Integration

Date
29.01.2025

22 Palace Road

Energy & Sustainability Statement

Document status

Project no	Project	Client	In conjunction with:
856	22 Palace Road London N11 2PS	TA Palace Road Limited Unit 2 Archgate Business Centre 825 High Road London N12 8UB	JG Town Planning Wohl Enterprise Hub, Redbourne Avenue, London N3 2BS

Revision	Date	Status	Prepared by	Checked by
-	29.01.2025	Issue	Jennifer Williamson	Alan Harries

Contents

Executive Summary

This Energy Assessment and Sustainability Statement has been prepared by Integration Consultancy Limited in support of the full planning application for the proposed development at 22 Palace Road in London. The development comprises the refurbishment and extension of a two-storey office building into a three-storey residential building containing two refurbished and three new-build flats, as well as the creation of communal and private gardens.

CARBON PERFORMANCE

The proposed new-build areas of the development have been shown to have:

- **65% total onsite improvement in CO_2 emissions compared to the standard set out by Part L 2021.**
- **10% energy efficiency ("Be Lean") contribution to the improvement in CO_2.**
- **55% renewable energy ("Be Green") contribution to the improvement in CO_2, compared to local policy target of 20%.**

This achieved by high-performance building fabric; passive low energy design; and low carbon building services systems, such as electric storage heaters for flexible residential space heating, mechanical ventilation with heat recovery (MVHR) and LED lighting; together with renewable energy generation, such as heat pumps for residential hot water and a 3 kWp roof-top solar PV array.

The table below shows the regulated and unregulated energy use for the new-build areas:

Carbon dioxide emissions (Tonnes CO_2 per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	2.3	1.3
After "Be Lean" (energy demand reduction)	2.1	1.3
After "Be Clean" (heat network / CHP)	2.1	1.3
After "Be Green" (renewable energy)	0.8	1.3

Table 1: New-build regulated and unregulated CO_2 emissions after each stage of the energy hierarchy

This performance can be expressed as savings between each stage in the energy hierarchy:

Regulated carbon dioxide emissions (Tonnes CO_2 per annum)	(Tonnes CO_2 per annum)	(%)
Savings from "Be Lean" (energy demand reduction)	0.2	9.6%
Savings from "Be Clean" (heat network / CHP)	0.0	0.0%
Savings from "Be Green" (renewable energy)	1.3	55.1%
Total cumulative on-site savings	1.5	64.7%

Table 2: New-build regulated CO_2 emissions savings after each stage of the energy hierarchy

SUSTAINABILITY PERFORMANCE

In addition to the low carbon performance set out above, the scheme benefits from several sustainability aspects. These include the use of water saving devices to achieve 105 litre per person per day. Health and wellbeing is supported by aspects such as high levels of fresh air provided by mechanical ventilation with heat recovery and through the provision of outdoor communal and private gardens. In terms of sustainable travel, the site has good links to low-energy public transportation, achieving a high PTAL score of 5. The scheme also provides fully covered, secure cycle storage facilities.

The scheme is also demand-side response (DSR) enabled through the provision of electric storage heaters and electric-powered individual DHW heat pumps in order to work with National Grid signalling / time of use tariffs. This supports the transition to low carbon electricity and reduces energy costs for residents. A residents' guide will be created to help residents reduce energy, water and waste, avoid overheating and keep air quality high.

1 Introduction

Integration Consultancy Limited has been appointed to undertake an Energy and Sustainability Assessment in support of the full planning application for the proposed development at 22 Palace Road in London. This report is one of several that accompany the planning application and should be read in conjunction with these documents.

The importance of developing a robust well-considered energy and sustainability strategy cannot be overstated. This strategy sets out the roadmap for the entire project and ultimately the success of the strategy will translate into the success of the building's performance on practical completion and throughout its lifecycle.

Underpinning the energy strategy is the 'Be Lean', 'Be Clean' and 'Be Green' design framework which has been adopted by the London Plan:

- 'Be Lean' (energy demand minimisation through 'passive' and 'active' design measures)
- 'Be Clean' (efficient energy supply)
- 'Be Green' (renewable energy generation)

This report sets out the scheme's energy and sustainability aspirations and demonstrates, via the approved calculation methodologies, how these will be achieved through the detailed design and construction stages.

As part of this exercise, the feasibility of implementing a variety of low carbon technologies and renewable energy systems is considered based on aspects such as site location and climate, potential carbon savings, economic viability, environmental impacts and practical aspects such as integration and maintenance considerations.

1.1 THE DEVELOPMENT SITE

The site is located at 22 Palace Road in London, N11 2PS.

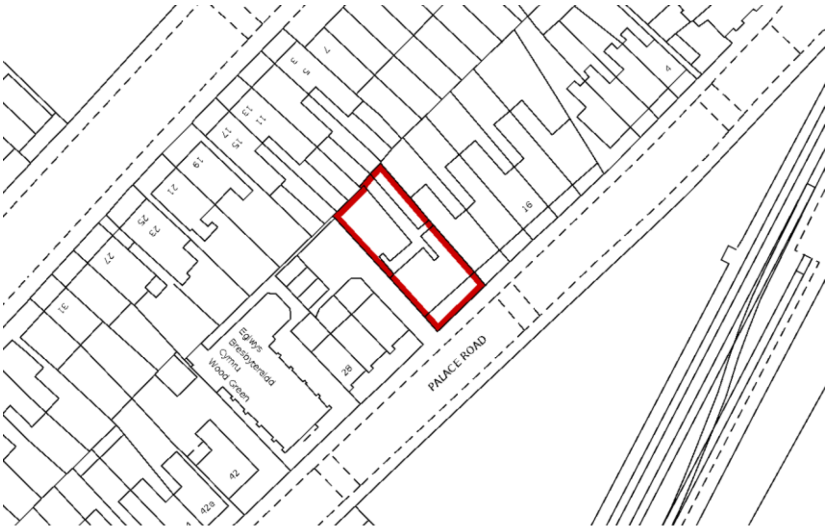

Figure 1: Site Location

1.2 PROPOSED DEVELOPMENT OVERVIEW

The development comprises the refurbishment and extension of a two-storey office building into a three-storey residential building containing two refurbished and three new-build flats, as well as the creation of communal and private gardens.

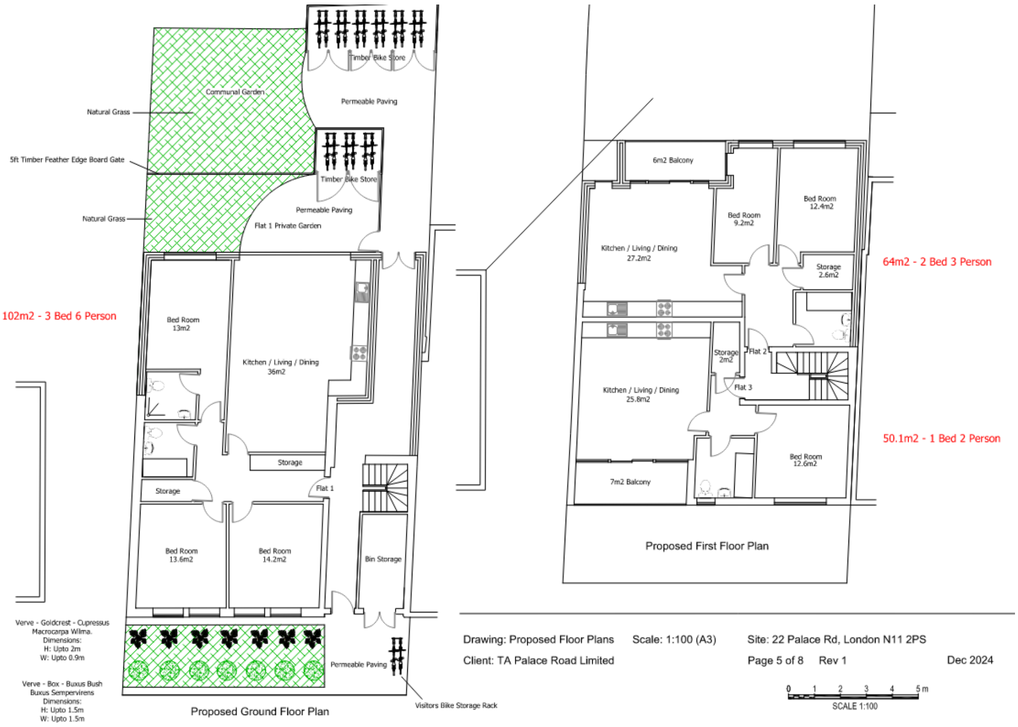

Figure 2: Proposed development scheme, ground and first floor

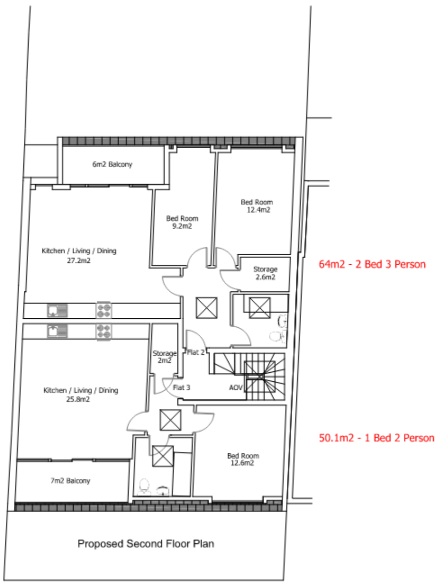

Figure 3: Proposed development scheme, second floor

Figure 4: Proposed development scheme, elevations

The proposed accommodation is summarised below.

Ref	Type	Area (m²)
Ground Floor	1 no. 3-bed flat (refurbished)	102
1st Floor	1 no. 1-bed flat (refurbished) and 1 no. 2-bed flat (new-build)	114
2nd floor	1 no. 1-bed (new-build) and 1 no. 2-bed flat (new-build)	114

Table 3: Accommodation Summary

1.3 ENERGY AND SUSTAINABILITY ASPIRATIONS

The scheme has adopted energy and sustainability targets in line with the national and local policy as detailed in section 2. These include:

Zero Fossil Fuels on site: In order to achieve zero carbon on-site by 2050, the scheme aims not to use any fossil fuels on site.

Low CO_2 emissions: Achieve a minimum on-site carbon reduction contribution as close to 100% below Part L as possible.

Renewable energy: Achieve a minimum carbon reduction of 20% from on-site renewable energy regeneration.

Flexible Energy use: The scheme aims to be able to use low-to-zero carbon electricity available at off peak periods, to charge thermal stores for space heating and hot water.

Low Water Use: Achieve at least 105l/p/d.

Sustainable Transport: Promote sustainable transport and cycle use.

2 Policy Review

2.1 NATIONAL PLANNING POLICY FRAMEWORK (NPPF – DECEMBER 2024)

Sustainable Development

The NPPF is very clear on the importance of sustainable development with the first line of the first main chapter stating "*The purpose of the planning system is to contribute to the achievement of sustainable development". Sustainable development meaning:*

a. an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;

b. a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed, beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and

c. an environmental objective – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

At the heart of the Framework is a presumption in favour of sustainable development.

Meeting the Challenge of Climate Change

Section 14 of the NPPF relates to the challenge of climate change. Paragraph 161 states:

"The planning system should support the transition to net zero by 2050 and take full account of all climate impacts including overheating, water scarcity, storm and flood risks and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Conserving and Enhancing the Natural Environment

Section 15 of the NPPF relates to conserving and enhancing the natural environment. Paragraph 192 states:

"...Opportunities to improve air quality or mitigate impacts should be identified, such as through traffic and travel management, and green infrastructure provision and enhancement. So far as possible these opportunities should be considered at the plan-making stage, to ensure a strategic approach and limit the need for issues to be reconsidered when determining individual applications..."

National Carbon Targets

The UK government declared a Climate Emergency and amended the Climate Change Act in June 2019 to set a legally-binding carbon emission target for the UK of "at least 100% of 1990 levels by 2050" i.e. net zero carbon emissions[1]. Around 20% of the UK's emissions come directly from residential energy use and government has set out a consultation process leading up to the Future Homes Standard which will define how the housing sector will respond to the emergency. This will replace Building Regulations in 2025.

[1] Climate Change Act 2008 (c. 27) as amended by The Climate Change Act 2008 (2050 Target Amendment) Order 2019 [SI 2019 No. 1056]

2.2 LONDON PLAN 2021

Regional policy in London is controlled by The Greater London Authority and is set out in The London Plan adopted on 2nd March 2021 which provides policy and guidance in the London context. One of the key overarching goals for London is to become a zero-carbon city by 2030.

Chapter 9 (Sustainable Infrastructure) of the London Plan sets out a range of policies in relation to sustainability, including air quality improvement, reducing greenhouse gas emissions, managing infrastructures, minimising waste and protecting waterways.

Policy SI 2 Minimising Greenhouse Gas Emissions refers to major developments only and so is not included here; however, it states that the energy hierarchy (Be Lean, Be Clean, Be Green) should inform the design, construction and operation of all new buildings.

Other key policies within the London Plan applicable to the proposed development and addressed in this report are:

POLICY SI 5 – WATER INFRASTRUCTURE

a. *In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.*

b. *Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient and sustainable manner taking energy consumption into account.*

c. *Development proposals should:*

- *through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)*
- *achieve at least the BREEAM excellent standard for the 'Wat 01' water category 160 or equivalent (commercial development)*
- *incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.*

2.3 HARINGEY LOCAL POLICY

The Haringey Development Management DPD was adopted in July 2017 and is supported by Haringey's Local Plan Strategic Policies 2013-2026, which was adopted in March 2013 and consolidated with alterations since 2017. The council are currently in the process of developing a new local plan, completing the 'call for sites' step in June 2024.

2.3.1 Local Plan: Development Management DPD

Policy DM21: Sustainable Design, Layout and Construction

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

  a *Apply the energy hierarchy to minimise energy use in order to meet, and if possible exceed, minimum carbon dioxide reduction requirements;*

  b *Apply the cooling hierarchy to reduce the potential for overheating and limit reliance on mechanical air conditioning systems;*

  c *Maximise opportunities to enhance biodiversity on-site, including through appropriate landscaping, Sustainable Drainage Systems, living roofs and green walls;*

  d *Wherever possible, use building materials with high environmental performance ratings; and*

  e *Seek opportunities for locally sourced labour.*

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

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

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

Policy DM22: Decentralised Energy

A Subject to other policy requirements, proposals that contribute to the provision and use of Decentralised Energy network infrastructure will be supported.

Communal energy systems

B All development that incorporates site-wide communal energy systems should examine opportunities for extending such systems, irrespective of whether it is connected to a DE network.

C All development that incorporates site-wide communal energy systems should optimise opportunities for extending such systems beyond the site boundary to supply energy to neighbouring existing and planned future developments.

Existing and planned future DE networks

D All development proposals should prioritise connection to existing or planned future DE networks.

E All major development located within 500 metres of an existing DE Network, and minor new-build development located within 25 metres, will be expected to secure connection to that network subject to demonstration of technical feasibility and financial viability.

F All major development located within 500 metres of a planned future DE Network, which is considered by the Council likely to be operational within 3 years of a grant of planning permission, will be expected to secure connection to that network subject to demonstration of technical feasibility and financial viability.

DE network 'connection zones'

G All major development located within 500 metres of a DE network 'connection zone' should be designed for connection to a DE network.

H All minor new-build development located within 25 metres of a DE network 'connection zone' should be designed for connection to a DE network. Customer charters

I Where site-wide communal and district heating systems are operational, the Council will strongly encourage heat and energy service providers to enter into customer charters with domestic and micro-business customers.

2.3.2 Local Plan: Strategic Policies Document SPD

SP4: Working towards a Low Carbon Haringey

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

1. *In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:*
    a. *From 2011 onwards, all new residential development will achieve a minimum 25% reduction in total (regulated) CO_2 emissions in line with Code for Sustainable Homes Level 4 energy standards, and should aim to achieve Level 6.*[2] *All new residential development shall be zero carbon from 2016 onwards; and*
    b. *From 2011 onwards all new non-residential development shall be built to at least BREEAM "very good" standard and should aim to achieve BREEAM "excellent" or the current nationally agreed standard. All new non-residential development shall be zero carbon from 2019.*
2. *The Council will promote low- and zero-carbon energy generation through the following measures:*
    a. *Requiring all developments to assess, identify and implement, where viable, site-wide and area-wide decentralised energy facilities including the potential to link into a wider network;*
    b. *Establishing local networks of decentralised heat and energy facilities by requiring developers to prioritise connection to existing or planned networks where feasible;*
    c. *Working with neighbouring boroughs and other partners to explore ways of implementing sub-regional decentralised energy networks including the potential in the Upper Lee Valley Opportunity Area; and*
    d. *All new developments are required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy regeneration, which can include connections to local sources of decentralised renewable energy.*

[2] It should be noted that the Code for Sustainable Homes is no longer in use.

3 Design Approach - Sustainability

3.1 WATER USE

The development adopts equipment specification in line with the higher water use standard of 105l/p/day.

Fitting	Water Consumption (residential)
WC	4 / 2.6 litres dual flush
Shower	8 litres / minute
Washbasin	5 litres / minute
Kitchen sink	6 litres / minute
Dishwasher	1.25 litres/place setting
Washing machine	8.17 litres/kg

Table 4: Minimum water fitting standards for residential units.

3.2 AIR QUALITY

Air quality is a priority for London and Policy SI 1 "Improving Air" states that developments proposals must be at least Air Quality Neutral.

The scheme supports air quality by:

- The use of electric storage heaters, heat pumps and direct electric for all space heating and hot water use which means no fossil fuel combustion on site.
- Mechanical ventilation with heat recovery (MVHR) offers a means for occupants to filter fresh air.
- Construction environmental management plan (CEMP) to incorporate best practice for air quality and dust control.

3.3 NOISE

Quality of life is improved by reducing the number of people adversely affected by noise and promoting more quiet and tranquil spaces. The scheme supports low noise impacts through high air tightness and MVHR to reduce external noise ingress for occupants.

3.4 BIODIVERSITY & URBAN GREENING

The provision of green infrastructure has been incorporated through the creation of outdoor communal and private gardens to the rear of the development as well as a front garden. Bushes will be planted in the front garden to increase biodiversity and provide new habitats for fauna. Please refer to the DAS/landscape reporting for further information.

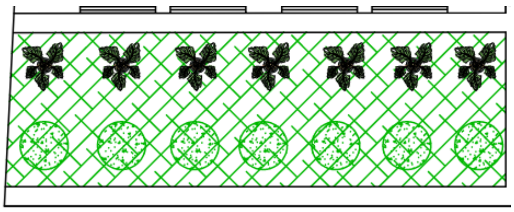

Figure 5: Front garden proposed bush species

3.5 SUSTAINABLE MATERIALS & MINIMISING WASTE

New materials will be sustainably procured and using local supplies where feasible, following the BRE Green Guide to Specification[3]. The construction build-up for each element can be rated from A+ to E where A+ is least likely to affect the environment and E is likely to have the most impact. The materials for the development will aim to achieve a rating between A to C where feasible.

All timber used during the site preparation and construction will be Forest Stewardship Council (FSC) certified or Programme for the Endorsement of Forestry Certification (PEFC) and all non-timber materials are to be sourced from organisations with an environmental management system such as ISO 14001 or BES 6001. This standard enables construction product manufacturers to ensure and then prove that their products have been made with constituent materials that have been responsibly sourced. The standard describes a framework for the organisational governance, supply chain management and environmental and social aspects that must be addressed in order to ensure the responsible sourcing of construction products.

A construction waste recycling requirement will be included in the contractor specification to ensure a construction waste management plan is in place. This will include ways to design out waste, reduce amounts of packaging and to participate in packaging take back schemes as well as ensuring that all waste is sent to private local dedicated construction waste plants with high landfill diversion rates.

The scheme has a dedicated waste storage and segregation area.

3.6 SUSTAINABLE TRANSPORT

The site has links to low energy public transportation, achieving a high PTAL score of 5. It is a 5-minute walk from Bounds Green underground station for the London Underground Piccadilly line, a 4-minute walk to Bowes Park train station for Great Northern Rail and a 1-minute walk to the closest bus stop.

The scheme also provides fully covered, secure cycle storage facilities.

3.7 DEMAND SIDE RESPONSE

Demand side flexibility refers to the ability of a system to reduce or increase energy consumption for a period of time in response to an external driver (e.g. energy prices or signals from network managers).

Smart buildings have been identified and acknowledged as key enablers of future energy systems for which there will be a larger share of distributed and renewable power and heat generation. Demand-side flexibility can allow demand/supply matching and make best use of existing network connections and local renewable energy generation capacity.

The scheme facilitates the use of Demand Side Response and reduces peak energy demand by:

- The use of thermal stores such as electric storage heaters and individual DHW heat pumps for residential space heating and hot water.
- Limiting demand such as peak solar gains (refer to cooling and overheating section).
- The installation of smart meters.
- The use of on-site generation, solar PV.

Integration has carried out a research project which quantifies the savings from flexible hot water and heating use. The study analysed real-life hourly carbon factors from the UK's electricity grid taken over a 12-month period. The graph below illustrates the diurnal cycling of carbon factors for 3 example days. As can be seen there are frequent opportunities where carbon savings can be made by using electricity during low carbon periods and avoiding use during periods where the carbon intensity is high. For instance, by charging the thermal store in an electric storage heater at night and using the energy during the day.

[3] *https://www.bregroup.com/greenguide/podpage.jsp?id=2126*

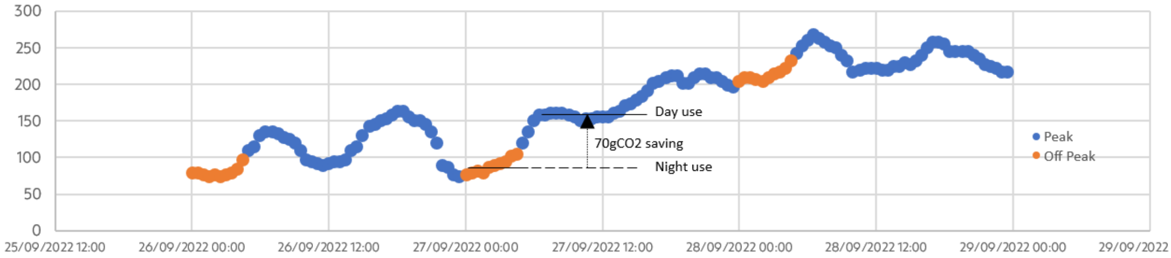

Figure 6: Example daily carbon intensity variations (example off peak thermal store charging from midnight to 4am shown in orange).

As the UK electricity grid continues to decarbonise, the performance benefits will increase significantly.

As well as saving money on energy bills by being flexible, energy users can also earn money. The first demand side response scheme has already been launched by National Grid, marking a new era of energy use. This scheme highlights the value to shifting electric use during peak times. National Grid paid £3 for each kWh shifted which is more than seven times the value of daytime electricity and more than 23 times the cost of nighttime electricity. This means shifting 1 kWh of energy use from peak times allows you to use 23 kWh at nighttime for free.

4 Design Approach - Energy

4.1 THE ENERGY HIERARCHY

The energy hierarchy, as referred to in the London Plan and illustrated below, sets out a four-stage approach to strategic decision-making for the reduction of energy and associated greenhouse gas emissions. The evaluation of the scheme's carbon emissions, as presented in the subsequent sections, follows this structure.

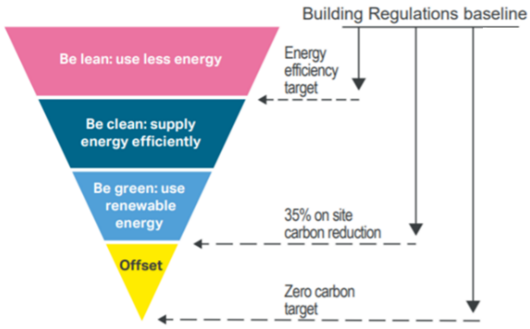

Figure 7: Energy Hierarchy Methodology

BE LEAN - Minimise Energy Demand
Passive design such as optimising form, orientation and site layout, natural ventilation with thermal mass, daylight and solar shading as well as active design measures such as LED lighting and efficient mechanical ventilation with heat recovery.

BE CLEAN - Deliver Energy Efficiently
Efficient energy provision for space heating and cooling infrastructure e.g. high efficiency cooling plant, combined heat and power (CHP) or, if available, connection to a district heating/cooling network.

BE GREEN - Use Renewable Energy
Energy supply derived from local renewable resources including solar, wind energy, hydropower and local heat sources such as geothermal energy. Provision of non-local options can also be considered.

