Sustainability and Energy Strategy

Darwin Court
Prepared for Airspace Group Ltd
January 2024

envision

Revision	Date
A	17th January 2024

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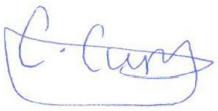
Charlie Curry OCDEA	
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EXECUTIVE SUMMARY

1. This Sustainability and Energy Statement, has been prepared by Envision on behalf of Airspace Group Ltd and is submitted in support of a full planning application for the construction of a single-storey roof extension to the properties comprising Darwin Court, to provide residential units together with a range of upgrades to the existing buildings including accessibility enhancements, fire safety upgrades, waste and refuse store enhancements, landscaping, and other works.

2. The primary purpose of this document is to explain how the scheme can meet the London Plan's and the London Borough of Camden's sustainability policies. Envision has undertaken a review of the relevant policies and worked with the design team to determine and agree the relevance and approach that should be taken to fulfil each policy.

Summary of Sustainability Strategy

3. The scheme will deliver a series of sustainability measures which are compatible with both the London Plan and the London Borough of Camden's requirements for sustainable design and construction:

- Sustainable material selections with timber to be procured with Forest Stewardship Council accreditation and the main contractor to adopt best practice measures to reduce water and energy use through construction;
- The development of a Site Waste Management Plan to ensure waste generation is minimised during construction;
- No car parking and cycle storage to promote sustainable modes of transport, has been incorporated.
- Development of a sustainable procurement plan by the contractor to maximise the environmental performance of chosen materials; and
- Water conservation measures within the units to comply with 105 litres / bedspace per day.

Summary of Energy Strategy

4. In line with the policy CC1, the applicant has sought to make the fullest contribution to minimising CO_2 emissions whilst following the London Plan Energy Hierarchy.

5. Envision has produced Part L1 2021 compliant SAP models in order to determine the energy and CO_2 emissions for the proposed development. These have been calculated using Elmhurst 10.2 Software with detailed calculations provided in the Appendix. This is in line with the *'Part L 2021 and the Energy Assessment Guidance 2022'*.

6. Policy CC1 requires all developments to follow the energy hierarchy to reduce carbon emissions through the specification of highly efficient fabric and renewable energy. In this development carbon savings will be made through the following:

- This will be achieved through the incorporation of passive design measures, and efficient fabric including triple-glazed windows.
- Reduced Air Permeability, lower than standard Buildings Regulations;
- High efficiency LED throughout the development;
- Efficient, electric systems have been specified including highly efficient heat pump systems for the heating and hot water and a PV array.

Carbon Savings Predicted

7. As seen in the table below, the new residential aspect of the development reduces CO_2 emissions by 5.23 tonnes.CO_2.year, equal to a 73.13% saving beyond the Part L Target. The development also demonstrates a 39.83% saving from the inclusion of renewable energy, therefore complying with Camden's Local Policy.

Table A.1 – Final CO_2 Reductions Chart

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021 of the Building Regulations Compliant Development	7.16	3.09
After energy demand reduction	4.77	3.09
After heat network / CHP	4.77	n/a
After renewable energy	1.92	3.09

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	(%)
Savings from energy demand reduction	2.38	33.30%
Savings from renewable energy	2.85	39.83%
Cumulative on-site savings	5.23	73.13%

1 INTRODUCTION

1.1 Envision has been appointed by Airspace Group Ltd to produce a Sustainability and Energy Statement in support of a full planning application for the construction of a single-storey roof extension to the properties comprising Darwin Court, to provide residential units together with a range of upgrades to the existing buildings including accessibility enhancements, fire safety upgrades, waste and refuse store enhancements, landscaping, and other works.

Scope

1.2 The primary purpose of this statement is to explain how best practice sustainable design and construction measures would be incorporated in the proposed development to ensure alignment with local planning policy.

1.3 Section 4 (Energy Assessment) sets the parameters of detailed design, but remains at a strategic level. The calculations in this document are an indication of system size and carbon emissions based on guidance documents, approved software and practical experience. They are not design calculations but establish the viability and feasibility of various technologies for the proposed development.

1.4 This statement is structured as follows:

- The remainder of this section provides a description of the site and the development proposals;
- Section 2 provides a description of the main sustainability and energy policies relevant to the application;
- Section 3 details the sustainable design measures incorporated into the design;
- Section 4 includes the Energy Statement, including measures proposed to reduce energy demand and carbon dioxide in operation;
- Section 5 provides a concluding summary.

Site Location and Existing Situation

1.5 Darwin Court, located at 2-24 Gloucester Avenue, comprises 5 x flat roofed apartment buildings constructed in the 1970s. The buildings are constructed in a linear form and are set within large plots with areas of soft landscaping.

1.6 The buildings contribute to the varied character of Gloucester Road, which includes a range of buildings with varying heights, age and architectural style.

1.7 The site is located within the Primrose Hill Conservation Area. None of the buildings are statutory listed, and the buildings are noted as making a negative contribution to the character and appearance of the Conservation Area.

Figure 1.1 – Site Location

The Proposed Development

1.8 The proposed development would seek the construction of a single-storey roof extension to each of the five existing buildings to provide eight self-contained residential dwellings (6 x two-bedroom units and 2x three-bedroom units). The proposal would also deliver improvements to the existing entrances to the buildings.

1.9 The proposed development provides an opportunity to optimise an existing residential building and provide significant upgrades to the existing building to benefit existing residents.

Figure 1.2 – Proposed Site Layout – 8th Floor

2 SUSTAINABILITY & ENERGY POLICY CONTEXT

2.1 Many definitions of sustainable development exist, although the common objective for all is the integration of economic, social and environmental issues to ensure a better quality of life for people today, without compromising the needs of future generations. A key mechanism for delivering the principles of sustainable development lies within the UK planning system, which is implemented through national guidance and local planning policies. A review of all the relevant policy, regulatory and energy guidance documents was undertaken to gain an understanding of the guiding requirements for sustainability.

National Planning Policy Framework

2.2 The revised National Planning Policy Framework (NPPF) was released on 20th July 2021. This replaces the previous National Planning Policy Framework published in March 2012, revised in July 2018 and updated in February 2019. It sets out the framework for all planning policy in England and how these policies are expected to be applied. At a very high level, the objective of sustainable development can be summarised as meeting the needs of the present without compromising the ability of future generations to meet their own needs. At a similarly high level, members of the United Nations – including the United Kingdom – have agreed to pursue the 17 Global Goals for Sustainable Development in the period to 2030. These address social progress, economic well-being and environmental protection.

2.3 The NPPF sets out a presumption in favour of sustainable development, and the need to support economic growth through the planning system. Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

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.

2.4 Planning plays a key role in helping shape places to radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure.

This is central to the economic, social and environmental dimensions of sustainable development. The NPPF does not include detailed measures on sustainable design codes and standards to apply, although expects that when setting any local requirement for a building's sustainability, local planning authorities should do so in a way consistent with the national technical standards.

London Plan Policy

2.5 The London Plan (2021) sets out the Mayor's vision for London. In accordance with the NPPF, it promotes economic development, and endorses the principles of sustainable development. It is the main vehicle for strategic decision-making on London's development, including development decisions. The Plan contains a number of policies directly related to a development's sustainable design and energy reduction, including:

- Policy G1 Green Infrastructure;
- Policy G5 Urban Greening;
- Policy G 6 Biodiversity and Access to Nature;
- Policy SI 1 Improving Air Quality;
- Policy SI 2 Minimising greenhouse gas emissions;
- Policy SI 3 Energy Infrastructure;
- Policy SI 4 Managing heat risk;
- Policy SI 7 Reducing Waste and supporting the circular economy;
- Policy SI 12 Flood Risk Management;
- Policy SI 13 Sustainable Drainage; and
- Policy T 5 Cycling.
- Policy T6.1 Residential Parking.

2.6 Of particular importance to the CO_2 and Energy reductions required for a development is *Policy SI-2: Minimising carbon dioxide emissions.*

2.7 Policy SI2 requires that development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

a. Be Lean: use less energy and manage demand during operation;

b. Be Clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly; and

c. Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.

London Borough of Camden

2.8 The Council aims to tackle the causes of climate change in the borough by ensuring developments meet the highest feasible environmental standards.

2.9 The London Borough of Camden's Local Plan Policy CC1 Climate Change Mitigation states that developments should be meeting the following requirements:

CE1: The Council recognises the Government's targets to reduce national carbon dioxide emissions by 34 per cent against 1990 levels by 2020 in order to meet a 80 per cent reduction by 2050 and will require development to make a significant contribution towards this target.

2.10 To deliver this the Council will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.

2.11 Camden's local plan also states that developments over 5 units are expected to demonstrate a 20% reduction in carbon emissions from onsite renewables.

2.12 The development will follow the energy hierarchy, as per the London plan, ensuring savings are achieved at each of these stages. The proposal is not classed as a major development so any Policies referring to major developments do not apply.

