
Date
14.08.2026

22 Palace Road Energy & Sustainability Statement

Document status

Project no 856		Project 22 Palace Road London N11 2PS	Client TA Palace Road Limited Unit 2 Archgate Business Centre 825 High Road London N12 8UB	In conjunction with: 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
1	02.05.2025	Issue with TM54	Oscar Akam	Alan Harries
2	06.05.2025	Issue with TM54	Oscar Akam	Alan Harries
3	13.08.2025	Updated strategy	Gregory May	Alan Harries
4	19.08.2025	Updated strategy	Gregory May	Alan Harries
5	21.08.2025	Update strategy	Gregory May	Alan Harries
5	14.08.2026	Update strategy	Oscar Akam	Alan Harries

Contents

EXECUTIVE SUMMARY	5
Carbon Performance	5
Sustainability	5
1 INTRODUCTION	6
1.1 The Development Site.....	6
1.2 Proposed Development Overview	7
1.3 Energy and Sustainability Aspirations.....	8
2 POLICY REVIEW	9
2.1 National Planning Policy Framework (NPPF – December 2024).....	9
2.2 London Plan 2021.....	10
2.3 Haringey Local Policy.....	10
3 DESIGN APPROACH - SUSTAINABILITY	12
3.1 Water use.....	12
3.2 Air Quality.....	12
3.3 Biodiversity & Urban Greening.....	12
3.4 Sustainable Materials & Minimising Waste.....	13
3.5 Sustainable Transport.....	13
4 DESIGN APPROACH - ENERGY	14
4.1 The Energy Hierarchy.....	14
4.2 Climate Analysis.....	14
4.3 Building Fabric Performance & Insulation.....	15
4.4 Air Tightness, Infiltration and Thermal Bridging.....	15
4.5 Natural & Mechanical Ventilation.....	15
4.6 Solar Exposure & Daylight.....	15
4.7 Cooling & Overheating.....	16
4.8 Active Building Services Systems	16
5 CARBON EMISSIONS – NEW-BUILD DWELLINGS	17
5.1 Baseline.....	17
5.2 “Be Lean”	18
5.3 “Be Clean”	19
5.4 “Be Green”	20

5.5	Summary.....	21
6	CARBON EMISSIONS – REFURBISHED DWELLINGS	22
6.1	Baseline.....	22
6.2	“Be Lean”	23
6.3	“Be Clean”	23
6.4	“Be Green”	23
6.5	Summary.....	24
7	SUMMARY	25
7.1	Sustainability Summary.....	25
7.2	Carbon Emissions Summary.....	25
7.3	Cost of Energy Summary	25
APPENDIX A: TECHNOLOGY FEASIBILITY STUDY SUMMARY		26
APPENDIX B: SAP DATASHEETS		27

Executive Summary

This updated 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 four refurbished flats and one new-build flat, as well as the creation of communal and private gardens. This update follows a viability exercise carried out on the proposed scheme.

CARBON PERFORMANCE

The proposed development has been shown to have:

- **84.6% total onsite improvement** in CO₂ emissions compared to the standard set out by Part L 2021.
- **13.6% energy efficiency ("Be Lean")** contribution to the improvement in CO₂.
- **71.1% renewable energy ("Be Green")** contribution to the improvement in CO₂, compared to **local policy target of 20%**.

For the new-build apartment, this is achieved with high-performance building fabric, passive low-energy design principles, and low-carbon building services, including a heat pump for hot water and space heating, mechanical ventilation with heat recovery (MVHR), and energy-efficient LED lighting. For the refurbished flats, the scheme adopts high efficiency heat pumps for space heating and hot water. A 7.0 kWp roof-top solar PV array is also proposed. The table below shows the site-wide regulated and unregulated energy use:

Carbon dioxide emissions (Tonnes CO ₂ per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	5.6	2.2
After "Be Lean" (energy demand reduction)	4.9	2.2
After "Be Clean" (heat network / CHP)	4.9	2.2
After "Be Green" (renewable energy)	0.9	2.2

Table 1: Site wide regulated and unregulated CO₂ 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)	0.8	13.6%
Savings from "Be Clean" (heat network / CHP)	0.0	0.0%
Savings from "Be Green" (renewable energy)	4.0	71.1%
Total cumulative on-site savings	4.8	84.6%

Table 2: Site wide regulated CO₂ emissions savings after each stage of the energy hierarchy

SUSTAINABILITY

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. 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. 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 carried out an updated Energy and Sustainability Assessment for the proposed development at 22 Palace Road in London following a cost/viability exercise.

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.

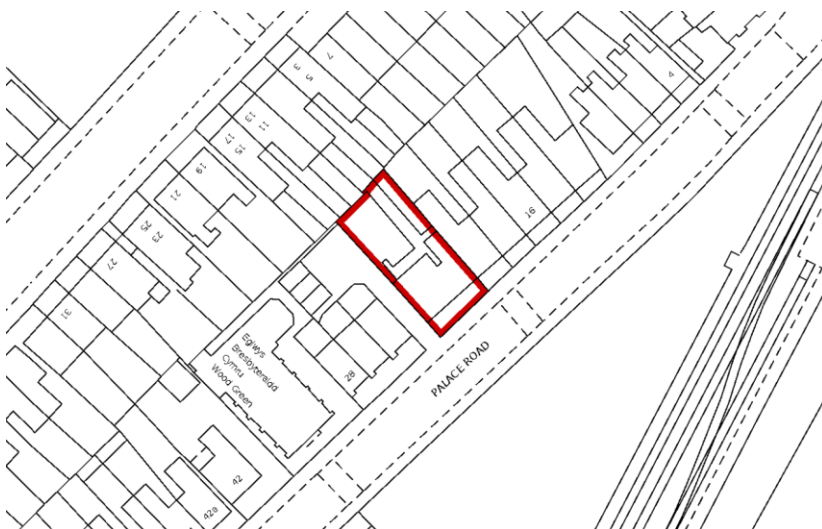


Figure 1: Site Location

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 four refurbished and a new-build flat, as well as the creation of communal and private gardens.

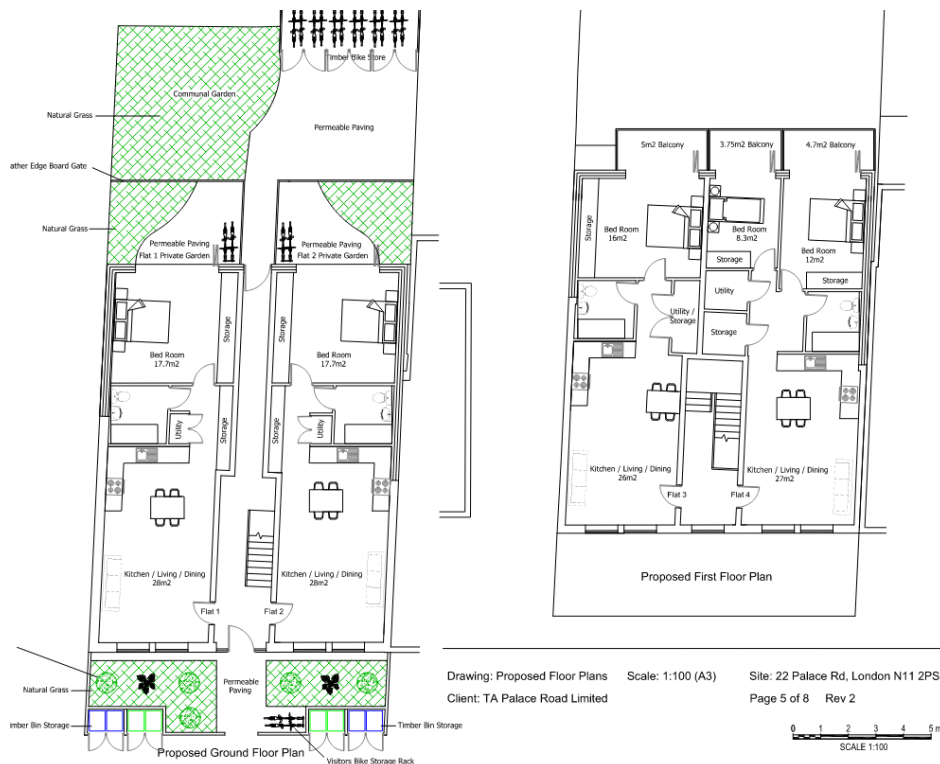


Figure 2: Proposed development scheme, ground and first floor

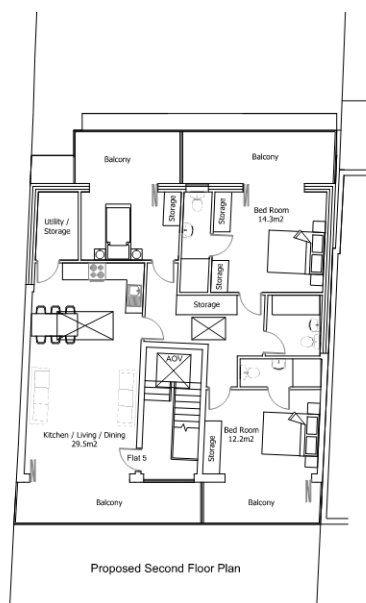


Figure 3: Proposed development scheme, second floor



Figure 4: Proposed development scheme, elevations

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:

Low CO₂ 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 generation.

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

Sustainable Transport: Promote sustainable transport and cycle use.

Zero Fossil Fuels on site: The scheme aims not to use any fossil fuels on site.

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 emissions¹. 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 SI5 – 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) CO₂ 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 3: 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:

- Mechanical ventilation with heat recovery (MVHR) offers a means for occupants to filter fresh air on the second floor.
- Construction environmental management plan (CEMP) to incorporate best practice for air quality and dust control.

3.3 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.

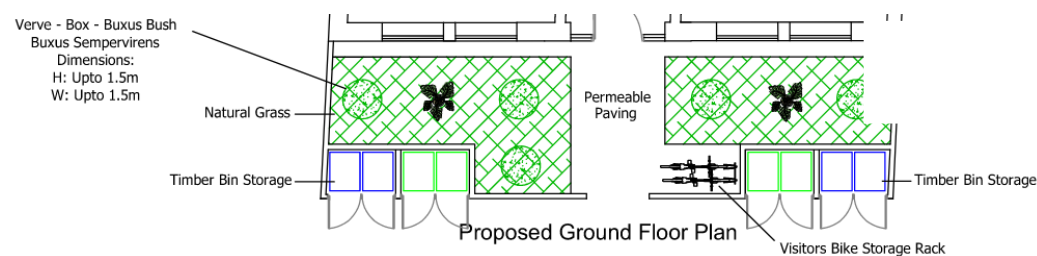


Figure 5: Front garden proposed bush species

3.4 SUSTAINABLE MATERIALS & MINIMISING WASTE

New materials will be sustainably procured and using local supplies where feasible, following the BRE Green Guide to Specification³. 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.

3.5 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 <https://www.bregroup.com/greenguide/podpage.jsp?id=2126>

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.

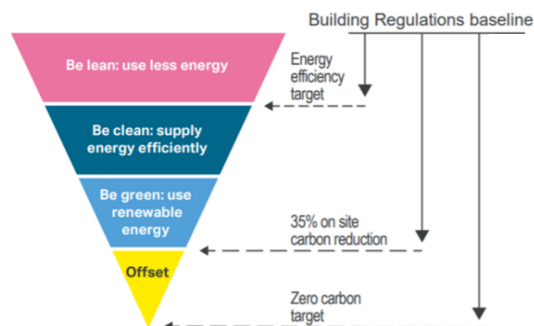


Figure 6: Energy Hierarchy Methodology

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.

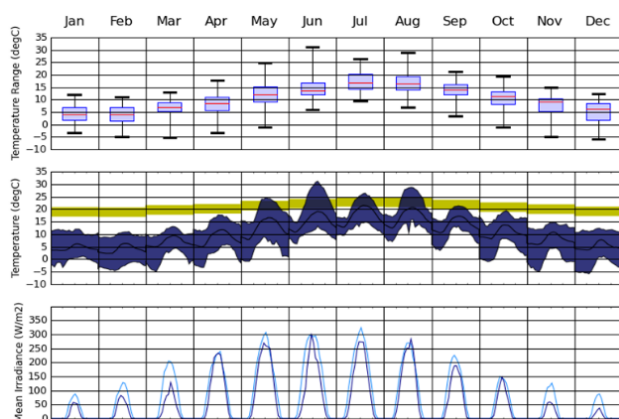


Figure 7: Average historic local climate data

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 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 unit.

Thermal Bridge	Thermal Transmittance (Ψ) - residential
E2: Lintel	0.20
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
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 4: Proposed Psi Values for the new-build residential areas

4.5 NATURAL & MECHANICAL 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.

The new build apartment uses high-efficiency mechanical ventilation with heat recovery to ensure high air quality and low space heating demand during the heating season. The system will have a summer bypass to support night-time free cooling of thermal mass.

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 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 for the new build unit. This system will have "heat recovery by-pass" mode in order to be operable in summer night-cooling mode.
6. Active Cooling	- None.

Table 5: Cooling hierarchy

4.8 ACTIVE BUILDING SERVICES SYSTEMS

Space heating and domestic hot water (DHW) will be provided by a heat pump system in the new build apartment. In the refurbished apartments high efficiency heat pumps will be used for space heating and hot water. Energy use associated with DHW will be minimised by the use of water efficient fittings.

As mentioned, high-efficiency mechanical ventilation with heat recovery will be used in the new build apartment. 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.

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/(m².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 = $0.85 \times (0.2 + 0.051 V^{2/3})$ 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 6: 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 in the new build areas has been specified as per the table below.

Element	Proposed new-build residential development
External walls U-value	0.18 W/m ² /°C
Roof U-value	0.12 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 (Be Green: Individual heat pumps e.g. Daikin Altherma Multi+ Split System)
Hot water	Be Lean: Central gas-fired boiler (Be Green: Individual heat pumps e.g. Daikin Altherma Multi+ Split System)
Lighting	90 lm/W
Communal corridors heated	Yes

Table 7: Proposed new-build residential development (Be Lean)

“Be Lean” Total Carbon Emissions

The “Be Lean” CO₂ 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 (using the GLA Spreadsheet).

Unit type	Total Area (m ²)	TER (kg.CO ₂ /m ² /yr)	DER (kg.CO ₂ /m ² /yr)
L02_flat_5	93 (1 unit)	11.5	10.2

Table 8: Be Lean regulated emissions for the new-build dwelling

5.3 “BE CLEAN”

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.

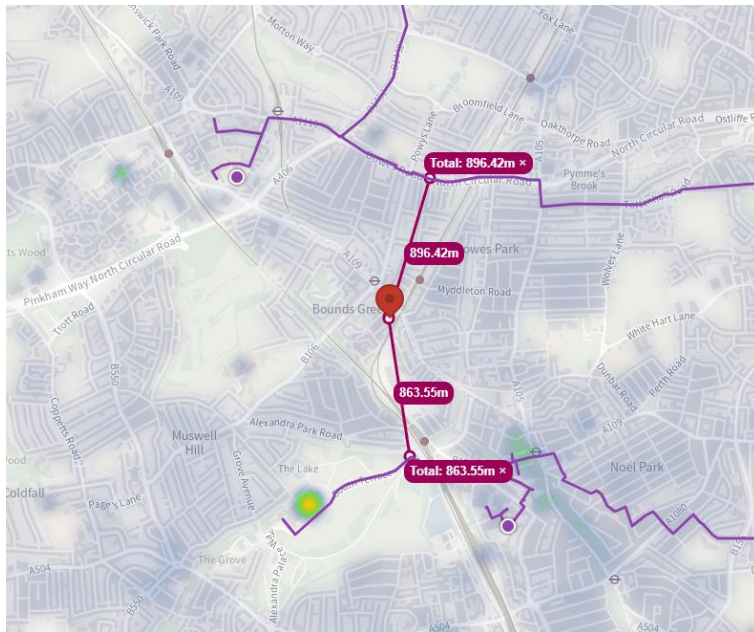


Figure 8: London Heat Map tool showing existing (red) and proposed (purple) heat networks near site.

5.4 “BE GREEN”

A renewable energy feasibility exercise has been carried out for the new-build flat 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.

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. This is split across the refurbished and new-build flats.

Total installed capacity of the system: 7.0 kWp
Panel inclination: 30 degrees
Panel orientation: SE

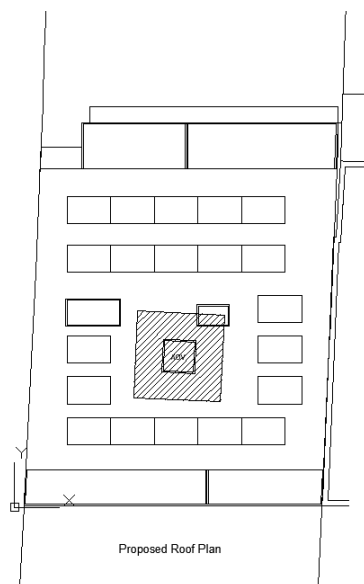


Figure 9: Indicative solar PV layout

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 new build apartment and refurbished units will use individual heat pumps for residential DHW and space heating.