4.2 CLIMATE ANALYSIS

The local climate is heating dominated, hence the key passive measure to be implemented are high levels of insulation and air-tightness. Temperatures in the summer can occasionally rise above comfortable levels and this will tend to intensify as a consequence of climate change and further urbanisation.

The diurnal temperature variations are high with an average daily temperature swing of 8-10°C even during peak summer. This creates potential for passive summertime cooling using night-time cooling via openable windows or mechanical ventilation.

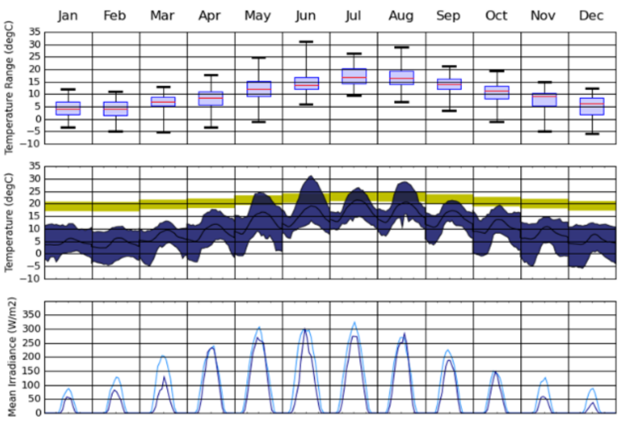

Figure 8: Average historic local climate data

4.3 BUILDING FABRIC PERFORMANCE & INSULATION

High levels of insulation are proposed as summarised later in this section. The thermal performance of all exposed elements equals or exceeds the relevant minimum requirements for Building Regulations 2021. This will significantly reduce energy consumption and ensure optimum occupant comfort all year round by retaining heat in the winter and reducing heat gains in the summer.

This is particularly relevant for glazed surfaces that can be a cause of overheating in summer or overcooling and condensation formation in winter. High-performance glazing will also improve occupant comfort by reducing radiant temperature asymmetry which can be a comfort issue especially during the winter months.

4.4 AIR TIGHTNESS, INFILTRATION AND THERMAL BRIDGING

A low target air-permeability rate has been selected for the new-build areas as summarised later in this section. The key to achieving high levels of airtightness is the build quality of construction.

Minimising thermal bridging is an important aspect of the design; see the table below for the proposed Psi values for the new-build residential units.

Thermal Bridge	Thermal Transmittance (Ψ) - residential
E2: Lintel	0.30
E3: Sill	0.04
E4: Jamb	0.05
E7: Party floor between dwellings	0.07
E14: Flat Roof	0.08
E16: Corner (normal)	0.09
E17: Corner (inverted)	-0.09
E18: Party wall between dwellings	0.06
E23: Balcony support penetrates	1.00
P4: Party wall – roof (insulation at ceiling level)	0.12
R1: Head of roof window	0.08
R2: Sill of roof window	0.06
R3: Jamb of roof window	0.08

Table 5: Proposed Psi Values for residential units

4.5 NATURAL VENTILATION

Daytime natural ventilation can assist in removing excess heat during the mid-season and summer months and enables the provision of high air quality. When used in combination with thermal mass, natural ventilation will reduce high internal daily temperature fluctuations and minimise the overheating risk in the summer. Therefore, occupant comfort can be maintained with reduced reliance on mechanical cooling systems.

4.6 SOLAR EXPOSURE & DAYLIGHT

Maximising exposure to solar energy and daylight is essential to reduce reliance on artificial lighting, reducing winter daytime heating requirements and contributing to the general wellbeing of occupants.

The site has good access to solar energy and natural daylight, as there are minimal surrounding buildings that overshadow during the main solar hours. This makes the development roof suitable for solar energy harvesting.

Fenestration on the facades maximises natural daylight to provide amenity and reduce artificial lighting energy use. Internal shading can be incorporated to minimise the risk of overheating and glare without overly compromising daylight availability.

4.7 ACTIVE BUILDING SERVICES SYSTEMS

Space heating will be provided by electric storage heaters, and domestic hot water (DHW) will be provided by individual heat pumps.

Energy use associated with DHW will be minimised by the use of water efficient fittings.

High-efficiency mechanical ventilation with heat recovery will be used throughout the development. The systems will have a summer bypass to support night-time free cooling of thermal mass.

Low-energy fixed lighting, generally comprising of high-efficiency LED fittings, will be installed throughout the development with timer, daylight dimming, and motion-sensor control as appropriate.

All building services systems will be in accordance with and exceed the relevant efficiency requirements outlined in the Building Service Compliance Guide.

4.8 COOLING & OVERHEATING

The cooling and overheating strategies are summarised in the table below using the cooling hierarchy which has been applied to the design.

Hierarchy Measure	Application to proposed development
1. Minimise Internal Heat Gains	- Low energy LED lighting. - Insulation on hot water distribution.
2. Minimise External Heat Gains	- High level of fabric insulation. - Low g-value windows 0.4.
3 & 4 Heat Management and Passive Ventilation	- Openable window areas. -Night-time ventilation strategy. -Internal blinds with light coloured external facing surfaces (with relatively high reflective properties).
5. Mechanical Ventilation	- Mechanical Ventilation with Heat Recovery (MVHR) is specified. System will have “heat recovery by-pass” mode in order to be operable in summer night-cooling mode.
6. Active Cooling	- None.

Table 6: Cooling hierarchy

5 Carbon Emissions – New-Build Dwellings

5.1 BASELINE

Energy demand and annual carbon emissions are calculated using BRE accredited energy compliance SAP 10.2 software.

The amount of carbon emission reductions achieved by the proposed scheme (new-build dwellings) is compared to the notional Target Emission Rate (TER) which forms the baseline comparison target. This notional dwelling is produced by the energy model and intends to replicate the actual dwelling in terms of area, form, orientation and usage. The fabric parameters and system efficiencies for this notional dwelling meet and, in some parts exceed, the minimum requirements for compliance with Part L of the 2021 Building Regulations as summarised in the table below.

For dwellings, within Part L1 of the Building Regulations (2021), the Target Fabric Energy Efficiency (TFEE) sits alongside the TER. The TFEE is the minimum fabric energy performance requirement for a new dwelling. The Dwelling Fabric Energy Efficiency (DFEE) rate is the actual fabric energy performance of the new dwelling. The DFEE must not exceed the TFEE. It is expressed as the amount of energy demand in kWh/(m^2.year). The notional dwelling is not prescriptive, and specifications can be varied provided that the TFEE and TER rate are achieved or bettered. To prevent poor performance of individual elements, limiting fabric values set out in approved document Part L1 and limiting building services efficiencies set out in the Domestic Building Services Compliance Guide, have been followed.

The new-build residential Notional Building baseline values are:

Element	**Notional Building value**
External Walls U-value	0.18 W/m^2/°C
Floor U-value	0.13 W/m^2/°C
Roof U-value	0.11 W/m^2/°C
Windows/Glazed Doors U-value (g-value)	1.2 W/m^2/°C (0.63)
Rooflights U-value (g-value)	1.7 W/m^2/°C (0.63)
External opaque doors U-value	1.0 W/m^2/°C
Air tightness	5.0 m^3/m^2/h @50Pa
Linear thermal transmittance	Standardised psi values SAP Appendix R
Ventilation type	Natural with intermittent extract fans
Air-conditioning	None
Heating source	Mains Gas (89.5% SEDBUK 2009)
Heating emitters and controls	Radiators. Time and temperature zone control. Weather compensation. Boiler interlock.
Hot water storage	If cylinder, declared loss factor = 0.85 x (0.2 + 0.051 $V^{2/3}$) kWh/day where V is the volume of the cylinder in litres. Separate time control.
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths. Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98.
Lighting	100% low energy lighting, (80lm/W)
Photovoltaic (PV) system	For flats: kWp = 40% of dwelling floor area / (6.5 x number of storeys in block. System facing south-east or south-west

Table 7: Notional Dwelling (Building) Specification (Table 1.1, Part L1)

5.2 "BE LEAN"

As part of the "Be Lean" approach seeking to minimise energy demand, the building fabric has been specified to meet or exceed the minimum fabric parameters outlined in Part L of the Building Regulations 2021, as per the table below.

Element	Proposed residential development
External walls U-value	0.16 $W/m^2/°C$
Roof U-value	0.10 $W/m^2/°C$
Windows U-value (g-value)	1.0 $W/m^2/°C$ (g=0.4)
Rooflights U-value (g-value)	1.0 $W/m^2/°C$ (g=0.4)
Air tightness	3.0 $m^3/m^2/h$ @50Pa
Linear thermal transmittance	Psi values in Section 4.4
Ventilation type	Mechanical ventilation with heat recovery e.g. MRXBOXAB-ECO2
Air-conditioning	None
Heating	Be Lean: Central gas-fired boiler (SEDBUK 89.5% efficient) (Be Green: Electric storage heaters with efficiency = 100%)
Hot water	Be Lean: Central gas-fired boiler (SEDBUK 89.5% efficient) (Be Green: Individual heat pumps with efficiency = 300%)
Lighting	90 lm/W
Communal corridors heated	Yes

Table 8: Proposed new-build residential development (Be Lean)

5.2.1 "Be Lean" Total Carbon Emissions

The "Be Lean" CO_2 emissions associated with regulated energy consumption, the Dwelling Emissions Rates (DER), are given below in relation to the baseline Target Emission Rates (TER). The DER has been adjusted to include the same amount of PV as in the TER.

Unit type	Total Area (m^2)	TER ($kg.CO_2/m^2/yr$)	DER ($kg.CO_2/m^2/yr$)
L02_1B2P	50 (1 unit)	13.6	12.8
L02_2B3P	128 (2 units)	12.7	11.2

Table 9: Be Lean regulated emissions for new-build dwellings

5.3 "BE CLEAN"

5.3.1 Connection to Third Party Heat Networks

The London Heat Map tool shows that the site is over 800m from any existing or proposed heat networks. As a non-major scheme, connection to third party heat networks is not considered viable for this development.

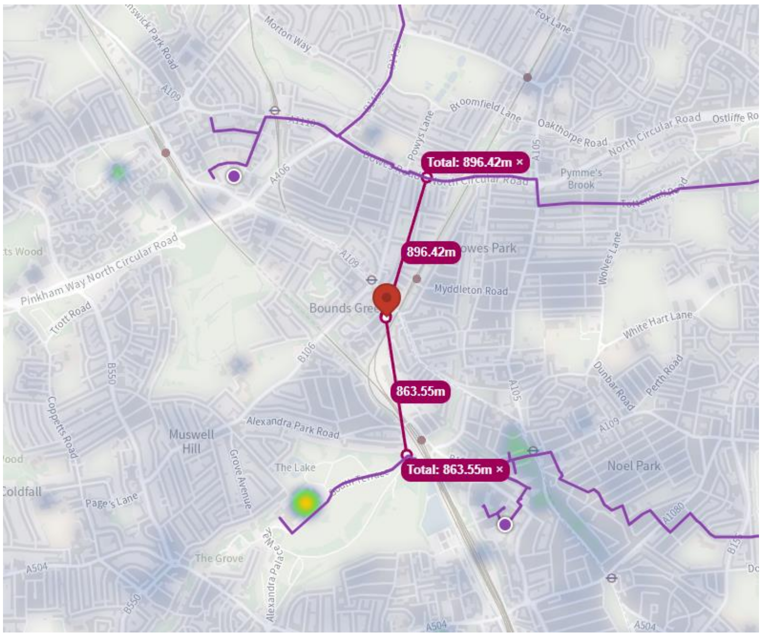

Figure 9: London Heat Map tool showing existing (red) and proposed (purple) heat networks near site.

5.4 "BE GREEN"

A renewable energy feasibility exercise has been carried out in order to determine the most viable option(s) for the development (see Appendix A). The viable technology options are air source heat pumps and solar photovoltaics (PV), and these are presented below.

5.4.1 Air Source Heat Pumps

Air source heat pumps (ASHP) extract heat energy from the air which is naturally replenished by renewable solar energy. An ASHP can create around 3kW of renewable energy for every 1kW of electrical power it consumes, which makes it one of the lowest carbon, reliable heating technologies available. The scheme will use individual heat pumps for the residential DHW.

5.4.2 Photovoltaic (PV) panels

The image below shows the amount of roof that is available within the development and that will be used to install photovoltaic modules. Local shading is considered to be very little.

Total installed capacity of the system:	3.0 kWp
Panel inclination:	15 degrees
Panel orientation:	SE
Energy generation:	1482 kWh/a
Carbon emission reduction:	0.20 tonnes of CO_2/a

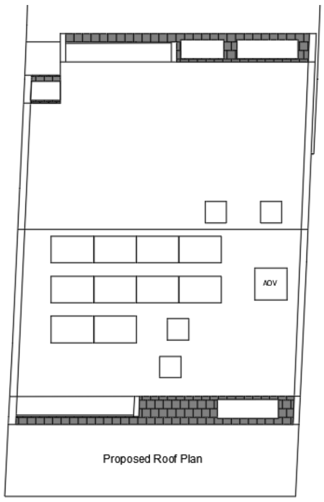

Figure 10: Indicative solar PV layout

5.4.3 "Be Green" Total Carbon Emissions

The CO_2 emissions associated with regulated energy consumption are given below.

Unit type	Area (m^2)	TER (kg.CO_2/m^2/yr.)	DER (kg.CO_2/m^2/yr.)
L02_1B2P	50 (1 unit)	13.6	4.6
L02_2B3P	128 (2 units)	12.7	4.6

Table 10: Be Green regulated emissions for new-build dwellings

6 Carbon Emissions – Refurbished Dwellings

6.1 "BE LEAN"

As part of the "Be Lean" approach seeking to minimise energy demand, the building fabric for the refurbished dwellings has been specified to meet or exceed the minimum fabric parameters outlined in Part L of the Building Regulations 2021, as per the tables below.

Element	Limiting U-values for new fabric elements in existing dwellings
External walls U-value	0.18 W/m²/°C
Floor U-value	0.18 W/m²/°C
Windows/Doors U-value	1.4 W/m²/°C

Table 11: Limiting U-values for new fabric elements in existing dwellings (Part L 2021)

Element	Limiting U-values for existing fabric elements in existing dwellings
External walls U-value (cavity insulation / internal or external insulation)	0.55 / 0/30 W/m²/°C
Floor U-value	0.25 W/m²/°C

Table 12: Limiting U-values for existing fabric elements in existing dwellings (Part L 2021)

6.2 "BE CLEAN"

Please refer to the Be Clean commentary given for the new-build dwellings carbon assessment (Section 5.3).

6.3 "BE GREEN"

Please refer to the Be Green commentary given for the new-build dwellings carbon assessment (Section 5.4).

7 Summary

7.1 SUSTAINABILITY SUMMARY

In addition to the low carbon performance set out above, the scheme benefits from several sustainability aspects. These include the use of water saving devices to achieve 105 litre per person per day. Health and wellbeing is supported by aspects such as high levels of fresh air provided by mechanical ventilation with heat recovery and through the provision of outdoor communal and private gardens. In terms of sustainable travel, the site has good links to low-energy public transportation, achieving a high PTAL score of 5. The scheme also provides fully covered, secure cycle storage facilities.

The scheme is also demand-side response (DSR) enabled through the provision of electric storage heaters and electric-powered individual DHW heat pumps in order to work with National Grid signalling / time of use tariffs. This supports the transition to low carbon electricity and reduces energy costs for residents. A residents' guide will be created to help residents reduce energy, water and waste, avoid overheating and keep air quality high.

7.2 CARBON EMISSIONS SUMMARY

He scheme uses high-performance building fabric; passive low energy design; and low carbon building services systems, such as electric storage heaters for flexible residential space heating, mechanical ventilation with heat recovery (MVHR) and LED lighting; together with renewable energy generation, such as heat pumps for residential hot water and commercial space heating, and a 3 kWp roof-top solar PV array.

The predicted total annual CO_2 emissions of the proposed new-build areas of the development following the introduction of passive design measures (Be Lean); active design measures and efficient energy provision for space heating and hot water (Be Clean); and renewable energy systems (Be Green), are summarised below.

The table below shows the regulated and unregulated energy use for the new-build areas:

Carbon dioxide emissions (Tonnes CO_2 per annum)	**Regulated**	**Unregulated**
Baseline: Part L 2021 (Building Regulations) Compliance	2.3	1.3
After "Be Lean" (energy demand reduction)	2.1	1.3
After "Be Clean" (heat network / CHP)	2.1	1.3
After "Be Green" (renewable energy)	0.8	1.3

Table 13: New-build regulated and unregulated CO_2 emissions after each stage of the energy hierarchy

This performance can be expressed as savings between each stage in the energy hierarchy:

Regulated carbon dioxide emissions (Tonnes CO_2 per annum)	**(Tonnes CO_2 per annum)**	**(%)**
Savings from "Be Lean" (energy demand reduction)	0.2	9.6%
Savings from "Be Clean" (heat network / CHP)	0.0	0.0%
Savings from "Be Green" (renewable energy)	1.3	55.1%
Total cumulative on-site savings	1.5	64.7%

Table 14: New-build regulated CO_2 emissions savings after each stage of the energy hierarchy

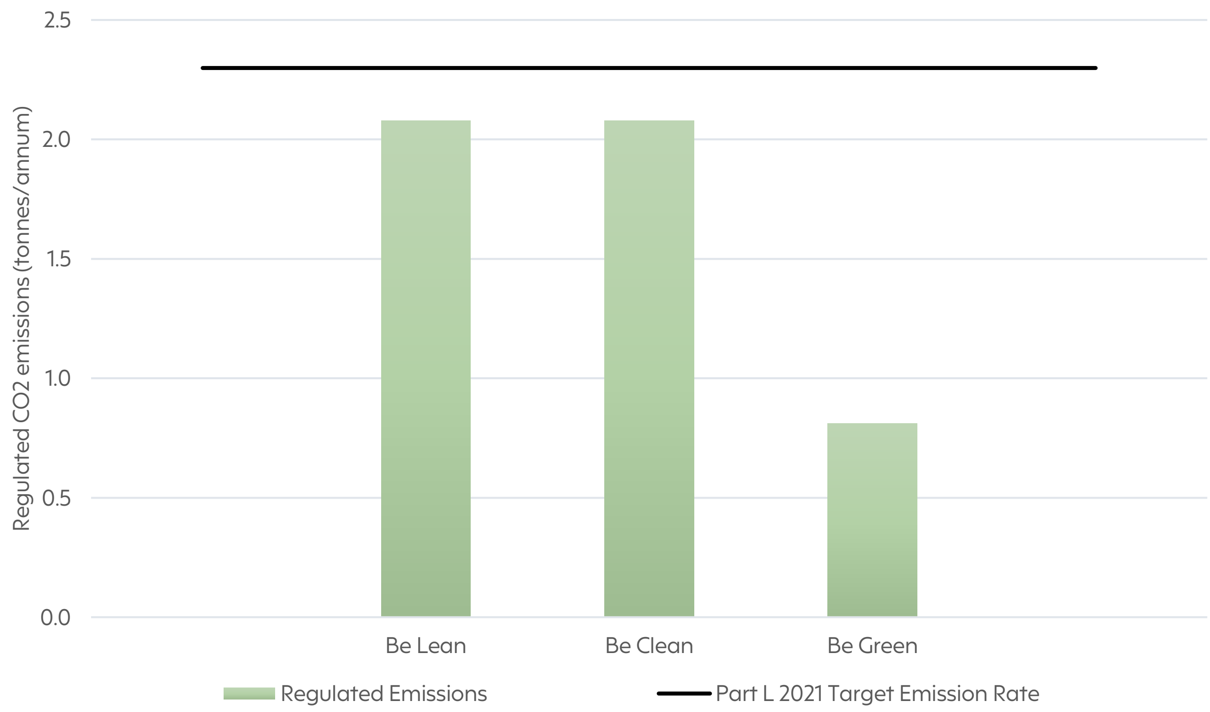

Figure 11: Summary of new-build savings from the baseline

7.3 FUTURE PROOFING TO 2050 SUMMARY

The site has been future-proofed to achieve zero carbon on-site emissions by 2050 through several mechanisms. The main strategy is by avoiding fossil fuels on site and the use of electricity for 100% of energy requirements. This means that as the UK electricity grid continues its decarbonisation towards the 2050 goal of net zero, the scheme will be able to be supplied by zero carbon electricity.

7.4 COST OF ENERGY SUMMARY

The scheme aims to protect the consumer from high prices by:

- Reducing energy demands.
- Generating energy onsite via solar PV.
- Creating building user guides to help occupants to reduce energy bills.
- Promoting the use of smart energy tariff such to provide cheaper electricity during non-peak times. This means electric storage heaters and DHW heat pumps can be charged at night when electricity costs are much lower.

Appendix A: Technology Feasibility Study Summary

Technology	Assessment/Viability	
Wind Power	Wind turbine installed on the roof of the development.	Due to the high cost per kW for smaller building-mounted turbines and the impacts in terms of visual, noise and shadow flicker, wind turbines are not considered a viable technology for the development. CONCLUSION: NOT CONSIDERED FEASIBLE
Ground Source Heat Pumps	Open or closed loop GSHP system requiring extraction of ground water and / or deep boreholes.	Ground-source heat pumps are one of the lowest carbon methods of providing reliable low-carbon heat and require low maintenance. However, they have high installation costs and there is limited space available for equipment, plant and bore holes. CONCLUSION: NOT CONSIDERED FEASIBLE
Air Source Heat Pumps	Electric powered external plant serving each unit providing heating and hot water	Air source heat pumps are one of the lowest carbon methods of providing reliable low-carbon heat. They require low maintenance. External visual or noise impacts can be suitably mitigated by an acoustic enclosure. **CONCLUSION: CONSIDERED FEASIBLE**
Solar Thermal Collectors	Roof-mounted solar thermal panels providing hot water heating	Roof areas have some potential for solar thermal energy collection. However, the integration with a heat pump would result in a complex system. Therefore, solar PV is preferred over solar thermal technology. CONCLUSION: NOT CONSIDERED FEASIBLE
Solar Photovoltaic Panels	Roof-mounted Photovoltaic panels (PV) provide electricity directly to the scheme, exporting any surplus production to the grid.	The roof has some potential for solar PV. This technology also supports air source heat pumps. **CONCLUSION: CONSIDERED FEASIBLE**
Combined Heat & Power (CHP)	Gas powered turbine generating electricity on site. Waste heat is also made available for on-site use	Carbon offsetting potential of CHP is significantly reduced now that the UK's electricity grid is much cleaner after the increase in renewable energy deployment and decrease in coal generation. CONCLUSION: NOT CONSIDERED FEASIBLE
Energy Storage	Stand-alone battery storage	Battery scheme is not considered beneficial as there are limited carbon saving benefits due to the significant energy use on site relative to the amount of PV installed. In addition, batteries have high embodied carbon emissions and initial capital costs. CONCLUSION: NOT CONSIDERED FEASIBLE
Biomass Heating	Biomass-fired community heating system.	Biomass heating is an established technology but has high maintenance requirements, fuel storage and delivery issues and is a source of increase in pollution, notably particulates (PM10), SO_2 and NOX emissions. CONCLUSION: NOT CONSIDERED FEASIBLE

Table A1: Summary of Low and Zero Carbon Study Analysis Results

Appendix B: SAP Datasheets

This appendix contains the Be Lean and Be Green SAP datasheets for an example new-build unit.