GLA Guidance on Preparing Energy Assessments

2.13 The GLA guidance on preparing energy assessments (2022) provides a detailed methodology on how to demonstrate a reduction in CO_2 emissions for new development. The new guidance explains how London Plan policies apply now that Part L 2021 has taken effect, and the updates made to the GLA's carbon emissions reporting spreadsheet and how to determine the CO2 emissions baseline under Part L 2021.

2.14 This explains the updates made to the GLA's carbon emissions reporting spreadsheet and how to determine the CO_2 emissions baseline under Part L 2021. This guidance document explains how to prepare an energy assessment to accompany strategic planning applications referred to the Mayor. Although primarily aimed at strategic planning applications, London boroughs are encouraged to apply the same structure for energy assessments related to non-referable applications and adapt it for relevant scales of development.

2.15 Applicant's in London must continue to meet the London Plan net zero carbon target by following the energy hierarchy (Policy SI 2), the heating hierarchy (Policy SI 3) and by maximising on-site carbon reductions. Planning applicants will be expected to demonstrate that at each stage of the energy hierarchy they have maximised opportunities for carbon reduction to achieve as close to zero as possible. An on-site carbon reduction of at least 35 per cent beyond Part L 2021 of building regulations should be achieved. Once it has been demonstrated that carbon reductions have been maximised, any remaining emissions to zero should be offset by a contribution to the relevant borough's carbon offset fund.

2.16 This sustainability and energy statement draws from this guidance, in particular for the calculation of energy performance against the new building regulations.

3 SUSTAINABILITY STATEMENT

3.1 This section includes a review of the scheme against the relevant policies in section 2 and identifies a series of practical measures that would be brought forward in design and construction which contribute to the developments' sustainability.

3.2 The review is structured against the following thematic areas:

- Climate Change Mitigation;
- Climate Change Adaptation;
- Reducing Waste and Supporting a Circular Economy;
- Sustainable Transport;
- Pollution Control; and
- Sustainable Construction

Climate Change Mitigation

3.3 Climate change mitigation involves a radical reduction in carbon emissions released from the built environment. This relates to both energy use in buildings and energy embodied within the construction process.

3.4 The London Plan sets out an established energy hierarchy in Policy SI2 which is relevant to new build projects. This focuses on how new development can reduce regulated energy demands. The strategy is presented in the next section (section 4).

Climate Change Adaptation

Overheating Risks

3.5 The risk of overheating in buildings is anticipated to rise as a result of climate change. A number of passive design measures have been specified in order to reduce the risk of overheating and are discussed in the table below.

Cooling Method	Measures Employed
Minimise internal heat generation through energy efficient design	• U-values specified in excess of the Part L Building Regulations minimum targets
Reducing the amount of heat entering the building in summer	• Glazing configuration optimised to limit solar gains. The g-value of all installed glazing will be as low as economically and feasibly possible. • External Glazing has been offset into the external structure to provide further shading. • The development is surrounded by a number of tall trees which will provide external shading to the development.
Use of high ceilings to manage the heat within the building	• Floor-to-ceiling heights are maximised within the dwellings
Mechanical ventilation	• Mechanical ventilation with heat recovery has been proposed to serve all office spaces. MVHR units shall incorporate a full summertime bypass to allow for 'free cooling' when possible.

3.6 In addition the new units will be built to comply with Building Regulations Part O to ensure the risk of overheating is limited.

Water Conservation Measures

3.7 Water fittings will be specified with the following or similar flow rates to meet the target water consumption of 105 l/p/day for the development:

- Wash basin taps – 6.5 l/min
- Showers – 7.5 l/min
- Bath – 120l to overflow
- Dishwasher - 1.2 l/place setting
- Washing machine - 9 l/kg load
- WC – 6/4 litre dual flush
- Kitchen taps – 6.5 l/min

Water meters will be installed to encourage residents to limit their consumption.

Flood Risk and Sustainable Drainage

3.8 The development has been identified to be in Flood Zone 1, which has a low risk of flooding.

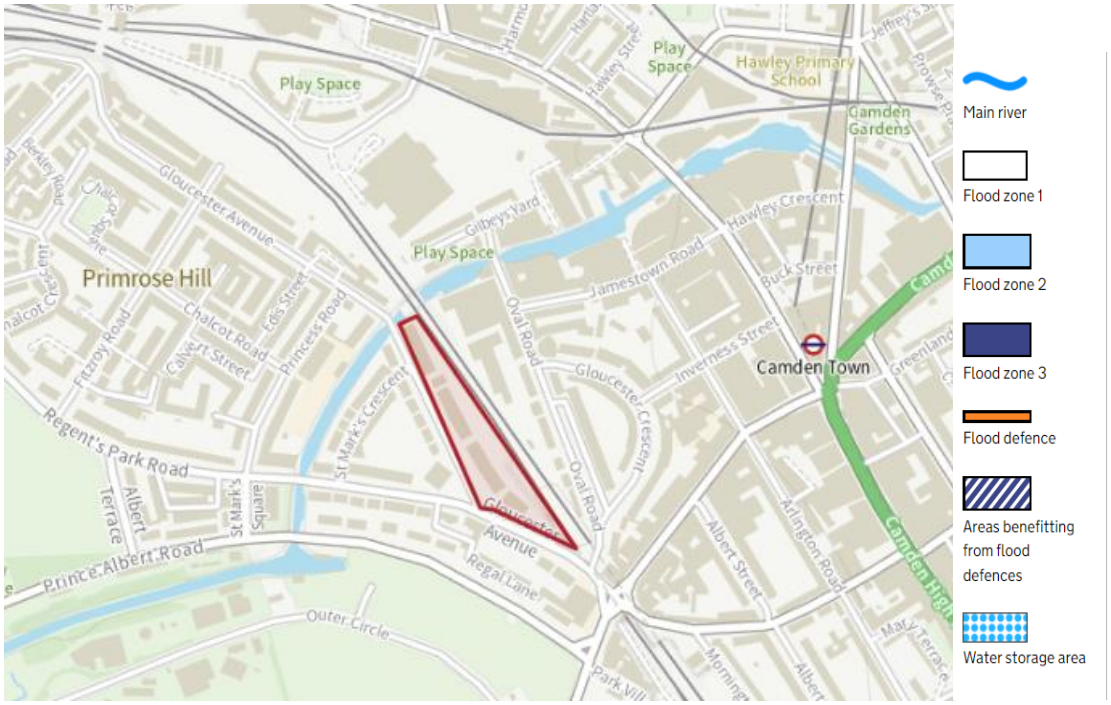

Figure 3.1 – Site Location from Environment Agency Flood Map

Reducing Waste and Supporting a Circular Economy

Sustainable Materials

3.9 Materials will be specified to reduce the embodied carbon of the development, including re-use and specifying materials with recycled content wherever possible.

3.10 Insulating materials will be specified to maximise thermal performance whilst still paying attention to the environmental impact of the materials used. If possible, materials with a high recycled content will be specified.

3.11 Responsible sourcing will also be pursued. All timber used on-site during the construction phase and within the building will be from legal sources. All timber will be FSC or equivalent responsibly sourced timber. Sourcing of other materials will include products where the manufacturer employs an environmental management system such as ISO 14001 or BES 6001, inline with the sustainable procurement plan. Where possible, materials will be sourced locally.

3.12 Non-toxic materials will be used wherever possible, including the specification of products with low VOC content in line with European testing standards.

Construction Waste Management

3.13 Consideration has been given to rationalising material use in the structure of the building, including the structural frame and envelope as part of an ongoing design optimisation exercise.

3.14 A Resource Management Plan will be developed which sets out procedures for managing waste on the site, including setting the total waste and landfill diversion targets which will be monitored throughout the build.

3.15 It is also anticipated that at least 95% by volume of construction waste and non-hazardous demolition waste will be diverted from landfill. This is in accordance with London Plan Policy SI7 of the London Plan.

Operational Waste

3.16 The buildings will have sufficient space for their own waste storage facilities. Waste will be sorted to provide storage for both general, recyclable and food waste. The bins will be labelled to provide guidance on what can be included in waste stream.

Sustainable Transport

3.17 Transport for London's (TfL) Web-based Connectivity Assessment Toolkit (WebCAT) recognises that the site has a Public Transport Accessibility Level (PTAL) rating of 5.