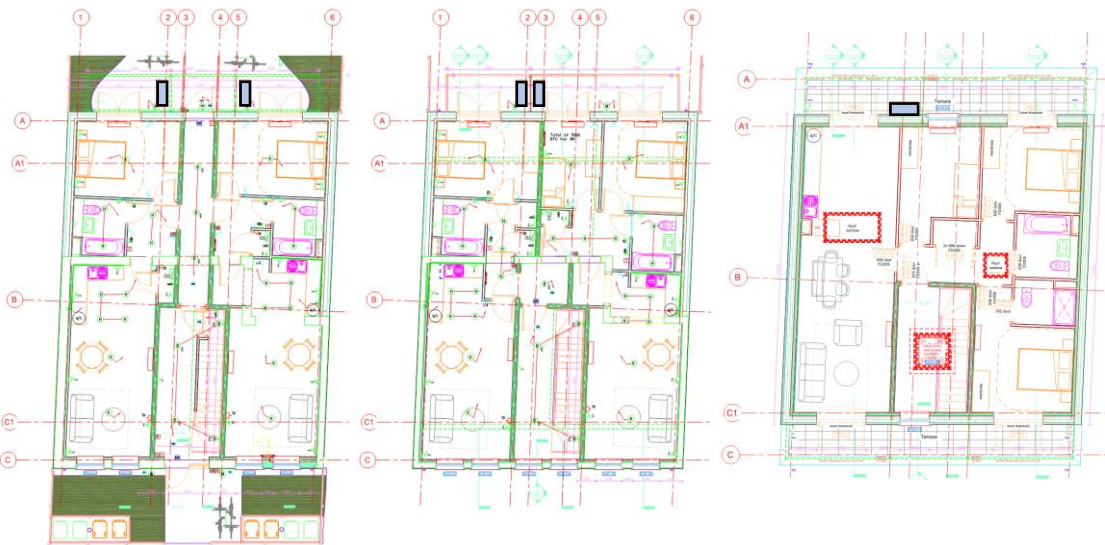


Figure 10: Indicative heat pump layout (outlined in black)

“Be Green” Total Carbon Emissions

The CO₂ 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_flat_5	93 (1 unit)	11.5	2.5

Table 9: Be Green regulated emissions for the new-build dwelling

5.5 SUMMARY

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

Carbon dioxide emissions (Tonnes CO ₂ per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	1.1	0.6
After “Be Lean” (energy demand reduction)	1.0	0.6
After “Be Clean” (heat network / CHP)	1.0	0.6
After “Be Green” (renewable energy)	0.2	0.6

Table 10: New-build regulated and unregulated CO₂ 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)	0.1	11.1%
Savings from “Be Clean” (heat network / CHP)	0.0	0.0%
Savings from “Be Green” (renewable energy)	0.7	67.3%
Total cumulative on-site savings	0.8	78.4%

Table 11: New-build regulated CO₂ emissions savings after each stage of the energy hierarchy

6 Carbon Emissions – Refurbished Dwellings

6.1 BASELINE

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

For the refurbished areas, the DER of the proposed development is compared to the DER of the notional existing building which follows the GLA's residential notional specification for existing buildings, as summarised in Table 12 of the GLA Energy Assessment Guidance 2022.

Fabric values set out in approved document Part L1 and building services efficiencies set out in the Domestic Building Services Compliance Guide, have been followed.

The notional existing building baseline values, which apply to the refurbished residential areas, are:

Element	Notional Existing Building value
External Walls U-value	Existing: 0.30 W/m ² /°C New: 0.18 W/m ² /°C
Floor U-value	0.25 W/m ² /°C
Roof U-value	Existing: 0.18 W/m ² /°C New: 0.11 W/m ² /°C
Windows/Glazed Doors U-value (g-value)	1.6 W/m ² /°C (0.63)
External opaque doors U-value	1.6 W/m ² /°C
Air tightness	15.0 m ³ /m ² /h @50Pa
Ventilation type	Natural with intermittent extract fans
Air-conditioning	None
Heating source	Mains Gas (89.5% SEDBUK 2009)
Hot water	Same as space heating
Lighting	100% low energy lighting. (75lm/W)

Table 12: Notional Existing Dwelling (Building) Specification (Table 12, GLA Energy Assessment Guidance 2022)

6.2 “BE LEAN”

As part of the “Be Lean” approach seeking to minimise energy demand, the building fabric in the refurbished areas has been specified as per the table below.

Element	Proposed refurbished residential development
Existing external walls U-value Solid	0.30 W/m ² /°C
New external walls U-value Solid	0.18 W/m ² /°C
Floor U-value	0.25 W/m ² /°C
Roof U-value	0.12 W/m ² /°C
Windows U-value (g-value)	1.4 W/m ² /°C (g=0.4)
Air tightness	6.0 m ³ /m ² /h @50Pa
Ventilation type	Natural Ventilation with Intermittent extracts
Air-conditioning	None
Heating	Be Lean: Central gas-fired boiler (Be Green: Individual heat pumps e.g. Daikin Altherma Multi+ Split System)
Hot water	Be Lean: Central gas-fired boiler (Be Green: Individual heat pumps e.g. Daikin Altherma Multi+ Split System)
Lighting	90 lm/W
Communal corridors heated	Yes

Table 13: Proposed refurb area residential development (Be Lean)

“Be Lean” Total Carbon Emissions

The “Be Lean” CO₂ emissions associated with regulated energy consumption, the Dwelling Emissions Rate (DER), is given below in relation to the baseline Target Emission Rate (TER), which is the DER of the notional existing building.

Unit type	Area (m ²)	TER (kg.CO ₂ /m ² /yr)	DER (kg.CO ₂ /m ² /yr)
L01_flat_3	52.7 (1 unit)	21.7	18.6

Table 14: Be Lean regulated emissions for a sample refurbished dwelling

6.3 “BE CLEAN”

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

6.4 “BE GREEN”

Please refer to the Be Green commentary for the new-build dwelling carbon assessment (Section 5.4). Heat pumps are proposed and the 7kWpeak PV array is split across the refurbished and new-build flats.

“Be Green” Total Carbon Emissions

The CO₂ 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.)
L01_flat_3	52.7 (1 unit)	21.7	3.0

Table 15: Be Green regulated emissions for a sample refurbished dwelling

6.5 SUMMARY

The table below shows the regulated and unregulated energy use for the refurbished areas.

Carbon dioxide emissions (Tonnes CO ₂ per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	4.6	1.6
After “Be Lean” (energy demand reduction)	3.9	1.6
After “Be Clean” (heat network / CHP)	3.9	1.6
After “Be Green” (renewable energy)	0.6	1.6

Table 16: Refurbished units regulated and unregulated CO₂ 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)	0.6	14.1%
Savings from “Be Clean” (heat network / CHP)	0.0	0.0%
Savings from “Be Green” (renewable energy)	3.3	72.0%
Total cumulative on-site savings	3.9	86.1%

Table 17: Refurbished units regulated CO₂ emissions savings after each stage of the energy hierarchy

7 Summary

7.1 SUSTAINABILITY SUMMARY

In addition to the low carbon performance set out below, the scheme benefits from several sustainability aspects. These include the use of water saving devices to achieve 105 litre per person per day. 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. 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

The proposed development has been shown to have:

- **84.6% total onsite improvement** in CO₂ emissions compared to the standard set out by Part L 2021.
- **13.6% energy efficiency** ("Be Lean") contribution to the improvement in CO₂.
- **71.1% renewable energy** ("Be Green") contribution to the improvement in CO₂, compared to **local policy target of 20%**.

For the new-build apartment, this is achieved with high-performance building fabric, passive low-energy design principles, and low-carbon building services, including a heat pump for hot water and space heating, mechanical ventilation with heat recovery (MVHR), and energy-efficient LED lighting. For the refurbished flats, the scheme adopts high efficiency heat pumps for space heating and hot water. A 7.0 kWp roof-top solar PV array is also proposed.

The table below shows the regulated and unregulated energy use for the whole development:

Carbon dioxide emissions (Tonnes CO ₂ per annum)	Regulated	Unregulated
Baseline: Part L 2021 (Building Regulations) Compliance	5.6	2.2
After "Be Lean" (energy demand reduction)	4.9	2.2
After "Be Clean" (heat network / CHP)	4.9	2.2
After "Be Green" (renewable energy)	0.9	2.2

Table 18: Whole development regulated and unregulated CO₂ 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)	0.8	13.6%
Savings from "Be Clean" (heat network / CHP)	0.0	0.0%
Savings from "Be Green" (renewable energy)	4.0	71.1%
Total cumulative on-site savings	4.8	84.6%

Table 19: Whole development regulated CO₂ emissions savings after each stage of the energy hierarchy

7.3 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 tariffs such to provide cheaper electricity during non-peak times. For example, this means charging DHW thermal stores at night when electricity costs are much lower.

Appendix A: Technology Feasibility Study Summary

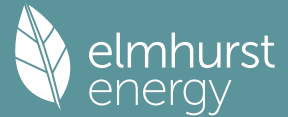
Technology	Assessment/Viability	
	Wind Power	Wind turbine installed on the roof of the development. Due to the high cost per kW for smaller building-mounted turbines and the impacts in terms of visual, noise and shadow flicker, wind turbines are not considered a viable technology for the development. 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 the use of an external 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), SO2 and NOX emissions. CONCLUSION: NOT CONSIDERED FEASIBLE

Table A1: Summary of Low and Zero Carbon Study Analysis Results for New-Build Flat

Appendix B: SAP Datasheets

The appended folder contains the Baseline, Be Lean and Be Green SAP datasheets for the example refurbished unit, as well as the Be Lean and Be Green SAP datasheets for the new-build unit.

Full SAP Calculation Printout



Plot Reference	L01_flat 3 (partial refurb)			Issued on Date	10/08/2026
Assessment Reference	Be Green	Plot Type Ref	L02_2B3P		
Plot Address	22, Palace Road, London, N11 2PS			SAP Version	10.2
SAP Rating	88 B	DER	3.01	TER	11.31
Environmental	98 A	% DER < TER			73.39
CO ₂ Emissions (t/year)	0.14	DFEE	42.53	TFEE	25.90
Compliance Check	See BREL	% DFEE < TFEE			-64.19
% DPER < TPER	36.57	DPER	37.78	TPER	59.56
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 (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	52.7000	2.5000	131.7500
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.7000		
Dwelling volume			131.7500

2. Ventilation rate

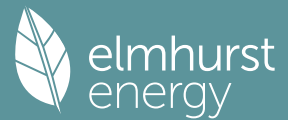
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	1 * 10 = 10.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	10.0000 / (5) = 0.0759 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	6.0000 (17)
Infiltration rate	0.3759 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3477 (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	0.4433	0.4346	0.4259	0.3825	0.3738	0.3303	0.3303	0.3216	0.3477	0.3738	0.3912	0.4086 (22b)
Effective ac	0.5983	0.5945	0.5907	0.5731	0.5699	0.5546	0.5546	0.5517	0.5605	0.5699	0.5765	0.5835 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
New window (notional)			5.3000	1.3258	7.0265		(27)
Refurb window (limiting)			3.4400	1.3258	4.5606		(27)
Refurb wall (limiting)	30.8000	3.4400	27.3600	0.3000	8.2080	110.0000	3009.6000 (29a)
New wall (notional)	22.4000	5.3000	17.1000	0.1800	3.0780	190.0000	3249.0000 (29a)
New roof (notional)	4.7000		4.7000	0.1200	0.5640	9.0000	42.3000 (30)
Total net area of external elements Aum(A, m ²)			57.9000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	23.4371		(33)
Main dwelling							
Party Floor 1			52.7000			40.0000	2108.0000 (32d)
Heat capacity Cm = Sum (A x k)					(28)...(30) + (32) + (32a)...(32e) =		8408.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							159.5617 (35)
Thermal bridges (Default value 0.200 * total exposed area)							11.5800 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss					(33) + (36) + (36a) =		35.0171 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	26.0113	25.8454	25.6828	24.9189	24.7760	24.1107	24.1107
Heat transfer coeff						23.9875	24.3670

Full SAP Calculation Printout



Average = Sum(39)m / 12 =	61.0284	60.8625	60.6999	59.9360	59.7931	59.1279	59.1279	59.0047	59.3841	59.7931	60.0822	60.3845 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1580	1.1549	1.1518	1.1373	1.1346	1.1220	1.1220	1.1196	1.1268	1.1346	1.1401	1.1458 (40)
HLP (average)												1.1373
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.7697 (42)
Hot water usage for mixer showers												
69.1708	68.1313	66.6165	63.7183	61.5795	59.1943	57.8386	59.3419	60.9898	63.5507	66.5112	68.9058 (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												
32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537 (42c)	
Average daily hot water use (litres/day)												93.5492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
101.9245	99.6939	96.9881	92.8989	89.5690	85.9928	84.6371	87.3314	90.1703	93.9223	98.0738	101.6595 (44)	
Energy content	161.4235	141.9628	149.0672	127.1739	120.5771	105.7382	102.3612	108.1345	111.1890	127.4517	139.7242	159.1742 (45)
Energy content (annual)										Total = Sum(45)m =		1553.9774
Distribution loss (46)m = 0.15 x (45)m												
24.2135	21.2944	22.3601	19.0761	18.0866	15.8607	15.3542	16.2202	16.6784	19.1178	20.9586	23.8761 (46)	
Water storage loss (or HIU loss):												
Store volume												120.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss												
26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)	
If cylinder contains dedicated solar storage												
26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (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 (61)	
Total heat required for water heating calculated for each month												
211.4699	187.1660	199.1136	175.6059	170.6235	154.1702	152.4076	158.1809	159.6210	177.4981	188.1562	209.2206 (62)	
WWHRS	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 (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 (63c)	
FGHRS	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												
211.4699	187.1660	199.1136	175.6059	170.6235	154.1702	152.4076	158.1809	159.6210	177.4981	188.1562	209.2206 (64)	
									Total per year (kWh/year) = Sum(64)m =		2143.2334 (64)	
12Total per year (kWh/year)											2143 (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												
93.7104	83.3652	89.6019	81.0309	80.1290	73.9035	74.0722	75.9918	75.7160	82.4148	85.2039	92.9625 (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	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	81.8705	90.6423	81.8705	84.5995	81.8705	84.5995	81.8705	81.8705	84.5995	81.8705	84.5995	81.8705 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	154.2407	155.8412	151.8079	143.2215	132.3827	122.1957	115.3902	113.7897	117.8230	126.4094	137.2482	147.4352 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486 (69)
Pumps, fans	7.9050	7.9050	7.9050	7.9050	7.9050	0.0000	0.0000	0.0000	0.0000	7.9050	7.9050	7.9050 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887 (71)
Water heating gains (Table 5)												
	125.9549	124.0554	120.4327	112.5430	107.7003	102.6438	99.5594	102.1396	105.1610	110.7726	118.3387	124.9496 (72)
Total internal gains												
	419.5168	427.9897	411.5619	397.8147	379.4042	358.9848	346.3659	347.3455	357.1293	376.5033	397.6372	411.7060 (73)

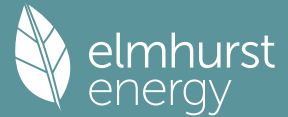
6. Solar gains

[Jan]												Gains	
	Area				Solar flux		g		FF		Access		W
	m2				Table 6a		Specific data		Specific data		factor		
					W/m2		or Table 6b		or Table 6c		Table 6d		
Northwest	5.3000				11.2829		0.4000		0.7000		0.7700		11.6035 (81)
Southeast	3.4400				36.7938		0.4000		0.7000		0.7700		24.5598 (77)
Solar gains	36.1633	65.4537	99.7941	140.8093	173.3807	179.0163	169.7238	144.3708	113.8317	75.1006	44.0172	30.4941 (83)	
Total gains	455.6801	493.4434	511.3560	538.6241	552.7849	538.0011	516.0897	491.7163	470.9610	451.6038	441.6544	442.2001 (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	38.2741	38.3784	38.4812	38.9716	39.0648	39.5043	39.5043	39.5868	39.3338	39.0648	38.8768	38.6822
alpha	3.5516	3.5586	3.5654	3.5981	3.6043	3.6336	3.6336	3.6391	3.6223	3.6043	3.5918	3.5788
util living area												
	0.9675	0.9548	0.9340	0.8816	0.7851	0.6311	0.4824	0.5216	0.7261	0.8879	0.9495	0.9704 (86)
Living	19.3559	19.5525	19.8538	20.2845	20.6509	20.8885	20.9679	20.9571	20.8058	20.3683	19.8125	19.3307
Non living	18.8728	19.0684	19.3669	19.7924	20.1408	20.3578	20.4201	20.4140	20.2876	19.8782	19.3326	18.8526
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0