Full SAP Calculation Printout

Property Reference	L02_2B3P	Issued on Date	29/01/2025
Assessment Reference	Be Green	Prop Type Ref	L02_2B3P
Property	22, Palace Road, London, N11 2PS		

SAP Rating	85 B	DER	4.56	TER	12.58
Environmental	97 A	% DER < TER			63.75
CO_2 Emissions (t/year)	0.22	DFEE	33.21	TFEE	36.24
Compliance Check	See BREL	% DFEE < TFEE			8.38
% DPER < TPER	29.24	DPER	46.84	TPER	66.20

Assessor Details	Dr. Alan Harries	Assessor ID	BC24-0001
Client			

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2862	0.2825	0.2787	0.2600	0.2562	0.2375	0.2375	0.2337	0.2450	0.2562	0.2637	0.2712	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.9216	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200

	Length	Psi	L x Psi
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.4330 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 34.2343 (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	15.1140	14.9160	14.7180	13.7280	13.5300	12.5400	12.5400	12.3420	12.9360	13.5300	13.9260	14.3220	(38)
Heat transfer coeff	49.3483	49.1503	48.9523	47.9623	47.7643	46.7743	46.7743	46.5763	47.1703	47.7643	48.1603	48.5563	(39)
Average = Sum(39)m / 12 =												47.9128	
HLP	0.7711	0.7680	0.7649	0.7494	0.7463	0.7308	0.7308	0.7278	0.7370	0.7463	0.7525	0.7587	(40)
HLP (average)												0.7486	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0922 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)

Average daily hot water use (litres/day) 102.9763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)

Energy content (annual) Total = Sum(45)m = 1710.5733
Distribution loss (46)m = 0.15 x (45)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)

Water storage loss:
Store volume 173.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9200 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0368 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(56)
If cylinder contains dedicated solar storage	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(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	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(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	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)

Total per year (kWh/year) = Sum(64)m = 2089.0053 (64)
12Total per year (kWh/year) 2089 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	59.0820	51.9593	54.5595	46.5464	44.1320	38.7008	37.4648	39.5779	40.6959	46.6482	51.1399	58.2588	(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	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	93.7703	103.8171	93.7703	96.8959	93.7703	96.8959	93.7703	93.7703	96.8959	93.7703	96.8959	93.7703	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	182.9108	184.8088	180.0258	169.8433	156.9898	144.9093	136.8388	134.9408	139.7238	149.9062	162.7598	174.8402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	79.4113	77.3204	73.3327	64.6478	59.3172	53.7511	50.3560	53.1961	56.5221	62.6991	71.0277	78.3048	(72)
Total internal gains	410.4751	420.3290	401.5115	385.7699	364.4600	349.9392	335.3478	336.2899	347.5246	360.7584	385.0661	401.2980	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	0.7700	26.3816	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	34.7681	71.1187	127.7169	207.2771	275.5151	292.2147	273.9750	220.4569	154.9872	86.9152	43.8393	28.3183	(83)

Total gains	445.2432	491.4477	529.2283	593.0470	639.9751	642.1539	609.3228	556.7468	502.5117	447.6735	428.9055	429.6163	(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	43.5621	43.7376	43.9145	44.8210	45.0068	45.9593	45.9593	46.1547	45.5735	45.0068	44.6367	44.2727	
alpha	3.9041	3.9158	3.9276	3.9881	4.0005	4.0640	4.0640	4.0770	4.0382	4.0005	3.9758	3.9515	
util living area	0.9563	0.9351	0.8950	0.7908	0.6354	0.4547	0.3350	0.3800	0.6032	0.8393	0.9313	0.9608	(86)
MIT	20.1079	20.2354	20.4193	20.6604	20.8036	20.8641	20.8752	20.8735	20.8342	20.6419	20.3534	20.0971	(87)
Th 2	20.2785	20.2812	20.2839	20.2974	20.3001	20.3137	20.3137	20.3164	20.3082	20.3001	20.2947	20.2893	(88)
util rest of house	0.9502	0.9263	0.8810	0.7657	0.5981	0.4092	0.2838	0.3253	0.5534	0.8135	0.9207	0.9553	(89)
MIT 2	19.2148	19.3767	19.6071	19.9084	20.0719	20.1464	20.1557	20.1576	20.1144	19.8950	19.5380	19.2103	(90)
Living area fraction										fLA = Living area / (4) =		0.4219	(91)
MIT	19.5916	19.7390	19.9498	20.2257	20.3806	20.4492	20.4593	20.4596	20.4180	20.2101	19.8820	19.5844	(92)
Temperature adjustment												0.4000	
adjusted MIT	19.9916	20.1390	20.3498	20.6257	20.7806	20.8492	20.8593	20.8596	20.8180	20.6101	20.2820	19.9844	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9475	0.9244	0.8824	0.7778	0.6240	0.4449	0.3246	0.3689	0.5905	0.8254	0.9205	0.9527	(94)
Useful gains	421.8843	454.3172	466.9652	461.2503	399.3275	285.6780	197.7922	205.3586	296.7273	369.5278	394.7948	409.2896	(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	774.3526	749.0020	677.9778	562.3909	433.7296	292.3023	199.2238	207.7128	316.8913	478.1256	634.8491	766.4316	(97)
Space heating kWh	262.2363	198.0282	156.9934	72.8212	25.5952	0.0000	0.0000	0.0000	0.0000	80.7968	172.8391	265.7137	(98a)
Space heating requirement - total per year (kWh/year)												1235.0239	
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	262.2363	198.0282	156.9934	72.8212	25.5952	0.0000	0.0000	0.0000	0.0000	80.7968	172.8391	265.7137	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1235.0239	
Space heating per m2										(98c) / (4) =		19.2972	(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)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	262.2363	198.0282	156.9934	72.8212	25.5952	0.0000	0.0000	0.0000	0.0000	80.7968	172.8391	265.7137	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	262.2363	198.0282	156.9934	72.8212	25.5952	0.0000	0.0000	0.0000	0.0000	80.7968	172.8391	265.7137	(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)
Space heating fuel used, main system 2												0.0000	(213)
Water heating													
Water heating requirement	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	69.2615	61.1639	64.7718	56.4748	54.4201	48.6863	47.8015	49.8992	50.6668	56.9180	61.0349	68.4442	(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	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(231)
Lighting	18.7314	15.0270	13.5302	9.9128	7.6569	6.2558	6.9849	9.0792	11.7930	15.4731	17.4768	19.2520	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-8.2026	-14.4394	-26.1365	-35.1919	-41.9663	-40.0590	-39.2388	-34.3099	-26.3913	-18.1852	-9.7543	-6.7069	(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	1235.0239	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	302.9550	
Water heating fuel used	689.5431	(219)
Space cooling fuel	0.0000	(221)

```
Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)
   mechanical ventilation fans (SFP =       0.7280)                                                                             142.1056 (230a)
Total electricity for the above, kWh/year                                                                                       142.1056 (231)
Electricity for lighting (calculated in Appendix L)                                                                             151.1730 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation                                                                                                                  -300.5822 (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                                                                                            1917.2635 (238)


----------------------------------------------------------------------------------------------------
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                                                     1235.0239              0.1560            192.6394 (261)
Space heating - main system 2                                                        0.0000              0.0000              0.0000 (262)
Total CO2 associated with community systems                                                                                  0.0000 (373)
Water heating (other fuel)                                                         689.5431              0.1411             97.2772 (264)
Space and water heating                                                                                                    289.9166 (265)
Pumps, fans and electric keep-hot                                                  142.1056              0.1387             19.7118 (267)
Energy for lighting                                                                151.1730              0.1443             21.8189 (268)

 Energy saving/generation technologies
PV Unit electricity used in dwelling                                              -300.5822              0.1314            -39.4826
PV Unit electricity exported                                                         0.0000              0.0000              0.0000
Total                                                                                                                      -39.4826 (269)
Total CO2, kg/year                                                                                                         291.9648 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)                                                                              4.5600 (273)


----------------------------------------------------------------------------------------------------
13a. Primary energy - Individual heating systems including micro-CHP
----------------------------------------------------------------------------------------------------
                                                                                     Energy Primary energy factor        Primary energy
                                                                                   kWh/year          kg CO2/kWh            kWh/year
Space heating - main system 1                                                     1235.0239              1.5775           1948.2101 (275)
Space heating - main system 2                                                        0.0000              0.0000              0.0000 (276)
Total CO2 associated with community systems                                                                                  0.0000 (473)
Water heating (other fuel)                                                         689.5431              1.5217           1049.2449 (278)
Space and water heating                                                                                                   2997.4550 (279)
Pumps, fans and electric keep-hot                                                  142.1056              1.5128            214.9774 (281)
Energy for lighting                                                                151.1730              1.5338            231.8742 (282)

 Energy saving/generation technologies
PV Unit electricity used in dwelling                                              -300.5822              1.4853           -446.4504
PV Unit electricity exported                                                         0.0000              0.0000              0.0000
Total                                                                                                                     -446.4504 (283)
Total Primary energy kWh/year                                                                                             2997.8562 (286)
Dwelling Primary energy Rate (DPER)                                                                                         46.8400 (287)


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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         Storey height              Volume
                                                                                       (m2)                   (m)                (m3)
Ground floor                                                                        64.0000 (1b)    x      2.5000 (2b)    =    160.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)               64.0000                                                             (4)
Dwelling volume                                                                         (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =    160.0000 (5)


----------------------------------------------------------------------------------------------------
2. Ventilation rate
----------------------------------------------------------------------------------------------------
                                                                                                                         m3 per hour

Number of open chimneys                                                                                         0 * 80 =      0.0000 (6a)
Number of open flues                                                                                            0 * 20 =      0.0000 (6b)
Number of chimneys / flues attached to closed fire                                                              0 * 10 =      0.0000 (6c)
Number of flues attached to solid fuel boiler                                                                   0 * 20 =      0.0000 (6d)
Number of flues attached to other heater                                                                        0 * 35 =      0.0000 (6e)
Number of blocked chimneys                                                                                      0 * 20 =      0.0000 (6f)
Number of intermittent extract fans                                                                             2 * 10 =     20.0000 (7a)
Number of passive vents                                                                                         0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                                    0 * 40 =      0.0000 (7c)

                                                                                                                Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =       20.0000 / (5) =      0.1250 (8)
Pressure test                                                                                                                    Yes
Pressure Test Method                                                                                                      Blower Door
Measured/design AP50                                                                                                          5.0000 (17)
Infiltration rate                                                                                                             0.3750 (18)
Number of sides sheltered                                                                                                          0 (19)

Shelter factor                                                                        (20) = 1  -  [0.075 x (19)]  =      1.0000 (20)
Infiltration rate adjusted to include shelter factor                                           (21) = (18) x (20)  =      0.3750 (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	0.4781	0.4688	0.4594	0.4125	0.4031	0.3562	0.3562	0.3469	0.3750	0.4031	0.4219	0.4406	(22b)
Effective ac	0.6143	0.6099	0.6055	0.5851	0.5813	0.5635	0.5635	0.5602	0.5703	0.5813	0.5890	0.5971	(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 Opening Type (Uw = 1.20)			12.0500	1.1450	13.7977			(27)
Rooflights			1.2800	2.0221	2.5882			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1800	7.5510			(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1100	6.8992			(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	30.8361			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 120.9216 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.0500	0.3500
E3 Sill	7.0000	0.0500	0.3500
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	0.0200	0.0060
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 6.4590 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 37.2951 (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	32.4351	32.2008	31.9711	30.8921	30.6903	29.7505	29.7505	29.5765	30.1125	30.6903	31.0986	31.5256	(38)
Heat transfer coeff	69.7303	69.4959	69.2662	68.1873	67.9854	67.0457	67.0457	66.8717	67.4076	67.9854	68.3938	68.8207	(39)
Average = Sum(39)m / 12 =												68.1863	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0895	1.0859	1.0823	1.0654	1.0623	1.0476	1.0476	1.0449	1.0532	1.0623	1.0687	1.0753	(40)
HLP (average)												1.0654	
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 2.0922 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												102.9763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)
Energy content (annual)											Total = Sum(45)m =	1710.5733	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	224.2852	198.3543	210.6836	185.0812	179.3226	161.4853	159.2711	165.6263	167.4855	186.8901	198.8962	221.8092	(62)
WWHRS	-34.8078	-30.7843	-32.2356	-26.6923	-24.8763	-21.2868	-19.9530	-21.2180	-22.0242	-25.9640	-29.4141	-34.1632	(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	189.4774	167.5700	178.4481	158.3888	154.4464	140.1985	139.3181	144.4082	145.4614	160.9261	169.4821	187.6460	(64)

Total per year (kWh/year) = Sum(64)m = 1935.7711 (64)
12Total per year (kWh/year) 1936 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	96.3580	85.6279	91.8354	82.6199	81.4079	74.7743	74.7408	76.8538	76.7694	83.9241	87.2134	95.5347	(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	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	92.4420	102.3465	92.4420	95.5234	92.4420	95.5234	92.4420	92.4420	95.5234	92.4420	95.5234	92.4420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	182.9108	184.8088	180.0258	169.8433	156.9898	144.9093	136.8388	134.9408	139.7238	149.9062	162.7598	174.8402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	(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)													
	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)													
	129.5134	127.4224	123.4347	114.7499	109.4192	103.8532	100.4580	103.2982	106.6241	112.8012	121.1298	128.4068	(72)
Total internal gains													
	462.2488	471.9604	453.2852	437.4993	416.2338	398.6687	384.1216	385.0637	396.2541	412.5321	436.7956	453.0718	(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	
Northwest	12.0500	11.2829	0.6300	0.7000	0.7700	41.5510	(81)
Northwest	1.2800	26.0000	0.6300	0.7000	1.0000	13.2088	(82)

Solar gains	54.7598	112.0119	201.1541	326.4615	433.9363	460.2381	431.5107	347.2196	244.1048	136.8914	69.0469	44.6013	(83)
Total gains	517.0086	583.9724	654.4393	763.9609	850.1700	858.9068	815.6323	732.2833	640.3588	549.4235	505.8426	497.6731	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.8290	30.9330	31.0356	31.5267	31.6203	32.0635	32.0635	32.1469	31.8913	31.6203	31.4315	31.2365	
alpha	3.0553	3.0622	3.0690	3.1018	3.1080	3.1376	3.1376	3.1431	3.1261	3.1080	3.0954	3.0824	
util living area													
	0.9517	0.9297	0.8866	0.7845	0.6358	0.4695	0.3520	0.4037	0.6265	0.8422	0.9282	0.9562	(86)
MIT	19.0608	19.3372	19.7740	20.3440	20.7332	20.9246	20.9770	20.9649	20.8135	20.2894	19.6033	19.0294	(87)
Th 2	20.0094	20.0124	20.0153	20.0292	20.0318	20.0439	20.0439	20.0461	20.0392	20.0318	20.0265	20.0210	(88)
util rest of house													
	0.9441	0.9189	0.8692	0.7537	0.5887	0.4078	0.2792	0.3259	0.5621	0.8115	0.9154	0.9493	(89)
MIT 2	17.7620	18.1096	18.6531	19.3465	19.7856	19.9886	20.0320	20.0267	19.8881	19.3026	18.4583	17.7300	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	18.3099	18.6275	19.1260	19.7673	20.1854	20.3835	20.4307	20.4225	20.2785	19.7189	18.9413	18.2782	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3099	18.6275	19.1260	19.7673	20.1854	20.3835	20.4307	20.4225	20.2785	19.7189	18.9413	18.2782	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9271	0.9001	0.8508	0.7446	0.5965	0.4302	0.3091	0.3572	0.5790	0.8002	0.8977	0.9332	(94)
Useful gains	479.3243	525.6380	556.7663	568.8077	507.1455	369.5354	252.1033	261.5634	370.7915	439.6286	454.0705	464.4323	(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													
	976.9168	954.0049	874.5547	741.0121	576.8812	387.7566	256.8292	268.9890	416.4775	619.9541	809.8741	968.8713	(97)
Space heating kWh													
	370.2088	287.8626	236.4345	123.9871	51.8834	0.0000	0.0000	0.0000	0.0000	134.1622	256.1786	375.3027	(98a)
Space heating requirement - total per year (kWh/year)												1836.0198	
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													
	370.2088	287.8626	236.4345	123.9871	51.8834	0.0000	0.0000	0.0000	0.0000	134.1622	256.1786	375.3027	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1836.0198	
Space heating per m2											(98c) / (4) =	28.6878	(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													
	370.2088	287.8626	236.4345	123.9871	51.8834	0.0000	0.0000	0.0000	0.0000	134.1622	256.1786	375.3027	(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)													
	401.0930	311.8771	256.1588	134.3306	56.2117	0.0000	0.0000	0.0000	0.0000	145.3545	277.5499	406.6118	(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													
	189.4774	167.5700	178.4481	158.3888	154.4464	140.1985	139.3181	144.4082	145.4614	160.9261	169.4821	187.6460	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.5342	85.2619	84.6917	83.5166	81.8869	79.8000	79.8000	79.8000	79.8000	83.6548	84.9838	85.5827	(217)
Fuel for water heating, kWh/month													
	221.5224	196.5355	210.7033	189.6494	188.6093	175.6873	174.5841	180.9627	182.2825	192.3693	199.4288	219.2570	(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	19.2076	15.4091	13.8742	10.1648	7.8516	6.4148	7.1625	9.3101	12.0928	15.8665	17.9211	19.7415	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-21.8458	-31.8328	-47.2831	-55.0068	-60.9268	-57.4708	-56.7788	-52.8104	-46.0718	-37.2282	-24.3858	-18.7690	(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	-9.3904	-20.0295	-40.3199	-61.3031	-81.7793	-82.4190	-81.4375	-68.6143	-49.8553	-28.8769	-12.6138	-7.4045	(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	1989.1872	(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	2331.5917	(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)	155.0165	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1054.4534	(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	3507.3420	(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	1989.1872	0.2100	417.7293	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2331.5917	0.2100	489.6343	(264)
Space and water heating			907.3636	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	155.0165	0.1443	22.3737	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-510.4101	0.1339	-68.3358	
PV Unit electricity exported	-544.0433	0.1255	-68.3003	
Total			-136.6361	(269)
Total CO2, kg/year			805.0304	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.5800	(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	1989.1872	1.1300	2247.7816	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2331.5917	1.1300	2634.6986	(278)
Space and water heating			4882.4802	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	155.0165	1.5338	237.7695	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-510.4101	1.4948	-762.9475	
PV Unit electricity exported	-544.0433	0.4608	-250.7002	
Total			-1013.6477	(283)
Total Primary energy kWh/year			4236.7028	(286)
Target Primary Energy Rate (TPER)			66.2000	(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		64.0000	(1b)	x	2.5000	(2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000								(4)
Dwelling volume					(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =			160.0000	(5)

2. Ventilation rate

m3 per hour

```
Number of open chimneys                                                                              0 * 80 =      0.0000 (6a)
Number of open flues                                                                                 0 * 20 =      0.0000 (6b)
Number of chimneys / flues attached to closed fire                                                   0 * 10 =      0.0000 (6c)
Number of flues attached to solid fuel boiler                                                        0 * 20 =      0.0000 (6d)
Number of flues attached to other heater                                                             0 * 35 =      0.0000 (6e)
Number of blocked chimneys                                                                           0 * 20 =      0.0000 (6f)
Number of intermittent extract fans                                                                  2 * 10 =     20.0000 (7a)
Number of passive vents                                                                              0 * 10 =      0.0000 (7b)
Number of flueless gas fires                                                                         0 * 40 =      0.0000 (7c)

                                                                                                     Air changes per hour
Infiltration due to chimneys, flues and fans   = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =         20.0000 / (5) =      0.1250 (8)
Pressure test                                                                                                         Yes
Pressure Test Method                                                                                          Blower Door
Measured/design AP50                                                                                               3.0000 (17)
Infiltration rate                                                                                                  0.2750 (18)
Number of sides sheltered                                                                                               0 (19)

Shelter factor                                                                 (20) = 1  -  [0.075 x (19)]  =      1.0000 (20)
Infiltration rate adjusted to include shelter factor                                   (21) = (18) x (20)   =      0.2750 (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
                 0.3506     0.3438     0.3369     0.3025     0.2956     0.2612     0.2612     0.2544     0.2750     0.2956     0.3094     0.3231 (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     0.5615     0.5591     0.5567     0.5458     0.5437     0.5341     0.5341     0.5324     0.5378     0.5437     0.5479     0.5522 (25)


----------------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
----------------------------------------------------------------------------------------------------
Element                                     Gross       Openings         NetArea        U-value          A x U       K-value            A x K
                                               m2             m2              m2         W/m2K            W/K        kJ/m2K             kJ/K
Window (Uw = 1.00)                                                       12.0500         0.9615        11.5865                                (27)
Rooflights                                                                1.2800         0.9615         1.2308                                (27a)
External Wall 1                           54.0000        12.0500         41.9500         0.1600         6.7120      110.0000        4614.5000 (29a)
External Roof 1                           64.0000         1.2800         62.7200         0.1000         6.2720        9.0000         564.4800 (30)
Total net area of external elements Aum(A, m2)                          118.0000                                                          (31)
Fabric heat loss, W/K = Sum (A x U)                                            (26)...(30) + (32) =    25.8013                                (33)
Party Floor 1                                                            64.0000                                      40.0000        2560.0000 (32d)

Heat capacity Cm = Sum(A x k)                                                   (28)...(30) + (32) + (32a)...(32e) =   7738.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                       120.9216 (35)
List of Thermal Bridges
        K1 Element                                                                      Length      Psi-value          Total
        E2 Other lintels (including other steel lintels)                                7.0000         0.3000         2.1000
        E3 Sill                                                                         7.0000         0.0400         0.2800
        E4 Jamb                                                                        12.4000         0.0500         0.6200
        E7 Party floor between dwellings (in blocks of flats)                          12.5000         0.0700         0.8750
        E14 Flat roof                                                                  21.5000         0.0800         1.7200
        E23 Balcony within or between dwellings, balcony support penetrates wall insulation 0.3000     1.0000         0.3000
        E16 Corner (normal)                                                             7.5000         0.0900         0.6750
        E17 Corner (inverted - internal area greater than external area)                2.5000        -0.0900        -0.2250
        E18 Party wall between dwellings                                                3.8000         0.0600         0.2280
        R1 Head of roof window                                                          1.6000         0.0800         0.1280
        R2 Sill of roof window                                                          1.6000         0.0600         0.0960
        R3 Jamb of roof window                                                          3.2000         0.0800         0.2560
        P4 Party wall - Roof (insulation at ceiling level)                             11.5000         0.1200         1.3800
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                               8.4330 (36)
Point Thermal bridges                                                                                       (36a) =      0.0000
Total fabric heat loss                                                                         (33) + (36) + (36a) =     34.2343 (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           29.6456    29.5195    29.3960    28.8158    28.7072    28.2018    28.2018    28.1083    28.3965    28.7072    28.9268    29.1564 (38)
Heat transfer coeff
                63.8799    63.7538    63.6303    63.0501    62.9415    62.4361    62.4361    62.3426    62.6308    62.9415    63.1611    63.3907 (39)
Average = Sum(39)m / 12 =                                                                                                63.0496

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.9981     0.9962     0.9942     0.9852     0.9835     0.9756     0.9756     0.9741     0.9786     0.9835     0.9869     0.9905 (40)
HLP (average)                                                                                                            0.9851
Days in mont         31         28         31         30         31         30         31         31         30         31         30         31


----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                        2.0922 (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
                25.6236    25.2430    24.7071    23.7191    22.9792    22.1588    21.7157    22.2478    22.8272    23.7051    24.7135    25.5369 (42b)
Hot water usage for other uses
                36.0560    34.7449    33.4338    32.1226    30.8115    29.5004    29.5004    30.8115    32.1226    33.4338    34.7449    36.0560 (42c)
Average daily hot water use (litres/day)                                                                                56.5353 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                61.6796    59.9879    58.1409    55.8417    53.7907    51.6592    51.2160    53.0593    54.9498    57.1388    59.4584    61.5930 (44)
Energy conte    97.6854    85.4220    89.3604    76.4445    72.4126    63.5210    61.9414    65.6985    67.7587    77.5368    84.7094    96.4397 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =    938.9304
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
                83.0326    72.6087    75.9563    64.9778    61.5507    53.9928    52.6502    55.8437    57.5949    65.9063    72.0030    81.9738 (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
                83.0326     72.6087     75.9563     64.9778     61.5507     53.9928     52.6502     55.8437     57.5949     65.9063     72.0030     81.9738 (64)
                                                                                            Total per year (kWh/year) = Sum(64)m =    798.0908 (64)
12Total per year (kWh/year)                                                                                                                798 (64)
Electric shower(s)
                47.4883     42.3125     46.2036     44.0915     44.9189     42.8483     44.2765     44.9189     44.0915     46.2036     45.3348     47.4883 (64a)
                                                        Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =    540.1766 (64a)
Heat gains from water heating, kWh/month
                32.6302     28.7303     30.5400     27.2673     26.6174     24.2103     24.2317     25.1907     25.4216     28.0275     29.3344     32.3655 (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          104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                93.7703    103.8171     93.7703     96.8959     93.7703     96.8959     93.7703     93.7703     96.8959     93.7703     96.8959     93.7703 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               182.9108    184.8088    180.0258    169.8433    156.9898    144.9093    136.8388    134.9408    139.7238    149.9062    162.7598    174.8402 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609 (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)
               -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873 (71)
Water heating gains (Table 5)
                43.8578     42.7534     41.0484     37.8713     35.7761     33.6254     32.5695     33.8584     35.3078     37.6713     40.7423     43.5020 (72)
Total internal gains
               374.9216    385.7620    369.2272    358.9933    340.9189    329.8134    317.5613    316.9522    326.3102    335.7306    354.7807    366.4953 (73)


