38)
Heat transfer coeff	107.4441	107.1874	106.9307	105.6474	105.3907	104.1074	104.1074	103.8507	104.6207	105.3907	105.9041	106.4174	(39)

Average = Sum(39)m / 12 = 105.5832

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1770	1.1741	1.1713	1.1573	1.1545	1.1404	1.1404	1.1376	1.1460	1.1545	1.1601	1.1657	(40)
HLP (average)												1.1566	
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 2.6430 (42)

Hot water usage for mixer showers

94.2338	92.8176	90.7540	86.8057	83.8919	80.6425	78.7955	80.8435	83.0885	86.5774	90.6105	93.8727	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 152.2256 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5254	162.1534	157.9546	151.3488	146.0643	140.3511	137.9923	142.1711	146.6016	152.6206	159.3347	165.0643	(44)
Energy conte	262.1517	230.9043	242.7704	207.1890	196.6306	172.5780	166.8897	176.0376	180.7744	207.1047	227.0015	258.4507	(45)

Energy content (annual) Total = Sum(45)m = 2528.4827

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

39.3228	34.6357	36.4156	31.0783	29.4946	25.8867	25.0335	26.4056	27.1162	31.0657	34.0502	38.7676	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.0260 (55)

Total storage loss

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)

If cylinder contains dedicated solar storage

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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

317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(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													
317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(64)

Total per year (kWh/year) = Sum(64)m = 3176.8687 (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

105.7754	93.5847	99.3311	86.8999	83.9896	75.3918	74.1008	77.1424	78.1171	87.4722	93.4876	104.5448	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)

-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

142.1712	139.2629	133.5095	120.6944	112.8892	104.7108	99.5978	103.6860	108.4960	117.5702	129.8439	140.5172	(72)

Total internal gains

665.4645	659.9684	635.4062	592.6010	551.6604	516.0797	496.6401	503.3162	526.9349	565.9992	611.4084	649.4839	(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	
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183	(75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374	(79)

Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268	(83)
Total gains	939.9202	1134.6819	1304.0914	1453.2520	1544.9767	1515.1078	1454.4435	1360.1739	1261.7902	1095.8252	941.4568	883.5107	(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	50.6949	50.8163	50.9383	51.5571	51.6827	52.3198	52.3198	52.4491	52.0630	51.6827	51.4321	51.1840	
alpha	4.3797	4.3878	4.3959	4.4371	4.4455	4.4880	4.4880	4.4966	4.4709	4.4455	4.4288	4.4123	
util living area	0.9711	0.9392	0.8776	0.7603	0.6009	0.4335	0.3137	0.3491	0.5510	0.8165	0.9454	0.9769	(86)
Living	20.0605	20.2787	20.5291	20.7586	20.8792	20.9217	20.9293	20.9284	20.9043	20.7311	20.3546	20.0165	
Non living	19.1047	19.3158	19.5507	19.7609	19.8564	19.8951	19.8986	19.9007	19.8816	19.7471	19.4024	19.0695	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.5194	20.2787	20.5291	20.7586	20.8792	20.9217	20.9293	20.9284	20.9043	20.7311	20.3546	20.1541	(87)
Th 2	19.9385	19.9407	19.9430	19.9543	19.9566	19.9680	19.9680	19.9703	19.9634	19.9566	19.9521	19.9475	(88)
util rest of house	0.9638	0.9253	0.8520	0.7176	0.5432	0.3662	0.2408	0.2720	0.4760	0.7709	0.9303	0.9710	(89)
MIT 2	19.5120	19.3158	19.5507	19.7609	19.8564	19.8951	19.8986	19.9007	19.8816	19.7471	19.4024	19.1923	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	19.7065	19.5018	19.7396	19.9536	20.0539	20.0933	20.0977	20.0992	20.0791	19.9371	19.5863	19.3781	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7065	19.5018	19.7396	19.9536	20.0539	20.0933	20.0977	20.0992	20.0791	19.9371	19.5863	19.3781	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9619	0.9185	0.8465	0.7176	0.5488	0.3745	0.2500	0.2817	0.4847	0.7699	0.9240	0.9671	(94)
Useful gains	904.1562	1042.2398	1103.9127	1042.8021	847.8119	567.3812	363.5869	383.2237	611.5430	843.7217	869.9149	854.4616	(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	1655.3389	1565.1286	1415.7226	1167.7854	880.4239	571.8952	364.1328	384.1608	625.5361	984.0455	1322.3462	1615.2106	(97)
Space heating kWh	558.8799	351.3813	231.9866	89.9880	24.2634	0.0000	0.0000	0.0000	0.0000	104.4009	325.7505	565.9973	(98a)
Space heating requirement - total per year (kWh/year)												2252.6479	
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	558.8799	351.3813	231.9866	89.9880	24.2634	0.0000	0.0000	0.0000	0.0000	104.4009	325.7505	565.9973	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2252.6479	
Space heating per m2											(98c) / (4) =	24.6757	(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 %)	236.4675 (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	558.8799	351.3813	231.9866	89.9880	24.2634	0.0000	0.0000	0.0000	0.0000	104.4009	325.7505	565.9973	(98)
Space heating efficiency (main heating system 1)	236.4675	236.4675	236.4675	236.4675	236.4675	0.0000	0.0000	0.0000	0.0000	236.4675	236.4675	236.4675	(210)
Space heating fuel (main heating system)	236.3453	148.5960	98.1051	38.0551	10.2608	0.0000	0.0000	0.0000	0.0000	44.1502	137.7570	239.3552	(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
317.2201 280.6435 297.8388 260.4810 251.6990 225.8700 221.9581 231.1060 234.0664 262.1731 280.2935 313.5191 (64)
Efficiency of water heater
(217)m 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 177.9361 (217)
Fuel for water heating, kWh/month
178.2776 157.7216 167.3853 146.3902 141.4547 126.9389 124.7404 129.8815 131.5452 147.3412 157.5248 176.1976 (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 34.8042 31.4360 34.8042 33.6815 34.8042 33.6815 34.8042 34.8042 33.6815 34.8042 33.6815 34.8042 (231)
Lighting 49.5314 39.7359 35.7778 26.2123 20.2472 16.5421 18.4701 24.0082 31.1843 40.9154 46.2139 50.9080 (232)
Electricity generated by PVs (Appendix M) (negative quantity)
(233a)m -24.7553 -37.9032 -58.7790 -70.6691 -80.3391 -76.4166 -75.5083 -69.0358 -57.9512 -44.8254 -28.0962 -21.0451 (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 1 952.6247 (211)
Space heating fuel - main system 2 0.0000 (213)
Space heating fuel - secondary 0.0000 (215)
Efficiency of water heater 177.9361
Water heating fuel used 1785.3990 (219)
Space cooling fuel 0.0000 (221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.4980)
mechanical ventilation fans (SFP = 1.4980) 409.7912 (230a)
Total electricity for the above, kWh/year 409.7912 (231)
Electricity for lighting (calculated in Appendix L) 399.7467 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation -645.3241 (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 2902.2375 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	952.6247	16.4900	157.0878 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1785.3990	16.4900	294.4123 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	409.7912	16.4900	67.5746 (249)
Energy for lighting	399.7467	16.4900	65.9182 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-645.3241	16.4900	-106.4139
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-106.4139 (252)
Total energy cost			478.5790 (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] = 1.2641 (257)
SAP value 79.5084
SAP rating (Section 12) 80 (258)
SAP band C