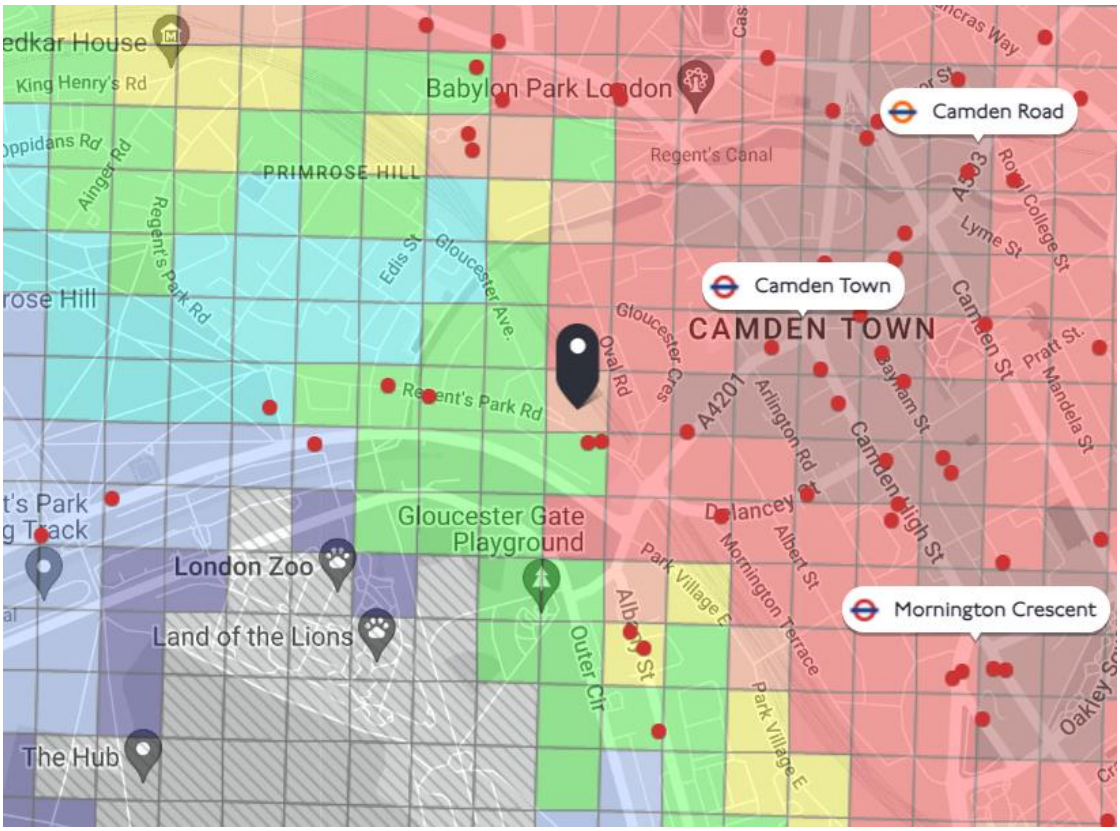

Figure 3.2 Local Public transport options and walking times

3.18 The development has a number of transport modes within a 10- minute proximity. This includes over 5 Bus stops and Camden Town Station within a 7 minute walk.

Pollution Control

3.19 Any new development can potentially lead to detrimental environmental effects; as is the nature of construction. These potential effects have been considered during the planning stages of this proposal. The development is not of the scale that would require an Environmental Impact Assessment (EIA), however the measures as outlined in this section, and subsequently implemented, will ensure that any potential impacts can be appropriately controlled.

Air Quality

3.20 The construction site will be managed in such a way that the environmental impact is minimised. This includes following best practice policies for dust pollution by using dust sheets, covering skips and damping down where appropriate.

3.21 A fully electric system has been specified, with heat pumps providing the heating and hot water system. This will result in zero NOx Emissions for the operation of the development.

Noise

3.22 The development will comply with Building Regulations Part E, providing a good level of sound insulation. All windows are to be specified as high efficiency triple glazing to minimise the transmission of noise between the property and surrounding area.

Light Pollution

3.23 All lighting will be low energy light fittings specified to have a luminous efficacy greater than 120 lm/W for residential. All external lighting will be appropriately controlled to ensure that spaces not lit during daylight hours, with PIR sensors to provide light when the area is occupied. The proposed development is in an urban location, and therefore will not significantly contribute to increasing the effects of light pollution.

Sustainable Construction

3.24 The construction phase of the development can have a significant effect on the quality of the site and its surroundings, including the local environment, neighbouring residents, surrounding employees and the general public. Sustainable construction involves the prudent use of existing and new resources, the efficient management of the construction process, and consideration of potential adverse environmental impacts on local sensitive receptors.

3.25 It is not considered that the construction phase will yield an adverse level of disturbance, particularly given the surrounding land uses, although various measures adopted by the contractor will ensure that any potential disturbance is minimised. The principal contractor will be required to deliver high standards of sustainable construction, which will be achieved through the following:

- Registering the site against the Considerate Constructors Scheme, and;

- Managing the construction site to reduce environmental effects, this will include adopting best practice measures to protect water and air quality, monitoring water and energy use from construction activities.

4 ENERGY STATEMENT

4.1 In line with the London Plan policies this energy statement will follow the following energy hierarchy to make best endeavours to reduce carbon dioxide onsite:

a. Be Lean: use less energy and manage demand during operation;
b. Be Clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly;
c. Be Green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site.

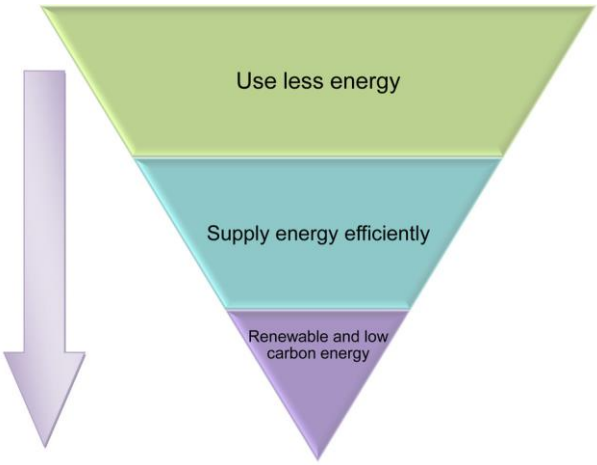

Fig 4.1 - 'Energy Hierarchy'

Methodology

4.2 Local planning validation requires that applicants should demonstrate how the energy hierarchy has been applied to make the fullest contribution to CO2 reduction in line with Policy SP6.

4.3 In accordance with NCM guidance, the appropriate methodology for calculating the energy performance of the domestic portion is "The Government's Standard Assessment Procedure for Energy Rating of Dwellings". This procedure was undertaken using Stroma FSAP 10 which is a Department of Communities and Local Government (DCLG) approved methodology and software for undertaking SAP assessments.

Establishing the Target Emission Rate (TER)

4.4 The total emissions savings calculated in this report for the new-build development is expressed against a Building Regulation Target Emission Rate. This is the Baseline against which the measures implemented must show an improvement.

4.5 The Target Emission Rates for the development have been established using The Standard Assessment Procedure for the Energy Rating of Dwellings (SAP).

4.6 The calculated carbon emissions and total energy demand for the Target Emission Rate are illustrated below for the development. The calculated figures demonstrate a Part L1 Building Regulations 2021 compliant model.

Table 4.1 – Target CO_2 emissions

Unit	Total Floor Area (m^2)	TER	Total Target CO2 (tn.CO2.yr)	TPER	Total Target Primary Energy (kWh.yr)
3 Bed Unit	*382*	**5.61**	2.14	32.34	12,353.88
2 Bed Unit (SE)	*372*	**7.17**	2.66	39.4	14,656.80
2 Bed Unit (NW)	*372*	**6.31**	2.34	34.73	12,919.56
		Total =	**7.16**		**39,930.24**

4.7 The figure of 7.15 tn.CO_2.yr the targets that must be reached and improved upon by the proposals in this Energy Assessment in order to comply with Part L Building Regulations. This will be achieved through the implementation of fabric efficiency, energy-reduction and carbon-saving measures as outlined in the ensuing sections.

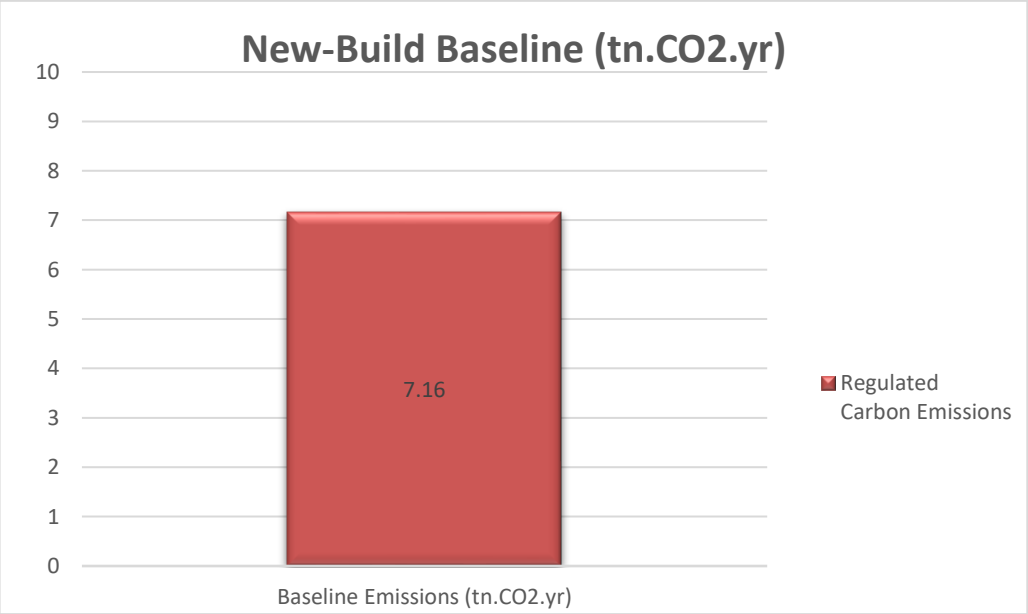

Fig 4.2 – Target CO_2 emissions

Applying the London Plan Energy Hierarchy: Stage 1 – Be Lean

4.8 The Greater London Authority seeks a 'fabric first' approach to reducing the carbon footprint of London's built environment. This is achieved through buildings using less energy by improving u-values, air-tightness and lighting efficiency amongst others. This is the first step to consider in reducing a building's carbon emissions before the efficient delivery of power, heat or renewables are considered by a design-team.