-------------------------------------------------------------------------------------------
6. Solar gains
-------------------------------------------------------------------------------------------
[Jan]                                        Area          Solar flux              g              FF            Access              Gains
                                               m2            Table 6a    Specific data   Specific data          factor                  W
                                                                 W/m2     or Table 6b     or Table 6c         Table 6d
-------------------------------------------------------------------------------------------
Northwest                                 12.0500             11.2829          0.4000          0.7000           0.7700            26.3816 (81)
Northwest                                  1.2800             26.0000          0.4000          0.7000           1.0000             8.3866 (82)
-------------------------------------------------------------------------------------------

Solar gains     34.7681     71.1187    127.7169    207.2771    275.5151    292.2147    273.9750    220.4569    154.9872     86.9152     43.8393     28.3183 (83)
Total gains    409.6897    456.8807    496.9440    566.2705    616.4340    622.0281    591.5363    537.4091    481.2974    422.6457    398.6200    394.8136 (84)


-------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                            21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                   Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
tau             33.6525     33.7190     33.7845     34.0954     34.1542     34.4306     34.4306     34.4823     34.3236     34.1542     34.0354     33.9122
alpha            3.2435      3.2479      3.2523      3.2730      3.2769      3.2954      3.2954      3.2988      3.2882      3.2769      3.2690      3.2608
util living area
                 0.9719      0.9586      0.9335      0.8651      0.7460      0.5796      0.4438      0.5000      0.7240      0.9001      0.9572      0.9749 (86)

MIT             19.0149     19.2518     19.6364     20.1860     20.6256     20.8831     20.9635     20.9460     20.7499     20.1822     19.5210     18.9760 (87)
Th 2            20.0849     20.0865     20.0881     20.0957     20.0971     20.1037     20.1037     20.1050     20.1012     20.0971     20.0943     20.0913 (88)
util rest of house
                 0.9673      0.9520      0.9224      0.8424      0.7042      0.5145      0.3609      0.4143      0.6649      0.8783      0.9492      0.9708 (89)
MIT 2           18.2678     18.5023     18.8806     19.4134     19.8155     20.0331     20.0880     20.0800     19.9343     19.4213     18.7761     18.2339 (90)
Living area fraction                                                                                         fLA = Living area / (4) =     0.4219 (91)
MIT             18.5830     18.8185     19.1995     19.7393     20.1573     20.3917     20.4573     20.4453     20.2784     19.7423     19.0903     18.5469 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT    18.5830     18.8185     19.1995     19.7393     20.1573     20.3917     20.4573     20.4453     20.2784     19.7423     19.0903     18.5469 (93)


-------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------

                   Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Utilisation      0.9575      0.9403      0.9093      0.8323      0.7072      0.5362      0.3944      0.4479      0.6774      0.8682      0.9379      0.9617 (94)
Useful gains   392.2915    429.5922    451.8782    471.2836    435.9483    333.5407    233.2888    240.7185    326.0397    366.9392    373.8540    379.6775 (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
               912.3968    887.3593    808.0701    683.4202    532.3130    361.6135    240.8377    252.1961    386.9563    575.4315    757.3235    909.4633 (97)
Space heating kWh
               386.9583    307.6195    265.0067    152.7384     71.6953      0.0000      0.0000      0.0000      0.0000    155.1182    276.0981    394.1606 (98a)
Space heating requirement - total per year (kWh/year)                                                                                2009.3951
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
               386.9583    307.6195    265.0067    152.7384     71.6953      0.0000      0.0000      0.0000      0.0000    155.1182    276.0981    394.1606 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                       2009.3951
Space heating per m2                                                                                             (98c) / (4) =     31.3968 (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    586.8998    462.0275    473.8035      0.0000      0.0000      0.0000      0.0000 (100)
Utilisation      0.0000      0.0000      0.0000      0.0000      0.0000      0.8203      0.8768      0.8422      0.0000      0.0000      0.0000      0.0000 (101)
Useful loss      0.0000      0.0000      0.0000      0.0000      0.0000    481.4438    405.0887    399.0217      0.0000      0.0000      0.0000      0.0000 (102)
Total gains      0.0000      0.0000      0.0000      0.0000      0.0000    680.2594    647.0987    587.4019      0.0000      0.0000      0.0000      0.0000 (103)
Space cooling kWh
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.0000	0.0000	0.0000	0.0000	0.0000	143.1473	180.0554	140.1548	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	35.7868	45.0139	35.0387	0.0000	0.0000	0.0000	0.0000	(107)

Space cooling requirement	115.8394	(107)
Energy for space heating	31.3968	(99)
Energy for space cooling	1.8100	(108)
Total	33.2068	(109)
Fabric Energy Efficiency (DFEE)	33.2	(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	64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(5)

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2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.1250	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3750	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3750	(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	0.4781	0.4688	0.4594	0.4125	0.4031	0.3562	0.3562	0.3469	0.3750	0.4031	0.4219	0.4406	(22b)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6143	0.6099	0.6055	0.5851	0.5813	0.5635	0.5635	0.5602	0.5703	0.5813	0.5890	0.5971	(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 Opening Type (Uw = 1.20)			12.0500	1.1450	13.7977			(27)
Rooflights			1.2800	2.0221	2.5882			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1800	7.5510			(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1100	6.8992			(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.8361			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 120.9216 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.0500	0.3500
E3 Sill	7.0000	0.0500	0.3500
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	0.0200	0.0060
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4590	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	37.2951	(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	32.4351	32.2008	31.9711	30.8921	30.6903	29.7505	29.7505	29.5765	30.1125	30.6903	31.0986	31.5256	(38)

```
Heat transfer coeff
                 69.7303    69.4959    69.2662    68.1873    67.9854    67.0457    67.0457    66.8717    67.4076    67.9854    68.3938    68.8207 (39)
Average = Sum(39)m / 12 =                                                                                                                   68.1863

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP               1.0895     1.0859     1.0823     1.0654     1.0623     1.0476     1.0476     1.0449     1.0532     1.0623     1.0687     1.0753 (40)
HLP (average)                                                                                                                                1.0654
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                                                                                                                            2.0922 (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
                 25.6236    25.2430    24.7071    23.7191    22.9792    22.1588    21.7157    22.2478    22.8272    23.7051    24.7135    25.5369 (42b)
Hot water usage for other uses
                 36.0560    34.7449    33.4338    32.1226    30.8115    29.5004    29.5004    30.8115    32.1226    33.4338    34.7449    36.0560 (42c)
Average daily hot water use (litres/day)                                                                                                    56.5353 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                 61.6796    59.9879    58.1409    55.8417    53.7907    51.6592    51.2160    53.0593    54.9498    57.1388    59.4584    61.5930 (44)
Energy conte     97.6854    85.4220    89.3604    76.4445    72.4126    63.5210    61.9414    65.6985    67.7587    77.5368    84.7094    96.4397 (45)
Energy content (annual)                                                                                      Total = Sum(45)m =    938.9304
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
                 83.0326    72.6087    75.9563    64.9778    61.5507    53.9928    52.6502    55.8437    57.5949    65.9063    72.0030    81.9738 (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
                 83.0326    72.6087    75.9563    64.9778    61.5507    53.9928    52.6502    55.8437    57.5949    65.9063    72.0030    81.9738 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =    798.0908 (64)
12Total per year (kWh/year)                                                                                                                     798 (64)
Electric shower(s)
                 47.4883    42.3125    46.2036    44.0915    44.9189    42.8483    44.2765    44.9189    44.0915    46.2036    45.3348    47.4883 (64a)
                                                  Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =    540.1766 (64a)
Heat gains from water heating, kWh/month
                 32.6302    28.7303    30.5400    27.2673    26.6174    24.2103    24.2317    25.1907    25.4216    28.0275    29.3344    32.3655 (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           104.6091   104.6091   104.6091   104.6091   104.6091   104.6091   104.6091   104.6091   104.6091   104.6091   104.6091   104.6091 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 92.4420   102.3465    92.4420    95.5234    92.4420    95.5234    92.4420    92.4420    95.5234    92.4420    95.5234    92.4420 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                182.9108   184.8088   180.0258   169.8433   156.9898   144.9093   136.8388   134.9408   139.7238   149.9062   162.7598   174.8402 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 33.4609    33.4609    33.4609    33.4609    33.4609    33.4609    33.4609    33.4609    33.4609    33.4609    33.4609    33.4609 (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)
                -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873 (71)
Water heating gains (Table 5)
                 43.8578    42.7534    41.0484    37.8713    35.7761    33.6254    32.5695    33.8584    35.3078    37.6713    40.7423    43.5020 (72)
Total internal gains
                373.5933   384.2914   367.8989   357.6208   339.5906   328.4408   316.2330   315.6239   324.9377   334.4023   353.4081   365.1670 (73)


---------------------------------------------------------------------------------------------------
6. Solar gains
---------------------------------------------------------------------------------------------------
[Jan]                                        Area         Solar flux               g               FF           Access               Gains
                                               m2           Table 6a   Specific data   Specific data           factor                   W
                                                               W/m2      or Table 6b     or Table 6c         Table 6d
---------------------------------------------------------------------------------------------------
Northwest                                 12.0500            11.2829          0.6300          0.7000           0.7700             41.5510 (81)
Northwest                                  1.2800            26.0000          0.6300          0.7000           1.0000             13.2088 (82)
---------------------------------------------------------------------------------------------------

Solar gains      54.7598   112.0119   201.1541   326.4615   433.9363   460.2381   431.5107   347.2196   244.1048   136.8914    69.0469    44.6013 (83)
Total gains     428.3531   496.3034   569.0530   684.0823   773.5269   788.6790   747.7437   662.8436   569.0425   471.2937   422.4551   409.7683 (84)


---------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
---------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau              30.8290    30.9330    31.0356    31.5267    31.6203    32.0635    32.0635    32.1469    31.8913    31.6203    31.4315    31.2365
alpha             3.0553     3.0622     3.0690     3.1018     3.1080     3.1376     3.1376     3.1431     3.1261     3.1080     3.0954     3.0824
util living area
                  0.9697     0.9521     0.9159     0.8218     0.6758     0.5041     0.3813     0.4408     0.6767     0.8835     0.9532     0.9732 (86)

MIT              18.8397    19.1339    19.6034    20.2362    20.6814    20.9079    20.9712    20.9550    20.7665    20.1545    19.4093    18.8061 (87)
Th 2             20.0094    20.0124    20.0153    20.0292    20.0318    20.0439    20.0439    20.0461    20.0392    20.0318    20.0265    20.0210 (88)
util rest of house
                  0.9646     0.9442     0.9020     0.7939     0.6292     0.4397     0.3034     0.3576     0.6128     0.8582     0.9442     0.9688 (89)
MIT 2            18.0420    18.3332    18.7930    19.4022    19.7998    19.9906    20.0321    20.0264    19.8886    19.3431    18.6180    18.0170 (90)
Living area fraction                                                                                       fLA = Living area / (4) =      0.4219 (91)
```

MIT	18.3786	18.6710	19.1349	19.7540	20.1717	20.3776	20.4283	20.4181	20.2589	19.6854	18.9519	18.3499	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3786	18.6710	19.1349	19.7540	20.1717	20.3776	20.4283	20.4181	20.2589	19.6854	18.9519	18.3499	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9537	0.9307	0.8871	0.7851	0.6363	0.4628	0.3353	0.3909	0.6284	0.8476	0.9316	0.9586	(94)
Useful gains	408.5065	461.9280	504.7866	537.0731	492.1944	365.0044	250.7126	259.1172	357.5831	399.4617	393.5423	392.8073	(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	981.7019	957.0263	875.1732	740.1071	575.9536	387.3618	256.6690	268.6973	415.1591	617.6761	810.5930	973.8044	(97)
Space heating kWh	426.4574	332.7060	275.5677	146.1845	62.3168	0.0000	0.0000	0.0000	0.0000	162.3515	300.2766	432.2619	(98a)
Space heating requirement - total per year (kWh/year)												2138.1223	
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	426.4574	332.7060	275.5677	146.1845	62.3168	0.0000	0.0000	0.0000	0.0000	162.3515	300.2766	432.2619	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2138.1223	
Space heating per m2											(98c) / (4) =	33.4082	(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	630.2294	496.1380	508.2246	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8640	0.9080	0.8749	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	544.5325	450.4824	444.6392	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	870.2716	825.1874	730.4867	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	234.5321	278.7806	212.6705	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	58.6330	69.6951	53.1676	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												181.4958	(107)
Energy for space heating												33.4082	(99)
Energy for space cooling												2.8359	(108)
Total												36.2440	(109)
Fabric Energy Efficiency (TFEE)												36.2	(109)

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

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1. Overall dwelling characteristics

		Area (m2)			Storey height (m)			Volume (m3)	
Ground floor		64.0000	(1b)	x	2.5000	(2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000								(4)
Dwelling volume						(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2862	0.2825	0.2787	0.2600	0.2562	0.2375	0.2375	0.2337	0.2450	0.2562	0.2637	0.2712	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.9216	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4330	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	34.2343	(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	15.1140	14.9160	14.7180	13.7280	13.5300	12.5400	12.5400	12.3420	12.9360	13.5300	13.9260	14.3220	(38)
Heat transfer coeff	49.3483	49.1503	48.9523	47.9623	47.7643	46.7743	46.7743	46.5763	47.1703	47.7643	48.1603	48.5563	(39)
Average = Sum(39)m / 12 =												47.9128	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7711	0.7680	0.7649	0.7494	0.7463	0.7308	0.7308	0.7278	0.7370	0.7463	0.7525	0.7587	(40)
HLP (average)												0.7486	
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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.0922	(42)
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												102.9763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)
Energy content (annual)										Total = Sum(45)m =		1710.5733	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)
Water storage loss:													
Store volume												173.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9200	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0368	(55)
Total storage loss	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(56)
If cylinder contains dedicated solar storage	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(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	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(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	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)
								Total per year (kWh/year) = Sum(64)m =				2089.0053	(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	59.0820	51.9593	54.5595	46.5464	44.1320	38.7008	37.4648	39.5779	40.6959	46.6482	51.1399	58.2588	(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	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	(66)

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

	21.0634	18.7084	15.2147	11.5185	8.6102	7.2691	7.8545	10.2096	13.7033	17.3995	20.3078	21.6489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	273.0011	275.8340	268.6952	253.4975	234.3132	216.2826	204.2371	201.4042	208.5430	223.7407	242.9250	260.9556	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	79.4113	77.3204	73.3327	64.6478	59.3172	53.7511	50.3560	53.1961	56.5221	62.6991	71.0277	78.3048	(72)
Total internal gains	464.9648	463.3517	448.7314	421.1528	393.7295	368.7917	353.9365	356.2988	370.2573	395.3282	425.7494	452.3981	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	1.0000	34.2618	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

Solar gains	42.6483	87.1591	156.6166	254.7387	339.3128	360.2298	337.6018	271.1809	190.2019	106.5178	53.7547	34.7537	(83)
Total gains	507.6131	550.5107	605.3480	675.8915	733.0422	729.0215	691.5382	627.4797	560.4592	501.8460	479.5040	487.1518	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.5621	43.7376	43.9145	44.8210	45.0068	45.9593	45.9593	46.1547	45.5735	45.0068	44.6367	44.2727	
alpha	3.9041	3.9158	3.9276	3.9881	4.0005	4.0640	4.0640	4.0770	4.0382	4.0005	3.9758	3.9515	
util living area	0.9362	0.9117	0.8551	0.7345	0.5709	0.4041	0.2961	0.3386	0.5517	0.7959	0.9070	0.9430	(86)
MIT	20.2028	20.3169	20.5041	20.7136	20.8267	20.8691	20.8764	20.8753	20.8460	20.6878	20.4221	20.1871	(87)
Th 2	20.2785	20.2812	20.2839	20.2974	20.3001	20.3137	20.3137	20.3164	20.3082	20.3001	20.2947	20.2893	(88)
util rest of house	0.9279	0.9006	0.8379	0.7072	0.5347	0.3626	0.2505	0.2894	0.5037	0.7669	0.8937	0.9356	(89)
MIT 2	19.3330	19.4769	19.7084	19.9678	20.0948	20.1504	20.1565	20.1587	20.1249	19.9464	19.6215	19.3226	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	19.7000	19.8313	20.0441	20.2825	20.4035	20.4536	20.4602	20.4611	20.4291	20.2592	19.9593	19.6873	(92)
Temperature adjustment												0.4000	
adjusted MIT	20.1000	20.2313	20.4441	20.6825	20.8035	20.8536	20.8602	20.8611	20.8291	20.6592	20.3593	20.0873	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9256	0.8998	0.8419	0.7225	0.5609	0.3953	0.2868	0.3287	0.5401	0.7822	0.8950	0.9332	(94)
Useful gains	469.8524	495.3362	509.6550	488.3010	411.1940	288.1840	198.3617	206.2393	302.7196	392.5634	429.1629	454.6190	(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	779.7013	753.5363	682.5946	565.1137	434.8246	292.5082	199.2665	207.7796	317.4139	480.4701	638.5704	771.4283	(97)
Space heating kWh	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(98a)
Space heating requirement - total per year (kWh/year)												1057.4736	
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	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1057.4736	
Space heating per m2											(98c) / (4) =	16.5230	(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)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(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)
Space heating fuel used, main system 2												0.0000	(213)

Water heating

Water heating requirement	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	69.2615	61.1639	64.7718	56.4748	54.4201	48.6863	47.8015	49.8992	50.6668	56.9180	61.0349	68.4442	(219)

Space cooling fuel requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(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	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(231)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-8.1729	-14.3662	-25.9037	-34.8276	-41.6665	-40.0544	-39.2337	-34.3047	-26.3870	-18.0735	-9.7146	-6.6859	(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	1057.4736	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	302.9550	
Water heating fuel used	689.5431	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)

mechanical ventilation fans (SFP = 0.7280)	142.1056	(230a)
Total electricity for the above, kWh/year	142.1056	(231)
Electricity for lighting (calculated in Appendix L)	148.7948	(232)