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

	Energy	Emission factor	Emissions

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	952.6247	0.1574	149.9267	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1785.3990	0.1410	251.7294	(264)
Space and water heating			401.6561	(265)
Pumps, fans and electric keep-hot	409.7912	0.1387	56.8431	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-645.3241	0.1332	-85.9258	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-85.9258	(269)
Total CO2, kg/year			430.2691	(272)
CO2 emissions per m2			4.7100	(273)
EI value			95.7696	
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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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	4.1000	3.7000	3.8000	3.2000	3.4000	3.7000	3.5000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0500	1.0000	1.0250	0.9250	0.9500	0.8000	0.8500	0.9250	0.8750	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.1457	0.1388	0.1422	0.1283	0.1318	0.1110	0.1179	0.1283	0.1214	0.1283	0.1249	0.1388	(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) =	70.4000	(23c)

Effective ac	0.2937	0.2867	0.2902	0.2763	0.2798	0.2590	0.2659	0.2763	0.2694	0.2763	0.2729	0.2867	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)

Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6630			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3 Sill	7.2000	0.0400	0.2880
E4 Jamb	33.9800	0.0500	1.6990
E5 Ground floor (normal)	26.4300	0.1600	4.2288
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14 Flat roof	9.6500	0.0600	0.5790
P1 Party wall - Ground floor	2.5500	0.0800	0.2040
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16 Corner (normal)	26.8600	0.0900	2.4174
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18 Party wall between dwellings	9.2400	0.0600	0.5544
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1 Head of roof window	1.8000	0.2400	0.4320
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3 Jamb of roof window	2.4000	0.2400	0.5760
R2 Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	21.7315	21.2182	21.4749	20.4482	20.7048	19.1648	19.6782	20.4482	19.9348	20.4482	20.1915	21.2182	(38)
Heat transfer coeff	105.1340	104.6207	104.8774	103.8507	104.1074	102.5673	103.0807	103.8507	103.3373	103.8507	103.5940	104.6207	(39)
Average = Sum(39)m / 12 =												103.9576	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1516	1.1460	1.1488	1.1376	1.1404	1.1235	1.1292	1.1376	1.1320	1.1376	1.1348	1.1460	(40)
HLP (average)												1.1388	
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 2.6430 (42)
Hot water usage for mixer showers

94.2338	92.8176	90.7540	86.8057	83.8919	80.6425	78.7955	80.8435	83.0885	86.5774	90.6105	93.8727	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 152.2256 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5254	162.1534	157.9546	151.3488	146.0643	140.3511	137.9923	142.1711	146.6016	152.6206	159.3347	165.0643	(44)
Energy conte	262.1517	230.9043	242.7704	207.1890	196.6306	172.5780	166.8897	176.0376	180.7744	207.1047	227.0015	258.4507	(45)
Energy content (annual)										Total = Sum(45)m =		2528.4827	
Distribution loss (46)m = 0.15 x (45)m	39.3228	34.6357	36.4156	31.0783	29.4946	25.8867	25.0335	26.4056	27.1162	31.0657	34.0502	38.7676	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0260 (55)
Total storage loss

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)

If cylinder contains dedicated solar storage

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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

317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(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

317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(64)

Total per year (kWh/year) = Sum(64)m = 3176.8687 (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