Fabric Efficiency

4.9 U-Values, are used to measure how effective elements of a buildings fabric are as insulators. That is, how effective they are at preventing heat from transmitting between the inside and the outside of a building. Very broadly, the better (i.e. lower) the U-value of a buildings fabric, the less energy is required to maintain comfortable conditions inside the building. The following U-Values are proposed for the residential aspect of the development:

Table 4.3 – Proposed U-Values

Domestic		
Elements	New Building Elements: U-Values – W/m² K	Comment
External Wall	0.13	n/a
Corridor Walls	0.15	n/a
Roof	0.11	n/a
External Windows	Triple Glazed U-Values: 0.8	Frame factor of 0.8 G-Values: 0.57
External Solid Doors	1	n/a
Thermal Bridges	Y= 0.08 To be calculated at the detailed design stage	

Air Permeability

4.10 The designed Air Permeability Rate (APR) has been set at 3 $m^3/h.m^2$ @ 50Pa for the entire development.

Lighting Strategy – Domestic

4.11 The Light fittings will be specified as LED, low-energy with local manual switching and if appropriate, occupancy sensing. The light fittings have been specified as to have a 100 lm/W efficiency.

Ventilation Strategy

4.12 The development will include mechanical ventilation with heat recovery (MVHR). This has been assumed as a MRXBOX90L MVHR system which incorporates a full summertime bypass to assist with overheating in the summer.

Space & Water Heating

4.13 In line with the 'GLA guidance on preparing Energy Assessments' methodology, a base case has been generated for the Be Lean Case, utilising a gas boiler with an efficiency of 92.3%.

Be Lean Stage CO_2 Reductions

4.14 The Part L 2021 GLA carbon emissions reporting spreadsheet has been used to collate the information and offer consistent and transparent process for presenting part L 2021 carbon emission performance. This includes an offset of the energy saving technologies applied to the notional building at Lean stage to highlight the passive design savings.

4.15 The following tables and graphs represent the Be-Lean improvements for the new-build apartments over the TER and TPER emissions.

Table 4.7 – Be-Lean Emissions – Domestic

Unit	Total Floor Area (m^2)	DER	Total CO2 (tn.CO2.yr)
3 Bed Unit	*382*	**9.99**	**1.38**
2 Bed Unit (SE)	*372*	**11.50**	**1.90**
2 Bed Unit (NW)	*372*	**10.41**	**1.49**
		Total =	**4.77**
		Difference over Baseline	2.38
		% Difference	**33.30%**

4.16 As detailed above, the measures as taken at the 'Be-Lean' stage enable the residential aspect of the development to achieve a 33.30% reduction in regulated CO_2 emissions over the Part L Target Emission Rate. This has been achieved by adopting the lowest U-Values feasible, a low air permeability rate and high performance-glazed windows.

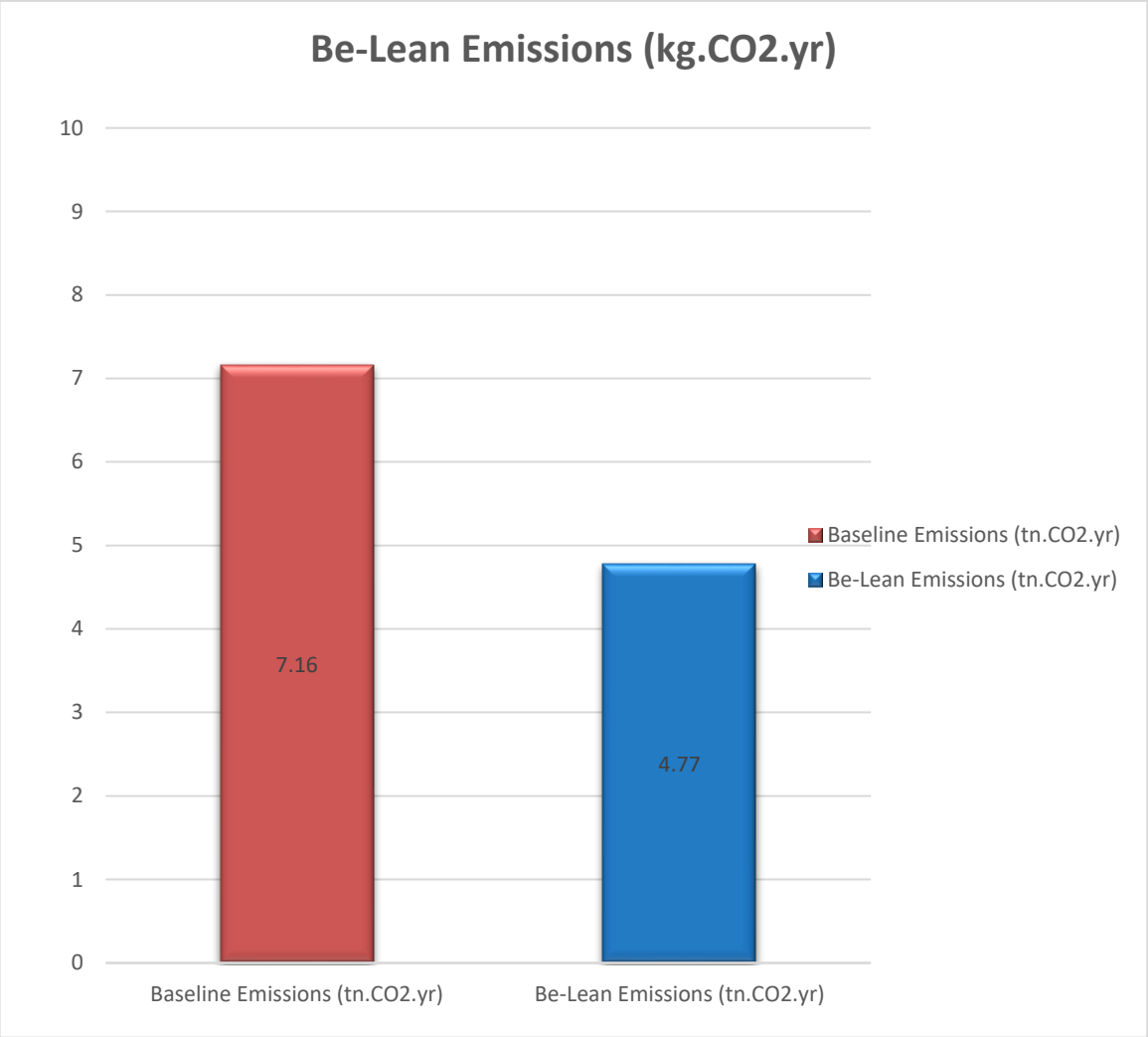

Fig 4.4 – Be-Lean Stage Reductions - Domestic

Applying the London Plan Energy Hierarchy: Stage 2 – Be Clean

4.17 As part of the Be Clean approach, the use of energy-efficient equipment, heat networks and community heating has been considered. As this development is a minor development, district heating networks and community heating systems are not viable. As a result, no savings are made at the Be Clean stage.

Applying the London Plan Energy Hierarchy: Stage 3 – Be Green

4.18 An analysis of low carbon/renewable technologies was undertaken to determine which would be suitable for application in a development of this size and nature. This determined that the renewable systems deemed to be the most suitable for the development is the use of an Air-Source Heat Pump providing renewable heating and hot water for the residential units.

Low-Carbon/Renewable Technology 1 – Domestic Air Source Heat Pump

4.19 The low-carbon/renewable energy proposed for development is an air-source heat pump (ASHP) providing space heating and hot water. ASHPs with the following specifications have been assumed:

- The modelled ASHP to provide space heating is an ECODAN 8.5 kW system for each 2 bed residential unit and a 11.2 kW for each 3 bed unit.
- The ASHP will be selected to operate on R32 which is an F-Gas compliant refrigerant;
- These units will need to be placed on the roof of the development and external access will need to be provided.

4.20 The hot water will be provided by an equivalent unit. The following system has been assumed:

- The cylinder will have a volume of 210l and a measured loss of 1.77kw/day for the 2 bed units.
- The cylinder will have a volume of 300l and a measured loss of 2.09kw/day for the 3 bed units.