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24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1589	19.5525	19.8538	20.2845	20.6509	20.8885	20.9679	20.9571	20.8058	20.3683	19.8125	19.5642 (87)
Th 2	20.4210	20.4226	20.4241	20.4313	20.4327	20.4390	20.4390	20.4402	20.4366	20.4327	20.4300	20.4271 (88)
util rest of house	0.9640	0.9501	0.9268	0.8681	0.7600	0.5891	0.4271	0.4662	0.6886	0.8726	0.9434	0.9673 (89)
MIT 2	19.6290	19.0684	19.3669	19.7924	20.1408	20.3578	20.4201	20.4140	20.2876	19.8782	19.3326	19.0728 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	19.9176	19.3320	19.6321	20.0604	20.4186	20.6468	20.7185	20.7098	20.5698	20.1451	19.5939	19.3404 (92)
Temperature adjustment												0.0000
adjusted MIT	19.9176	19.3320	19.6321	20.0604	20.4186	20.6468	20.7185	20.7098	20.5698	20.1451	19.5939	19.3404 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9607	0.9393	0.9152	0.8584	0.7593	0.6051	0.4551	0.4934	0.6979	0.8639	0.9329	0.9602 (94)
Useful gains	437.7582	463.5025	467.9887	462.3300	419.7347	325.5490	234.8546	242.6048	328.6904	390.1534	412.0073	424.5998 (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	953.1171	878.3692	797.1141	668.9084	521.3122	357.5347	243.5162	254.2962	384.2047	570.7311	750.6641	914.2472 (97)
Space heating kWh	383.4270	278.7904	244.8693	148.7365	75.5736	0.0000	0.0000	0.0000	0.0000	134.3498	243.8329	364.2977 (98a)
Space heating requirement - total per year (kWh/year)												1873.8771
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	383.4270	278.7904	244.8693	148.7365	75.5736	0.0000	0.0000	0.0000	0.0000	134.3498	243.8329	364.2977 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1873.8771
Space heating per m2										(98c) / (4) =		35.5574 (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 %)	416.0758 (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	383.4270	278.7904	244.8693	148.7365	75.5736	0.0000	0.0000	0.0000	0.0000	134.3498	243.8329	364.2977 (98)
Space heating efficiency (main heating system 1)	416.0758	416.0758	416.0758	416.0758	416.0758	0.0000	0.0000	0.0000	0.0000	416.0758	416.0758	416.0758 (210)
Space heating fuel (main heating system)	92.1532	67.0047	58.8521	35.7474	18.1634	0.0000	0.0000	0.0000	0.0000	32.2898	58.6030	87.5556 (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	211.4699	187.1660	199.1136	175.6059	170.6235	154.1702	152.4076	158.1809	159.6210	177.4981	188.1562	209.2206 (64)
Efficiency of water heater (217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000 (216)
Fuel for water heating, kWh/month	124.3940	110.0977	117.1256	103.2976	100.3668	90.6883	89.6515	93.0476	93.8947	104.4107	110.6801	123.0709 (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	6.7138	6.0641	6.7138	6.4973	6.7138	6.4973	6.7138	6.7138	6.4973	6.7138	6.4973	6.7138 (231)
Lighting	16.3543	13.1200	11.8131	8.6548	6.6852	5.4619	6.0985	7.9270	10.2964	13.5095	15.2589	16.8088 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-19.4300	-30.1024	-47.6675	-58.0272	-65.7479	-61.4434	-60.5955	-55.4577	-46.4035	-35.9663	-22.1149	-16.4275 (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	-5.2557	-12.2162	-26.9082	-44.7567	-63.1102	-65.8680	-64.7808	-52.9458	-36.6004	-18.8601	-7.3993	-4.0662 (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												450.3692 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												170.0000
Water heating fuel used												1260.7256 (219)
Space cooling fuel												0.0000 (221)

Electricity for pumps and fans:	
warm air heating system fans	79.0500 (230b)
Total electricity for the above, kWh/year	79.0500 (231)
Electricity for lighting (calculated in Appendix L)	131.9886 (232)

Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-922.1513 (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	999.9821 (238)

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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	450.3692	0.1549	69.7676 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1260.7256	0.1408	177.5156 (264)
Space and water heating			247.2831 (265)
Pumps, fans and electric keep-hot	79.0500	0.1387	10.9652 (267)
Energy for lighting	131.9886	0.1443	19.0500 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-519.3837	0.1331	-69.1334
PV Unit electricity exported	-402.7676	0.1231	-49.5952
Total			-118.7286 (269)
Total CO2, kg/year			158.5697 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.0100 (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	450.3692	1.5735	708.6570 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1260.7256	1.5206	1917.1077 (278)
Space and water heating			2625.7648 (279)
Pumps, fans and electric keep-hot	79.0500	1.5128	119.5868 (281)
Energy for lighting	131.9886	1.5338	202.4486 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-519.3837	1.4919	-774.8492
PV Unit electricity exported	-402.7676	0.4518	-181.9898
Total			-956.8391 (283)
Total Primary energy kWh/year			1990.9611 (286)
Dwelling Primary energy Rate (DPER)			37.7800 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling	52.7000 (1b)	x 2.5000 (2b)	= 131.7500 (1b) - (3b)
Ground floor			(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.7000		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 131.7500 (5)
Dwelling volume			

2. Ventilation rate

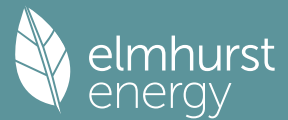
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1518 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4018 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3717 (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	0.4739	0.4646	0.4553	0.4088	0.3995	0.3531	0.3531	0.3438	0.3717	0.3995	0.4181	0.4367 (22b)
Effective ac	0.6123	0.6079	0.6036	0.5836	0.5798	0.5623	0.5623	0.5591	0.5691	0.5798	0.5874	0.5954 (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
Main dwelling							
TER Opening Type			8.7400	1.1450	10.0076		(27)
Refrurb wall (limiting)	30.8000	3.4400	27.3600	0.1800	4.9248		(29a)
New wall (notional)	22.4000	5.3000	17.1000	0.1800	3.0780		(29a)
New roof (notional)	4.7000		4.7000	0.1100	0.5170		(30)

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Total net area of external elements Aum(A, m2) 57.9000 (31)
 Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 18.5274 (33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 159.5617 (35)
 Thermal bridges (User defined value 0.050 * total exposed area) 2.8950 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 21.4224 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	26.6204	26.4308	26.2450	25.3723	25.2090	24.4489	24.4489	24.3081	24.7417	25.2090	25.5393	25.8847 (38)
Average = Sum(39)m / 12 =	48.0428	47.8532	47.6674	46.7947	46.6314	45.8713	45.8713	45.7306	46.1641	46.6314	46.9618	47.3071 (39)
												46.7939
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9116	0.9080	0.9045	0.8879	0.8848	0.8704	0.8704	0.8678	0.8760	0.8848	0.8911	0.8977 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy 1.7697 (42)												
Hot water usage for mixer showers												
	69.1708	68.1313	66.6165	63.7183	61.5795	59.1943	57.8386	59.3419	60.9898	63.5507	66.5112	68.9058 (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												
	32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537 (42c)
Average daily hot water use (litres/day)												
	32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537 (43)
Daily hot water use												
	101.9245	99.6939	96.9881	92.8989	89.5690	85.9928	84.6371	87.3314	90.1703	93.9223	98.0738	101.6595 (44)
Energy content (annual)												
	161.4235	141.9628	149.0672	127.1739	120.5771	105.7382	102.3612	108.1345	111.1890	127.4517	139.7242	159.1742 (45)
Distribution loss (46)m = 0.15 x (45)m												
	24.2135	21.2944	22.3601	19.0761	18.0866	15.8607	15.3542	16.2202	16.6784	19.1178	20.9586	23.8761 (46)
Water storage loss (or HIU loss):												
Store volume												
a) If manufacturer declared loss factor is known (kWh/day):												
Temperature factor from Table 2b												
Enter (49) or (54) in (55)												
Total storage loss												
	20.5007	18.5168	20.5007	19.8394	20.5007	19.8394	20.5007	20.5007	19.8394	20.5007	19.8394	20.5007 (56)
If cylinder contains dedicated solar storage												
	20.5007	18.5168	20.5007	19.8394	20.5007	19.8394	20.5007	20.5007	19.8394	20.5007	19.8394	20.5007 (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												
	205.1866	181.4908	192.8303	169.5253	164.3402	148.0896	146.1243	151.8976	153.5404	171.2148	182.0756	202.9373 (62)
WWHRS												
	-31.6220	-27.9668	-29.2852	-24.2493	-22.5995	-19.3385	-18.1268	-19.2760	-20.0084	-23.5877	-26.7220	-31.0364 (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												
	173.5646	153.5240	163.5451	145.2760	141.7408	128.7510	127.9975	132.6216	133.5320	147.6271	155.3536	171.9008 (64)
12Total per year (kWh/year)												
	1775.4343	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775	1775 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Heat gains from water heating, kWh/month												
	88.6838	78.8250	84.5753	76.1664	75.1024	69.0391	69.0456	70.9652	70.8515	77.3882	80.3394	87.9359 (65)

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

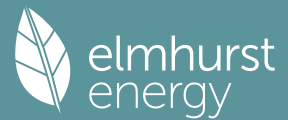
Metabolic gains (Table 5), Watts												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	80.6041	89.2402	80.6041	83.2909	80.6041	83.2909	80.6041	80.6041	83.2909	80.6041	83.2909	80.6041 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	154.2407	155.8412	151.8079	143.2215	132.3827	122.1957	115.3902	113.7897	117.8230	126.4094	137.2482	147.4352 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486 (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)												
	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887 (71)
Water heating gains (Table 5)												
	119.1986	117.2991	113.6765	105.7867	100.9441	95.8876	92.8032	95.3833	98.4048	104.0164	111.5825	118.1934 (72)
Total internal gains												
	406.5892	414.9263	398.6342	384.8449	366.4766	350.9200	338.3433	339.3229	349.0645	363.5756	384.6674	398.7784 (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	
Southeast	3.4400	36.7938	0.6300	0.7000	0.7700	38.6817 (77)
Northwest	5.3000	11.2829	0.6300	0.7000	0.7700	18.2755 (81)
Solar gains	56.9572	103.0896	157.1757	221.7747	273.0746	281.9507
Total gains	463.5464	518.0159	555.8100	606.6196	639.5512	632.8706
						605.6582
						566.7069
						179.2849
						118.2834
						69.3271
						48.0282 (83)
						446.8066 (84)

7. Mean internal temperature (heating season)

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Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	48.6193	48.8119	49.0021	49.9160	50.0908	50.9208	50.9208	51.0776	50.5979	50.0908	49.7385	49.3754
alpha	4.2413	4.2541	4.2668	4.3277	4.3394	4.3947	4.3947	4.4052	4.3732	4.3394	4.3159	4.2917
util living area	0.9563	0.9309	0.8868	0.7833	0.6318	0.4552	0.3315	0.3682	0.5748	0.8153	0.9257	0.9612 (86)
MIT	19.9110	20.1249	20.3974	20.7220	20.9096	20.9832	20.9967	20.9948	20.9546	20.7186	20.2908	19.8878 (87)
Th 2	20.1576	20.1607	20.1637	20.1778	20.1804	20.1927	20.1927	20.1950	20.1880	20.1804	20.1751	20.1695 (88)
util rest of house	0.9486	0.9193	0.8683	0.7518	0.5866	0.4008	0.2715	0.3051	0.5156	0.7807	0.9114	0.9543 (89)
MIT 2	18.9038	19.1708	19.5059	19.8970	20.1008	20.1813	20.1912	20.1924	20.1541	19.9038	19.3913	18.8837 (90)
Living area fraction									fLA = Living area / (4) =			0.5446 (91)
MIT	19.4523	19.6904	19.9914	20.3463	20.5413	20.6180	20.6298	20.6294	20.5901	20.3475	19.8811	19.4305 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4523	19.6904	19.9914	20.3463	20.5413	20.6180	20.6298	20.6294	20.5901	20.3475	19.8811	19.4305 (93)

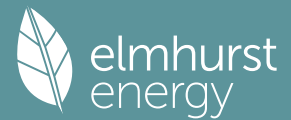
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9409	0.9118	0.8642	0.7586	0.6069	0.4297	0.3041	0.3393	0.5455	0.7883	0.9056	0.9469 (94)
Useful gains	436.1473	472.3418	480.3046	460.1679	388.1705	271.9464	184.1556	192.2910	288.2144	379.8291	411.1352	423.0792 (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	727.9610	707.7680	643.1005	535.6253	412.2810	276.0540	184.8544	193.4125	299.6084	454.5419	600.2245	720.5107 (97)
Space heating kWh	217.1094	158.2064	121.1202	54.3293	17.9383	0.0000	0.0000	0.0000	0.0000	55.5864	136.1443	221.2891 (98a)
Space heating requirement - total per year (kWh/year)												981.7232
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	217.1094	158.2064	121.1202	54.3293	17.9383	0.0000	0.0000	0.0000	0.0000	55.5864	136.1443	221.2891 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												981.7232
Space heating per m2										(98c) / (4) =		18.6285 (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	217.1094	158.2064	121.1202	54.3293	17.9383	0.0000	0.0000	0.0000	0.0000	55.5864	136.1443	221.2891 (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)	235.2214	171.4045	131.2244	58.8617	19.4347	0.0000	0.0000	0.0000	0.0000	60.2236	147.5020	239.7498 (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	173.5646	153.5240	163.5451	145.2760	141.7408	128.7510	127.9975	132.6216	133.5320	147.6271	155.3536	171.9008 (64)
Efficiency of water heater (217)m	84.5629	84.1272	83.3963	82.0638	80.7190	79.8000	79.8000	79.8000	79.8000	82.0754	83.7651	79.8000 (216)
Fuel for water heating, kWh/month	205.2490	182.4903	196.1059	177.0281	175.5977	161.3422	160.3979	166.1925	167.3334	179.8677	185.4633	203.1271 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	16.7479	13.4358	12.0975	8.8631	6.8461	5.5933	6.2453	8.1178	10.5443	13.8346	15.6262	17.2134 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-18.1215	-26.4752	-39.4304	-46.0060	-51.0872	-48.2541	-47.6941	-44.3111	-38.5655	-31.0438	-20.2602	-15.5630 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-7.5995	-16.2302	-32.7052	-49.7680	-66.4223	-66.9363	-66.1184	-55.6745	-40.4245	-23.3897	-10.2067	-5.9892 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												1063.6221 (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												2160.1950 (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)												135.1654 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-868.2765 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												

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Energy saved or generated	-0.0000 (236)
Energy used	0.0000 (237)
Total delivered energy for all uses	2576.7061 (238)

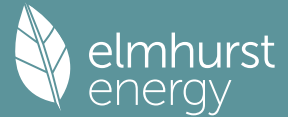
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1063.6221	0.2100	223.3606 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2160.1950	0.2100	453.6410 (264)
Space and water heating			677.0016 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	135.1654	0.1443	19.5085 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-426.8121	0.1338	-57.1154
PV Unit electricity exported	-441.4644	0.1255	-55.4148
Total			-112.5302 (269)
Total CO2, kg/year			595.9092 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.3100 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	1063.6221	1.1300	1201.8930 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2160.1950	1.1300	2441.0204 (278)
Space and water heating			3642.9134 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	135.1654	1.5338	207.3213 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-426.8121	1.4945	-637.8825
PV Unit electricity exported	-441.4644	0.4607	-203.4030
Total			-841.2855 (283)
Total Primary energy kWh/year			3139.0499 (286)
Target Primary Energy Rate (TPER)			59.5600 (287)

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Plot Reference	L01_flat 3 (partial refurb)			Issued on Date	10/08/2026
Assessment Reference	Be Lean	Plot Type Ref	L02_2B3P		
Plot Address	22, Palace Road, London, N11 2PS			SAP Version	10.2
SAP Rating	83 B	DER	18.61	TER	11.53
Environmental	87 B	% DER < TER			-61.41
CO ₂ Emissions (t/year)	0.88	DFEE	42.53	TFEE	25.90
Compliance Check	See BREL	% DFEE < TFEE			-64.19
% DPER < TPER	-68.87	DPER	102.64	TPER	60.78
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 (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	52.7000	2.5000	131.7500
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.7000		
Dwelling volume			131.7500

2. Ventilation rate

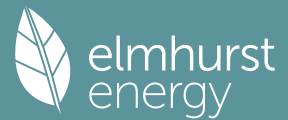
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	1 * 10 = 10.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	10.0000 / (5) = 0.0759 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	6.0000 (17)
Infiltration rate	0.3759 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3477 (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	0.4433	0.4346	0.4259	0.3825	0.3738	0.3303	0.3303	0.3216	0.3477	0.3738	0.3912	0.4086 (22b)
Effective ac	0.5983	0.5945	0.5907	0.5731	0.5699	0.5546	0.5546	0.5517	0.5605	0.5699	0.5765	0.5835 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
New window (notional)			5.3000	1.3258	7.0265		(27)
Refurb window (limiting)			3.4400	1.3258	4.5606		(27)
Refurb wall (limiting)	30.8000	3.4400	27.3600	0.3000	8.2080	110.0000	3009.6000 (29a)
New wall (notional)	22.4000	5.3000	17.1000	0.1800	3.0780	190.0000	3249.0000 (29a)
New roof (notional)	4.7000		4.7000	0.1200	0.5640	9.0000	42.3000 (30)
Total net area of external elements Aum(A, m ²)			57.9000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	23.4371	(33)
Main dwelling							
Party Floor 1			52.7000			40.0000	2108.0000 (32d)
Heat capacity Cm = Sum (A x k)					(28)...(30) + (32) + (32a)...(32e) =		8408.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							159.5617 (35)
Thermal bridges (Default value 0.200 * total exposed area)							11.5800 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss					(33) + (36) + (36a) =		35.0171 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	26.0113	25.8454	25.6828	24.9189	24.7760	24.1107	24.1107
Heat transfer coeff						23.9875	24.3670