	105.7754	93.5847	99.3311	86.8999	83.9896	75.3918	74.1008	77.1424	78.1171	87.4722	93.4876	104.5448 (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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)

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

	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)

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

	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)

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

	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)

	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

	142.1712	139.2629	133.5095	120.6944	112.8892	104.7108	99.5978	103.6860	108.4960	117.5702	129.8439	140.5172	(72)

Total internal gains

	665.4645	659.9684	635.4062	592.6010	551.6604	516.0797	496.6401	503.3162	526.9349	565.9992	611.4084	649.4839	(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	
Northeast	9.9200	12.9236	0.4000	0.7000	0.7700	24.8763	(75)
Southwest	16.5200	40.4699	0.6000	1.0000	0.7700	277.9885	(79)

Solar gains	302.8647	454.9273	651.7562	867.0599	976.9804	1060.2739	1024.0038	929.4543	792.1572	562.6856	373.1787	255.7406	(83)
Total gains	968.3292	1114.8957	1287.1624	1459.6609	1528.6408	1576.3536	1520.6439	1432.7705	1319.0921	1128.6848	984.5871	905.2245	(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	51.8088	52.0630	51.9356	52.4491	52.3198	53.1053	52.8409	52.4491	52.7096	52.4491	52.5790	52.0630	
alpha	4.4539	4.4709	4.4624	4.4966	4.4880	4.5404	4.5227	4.4966	4.5140	4.4966	4.5053	4.4709	
util living area	0.9576	0.9272	0.8425	0.6880	0.4982	0.2920	0.1694	0.1956	0.4106	0.7283	0.9125	0.9667	(86)
Living	20.2348	20.3893	20.6438	20.8353	20.9120	20.9306	20.9315	20.9311	20.9254	20.8296	20.5269	20.1801	
Non living	19.2917	19.4415	19.6711	19.8378	19.8895	19.9132	19.9087	19.9015	19.9042	19.8383	19.5820	19.2432	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.6085	20.3893	20.6438	20.8353	20.9120	20.9306	20.9315	20.9311	20.9254	20.8296	20.5269	20.2948	(87)
Th 2	19.9589	19.9634	19.9611	19.9703	19.9680	19.9817	19.9771	19.9703	19.9748	19.9703	19.9725	19.9634	(88)
util rest of house	0.9467	0.9102	0.8097	0.6370	0.4342	0.2263	0.1001	0.1211	0.3333	0.6678	0.8888	0.9580	(89)
MIT 2	19.6176	19.4415	19.6711	19.8378	19.8895	19.9132	19.9087	19.9015	19.9042	19.8383	19.5820	19.3439	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	19.8090	19.6245	19.8590	20.0304	20.0870	20.1097	20.1062	20.1003	20.1014	20.0297	19.7645	19.5276	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8090	19.6245	19.8590	20.0304	20.0870	20.1097	20.1062	20.1003	20.1014	20.0297	19.7645	19.5276	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9038	0.8062	0.6401	0.4417	0.2346	0.1089	0.1305	0.3430	0.6715	0.8832	0.9535	(94)
Useful gains	915.0102	1007.6026	1037.6917	934.3820	675.2678	369.8421	165.5644	186.9446	452.3856	757.9628	869.5608	863.1634	(95)
Ext temp.	5.5000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.7000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	1504.3583	1435.8688	1254.2253	1000.1275	685.7526	370.2363	165.5709	186.9618	454.8294	823.5068	1177.2921	1478.0346	(97)
Space heating kWh	438.4750	287.7949	161.1010	47.3368	7.8007	0.0000	0.0000	0.0000	0.0000	48.7647	221.5666	457.4642	(98a)

Space heating requirement - total per year (kWh/year) 1670.3039

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

	438.4750	287.7949	161.1010	47.3368	7.8007	0.0000	0.0000	0.0000	0.0000	48.7647	221.5666	457.4642	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 1670.3039

Space heating per m2 (98c) / (4) = 18.2967 (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 %)												236.2687	(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													
	438.4750	287.7949	161.1010	47.3368	7.8007	0.0000	0.0000	0.0000	0.0000	48.7647	221.5666	457.4642	(98)
Space heating efficiency (main heating system 1)													
	236.2687	236.2687	236.2687	236.2687	236.2687	0.0000	0.0000	0.0000	0.0000	236.2687	236.2687	236.2687	(210)
Space heating fuel (main heating system)													
	185.5832	121.8083	68.1855	20.0351	3.3016	0.0000	0.0000	0.0000	0.0000	20.6395	93.7774	193.6203	(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													
	317.2201	280.6435	297.8388	260.4810	251.6990	225.8700	221.9581	231.1060	234.0664	262.1731	280.2935	313.5191	(64)
Efficiency of water heater												178.1923	(216)
(217)m	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	(217)
Fuel for water heating, kWh/month													
	178.0212	157.4947	167.1446	146.1797	141.2513	126.7563	124.5610	129.6947	131.3560	147.1293	157.2983	175.9442	(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	34.8042	31.4360	34.8042	33.6815	34.8042	33.6815	34.8042	34.8042	33.6815	34.8042	33.6815	34.8042	(231)
Lighting	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-27.2329	-36.8157	-57.6608	-70.8936	-79.3127	-79.7811	-79.2724	-73.5181	-61.8505	-47.2285	-31.4079	-22.9929	(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												706.9510	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												178.1923	
Water heating fuel used												1782.8313	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.4980)													
mechanical ventilation fans (SFP = 1.4980)												409.7912	(230a)
Total electricity for the above, kWh/year												409.7912	(231)
Electricity for lighting (calculated in Appendix L)												399.7467	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-667.9670	(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												2631.3531	(238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	706.9510	21.5100	152.0652	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1782.8313	21.5100	383.4870	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	409.7912	21.5100	88.1461	(249)
Energy for lighting	399.7467	21.5100	85.9855	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-667.9670	21.5100	-143.6797	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-143.6797	(252)
Total energy cost			566.0041	(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	706.9510	0.1584	112.0001 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1782.8313	0.1410	251.3674 (264)
Space and water heating			363.3675 (265)
Pumps, fans and electric keep-hot	409.7912	0.1387	56.8431 (267)
Energy for lighting	399.7467	0.1443	57.6958 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-667.9670	0.1330	-88.8249
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-88.8249 (269)
Total CO2, kg/year			389.0815 (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	706.9510	1.5864	1121.5370 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1782.8313	1.5213	2712.3054 (278)
Space and water heating			3833.8424 (279)
Pumps, fans and electric keep-hot	409.7912	1.5128	619.9322 (281)
Energy for lighting	399.7467	1.5338	613.1448 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-667.9670	1.4914	-996.1786
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-996.1786 (283)
Total Primary energy kWh/year			4070.7407 (286)