Low-Carbon/Renewable Technology 2 – PV

4.21 The development will also include a PV array on the roof of each block. The following array will be linked to each of the new build units and the remainder of the arrays will be utilised to provide energy to the existing block. These units will include an export capable meter.

4.22 The total PV array on the development is 69kWp covering an area of 300m^2.

a. Block A: 60 sqm PV Area (30 panels @ 2000x1000mm

b. Block B: 60 sqm PV Area (30 panels @ 2000x1000mm)

c. Block C: 60 sqm PV Area (30 panels @ 2000x1000mm)

d. Block D: 60 sqm PV Area (30 panels @ 2000x1000mm)

e. Block E: 60 sqm PV Area (30 panels @ 2000x1000mm)

Table 4.8 – PV for new build units

Served Area	PV Area	PV Peak Power (kWp)	PV Energy Generation (kWh.annum)
3 Bed Units – Per Unit	11.6m^2	2.2	1635.81 kWh
2 Bed Units – Per Unit	10.5m^2	2	1392.71 kWh
Total PV for New Build Units	86.2m^2	16.4	11,627.88 kWh

Be-Green CO2 Reductions

4.23 The following tables and graphs represent the Be-Green improvements for the residential units of the development over the Target Emission Rate (TER) baseline emissions:

Table 4.9 –Be-Green Improvement over TER – Domestic

Unit	Total Floor Area (m²)	DER	Total CO_2 (tn.CO_2.yr)	DPER	Total Building Primary Energy (kWh.yr)
3 Bed Unit	*382*	2.21	0.84	26.39	10,080.98
2 Bed Unit (SE)	*372*	1.60	0.59	21.59	8,031.48
2 Bed Unit (NW)	*372*	1.30	0.48	18.62	6,926.64
		Total =	**1.92**		**25,039.10**
		Be-Green Savings	2.85		92033.10
		% Difference	**59.72%**		**78.61%**
		Difference over Baseline	5.23		14891.14
		% Difference	**73.13%**		**37.29%**

4.24 As detailed above, the measures as taken at this stage would result in a 73.13**%** reduction in the new-build residential regulated CO_2 emissions over the Building Regulations Part L Target Emission Rate.

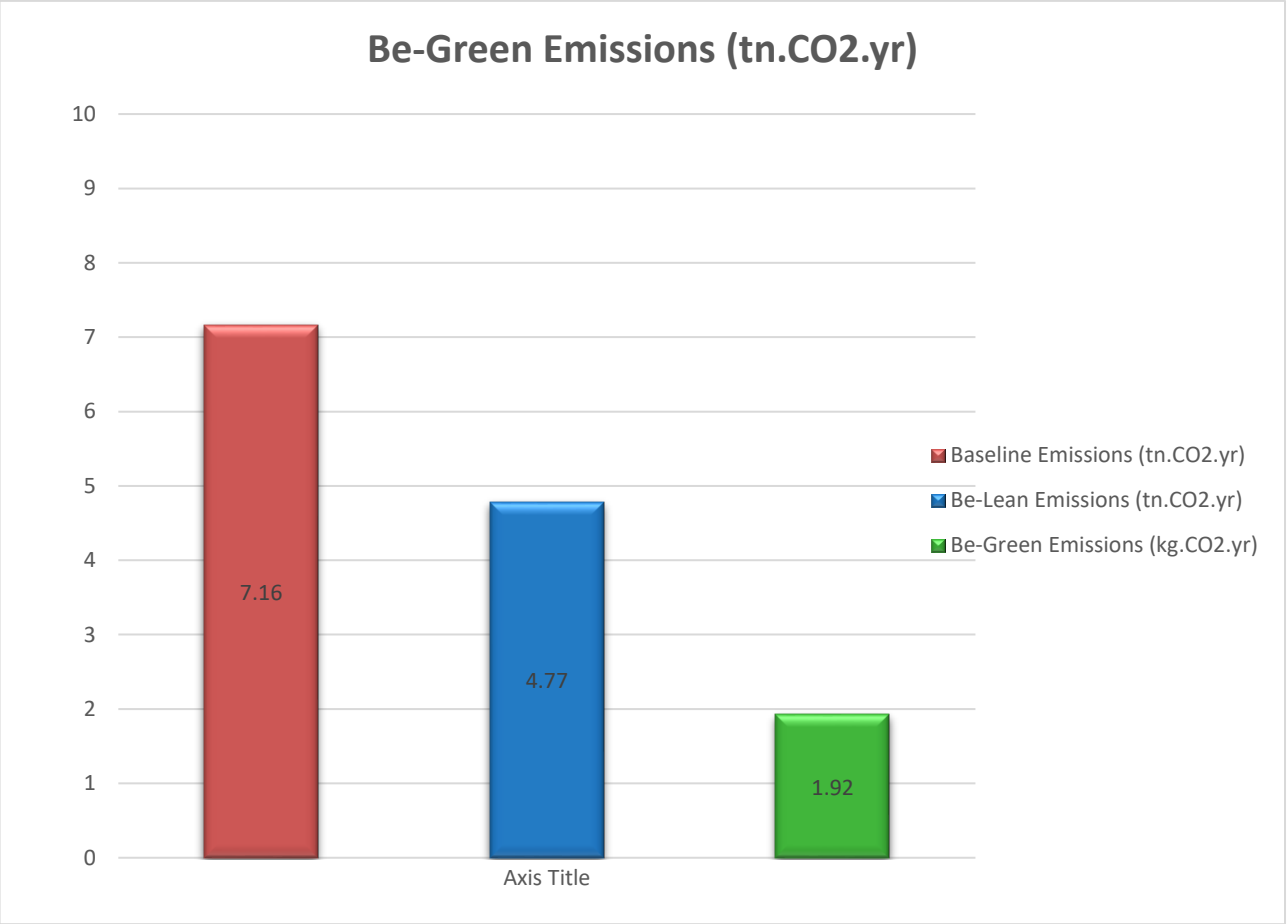

Fig 4.6 –Be-Green Reductions – Domestic

Final CO_2 Reduction Charts

4.25 In accordance with the 'GLA guidance on preparing energy assessments', the final carbon emissions and predicted savings are presented below for the development.

Table 4.10 – Final CO_2 reductions – Domestic

	Carbon Dioxide Emissions for domestic buildings (Tonnes CO2 per annum)	
	Regulated	Unregulated
Baseline: Existing development	7.16	3.09
After energy demand reduction	4.77	3.09
After heat network / CHP	4.77	n/a
After renewable energy	1.92	3.09
	Regulated domestic carbon dioxide savings (Tonnes CO2 per annum)	(%)
Savings from energy demand reduction	2.38	33.30%
Savings from renewable energy	2.85	39.83%
Cumulative on-site savings	5.23	73.13%

4.26 The residential aspect of the development has achieved a 73.13% saving overall. The development utilises an efficient ASHP and PV array to demonstrate a 39.83% carbon saving from the inclusion of renewable energy.

5 CONCLUSION

5.1 This Sustainability and Energy Statement, has been prepared by Envision on the behalf of Airspace Group Ltd and is submitted in support of the full planning application for the construction of 8 additional residential flats on top of an existing residential block.

5.2 The most relevant policy when considering the sustainability of the application of CC1 of the Local Plan. This requires all development to follow the London Plan requirements and to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

5.3 The Local Plan details that the energy hierarchy should be followed, and that savings should be made through energy efficient fabric and renewable and LZC technologies.

5.4 The Energy Statement presented in Section 4 of this report explains the approach which has been taken to minimise carbon emissions. A reduction in emissions has been achieved through adopting efficient building fabric, including new insulation and highly efficient glazing. Measures are also incorporated to minimise pollution, footprint of the development and reduce water use.

5.5 The scheme will incorporate a range of energy-saving measures and is to achieve a 73.13% reduction in carbon emissions, compared to a notional existing building baseline. A 39.83% saving has been achieved through the inclusion of highly efficient ASHPs and PV.

5.6 The development is considered to comply with the London Borough of Camden's Energy and Sustainability policies, along with those found within the London Plan (2021).