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Average = Sum(39)m / 12 =	61.0284	60.8625	60.6999	59.9360	59.7931	59.1279	59.1279	59.0047	59.3841	59.7931	60.0822	60.3845 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1580	1.1549	1.1518	1.1373	1.1346	1.1220	1.1220	1.1196	1.1268	1.1346	1.1401	1.1458 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.7697 (42)
Hot water usage for mixer showers													
69.1708	68.1313	66.6165	63.7183	61.5795	59.1943	57.8386	59.3419	60.9898	63.5507	66.5112	68.9058	(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													
32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537	(42c)	
Average daily hot water use (litres/day)												93.5492 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
101.9245	99.6939	96.9881	92.8989	89.5690	85.9928	84.6371	87.3314	90.1703	93.9223	98.0738	101.6595	(44)	
Energy content (annual)	161.4235	141.9628	149.0672	127.1739	120.5771	105.7382	102.3612	108.1345	111.1890	127.4517	139.7242	159.1742 (45)	
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1553.9774	
24.2135	21.2944	22.3601	19.0761	18.0866	15.8607	15.3542	16.2202	16.6784	19.1178	20.9586	23.8761	(46)	
Water storage loss (or HIU 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	(61)	
Total heat required for water heating calculated for each month													
231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622	(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													
231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622	(64)	
12Total per year (kWh/year)												2374.4974 (64)	
Electric shower(s)												2374 (64)	
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)	
Heat gains from water heating, kWh/month													
109.4237	97.5578	105.3152	96.2373	95.8423	89.1099	89.7855	91.7051	90.9224	98.1281	100.4103	108.6758	(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	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	81.8705	90.6423	81.8705	84.5995	81.8705	84.5995	81.8705	81.8705	84.5995	81.8705	84.5995	81.8705 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	154.2407	155.8412	151.8079	143.2215	132.3827	122.1957	115.3902	113.7897	117.8230	126.4094	137.2482	147.4352 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486 (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)												
	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887 (71)
Water heating gains (Table 5)												
	147.0749	145.1754	141.5527	133.6630	128.8203	123.7638	120.6794	123.2596	126.2810	131.8926	139.4587	146.0696 (72)
Total internal gains												
	432.7318	441.2047	424.7769	411.0297	392.6192	380.1048	367.4859	368.4655	378.2493	389.7183	410.8522	424.9210 (73)

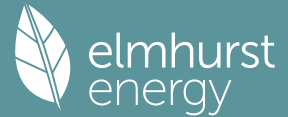
6. Solar gains

[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			5.3000	11.2829		0.4000	0.7000	0.7700		11.6035 (81)		
Southeast			3.4400	36.7938		0.4000	0.7000	0.7700		24.5598 (77)		
Solar gains	36.1633	65.4537	99.7941	140.8093	173.3807	179.0163	169.7238	144.3708	113.8317	75.1006	44.0172	30.4941 (83)
Total gains	468.8951	506.6584	524.5710	551.8391	565.9999	559.1211	537.2097	512.8363	492.0810	464.8188	454.8694	455.4151 (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	38.2741	38.3784	38.4812	38.9716	39.0648	39.5043	39.5043	39.5868	39.3338	39.0648	38.8768	38.6822
alpha	3.5516	3.5586	3.5654	3.5981	3.6043	3.6336	3.6336	3.6391	3.6223	3.6043	3.5918	3.5788
util living area												
	0.9647	0.9514	0.9295	0.8749	0.7758	0.6135	0.4657	0.5033	0.7070	0.8802	0.9453	0.9678 (86)
MIT	19.3885	19.5835	19.8822	20.3072	20.6655	20.8984	20.9714	20.9618	20.8227	20.3916	19.8428	19.3639 (87)
Th 2	19.9537	19.9563	19.9588	19.9705	19.9727	19.9829	19.9829	19.9848	19.9790	19.9727	19.9682	19.9636 (88)
util rest of house												

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MIT 2	0.9577	0.9418	0.9150	0.8483	0.7273	0.5351	0.3658	0.4026	0.6347	0.8494	0.9329	0.9614 (89)
Living area fraction	18.1068	18.3528	18.7275	19.2538	19.6681	19.9126	19.9700	19.9663	19.8437	19.3650	18.6899	18.0825 (90)
MIT	18.8048	19.0230	19.3564	19.8275	20.2113	20.4495	20.5154	20.5084	fLA = Living area / (4) =			0.5446 (91)
Temperature adjustment									20.3769	19.9241	19.3178	18.7803 (92)
adjusted MIT	18.8048	19.0230	19.3564	19.8275	20.2113	20.4495	20.5154	20.5084	20.3769	19.9241	19.3178	18.7803 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9479	0.9312	0.9050	0.8441	0.7394	0.5724	0.4192	0.4559	0.6646	0.8478	0.9233	0.9520	(94)
Useful gains	444.4556	471.8190	474.7170	465.7887	418.5194	320.0451	225.1944	233.7861	327.0313	394.0595	419.9844	433.5718	(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	885.2063	859.5635	780.3803	654.9499	508.9159	345.8660	231.5071	242.4166	372.7474	557.5148	734.0719	880.4259	(97)
Space heating kWh	327.9185	260.5643	227.4135	136.1961	67.2550	0.0000	0.0000	0.0000	0.0000	121.6107	226.1431	332.4595	(98a)
Space heating requirement - total per year (kWh/year)												1699.5607	
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(98b)
Solar heating contribution - total per year (kWh/year)												0.0000	
Space heating kWh	327.9185	260.5643	227.4135	136.1961	67.2550	0.0000	0.0000	0.0000	0.0000	121.6107	226.1431	332.4595	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1699.5607	
Space heating per m2											(98c) / (4) =	32.2497	(99)

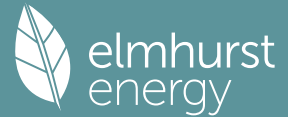
9b. Energy requirements

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	327.9185	260.5643	227.4135	136.1961	67.2550	0.0000	0.0000	0.0000	0.0000	121.6107	226.1431	332.4595	(98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00													
307a	327.9185	260.5643	227.4135	136.1961	67.2550	0.0000	0.0000	0.0000	0.0000	121.6107	226.1431	332.4595	
Space heating requirement	327.9185	260.5643	227.4135	136.1961	67.2550	0.0000	0.0000	0.0000	0.0000	121.6107	226.1431	332.4595	(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	231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622	(64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00													
310a	231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622	
Water heating fuel	231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622	(310)
Cooling System Energy Efficiency Ratio	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(331)
Lighting	16.3543	13.1200	11.8131	8.6548	6.6852	5.4619	6.0985	7.9270	10.2964	13.5095	15.2589	16.8088	(332)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(333a)
(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	(334a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(335a)
(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	(335b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(336)
(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	(337)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(338)
(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	(339)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(340)
(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	(341)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(342)
(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	(343)
Annual totals kWh/year													
Space heating fuel - community heating												1699.5607	(307)
Space heating fuel - secondary												0.0000	(309)
Water heating fuel - community heating												2374.4974	(310)
Efficiency of water heater												0.0000	(311)
Electricity used for heat distribution												16.9956	(313)
Space cooling fuel												0.0000	(321)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(331)
Electricity for lighting (calculated in Appendix L)												131.9886	(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												4206.0468	(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	4552.0203	0.2100	398.7796	(367)
Electrical energy for heat distribution (space & water)	16.9956	0.0000	5.9702	(372)
Overall CO2 factor for heat network			0.2361	(386)
Total CO2 associated with community systems			961.8945	(373)
Space and water heating			961.8945	(376)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(378)

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Energy for lighting	131.9886	0.1443	19.0500 (379)
Total CO ₂ , kg/year			980.9445 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			18.6100 (384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Efficiency of heat source Boilers			89.5000 (467a)
Space and Water heating from Boilers	4552.0203	1.1300	2145.8141 (467)
Electrical energy for heat distribution (space & water)	16.9956	0.0000	62.8281 (472)
Overall CO ₂ factor for heat network			1.2780 (486)
Total CO ₂ associated with community systems			5206.6110 (473)
Space and water heating			5206.6110 (476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (478)
Energy for lighting	131.9886	1.5338	202.4486 (479)
Total Primary energy kWh/year			5409.0596 (483)
Dwelling Primary energy Rate (DPER)			102.6400 (484)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	52.7000 (1b)	x 2.5000 (2b)	= 131.7500 (1b) - (3b)
Ground floor			(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.7000		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 131.7500 (5)

2. Ventilation rate

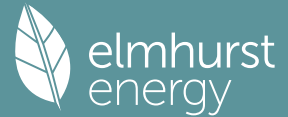
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	20.0000 / (5) = 0.1518 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4018 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3717 (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	0.4739	0.4646	0.4553	0.4088	0.3995	0.3531	0.3531	0.3438	0.3717	0.3995	0.4181	0.4367 (22b)
Effective ac	0.6123	0.6079	0.6036	0.5836	0.5798	0.5623	0.5623	0.5591	0.5691	0.5798	0.5874	0.5954 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
TER Opening Type			8.7400	1.1450	10.0076		(27)
Refurb wall (limiting)	30.8000	3.4400	27.3600	0.1800	4.9248		(29a)
New wall (notional)	22.4000	5.3000	17.1000	0.1800	3.0780		(29a)
New roof (notional)	4.7000		4.7000	0.1100	0.5170		(30)
Total net area of external elements Aum(A, m ²)			57.9000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		18.5274		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							159.5617 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							2.8950 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	21.4224 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	26.6204	26.4308	26.2450	25.3723	25.2090	24.4489	24.4489
Heat transfer coeff	48.0428	47.8532	47.6674	46.7947	46.6314	45.8713	45.8713
Average = Sum(39)m / 12 =						45.7306	46.1641
						46.6314	46.9618
						47.3071	47.3071 (39)
						46.7939	46.7939
HLP	0.9116	0.9080	0.9045	0.8879	0.8848	0.8704	0.8704
HLP (average)						0.8678	0.8678

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Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												1.7697 (42)
Hot water usage for mixer showers	69.1708	68.1313	66.6165	63.7183	61.5795	59.1943	57.8386	59.3419	60.9898	63.5507	66.5112	68.9058 (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	32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537 (42c)
Average daily hot water use (litres/day)												93.5492 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	101.9245	99.6939	96.9881	92.8989	89.5690	85.9928	84.6371	87.3314	90.1703	93.9223	98.0738	101.6595 (44)
Energy conte	161.4235	141.9628	149.0672	127.1739	120.5771	105.7382	102.3612	108.1345	111.1890	127.4517	139.7242	159.1742 (45)
Energy content (annual)										Total =	Sum(45)m =	1553.9774
Distribution loss (46)m = 0.15 x (45)m												
	24.2135	21.2944	22.3601	19.0761	18.0866	15.8607	15.3542	16.2202	16.6784	19.1178	20.9586	23.8761 (46)
Water storage loss (or HIU 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												
	210.0624	185.8948	197.7061	174.2439	169.2160	152.8081	151.0001	156.7734	158.2590	176.0907	186.7941	207.8131 (62)
WWHRS	-31.6220	-27.9668	-29.2852	-24.2493	-22.5995	-19.3385	-18.1268	-19.2760	-20.0084	-23.5877	-26.7220	-31.0364 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	178.4404	157.9280	168.4209	149.9946	146.6166	133.4696	132.8733	137.4974	138.2506	152.5030	160.0721	176.7767 (64)
										Total per year (kWh/year) =	Sum(64)m =	1832.8432 (64)
12Total per year (kWh/year)												1833 (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)
												0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) =												
Heat gains from water heating, kWh/month	92.5844	82.3482	88.4760	79.9413	79.0030	72.8139	72.9462	74.8659	74.6263	81.2888	84.1142	91.8366 (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	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.6041	89.2402	80.6041	83.2909	80.6041	83.2909	80.6041	80.6041	83.2909	80.6041	83.2909	80.6041 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	154.2407	155.8412	151.8079	143.2215	132.3827	122.1957	115.3902	113.7897	117.8230	126.4094	137.2482	147.4352 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887 (71)
Water heating gains (Table 5)	124.4415	122.5420	118.9193	111.0295	106.1869	101.1304	98.0460	100.6262	103.6476	109.2592	116.8253	123.4362 (72)
Total internal gains	411.8320	420.1692	403.8771	390.0877	371.7194	356.1628	343.5861	344.5657	354.3073	368.8184	389.9102	404.0212 (73)

6. Solar gains												

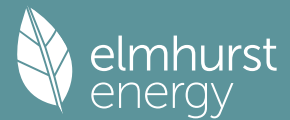
[Jan]												
			Area	Solar flux								
			m2	Table 6a								
				W/m2								
					Specific data							
					or Table 6b							
						Specific data						
						or Table 6c						
								Access				
								factor				
								Table 6d				
Southeast			3.4400	36.7938	0.6300	0.7000		0.7700				38.6817 (77)
Northwest			5.3000	11.2829	0.6300	0.7000		0.7700				18.2755 (81)

Solar gains	56.9572	103.0896	157.1757	221.7747	273.0746	281.9507	267.3149	227.3840	179.2849	118.2834	69.3271	48.0282 (83)
Total gains	468.7892	523.2587	561.0528	611.8624	644.7940	638.1135	610.9010	571.9497	533.5922	487.1019	459.2373	452.0494 (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	48.6193	48.8119	49.0021	49.9160	50.0908	50.9208	50.9208	51.0776	50.5979	50.0908	49.7385	49.3754
alpha	4.2413	4.2541	4.2668	4.3277	4.3394	4.3947	4.3947	4.4052	4.3732	4.3394	4.3159	4.2917
util living area	0.9547	0.9288	0.8840	0.7795	0.6278	0.4518	0.3287	0.3649	0.5701	0.8109	0.9232	0.9597 (86)
MIT	19.9240	20.1364	20.4068	20.7275	20.9118	20.9837	20.9968	20.9950	20.9561	20.7251	20.3020	19.9010 (87)
Th 2	20.1576	20.1607	20.1637	20.1778	20.1804	20.1927	20.1927	20.1950	20.1880	20.1804	20.1751	20.1695 (88)
util rest of house												
	0.9468	0.9169	0.8653	0.7478	0.5826	0.3976	0.2691	0.3023	0.5111	0.7760	0.9085	0.9525 (89)
MIT 2	18.9199	19.1848	19.5169	19.9029	20.1028	20.1816	20.1912	20.1925	20.1552	19.9108	19.4047	18.9002 (90)
Living area fraction												
	19.4667	19.7030	20.0015	20.3520	20.5434	20.6184	20.6299	20.6295	20.5914	20.3543	19.8934	19.4452 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4667	19.7030	20.0015	20.3520	20.5434	20.6184	20.6299	20.6295	20.5914	20.3543	19.8934	19.4452 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9390	0.9095	0.8613	0.7549	0.6031	0.4264	0.3015	0.3363	0.5409	0.7839	0.9028	0.9451	(94)
Useful gains	440.2040	475.9253	483.2074	461.8851	388.8485	272.0878	184.1828	192.3369	288.6340	381.8241	414.6062	427.2316	(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	728.6505	708.3734	643.5821	535.8927	412.3799	276.0736	184.8583	193.4190	299.6681	454.8554	600.8008	721.2078	(97)
Space heating kWh	214.6042	156.2052	119.3188	53.2855	17.5073	0.0000	0.0000	0.0000	0.0000	54.3352	134.0601	218.7183	(98a)
Space heating requirement - total per year (kWh/year)												968.0346	
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	214.6042	156.2052	119.3188	53.2855	17.5073	0.0000	0.0000	0.0000	0.0000	54.3352	134.0601	218.7183	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												968.0346	
Space heating per m2										(98c) / (4) =		18.3688	(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	214.6042	156.2052	119.3188	53.2855	17.5073	0.0000	0.0000	0.0000	0.0000	54.3352	134.0601	218.7183	(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)	232.5073	169.2364	129.2728	57.7307	18.9679	0.0000	0.0000	0.0000	0.0000	58.8681	145.2439	236.9646	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	178.4404	157.9280	168.4209	149.9946	146.6166	133.4696	132.8733	137.4974	138.2506	152.5030	160.0721	176.7767	(64)	
Efficiency of water heater (217)m	84.4747	84.0352	83.3010	81.9779	80.6722	79.8000	79.8000	79.8000	79.8000	81.9827	83.6648	84.5384	(216)	
Fuel for water heating, kWh/month	211.2353	187.9308	202.1836	182.9695	181.7437	167.2551	166.5079	172.3025	173.2463	186.0184	191.3255	209.1082	(219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)	
Lighting	16.7479	13.4358	12.0975	8.8631	6.8461	5.5933	6.2453	8.1178	10.5443	13.8346	15.6262	17.2134	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-18.1215	-26.4752	-39.4304	-46.0060	-51.0872	-48.2541	-47.6941	-44.3111	-38.5655	-31.0438	-20.2602	-15.5630	(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	-7.5995	-16.2302	-32.7052	-49.7680	-66.4223	-66.9363	-66.1184	-55.6745	-40.4245	-23.3897	-10.2067	-5.9892	(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												1048.7916	(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												2231.8270	(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)												135.1654	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation												-868.2765	(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												2633.5075	(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	1048.7916	0.2100	220.2462	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2231.8270	0.2100	468.6837	(264)
Space and water heating			688.9299	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	135.1654	0.1443	19.5085	(268)

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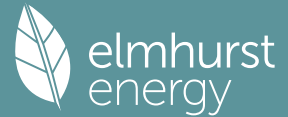


Energy saving/generation technologies			
PV Unit electricity used in dwelling	-426.8121	0.1338	-57.1154
PV Unit electricity exported	-441.4644	0.1255	-55.4148
Total			-112.5302 (269)
Total CO2, kg/year			607.8375 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5300 (273)

----- 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	1048.7916	1.1300	1185.1345 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2231.8270	1.1300	2521.9645 (278)
Space and water heating			3707.0990 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	135.1654	1.5338	207.3213 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-426.8121	1.4945	-637.8825
PV Unit electricity exported	-441.4644	0.4607	-203.4030
Total			-841.2855 (283)
Total Primary energy kWh/year			3203.2355 (286)
Target Primary Energy Rate (TPER)			60.7800 (287)