SAP 10 EPC IMPROVEMENTS

Unit 1 BeGreen

Current energy efficiency rating: C 80
Current environmental impact rating: A 96

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	-£ 71	-41 kg (10.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	0.45 kg/m²	B 82	A 96
Total Savings	£71	0.45 kg/m²		

Potential energy efficiency rating: B 82
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 526 TEST (30 Aug 2023)
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	£710	£634	£76
Space heating	£240	£258	-£17
Water heating	£383	£291	£93
Lighting	£86	£86	£0
Generated (PV)	-£144	-£139	-£4
Total cost of fuels	£566	£495	£72
Total cost of uses	£565	£496	£72
Delivered energy	29 kWh/m²	25 kWh/m²	4 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.3 tonnes	0.0 tonnes
CO2 emissions per m²	4 kg/m²	4 kg/m²	0 kg/m²
Primary energy	45 kWh/m²	39 kWh/m²	5 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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	224.2286	(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) =		70.4000 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.3249	0.3214	0.3180	0.3006	0.2972	0.2798	0.2798	0.2763	0.2867	0.2972	0.3041	0.3110	(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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		214.7961 (35)

List of Thermal Bridges

		Length	Psi-value	Total
K1	Element			
E1	Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3	Sill	7.2000	0.0400	0.2880
E4	Jamb	33.9800	0.0500	1.6990

E5 Ground floor (normal)	26.4300	0.1600	4.2288	
E6 Intermediate floor within a dwelling	41.6500	0.0700	2.9155	
E11 Eaves (insulation at rafter level)	19.4300	0.0400	0.7772	
E14 Flat roof	9.6500	0.0600	0.5790	
P1 Party wall - Ground floor	2.5500	0.0800	0.2040	
P2 Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000	
P5 Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600	
E16 Corner (normal)	26.8600	0.0900	2.4174	
E17 Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178	
E18 Party wall between dwellings	9.2400	0.0600	0.5544	
R7 Flat ceiling (inverted)	7.7900	0.1200	0.9348	
R1 Head of roof window	1.8000	0.2400	0.4320	
R9 Roof to wall (flat ceiling)	2.9500	0.1200	0.3540	
R3 Jamb of roof window	2.4000	0.2400	0.5760	
R2 Sill of roof window	1.8000	0.2400	0.4320	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	24.0416	23.7849	23.5282	22.2449	21.9882	20.7048	20.7048	20.4482	21.2182	21.9882	22.5016	23.0149	(38)
Heat transfer coeff	107.4441	107.1874	106.9307	105.6474	105.3907	104.1074	104.1074	103.8507	104.6207	105.3907	105.9041	106.4174	(39)

Average = Sum(39)m / 12 = 105.5832

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1770	1.1741	1.1713	1.1573	1.1545	1.1404	1.1404	1.1376	1.1460	1.1545	1.1601	1.1657	(40)
HLP (average)												1.1566	
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 2.6430 (42)

Hot water usage for mixer showers

94.2338	92.8176	90.7540	86.8057	83.8919	80.6425	78.7955	80.8435	83.0885	86.5774	90.6105	93.8727	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 152.2256 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5254	162.1534	157.9546	151.3488	146.0643	140.3511	137.9923	142.1711	146.6016	152.6206	159.3347	165.0643	(44)
Energy conte	262.1517	230.9043	242.7704	207.1890	196.6306	172.5780	166.8897	176.0376	180.7744	207.1047	227.0015	258.4507	(45)

Energy content (annual) Total = Sum(45)m = 2528.4827

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

39.3228	34.6357	36.4156	31.0783	29.4946	25.8867	25.0335	26.4056	27.1162	31.0657	34.0502	38.7676	(46)

Water storage loss:

Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0260 (55)

Total storage loss

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)

If cylinder contains dedicated solar storage

31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(57)
Primary loss 23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	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