APPENDIX I – SAP CALCULATIONS

Full SAP Calculation Printout

Property Reference	Dwelling 3	**Issued on Date**	25/06/2024
Assessment Reference	Dwelling 1_Be Green_Copy	**Prop Type Ref**	
Property	SE17 1AD		

SAP Rating	92 A	**DER**	1.31	**TER**	6.31
Environmental	99 A	**% DER < TER**			79.24
CO_2 Emissions (t/year)	0.11	**DFEE**	34.40	**TFEE**	37.66
Compliance Check	See BREL	**% DFEE < TFEE**			8.63
% DPER < TPER	45.99	**DPER**	18.76	**TPER**	34.73

Assessor Details	Mr. Sam Wallis	**Assessor ID**	BA56-0001
Client			

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	124.0000	(1b)	x 2.6500	(2b) =	328.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	328.6000	(5)

2. Ventilation rate

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

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

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		71.2000 (23c)

Effective ac	0.3209	0.3174	0.3140	0.2966	0.2932	0.2758	0.2758	0.2723	0.2827	0.2932	0.3001	0.3070	(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	
door			2.0000	1.0000	2.0000			(26)
Window (Uw = 0.80)			50.0900	0.7752	38.8295			(27)
external wall	99.6400	50.0900	49.5500	0.1300	6.4415			(29a)
corridor wall	29.6800	2.0000	27.6800	0.1500	4.1520			(29a)
external roof	124.0000		124.0000	0.1100	13.6400			(30)
Total net area of external elements Aum(A, m2)			253.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.0630			(33)
Party Wall 1			5.8300	0.0000	0.0000			(32)
Party Floor 1			124.0000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.0000 (35)
Thermal bridges (User defined value 0.080 * total exposed area)		20.2656 (36)
Point Thermal bridges	(36a) =	0.1500 (36a)
Total fabric heat loss	(33) + (36) + (36a) =	85.4786 (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	34.7984	34.4223	34.0461	32.1654	31.7893	29.9086	29.9086	29.5324	30.6608	31.7893	32.5416	33.2939	(38)
Heat transfer coeff	120.2770	119.9008	119.5247	117.6440	117.2678	115.3871	115.3871	115.0110	116.1394	117.2678	118.0201	118.7724	(39)
Average = Sum(39)m / 12 =												117.5499	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9669	0.9639	0.9487	0.9457	0.9305	0.9305	0.9275	0.9366	0.9457	0.9518	0.9578	(40)
HLP (average)												0.9480	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8775 (42)

Hot water usage for mixer showers

90.5832	89.2219	87.2383	83.4429	80.6420	77.5185	75.7430	77.7117	79.8697	83.2234	87.1003	90.2362	(42a)

Hot water usage for baths

31.2862	30.8216	30.1673	28.9608	28.0575	27.0558	26.5147	27.1644	27.8719	28.9437	30.1750	31.1805	(42b)

Hot water usage for other uses

44.0988	42.4952	40.8916	39.2880	37.6844	36.0808	36.0808	37.6844	39.2880	40.8916	42.4952	44.0988	(42c)

Average daily hot water use (litres/day) 152.6118 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.9683	162.5387	158.2972	151.6918	146.3839	140.6551	138.3386	142.5606	147.0296	153.0588	159.7706	165.5154	(44)
Energy conte	262.8532	231.4530	243.2969	207.6584	197.0608	172.9518	167.3085	176.5198	181.3022	207.6993	227.6225	259.1572	(45)
Energy content (annual)											Total = Sum(45)m =	2534.8836	

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

39.4280	34.7180	36.4945	31.1488	29.5591	25.9428	25.0963	26.4780	27.1953	31.1549	34.1434	38.8736	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7700 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9558 (55)

Total storage loss

29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)

If cylinder contains dedicated solar storage

29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(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

315.7454	279.2266	296.1891	258.8444	249.9530	224.1378	220.2007	229.4120	232.4882	260.5915	278.8085	312.0494	(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

315.7454	279.2266	296.1891	258.8444	249.9530	224.1378	220.2007	229.4120	232.4882	260.5915	278.8085	312.0494	(64)

Total per year (kWh/year) = Sum(64)m = 3157.6466 (64)

12Total per year (kWh/year) 3158 (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

129.7124	115.1770	123.2100	109.9952	107.8365	98.4553	97.9438	101.0066	101.2318	111.3738	116.6333	128.4835	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	146.4397	162.1297	146.4397	151.3211	146.4397	151.3211	146.4397	146.4397	151.3211	146.4397	151.3211	146.4397	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.3331	293.3459	285.7539	269.5913	249.1890	230.0137	217.2035	214.1907	221.7828	237.9453	258.3476	277.5229	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	(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)	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	(71)
Water heating gains (Table 5)	174.3447	171.3944	165.6048	152.7711	144.9415	136.7434	131.6449	135.7615	140.5997	149.6959	161.9907	172.6929	(72)
Total internal gains	677.2805	693.0329	663.9614	639.8465	606.7333	584.2412	561.4511	562.5550	579.8665	600.2440	637.8223	662.8185	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.0200	11.2829	0.5700	0.8000	0.7700	14.3333	(75)
Southeast	30.5200	36.7938	0.5700	0.8000	0.7700	354.8605	(77)
Southwest	15.5500	36.7938	0.5700	0.8000	0.7700	180.8021	(79)

Solar gains	549.9959	941.6074	1300.9943	1633.1915	1848.6578	1843.7994	1774.0779	1612.0293	1415.8363	1044.0865	659.6353	470.1209	(83)
Total gains	1227.2764	1634.6404	1964.9556	2273.0380	2455.3910	2428.0407	2335.5290	2174.5843	1995.7028	1644.3304	1297.4576	1132.9394	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3651	34.4729	34.5814	35.1343	35.2469	35.8214	35.8214	35.9386	35.5894	35.2469	35.0223	34.8004	
alpha	3.2910	3.2982	3.3054	3.3423	3.3498	3.3881	3.3881	3.3959	3.3726	3.3498	3.3348	3.3200	
util living area													

	0.9126	0.8267	0.7174	0.5699	0.4274	0.3004	0.2164	0.2418	0.3903	0.6449	0.8502	0.9277	(86)
Living	19.8705	20.2309	20.5292	20.7575	20.8597	20.8983	20.9065	20.9054	20.8822	20.7211	20.2774	19.8020	
Non living	18.7981	19.2367	19.5899	19.8581	19.9678	20.0172	20.0236	20.0257	19.9990	19.8290	19.3122	18.7217	
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	20.4222	20.2309	20.5292	20.7575	20.8597	20.8983	20.9065	20.9054	20.8822	20.7211	20.2774	19.9696	(87)
Th 2	20.1084	20.1110	20.1135	20.1263	20.1288	20.1416	20.1416	20.1442	20.1365	20.1288	20.1237	20.1186	(88)
util rest of house													
	0.9009	0.8075	0.6909	0.5372	0.3909	0.2612	0.1746	0.1974	0.3445	0.6062	0.8297	0.9178	(89)
MIT 2	19.5860	19.2367	19.5899	19.8581	19.9678	20.0172	20.0236	20.0257	19.9990	19.8290	19.3122	18.9734	(90)
Living area fraction										fLA = Living area / (4) =		0.4508	(91)
MIT	19.9630	19.6849	20.0133	20.2636	20.3699	20.4144	20.4216	20.4223	20.3971	20.2312	19.7473	19.4225	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.9630	19.6849	20.0133	20.2636	20.3699	20.4144	20.4216	20.4223	20.3971	20.2312	19.7473	19.4225	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8989	0.7974	0.6877	0.5425	0.4011	0.2737	0.1883	0.2119	0.3585	0.6109	0.8200	0.9088	(94)
Useful gains	1103.1409	1303.5236	1351.3087	1233.1001	984.9476	664.6712	439.7049	460.7069	715.4624	1004.5619	1063.9303	1029.5997	(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													
	1883.8953	1772.7198	1615.1749	1336.8568	1016.7011	670.9114	440.9665	462.6089	731.3458	1129.4245	1492.6415	1808.0115	(97)
Space heating kWh													
	580.8813	315.2998	196.3165	74.7049	23.6246	0.0000	0.0000	0.0000	0.0000	92.8978	308.6720	579.1383	(98a)
Space heating requirement - total per year (kWh/year)												2171.5352	
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													
	580.8813	315.2998	196.3165	74.7049	23.6246	0.0000	0.0000	0.0000	0.0000	92.8978	308.6720	579.1383	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2171.5352	
Space heating per m2											(98c) / (4) =	17.5124	(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 %)	274.2634	(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													
	580.8813	315.2998	196.3165	74.7049	23.6246	0.0000	0.0000	0.0000	0.0000	92.8978	308.6720	579.1383	(98)
Space heating efficiency (main heating system 1)													
	274.2634	274.2634	274.2634	274.2634	274.2634	0.0000	0.0000	0.0000	0.0000	274.2634	274.2634	274.2634	(210)
Space heating fuel (main heating system)													
	211.7969	114.9624	71.5795	27.2384	8.6139	0.0000	0.0000	0.0000	0.0000	33.8717	112.5458	211.1614	(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													
	315.7454	279.2266	296.1891	258.8444	249.9530	224.1378	220.2007	229.4120	232.4882	260.5915	278.8085	312.0494	(64)
Efficiency of water heater												279.6279	(216)
(217)m	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	279.6279	(217)
Fuel for water heating, kWh/month													
	112.9163	99.8565	105.9226	92.5675	89.3877	80.1557	78.7478	82.0419	83.1420	93.1923	99.7070	111.5945	(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	42.3221	38.2264	42.3221	40.9569	42.3221	40.9569	42.3221	42.3221	40.9569	42.3221	40.9569	42.3221	(231)
Lighting	28.3128	22.7135	20.4510	14.9833	11.5735	9.4557	10.5578	13.7234	17.8253	23.3878	26.4164	29.0997	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-38.6155	-57.1881	-86.0982	-100.7229	-112.3932	-106.0695	-104.7641	-96.7059	-82.7267	-66.1839	-43.0555	-32.9691	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-11.4710	-26.3919	-56.2481	-90.0492	-123.2896	-125.6442	-123.8874	-103.0681	-73.7364	-40.6620	-16.3543	-8.9448	(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	791.7701	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	279.6279	
Water heating fuel used	1129.2317	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 1.2430)		
mechanical ventilation fans (SFP = 1.2430)	498.3088	(230a)
Total electricity for the above, kWh/year	498.3088	(231)
Electricity for lighting (calculated in Appendix L)	228.5002	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1727.2394	(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	920.5713	(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	791.7701	0.1578	124.9210	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1129.2317	0.1410	159.2364	(264)
Space and water heating			284.1573	(265)
Pumps, fans and electric keep-hot	498.3088	0.1387	69.1216	(267)
Energy for lighting	228.5002	0.1443	32.9796	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-927.4925	0.1337	-124.0139	
PV Unit electricity exported	-799.7469	0.1242	-99.3377	
Total			-223.3516	(269)
Total CO2, kg/year			162.9069	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			1.3100	(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	791.7701	1.5840	1254.1464	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1129.2317	1.5214	1718.0366	(278)
Space and water heating			2972.1830	(279)
Pumps, fans and electric keep-hot	498.3088	1.5128	753.8415	(281)
Energy for lighting	228.5002	1.5338	350.4812	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-927.4925	1.4941	-1385.7826	
PV Unit electricity exported	-799.7469	0.4559	-364.5905	
Total			-1750.3731	(283)
Total Primary energy kWh/year			2326.1326	(286)
Dwelling Primary energy Rate (DPER)			18.7600	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	124.0000	(1b)	x 2.6500	(2b) =	328.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		328.6000	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1217 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3717 (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) =	0.3438 (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	0.4384	0.4298	0.4212	0.3782	0.3696	0.3267	0.3267	0.3181	0.3438	0.3696	0.3868	0.4040	(22b)
Effective ac	0.5961	0.5924	0.5887	0.5715	0.5683	0.5534	0.5534	0.5506	0.5591	0.5683	0.5748	0.5816	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.20)			29.0000	1.1450	33.2061			(27)
external wall	99.6400	29.0000	70.6400	0.1800	12.7152			(29a)
corridor wall	29.6800	2.0000	27.6800	0.1800	4.9824			(29a)
external roof	124.0000		124.0000	0.1100	13.6400			(30)
Total net area of external elements Aum(A, m2)			253.3200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.5437			(33)
Party Wall 1			5.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 120.0000 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	21.1000	0.0500	1.0550
E3 Sill	21.1000	0.0500	1.0550
E4 Jamb	33.3000	0.0500	1.6650
E7 Party floor between dwellings (in blocks of flats)	48.8000	0.0700	3.4160
E14 Flat roof	48.8000	0.0800	3.9040
E16 Corner (normal)	21.2000	0.0900	1.9080
E17 Corner (inverted - internal area greater than external area)	15.9000	-0.0900	-1.4310
E18 Party wall between dwellings	5.3000	0.0600	0.3180