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Plot Reference	L01_flat 3 (partial refurb)			Issued on Date	10/08/2026
Assessment Reference	Part L Baseline	Plot Type Ref	L02_2B3P		
Plot Address	22, Palace Road, London, N11 2PS			SAP Version	10.2
SAP Rating	81 B	DER	21.67	TER	11.53
Environmental	85 B	% DER < TER			-87.94
CO ₂ Emissions (t/year)	0.99	DFEE	57.69	TFEE	25.90
Compliance Check	See BREL	% DFEE < TFEE			-122.73
% DPER < TPER	-96.22	DPER	119.26	TPER	60.78
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 (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	52.7000 (1b)	2.5000 (2b)	131.7500 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.7000		131.7500 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 131.7500 (5)

2. Ventilation rate

	m ³ 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	1 * 10 = 10.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	10.0000 / (5) = 0.0759 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.8259 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.7640 (21)

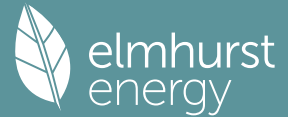
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.9740	0.9549	0.9358	0.8404	0.8213	0.7258	0.7258	0.7067	0.7640	0.8213	0.8595	0.8977 (22b)
Effective ac	0.9744	0.9560	0.9379	0.8531	0.8372	0.7634	0.7634	0.7497	0.7918	0.8372	0.8693	0.9029 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
New window (notional)			5.3000	1.5038	7.9699		(27)
Refurb window (limiting)			3.4400	1.5038	5.1729		(27)
Refurb wall (limiting)	30.8000	3.4400	27.3600	0.3000	8.2080	110.0000	3009.6000 (29a)
New wall (notional)	22.4000	5.3000	17.1000	0.1800	3.0780	190.0000	3249.0000 (29a)
New roof (notional)	4.7000		4.7000	0.1800	0.8460	9.0000	42.3000 (30)
Total net area of external elements Aum(A, m ²)			57.9000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	25.2749		(33)
Main dwelling							
Party Floor 1			52.7000			40.0000	2108.0000 (32d)
Heat capacity Cm = Sum (A x k)						(28)...(30) + (32) + (32a)...(32e) =	8408.9000 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							159.5617 (35)
Thermal bridges (Default value 0.200 * total exposed area)							11.5800 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	36.8549 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	42.3638	41.5629	40.7779	37.0906	36.4007	33.1892	33.1892	32.5944	34.4262	36.4007	37.7963	39.2554 (38)
Heat transfer coeff												

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Average = Sum(39)m / 12 =	79.2186	78.4177	77.6327	73.9454	73.2555	70.0440	70.0440	69.4493	71.2811	73.2555	74.6512	76.1102 (39)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.5032	1.4880	1.4731	1.4031	1.3900	1.3291	1.3291	1.3178	1.3526	1.3900	1.4165	1.4442 (40)
HLP (average)												1.4031
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.7697 (42)
Hot water usage for mixer showers												
69.1708	68.1313	66.6165	63.7183	61.5795	59.1943	57.8386	59.3419	60.9898	63.5507	66.5112	68.9058 (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												
32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537 (42c)	
Average daily hot water use (litres/day)												93.5492 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												
101.9245	99.6939	96.9881	92.8989	89.5690	85.9928	84.6371	87.3314	90.1703	93.9223	98.0738	101.6595 (44)	
Energy content	161.4235	141.9628	149.0672	127.1739	120.5771	105.7382	102.3612	108.1345	111.1890	127.4517	139.7242	159.1742 (45)
Energy content (annual)										Total = Sum(45)m =		1553.9774 (45)
Distribution loss (46)m = 0.15 x (45)m												
24.2135	21.2944	22.3601	19.0761	18.0866	15.8607	15.3542	16.2202	16.6784	19.1178	20.9586	23.8761 (46)	
Water storage loss (or HIU 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 (61)	
Total heat required for water heating calculated for each month												
231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622 (62)	
WWHRS	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 (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 (63c)	
FGHRS	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												
231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622 (64)	
12Total per year (kWh/year)												2374.4974 (64)
Electric shower(s)												2374 (64)
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month												
109.4237	97.5578	105.3152	96.2373	95.8423	89.1099	89.7855	91.7051	90.9224	98.1281	100.4103	108.6758 (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	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	80.6041	89.2402	80.6041	83.2909	80.6041	83.2909	80.6041	80.6041	83.2909	80.6041	83.2909	80.6041 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	154.2407	155.8412	151.8079	143.2215	132.3827	122.1957	115.3902	113.7897	117.8230	126.4094	137.2482	147.4352 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486 (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)												
	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887 (71)
Water heating gains (Table 5)												
	147.0749	145.1754	141.5527	133.6630	128.8203	123.7638	120.6794	123.2596	126.2810	131.8926	139.4587	146.0696 (72)
Total internal gains												
	431.4654	439.8026	423.5105	409.7211	391.3528	378.7962	366.2195	367.1991	376.9407	388.4519	409.5436	423.6546 (73)

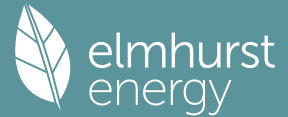
6. Solar gains

[Jan]												Gains
						Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d		W
Northwest						5.3000	11.2829	0.6300	0.7000	0.7700		18.2755 (81)
Southeast						3.4400	36.7938	0.6300	0.7000	0.7700		38.6817 (77)
Solar gains	56.9572	103.0896	157.1757	221.7747	273.0746	281.9507	267.3149	227.3840	179.2849	118.2834	69.3271	48.0282 (83)
Total gains	488.4226	542.8921	580.6862	631.4958	664.4274	660.7469	633.5344	594.5831	556.2256	506.7353	478.8707	471.6828 (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	29.4856	29.7867	30.0879	31.5882	31.8857	33.3477	33.3477	33.6332	32.7690	31.8857	31.2896	30.6898
alpha	2.9657	2.9858	3.0059	3.1059	3.1257	3.2232	3.2232	3.2422	3.1846	3.1257	3.0860	3.0460
util living area												
	0.9665	0.9525	0.9288	0.8690	0.7670	0.6009	0.4608	0.5016	0.7123	0.8850	0.9483	0.9692 (86)
MIT	18.7763	19.0450	19.4568	20.0741	20.5392	20.8604	20.9556	20.9420	20.7410	20.1587	19.4434	18.8231 (87)
Th 2	19.6851	19.6965	19.7077	19.7609	19.7710	19.8181	19.8181	19.8269	19.7999	19.7710	19.7507	19.7296 (88)
util rest of house												

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MIT 2	0.9591	0.9421	0.9125	0.8386	0.7118	0.5132	0.3475	0.3877	0.6314	0.8520	0.9353	0.9625 (89)
Living area fraction	17.1689	17.5129	18.0345	18.8215	19.3633	19.7259	19.7997	19.8007	19.6084	18.9439	18.0513	17.2542 (90)
MIT	18.0443	18.3473	18.8091	19.5037	20.0037	20.3437	20.4292	20.4222	fLA = Living area / (4) =			0.5446 (91)
Temperature adjustment									20.2252	19.6055	18.8094	18.1086 (92)
adjusted MIT	18.0443	18.3473	18.8091	19.5037	20.0037	20.3437	20.4292	20.4222	20.2252	19.6055	18.8094	18.1086 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9466	0.9281	0.8984	0.8312	0.7232	0.5540	0.4077	0.4474	0.6624	0.8467	0.9228	0.9509	(94)
Useful gains	462.3483	503.8397	521.6930	524.9246	480.5183	366.0566	258.2621	266.0083	368.4337	429.0639	441.9035	448.5125	(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	1088.8060	1054.5037	955.5855	784.0949	608.2935	402.3141	268.2134	279.3387	436.6111	659.7028	874.1240	1058.5881	(97)
Space heating kWh	466.0846	370.0463	322.8160	186.6026	95.0648	0.0000	0.0000	0.0000	0.0000	171.5954	311.1988	453.8962	(98a)
Space heating requirement - total per year (kWh/year)												2377.3046	
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	466.0846	370.0463	322.8160	186.6026	95.0648	0.0000	0.0000	0.0000	0.0000	171.5954	311.1988	453.8962	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2377.3046	
Space heating per m2											(98c) / (4) =	45.1101	(99)

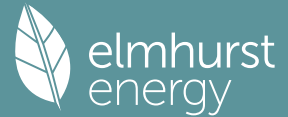
9b. Energy requirements

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	466.0846	370.0463	322.8160	186.6026	95.0648	0.0000	0.0000	0.0000	0.0000	171.5954	311.1988	453.8962 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00												
307a	466.0846	370.0463	322.8160	186.6026	95.0648	0.0000	0.0000	0.0000	0.0000	171.5954	311.1988	453.8962
Space heating requirement	466.0846	370.0463	322.8160	186.6026	95.0648	0.0000	0.0000	0.0000	0.0000	171.5954	311.1988	453.8962 (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	231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622 (64)
Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00												
310a	231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622
Water heating fuel	231.1115	204.9068	218.7552	194.6139	190.2651	173.1782	172.0492	177.8225	178.6290	197.1397	207.1642	228.8622 (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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (331)
Lighting	17.1359	13.7471	12.3777	9.0684	7.0047	5.7229	6.3899	8.3059	10.7885	14.1551	15.9882	17.6122 (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												2377.3046 (307)
Space heating fuel - secondary												0.0000 (309)
Water heating fuel - community heating												2374.4974 (310)
Efficiency of water heater												0.0000 (311)
Electricity used for heat distribution												23.7730 (313)
Space cooling fuel												0.0000 (321)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (331)
Electricity for lighting (calculated in Appendix L)												138.2965 (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												4890.0985 (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	5309.2760	0.2100	557.8033 (367)	
Electrical energy for heat distribution (space & water)	23.7730	0.0000	7.0197 (372)	
Overall CO2 factor for heat network			0.2361 (386)	
Total CO2 associated with community systems			1121.9677 (373)	
Space and water heating			1121.9677 (376)	
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (378)	

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Energy for lighting	138.2965	0.1443	19.9605 (379)
Total CO ₂ , kg/year			1141.9281 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			21.6700 (384)

13b. Primary energy - Community heating scheme

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Efficiency of heat source Boilers			89.5000 (467a)
Space and Water heating from Boilers	5309.2760	1.1300	3001.5130 (467)
Electrical energy for heat distribution (space & water)	23.7730	0.0000	73.4911 (472)
Overall CO ₂ factor for heat network			1.2780 (486)
Total CO ₂ associated with community systems			6072.9729 (473)
Space and water heating			6072.9729 (476)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (478)
Energy for lighting	138.2965	1.5338	212.1238 (479)
Total Primary energy kWh/year			6285.0968 (483)
Dwelling Primary energy Rate (DPER)			119.2600 (484)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Main dwelling	52.7000 (1b)	2.5000 (2b)	131.7500 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	52.7000		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 131.7500 (5)

2. Ventilation rate

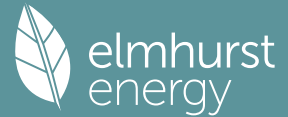
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1518 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.4018 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3717 (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	0.4739	0.4646	0.4553	0.4088	0.3995	0.3531	0.3531	0.3438	0.3717	0.3995	0.4181	0.4367 (22b)
Effective ac	0.6123	0.6079	0.6036	0.5836	0.5798	0.5623	0.5623	0.5591	0.5691	0.5798	0.5874	0.5954 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
TER Opening Type			8.7400	1.1450	10.0076		(27)
Refurb wall (limiting)	30.8000	3.4400	27.3600	0.1800	4.9248		(29a)
New wall (notional)	22.4000	5.3000	17.1000	0.1800	3.0780		(29a)
New roof (notional)	4.7000		4.7000	0.1100	0.5170		(30)
Total net area of external elements Aum(A, m ²)			57.9000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 18.5274		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							159.5617 (35)
Thermal bridges (User defined value 0.050 * total exposed area)							2.8950 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	21.4224 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							
(38)m	26.6204	26.4308	26.2450	25.3723	25.2090	24.4489	24.4489
Heat transfer coeff	48.0428	47.8532	47.6674	46.7947	46.6314	45.8713	45.8713
Average = Sum(39)m / 12 =							
HLP	0.9116	0.9080	0.9045	0.8879	0.8848	0.8704	0.8704
HLP (average)							0.8678

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Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												
Assumed occupancy												1.7697 (42)
Hot water usage for mixer showers	69.1708	68.1313	66.6165	63.7183	61.5795	59.1943	57.8386	59.3419	60.9898	63.5507	66.5112	68.9058 (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	32.7537	31.5626	30.3716	29.1805	27.9895	26.7985	26.7985	27.9895	29.1805	30.3716	31.5626	32.7537 (42c)
Average daily hot water use (litres/day)												93.5492 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	101.9245	99.6939	96.9881	92.8989	89.5690	85.9928	84.6371	87.3314	90.1703	93.9223	98.0738	101.6595 (44)
Energy content (annual)	161.4235	141.9628	149.0672	127.1739	120.5771	105.7382	102.3612	108.1345	111.1890	127.4517	139.7242	159.1742 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		1553.9774
Water storage loss (or HIU loss):	24.2135	21.2944	22.3601	19.0761	18.0866	15.8607	15.3542	16.2202	16.6784	19.1178	20.9586	23.8761 (46)
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	210.0624	185.8948	197.7061	174.2439	169.2160	152.8081	151.0001	156.7734	158.2590	176.0907	186.7941	207.8131 (62)
WWHRS	-31.6220	-27.9668	-29.2852	-24.2493	-22.5995	-19.3385	-18.1268	-19.2760	-20.0084	-23.5877	-26.7220	-31.0364 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
Output from w/h	178.4404	157.9280	168.4209	149.9946	146.6166	133.4696	132.8733	137.4974	138.2506	152.5030	160.0721	176.7767 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		1832.8432 (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	92.5844	82.3482	88.4760	79.9413	79.0030	72.8139	72.9462	74.8659	74.6263	81.2888	84.1142	91.8366 (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	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859	88.4859 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	80.6041	89.2402	80.6041	83.2909	80.6041	83.2909	80.6041	80.6041	83.2909	80.6041	83.2909	80.6041 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	154.2407	155.8412	151.8079	143.2215	132.3827	122.1957	115.3902	113.7897	117.8230	126.4094	137.2482	147.4352 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486	31.8486 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887	-70.7887 (71)
Water heating gains (Table 5)	124.4415	122.5420	118.9193	111.0295	106.1869	101.1304	98.0460	100.6262	103.6476	109.2592	116.8253	123.4362 (72)
Total internal gains	411.8320	420.1692	403.8771	390.0877	371.7194	356.1628	343.5861	344.5657	354.3073	368.8184	389.9102	404.0212 (73)

6. Solar gains												

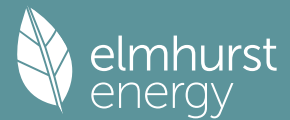
[Jan]												
	Area											
	m2											
	Solar flux											
	Table 6a											
	W/m2											
	Specific data											
	or Table 6b											
	Specific data											
	or Table 6c											
	Access											
	factor											
	Table 6d											
	Gains											
	W											
Southeast	3.4400											38.6817 (77)
Northwest	5.3000											18.2755 (81)

Solar gains	56.9572	103.0896	157.1757	221.7747	273.0746	281.9507	267.3149	227.3840	179.2849	118.2834	69.3271	48.0282 (83)
Total gains	468.7892	523.2587	561.0528	611.8624	644.7940	638.1135	610.9010	571.9497	533.5922	487.1019	459.2373	452.0494 (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	48.6193	48.8119	49.0021	49.9160	50.0908	50.9208	50.9208	51.0776	50.5979	50.0908	49.7385	49.3754
alpha	4.2413	4.2541	4.2668	4.3277	4.3394	4.3947	4.3947	4.4052	4.3732	4.3394	4.3159	4.2917
util living area	0.9547	0.9288	0.8840	0.7795	0.6278	0.4518	0.3287	0.3649	0.5701	0.8109	0.9232	0.9597 (86)
MIT	19.9240	20.1364	20.4068	20.7275	20.9118	20.9837	20.9968	20.9950	20.9561	20.7251	20.3020	19.9010 (87)
Th 2	20.1576	20.1607	20.1637	20.1778	20.1804	20.1927	20.1927	20.1950	20.1880	20.1804	20.1751	20.1695 (88)
util rest of house	0.9468	0.9169	0.8653	0.7478	0.5826	0.3976	0.2691	0.3023	0.5111	0.7760	0.9085	0.9525 (89)
MIT 2	18.9199	19.1848	19.5169	19.9029	20.1028	20.1816	20.1912	20.1925	20.1552	19.9108	19.4047	18.9002 (90)
Living area fraction	19.4667	19.7030	20.0015	20.3520	20.5434	20.6184	20.6299	20.6295	20.5914	20.3543	19.8934	19.4452 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4667	19.7030	20.0015	20.3520	20.5434	20.6184	20.6299	20.6295	20.5914	20.3543	19.8934	19.4452 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9390	0.9095	0.8613	0.7549	0.6031	0.4264	0.3015	0.3363	0.5409	0.7839	0.9028	0.9451	(94)
Useful gains	440.2040	475.9253	483.2074	461.8851	388.8485	272.0878	184.1828	192.3369	288.6340	381.8241	414.6062	427.2316	(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	728.6505	708.3734	643.5821	535.8927	412.3799	276.0736	184.8583	193.4190	299.6681	454.8554	600.8008	721.2078	(97)
Space heating kWh	214.6042	156.2052	119.3188	53.2855	17.5073	0.0000	0.0000	0.0000	0.0000	54.3352	134.0601	218.7183	(98a)
Space heating requirement - total per year (kWh/year)												968.0346	
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	214.6042	156.2052	119.3188	53.2855	17.5073	0.0000	0.0000	0.0000	0.0000	54.3352	134.0601	218.7183	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												968.0346	
Space heating per m2										(98c) / (4) =		18.3688	(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	214.6042	156.2052	119.3188	53.2855	17.5073	0.0000	0.0000	0.0000	0.0000	54.3352	134.0601	218.7183	(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)	232.5073	169.2364	129.2728	57.7307	18.9679	0.0000	0.0000	0.0000	0.0000	58.8681	145.2439	236.9646	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating														
Water heating requirement	178.4404	157.9280	168.4209	149.9946	146.6166	133.4696	132.8733	137.4974	138.2506	152.5030	160.0721	176.7767	(64)	
Efficiency of water heater (217)m	84.4747	84.0352	83.3010	81.9779	80.6722	79.8000	79.8000	79.8000	79.8000	81.9827	83.6648	84.5384	(216)	
Fuel for water heating, kWh/month	211.2353	187.9308	202.1836	182.9695	181.7437	167.2551	166.5079	172.3025	173.2463	186.0184	191.3255	209.1082	(219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041	(231)	
Lighting	16.7479	13.4358	12.0975	8.8631	6.8461	5.5933	6.2453	8.1178	10.5443	13.8346	15.6262	17.2134	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-18.1215	-26.4752	-39.4304	-46.0060	-51.0872	-48.2541	-47.6941	-44.3111	-38.5655	-31.0438	-20.2602	-15.5630	(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	-7.5995	-16.2302	-32.7052	-49.7680	-66.4223	-66.9363	-66.1184	-55.6745	-40.4245	-23.3897	-10.2067	-5.9892	(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												1048.7916	(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												2231.8270	(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)												135.1654	(232)	
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation												-868.2765	(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												2633.5075	(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	1048.7916	0.2100	220.2462	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2231.8270	0.2100	468.6837	(264)
Space and water heating			688.9299	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	135.1654	0.1443	19.5085	(268)