317.2201	280.6435	296.4431	253.7274	238.9047	213.2633	208.9312	219.0095	228.6635	260.7774	280.2935	313.5191	(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 643.0230 (H24)
Heat delivered to space heating 0.0000 (H29)
Solar input 643.0230

Solar input -0.0000	-16.1776	-59.4068	-82.5684	-109.1215	-100.7831	-100.1301	-86.8562	-59.1513	-28.8281	-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

317.2201	264.4659	237.0363	171.1590	129.7832	112.4802	108.8011	132.1534	169.5123	231.9493	280.2935	313.5191	(64)

Total per year (kWh/year) = Sum(64)m = 2468.3733 (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

105.7754	93.5847	98.2145	81.4971	73.7541	65.3064	63.6792	67.4653	73.7948	86.3556	93.4876	104.5448	(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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)

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

	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)

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

	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)

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

	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)

	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

	142.1712	139.2629	132.0087	113.1904	99.1319	90.7034	85.5903	90.6791	102.4928	116.0694	129.8439	140.5172	(72)

Total internal gains

	665.4645	659.9684	633.9054	585.0970	537.9031	502.0723	482.6326	490.3092	520.9317	564.4984	611.4084	649.4839	(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	
Northeast	9.9200	11.2829	0.4000	0.7000	0.7700	21.7183	(75)
Southwest	16.5200	36.7938	0.6000	1.0000	0.7700	252.7374	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	274.4557	474.7135	668.6852	860.6510	993.3163	999.0281	957.8034	856.8577	734.8552	529.8260	330.0484	234.0268	(83)
Total gains	939.9202	1134.6819	1302.5906	1445.7480	1531.2194	1501.1004	1440.4360	1347.1670	1255.7870	1094.3244	941.4568	883.5107	(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	50.6949	50.8163	50.9383	51.5571	51.6827	52.3198	52.3198	52.4491	52.0630	51.6827	51.4321	51.1840	
alpha	4.3797	4.3878	4.3959	4.4371	4.4455	4.4880	4.4880	4.4966	4.4709	4.4455	4.4288	4.4123	

util living area

	0.9711	0.9392	0.8780	0.7626	0.6053	0.4373	0.3167	0.3524	0.5532	0.8170	0.9454	0.9769	(86)

Living	20.0605	20.2787	20.5283	20.7564	20.8777	20.9214	20.9293	20.9283	20.9039	20.7304	20.3546	20.0165	
Non living	19.1047	19.3158	19.5499	19.7592	19.8554	19.8949	19.8986	19.9007	19.8813	19.7466	19.4024	19.0695	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.5194	20.2787	20.5283	20.7564	20.8777	20.9214	20.9293	20.9283	20.9039	20.7304	20.3546	20.1541	(87)
Th 2	19.9385	19.9407	19.9430	19.9543	19.9566	19.9680	19.9680	19.9703	19.9634	19.9566	19.9521	19.9475	(88)

util rest of house

	0.9638	0.9253	0.8524	0.7201	0.5474	0.3695	0.2431	0.2746	0.4781	0.7715	0.9303	0.9710	(89)
MIT 2	19.5120	19.3158	19.5499	19.7592	19.8554	19.8949	19.8986	19.9007	19.8813	19.7466	19.4024	19.1923	(90)
Living area fraction										fLA = Living area / (4) =		0.1931	(91)
MIT	19.7065	19.5018	19.7389	19.9518	20.0529	20.0931	20.0976	20.0991	20.0788	19.9366	19.5863	19.3781	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7065	19.5018	19.7389	19.9518	20.0529	20.0931	20.0976	20.0991	20.0788	19.9366	19.5863	19.3781	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9619	0.9185	0.8469	0.7200	0.5530	0.3779	0.2524	0.2844	0.4868	0.7705	0.9240	0.9671	(94)
Useful gains	904.1562	1042.2398	1103.1650	1040.9123	846.7183	567.1961	363.5616	383.1813	611.2758	843.2181	869.9149	854.4616	(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

	1655.3389	1565.1286	1415.6424	1167.5899	880.3131	571.8761	364.1298	384.1560	625.5086	983.9927	1322.3462	1615.2106	(97)

Space heating kWh

	558.8799	351.3813	232.4832	91.2079	24.9945	0.0000	0.0000	0.0000	0.0000	104.7364	325.7505	565.9973	(98a)

Space heating requirement - total per year (kWh/year) 2255.4310

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

	558.8799	351.3813	232.4832	91.2079	24.9945	0.0000	0.0000	0.0000	0.0000	104.7364	325.7505	565.9973	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 2255.4310