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.8900 (36)
Point Thermal bridges (36a) = 0.1500 (36a)
Total fabric heat loss (33) + (36) + (36a) = 78.5837 (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	64.6399	64.2353	63.8386	61.9756	61.6270	60.0044	60.0044	59.7039	60.6294	61.6270	62.3322	63.0694	(38)
Heat transfer coeff	143.2237	142.8190	142.4224	140.5593	140.2108	138.5881	138.5881	138.2876	139.2131	140.2108	140.9159	141.6531	(39)
Average = Sum(39)m / 12 =												140.5577	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1550	1.1518	1.1486	1.1335	1.1307	1.1176	1.1176	1.1152	1.1227	1.1307	1.1364	1.1424	(40)
HLP (average)												1.1335	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8775 (42)

Hot water usage for mixer showers

72.4666	71.3776	69.7906	66.7543	64.5136	62.0148	60.5944	62.1693	63.8958	66.5787	69.6803	72.1889	(42a)

Hot water usage for baths

31.2862	30.8216	30.1673	28.9608	28.0575	27.0558	26.5147	27.1644	27.8719	28.9437	30.1750	31.1805	(42b)

Hot water usage for other uses

44.0988	42.4952	40.8916	39.2880	37.6844	36.0808	36.0808	37.6844	39.2880	40.8916	42.4952	44.0988	(42c)

Average daily hot water use (litres/day) 135.9089 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.8516	144.6944	140.8495	135.0032	130.2555	125.1514	123.1900	127.0182	131.0557	136.4141	142.3505	147.4682	(44)
Energy conte	234.1608	206.0428	216.4805	184.8126	175.3489	153.8882	148.9876	157.2751	161.6048	185.1126	202.8044	230.8996	(45)
Energy content (annual)										Total = Sum(45)m =		2257.4179	
Distribution loss (46)m = 0.15 x (45)m	35.1241	30.9064	32.4721	27.7219	26.3023	23.0832	22.3481	23.5913	24.2407	27.7669	30.4207	34.6349	(46)

Water storage loss:

Store volume 210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7016 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9188 (55)

Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	285.9074	252.7817	268.2270	234.8899	227.0955	203.9656	200.7342	209.0217	211.6821	236.8592	252.8817	282.6462	(62)
WWHRS	-33.1287	-29.2993	-30.6805	-25.4047	-23.6763	-20.2599	-18.9905	-20.1945	-20.9617	-24.7116	-27.9952	-32.5152	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	252.7787	223.4824	237.5465	209.4852	203.4193	183.7056	181.7437	188.8272	190.7204	212.1477	224.8865	250.1310	(64)
									Total per year (kWh/year) = Sum(64)m =			2558.8743	(64)
12Total per year (kWh/year)												2559	(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

119.2558	105.9003	113.3770	101.5121	99.7008	91.2297	90.9356	93.6912	93.7955	102.9472	107.4943	118.1714	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	146.4397	162.1297	146.4397	151.3211	146.4397	151.3211	146.4397	146.4397	151.3211	146.4397	151.3211	146.4397	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.3331	293.3459	285.7539	269.5913	249.1890	230.0137	217.2035	214.1907	221.7828	237.9453	258.3476	277.5229	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	(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)	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	(71)
Water heating gains (Table 5)	160.2900	157.5898	152.3885	140.9890	134.0064	126.7079	122.2253	125.9291	130.2715	138.3699	149.2977	158.8325	(72)
Total internal gains	666.2258	682.2283	653.7450	631.0643	598.7982	574.2057	552.0315	552.7225	569.5383	591.9179	628.1293	651.9581	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3300	11.2829	0.6300	0.7000	0.7700	8.0343	(75)
Southeast	17.6700	36.7938	0.6300	0.7000	0.7700	198.6934	(77)
Southwest	9.0000	36.7938	0.6300	0.7000	0.7700	101.2021	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	307.9298	527.1870	728.4088	914.4152	1035.0660	1032.3512	993.3116	902.5714	792.7118	584.5652	369.3149	263.2093	(83)
Total gains	974.1556	1209.4154	1382.1538	1545.4795	1633.8642	1606.5569	1545.3431	1455.2939	1362.2501	1176.4831	997.4442	915.1673	(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	28.8593	28.9411	29.0217	29.4063	29.4794	29.8246	29.8246	29.8894	29.6907	29.4794	29.3319	29.1793	
alpha	2.9240	2.9294	2.9348	2.9604	2.9653	2.9883	2.9883	2.9926	2.9794	2.9653	2.9555	2.9453	
util living area	0.9558	0.9215	0.8718	0.7821	0.6584	0.5059	0.3794	0.4156	0.6074	0.8216	0.9282	0.9623	(86)
MIT	18.8591	19.2617	19.7368	20.2740	20.6630	20.8899	20.9651	20.9537	20.8028	20.2741	19.4774	18.7941	(87)
Th 2	19.9561	19.9588	19.9614	19.9735	19.9758	19.9864	19.9864	19.9884	19.9823	19.9758	19.9712	19.9664	(88)
util rest of house	0.9486	0.9095	0.8525	0.7501	0.6097	0.4382	0.2976	0.3319	0.5405	0.7877	0.9152	0.9561	(89)
MIT 2	17.4770	17.9808	18.5688	19.2216	19.6648	19.9057	19.9686	19.9632	19.8254	19.2408	18.2670	17.4016	(90)
Living area fraction									fLA = Living area / (4) =			0.4508	(91)
MIT	18.1001	18.5582	19.0954	19.6960	20.1148	20.3494	20.4179	20.4097	20.2660	19.7066	18.8127	18.0294	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1001	18.5582	19.0954	19.6960	20.1148	20.3494	20.4179	20.4097	20.2660	19.7066	18.8127	18.0294	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9317	0.8894	0.8336	0.7406	0.6167	0.4632	0.3331	0.3676	0.5601	0.7776	0.8966	0.9404	(94)
Useful gains	907.5922	1075.6845	1152.1005	1144.6270	1007.6239	744.1851	514.7691	534.9565	763.0154	914.7771	894.2932	860.6277	(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	1976.4950	1950.6494	1793.8616	1517.4839	1179.8427	796.7934	529.1111	554.4916	858.3945	1276.8466	1650.5031	1958.9726	(97)
Space heating kWh	795.2637	587.9764	477.4703	268.4570	128.1308	0.0000	0.0000	0.0000	0.0000	269.3797	544.4711	817.1686	(98a)
Space heating requirement - total per year (kWh/year)												3888.3175	
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	795.2637	587.9764	477.4703	268.4570	128.1308	0.0000	0.0000	0.0000	0.0000	269.3797	544.4711	817.1686	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3888.3175	
Space heating per m2										(98c) / (4) =		31.3574	(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	795.2637	587.9764	477.4703	268.4570	128.1308	0.0000	0.0000	0.0000	0.0000	269.3797	544.4711	817.1686	(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)	861.6075	637.0275	517.3026	290.8526	138.8199	0.0000	0.0000	0.0000	0.0000	291.8523	589.8928	885.3398	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	252.7787	223.4824	237.5465	209.4852	203.4193	183.7056	181.7437	188.8272	190.7204	212.1477	224.8865	250.1310	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.4484	86.1249	85.5929	84.6171	83.0530	79.8000	79.8000	79.8000	79.8000	84.5965	85.9660	86.5133	(217)
Fuel for water heating, kWh/month	292.4041	259.4865	277.5306	247.5684	244.9269	230.2075	227.7490	236.6256	238.9980	250.7759	261.5994	289.1242	(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	30.4273	24.4099	21.9784	16.1023	12.4379	10.1619	11.3463	14.7483	19.1566	25.1345	28.3893	31.2730	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-89.6649	-115.0730	-150.7193	-153.9064	-153.8763	-139.4095	-137.4796	-135.2578	-130.2876	-123.3131	-94.3423	-78.9051	(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	-91.8955	-186.3766	-358.4731	-522.1453	-675.6025	-673.6997	-665.9026	-570.5230	-427.2889	-260.9227	-120.7179	-73.2280	(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	(235d)