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Energy saving/generation technologies			
PV Unit electricity used in dwelling	-426.8121	0.1338	-57.1154
PV Unit electricity exported	-441.4644	0.1255	-55.4148
Total			-112.5302 (269)
Total CO2, kg/year			607.8375 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5300 (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	1048.7916	1.1300	1185.1345 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2231.8270	1.1300	2521.9645 (278)
Space and water heating			3707.0990 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	135.1654	1.5338	207.3213 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-426.8121	1.4945	-637.8825
PV Unit electricity exported	-441.4644	0.4607	-203.4030
Total			-841.2855 (283)
Total Primary energy kWh/year			3203.2355 (286)
Target Primary Energy Rate (TPER)			60.7800 (287)

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Plot Reference	L02_flat 5 (new build)			Issued on Date	10/08/2026
Assessment Reference	Be Green	Plot Type Ref	L02_2B3P		
Plot Address	22, Palace Road, London, N11 2PS			SAP Version	10.2
SAP Rating	88 B	DER	2.49	TER	11.34
Environmental	98 A	% DER < TER			78.04
CO ₂ Emissions (t/year)	0.2	DFEE	36.19	TFEE	36.49
Compliance Check	See BREL	% DFEE < TFEE			0.82
% DPER < TPER	50.74	DPER	29.26	TPER	59.40
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 (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	93.0000 (1b)	2.5000 (2b)	232.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0000		
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	232.5000 (5)

2. Ventilation rate

	m ³ 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)

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)

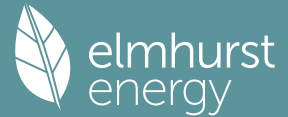
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500 (21)

	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) =												80.1000 (23c)
Effective ac	0.2907	0.2870	0.2833	0.2645	0.2607	0.2420	0.2420	0.2382	0.2495	0.2607	0.2682	0.2757 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			28.3100	0.9615	27.2212		(27)
Rooflight			2.9600	0.9615	2.8462		(27a)
External Wall 1	83.6000	28.3100	55.2900	0.1800	9.9522	110.0000	6081.9000 (29a)
External Roof 1	93.0000	2.9600	90.0400	0.1200	10.8048	9.0000	810.3600 (30)
Total net area of external elements Aum(A, m ²)			176.6000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	50.8243	(33)
Main dwelling							
Party Floor 1			93.0000			40.0000	3720.0000 (32d)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10612.2600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							114.1103 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E7 Party floor between dwellings (in blocks of flats)				17.1000	0.0700	1.1970	
E14 Flat roof				38.4700	0.0800	3.0776	

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E16 Corner (normal)						10.0000	0.0900	0.9000				
E18 Party wall between dwellings						5.0000	0.0600	0.3000				
R1 Head of roof window						3.2000	0.0800	0.2560				
R2 Sill of roof window						3.2000	0.0600	0.1920				
R3 Jamb of roof window						3.6000	0.0800	0.2880				
P4 Party wall - Roof (insulation at ceiling level)						11.5000	0.1200	1.3800				
E2 Other lintels (including other steel lintels)						12.1000	0.2000	2.4200				
E3 Sill						12.1000	0.0400	0.4840				
E4 Jamb						21.6800	0.0500	1.0840				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)											11.5786	(36)
Point Thermal Bridges											0.0000	
Total fabric heat loss											(33) + (36) + (36a) =	62.4029 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	22.3078	22.0201	21.7324	20.2938	20.0060	18.5674	18.5674	18.2797	19.1429	20.0060	20.5815	21.1569 (38)
Average = Sum(39)m / 12 =	84.7107	84.4230	84.1353	82.6967	82.4090	80.9704	80.9704	80.6826	81.5458	82.4090	82.9844	83.5598 (39)
												82.6247
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9109	0.9078	0.9047	0.8892	0.8861	0.8706	0.8706	0.8676	0.8768	0.8861	0.8923	0.8985 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
												0.8884
												31

4. Water heating energy requirements (kWh/year)												

Assumed occupancy												2.6646 (42)
Hot water usage for mixer showers												
	68.8963	67.8609	66.3522	63.4655	61.3351	58.9594	57.6091	59.1064	60.7477	63.2985	66.2473	68.6323 (42a)
Hot water usage for baths												
	29.7509	29.3090	28.6868	27.5396	26.6806	25.7280	25.2135	25.8314	26.5041	27.5233	28.6942	29.6503 (42b)
Hot water usage for other uses												
	41.9181	40.3938	38.8695	37.3453	35.8210	34.2967	34.2967	35.8210	37.3453	38.8695	40.3938	41.9181 (42c)
Average daily hot water use (litres/day)												129.2112 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	140.5653	137.5638	133.9086	128.3503	123.8366	118.9841	117.1192	120.7587	124.5971	129.6914	135.3353	140.2008 (44)
Energy conte	222.6211	195.8890	205.8125	175.7052	166.7079	146.3048	141.6456	149.5245	153.6407	175.9900	192.8100	219.5205 (45)
Energy content (annual)										Total = Sum(45)m =		2146.1718
Distribution loss (46)m = 0.15 x (45)m												
	33.3932	29.3834	30.8719	26.3558	25.0062	21.9457	21.2468	22.4287	23.0461	26.3985	28.9215	32.9281 (46)
Water storage loss (or HIU loss):												
Store volume												120.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.6000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8640 (55)
Total storage loss												
	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (56)
If cylinder contains dedicated solar storage												
	26.7840	24.1920	26.7840	25.9200	26.7840	25.9200	26.7840	26.7840	25.9200	26.7840	25.9200	26.7840 (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												
	272.6675	241.0922	255.8589	224.1372	216.7543	194.7368	191.6920	199.5709	202.0727	226.0364	241.2420	269.5669 (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												
	272.6675	241.0922	255.8589	224.1372	216.7543	194.7368	191.6920	199.5709	202.0727	226.0364	241.2420	269.5669 (64)
										Total per year (kWh/year) = Sum(64)m =		2735.4278 (64)
12Total per year (kWh/year)												2735 (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												
	114.0586	101.2957	108.4698	97.1676	95.4675	87.3920	87.1343	89.7540	89.8311	98.5538	102.8549	113.0277 (65)

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

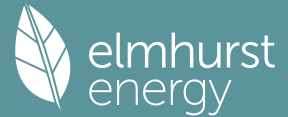
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	123.3171	136.5297	123.3171	127.4277	123.3171	127.4277	123.3171	123.3171	127.4277	123.3171	127.4277	123.3171 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	244.4900	247.0270	240.6338	227.0233	209.8424	193.6949	182.9074	180.3703	186.7636	200.3741	217.5549	233.7024 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839 (71)
Water heating gains (Table 5)												
	153.3046	150.7376	145.7927	134.9550	128.3165	121.3777	117.1160	120.6371	124.7654	132.4648	142.8540	151.9189 (72)
Total internal gains												
	584.0807	597.2632	572.7125	552.3748	524.4451	505.4693	486.3094	487.2935	501.9257	519.1250	550.8056	571.9074 (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					
Southeast			16.6500	36.7938	0.4000	0.8000	0.7700	135.8540 (77)				
Northwest			11.6600	11.2829	0.4000	0.8000	0.7700	29.1745 (81)				
Northwest			2.9600	26.0000	0.4000	0.8000	1.0000	22.1645 (82)				

Solar gains	187.1930	336.8292	505.4569	695.9004	839.2952	858.5513	817.2688	707.0738	571.2468	384.5946	227.5628	157.9902 (83)

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Total gains 771.2737 934.0924 1078.1694 1248.2752 1363.7403 1364.0206 1303.5782 1194.3673 1073.1724 903.7195 778.3683 729.8977 (84)

7. Mean internal temperature (heating season)

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

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	34.7990	34.9176	35.0370	35.6465	35.7710	36.4065	36.4065	36.5364	36.1496	35.7710	35.5229	35.2783	21.0000 (85)
alpha	3.3199	3.3278	3.3358	3.3764	3.3847	3.4271	3.4271	3.4358	3.4100	3.3847	3.3682	3.3519	
util living area	0.9345	0.8882	0.8144	0.6801	0.5239	0.3713	0.2710	0.3069	0.4950	0.7511	0.8946	0.9431	(86)
Living	19.4816	19.8399	20.2503	20.6655	20.8855	20.9738	20.9932	20.9897	20.9304	20.6064	19.9932	19.4277	
Non living	19.1028	19.4553	19.8552	20.2569	20.4605	20.5448	20.5603	20.5593	20.5067	20.2086	19.6150	19.0545	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.2232	19.8399	20.2503	20.6655	20.8855	20.9738	20.9932	20.9897	20.9304	20.6064	19.9932	19.6476	(87)
Th 2	20.5446	20.5461	20.5477	20.5554	20.5569	20.5647	20.5647	20.5662	20.5616	20.5569	20.5538	20.5508	(88)
util rest of house	0.9300	0.8810	0.8034	0.6637	0.5032	0.3475	0.2447	0.2788	0.4679	0.7333	0.8867	0.9391	(89)
MIT 2	19.8070	19.4553	19.8552	20.2569	20.4605	20.5448	20.5603	20.5593	20.5067	20.2086	19.6150	19.2638	(90)
Living area fraction									fLA = Living area / (4) =			0.3194	(91)
MIT	19.9400	19.5781	19.9814	20.3874	20.5962	20.6818	20.6985	20.6968	20.6420	20.3357	19.7358	19.3863	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9400	19.5781	19.9814	20.3874	20.5962	20.6818	20.6985	20.6968	20.6420	20.3357	19.7358	19.3863	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9233	0.8638	0.7885	0.6573	0.5050	0.3539	0.2528	0.2873	0.4729	0.7240	0.8702	0.9269	(94)
Useful gains	712.0796	806.8624	850.1076	820.4983	688.7248	482.7537	329.5791	343.1494	507.5397	654.3103	677.3723	676.5178	(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	1324.8712	1239.1692	1134.2604	949.9665	733.1261	492.4425	331.8597	346.6738	533.4729	802.3072	1048.5744	1268.9687	(97)
Space heating kWh	455.9170	290.5101	211.4097	93.2171	33.0346	0.0000	0.0000	0.0000	0.0000	110.1097	267.2655	440.7834	(98a)
Space heating requirement - total per year (kWh/year)												1902.2471	
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	455.9170	290.5101	211.4097	93.2171	33.0346	0.0000	0.0000	0.0000	0.0000	110.1097	267.2655	440.7834	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1902.2471	
Space heating per m2										(98c) / (4) =		20.4543	(99)

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

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

Fraction of space heat from main system(s)

Efficiency of main space heating system 1 (in %)

Efficiency of main space heating system 2 (in %)

Efficiency of secondary/supplementary heating system, %

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	455.9170	290.5101	211.4097	93.2171	33.0346	0.0000	0.0000	0.0000	0.0000	110.1097	267.2655	440.7834	(98)
Space heating efficiency (main heating system 1)	430.4427	430.4427	430.4427	430.4427	430.4427	0.0000	0.0000	0.0000	0.0000	430.4427	430.4427	430.4427	(210)
Space heating fuel (main heating system)	105.9182	67.4910	49.1145	21.6561	7.6746	0.0000	0.0000	0.0000	0.0000	25.5806	62.0909	102.4024	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	272.6675	241.0922	255.8589	224.1372	216.7543	194.7368	191.6920	199.5709	202.0727	226.0364	241.2420	269.5669	(64)
Efficiency of water heater (217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(216)
Fuel for water heating, kWh/month	160.3927	141.8190	150.5052	131.8454	127.5025	114.5511	112.7600	117.3946	118.8663	132.9626	141.9070	158.5688	(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	15.6349	14.1219	15.6349	15.1306	15.6349	15.1306	15.6349	15.6349	15.1306	15.6349	15.1306	15.6349	(231)
Lighting	24.6336	19.7620	17.7935	13.0363	10.0696	8.2269	9.1858	11.9401	15.5090	20.3486	22.9837	25.3183	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-20.1739	-31.7070	-50.9278	-63.1682	-73.0779	-69.8076	-68.7901	-62.3144	-51.3551	-38.3884	-23.1340	-17.0120	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-4.5117	-10.6116	-23.6479	-39.6157	-55.7802	-57.5039	-56.5863	-46.0890	-31.6487	-16.4381	-6.3802	-3.4816	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												441.9281	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												170.0000	
Water heating fuel used												1609.0752	(219)
Space cooling fuel												0.0000	(221)

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Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6490)	
Mechanical ventilation fans (SFP = 0.6490)	184.0889 (230a)
Total electricity for the above, kWh/year	184.0889 (231)
Electricity for lighting (calculated in Appendix L)	198.8074 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-922.1513 (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	1511.7482 (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	441.9281	0.1567	69.2339 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1609.0752	0.1410	226.8165 (264)
Space and water heating			296.0504 (265)
Pumps, fans and electric keep-hot	184.0889	0.1387	25.5354 (267)
Energy for lighting	198.8074	0.1443	28.6940 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-569.8564	0.1326	-75.5769
PV Unit electricity exported	-352.2949	0.1232	-43.3973
Total			-118.9742 (269)
Total CO2, kg/year			231.3056 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.4900 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	441.9281	1.5799	698.2156 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1609.0752	1.5212	2447.7653 (278)
Space and water heating			3145.9810 (279)
Pumps, fans and electric keep-hot	184.0889	1.5128	278.4896 (281)
Energy for lighting	198.8074	1.5338	304.9374 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-569.8564	1.4900	-849.1136
PV Unit electricity exported	-352.2949	0.4520	-159.2536
Total			-1008.3672 (283)
Total Primary energy kWh/year			2721.0407 (286)
Dwelling Primary energy Rate (DPER)			29.2600 (287)

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

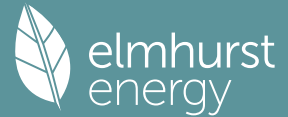
1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Main dwelling	93.0000 (1b)	2.5000 (2b)	232.5000 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	232.5000 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) = 0.1290 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3790 (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) = 0.3790 (21)

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Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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												
Effective ac	0.4833	0.4738	0.4643	0.4169	0.4075	0.3601	0.3601	0.3506	0.3790	0.4075	0.4264	0.4454 (22b)
	0.6168	0.6122	0.6078	0.5869	0.5830	0.5648	0.5648	0.5615	0.5718	0.5830	0.5909	0.5992 (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
Main dwelling							
TER Opening Type			21.0500	1.1450	24.1031		(27)
TER Roof Light			2.2000	1.5918	4.4485		(27a)
External Wall 1	83.6000	21.0500	62.5500	0.1800	11.2590		(29a)
External Roof 1	93.0000	2.2000	90.8000	0.1100	9.9880		(30)
Total net area of external elements Aum(A, m2)			176.6000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	49.7986	(33)

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

114.1103 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	17.1000	0.0700	1.1970
E14 Flat roof	38.4700	0.0800	3.0776
E16 Corner (normal)	10.0000	0.0900	0.9000
E18 Party wall between dwellings	5.0000	0.0600	0.3000
R1 Head of roof window	3.2000	0.0800	0.2560
R2 Sill of roof window	3.2000	0.0600	0.1920
R3 Jamb of roof window	3.6000	0.0800	0.2880
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800
E2 Other lintels (including other steel lintels)	12.1000	0.0500	0.6050
E3 Sill	12.1000	0.0500	0.6050
E4 Jamb	21.6800	0.0500	1.0840