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

PV generation	-299.3909	(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	1738.5263	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1057.4736	16.4900	174.3774	(240)
Space heating - main system 2	0.0000	16.4900	0.0000	(241)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	689.5431	16.4900	113.7057	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	142.1056	16.4900	23.4332	(249)
Energy for lighting	148.7948	16.4900	24.5363	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-299.3909	16.4900	-49.3696	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-49.3696	(252)
Total energy cost			286.6830	(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] =	0.9468	(257)
SAP value		84.6517	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1057.4736	0.1563	165.3347	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	689.5431	0.1411	97.2772	(264)
Space and water heating			262.6119	(265)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(267)
Energy for lighting	148.7948	0.1443	21.4757	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-299.3909	0.1313	-39.3119	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-39.3119	(269)
Total CO2, kg/year			264.4875	(272)
CO2 emissions per m2			4.1300	(273)
EI value			96.7485	
EI rating			97	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	64.0000	(1b)	x	2.5000	(2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	160.0000	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.5000	4.3000	4.3000	3.9000	4.0000	3.4000	3.5000	3.8000	3.7000	3.9000	3.8000	4.2000	(22)
Wind factor	1.1250	1.0750	1.0750	0.9750	1.0000	0.8500	0.8750	0.9500	0.9250	0.9750	0.9500	1.0500	(22a)
Adj infilt rate	0.1687	0.1612	0.1612	0.1462	0.1500	0.1275	0.1313	0.1425	0.1388	0.1462	0.1425	0.1575	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2637	0.2562	0.2562	0.2412	0.2450	0.2225	0.2262	0.2375	0.2337	0.2412	0.2375	0.2525	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.9216	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4330	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	34.2343	(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	13.9260	13.5300	13.5300	12.7380	12.9360	11.7480	11.9460	12.5400	12.3420	12.7380	12.5400	13.3320	(38)
Heat transfer coeff	48.1603	47.7643	47.7643	46.9723	47.1703	45.9823	46.1803	46.7743	46.5763	46.9723	46.7743	47.5663	(39)
Average = Sum(39)m / 12 =												47.0548	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7525	0.7463	0.7463	0.7339	0.7370	0.7185	0.7216	0.7308	0.7278	0.7339	0.7308	0.7432	(40)
HLP (average)												0.7352	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.0922	(42)

```
Hot water usage for mixer showers
                76.1395    74.9953    73.3279    70.1377    67.7834    65.1579    63.6656    65.3204    67.1343    69.9532    73.2120    75.8478 (42a)
Hot water usage for baths
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (42b)
Hot water usage for other uses
                36.0560    34.7449    33.4338    32.1226    30.8115    29.5004    29.5004    30.8115    32.1226    33.4338    34.7449    36.0560 (42c)
Average daily hot water use (litres/day)                                                                                              102.9763 (43)

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
               112.1955   109.7402   106.7617   102.2604    98.5949    94.6583    93.1660    96.1319    99.2569   103.3870   107.9569   111.9038 (44)
Energy conte   177.6903   156.2686   164.0887   139.9893   132.7277   116.3935   112.6762   119.0313   122.3937   140.2952   153.8044   175.2143 (45)
Energy content (annual)                                                                                 Total = Sum(45)m =   1710.5733
Distribution loss  (46)m = 0.15 x (45)m
                26.6535    23.4403    24.6133    20.9984    19.9092    17.4590    16.9014    17.8547    18.3591    21.0443    23.0707    26.2822 (46)
Water storage loss:
Store volume                                                                                                                          173.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                           1.9200 (48)
  Temperature factor from Table 2b                                                                                                      0.5400 (49)
Enter (49) or (54) in (55)                                                                                                              1.0368 (55)
Total storage loss
                32.1408    29.0304    32.1408    31.1040    32.1408    31.1040    32.1408    32.1408    31.1040    32.1408    31.1040    32.1408 (56)
If cylinder contains dedicated solar storage
                32.1408    29.0304    32.1408    31.1040    32.1408    31.1040    32.1408    32.1408    31.1040    32.1408    31.1040    32.1408 (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
               209.8311   185.2990   196.2295   171.0933   164.8685   147.4975   144.8170   151.1721   153.4977   172.4360   184.9084   207.3551 (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
               209.8311   185.2990   196.2295   171.0933   164.8685   147.4975   144.8170   151.1721   153.4977   172.4360   184.9084   207.3551 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =   2089.0053 (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
                59.0820    51.9593    54.5595    46.5464    44.1320    38.7008    37.4648    39.5779    40.6959    46.6482    51.1399    58.2588 (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          125.5309   125.5309   125.5309   125.5309   125.5309   125.5309   125.5309   125.5309   125.5309   125.5309   125.5309   125.5309 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                21.0634    18.7084    15.2147    11.5185     8.6102     7.2691     7.8545    10.2096    13.7033    17.3995    20.3078    21.6489 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               273.0011   275.8340   268.6952   253.4975   234.3132   216.2826   204.2371   201.4042   208.5430   223.7407   242.9250   260.9556 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                49.6453    49.6453    49.6453    49.6453    49.6453    49.6453    49.6453    49.6453    49.6453    49.6453    49.6453    49.6453 (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)
               -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873   -83.6873 (71)
Water heating gains (Table 5)
                79.4113    77.3204    73.3327    64.6478    59.3172    53.7511    50.3560    53.1961    56.5221    62.6991    71.0277    78.3048 (72)
Total internal gains
               464.9648   463.3517   448.7314   421.1528   393.7295   368.7917   353.9365   356.2988   370.2573   395.3282   425.7494   452.3981 (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
                                                                  W/m2      or Table 6b      or Table 6c         Table 6d
-----------------------------------------------------------------------------------------------------
Northwest                                  12.0500             12.4928           0.4000           0.7000           1.0000            37.9356 (81)
Northwest                                   1.2800             29.0000           0.4000           0.7000           1.0000             9.3542 (82)
-----------------------------------------------------------------------------------------------------

Solar gains     47.2898    87.0977   159.0430   265.3813   342.2025   388.5792   365.6332   301.3661   211.4530   116.3982    61.6316    39.4231 (83)
Total gains    512.2546   550.4494   607.7744   686.5341   735.9320   757.3709   719.5697   657.6649   581.7103   511.7264   487.3810   491.8212 (84)


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7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                            21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             44.6367    45.0068    45.0068    45.7656    45.5735    46.7510    46.5505    45.9593    46.1547    45.7656    45.9593    45.1941
alpha            3.9758     4.0005     4.0005     4.0510     4.0382     4.1167     4.1034     4.0640     4.0770     4.0510     4.0640     4.0129
util living area
                 0.9199     0.8952     0.8173     0.6666     0.4787     0.2842     0.1732     0.1989     0.4315     0.7242     0.8755     0.9271 (86)

MIT             20.3245    20.4149    20.6079    20.7813    20.8564    20.8782    20.8794    20.8781    20.8688    20.7673    20.5431    20.3124 (87)
Th 2            20.2947    20.3001    20.3001    20.3109    20.3082    20.3245    20.3218    20.3137    20.3164    20.3109    20.3137    20.3028 (88)
util rest of house
                 0.9094     0.8821     0.7961     0.6350     0.4393     0.2438     0.1297     0.1503     0.3807     0.6874     0.8579     0.9174 (89)
MIT 2           19.4989    19.6147    19.8480    20.0571    20.1330    20.1694    20.1672    20.1576    20.1537    20.0462    19.7862    19.4912 (90)
Living area fraction                                                                                   fLA = Living area / (4) =     0.4219 (91)
MIT             19.8472    19.9523    20.1686    20.3626    20.4382    20.4684    20.4677    20.4615    20.4554    20.3504    20.1055    19.8377 (92)
Temperature adjustment                                                                                                                  0.4000
adjusted MIT    20.2472    20.3523    20.5686    20.7626    20.8382    20.8684    20.8677    20.8615    20.8554    20.7504    20.5055    20.2377 (93)


-----------------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------------

                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9086     0.8831     0.8045     0.6560     0.4696     0.2763     0.1647     0.1891     0.4209     0.7113     0.8631     0.9165 (94)
Useful gains   465.4488   486.1275   488.9541   450.3586   345.5804   209.2932   118.5158   124.3753   244.8586   364.0011   420.6498   450.7360 (95)
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext temp.	5.3000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.2000	15.5000	11.9000	8.2000	5.3000	(96)
Heat loss rate W	719.8635	699.8563	614.6608	496.1513	355.5772	210.0678	118.5764	124.4919	249.4333	415.7249	575.5817	710.5303	(97)
Space heating kWh	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(98a)

Space heating requirement - total per year (kWh/year) 810.1647

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 810.1647

Space heating per m2 (98c) / (4) = 12.6588 (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)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(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)

Space heating fuel used, main system 2 0.0000 (213)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	69.2615	61.1639	64.7718	56.4748	54.4201	48.6863	47.8015	49.8992	50.6668	56.9180	61.0349	68.4442	(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	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(231)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-8.9999	-14.2701	-25.8131	-35.2273	-41.2770	-42.0435	-41.2982	-36.8683	-28.5260	-19.2432	-10.9586	-7.5401	(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	810.1647	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	302.9550	
Water heating fuel used	689.5431	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)

mechanical ventilation fans (SFP = 0.7280)	142.1056	(230a)
Total electricity for the above, kWh/year	142.1056	(231)
Electricity for lighting (calculated in Appendix L)	148.7948	(232)

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

PV generation	-312.0654	(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	1478.5429	(238)

10a. Fuel costs - using BEDF prices (560)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	810.1647	26.0600	211.1289	(240)
Space heating - main system 2	0.0000	26.0600	0.0000	(241)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	689.5431	26.0600	179.6949	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	142.1056	26.0600	37.0327	(249)
Energy for lighting	148.7948	26.0600	38.7759	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-312.0654	26.0600	-81.3242	

PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-81.3242 (252)
Total energy cost			385.3083 (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	810.1647	0.1573	127.4231 (261)
Space heating - main system 2	0.0000	0.0000	0.0000 (262)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	689.5431	0.1411	97.2772 (264)
Space and water heating			224.7003 (265)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118 (267)
Energy for lighting	148.7948	0.1443	21.4757 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-312.0654	0.1311	-40.9253
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-40.9253 (269)
Total CO2, kg/year			224.9625 (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	810.1647	1.5823	1281.8892 (275)
Space heating - main system 2	0.0000	0.0000	0.0000 (276)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	689.5431	1.5217	1049.2449 (278)
Space and water heating			2331.1341 (279)
Pumps, fans and electric keep-hot	142.1056	1.5128	214.9774 (281)
Energy for lighting	148.7948	1.5338	228.2264 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-312.0654	1.4845	-463.2556
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-463.2556 (283)
Total Primary energy kWh/year			2311.0823 (286)

SAP 10 EPC IMPROVEMENTS

Be Green

Current energy efficiency rating: B 85
Current environmental impact rating: A 97

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

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

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

Potential energy efficiency rating: B 85
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 560 TEST (06 Jan 2025)
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	£467	£467	£0
Space heating	£248	£248	£0
Water heating	£180	£180	£0
Lighting	£39	£39	£0
Generated (PV)	-£81	-£81	£0
Total cost of fuels	£386	£386	£0
Total cost of uses	£386	£386	£0
Delivered energy	23 kWh/m²	23 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.2 tonnes	0.2 tonnes	0.0 tonnes
CO2 emissions per m²	4 kg/m²	4 kg/m²	0 kg/m²
Primary energy	36 kWh/m²	36 kWh/m²	0 kWh/m²

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

1. Overall dwelling characteristics

	Area (m2)			Storey height (m)			Volume (m3)	
Ground floor	64.0000	(1b)	x	2.5000	(2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000							(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	160.0000	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2862	0.2825	0.2787	0.2600	0.2562	0.2375	0.2375	0.2337	0.2450	0.2562	0.2637	0.2712	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.9216	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4330	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	34.2343	(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	15.1140	14.9160	14.7180	13.7280	13.5300	12.5400	12.5400	12.3420	12.9360	13.5300	13.9260	14.3220	(38)
Heat transfer coeff	49.3483	49.1503	48.9523	47.9623	47.7643	46.7743	46.7743	46.5763	47.1703	47.7643	48.1603	48.5563	(39)
Average = Sum(39)m / 12 =												47.9128	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7711	0.7680	0.7649	0.7494	0.7463	0.7308	0.7308	0.7278	0.7370	0.7463	0.7525	0.7587	(40)
HLP (average)												0.7486	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.0922	(42)
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)

Hot water usage for other uses

	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)

Average daily hot water use (litres/day) 102.9763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6763	119.0313	122.3937	140.2952	153.8044	175.2143	(45)

Energy content (annual) Total = Sum(45)m = 1710.5733

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)

Water storage loss:

Store volume 173.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.9200 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.0368 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(56)
If cylinder contains dedicated solar storage	32.1408	29.0304	32.1408	31.1040	32.1408	31.1040	32.1408	32.1408	31.1040	32.1408	31.1040	32.1408	(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	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(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	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)

Total per year (kWh/year) = Sum(64)m = 2089.0053 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	59.0820	51.9593	54.5595	46.5464	44.1320	38.7008	37.4648	39.5779	40.6959	46.6482	51.1399	58.2588	(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	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0634	18.7084	15.2147	11.5185	8.6102	7.2691	7.8545	10.2096	13.7033	17.3995	20.3078	21.6489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	273.0011	275.8340	268.6952	253.4975	234.3132	216.2825	204.2371	201.4042	208.5430	223.7407	242.9250	260.9556	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	79.4113	77.3204	73.3327	64.6478	59.3172	53.7511	50.3560	53.1961	56.5221	62.6991	71.0277	78.3048	(72)
Total internal gains	464.9648	463.3517	448.7314	421.1528	393.7295	368.7917	353.9365	356.2988	370.2573	395.3282	425.7494	452.3981	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	1.0000	34.2618	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	42.6483	87.1591	156.6166	254.7387	339.3128	360.2298	337.6018	271.1809	190.2019	106.5178	53.7547	34.7537	(83)
Total gains	507.6131	550.5107	605.3480	675.8915	733.0422	729.0215	691.5382	627.4797	560.4592	501.8460	479.5040	487.1518	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.5621	43.7376	43.9145	44.8210	45.0068	45.9593	45.9593	46.1547	45.5735	45.0068	44.6367	44.2727	
alpha	3.9041	3.9158	3.9276	3.9881	4.0005	4.0640	4.0640	4.0770	4.0382	4.0005	3.9758	3.9515	
util living area	0.9362	0.9117	0.8551	0.7345	0.5709	0.4041	0.2961	0.3386	0.5517	0.7959	0.9070	0.9430	(86)
MIT	20.2028	20.3169	20.5041	20.7136	20.8267	20.8691	20.8764	20.8753	20.8460	20.6878	20.4221	20.1871	(87)
Th 2	20.2785	20.2812	20.2839	20.2974	20.3001	20.3137	20.3137	20.3164	20.3082	20.3001	20.2947	20.2893	(88)
util rest of house	0.9279	0.9006	0.8379	0.7072	0.5347	0.3626	0.2505	0.2894	0.5037	0.7669	0.8937	0.9356	(89)
MIT 2	19.3330	19.4769	19.7084	19.9678	20.0948	20.1504	20.1565	20.1587	20.1249	19.9464	19.6215	19.3226	(90)

Living area fraction fLA = Living area / (4) = 0.4219 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.7000	19.8313	20.0441	20.2825	20.4035	20.4536	20.4602	20.4611	20.4291	20.2592	19.9593	19.6873	(92)

Temperature adjustment 0.4000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	20.1000	20.2313	20.4441	20.6825	20.8035	20.8536	20.8602	20.8611	20.8291	20.6592	20.3593	20.0873	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9256	0.8998	0.8419	0.7225	0.5609	0.3953	0.2868	0.3287	0.5401	0.7822	0.8950	0.9332	(94)
Useful gains	469.8524	495.3362	509.6550	488.3010	411.1940	288.1840	198.3617	206.2393	302.7196	392.5634	429.1629	454.6190	(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	779.7013	753.5363	682.5946	565.1137	434.8246	292.5082	199.2665	207.7796	317.4139	480.4701	638.5704	771.4283	(97)
Space heating kWh	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(98a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement - total per year (kWh/year)												1057.4736	
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	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1057.4736	
Space heating per m2										(98c) / (4) =		16.5230	(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)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	230.5276	173.5105	128.6671	55.3051	17.5812	0.0000	0.0000	0.0000	0.0000	65.4026	150.7734	235.7061	(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)
Space heating fuel used, main system 2												0.0000	(213)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	69.2615	61.1639	64.7718	56.4748	54.4201	48.6863	47.8015	49.8992	50.6668	56.9180	61.0349	68.4442	(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	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(231)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-8.1729	-14.3662	-25.9037	-34.8276	-41.6665	-40.0544	-39.2337	-34.3047	-26.3870	-18.0735	-9.7146	-6.6859	(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	1057.4736	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	302.9550	
Water heating fuel used	689.5431	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)

mechanical ventilation fans (SFP = 0.7280)	142.1056	(230a)
Total electricity for the above, kWh/year	142.1056	(231)
Electricity for lighting (calculated in Appendix L)	148.7948	(232)

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

PV generation	-299.3909	(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	1738.5263	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1057.4736	16.4900	174.3774	(240)
Space heating - main system 2	0.0000	16.4900	0.0000	(241)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	689.5431	16.4900	113.7057	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	142.1056	16.4900	23.4332	(249)
Energy for lighting	148.7948	16.4900	24.5363	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-299.3909	16.4900	-49.3696	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-49.3696	(252)
Total energy cost			286.6830	(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] =	0.9468	(257)
SAP value		84.6517	
SAP rating (Section 12)		85	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	1057.4736	0.1563	165.3347	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	689.5431	0.1411	97.2772	(264)
Space and water heating			262.6119	(265)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(267)
Energy for lighting	148.7948	0.1443	21.4757	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-299.3909	0.1313	-39.3119	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-39.3119	(269)
Total CO2, kg/year			264.4875	(272)
CO2 emissions per m2			4.1300	(273)
EI value			96.7485	
EI rating			97	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.5000	4.3000	4.3000	3.9000	4.0000	3.4000	3.5000	3.8000	3.7000	3.9000	3.8000	4.2000	(22)
Wind factor	1.1250	1.0750	1.0750	0.9750	1.0000	0.8500	0.8750	0.9500	0.9250	0.9750	0.9500	1.0500	(22a)
Adj infilt rate	0.1687	0.1612	0.1612	0.1462	0.1500	0.1275	0.1313	0.1425	0.1388	0.1462	0.1425	0.1575	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2637	0.2562	0.2562	0.2412	0.2450	0.2225	0.2262	0.2375	0.2337	0.2412	0.2375	0.2525	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)

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External Roof 1                                      64.0000        1.2800        62.7200        0.1000        6.2720        9.0000       564.4800 (30)
Total net area of external elements Aum(A, m2)                                  118.0000                                                         (31)
Fabric heat loss, W/K = Sum (A x U)                                       (26)...(30) + (32) =     25.8013                                       (33)
Party Floor 1                                                                    64.0000                                   40.0000      2560.0000 (32d)

Heat capacity Cm = Sum(A x k)                                                          (28)...(30) + (32) + (32a)...(32e) =    7738.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                120.9216 (35)
List of Thermal Bridges
        K1 Element                                                                      Length      Psi-value          Total
        E2 Other lintels (including other steel lintels)                                7.0000        0.3000          2.1000
        E3 Sill                                                                          7.0000        0.0400          0.2800
        E4 Jamb                                                                         12.4000        0.0500          0.6200
        E7 Party floor between dwellings (in blocks of flats)                           12.5000        0.0700          0.8750
        E14 Flat roof                                                                   21.5000        0.0800          1.7200
        E23 Balcony within or between dwellings, balcony support penetrates wall insulation   0.3000   1.0000       0.3000
        E16 Corner (normal)                                                              7.5000        0.0900          0.6750
        E17 Corner (inverted - internal area greater than external area)                 2.5000       -0.0900         -0.2250
        E18 Party wall between dwellings                                                 3.8000        0.0600          0.2280
        R1 Head of roof window                                                           1.6000        0.0800          0.1280
        R2 Sill of roof window                                                           1.6000        0.0600          0.0960
        R3 Jamb of roof window                                                           3.2000        0.0800          0.2560
        P4 Party wall - Roof (insulation at ceiling level)                              11.5000        0.1200          1.3800
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                         8.4330 (36)
Point Thermal bridges                                                                                          (36a) =          0.0000
Total fabric heat loss                                                                             (33) + (36) + (36a) =         34.2343 (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          13.9260     13.5300     13.5300     12.7380     12.9360     11.7480     11.9460     12.5400     12.3420     12.7380     12.5400     13.3320 (38)
Heat transfer coeff
               48.1603     47.7643     47.7643     46.9723     47.1703     45.9823     46.1803     46.7743     46.5763     46.9723     46.7743     47.5663 (39)
Average = Sum(39)m / 12 =                                                                                                           47.0548

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
HLP             0.7525      0.7463      0.7463      0.7339      0.7370      0.7185      0.7216      0.7308      0.7278      0.7339      0.7308      0.7432 (40)
HLP (average)                                                                                                                        0.7352
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                                                                                                                   2.0922 (42)
Hot water usage for mixer showers
               76.1395     74.9953     73.3279     70.1377     67.7834     65.1579     63.6656     65.3204     67.1343     69.9532     73.2120     75.8478 (42a)
Hot water usage for baths
                0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (42b)
Hot water usage for other uses
               36.0560     34.7449     33.4338     32.1226     30.8115     29.5004     29.5004     30.8115     32.1226     33.4338     34.7449     36.0560 (42c)
Average daily hot water use (litres/day)                                                                                          102.9763 (43)

                 Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Daily hot water use
              112.1955    109.7402    106.7617    102.2604     98.5949     94.6583     93.1660     96.1319     99.2569    103.3870    107.9569    111.9038 (44)
Energy conte  177.6903    156.2686    164.0887    139.9893    132.7277    116.3935    112.6762    119.0313    122.3937    140.2952    153.8044    175.2143 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =     1710.5733
Distribution loss  (46)m = 0.15 x (45)m
               26.6535     23.4403     24.6133     20.9984     19.9092     17.4590     16.9014     17.8547     18.3591     21.0443     23.0707     26.2822 (46)
Water storage loss:
Store volume                                                                                                                      173.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                       1.9200 (48)
  Temperature factor from Table 2b                                                                                                  0.5400 (49)
Enter (49) or (54) in (55)                                                                                                          1.0368 (55)
Total storage loss
               32.1408     29.0304     32.1408     31.1040     32.1408     31.1040     32.1408     32.1408     31.1040     32.1408     31.1040     32.1408 (56)
If cylinder contains dedicated solar storage
               32.1408     29.0304     32.1408     31.1040     32.1408     31.1040     32.1408     32.1408     31.1040     32.1408     31.1040     32.1408 (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
              209.8311    185.2990    196.2295    171.0933    164.8685    147.4975    144.8170    151.1721    153.4977    172.4360    184.9084    207.3551 (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
              209.8311    185.2990    196.2295    171.0933    164.8685    147.4975    144.8170    151.1721    153.4977    172.4360    184.9084    207.3551 (64)
                                                                                     Total per year (kWh/year) = Sum(64)m =    2089.0053 (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
               59.0820     51.9593     54.5595     46.5464     44.1320     38.7008     37.4648     39.5779     40.6959     46.6482     51.1399     58.2588 (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         125.5309    125.5309    125.5309    125.5309    125.5309    125.5309    125.5309    125.5309    125.5309    125.5309    125.5309    125.5309 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               21.0634     18.7084     15.2147     11.5185      8.6102      7.2691      7.8545     10.2096     13.7033     17.3995     20.3078     21.6489 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              273.0011    275.8340    268.6952    253.4975    234.3132    216.2826    204.2371    201.4042    208.5430    223.7407    242.9250    260.9556 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               49.6453     49.6453     49.6453     49.6453     49.6453     49.6453     49.6453     49.6453     49.6453     49.6453     49.6453     49.6453 (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)
              -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873 (71)
Water heating gains (Table 5)
               79.4113     77.3204     73.3327     64.6478     59.3172     53.7511     50.3560     53.1961     56.5221     62.6991     71.0277     78.3048 (72)
Total internal gains
              464.9648    463.3517    448.7314    421.1528    393.7295    368.7917    353.9365    356.2988    370.2573    395.3282    425.7494    452.3981 (73)


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6. Solar gains
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[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	
Northwest	12.0500	12.4928	0.4000	0.7000	1.0000	37.9356	(81)
Northwest	1.2800	29.0000	0.4000	0.7000	1.0000	9.3542	(82)

Solar gains	47.2898	87.0977	159.0430	265.3813	342.2025	388.5792	365.6332	301.3661	211.4530	116.3982	61.6316	39.4231	(83)
Total gains	512.2546	550.4494	607.7744	686.5341	735.9320	757.3709	719.5697	657.6649	581.7103	511.7264	487.3810	491.8212	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6367	45.0068	45.0068	45.7656	45.5735	46.7510	46.5505	45.9593	46.1547	45.7656	45.9593	45.1941	
alpha	3.9758	4.0005	4.0005	4.0510	4.0382	4.1167	4.1034	4.0640	4.0770	4.0510	4.0640	4.0129	
util living area	0.9199	0.8952	0.8173	0.6666	0.4787	0.2842	0.1732	0.1989	0.4315	0.7242	0.8755	0.9271	(86)
MIT	20.3245	20.4149	20.6079	20.7813	20.8564	20.8782	20.8794	20.8781	20.8688	20.7673	20.5431	20.3124	(87)
Th 2	20.2947	20.3001	20.3001	20.3109	20.3082	20.3245	20.3218	20.3137	20.3164	20.3109	20.3137	20.3028	(88)
util rest of house	0.9094	0.8821	0.7961	0.6350	0.4393	0.2438	0.1297	0.1503	0.3807	0.6874	0.8579	0.9174	(89)
MIT 2	19.4989	19.6147	19.8480	20.0571	20.1330	20.1694	20.1672	20.1576	20.1537	20.0462	19.7862	19.4912	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	19.8472	19.9523	20.1686	20.3626	20.4382	20.4684	20.4677	20.4615	20.4554	20.3504	20.1055	19.8377	(92)
Temperature adjustment												0.4000	
adjusted MIT	20.2472	20.3523	20.5686	20.7626	20.8382	20.8684	20.8677	20.8615	20.8554	20.7504	20.5055	20.2377	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9086	0.8831	0.8045	0.6560	0.4696	0.2763	0.1647	0.1891	0.4209	0.7113	0.8631	0.9165	(94)
Useful gains	465.4488	486.1275	488.9541	450.3586	345.5804	209.2932	118.5158	124.3753	244.8586	364.0011	420.6498	450.7360	(95)
Ext temp.	5.3000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.2000	15.5000	11.9000	8.2000	5.3000	(96)
Heat loss rate W	719.8635	699.8563	614.6608	496.1513	355.5772	210.0678	118.5764	124.4919	249.4333	415.7249	575.5817	710.5303	(97)
Space heating kWh	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(98a)
Space heating requirement - total per year (kWh/year)												810.1647	
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	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												810.1647	
Space heating per m2										(98c) / (4) =		12.6588	(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)
Fraction of main heating from main system 2	0.0000	(203)
Fraction of total heating from main system 1	1.0000	(204)
Fraction of total heating from main system 2	0.0000	(205)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	189.2845	143.6257	93.5258	32.9707	7.4376	0.0000	0.0000	0.0000	0.0000	38.4825	111.5509	193.2869	(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)
Space heating fuel used, main system 2												0.0000	(213)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	209.8311	185.2990	196.2295	171.0933	164.8685	147.4975	144.8170	151.1721	153.4977	172.4360	184.9084	207.3551	(64)
Efficiency of water heater												302.9550	(216)
(217)m	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	302.9550	(217)
Fuel for water heating, kWh/month	69.2615	61.1639	64.7718	56.4748	54.4201	48.6863	47.8015	49.8992	50.6668	56.9180	61.0349	68.4442	(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	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(231)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-8.9999	-14.2701	-25.8131	-35.2273	-41.2770	-42.0435	-41.2982	-36.8683	-28.5260	-19.2432	-10.9586	-7.5401	(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	810.1647	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	302.9550	
Water heating fuel used	689.5431	(219)
Space cooling fuel	0.0000	(221)

Electricity for pumps and fans:
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)

mechanical ventilation fans (SFP = 0.7280)	142.1056	(230a)
Total electricity for the above, kWh/year	142.1056	(231)
Electricity for lighting (calculated in Appendix L)	148.7948	(232)

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

PV generation	-312.0654	(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	1478.5429	(238)

10a. Fuel costs - using BEDF prices (560)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	810.1647	26.0600	211.1289	(240)
Space heating - main system 2	0.0000	26.0600	0.0000	(241)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	689.5431	26.0600	179.6949	(247)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(247a)
Pumps, fans and electric keep-hot	142.1056	26.0600	37.0327	(249)
Energy for lighting	148.7948	26.0600	38.7759	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-312.0654	26.0600	-81.3242	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-81.3242	(252)
Total energy cost			385.3083	(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	810.1647	0.1573	127.4231	(261)
Space heating - main system 2	0.0000	0.0000	0.0000	(262)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	689.5431	0.1411	97.2772	(264)
Space and water heating			224.7003	(265)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(267)
Energy for lighting	148.7948	0.1443	21.4757	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-312.0654	0.1311	-40.9253	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-40.9253	(269)
Total CO2, kg/year			224.9625	(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	810.1647	1.5823	1281.8892	(275)
Space heating - main system 2	0.0000	0.0000	0.0000	(276)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	689.5431	1.5217	1049.2449	(278)
Space and water heating			2331.1341	(279)
Pumps, fans and electric keep-hot	142.1056	1.5128	214.9774	(281)
Energy for lighting	148.7948	1.5338	228.2264	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-312.0654	1.4845	-463.2556	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-463.2556	(283)
Total Primary energy kWh/year			2311.0823	(286)

Full SAP Calculation Printout

elmhurst energy

Property Reference	L02_2B3P	Issued on Date	29/01/2025
Assessment Reference	Be Lean	Prop Type Ref	L02_2B3P
Property	22, Palace Road, London, N11 2PS		

SAP Rating	85 B	DER	13.38	TER	12.66
Environmental	90 B	% DER < TER			-5.69
CO_2 Emissions (t/year)	0.78	DFEE	33.21	TFEE	36.24
Compliance Check	See BREL	% DFEE < TFEE			8.38
% DPER < TPER	-13.94	DPER	75.90	TPER	66.61

Assessor Details	Dr. Alan Harries	Assessor ID	BC24-0001
Client			

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

1. Overall dwelling characteristics

		Area (m2)		Storey height (m)		Volume (m3)
Ground floor		64.0000 (1b)	x	2.5000 (2b)	=	160.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000 (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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2862	0.2825	0.2787	0.2600	0.2562	0.2375	0.2375	0.2337	0.2450	0.2562	0.2637	0.2712	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	120.9216	(35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200

E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.4330 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 34.2343 (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	15.1140	14.9160	14.7180	13.7280	13.5300	12.5400	12.5400	12.3420	12.9360	13.5300	13.9260	14.3220	(38)
Heat transfer coeff	49.3483	49.1503	48.9523	47.9623	47.7643	46.7743	46.7743	46.5763	47.1703	47.7643	48.1603	48.5563	(39)

Average = Sum(39)m / 12 = 47.9128

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7711	0.7680	0.7649	0.7494	0.7463	0.7308	0.7308	0.7278	0.7370	0.7463	0.7525	0.7587	(40)
HLP (average)												0.7486	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0922 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)

Average daily hot water use (litres/day) 102.9763 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)

Energy content (annual) Total = Sum(45)m = 1710.5733

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)

Water storage loss:
Store volume 173.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9200 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.4976 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(56)
If cylinder contains dedicated solar storage	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)

Total per year (kWh/year) = Sum(64)m = 2531.0933 (64)
12Total per year (kWh/year) 2531 (64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	114.8324	102.3145	110.3099	100.4984	99.8824	92.6528	93.2152	95.3283	94.6479	102.3986	105.0919	114.0092	(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	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	93.7703	103.8171	93.7703	96.8959	93.7703	96.8959	93.7703	93.7703	96.8959	93.7703	96.8959	93.7703	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	182.9108	184.8088	180.0258	169.8433	156.9898	144.9093	136.8388	134.9408	139.7238	149.9062	162.7598	174.8402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	154.3447	152.2537	148.2660	139.5812	134.2505	128.6845	125.2893	128.1295	131.4554	137.6325	145.9610	153.2381	(72)
Total internal gains	485.4084	495.2623	476.4448	460.7032	439.3933	424.8725	410.2811	411.2233	422.4579	435.6917	459.9995	476.2314	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	0.7700	26.3816	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	34.7681	71.1187	127.7169	207.2771	275.5151	292.2147	273.9750	220.4569	154.9872	86.9152	43.8393	28.3183	(83)