Space heating per m2 (98c) / (4) = 24.7062 (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 %)													236.4675 (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													
	558.8799	351.3813	232.4832	91.2079	24.9945	0.0000	0.0000	0.0000	0.0000	104.7364	325.7505	565.9973	(98)
Space heating efficiency (main heating system 1)													
	236.4675	236.4675	236.4675	236.4675	236.4675	0.0000	0.0000	0.0000	0.0000	236.4675	236.4675	236.4675	(210)
Space heating fuel (main heating system)													
	236.3453	148.5960	98.3151	38.5710	10.5700	0.0000	0.0000	0.0000	0.0000	44.2921	137.7570	239.3552	(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													
	317.2201	264.4659	237.0363	171.1590	129.7832	112.4802	108.8011	132.1534	169.5123	231.9493	280.2935	313.5191	(64)
Efficiency of water heater													177.9361 (216)
(217)m	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	177.9361	(217)
Fuel for water heating, kWh/month													
	178.2776	148.6297	133.2143	96.1913	72.9381	63.2138	61.1462	74.2701	95.2658	130.3554	157.5248	176.1976	(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	41.5987	37.5730	41.5987	40.2568	41.5987	40.2568	41.5987	41.5987	40.2568	41.5987	40.2568	41.5987	(231)
Lighting	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-24.7764	-37.8780	-58.2708	-69.0893	-76.9195	-72.7597	-71.8919	-66.4962	-56.8718	-44.6601	-28.1320	-21.0618	(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													953.8016 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													177.9361
Water heating fuel used													1387.2248 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.4980)													
mechanical ventilation fans (SFP = 1.4980)													409.7912 (230a)
pump for solar water heating													80.0000 (230g)
Total electricity for the above, kWh/year													489.7912 (231)
Electricity for lighting (calculated in Appendix L)													399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-628.8074 (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													2601.7569 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	953.8016	16.4900	157.2819	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1387.2248	16.4900	228.7534	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	409.7912	16.4900	67.5746	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	399.7467	16.4900	65.9182	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-628.8074	16.4900	-103.6903	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-103.6903	(252)
Total energy cost			429.0297	(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] =	1.1333 (257)
SAP value		81.6300
SAP rating (Section 12)		82 (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	953.8016	0.1574	150.0927	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1387.2248	0.1450	201.1533	(264)
Space and water heating			351.2460	(265)
Pumps, fans and electric keep-hot	489.7912	0.1387	67.9401	(267)
Energy for lighting	399.7467	0.1443	57.6958	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-628.8074	0.1334	-83.8995	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-83.8995	(269)
Total CO2, kg/year			392.9824	(272)
CO2 emissions per m2			4.3000	(273)
EI value			96.1362	
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	27.2700 (1b)	x	2.6000 (2b)	=	70.9020 (1b)	-
First floor	41.3900 (1c)	x	2.6000 (2c)	=	107.6140 (1c)	-
Second floor	22.6300 (1d)	x	2.0200 (2d)	=	45.7126 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	91.2900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		224.2286	(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	4.1000	3.7000	3.8000	3.2000	3.4000	3.7000	3.5000	3.7000	3.6000	4.0000	(22)
Wind factor	1.0500	1.0000	1.0250	0.9250	0.9500	0.8000	0.8500	0.9250	0.8750	0.9250	0.9000	1.0000	(22a)
Adj infilt rate	0.1457	0.1388	0.1422	0.1283	0.1318	0.1110	0.1179	0.1283	0.1214	0.1283	0.1249	0.1388	(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) = 70.4000 (23c)

Effective ac	0.2937	0.2867	0.2902	0.2763	0.2798	0.2590	0.2659	0.2763	0.2694	0.2763	0.2729	0.2867 (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	
Window North (Uw = 1.20)			9.9200	1.1450	11.3588			(27)
Door			2.0900	0.9800	2.0482			(26)
Windows South (Uw = 1.20)			16.5200	1.1450	18.9160			(27)
G Floor			27.2700	0.1000	2.7270	110.0000	2999.7000	(28a)
External Wall 1	164.1100	28.5300	135.5800	0.1400	18.9812	110.0000	14913.8000	(29a)
Insulation at rafter	40.8800		40.8800	0.1000	4.0880	9.0000	367.9200	(30)
Insulation at ceiling	10.2400		10.2400	0.1000	1.0240	9.0000	92.1600	(30)
flat roof	9.2000		9.2000	0.1000	0.9200	9.0000	82.8000	(30)
Total net area of external elements Aum(A, m2)			251.7000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	60.0632			(33)
Party Wall 1			27.0000	0.0000	0.0000	0.0000	0.0000	(32)
Internal Wall 1			91.2300			0.0000	0.0000	(32c)
Internal Floor 1			41.3900			18.0000	745.0200	(32d)
Internal Floor 2			22.6300			18.0000	407.3400	(32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 19608.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 214.7961 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E1	Steel lintel with perforated steel base plate	15.8100	0.5000	7.9050
E3	Sill	7.2000	0.0400	0.2880
E4	Jamb	33.9800	0.0500	1.6990
E5	Ground floor (normal)	26.4300	0.1600	4.2288
E6	Intermediate floor within a dwelling	41.6500	0.0700	2.9155
E11	Eaves (insulation at rafter level)	19.4300	0.0400	0.7772
E14	Flat roof	9.6500	0.0600	0.5790
P1	Party wall - Ground floor	2.5500	0.0800	0.2040
P2	Party wall - Intermediate floor within a dwelling	6.5500	0.0000	0.0000
P5	Party wall - Roof (insulation at rafter level)	8.0000	0.0200	0.1600
E16	Corner (normal)	26.8600	0.0900	2.4174
E17	Corner (inverted – internal area greater than external area)	12.4200	-0.0900	-1.1178
E18	Party wall between dwellings	9.2400	0.0600	0.5544
R7	Flat ceiling (inverted)	7.7900	0.1200	0.9348
R1	Head of roof window	1.8000	0.2400	0.4320
R9	Roof to wall (flat ceiling)	2.9500	0.1200	0.3540
R3	Jamb of roof window	2.4000	0.2400	0.5760
R2	Sill of roof window	1.8000	0.2400	0.4320