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

9.8846 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 59.6832 (37)

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

(38)m	Jan 47.3219	Feb 46.9740	Mar 46.6330	Apr 45.0313	May 44.7316	Jun 43.3365	Jul 43.3365	Aug 43.0782	Sep 43.8739	Oct 44.7316	Nov 45.3378	Dec 45.9716 (38)
Heat transfer coeff	107.0051	106.6572	106.3162	104.7144	104.4148	103.0197	103.0197	102.7613	103.5570	104.4148	105.0210	105.6548 (39)
Average = Sum(39)m / 12 =												104.7130

HLP	Jan 1.1506	Feb 1.1469	Mar 1.1432	Apr 1.1260	May 1.1227	Jun 1.1077	Jul 1.1077	Aug 1.1050	Sep 1.1135	Oct 1.1227	Nov 1.1293	Dec 1.1361 (40)
HLP (average)												1.1259
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

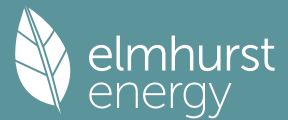
4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.6646 (42)
Hot water usage for mixer showers	68.8963	67.8609	66.3522	63.4655	61.3351	58.9594	57.6091	59.1064	60.7477	63.2985	66.2473	68.6323 (42a)
Hot water usage for baths	29.7509	29.3090	28.6868	27.5396	26.6806	25.7280	25.2135	25.8314	26.5041	27.5233	28.6942	29.6503 (42b)
Hot water usage for other uses	41.9181	40.3938	38.8695	37.3453	35.8210	34.2967	34.2967	35.8210	37.3453	38.8695	40.3938	41.9181 (42c)
Average daily hot water use (litres/day)												129.2112 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	140.5653	137.5638	133.9086	128.3503	123.8366	118.9841	117.1192	120.7587	124.5971	129.6914	135.3353	140.2008 (44)
Energy content (annual)	222.6211	195.8890	205.8125	175.7052	166.7079	146.3048	141.6456	149.5245	153.6407	175.9900	192.8100	219.5205 (45)
Distribution loss (46)m = 0.15 x (45)m										Total = Sum(45)m =		2146.1718
	33.3932	29.3834	30.8719	26.3558	25.0062	21.9457	21.2468	22.4287	23.0461	26.3985	28.9215	32.9281 (46)
Water storage loss (or HIU loss):												
Store volume												120.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2247 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.6613 (55)
Total storage loss	20.5007	18.5168	20.5007	19.8394	20.5007	19.8394	20.5007	20.5007	19.8394	20.5007	19.8394	20.5007 (56)
If cylinder contains dedicated solar storage	20.5007	18.5168	20.5007	19.8394	20.5007	19.8394	20.5007	20.5007	19.8394	20.5007	19.8394	20.5007 (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												
	266.3842	235.4170	249.5756	218.0565	210.4710	188.6562	185.4087	193.2876	195.9921	219.7531	235.1614	263.2836 (62)
WWHRS	-31.4965	-27.8558	-29.1690	-24.1531	-22.5098	-19.2618	-18.0548	-19.1995	-19.9290	-23.4941	-26.6159	-30.9132 (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	234.8877	207.5612	220.4066	193.9035	187.9613	169.3944	167.3538	174.0881	176.0631	196.2591	208.5454	232.3704 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2368.7947 (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)
												0.0000 (64a)
Heat gains from water heating, kWh/month	109.0320	96.7555	103.4431	92.3031	90.4409	82.5275	82.1076	84.7274	84.9666	93.5272	97.9904	108.0011 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
123.3171	136.5297	123.3171	127.4277	123.3171	127.4277	123.3171	123.3171	123.3171	127.4277	123.3171	127.4277	123.3171 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												

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Cooking gains	244.4900	247.0270	240.6338	227.0233	209.8424	193.6949	182.9074	180.3703	186.7636	200.3741	217.5549	233.7024 (68)
Pumps, fans	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230 (69)
Losses e.g. evaporation	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)
(negative values) (Table 5)												
Water heating gains	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839 (71)
Total internal gains	146.5484	143.9814	139.0365	128.1987	121.5603	114.6215	110.3597	113.8809	118.0092	125.7086	136.0978	145.1627 (72)
	580.3244	593.5070	568.9563	548.6186	520.6888	498.7130	479.5532	480.5373	495.1694	515.3687	547.0493	568.1512 (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
Southeast					12.3800	36.7938	0.6300	0.7000			0.7700			139.2091 (77)
Northwest					8.6700	11.2829	0.6300	0.7000			0.7700			29.8960 (81)
Northwest					2.2000	26.0000	0.6300	0.7000			1.0000			22.7027 (82)
Solar gains	191.8077	345.1304	517.9093	713.0392	859.9626	879.6919	837.3932	724.4865	585.3180	394.0717	233.1722			161.8853 (83)
Total gains	772.1322	938.6374	1086.8656	1261.6578	1380.6514	1378.4049	1316.9464	1205.0238	1080.4875	909.4404	780.2216			730.0365 (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)												
tau	27.5487	27.6385	27.7272	28.1513	28.2321	28.6144	28.6144	28.6864	28.4660	28.2321	28.0691	27.9008
alpha	2.8366	2.8426	2.8485	2.8768	2.8821	2.9076	2.9076	2.9124	2.8977	2.8821	2.8713	2.8601
util living area	0.9453	0.9097	0.8526	0.7436	0.6018	0.4474	0.3339	0.3762	0.5769	0.8041	0.9155	0.9521 (86)
MIT	18.8638	19.2534	19.7545	20.3302	20.7140	20.9125	20.9722	20.9604	20.8135	20.2770	19.4831	18.8075 (87)
Th 2	19.9597	19.9628	19.9657	19.9797	19.9823	19.9945	19.9945	19.9968	19.9898	19.9823	19.9770	19.9715 (88)
util rest of house	0.9369	0.8967	0.8319	0.7102	0.5538	0.3855	0.2614	0.2999	0.5120	0.7693	0.9010	0.9447 (89)
MIT 2	17.4905	17.9769	18.5948	19.2892	19.7201	19.9305	19.9801	19.9750	19.8408	19.2498	18.2817	17.4271 (90)
Living area fraction	17.9291	18.3846	18.9652	19.6217	20.0376	20.2441	20.2970	20.2897	20.1515	19.5778	18.6654	17.8679 (92)
MIT	17.9291	18.3846	18.9652	19.6217	20.0376	20.2441	20.2970	20.2897	20.1515	19.5778	18.6654	17.8679 (93)
Temperature adjustment												0.0000
adjusted MIT	17.9291	18.3846	18.9652	19.6217	20.0376	20.2441	20.2970	20.2897	20.1515	19.5778	18.6654	17.8679 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9151	0.8719	0.8085	0.6973	0.5565	0.4013	0.2836	0.3227	0.5229	0.7535	0.8776	0.9243 (94)
Ext temp.	706.5911	818.3694	878.6792	879.7925	768.3703	553.1583	373.4579	388.8257	564.9978	685.3071	684.7079	674.7550 (95)
Heat loss rate W	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)
Space heating kWh	1458.3788	1438.2270	1325.2475	1122.7127	870.5634	581.4576	380.8589	399.7089	626.6705	937.4177	1214.6059	1444.0841 (97)
Space heating requirement - total per year (kWh/year)	559.3301	416.5443	332.2468	174.9025	76.0316	0.0000	0.0000	0.0000	0.0000	187.5702	381.5265	572.3808 (98a)
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)	559.3301	416.5443	332.2468	174.9025	76.0316	0.0000	0.0000	0.0000	0.0000	187.5702	381.5265	572.3808 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (99)
Space heating per m ²												

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)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating efficiency (main heating system 1)	559.3301	416.5443	332.2468	174.9025	76.0316	0.0000	0.0000	0.0000	0.0000	187.5702	381.5265	572.3808 (98)
Space heating fuel (main heating system)	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 efficiency (main heating system 2)	605.9914	451.2939	359.9640	189.4935	82.3745	0.0000	0.0000	0.0000	0.0000	203.2180	413.3549	620.1309 (211)
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 (212)
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 (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	234.8877	207.5612	220.4066	193.9035	187.9613	169.3944	167.3538	174.0881	176.0631	196.2591	208.5454	232.3704 (64)
Water heating requirement	85.9337	85.5897	84.9778	83.8292	82.1994	79.8000	79.8000	79.8000	79.8000	83.9583	85.3961	79.8000 (216)
Efficiency of water heater (217)m	273.3360	242.5073	259.3697	231.3077	228.6650	212.2737	209.7166	218.1555	220.6304	233.7577	244.2095	270.2001 (219)
Fuel for water heating, kWh/month	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)
Space cooling fuel requirement (221)m	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)
Pumps and Fa	25.6229	20.5556	18.5080	13.5598	10.4740	8.5573	9.5547	12.4196	16.1318	21.1658	23.9067	26.3350 (232)
Lighting												
Electricity generated by PVs (Appendix M) (negative quantity)												

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(233a)m	-31.1292	-45.0374	-66.4116	-76.6558	-84.3487	-79.3176	-78.3151	-73.0849	-64.1622	-52.3574	-34.6191	-26.7780	(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	-14.2609	-30.3250	-60.8865	-92.3572	-123.0210	-123.9597	-122.5305	-103.3603	-75.2319	-43.7016	-19.1459	-11.2553	(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												2925.8212	(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												2844.1293	(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)												206.7912	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-1532.2527	(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												4530.4890	(238)

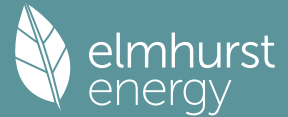
12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2925.8212	0.2100	614.4225 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2844.1293	0.2100	597.2672 (264)
Space and water heating			1211.6896 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	206.7912	0.1443	29.8464 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-712.2168	0.1341	-95.4741
PV Unit electricity exported	-820.0359	0.1256	-102.9967
Total			-198.4708 (269)
Total CO2, kg/year			1054.9944 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.3400 (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	2925.8212	1.1300	3306.1780 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2844.1293	1.1300	3213.8661 (278)
Space and water heating			6520.0441 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	206.7912	1.5338	317.1832 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-712.2168	1.4954	-1065.0515
PV Unit electricity exported	-820.0359	0.4610	-378.0570
Total			-1443.1085 (283)
Total Primary energy kWh/year			5524.2196 (286)
Target Primary Energy Rate (TPER)			59.4000 (287)

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Plot Reference	L02_flat 5 (new build)			Issued on Date	10/08/2026
Assessment Reference	Be Lean	Plot Type Ref	L02_2B3P		
Plot Address	22, Palace Road, London, N11 2PS			SAP Version	10.2
SAP Rating	85 B	DER	12.38	TER	11.53
Environmental	89 B	% DER < TER			-7.37
CO ₂ Emissions (t/year)	1.02	DFEE	36.19	TFEE	36.49
Compliance Check	See BREL	% DFEE < TFEE			0.82
% DPER < TPER	-16.09	DPER	70.15	TPER	60.43
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 (m ²)	Storey height (m)	Volume (m ³)
Main dwelling			
Ground floor	93.0000 (1b)	2.5000 (2b)	232.5000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	232.5000 (5)

2. Ventilation rate

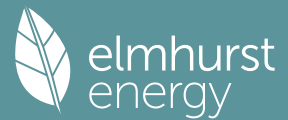
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
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)
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) =												80.1000 (23c)
Effective ac	0.2907	0.2870	0.2833	0.2645	0.2607	0.2420	0.2420	0.2382	0.2495	0.2607	0.2682	0.2757 (25)

3. Heat losses and heat loss parameter

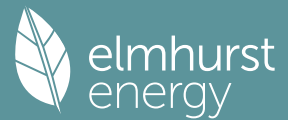
Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Main dwelling							
Window			28.3100	0.9615	27.2212		(27)
Rooflight			2.9600	0.9615	2.8462		(27a)
External Wall 1	83.6000	28.3100	55.2900	0.1800	9.9522	110.0000	6081.9000 (29a)
External Roof 1	93.0000	2.9600	90.0400	0.1200	10.8048	9.0000	810.3600 (30)
Total net area of external elements Aum(A, m ²)			176.6000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	50.8243	(33)
Main dwelling							
Party Floor 1			93.0000			40.0000	3720.0000 (32d)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10612.2600 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							114.1103 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E7 Party floor between dwellings (in blocks of flats)				17.1000	0.0700	1.1970	
E14 Flat roof				38.4700	0.0800	3.0776	

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E16 Corner (normal)						10.0000	0.0900	0.9000				
E18 Party wall between dwellings						5.0000	0.0600	0.3000				
R1 Head of roof window						3.2000	0.0800	0.2560				
R2 Sill of roof window						3.2000	0.0600	0.1920				
R3 Jamb of roof window						3.6000	0.0800	0.2880				
P4 Party wall - Roof (insulation at ceiling level)						11.5000	0.1200	1.3800				
E2 Other lintels (including other steel lintels)						12.1000	0.2000	2.4200				
E3 Sill						12.1000	0.0400	0.4840				
E4 Jamb						21.6800	0.0500	1.0840				
Thermal bridges (Sum(L x Psi) calculated using Appendix K)											11.5786	(36)
Point Thermal Bridges											0.0000	
Total fabric heat loss											(33) + (36) + (36a) =	62.4029 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	22.3078	22.0201	21.7324	20.2938	20.0060	18.5674	18.5674	18.2797	19.1429	20.0060	20.5815	21.1569 (38)
Average = Sum(39)m / 12 =	84.7107	84.4230	84.1353	82.6967	82.4090	80.9704	80.9704	80.6826	81.5458	82.4090	82.9844	83.5598 (39)
												82.6247
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.9109	0.9078	0.9047	0.8892	0.8861	0.8706	0.8706	0.8676	0.8768	0.8861	0.8923	0.8985 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31
												0.8884
												31
4. Water heating energy requirements (kWh/year)												
Assumed occupancy												2.6646 (42)
Hot water usage for mixer showers												
	68.8963	67.8609	66.3522	63.4655	61.3351	58.9594	57.6091	59.1064	60.7477	63.2985	66.2473	68.6323 (42a)
Hot water usage for baths												
	29.7509	29.3090	28.6868	27.5396	26.6806	25.7280	25.2135	25.8314	26.5041	27.5233	28.6942	29.6503 (42b)
Hot water usage for other uses												
	41.9181	40.3938	38.8695	37.3453	35.8210	34.2967	34.2967	35.8210	37.3453	38.8695	40.3938	41.9181 (42c)
Average daily hot water use (litres/day)												129.2112 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	140.5653	137.5638	133.9086	128.3503	123.8366	118.9841	117.1192	120.7587	124.5971	129.6914	135.3353	140.2008 (44)
Energy conte	222.6211	195.8890	205.8125	175.7052	166.7079	146.3048	141.6456	149.5245	153.6407	175.9900	192.8100	219.5205 (45)
Energy content (annual)										Total = Sum(45)m =		2146.1718
Distribution loss (46)m = 0.15 x (45)m												
	33.3932	29.3834	30.8719	26.3558	25.0062	21.9457	21.2468	22.4287	23.0461	26.3985	28.9215	32.9281 (46)
Water storage loss (or HIU loss):												
Store volume												200.0000 (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												
	292.3091	258.8330	275.5005	243.1452	236.3959	213.7448	211.3336	219.2125	221.0807	245.6780	260.2500	289.2085 (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												
	292.3091	258.8330	275.5005	243.1452	236.3959	213.7448	211.3336	219.2125	221.0807	245.6780	260.2500	289.2085 (64)
12Total per year (kWh/year)										Total per year (kWh/year) = Sum(64)m =		2966.6918 (64)
Electric shower(s)												2967 (64)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												
Heat gains from water heating, kWh/month												
	129.7719	115.4883	124.1830	112.3740	111.1808	102.5984	102.8475	105.4673	105.0375	114.2671	118.0613	128.7410 (65)
5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299	133.2299 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	123.3171	136.5297	123.3171	127.4277	123.3171	127.4277	123.3171	123.3171	127.4277	123.3171	127.4277	123.3171 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	244.4900	247.0270	240.6338	227.0233	209.8424	193.6949	182.9074	180.3703	186.7636	200.3741	217.5549	233.7024 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230	36.3230 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839	-106.5839 (71)
Water heating gains (Table 5)												
	174.4246	171.8576	166.9127	156.0750	149.4365	142.4977	138.2360	141.7571	145.8854	153.5848	163.9740	173.0389 (72)
Total internal gains												
	605.2007	618.3832	593.8325	573.4948	545.5651	526.5893	507.4294	508.4135	523.0457	540.2450	571.9256	593.0274 (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	
Southeast			16.6500		36.7938		0.4000		0.8000		0.7700	135.8540 (77)
Northwest			11.6600		11.2829		0.4000		0.8000		0.7700	29.1745 (81)
Northwest			2.9600		26.0000		0.4000		0.8000		1.0000	22.1645 (82)
Solar gains	187.1930	336.8292	505.4569	695.9004	839.2952	858.5513	817.2688	707.0738	571.2468	384.5946	227.5628	157.9902 (83)