```
Total gains     520.1765   566.3810   604.1617   667.9803   714.9084   717.0872   684.2562   631.6802   577.4451   522.6069   503.8388   504.5496 (84)


-----------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                               21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             43.5621    43.7376    43.9145    44.8210    45.0068    45.9593    45.9593    46.1547    45.5735    45.0068    44.6367    44.2727
alpha            3.9041     3.9158     3.9276     3.9881     4.0005     4.0640     4.0640     4.0770     4.0382     4.0005     3.9758     3.9515
util living area
                 0.9317     0.9049     0.8558     0.7398     0.5827     0.4104     0.2992     0.3364     0.5379     0.7792     0.8944     0.9370 (86)

MIT             19.9124    20.1058    20.3810    20.7218    20.9107    20.9835    20.9964    20.9944    20.9519    20.7107    20.2945    19.8964 (87)
Th 2            20.2785    20.2812    20.2839    20.2974    20.3001    20.3137    20.3137    20.3164    20.3082    20.3001    20.2947    20.2893 (88)
util rest of house
                 0.9229     0.8932     0.8386     0.7126     0.5462     0.3684     0.2531     0.2875     0.4905     0.7492     0.8798     0.9289 (89)
MIT 2           19.0105    19.2520    19.5912    20.0048    20.2159    20.3009    20.3116    20.3130    20.2682    20.0025    19.4995    18.9988 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.4219 (91)
MIT             19.3910    19.6122    19.9244    20.3073    20.5090    20.5889    20.6005    20.6004    20.5566    20.3012    19.8349    19.3775 (92)
Temperature adjustment                                                                                                             0.0000
adjusted MIT    19.3910    19.6122    19.9244    20.3073    20.5090    20.5889    20.6005    20.6004    20.5566    20.3012    19.8349    19.3775 (93)


-----------------------------------------------------------------------------------------------
8. Space heating requirement
-----------------------------------------------------------------------------------------------

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation      0.9103     0.8809     0.8291     0.7130     0.5573     0.3854     0.2724     0.3079     0.5078     0.7493     0.8691     0.9167 (94)
Useful gains   473.5054   498.9165   500.9261   476.2871   398.4119   276.3508   186.4209   194.5019   293.2418   391.5682   437.8919   462.5010 (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
               744.7141   723.1084   657.1574   547.1204   420.7562   280.1263   187.1217   195.6403   304.5612   463.3734   613.3159   736.9631 (97)
Space heating kWh
               201.7793   150.6569   116.2361    51.0000    16.6241     0.0000     0.0000     0.0000     0.0000    53.4231   126.3052   204.1998 (98a)
Space heating requirement - total per year (kWh/year)                                                                            920.2245
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
               201.7793   150.6569   116.2361    51.0000    16.6241     0.0000     0.0000     0.0000     0.0000    53.4231   126.3052   204.1998 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                   920.2245
Space heating per m2                                                                                          (98c) / (4) =       14.3785 (99)


-----------------------------------------------------------------------------------------------
9b. Energy requirements
-----------------------------------------------------------------------------------------------
Fraction of space heat from secondary/supplementary system (Table 11)                                                               0.0000 (301)
Fraction of space heat from community system                                                                                        1.0000 (302)
Fraction of heat from community Boilers-Space and Water                                                                             1.0000 (303a)
Factor for control and charging method (Table 4c(3)) for space heating                                                              1.0000 (305)
Factor for charging method (Table 4c(3)) for water heating                                                                          1.0000 (305a)
Distribution loss factor (Table 12c) for community heating system                                                                   1.0000 (306)
Efficiency of secondary/supplementary heating system, %                                                                             0.0000 (208)
Space heating:
Space heating requirement
               201.7793   150.6569   116.2361    51.0000    16.6241     0.0000     0.0000     0.0000     0.0000    53.4231   126.3052   204.1998 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00
307a           201.7793   150.6569   116.2361    51.0000    16.6241     0.0000     0.0000     0.0000     0.0000    53.4231   126.3052   204.1998
Space heating requirement
               201.7793   150.6569   116.2361    51.0000    16.6241     0.0000     0.0000     0.0000     0.0000    53.4231   126.3052   204.1998 (307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)                                             0.0000 (308)
Space heating fuel for secondary/supplementary system
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (309)

Water heating
Annual water heating requirement
               247.3783   219.2126   233.7767   207.4293   202.4157   183.8335   182.3642   188.7193   189.8337   209.9832   221.2444   244.9023 (64)
Water heat from Boilers = (64) x 1.00 x 1.00
310a           247.3783   219.2126   233.7767   207.4293   202.4157   183.8335   182.3642   188.7193   189.8337   209.9832   221.2444   244.9023
Water heating fuel
               247.3783   219.2126   233.7767   207.4293   202.4157   183.8335   182.3642   188.7193   189.8337   209.9832   221.2444   244.9023 (310)
Cooling System Energy Efficiency Ratio                                                                                              0.0000 (314)
Space coolin     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (315)
Pumps and Fa    12.0692    10.9013    12.0692    11.6799    12.0692    11.6799    12.0692    12.0692    11.6799    12.0692    11.6799    12.0692 (331)
Lighting        18.7314    15.0270    13.5302     9.9128     7.6569     6.2558     6.9849     9.0792    11.7930    15.4731    17.4768    19.2520 (332)
Electricity generated by PVs (Appendix M) (negative quantity)
(333a)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(334a)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(335a)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (335a)
Electricity generated by PVs (Appendix M) (negative quantity)
(333b)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)
(334b)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)
(335b)m          0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (335b)
Annual totals kWh/year
Space heating fuel - community heating                                                                                            920.2245 (307)
Space heating fuel - secondary                                                                                                      0.0000 (309)
Water heating fuel - community heating                                                                                           2531.0933 (310)
Efficiency of water heater                                                                                                          0.0000 (311)
Electricity used for heat distribution                                                                                              9.2022 (313)
Space cooling fuel                                                                                                                  0.0000 (321)

Electricity for pumps and fans:
    (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)
   mechanical ventilation fans (SFP =       0.7280)                                                                               142.1056 (330a)
Total electricity for the above, kWh/year                                                                                         142.1056 (331)
Electricity for lighting (calculated in Appendix L)                                                                               151.1730 (332)

Energy saving/generation technologies (Appendices M ,N and Q)
PV generation                                                                                                                       0.0000 (333)
Wind generation                                                                                                                     0.0000 (334)
Hydro-electric generation (Appendix N)                                                                                              0.0000 (335a)
```

Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	3744.5964	(338)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			89.5000	(367)
Space and Water heating from Boilers	3856.2210	0.2100	215.9186	(367)
Electrical energy for heat distribution (space & water)	9.2022	0.0000	4.9992	(372)
Overall CO2 factor for heat network			0.2361	(386)
Total CO2 associated with community systems			814.8056	(373)
Space and water heating			814.8056	(376)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(378)
Energy for lighting	151.1730	0.1443	21.8189	(379)
Total CO2, kg/year			856.3363	(383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			13.3800	(384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Boilers			89.5000	(467a)
Space and Water heating from Boilers	3856.2210	1.1300	1161.8477	(467)
Electrical energy for heat distribution (space & water)	9.2022	0.0000	53.0045	(472)
Overall CO2 factor for heat network			1.2779	(486)
Total CO2 associated with community systems			4410.5343	(473)
Space and water heating			4410.5343	(476)
Pumps, fans and electric keep-hot	142.1056	1.5128	214.9774	(478)
Energy for lighting	151.1730	1.5338	231.8742	(479)
Total Primary energy kWh/year			4857.3859	(483)
Dwelling Primary energy Rate (DPER)			75.9000	(484)

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	64.0000	(1b)	x	2.5000	(2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.0000								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	160.0000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1250	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3750	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3750	(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	0.4781	0.4688	0.4594	0.4125	0.4031	0.3562	0.3562	0.3469	0.3750	0.4031	0.4219	0.4406	(22b)
Effective ac	0.6143	0.6099	0.6055	0.5851	0.5813	0.5635	0.5635	0.5602	0.5703	0.5813	0.5890	0.5971	(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 Opening Type (Uw = 1.20)			12.0500	1.1450	13.7977			(27)
Rooflights			1.2800	2.0221	2.5882			(27a)

```
External Wall 1                               54.0000        12.0500        41.9500        0.1800        7.5510                             (29a)
External Roof 1                               64.0000         1.2800        62.7200        0.1100        6.8992                             (30)
Total net area of external elements Aum(A, m2)                             118.0000                                                       (31)
Fabric heat loss, W/K = Sum (A x U)                                              (26)...(30) + (32) =    30.8361                             (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                            120.9216 (35)
List of Thermal Bridges
        K1 Element                                                                            Length      Psi-value        Total
        E2 Other lintels (including other steel lintels)                                      7.0000        0.0500         0.3500
        E3 Sill                                                                               7.0000        0.0500         0.3500
        E4 Jamb                                                                              12.4000        0.0500         0.6200
        E7 Party floor between dwellings (in blocks of flats)                                12.5000        0.0700         0.8750
        E14 Flat roof                                                                        21.5000        0.0800         1.7200
        E23 Balcony within or between dwellings, balcony support penetrates wall insulation   0.3000        0.0200         0.0060
        E16 Corner (normal)                                                                   7.5000        0.0900         0.6750
        E17 Corner (inverted - internal area greater than external area)                      2.5000       -0.0900        -0.2250
        E18 Party wall between dwellings                                                      3.8000        0.0600         0.2280
        R1 Head of roof window                                                                1.6000        0.0800         0.1280
        R2 Sill of roof window                                                                1.6000        0.0600         0.0960
        R3 Jamb of roof window                                                                3.2000        0.0800         0.2560
        P4 Party wall - Roof (insulation at ceiling level)                                   11.5000        0.1200         1.3800
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                      6.4590 (36)
Point Thermal bridges                                                                                            (36a) =         0.0000
Total fabric heat loss                                                                              (33) + (36) + (36a) =      37.2951 (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           32.4351     32.2008     31.9711     30.8921     30.6903     29.7505     29.7505     29.5765     30.1125     30.6903     31.0986     31.5256 (38)
Heat transfer coeff
                69.7303     69.4959     69.2662     68.1873     67.9854     67.0457     67.0457     66.8717     67.4076     67.9854     68.3938     68.8207 (39)
Average = Sum(39)m / 12 =                                                                                                        68.1863

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
HLP              1.0895      1.0859      1.0823      1.0654      1.0623      1.0476      1.0476      1.0449      1.0532      1.0623      1.0687      1.0753 (40)
HLP (average)                                                                                                                   1.0654
Days in mont         31          28          31          30          31          30          31          31          30          31          30          31



-----------------------------------------------------------------------------------------------------
4. Water heating energy requirements (kWh/year)
-----------------------------------------------------------------------------------------------------
Assumed occupancy                                                                                                              2.0922 (42)
Hot water usage for mixer showers
                76.1395     74.9953     73.3279     70.1377     67.7834     65.1579     63.6656     65.3204     67.1343     69.9532     73.2120     75.8478 (42a)
Hot water usage for baths
                 0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000      0.0000 (42b)
Hot water usage for other uses
                36.0560     34.7449     33.4338     32.1226     30.8115     29.5004     29.5004     30.8115     32.1226     33.4338     34.7449     36.0560 (42c)
Average daily hot water use (litres/day)                                                                                     102.9763 (43)

                  Jan         Feb         Mar         Apr         May         Jun         Jul         Aug         Sep         Oct         Nov         Dec
Daily hot water use
               112.1955    109.7402    106.7617    102.2604     98.5949     94.6583     93.1660     96.1319     99.2569    103.3870    107.9569    111.9038 (44)
Energy conte   177.6903    156.2686    164.0887    139.9893    132.7277    116.3935    112.6762    119.0313    122.3937    140.2952    153.8044    175.2143 (45)
Energy content (annual)                                                                                  Total = Sum(45)m =    1710.5733
Distribution loss  (46)m = 0.15 x (45)m
                26.6535     23.4403     24.6133     20.9984     19.9092     17.4590     16.9014     17.8547     18.3591     21.0443     23.0707     26.2822 (46)
Water storage loss:
Store volume                                                                                                                 173.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  1.5159 (48)
  Temperature factor from Table 2b                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                     0.8186 (55)
Total storage loss
                25.3765     22.9207     25.3765     24.5579     25.3765     24.5579     25.3765     25.3765     24.5579     25.3765     24.5579     25.3765 (56)
If cylinder contains dedicated solar storage
                25.3765     22.9207     25.3765     24.5579     25.3765     24.5579     25.3765     25.3765     24.5579     25.3765     24.5579     25.3765 (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
               226.3292    200.2005    212.7277    187.0593    181.3667    163.4634    161.3151    167.6703    169.4636    188.9341    200.8743    223.8533 (62)
WWHRS          -34.8078    -30.7843    -32.2356    -26.6923    -24.8763    -21.2868    -19.9530    -21.2180    -22.0242    -25.9640    -29.4141    -34.1632 (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
               191.5214    169.4162    180.4921    160.3669    156.4904    142.1766    141.3622    146.4523    147.4395    162.9701    171.4602    189.6901 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1959.8379 (64)
12Total per year (kWh/year)                                                                                                      1960 (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
                97.9932     87.1048     93.4707     84.2024     83.0431     76.3568     76.3760     78.4891     78.3519     85.5593     88.7959     97.1699 (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          104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091    104.6091 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                92.4420    102.3465     92.4420     95.5234     92.4420     95.5234     92.4420     92.4420     95.5234     92.4420     95.5234     92.4420 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               182.9108    184.8088    180.0258    169.8433    156.9898    144.9093    136.8388    134.9408    139.7238    149.9062    162.7598    174.8402 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609     33.4609 (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)
               -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873    -83.6873 (71)
Water heating gains (Table 5)
               131.7113    129.6203    125.6326    116.9478    111.6171    106.0511    102.6559    105.4961    108.8220    114.9991    123.3276    130.6047 (72)
Total internal gains
               464.4467    474.1583    455.4831    439.6972    418.4316    400.8665    386.3194    387.2616    398.4519    414.7300    438.9935    455.2697 (73)



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6. Solar gains
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[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	
Northwest	12.0500	11.2829	0.6300	0.7000	0.7700	41.5510	(81)
Northwest	1.2800	26.0000	0.6300	0.7000	1.0000	13.2088	(82)

Solar gains	54.7598	112.0119	201.1541	326.4615	433.9363	460.2381	431.5107	347.2196	244.1048	136.8914	69.0469	44.6013	(83)
Total gains	519.2065	586.1703	656.6372	766.1587	852.3679	861.1047	817.8301	734.4812	642.5567	551.6214	508.0404	499.8710	(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	30.8290	30.9330	31.0356	31.5267	31.6203	32.0635	32.0635	32.1469	31.8913	31.6203	31.4315	31.2365	
alpha	3.0553	3.0622	3.0690	3.1018	3.1080	3.1376	3.1376	3.1431	3.1261	3.1080	3.0954	3.0824	
util living area	0.9512	0.9291	0.8858	0.7834	0.6347	0.4685	0.3512	0.4026	0.6250	0.8410	0.9275	0.9557	(86)
MIT	19.0660	19.3420	19.7782	20.3467	20.7345	20.9251	20.9772	20.9651	20.8148	20.2929	19.6082	19.0348	(87)
Th 2	20.0094	20.0124	20.0153	20.0292	20.0318	20.0439	20.0439	20.0461	20.0392	20.0318	20.0265	20.0210	(88)
util rest of house	0.9435	0.9183	0.8684	0.7526	0.5876	0.4068	0.2785	0.3250	0.5607	0.8102	0.9146	0.9488	(89)
MIT 2	17.7686	18.1156	18.6581	19.3495	19.7869	19.9889	20.0321	20.0268	19.8892	19.3066	18.4642	17.7368	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	18.3160	18.6330	19.1306	19.7702	20.1867	20.3839	20.4308	20.4227	20.2797	19.7227	18.9468	18.2844	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3160	18.6330	19.1306	19.7702	20.1867	20.3839	20.4308	20.4227	20.2797	19.7227	18.9468	18.2844	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9265	0.8994	0.8499	0.7435	0.5955	0.4293	0.3083	0.3562	0.5777	0.7989	0.8968	0.9326	(94)
Useful gains	481.0344	527.1980	558.0785	569.6735	507.5699	369.6727	252.1452	261.6339	371.1729	440.7096	455.6134	466.1756	(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	977.3383	954.3893	874.8744	741.2110	576.9709	387.7834	256.8372	269.0026	416.5567	620.2083	810.2496	969.2966	(97)
Space heating kWh	369.2501	287.0725	235.6962	123.5070	51.6344	0.0000	0.0000	0.0000	0.0000	133.5470	255.3380	374.3220	(98a)
Space heating requirement - total per year (kWh/year)												1830.3673	
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	369.2501	287.0725	235.6962	123.5070	51.6344	0.0000	0.0000	0.0000	0.0000	133.5470	255.3380	374.3220	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1830.3673	
Space heating per m2										(98c) / (4) =		28.5995	(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	369.2501	287.0725	235.6962	123.5070	51.6344	0.0000	0.0000	0.0000	0.0000	133.5470	255.3380	374.3220	(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)	400.0543	311.0211	255.3588	133.8104	55.9419	0.0000	0.0000	0.0000	0.0000	144.6880	276.6393	405.5493	(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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water heating requirement	191.5214	169.4162	180.4921	160.3669	156.4904	142.1766	141.3622	146.4523	147.4395	162.9701	171.4602	189.6901	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.5064	85.2325	84.6592	83.4812	81.8583	79.8000	79.8000	79.8000	79.8000	83.6169	84.9510	85.5548	(217)
Fuel for water heating, kWh/month	223.9849	198.7696	213.1984	192.0996	191.1723	178.1662	177.1456	183.5242	184.7613	194.9010	201.8342	221.7176	(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	19.2076	15.4091	13.8742	10.1648	7.8516	6.4148	7.1625	9.3101	12.0928	15.8665	17.9211	19.7415	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-21.8458	-31.8328	-47.2831	-55.0068	-60.9268	-57.4708	-56.7788	-52.8104	-46.0718	-37.2282	-24.3858	-18.7690	(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	-9.3904	-20.0295	-40.3199	-61.3031	-81.7793	-82.4190	-81.4375	-68.6143	-49.8553	-28.8769	-12.6138	-7.4045	(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		1983.0631	(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		2361.2747	(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)		155.0165	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV generation		-1054.4534	(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		3530.9008	(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	1983.0631	0.2100	416.4433	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2361.2747	0.2100	495.8677	(264)
Space and water heating			912.3109	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	155.0165	0.1443	22.3737	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-510.4101	0.1339	-68.3358	
PV Unit electricity exported	-544.0433	0.1255	-68.3003	
Total			-136.6361	(269)
Total CO2, kg/year			809.9777	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			12.6600	(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	1983.0631	1.1300	2240.8613	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2361.2747	1.1300	2668.2404	(278)
Space and water heating			4909.1017	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	155.0165	1.5338	237.7695	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-510.4101	1.4948	-762.9475	
PV Unit electricity exported	-544.0433	0.4608	-250.7002	
Total			-1013.6477	(283)
Total Primary energy kWh/year			4263.3243	(286)
Target Primary Energy Rate (TPER)			66.6100	(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	64.0000	(1b)	x	2.5000	(2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.0000								(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)		=	160.0000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1250	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.2750	(18)
Number of sides sheltered		0	(19)

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Shelter factor                                                                            (20) =  1  -  [0.075 x (19)]  =      1.0000 (20)
Infiltration rate adjusted to include shelter factor                                              (21) = (18) x (20)  =      0.2750 (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
                 0.3506     0.3438     0.3369     0.3025     0.2956     0.2612     0.2612     0.2544     0.2750     0.2956     0.3094     0.3231 (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     0.5615     0.5591     0.5567     0.5458     0.5437     0.5341     0.5341     0.5324     0.5378     0.5437     0.5479     0.5522 (25)
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3. Heat losses and heat loss parameter
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Element                                            Gross       Openings         NetArea        U-value          A x U       K-value            A x K
                                                      m2             m2              m2          W/m2K            W/K       kJ/m2K              kJ/K
Window (Uw = 1.00)                                                              12.0500         0.9615        11.5865                                (27)
Rooflights                                                                       1.2800         0.9615         1.2308                                (27a)
External Wall 1                                  54.0000        12.0500         41.9500         0.1600         6.7120      110.0000      4614.5000 (29a)
External Roof 1                                  64.0000         1.2800         62.7200         0.1000         6.2720        9.0000       564.4800 (30)
Total net area of external elements Aum(A, m2)                                 118.0000                                                          (31)
Fabric heat loss, W/K = Sum (A x U)                                        (26)...(30) + (32) =        25.8013                                   (33)
Party Floor 1                                                                   64.0000                                   40.0000      2560.0000 (32d)

Heat capacity Cm = Sum(A x k)                                                               (28)...(30) + (32) + (32a)...(32e) =    7738.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K                                                                                   120.9216 (35)
List of Thermal Bridges
        K1 Element                                                                                 Length      Psi-value         Total
        E2 Other lintels (including other steel lintels)                                           7.0000         0.3000        2.1000
        E3 Sill                                                                                    7.0000         0.0400        0.2800
        E4 Jamb                                                                                   12.4000         0.0500        0.6200
        E7 Party floor between dwellings (in blocks of flats)                                     12.5000         0.0700        0.8750
        E14 Flat roof                                                                             21.5000         0.0800        1.7200
        E23 Balcony within or between dwellings, balcony support penetrates wall insulation        0.3000         1.0000        0.3000
        E16 Corner (normal)                                                                        7.5000         0.0900        0.6750
        E17 Corner (inverted - internal area greater than external area)                           2.5000        -0.0900       -0.2250
        E18 Party wall between dwellings                                                           3.8000         0.0600        0.2280
        R1 Head of roof window                                                                     1.6000         0.0800        0.1280
        R2 Sill of roof window                                                                     1.6000         0.0600        0.0960
        R3 Jamb of roof window                                                                     3.2000         0.0800        0.2560
        P4 Party wall - Roof (insulation at ceiling level)                                        11.5000         0.1200        1.3800
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                            8.4330 (36)
Point Thermal bridges                                                                                                    (36a) =     0.0000
Total fabric heat loss                                                                               (33) + (36) + (36a) =       34.2343 (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           29.6456    29.5195    29.3960    28.8158    28.7072    28.2018    28.2018    28.1083    28.3965    28.7072    28.9268    29.1564 (38)
Heat transfer coeff
                63.8799    63.7538    63.6303    63.0501    62.9415    62.4361    62.4361    62.3426    62.6308    62.9415    63.1611    63.3907 (39)
Average = Sum(39)m / 12 =                                                                                                             63.0496