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 23.3393 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 83.4025 (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	21.7315	21.2182	21.4749	20.4482	20.7048	19.1648	19.6782	20.4482	19.9348	20.4482	20.1915	21.2182	(38)
Heat transfer coeff	105.1340	104.6207	104.8774	103.8507	104.1074	102.5673	103.0807	103.8507	103.3373	103.8507	103.5940	104.6207	(39)

Average = Sum(39)m / 12 = 103.9576

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1516	1.1460	1.1488	1.1376	1.1404	1.1235	1.1292	1.1376	1.1320	1.1376	1.1348	1.1460	(40)
HLP (average)												1.1388	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.6430 (42)
Hot water usage for mixer showers

94.2338	92.8176	90.7540	86.8057	83.8919	80.6425	78.7955	80.8435	83.0885	86.5774	90.6105	93.8727	(42a)

Hot water usage for baths

29.5949	29.1554	28.5365	27.3952	26.5407	25.5932	25.0813	25.6960	26.3652	27.3791	28.5438	29.4949	(42b)

Hot water usage for other uses

41.6966	40.1804	38.6642	37.1479	35.6317	34.1154	34.1154	35.6317	37.1479	38.6642	40.1804	41.6966	(42c)

Average daily hot water use (litres/day) 152.2256 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.5254	162.1534	157.9546	151.3488	146.0643	140.3511	137.9923	142.1711	146.6016	152.6206	159.3347	165.0643	(44)
Energy conte	262.1517	230.9043	242.7704	207.1890	196.6306	172.5780	166.8897	176.0376	180.7744	207.1047	227.0015	258.4507	(45)

Energy content (annual) Total = Sum(45)m = 2528.4827
Distribution loss (46)m = 0.15 x (45)m

39.3228	34.6357	36.4156	31.0783	29.4946	25.8867	25.0335	26.4056	27.1162	31.0657	34.0502	38.7676	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9000 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0260 (55)

Total storage loss
31.8060 28.7280 31.8060 30.7800 31.8060 30.7800 31.8060 31.8060 30.7800 31.8060 30.7800 31.8060 (56)
If cylinder contains dedicated solar storage
31.8060 28.7280 31.8060 30.7800 31.8060 30.7800 31.8060 31.8060 30.7800 31.8060 30.7800 31.8060 (57)
Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 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
317.2201 280.6435 296.4431 253.7274 238.9047 213.2633 208.9312 219.0095 228.6635 260.7774 280.2935 313.5191 (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 704.3027 (H24)
Heat delivered to space heating 0.0000 (H29)
Solar input 704.3027
Solar input -0.0000 -15.9237 -60.1537 -86.3344 -109.9041 -110.6413 -110.9924 -99.4803 -69.7005 -36.6127 -4.5595 -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
317.2201 264.7199 236.2893 167.3930 129.0006 102.6220 97.9387 119.5292 158.9630 224.1647 275.7340 313.5191 (64)
Total per year (kWh/year) = Sum(64)m = 2407.0937 (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
105.7754 93.5847 98.2145 81.4971 73.7541 65.3064 63.6792 67.4653 73.7948 86.3556 93.4876 104.5448 (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	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	158.5781	(66)

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

	56.5883	50.2612	40.8752	30.9451	23.1318	19.5289	21.1016	27.4287	36.8148	46.7448	54.5581	58.1610	(67)

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

	360.3449	364.0841	354.6613	334.6013	309.2792	285.4799	269.5805	265.8413	275.2641	295.3241	320.6462	344.4455	(68)

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

	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	53.5008	(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)

	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	-105.7188	(71)

Water heating gains (Table 5)

	142.1712	139.2629	132.0087	113.1904	99.1319	90.7034	85.5903	90.6791	102.4928	116.0694	129.8439	140.5172	(72)

Total internal gains

	665.4645	659.9684	633.9054	585.0970	537.9031	502.0723	482.6326	490.3092	520.9317	564.4984	611.4084	649.4839	(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	
Northeast	9.9200	12.9236	0.4000	0.7000	0.7700	24.8763	(75)
Southwest	16.5200	40.4699	0.6000	1.0000	0.7700	277.9885	(79)

Solar gains	302.8647	454.9273	651.7562	867.0599	976.9804	1060.2739	1024.0038	929.4543	792.1572	562.6856	373.1787	255.7406	(83)
Total gains	968.3292	1114.8957	1285.6616	1452.1569	1514.8835	1562.3461	1506.6364	1419.7636	1313.0889	1127.1840	984.5871	905.2245	(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	51.8088	52.0630	51.9356	52.4491	52.3198	53.1053	52.8409	52.4491	52.7096	52.4491	52.5790	52.0630	
alpha	4.4539	4.4709	4.4624	4.4966	4.4880	4.5404	4.5227	4.4966	4.5140	4.4966	4.5053	4.4709	
util living area	0.9576	0.9272	0.8430	0.6905	0.5023	0.2946	0.1710	0.1974	0.4124	0.7289	0.9125	0.9667	(86)
Living	20.2348	20.3893	20.6431	20.8338	20.9114	20.9306	20.9315	20.9311	20.9253	20.8292	20.5269	20.1801	
Non living	19.2917	19.4415	19.6705	19.8368	19.8892	19.9132	19.9087	19.9015	19.9041	19.8380	19.5820	19.2432	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.6085	20.3893	20.6431	20.8338	20.9114	20.9306	20.9315	20.9311	20.9253	20.8292	20.5269	20.2948	(87)