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Total gains 792.3937 955.2124 1099.2894 1269.3952 1384.8603 1385.1406 1324.6982 1215.4873 1094.2924 924.8395 799.4883 751.0177 (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	34.7990	34.9176	35.0370	35.6465	35.7710	36.4065	36.4065	36.5364	36.1496	35.7710	35.5229	35.2783
alpha	3.3199	3.3278	3.3358	3.3764	3.3847	3.4271	3.4271	3.4358	3.4100	3.3847	3.3682	3.3519
util living area	0.9301	0.8826	0.8077	0.6727	0.5174	0.3660	0.2668	0.3017	0.4869	0.7417	0.8882	0.9388 (86)
MIT	19.5170	19.8693	20.2718	20.6767	20.8898	20.9749	20.9936	20.9902	20.9338	20.6224	20.0234	19.4644 (87)
Th 2	20.1583	20.1609	20.1635	20.1767	20.1793	20.1925	20.1925	20.1952	20.1872	20.1793	20.1740	20.1688 (88)
util rest of house	0.9208	0.8684	0.7863	0.6417	0.4786	0.3221	0.2186	0.2503	0.4364	0.7075	0.8723	0.9306 (89)
MIT 2	18.4350	18.8711	19.3608	19.8430	20.0774	20.1736	20.1889	20.1894	20.1336	19.7966	19.0787	18.3769 (90)
Living area fraction	fLA = Living area / (4) = 0.3194 (91)											
MIT	18.7805	19.1899	19.6517	20.1092	20.3369	20.4295	20.4459	20.4452	20.3891	20.0603	19.3804	18.7242 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.7805	19.1899	19.6517	20.1092	20.3369	20.4295	20.4459	20.4452	20.3891	20.0603	19.3804	18.7242 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9022	0.8494	0.7719	0.6391	0.4862	0.3351	0.2338	0.2664	0.4492	0.7021	0.8544	0.9129 (94)
Useful gains	714.9100	811.4010	848.5188	811.2204	673.3239	464.1739	309.7336	323.7610	491.5402	649.3548	683.0949	685.6230 (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	1226.6549	1206.3933	1106.5248	926.9651	711.7546	472.0155	311.4036	326.3747	512.8528	779.6140	1019.0808	1213.6389 (97)
Space heating kWh	380.7382	265.4348	191.9565	83.3362	28.5924	0.0000	0.0000	0.0000	0.0000	96.9129	241.9098	392.8439 (98a)
Space heating requirement - total per year (kWh/year)	1681.7246											
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	380.7382	265.4348	191.9565	83.3362	28.5924	0.0000	0.0000	0.0000	0.0000	96.9129	241.9098	392.8439 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	1681.7246											
Space heating per m2	(98c) / (4) = 18.0831 (99)											

9b. Energy requirements

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

0.0000 (301)
1.0000 (302)
1.0000 (303a)
1.0000 (305)
1.0000 (305a)
1.0000 (306)
0.0000 (208)

Space heating:

Space heating requirement	380.7382	265.4348	191.9565	83.3362	28.5924	0.0000	0.0000	0.0000	0.0000	96.9129	241.9098	392.8439 (98)
Space heat from Boilers = (98) x 1.00 x 1.00 x 1.00	380.7382	265.4348	191.9565	83.3362	28.5924	0.0000	0.0000	0.0000	0.0000	96.9129	241.9098	392.8439
307a	380.7382	265.4348	191.9565	83.3362	28.5924	0.0000	0.0000	0.0000	0.0000	96.9129	241.9098	392.8439
Space heating requirement	380.7382	265.4348	191.9565	83.3362	28.5924	0.0000	0.0000	0.0000	0.0000	96.9129	241.9098	392.8439 (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
292.3091 258.8330 275.5005 243.1452 236.3959 213.7448 211.3336 219.2125 221.0807 245.6780 260.2500 289.2085 (64)

Water heat from Boilers = (64) x 1.00 x 1.00 x 1.00

310a 292.3091 258.8330 275.5005 243.1452 236.3959 213.7448 211.3336 219.2125 221.0807 245.6780 260.2500 289.2085

Water heating fuel 292.3091 258.8330 275.5005 243.1452 236.3959 213.7448 211.3336 219.2125 221.0807 245.6780 260.2500 289.2085 (310)

Cooling System Energy Efficiency Ratio 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 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 15.6349 14.1219 15.6349 15.1306 15.6349 15.1306 15.6349 15.6349 15.1306 15.6349 15.1306 15.6349 (331)

Lighting 24.6336 19.7620 17.7935 13.0363 10.0696 8.2269 9.1858 11.9401 15.5090 20.3486 22.9837 25.3183 (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 1681.7246 (307)

Space heating fuel - secondary 0.0000 (309)

Water heating fuel - community heating 2966.6918 (310)

Efficiency of water heater 0.0000 (311)

Electricity used for heat distribution 16.8172 (313)

Space cooling fuel 0.0000 (321)

Electricity for pumps and fans:

(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 0.6490)

mechanical ventilation fans (SFP = 0.6490) 184.0889 (330a)

Total electricity for the above, kWh/year 184.0889 (331)

Electricity for lighting (calculated in Appendix L) 198.8074 (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)

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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	5031.3126 (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	5193.7614	0.2100	394.5946 (367)
Electrical energy for heat distribution (space & water)	16.8172	0.0000	6.8100 (372)
Overall CO2 factor for heat network			0.2361 (386)
Total CO2 associated with community systems			1097.4999 (373)
Space and water heating			1097.4999 (376)
Pumps, fans and electric keep-hot	184.0889	0.1387	25.5354 (378)
Energy for lighting	198.8074	0.1443	28.6940 (379)
Total CO2, kg/year			1151.7293 (383)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			12.3800 (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	5193.7614	1.1300	2123.2948 (467)
Electrical energy for heat distribution (space & water)	16.8172	0.0000	71.6762 (472)
Overall CO2 factor for heat network			1.2780 (486)
Total CO2 associated with community systems			5940.6265 (473)
Space and water heating			5940.6265 (476)
Pumps, fans and electric keep-hot	184.0889	1.5128	278.4896 (478)
Energy for lighting	198.8074	1.5338	304.9374 (479)
Total Primary energy kWh/year			6524.0535 (483)
Dwelling Primary energy Rate (DPER)			70.1500 (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)
Main dwelling	93.0000 (1b)	x 2.5000 (2b)	= 232.5000 (1b) - (3b)
Ground floor			
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 232.5000 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	3 * 10 = 30.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

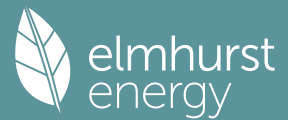
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour
Pressure test		30.0000 / (5) = 0.1290 (8)
Pressure Test Method		Yes
Measured/design AP50		Blower Door
Infiltration rate		5.0000 (17)
Number of sides sheltered		0.3790 (18)
		0 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3790 (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	0.4833	0.4738	0.4643	0.4169	0.4075	0.3601	0.3601	0.3506	0.3790	0.4075	0.4264	0.4454 (22b)
Effective ac	0.6168	0.6122	0.6078	0.5869	0.5830	0.5648	0.5648	0.5615	0.5718	0.5830	0.5909	0.5992 (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
Main dwelling							
TER Opening Type			21.0500	1.1450	24.1031		(27)
TER Roof Light			2.2000	1.5918	4.4485		(27a)

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External Wall 1	83.6000	21.0500	62.5500	0.1800	11.2590	(29a)
External Roof 1	93.0000	2.2000	90.8000	0.1100	9.9880	(30)
Total net area of external elements Aum(A, m2)			176.6000			(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	49.7986		(33)

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

114.1103 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E7 Party floor between dwellings (in blocks of flats)	17.1000	0.0700	1.1970
E14 Flat roof	38.4700	0.0800	3.0776
E16 Corner (normal)	10.0000	0.0900	0.9000
E18 Party wall between dwellings	5.0000	0.0600	0.3000
R1 Head of roof window	3.2000	0.0800	0.2560
R2 Sill of roof window	3.2000	0.0600	0.1920
R3 Jamb of roof window	3.6000	0.0800	0.2880
P4 Party wall - Roof (insulation at ceiling level)	11.5000	0.1200	1.3800
E2 Other lintels (including other steel lintels)	12.1000	0.0500	0.6050
E3 Sill	12.1000	0.0500	0.6050
E4 Jamb	21.6800	0.0500	1.0840

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

9.8846 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 59.6832 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.3219	46.9740	46.6330	45.0313	44.7316	43.3365	43.3365	43.0782	43.8739	44.7316	45.3378	45.9716	(38)
Heat transfer coeff	107.0051	106.6572	106.3162	104.7144	104.4148	103.0197	103.0197	102.7613	103.5570	104.4148	105.0210	105.6548	(39)
Average = Sum(39)m / 12 =												104.7130	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1506	1.1469	1.1432	1.1260	1.1227	1.1077	1.1077	1.1050	1.1135	1.1227	1.1293	1.1361	(40)
HLP (average)												1.1259	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy

2.6646 (42)

Hot water usage for mixer showers

68.8963 67.8609 66.3522 63.4655 61.3351 58.9594 57.6091 59.1064 60.7477 63.2985 66.2473 68.6323 (42a)

Hot water usage for baths

29.7509 29.3090 28.6868 27.5396 26.6806 25.7280 25.2135 25.8314 26.5041 27.5233 28.6942 29.6503 (42b)

Hot water usage for other uses

41.9181 40.3938 38.8695 37.3453 35.8210 34.2967 34.2967 35.8210 37.3453 38.8695 40.3938 41.9181 (42c)

Average daily hot water use (litres/day)

129.2112 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	140.5653	137.5638	133.9086	128.3503	123.8366	118.9841	117.1192	120.7587	124.5971	129.6914	135.3353	140.2008	(44)
Energy conte	222.6211	195.8890	205.8125	175.7052	166.7079	146.3048	141.6456	149.5245	153.6407	175.9900	192.8100	219.5205	(45)
Energy content (annual)										Total = Sum(45)m =		2146.1718	

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

33.3932 29.3834 30.8719 26.3558 25.0062 21.9457 21.2468 22.4287 23.0461 26.3985 28.9215 32.9281 (46)

Water storage loss (or HIU loss):

Store volume

200.0000 (47)

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

Temperature factor from Table 2b

1.6525 (48)

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

0.5400 (49)

Total storage loss

0.8924 (55)

27.6637 24.9865 27.6637 26.7713 27.6637 26.7713 27.6637 27.6637 26.7713 27.6637 26.7713 27.6637 (56)

If cylinder contains dedicated solar storage

27.6637 24.9865 27.6637 26.7713 27.6637 26.7713 27.6637 27.6637 26.7713 27.6637 26.7713 27.6637 (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

273.5472 241.8868 256.7385 224.9885 217.6340 195.5881 192.5716 200.4506 202.9240 226.9161 242.0933 270.4466 (62)

WWHRS -31.4965 -27.8558 -29.1690 -24.1531 -22.5098 -19.2618 -18.0548 -19.1995 -19.9290 -23.4941 -26.6159 -30.9132 (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 (64)

Output from w/h 242.0507 214.0310 227.5696 200.8354 195.1242 176.3264 174.5168 181.2511 182.9950 203.4221 215.4773 239.5334 (64)

Total per year (kWh/year) = Sum(64)m = 2453.1328 (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 114.7624 101.9313 109.1735 97.8486 96.1712 88.0730 87.8380 90.4578 90.5122 99.2575 103.5359 113.7314 (65)

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

Metabolic gains (Table 5), Watts

(66)m 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 133.2299 (66)

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

123.3171 136.5297 123.3171 127.4277 123.3171 127.4277 123.3171 123.3171 127.4277 123.3171 127.4277 123.3171 (67)

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

244.4900 247.0270 240.6338 227.0233 209.8424 193.6949 182.9074 180.3703 186.7636 200.3741 217.5549 233.7024 (68)

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

36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 36.3230 (69)

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

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

-106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 -106.5839 (71)

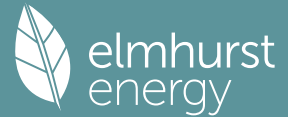
Water heating gains (Table 5)

154.2505 151.6835 146.7386 135.9008 129.2624 122.3236 118.0618 121.5830 125.7113 133.4107 143.7999 152.8648 (72)

Total internal gains 588.0266 601.2091 576.6584 556.3207 528.3909 506.4152 487.2553 488.2394 502.8716 523.0708 554.7515 575.8533 (73)

6. Solar gains

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[Jan]				Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Southeast				12.3800	36.7938		0.6300		0.7000	0.7700	139.2091 (77)
Northwest				8.6700	11.2829		0.6300		0.7000	0.7700	29.8960 (81)
Northwest				2.2000	26.0000		0.6300		0.7000	1.0000	22.7027 (82)

Solar gains	191.8077	345.1304	517.9093	713.0392	859.9626	879.6919	837.3932	724.4865	585.3180	394.0717	233.1722	161.8853 (83)
Total gains	779.8343	946.3396	1094.5677	1269.3599	1388.3535	1386.1070	1324.6485	1212.7259	1088.1896	917.1425	787.9237	737.7386 (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	27.5487	27.6385	27.7272	28.1513	28.2321	28.6144	28.6144	28.6864	28.4660	28.2321	28.0691	27.9008	
alpha	2.8366	2.8426	2.8485	2.8768	2.8821	2.9076	2.9076	2.9124	2.8977	2.8821	2.8713	2.8601	
util living area	0.9440	0.9082	0.8507	0.7414	0.5994	0.4453	0.3321	0.3741	0.5739	0.8014	0.9137	0.9509 (86)	
MIT	18.8766	19.2646	19.7636	20.3361	20.7170	20.9136	20.9726	20.9610	20.8160	20.2845	19.4947	18.8206 (87)	
Th 2	19.9597	19.9628	19.9657	19.9797	19.9823	19.9945	19.9945	19.9968	19.9898	19.9823	19.9770	19.9715 (88)	
util rest of house	0.9355	0.8950	0.8299	0.7078	0.5515	0.3836	0.2599	0.2981	0.5091	0.7664	0.8990	0.9434 (89)	
MIT 2	17.5064	17.9907	18.6056	19.2956	19.7230	19.9314	19.9804	19.9753	19.8430	19.2581	18.2957	17.4435 (90)	
Living area fraction										FLA = Living area / (4) =			0.3194 (91)
MIT	17.9440	18.3975	18.9754	19.6279	20.0404	20.2451	20.2972	20.2901	20.1537	19.5859	18.6786	17.8833 (92)	
Temperature adjustment												0.0000	
adjusted MIT	17.9440	18.3975	18.9754	19.6279	20.0404	20.2451	20.2972	20.2901	20.1537	19.5859	18.6786	17.8833 (93)	

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9135	0.8701	0.8065	0.6952	0.5544	0.3994	0.2820	0.3208	0.5202	0.7508	0.8755	0.9227 (94)
Useful gains	712.4156	823.4250	882.7404	882.4062	769.6729	553.6005	373.5925	389.0353	566.0562	688.5903	689.8445	680.7462 (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	1459.9746	1439.6095	1326.3359	1123.3668	870.8630	581.5514	380.8868	399.7526	626.9077	938.2616	1215.9952	1445.7085 (97)
Space heating kWh	556.1838	414.0760	330.0351	173.4916	75.2854	0.0000	0.0000	0.0000	0.0000	185.7555	378.8286	569.1320 (98a)
Space heating requirement - total per year (kWh/year)												2682.7879
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	556.1838	414.0760	330.0351	173.4916	75.2854	0.0000	0.0000	0.0000	0.0000	185.7555	378.8286	569.1320 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2682.7879
Space heating per m2										(98c) / (4) =		28.8472 (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	556.1838	414.0760	330.0351	173.4916	75.2854	0.0000	0.0000	0.0000	0.0000	185.7555	378.8286	569.1320 (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)	602.5827	448.6197	357.5678	187.9649	81.5660	0.0000	0.0000	0.0000	0.0000	201.2519	410.4318	616.6110 (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	242.0507	214.0310	227.5696	200.8354	195.1242	176.3264	174.5168	181.2511	182.9950	203.4221	215.4773	239.5334 (64)
Efficiency of water heater (217)m	85.8635	85.5136	84.8925	83.7333	82.1171	79.8000	79.8000	79.8000	79.8000	83.8566	85.3115	85.9294 (217)
Fuel for water heating, kWh/month	281.9016	250.2888	268.0679	239.8513	237.6169	220.9603	218.6927	227.1317	229.3170	242.5833	252.5771	278.7561 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	25.6229	20.5556	18.5080	13.5598	10.4740	8.5573	9.5547	12.4196	16.1318	21.1658	23.9067	26.3350 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-31.1292	-45.0374	-66.4116	-76.6558	-84.3487	-79.3176	-78.3151	-73.0849	-64.1622	-52.3574	-34.6191	-26.7780 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-14.2609	-30.3250	-60.8865	-92.3572	-123.0210	-123.9597	-122.5305	-103.3603	-75.2319	-43.7016	-19.1459	-11.2553 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2906.5958 (211)

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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	2947.7448	(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)	206.7912	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1532.2527	(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	4614.8791	(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	2906.5958	0.2100	610.3851 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2947.7448	0.2100	619.0264 (264)
Space and water heating			1229.4115 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	206.7912	0.1443	29.8464 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-712.2168	0.1341	-95.4741
PV Unit electricity exported	-820.0359	0.1256	-102.9967
Total			-198.4708 (269)
Total CO2, kg/year			1072.7163 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.5300 (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	2906.5958	1.1300	3284.4532 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2947.7448	1.1300	3330.9516 (278)
Space and water heating			6615.4048 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	206.7912	1.5338	317.1832 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-712.2168	1.4954	-1065.0515
PV Unit electricity exported	-820.0359	0.4610	-378.0570
Total			-1443.1085 (283)
Total Primary energy kWh/year			5619.5804 (286)
Target Primary Energy Rate (TPER)			60.4300 (287)