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP              0.9981     0.9962     0.9942     0.9852     0.9835     0.9756     0.9756     0.9741     0.9786     0.9835     0.9869     0.9905 (40)
HLP (average)                                                                                                                          0.9851
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                                                                                                                       2.0922 (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
                25.6236    25.2430    24.7071    23.7191    22.9792    22.1588    21.7157    22.2478    22.8272    23.7051    24.7135    25.5369 (42b)
Hot water usage for other uses
                36.0560    34.7449    33.4338    32.1226    30.8115    29.5004    29.5004    30.8115    32.1226    33.4338    34.7449    36.0560 (42c)
Average daily hot water use (litres/day)                                                                                               56.5353 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
                61.6796    59.9879    58.1409    55.8417    53.7907    51.6592    51.2160    53.0593    54.9498    57.1388    59.4584    61.5930 (44)
Energy conte    97.6854    85.4220    89.3604    76.4445    72.4126    63.5210    61.9414    65.6985    67.7587    77.5368    84.7094    96.4397 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =    938.9304
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
                83.0326    72.6087    75.9563    64.9778    61.5507    53.9928    52.6502    55.8437    57.5949    65.9063    72.0030    81.9738 (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
                83.0326    72.6087    75.9563    64.9778    61.5507    53.9928    52.6502    55.8437    57.5949    65.9063    72.0030    81.9738 (64)
                                                                                         Total per year (kWh/year) = Sum(64)m =    798.0908 (64)
12Total per year (kWh/year)                                                                                                              798 (64)
Electric shower(s)
                47.4883    42.3125    46.2036    44.0915    44.9189    42.8483    44.2765    44.9189    44.0915    46.2036    45.3348    47.4883 (64a)
                                                      Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =    540.1766 (64a)
Heat gains from water heating, kWh/month
                32.6302    28.7303    30.5400    27.2673    26.6174    24.2103    24.2317    25.1907    25.4216    28.0275    29.3344    32.3655 (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	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	93.7703	103.8171	93.7703	96.8959	93.7703	96.8959	93.7703	93.7703	96.8959	93.7703	96.8959	93.7703	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	182.9108	184.8088	180.0258	169.8433	156.9898	144.9093	136.8388	134.9408	139.7238	149.9062	162.7598	174.8402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	(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)													
	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)													
	43.8578	42.7534	41.0484	37.8713	35.7761	33.6254	32.5695	33.8584	35.3078	37.6713	40.7423	43.5020	(72)
Total internal gains													
	374.9216	385.7620	369.2272	358.9933	340.9189	329.8134	317.5613	316.9522	326.3102	335.7306	354.7807	366.4953	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	0.7700	26.3816	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

Solar gains	34.7681	71.1187	127.7169	207.2771	275.5151	292.2147	273.9750	220.4569	154.9872	86.9152	43.8393	28.3183	(83)
Total gains	409.6897	456.8807	496.9440	566.2705	616.4340	622.0281	591.5363	537.4091	481.2974	422.6457	398.6200	394.8136	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	33.6525	33.7190	33.7845	34.0954	34.1542	34.4306	34.4306	34.4823	34.3236	34.1542	34.0354	33.9122	
alpha	3.2435	3.2479	3.2523	3.2730	3.2769	3.2954	3.2954	3.2988	3.2882	3.2769	3.2690	3.2608	
util living area													
	0.9719	0.9586	0.9335	0.8651	0.7460	0.5796	0.4438	0.5000	0.7240	0.9001	0.9572	0.9749	(86)
MIT	19.0149	19.2518	19.6364	20.1860	20.6256	20.8831	20.9635	20.9460	20.7499	20.1822	19.5210	18.9760	(87)
Th 2	20.0849	20.0865	20.0881	20.0957	20.0971	20.1037	20.1037	20.1050	20.1012	20.0971	20.0943	20.0913	(88)
util rest of house													
	0.9673	0.9520	0.9224	0.8424	0.7042	0.5145	0.3609	0.4143	0.6649	0.8783	0.9492	0.9708	(89)
MIT 2	18.2678	18.5023	18.8806	19.4134	19.8155	20.0331	20.0880	20.0800	19.9343	19.4213	18.7761	18.2339	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	18.5830	18.8185	19.1995	19.7393	20.1573	20.3917	20.4573	20.4453	20.2784	19.7423	19.0903	18.5469	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5830	18.8185	19.1995	19.7393	20.1573	20.3917	20.4573	20.4453	20.2784	19.7423	19.0903	18.5469	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9575	0.9403	0.9093	0.8323	0.7072	0.5362	0.3944	0.4479	0.6774	0.8682	0.9379	0.9617	(94)
Useful gains	392.2915	429.5922	451.8782	471.2836	435.9483	333.5407	233.2888	240.7185	326.0397	366.9392	373.8540	379.6775	(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													
	912.3968	887.3593	808.0701	683.4202	532.3130	361.6135	240.8377	252.1961	386.9563	575.4315	757.3235	909.4633	(97)
Space heating kWh													
	386.9583	307.6195	265.0067	152.7384	71.6953	0.0000	0.0000	0.0000	0.0000	155.1182	276.0981	394.1606	(98a)
Space heating requirement - total per year (kWh/year)												2009.3951	
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													
	386.9583	307.6195	265.0067	152.7384	71.6953	0.0000	0.0000	0.0000	0.0000	155.1182	276.0981	394.1606	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2009.3951	
Space heating per m2										(98c) / (4) =		31.3968	(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	586.8998	462.0275	473.8035	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8203	0.8768	0.8422	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	481.4438	405.0887	399.0217	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	680.2594	647.0987	587.4019	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	143.1473	180.0554	140.1548	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	35.7868	45.0139	35.0387	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												115.8394	(107)
Energy for space heating												31.3968	(99)
Energy for space cooling												1.8100	(108)
Total												33.2068	(109)
Fabric Energy Efficiency (DFEE)												33.2	(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	64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	2 * 10 =	20.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1250	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3750	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3750	(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	0.4781	0.4688	0.4594	0.4125	0.4031	0.3562	0.3562	0.3469	0.3750	0.4031	0.4219	0.4406	(22b)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.6143	0.6099	0.6055	0.5851	0.5813	0.5635	0.5635	0.5602	0.5703	0.5813	0.5890	0.5971	(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 Opening Type (Uw = 1.20)			12.0500	1.1450	13.7977			(27)
Rooflights			1.2800	2.0221	2.5882			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1800	7.5510			(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1100	6.8992			(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.8361			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 120.9216 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.0500	0.3500
E3 Sill	7.0000	0.0500	0.3500
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	0.0200	0.0060
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		6.4590	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	37.2951	(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	32.4351	32.2008	31.9711	30.8921	30.6903	29.7505	29.7505	29.5765	30.1125	30.6903	31.0986	31.5256	(38)
Heat transfer coeff	69.7303	69.4959	69.2662	68.1873	67.9854	67.0457	67.0457	66.8717	67.4076	67.9854	68.3938	68.8207	(39)
Average = Sum(39)m / 12 =												68.1863	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0895	1.0859	1.0823	1.0654	1.0623	1.0476	1.0476	1.0449	1.0532	1.0623	1.0687	1.0753	(40)
HLP (average)												1.0654	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0922 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for baths	25.6236	25.2430	24.7071	23.7191	22.9792	22.1588	21.7157	22.2478	22.8272	23.7051	24.7135	25.5369	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												56.5353	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	61.6796	59.9879	58.1409	55.8417	53.7907	51.6592	51.2160	53.0593	54.9498	57.1388	59.4584	61.5930	(44)
Energy conte	97.6854	85.4220	89.3604	76.4445	72.4126	63.5210	61.9414	65.6985	67.7587	77.5368	84.7094	96.4397	(45)
Energy content (annual)										Total = Sum(45)m =		938.9304	
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	83.0326	72.6087	75.9563	64.9778	61.5507	53.9928	52.6502	55.8437	57.5949	65.9063	72.0030	81.9738	(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	83.0326	72.6087	75.9563	64.9778	61.5507	53.9928	52.6502	55.8437	57.5949	65.9063	72.0030	81.9738	(64)
								Total per year (kWh/year) = Sum(64)m =				798.0908	(64)
12Total per year (kWh/year)												798	(64)
Electric shower(s)	47.4883	42.3125	46.2036	44.0915	44.9189	42.8483	44.2765	44.9189	44.0915	46.2036	45.3348	47.4883	(64a)
					Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =							540.1766	(64a)
Heat gains from water heating, kWh/month	32.6302	28.7303	30.5400	27.2673	26.6174	24.2103	24.2317	25.1907	25.4216	28.0275	29.3344	32.3655	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	104.6091	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	92.4420	102.3465	92.4420	95.5234	92.4420	95.5234	92.4420	92.4420	95.5234	92.4420	95.5234	92.4420	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	182.9108	184.8088	180.0258	169.8433	156.9898	144.9093	136.8388	134.9408	139.7238	149.9062	162.7598	174.8402	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	33.4609	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	43.8578	42.7534	41.0484	37.8713	35.7761	33.6254	32.5695	33.8584	35.3078	37.6713	40.7423	43.5020	(72)
Total internal gains	373.5933	384.2914	367.8989	357.6208	339.5906	328.4408	316.2330	315.6239	324.9377	334.4023	353.4081	365.1670	(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	
Northwest	12.0500	11.2829	0.6300	0.7000	0.7700	41.5510	(81)
Northwest	1.2800	26.0000	0.6300	0.7000	1.0000	13.2088	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	54.7598	112.0119	201.1541	326.4615	433.9363	460.2381	431.5107	347.2196	244.1048	136.8914	69.0469	44.6013	(83)
Total gains	428.3531	496.3034	569.0530	684.0823	773.5269	788.6790	747.7437	662.8436	569.0425	471.2937	422.4551	409.7683	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	30.8290	30.9330	31.0356	31.5267	31.6203	32.0635	32.0635	32.1469	31.8913	31.6203	31.4315	31.2365	
alpha	3.0553	3.0622	3.0690	3.1018	3.1080	3.1376	3.1376	3.1431	3.1261	3.1080	3.0954	3.0824	
util living area	0.9697	0.9521	0.9159	0.8218	0.6758	0.5041	0.3813	0.4408	0.6767	0.8835	0.9532	0.9732	(86)
MIT	18.8397	19.1339	19.6034	20.2362	20.6814	20.9079	20.9712	20.9550	20.7665	20.1545	19.4093	18.8061	(87)
Th 2	20.0094	20.0124	20.0153	20.0292	20.0318	20.0439	20.0439	20.0461	20.0392	20.0318	20.0265	20.0210	(88)
util rest of house	0.9646	0.9442	0.9020	0.7939	0.6292	0.4397	0.3034	0.3576	0.6128	0.8582	0.9442	0.9688	(89)
MIT 2	18.0420	18.3332	18.7930	19.4022	19.7998	19.9906	20.0321	20.0264	19.8886	19.3431	18.6180	18.0170	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	18.3786	18.6710	19.1349	19.7540	20.1717	20.3776	20.4283	20.4181	20.2589	19.6854	18.9519	18.3499	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3786	18.6710	19.1349	19.7540	20.1717	20.3776	20.4283	20.4181	20.2589	19.6854	18.9519	18.3499	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9537	0.9307	0.8871	0.7851	0.6363	0.4628	0.3353	0.3909	0.6284	0.8476	0.9316	0.9586	(94)
Useful gains	408.5065	461.9280	504.7866	537.0731	492.1944	365.0044	250.7126	259.1172	357.5831	399.4617	393.5423	392.8073	(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	981.7019	957.0263	875.1732	740.1071	575.9536	387.3618	256.6690	268.6973	415.1591	617.6761	810.5930	973.8044	(97)
Space heating kWh	426.4574	332.7060	275.5677	146.1845	62.3168	0.0000	0.0000	0.0000	0.0000	162.3515	300.2766	432.2619	(98a)

```
Space heating requirement - total per year (kWh/year)                                                                          2138.1223
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
               426.4574   332.7060   275.5677   146.1845    62.3168     0.0000     0.0000     0.0000     0.0000   162.3515   300.2766   432.2619 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)                                                 2138.1223
Space heating per m2                                                                                      (98c) / (4) =          33.4082 (99)


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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   630.2294   496.1380   508.2246     0.0000     0.0000     0.0000     0.0000 (100)
Utilisation      0.0000     0.0000     0.0000     0.0000     0.0000     0.8640     0.9080     0.8749     0.0000     0.0000     0.0000     0.0000 (101)
Useful loss      0.0000     0.0000     0.0000     0.0000     0.0000   544.5325   450.4824   444.6392     0.0000     0.0000     0.0000     0.0000 (102)
Total gains      0.0000     0.0000     0.0000     0.0000     0.0000   870.2716   825.1874   730.4867     0.0000     0.0000     0.0000     0.0000 (103)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000   234.5321   278.7806   212.6705     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    58.6330    69.6951    53.1676     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling requirement                                                                                                      181.4958 (107)
Energy for space heating                                                                                                        33.4082 (99)
Energy for space cooling                                                                                                         2.8359 (108)
Total                                                                                                                           36.2440 (109)
Fabric Energy Efficiency (TFEE)                                                                                                   36.2 (109)


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SAP 10 WORKSHEET FOR New Build (As Designed)   (Version 10.2, February 2022)
CALCULATION OF ENERGY RATING
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-----------------------------------------------------------------------------------------------
1. Overall dwelling characteristics
-----------------------------------------------------------------------------------------------
                                                                                         Area         Storey height              Volume
                                                                                         (m2)              (m)                    (m3)
Ground floor                                                                          64.0000 (1b)     x      2.5000 (2b)     =     160.0000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)             64.0000                                                              (4)
Dwelling volume                                                                            (3a)+(3b)+(3c)+(3d)+(3e)...(3n) =     160.0000 (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                                                                                                        0 (19)

Shelter factor                                                                   (20) = 1  -  [0.075 x (19)]  =       1.0000 (20)
Infiltration rate adjusted to include shelter factor                                       (21) = (18) x (20)  =       0.1500 (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
                 0.1912     0.1875     0.1837     0.1650     0.1612     0.1425     0.1425     0.1388     0.1500     0.1612     0.1687     0.1762 (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) =                               81.0000 (23c)

Effective ac     0.2862     0.2825     0.2787     0.2600     0.2562     0.2375     0.2375     0.2337     0.2450     0.2562     0.2637     0.2712 (25)


-----------------------------------------------------------------------------------------------
3. Heat losses and heat loss parameter
-----------------------------------------------------------------------------------------------
Element                                      Gross       Openings        NetArea        U-value          A x U        K-value          A x K
                                                m2             m2             m2          W/m2K            W/K         kJ/m2K           kJ/K
Window (Uw = 1.00)                                                       12.0500         0.9615        11.5865                               (27)
Rooflights                                                                1.2800         0.9615         1.2308                               (27a)
External Wall 1                            54.0000        12.0500        41.9500         0.1600         6.7120       110.0000      4614.5000 (29a)
External Roof 1                            64.0000         1.2800        62.7200         0.1000         6.2720         9.0000       564.4800 (30)
```

Total net area of external elements Aum(A, m2)	118.0000			(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	25.8013		(33)
Party Floor 1	64.0000		40.0000	2560.0000 (32d)
Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =			7738.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K				120.9216 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4330 (36)
Point Thermal bridges	(36a) =	0.0000
Total fabric heat loss	(33) + (36) + (36a) =	34.2343 (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	15.1140	14.9160	14.7180	13.7280	13.5300	12.5400	12.5400	12.3420	12.9360	13.5300	13.9260	14.3220	(38)
Heat transfer coeff	49.3483	49.1503	48.9523	47.9623	47.7643	46.7743	46.7743	46.5763	47.1703	47.7643	48.1603	48.5563	(39)
Average = Sum(39)m / 12 =												47.9128	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7711	0.7680	0.7649	0.7494	0.7463	0.7308	0.7308	0.7278	0.7370	0.7463	0.7525	0.7587	(40)
HLP (average)												0.7486	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.0922	(42)
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												102.9763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)
Energy content (annual)										Total = Sum(45)m =		1710.5733	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)
Water storage loss:													
Store volume												173.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9200	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.4976	(55)
Total storage loss	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(56)
If cylinder contains dedicated solar storage	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
								Total per year (kWh/year) = Sum(64)m =				2531.0933	(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	114.8324	102.3145	110.3099	100.4984	99.8824	92.6528	93.2152	95.3283	94.6479	102.3986	105.0919	114.0092	(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	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0634	18.7084	15.2147	11.5185	8.6102	7.2691	7.8545	10.2096	13.7033	17.3995	20.3078	21.6489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	273.0011	275.8340	268.6952	253.4975	234.3132	216.2826	204.2371	201.4042	208.5430	223.7407	242.9250	260.9556	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	154.3447	152.2537	148.2660	139.5812	134.2505	128.6845	125.2893	128.1295	131.4554	137.6325	145.9610	153.2381	(72)
Total internal gains	539.8981	538.2850	523.6648	496.0861	468.6628	443.7251	428.8698	431.2321	445.1906	470.2615	500.6827	527.3315	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	1.0000	34.2618	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

Solar gains	42.6483	87.1591	156.6166	254.7387	339.3128	360.2298	337.6018	271.1809	190.2019	106.5178	53.7547	34.7537	(83)
Total gains	582.5465	625.4441	680.2814	750.8248	807.9756	803.9549	766.4715	702.4130	635.3925	576.7793	554.4374	562.0851	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	43.5621	43.7376	43.9145	44.8210	45.0068	45.9593	45.9593	46.1547	45.5735	45.0068	44.6367	44.2727	
alpha	3.9041	3.9158	3.9276	3.9881	4.0005	4.0640	4.0640	4.0770	4.0382	4.0005	3.9758	3.9515	
util living area	0.9075	0.8783	0.8136	0.6861	0.5260	0.3681	0.2676	0.3033	0.4949	0.7363	0.8666	0.9152	(86)
MIT	20.0534	20.2238	20.4982	20.7894	20.9379	20.9889	20.9977	20.9962	20.9642	20.7671	20.3906	20.0305	(87)
Th 2	20.2785	20.2812	20.2839	20.2974	20.3001	20.3137	20.3137	20.3164	20.3082	20.3001	20.2947	20.2893	(88)
util rest of house	0.8964	0.8644	0.7938	0.6578	0.4911	0.3299	0.2262	0.2589	0.4498	0.7044	0.8495	0.9050	(89)
MIT 2	19.1837	19.3949	19.7287	20.0788	20.2422	20.3052	20.3123	20.3141	20.2789	20.0637	19.6143	19.1640	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	19.5506	19.7446	20.0533	20.3786	20.5357	20.5936	20.6014	20.6018	20.5680	20.3604	19.9418	19.5296	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5506	19.7446	20.0533	20.3786	20.5357	20.5936	20.6014	20.6018	20.5680	20.3604	19.9418	19.5296	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8838	0.8529	0.7870	0.6612	0.5030	0.3456	0.2436	0.2775	0.4669	0.7073	0.8402	0.8925	(94)
Useful gains	514.8374	533.4639	535.3603	496.4165	406.4223	277.8113	186.7049	194.9334	296.6912	407.9663	465.8199	501.6828	(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	752.5911	729.6163	663.4670	550.5412	422.0302	280.3474	187.1649	195.7056	305.0978	466.2010	618.4650	744.3468	(97)
Space heating kWh	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(98a)
Space heating requirement - total per year (kWh/year)												788.3697	
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	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												788.3697	
Space heating per m2										(98c) / (4) =		12.3183	(99)

9b. Energy requirements

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(301)
Fraction of space heat from community system												1.0000	(302)
Fraction of heat from community Boilers-Space and Water												1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating												1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating												1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system												1.0000	(306)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating:													
Space heating requirement	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00													
307a	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	
Space heating requirement	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00													
310a	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	
Water heating fuel	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(331)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)

Annual totals kWh/year

Space heating fuel - community heating	788.3697	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	2531.0933	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	7.8837	(313)
Space cooling fuel	0.0000	(321)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)		
mechanical ventilation fans (SFP = 0.7280)	142.1056	(330a)
Total electricity for the above, kWh/year	142.1056	(331)
Electricity for lighting (calculated in Appendix L)	148.7948	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	3610.3634	(338)

10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Boilers	788.3697	4.4400	35.0036	(340a)
Space heating total			35.0036	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Boilers	2531.0933	4.4400	112.3805	(342a)
Water heating total			112.3805	(342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(347a)
Pumps, fans and electric keep-hot	142.1056	16.4900	23.4332	(349)
Energy for lighting	148.7948	16.4900	24.5363	(350)
Additional standing charges			92.0000	(351)
Total energy cost			287.3536	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600	(356)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9491	(357)
SAP value		84.6158	
SAP rating (Section 12)		85	(358)
SAP band		B	

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			89.5000	(367)
Space and Water heating from Boilers	3708.8972	0.2100	184.9806	(367)
Electrical energy for heat distribution (space & water)	7.8837	0.0000	4.7956	(372)
Overall CO2 factor for heat network			0.2361	(386)
Total CO2 associated with community systems			783.6640	(373)
Space and water heating			783.6640	(376)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(378)
Energy for lighting	148.7948	0.1443	21.4757	(379)
Total CO2, kg/year			824.8515	(383)
CO2 emissions per m2			12.8900	(384)
EI value			89.8596	(384a)
EI rating			90	(385)
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	64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(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	0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.5000	4.3000	4.3000	3.9000	4.0000	3.4000	3.5000	3.8000	3.7000	3.9000	3.8000	4.2000	(22)
Wind factor	1.1250	1.0750	1.0750	0.9750	1.0000	0.8500	0.8750	0.9500	0.9250	0.9750	0.9500	1.0500	(22a)
Adj infilt rate	0.1687	0.1612	0.1612	0.1462	0.1500	0.1275	0.1313	0.1425	0.1388	0.1462	0.1425	0.1575	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2637	0.2562	0.2562	0.2412	0.2450	0.2225	0.2262	0.2375	0.2337	0.2412	0.2375	0.2525	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	120.9216	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.4330	(36)
Point Thermal bridges	(36a) = 0.0000	
Total fabric heat loss	(33) + (36) + (36a) = 34.2343	(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	13.9260	13.5300	13.5300	12.7380	12.9360	11.7480	11.9460	12.5400	12.3420	12.7380	12.5400	13.3320	(38)
Heat transfer coeff	48.1603	47.7643	47.7643	46.9723	47.1703	45.9823	46.1803	46.7743	46.5763	46.9723	46.7743	47.5663	(39)
Average = Sum(39)m / 12 =												47.0548	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7525	0.7463	0.7463	0.7339	0.7370	0.7185	0.7216	0.7308	0.7278	0.7339	0.7308	0.7432	(40)
HLP (average)												0.7352	
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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy												2.0922	(42)
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												102.9763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)
Energy content (annual)											Total = Sum(45)m =	1710.5733	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)
Water storage loss:													
Store volume												173.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9200	(48)
Temperature factor from Table 2b												0.7800	(49)
Enter (49) or (54) in (55)												1.4976	(55)
Total storage loss	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(56)
If cylinder contains dedicated solar storage	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
											Total per year (kWh/year) = Sum(64)m =	2531.0933	(64)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	114.8324	102.3145	110.3099	100.4984	99.8824	92.6528	93.2152	95.3283	94.6479	102.3986	105.0919	114.0092	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts (66)m	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0634	18.7084	15.2147	11.5185	8.6102	7.2691	7.8545	10.2096	13.7033	17.3995	20.3078	21.6489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	273.0011	275.8340	268.6952	253.4975	234.3132	216.2826	204.2371	201.4042	208.5430	223.7407	242.9250	260.9556	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	154.3447	152.2537	148.2660	139.5812	134.2505	128.6845	125.2893	128.1295	131.4554	137.6325	145.9610	153.2381	(72)
Total internal gains	539.8981	538.2850	523.6648	496.0861	468.6628	443.7251	428.8698	431.2321	445.1906	470.2615	500.6827	527.3315	(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	
Northwest	12.0500	12.4928	0.4000	0.7000	1.0000	37.9356	(81)
Northwest	1.2800	29.0000	0.4000	0.7000	1.0000	9.3542	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	47.2898	87.0977	159.0430	265.3813	342.2025	388.5792	365.6332	301.3661	211.4530	116.3982	61.6316	39.4231	(83)
Total gains	587.1879	625.3827	682.7078	761.4674	810.8653	832.3042	794.5030	732.5982	656.6436	586.6597	562.3143	566.7546	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6367	45.0068	45.0068	45.7656	45.5735	46.7510	46.5505	45.9593	46.1547	45.7656	45.9593	45.1941	
alpha	3.9758	4.0005	4.0005	4.0510	4.0382	4.1167	4.1034	4.0640	4.0770	4.0510	4.0640	4.0129	
util living area	0.8858	0.8570	0.7702	0.6170	0.4381	0.2589	0.1569	0.1786	0.3850	0.6599	0.8269	0.8936	(86)
MIT	20.2390	20.3704	20.6464	20.8783	20.9742	20.9980	20.9998	20.9997	20.9890	20.8691	20.5654	20.2225	(87)
Th 2	20.2947	20.3001	20.3001	20.3109	20.3082	20.3245	20.3218	20.3137	20.3164	20.3109	20.3137	20.3028	(88)
util rest of house	0.8723	0.8411	0.7467	0.5855	0.4012	0.2220	0.1175	0.1349	0.3388	0.6221	0.8056	0.8808	(89)
MIT 2	19.4259	19.5895	19.9184	20.1898	20.2862	20.3233	20.3218	20.3136	20.3086	20.1856	19.8399	19.4127	(90)