Th 2	19.9589	19.9634	19.9611	19.9703	19.9680	19.9817	19.9771	19.9703	19.9748	19.9703	19.9725	19.9634	(88)
util rest of house	0.9467	0.9102	0.8102	0.6396	0.4379	0.2284	0.1011	0.1222	0.3348	0.6685	0.8888	0.9580	(89)
MIT 2	19.6176	19.4415	19.6705	19.8368	19.8892	19.9132	19.9087	19.9015	19.9041	19.8380	19.5820	19.3439	(90)
Living area fraction									fLA = Living area / (4) =			0.1931	(91)
MIT	19.8090	19.6245	19.8584	20.0293	20.0866	20.1097	20.1062	20.1003	20.1014	20.0294	19.7645	19.5276	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8090	19.6245	19.8584	20.0293	20.0866	20.1097	20.1062	20.1003	20.1014	20.0294	19.7645	19.5276	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9449	0.9038	0.8067	0.6427	0.4455	0.2367	0.1099	0.1317	0.3445	0.6722	0.8832	0.9535	(94)
Useful gains	915.0102	1007.6026	1037.0845	933.2388	674.8701	369.8250	165.5641	186.9438	452.3354	757.6832	869.5608	863.1634	(95)
Ext temp.	5.5000	5.9000	7.9000	10.4000	13.5000	16.5000	18.5000	18.3000	15.7000	12.1000	8.4000	5.4000	(96)
Heat loss rate W	1504.3583	1435.8688	1254.1616	1000.0122	685.7123	370.2343	165.5709	186.9616	454.8240	823.4783	1177.2921	1478.0346	(97)
Space heating kWh	438.4750	287.7949	161.5054	48.0768	8.0666	0.0000	0.0000	0.0000	0.0000	48.9516	221.5666	457.4642	(98a)
Space heating requirement - total per year (kWh/year)												1671.9010	
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	438.4750	287.7949	161.5054	48.0768	8.0666	0.0000	0.0000	0.0000	0.0000	48.9516	221.5666	457.4642	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1671.9010	
Space heating per m2										(98c) / (4) =		18.3142	(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 %)	236.2687 (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	438.4750	287.7949	161.5054	48.0768	8.0666	0.0000	0.0000	0.0000	0.0000	48.9516	221.5666	457.4642	(98)
Space heating efficiency (main heating system 1)	236.2687	236.2687	236.2687	236.2687	236.2687	0.0000	0.0000	0.0000	0.0000	236.2687	236.2687	236.2687	(210)
Space heating fuel (main heating system)	185.5832	121.8083	68.3566	20.3484	3.4142	0.0000	0.0000	0.0000	0.0000	20.7186	93.7774	193.6203	(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	317.2201	264.7199	236.2893	167.3930	129.0006	102.6220	97.9387	119.5292	158.9630	224.1647	275.7340	313.5191	(64)
Efficiency of water heater												178.1923	(216)
(217)m	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	178.1923	(217)
Fuel for water heating, kWh/month	178.0212	148.5585	132.6035	93.9395	72.3940	57.5906	54.9624	67.0788	89.2087	125.7993	154.7395	175.9442	(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	41.5987	37.5730	41.5987	40.2568	41.5987	40.2568	41.5987	41.5987	40.2568	41.5987	40.2568	41.5987	(231)
Lighting	49.5314	39.7359	35.7778	26.2123	20.2472	16.5421	18.4701	24.0082	31.1843	40.9154	46.2139	50.9080	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-27.2601	-36.7913	-57.1173	-69.1067	-75.8374	-75.4239	-74.8757	-70.2446	-60.3938	-46.9466	-31.4372	-23.0139	(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	707.6269 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	178.1923
Water heating fuel used	1350.8402 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.4980)	
mechanical ventilation fans (SFP = 1.4980)	409.7912 (230a)

pump for solar water heating	80.0000 (230g)
Total electricity for the above, kWh/year	489.7912 (231)
Electricity for lighting (calculated in Appendix L)	399.7467 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-648.4486 (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	2299.5564 (238)

10a. Fuel costs - using BEDF prices (526)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	707.6269	21.5100	152.2106 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1350.8402	21.5100	290.5657 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	409.7912	21.5100	88.1461 (249)
Pump for solar water heating	80.0000	21.5100	17.2080 (249)
Energy for lighting	399.7467	21.5100	85.9855 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-648.4486	21.5100	-139.4813
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-139.4813 (252)
Total energy cost			494.6346 (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	707.6269	0.1584	112.0967 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1350.8402	0.1456	196.6258 (264)
Space and water heating			308.7224 (265)
Pumps, fans and electric keep-hot	489.7912	0.1387	67.9401 (267)
Energy for lighting	399.7467	0.1443	57.6958 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-648.4486	0.1333	-86.4423
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-86.4423 (269)
Total CO2, kg/year			347.9160 (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	707.6269	1.5864	1122.5709 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1350.8402	1.5384	2078.1748 (278)
Space and water heating			3200.7457 (279)
Pumps, fans and electric keep-hot	489.7912	1.5128	740.9562 (281)
Energy for lighting	399.7467	1.5338	613.1448 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-648.4486	1.4926	-967.8707
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-967.8707 (283)
Total Primary energy kWh/year			3586.9759 (286)

APPENDIX D

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.