Living area fraction fLA = Living area / (4) = 0.4219 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	19.7689	19.9189	20.2255	20.4803	20.5765	20.6079	20.6078	20.6030	20.5956	20.4740	20.1460	19.7544	(92)

Temperature adjustment 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
adjusted MIT	19.7689	19.9189	20.2255	20.4803	20.5765	20.6079	20.6078	20.6030	20.5956	20.4740	20.1460	19.7544	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8611	0.8316	0.7441	0.5934	0.4156	0.2375	0.1341	0.1534	0.3578	0.6314	0.8000	0.8696	(94)
Useful gains	505.6055	520.0586	507.9771	451.8655	337.0017	197.6787	106.5518	112.3527	234.9307	370.3920	449.8383	492.8303	(95)
Ext temp.	5.3000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.2000	15.5000	11.9000	8.2000	5.3000	(96)
Heat loss rate W	696.8288	679.1577	598.2714	482.8886	343.2331	198.0886	106.5761	112.3994	237.3359	402.7398	558.7644	687.5403	(97)
Space heating kWh	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(98a)

Space heating requirement - total per year (kWh/year) 590.6943

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating kWh	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(98c)

Space heating requirement after solar contribution - total per year (kWh/year) 590.6943

Space heating per m2 (98c) / (4) = 9.2296 (99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00 307a	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	
Space heating requirement	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(307)

Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E) 0.0000 (308)

Space heating fuel for secondary/supplementary system

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement													
	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00													
310a	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	
Water heating fuel													
	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(331)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)

Annual totals kWh/year		
Space heating fuel - community heating	590.6943	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	2531.0933	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	5.9069	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)		
mechanical ventilation fans (SFP = 0.7280)	142.1056	(330a)
Total electricity for the above, kWh/year	142.1056	(331)
Electricity for lighting (calculated in Appendix L)	148.7948	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	3412.6880	(338)

10b. Fuel costs - using BEDF prices (560)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Boilers	590.6943	5.6000	33.0789	(340a)
Space heating total			33.0789	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Boilers	2531.0933	5.6000	141.7412	(342a)
Water heating total			141.7412	(342)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(347a)
Pumps, fans and electric keep-hot	142.1056	26.0600	37.0327	(349)
Energy for lighting	148.7948	26.0600	38.7759	(350)
Additional standing charges			99.0000	(351)
Total energy cost			349.6288	(355)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			89.5000	(367)
Space and Water heating from Boilers	3488.0308	0.2100	138.5987	(367)
Electrical energy for heat distribution (space & water)	5.9069	0.0000	4.4914	(372)
Overall CO2 factor for heat network			0.2361	(386)
Total CO2 associated with community systems			736.9779	(373)
Space and water heating			736.9779	(376)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(378)
Energy for lighting	148.7948	0.1443	21.4757	(379)
Total CO2, kg/year			778.1653	(383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Boilers			89.5000	(467a)
Space and Water heating from Boilers	3488.0308	1.1300	745.7928	(467)
Electrical energy for heat distribution (space & water)	5.9069	0.0000	47.8292	(472)
Overall CO2 factor for heat network			1.2779	(486)
Total CO2 associated with community systems			3989.3040	(473)
Space and water heating			3989.3040	(476)
Pumps, fans and electric keep-hot	142.1056	1.5128	214.9774	(478)
Energy for lighting	148.7948	1.5338	228.2264	(479)
Total Primary energy kWh/year			4432.5078	(483)

SAP 10 EPC IMPROVEMENTS

Be Lean

Current energy efficiency rating: B 85
Current environmental impact rating: B 90

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

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

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

Potential energy efficiency rating: B 85
Potential environmental impact rating: B 90

Fuel prices for cost data on this page from database revision number 560 TEST (06 Jan 2025)
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	£76	£76	£0
Community scheme	£274	£274	£0
Space heating	£169	£169	£0
Water heating	£142	£142	£0
Lighting	£39	£39	£0
Total cost of fuels	£350	£350	£0
Total cost of uses	£350	£350	£0
Delivered energy	53 kWh/m²	53 kWh/m²	0 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.8 tonnes	0.0 tonnes
CO2 emissions per m²	12 kg/m²	12 kg/m²	0 kg/m²
Primary energy	69 kWh/m²	69 kWh/m²	0 kWh/m²

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 64.0000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(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	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2862	0.2825	0.2787	0.2600	0.2562	0.2375	0.2375	0.2337	0.2450	0.2562	0.2637	0.2712	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 7738.9800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 120.9216 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 8.4330 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 34.2343 (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	15.1140	14.9160	14.7180	13.7280	13.5300	12.5400	12.5400	12.3420	12.9360	13.5300	13.9260	14.3220	(38)
Heat transfer coeff	49.3483	49.1503	48.9523	47.9623	47.7643	46.7743	46.7743	46.5763	47.1703	47.7643	48.1603	48.5563	(39)
Average = Sum(39)m / 12 =												47.9128	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7711	0.7680	0.7649	0.7494	0.7463	0.7308	0.7308	0.7278	0.7370	0.7463	0.7525	0.7587	(40)
HLP (average)												0.7486	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.0922 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												102.9763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)
Energy content (annual)										Total = Sum(45)m =		1710.5733	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)

Water storage loss:
Store volume 173.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.9200 (48)
Temperature factor from Table 2b 0.7800 (49)
Enter (49) or (54) in (55) 1.4976 (55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(56)
If cylinder contains dedicated solar storage	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
									Total per year (kWh/year) = Sum(64)m =			2531.0933	(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	114.8324	102.3145	110.3099	100.4984	99.8824	92.6528	93.2152	95.3283	94.6479	102.3986	105.0919	114.0092	(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	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0634	18.7084	15.2147	11.5185	8.6102	7.2691	7.8545	10.2096	13.7033	17.3995	20.3078	21.6489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	273.0011	275.8340	268.6952	253.4975	234.3132	216.2826	204.2371	201.4042	208.5430	223.7407	242.9250	260.9556	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	154.3447	152.2537	148.2660	139.5812	134.2505	128.6845	125.2893	128.1295	131.4554	137.6325	145.9610	153.2381	(72)

Total internal gains

539.8981	538.2850	523.6648	496.0861	468.6628	443.7251	428.8698	431.2321	445.1906	470.2615	500.6827	527.3315	(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	
Northwest	12.0500	11.2829	0.4000	0.7000	1.0000	34.2618	(81)
Northwest	1.2800	26.0000	0.4000	0.7000	1.0000	8.3866	(82)

Solar gains	42.6483	87.1591	156.6166	254.7387	339.3128	360.2298	337.6018	271.1809	190.2019	106.5178	53.7547	34.7537	(83)
Total gains	582.5465	625.4441	680.2814	750.8248	807.9756	803.9549	766.4715	702.4130	635.3925	576.7793	554.4374	562.0851	(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	43.5621	43.7376	43.9145	44.8210	45.0068	45.9593	45.9593	46.1547	45.5735	45.0068	44.6367	44.2727	
alpha	3.9041	3.9158	3.9276	3.9881	4.0005	4.0640	4.0640	4.0770	4.0382	4.0005	3.9758	3.9515	
util living area	0.9075	0.8783	0.8136	0.6861	0.5260	0.3681	0.2676	0.3033	0.4949	0.7363	0.8666	0.9152	(86)
MIT	20.0534	20.2238	20.4982	20.7894	20.9379	20.9889	20.9977	20.9962	20.9642	20.7671	20.3906	20.0305	(87)
Th 2	20.2785	20.2812	20.2839	20.2974	20.3001	20.3137	20.3137	20.3164	20.3082	20.3001	20.2947	20.2893	(88)
util rest of house	0.8964	0.8644	0.7938	0.6578	0.4911	0.3299	0.2262	0.2589	0.4498	0.7044	0.8495	0.9050	(89)
MIT 2	19.1837	19.3949	19.7287	20.0788	20.2422	20.3052	20.3123	20.3141	20.2789	20.0637	19.6143	19.1640	(90)
Living area fraction									fLA = Living area / (4) =			0.4219	(91)
MIT	19.5506	19.7446	20.0533	20.3786	20.5357	20.5936	20.6014	20.6018	20.5680	20.3604	19.9418	19.5296	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.5506	19.7446	20.0533	20.3786	20.5357	20.5936	20.6014	20.6018	20.5680	20.3604	19.9418	19.5296	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8838	0.8529	0.7870	0.6612	0.5030	0.3456	0.2436	0.2775	0.4669	0.7073	0.8402	0.8925	(94)
Useful gains	514.8374	533.4639	535.3603	496.4165	406.4223	277.8113	186.7049	194.9334	296.6912	407.9663	465.8199	501.6828	(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	752.5911	729.6163	663.4670	550.5412	422.0302	280.3474	187.1649	195.7056	305.0978	466.2010	618.4650	744.3468	(97)
Space heating kWh	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(98a)
Space heating requirement - total per year (kWh/year)												788.3697	
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	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												788.3697	
Space heating per m2										(98c) / (4) =		12.3183	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00													
307a	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	
Space heating requirement	176.8888	131.8144	95.3114	38.9698	11.6122	0.0000	0.0000	0.0000	0.0000	43.3266	109.9045	180.5420	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Annual water heating requirement	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00													
310a	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	
Water heating fuel	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(331)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)

Annual totals kWh/year

Space heating fuel - community heating			788.3697	(307)
Space heating fuel - secondary			0.0000	(309)
Water heating fuel - community heating			2531.0933	(310)
Efficiency of water heater			0.0000	(311)
Electricity used for heat distribution			7.8837	(313)
Space cooling fuel			0.0000	(321)
Electricity for pumps and fans:				
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)				
mechanical ventilation fans (SFP = 0.7280)			142.1056	(330a)
Total electricity for the above, kWh/year			142.1056	(331)
Electricity for lighting (calculated in Appendix L)			148.7948	(332)
Energy saving/generation technologies (Appendices M ,N and Q)				
PV generation			0.0000	(333)
Wind generation			0.0000	(334)
Hydro-electric generation (Appendix N)			0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)			0.0000	(335)
Appendix Q - special features				
Energy saved or generated			-0.0000	(336)
Energy used			0.0000	(337)
Total delivered energy for all uses			3610.3634	(338)

10b. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Boilers	788.3697	4.4400	35.0036	(340a)
Space heating total			35.0036	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Boilers	2531.0933	4.4400	112.3805	(342a)
Water heating total			112.3805	(342)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(347a)
Pumps, fans and electric keep-hot	142.1056	16.4900	23.4332	(349)
Energy for lighting	148.7948	16.4900	24.5363	(350)
Additional standing charges			92.0000	(351)
Total energy cost			287.3536	(355)

11b. SAP rating - Community heating scheme

Energy cost deflator (Table 12):		0.3600	(356)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9491	(357)
SAP value		84.6158	
SAP rating (Section 12)		85	(358)
SAP band		B	

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			89.5000	(367)
Space and Water heating from Boilers	3708.8972	0.2100	184.9806	(367)
Electrical energy for heat distribution (space & water)	7.8837	0.0000	4.7956	(372)
Overall CO2 factor for heat network			0.2361	(386)
Total CO2 associated with community systems			783.6640	(373)
Space and water heating			783.6640	(376)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(378)
Energy for lighting	148.7948	0.1443	21.4757	(379)
Total CO2, kg/year			824.8515	(383)
CO2 emissions per m2			12.8900	(384)
EI value			89.8596	(384a)
EI rating			90	(385)
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		64.0000 (1b)	x	2.5000 (2b)	=	160.0000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	64.0000						(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	160.0000	(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			0	(19)
Shelter factor		(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor		(21) = (18) x (20) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.5000	4.3000	4.3000	3.9000	4.0000	3.4000	3.5000	3.8000	3.7000	3.9000	3.8000	4.2000	(22)
Wind factor	1.1250	1.0750	1.0750	0.9750	1.0000	0.8500	0.8750	0.9500	0.9250	0.9750	0.9500	1.0500	(22a)
Adj infilt rate	0.1687	0.1612	0.1612	0.1462	0.1500	0.1275	0.1313	0.1425	0.1388	0.1462	0.1425	0.1575	(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) =	81.0000	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2637	0.2562	0.2562	0.2412	0.2450	0.2225	0.2262	0.2375	0.2337	0.2412	0.2375	0.2525	(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 (Uw = 1.00)			12.0500	0.9615	11.5865			(27)
Rooflights			1.2800	0.9615	1.2308			(27a)
External Wall 1	54.0000	12.0500	41.9500	0.1600	6.7120	110.0000	4614.5000	(29a)
External Roof 1	64.0000	1.2800	62.7200	0.1000	6.2720	9.0000	564.4800	(30)
Total net area of external elements Aum(A, m2)			118.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.8013			(33)
Party Floor 1			64.0000			40.0000	2560.0000	(32d)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	7738.9800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.9216	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	7.0000	0.3000	2.1000
E3 Sill	7.0000	0.0400	0.2800
E4 Jamb	12.4000	0.0500	0.6200
E7 Party floor between dwellings (in blocks of flats)	12.5000	0.0700	0.8750
E14 Flat roof	21.5000	0.0800	1.7200
E23 Balcony within or between dwellings, balcony support penetrates wall insulation	0.3000	1.0000	0.3000
E16 Corner (normal)	7.5000	0.0900	0.6750
E17 Corner (inverted - internal area greater than external area)	2.5000	-0.0900	-0.2250
E18 Party wall between dwellings	3.8000	0.0600	0.2280
R1 Head of roof window	1.6000	0.0800	0.1280
R2 Sill of roof window	1.6000	0.0600	0.0960
R3 Jamb of roof window	3.2000	0.0800	0.2560
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800

Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.4330	(36)
Point Thermal bridges	(36a) =	0.0000	
Total fabric heat loss	(33) + (36) + (36a) =	34.2343	(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	13.9260	13.5300	13.5300	12.7380	12.9360	11.7480	11.9460	12.5400	12.3420	12.7380	12.5400	13.3320	(38)
Heat transfer coeff	48.1603	47.7643	47.7643	46.9723	47.1703	45.9823	46.1803	46.7743	46.5763	46.9723	46.7743	47.5663	(39)
Average = Sum(39)m / 12 =												47.0548	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7525	0.7463	0.7463	0.7339	0.7370	0.7185	0.7216	0.7308	0.7278	0.7339	0.7308	0.7432	(40)
HLP (average)												0.7352	
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												2.0922	(42)
Hot water usage for mixer showers	76.1395	74.9953	73.3279	70.1377	67.7834	65.1579	63.6656	65.3204	67.1343	69.9532	73.2120	75.8478	(42a)
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)
Hot water usage for other uses	36.0560	34.7449	33.4338	32.1226	30.8115	29.5004	29.5004	30.8115	32.1226	33.4338	34.7449	36.0560	(42c)
Average daily hot water use (litres/day)												102.9763	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.1955	109.7402	106.7617	102.2604	98.5949	94.6583	93.1660	96.1319	99.2569	103.3870	107.9569	111.9038	(44)
Energy conte	177.6903	156.2686	164.0887	139.9893	132.7277	116.3935	112.6762	119.0313	122.3937	140.2952	153.8044	175.2143	(45)
Energy content (annual)											Total = Sum(45)m =	1710.5733	
Distribution loss (46)m = 0.15 x (45)m	26.6535	23.4403	24.6133	20.9984	19.9092	17.4590	16.9014	17.8547	18.3591	21.0443	23.0707	26.2822	(46)

Water storage loss:

Store volume	173.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.9200	(48)
Temperature factor from Table 2b	0.7800	(49)
Enter (49) or (54) in (55)	1.4976	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(56)
If cylinder contains dedicated solar storage	46.4256	41.9328	46.4256	44.9280	46.4256	44.9280	46.4256	46.4256	44.9280	46.4256	44.9280	46.4256	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(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	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)

Total per year (kWh/year) = Sum(64)m = 2531.0933 (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	114.8324	102.3145	110.3099	100.4984	99.8824	92.6528	93.2152	95.3283	94.6479	102.3986	105.0919	114.0092	(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	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	125.5309	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0634	18.7084	15.2147	11.5185	8.6102	7.2691	7.8545	10.2096	13.7033	17.3995	20.3078	21.6489	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	273.0011	275.8340	268.6952	253.4975	234.3132	216.2826	204.2371	201.4042	208.5430	223.7407	242.9250	260.9556	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	49.6453	(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)	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	-83.6873	(71)
Water heating gains (Table 5)	154.3447	152.2537	148.2660	139.5812	134.2505	128.6845	125.2893	128.1295	131.4554	137.6325	145.9610	153.2381	(72)
Total internal gains	539.8981	538.2850	523.6648	496.0861	468.6628	443.7251	428.8698	431.2321	445.1906	470.2615	500.6827	527.3315	(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	
Northwest	12.0500	12.4928	0.4000	0.7000	1.0000	37.9356	(81)
Northwest	1.2800	29.0000	0.4000	0.7000	1.0000	9.3542	(82)

Solar gains	47.2898	87.0977	159.0430	265.3813	342.2025	388.5792	365.6332	301.3661	211.4530	116.3982	61.6316	39.4231	(83)
Total gains	587.1879	625.3827	682.7078	761.4674	810.8653	832.3042	794.5030	732.5982	656.6436	586.6597	562.3143	566.7546	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6367	45.0068	45.0068	45.7656	45.5735	46.7510	46.5505	45.9593	46.1547	45.7656	45.9593	45.1941	
alpha	3.9758	4.0005	4.0005	4.0510	4.0382	4.1167	4.1034	4.0640	4.0770	4.0510	4.0640	4.0129	
util living area	0.8858	0.8570	0.7702	0.6170	0.4381	0.2589	0.1569	0.1786	0.3850	0.6599	0.8269	0.8936	(86)
MIT	20.2390	20.3704	20.6464	20.8783	20.9742	20.9980	20.9998	20.9997	20.9890	20.8691	20.5654	20.2225	(87)
Th 2	20.2947	20.3001	20.3001	20.3109	20.3082	20.3245	20.3218	20.3137	20.3164	20.3109	20.3137	20.3028	(88)
util rest of house	0.8723	0.8411	0.7467	0.5855	0.4012	0.2220	0.1175	0.1349	0.3388	0.6221	0.8056	0.8808	(89)
MIT 2	19.4259	19.5895	19.9184	20.1898	20.2862	20.3233	20.3218	20.3136	20.3086	20.1856	19.8399	19.4127	(90)

Living area fraction — fLA = Living area / (4) = 0.4219 (91)

MIT	19.7689	19.9189	20.2255	20.4803	20.5765	20.6079	20.6078	20.6030	20.5956	20.4740	20.1460	19.7544	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7689	19.9189	20.2255	20.4803	20.5765	20.6079	20.6078	20.6030	20.5956	20.4740	20.1460	19.7544	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8611	0.8316	0.7441	0.5934	0.4156	0.2375	0.1341	0.1534	0.3578	0.6314	0.8000	0.8696	(94)
Useful gains	505.6055	520.0586	507.9771	451.8655	337.0017	197.6787	106.5518	112.3527	234.9307	370.3920	449.8383	492.8303	(95)
Ext temp.	5.3000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.2000	15.5000	11.9000	8.2000	5.3000	(96)
Heat loss rate W	696.8288	679.1577	598.2714	482.8886	343.2331	198.0886	106.5761	112.3994	237.3359	402.7398	558.7644	687.5403	(97)
Space heating kWh	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(98a)
Space heating requirement - total per year (kWh/year)												590.6943	
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	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												590.6943	
Space heating per m2											(98c) / (4) =	9.2296	(99)

9b. Energy requirements

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(301)
Fraction of space heat from community system	1.0000	(302)
Fraction of heat from community Boilers-Space and Water	1.0000	(303a)
Factor for control and charging method (Table 4c(3)) for space heating	1.0000	(305)
Factor for charging method (Table 4c(3)) for water heating	1.0000	(305a)
Distribution loss factor (Table 12c) for community heating system	1.0000	(306)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)

Space heating:

Space heating requirement

	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00													
307a	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	
Space heating requirement													
	142.2701	106.9146	67.1790	22.3367	4.6361	0.0000	0.0000	0.0000	0.0000	24.0668	78.4268	144.8642	(307)
Efficiency of secondary/supplementary heating system in % (from Table 4a or Appendix E)												0.0000	(308)
Space heating fuel for secondary/supplementary system													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(309)
Water heating													
Annual water heating requirement													
	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00													
310a	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	
Water heating fuel													
	247.3783	219.2126	233.7767	207.4293	202.4157	183.8335	182.3642	188.7193	189.8337	209.9832	221.2444	244.9023	(310)
Cooling System Energy Efficiency Ratio												0.0000	(314)
Space coolin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(315)
Pumps and Fa	12.0692	10.9013	12.0692	11.6799	12.0692	11.6799	12.0692	12.0692	11.6799	12.0692	11.6799	12.0692	(331)
Lighting	18.4367	14.7906	13.3173	9.7568	7.5365	6.1573	6.8750	8.9364	11.6075	15.2297	17.2019	18.9491	(332)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
Electricity generated by PVs (Appendix M) (negative quantity)													
(333b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(334b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(334b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(335b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335b)

Annual totals kWh/year		
Space heating fuel - community heating	590.6943	(307)
Space heating fuel - secondary	0.0000	(309)
Water heating fuel - community heating	2531.0933	(310)
Efficiency of water heater	0.0000	(311)
Electricity used for heat distribution	5.9069	(313)
Space cooling fuel	0.0000	(321)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 0.7280)		
mechanical ventilation fans (SFP = 0.7280)	142.1056	(330a)
Total electricity for the above, kWh/year	142.1056	(331)
Electricity for lighting (calculated in Appendix L)	148.7948	(332)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	0.0000	(333)
Wind generation	0.0000	(334)
Hydro-electric generation (Appendix N)	0.0000	(335a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(335)
Appendix Q - special features		
Energy saved or generated	-0.0000	(336)
Energy used	0.0000	(337)
Total delivered energy for all uses	3412.6880	(338)

10b. Fuel costs - using BEDF prices (560)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating from Boilers	590.6943	5.6000	33.0789	(340a)
Space heating total			33.0789	(340)
Total CO2 associated with community systems			0.0000	(473)
Space heating - secondary	0.0000	0.0000	0.0000	(341)
Water heating from Boilers	2531.0933	5.6000	141.7412	(342a)
Water heating total			141.7412	(342)
Energy for instantaneous electric shower(s)	0.0000	26.0600	0.0000	(347a)
Pumps, fans and electric keep-hot	142.1056	26.0600	37.0327	(349)
Energy for lighting	148.7948	26.0600	38.7759	(350)
Additional standing charges			99.0000	(351)
Total energy cost			349.6288	(355)

12b. Carbon dioxide emissions - Community heating scheme

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Efficiency of heat source Boilers			89.5000	(367)
Space and Water heating from Boilers	3488.0308	0.2100	138.5987	(367)
Electrical energy for heat distribution (space & water)	5.9069	0.0000	4.4914	(372)
Overall CO2 factor for heat network			0.2361	(386)
Total CO2 associated with community systems			736.9779	(373)
Space and water heating			736.9779	(376)
Pumps, fans and electric keep-hot	142.1056	0.1387	19.7118	(378)
Energy for lighting	148.7948	0.1443	21.4757	(379)
Total CO2, kg/year			778.1653	(383)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Efficiency of heat source Boilers			89.5000	(467a)
Space and Water heating from Boilers	3488.0308	1.1300	745.7928	(467)
Electrical energy for heat distribution (space & water)	5.9069	0.0000	47.8292	(472)
Overall CO2 factor for heat network			1.2779	(486)
Total CO2 associated with community systems			3989.3040	(473)
Space and water heating			3989.3040	(476)
Pumps, fans and electric keep-hot	142.1056	1.5128	214.9774	(478)
Energy for lighting	148.7948	1.5338	228.2264	(479)
Total Primary energy kWh/year			4432.5078	(483)