Annual totals kWh/year		
Space heating fuel - main system 1	4212.6951	(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	3056.9961	(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)	245.5656	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-6129.0107	(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	1472.2461	(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	4212.6951	0.2100	884.6660	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3056.9961	0.2100	641.9692	(264)
Space and water heating			1526.6351	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	245.5656	0.1443	35.4427	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1502.2350	0.1367	-205.3185	
PV Unit electricity exported	-4626.7757	0.1268	-586.7670	
Total			-792.0856	(269)
Total CO2, kg/year			781.9216	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			6.3100	(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	4212.6951	1.1300	4760.3454	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3056.9961	1.1300	3454.4056	(278)
Space and water heating			8214.7510	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	245.5656	1.5338	376.6567	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1502.2350	1.5052	-2261.2266	
PV Unit electricity exported	-4626.7757	0.4656	-2154.0223	
Total			-4415.2490	(283)
Total Primary energy kWh/year			4306.2596	(286)
Target Primary Energy Rate (TPER)			34.7300	(287)

Full SAP Calculation Printout

Property Reference	Dwelling 3	**Issued on Date**	25/06/2024
Assessment Reference	Dwelling 1_Be Lean_Copy	**Prop Type Ref**	
Property	SE17 1AD		

SAP Rating	86 B	**DER**	10.41	**TER**	6.31
Environmental	90 B	**% DER < TER**			-64.98
CO_2 Emissions (t/year)	1.11	**DFEE**	34.40	**TFEE**	37.66
Compliance Check	See BREL	**% DFEE < TFEE**			8.63
% DPER < TPER	-74.93	**DPER**	60.75	**TPER**	34.73

Assessor Details	Mr. Sam Wallis	**Assessor ID**	BA56-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	124.0000	(1b)	x 2.6500	(2b) =	328.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	328.6000	(5)

2. Ventilation rate

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

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

Balanced mechanical ventilation with heat recovery

If mechanical ventilation		0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)		0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		71.2000 (23c)

Effective ac	0.3209	0.3174	0.3140	0.2966	0.2932	0.2758	0.2758	0.2723	0.2827	0.2932	0.3001	0.3070	(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	
door			2.0000	1.0000	2.0000			(26)
Window (Uw = 0.80)			50.0900	0.7752	38.8295			(27)
external wall	99.6400	50.0900	49.5500	0.1300	6.4415			(29a)
corridor wall	29.6800	2.0000	27.6800	0.1500	4.1520			(29a)
external roof	124.0000		124.0000	0.1100	13.6400			(30)
Total net area of external elements Aum(A, m2)			253.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		65.0630			(33)
Party Wall 1			5.8300	0.0000	0.0000			(32)
Party Floor 1			124.0000					(32d)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	120.0000	(35)
Thermal bridges (User defined value 0.080 * total exposed area)	20.2656	(36)
Point Thermal bridges (36a) =	0.1500	(36a)
Total fabric heat loss (33) + (36) + (36a) =	85.4786	(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	34.7984	34.4223	34.0461	32.1654	31.7893	29.9086	29.9086	29.5324	30.6608	31.7893	32.5416	33.2939	(38)
Heat transfer coeff	120.2770	119.9008	119.5247	117.6440	117.2678	115.3871	115.3871	115.0110	116.1394	117.2678	118.0201	118.7724	(39)
Average = Sum(39)m / 12 =												117.5499	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9700	0.9669	0.9639	0.9487	0.9457	0.9305	0.9305	0.9275	0.9366	0.9457	0.9518	0.9578	(40)
HLP (average)												0.9480	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.8775 (42)

Hot water usage for mixer showers

90.5832	89.2219	87.2383	83.4429	80.6420	77.5185	75.7430	77.7117	79.8697	83.2234	87.1003	90.2362	(42a)

Hot water usage for baths

31.2862	30.8216	30.1673	28.9608	28.0575	27.0558	26.5147	27.1644	27.8719	28.9437	30.1750	31.1805	(42b)

Hot water usage for other uses

44.0988	42.4952	40.8916	39.2880	37.6844	36.0808	36.0808	37.6844	39.2880	40.8916	42.4952	44.0988	(42c)

Average daily hot water use (litres/day) 152.6118 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	165.9683	162.5387	158.2972	151.6918	146.3839	140.6551	138.3386	142.5606	147.0296	153.0588	159.7706	165.5154	(44)
Energy conte	262.8532	231.4530	243.2969	207.6584	197.0608	172.9518	167.3085	176.5198	181.3022	207.6993	227.6225	259.1572	(45)
Energy content (annual)											Total = Sum(45)m =	2534.8836	

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

39.4280	34.7180	36.4945	31.1488	29.5591	25.9428	25.0963	26.4780	27.1953	31.1549	34.1434	38.8736	(46)

Water storage loss:

Store volume 210.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.7700 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.9558 (55)

Total storage loss

29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(56)

If cylinder contains dedicated solar storage

29.6298	26.7624	29.6298	28.6740	29.6298	28.6740	29.6298	29.6298	28.6740	29.6298	28.6740	29.6298	(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

315.7454	279.2266	296.1891	258.8444	249.9530	224.1378	220.2007	229.4120	232.4882	260.5915	278.8085	312.0494	(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

315.7454	279.2266	296.1891	258.8444	249.9530	224.1378	220.2007	229.4120	232.4882	260.5915	278.8085	312.0494	(64)
										Total per year (kWh/year) = Sum(64)m =	3157.6466	(64)
12Total per year (kWh/year)											3158	(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

129.7124	115.1770	123.2100	109.9952	107.8365	98.4553	97.9438	101.0066	101.2318	111.3738	116.6333	128.4835	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	146.4397	162.1297	146.4397	151.3211	146.4397	151.3211	146.4397	146.4397	151.3211	146.4397	151.3211	146.4397	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.3331	293.3459	285.7539	269.5913	249.1890	230.0137	217.2035	214.1907	221.7828	237.9453	258.3476	277.5229	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	(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)	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	(71)
Water heating gains (Table 5)	174.3447	171.3944	165.6048	152.7711	144.9415	136.7434	131.6449	135.7615	140.5997	149.6959	161.9907	172.6929	(72)
Total internal gains	680.2805	696.0329	666.9614	642.8465	609.7333	584.2412	561.4511	562.5550	579.8665	603.2440	640.8223	665.8185	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	4.0200	11.2829	0.5700	0.8000	0.7700	14.3333	(75)
Southeast	30.5200	36.7938	0.5700	0.8000	0.7700	354.8605	(77)
Southwest	15.5500	36.7938	0.5700	0.8000	0.7700	180.8021	(79)

Solar gains	549.9959	941.6074	1300.9943	1633.1915	1848.6578	1843.7994	1774.0779	1612.0293	1415.8363	1044.0865	659.6353	470.1209	(83)
Total gains	1230.2764	1637.6404	1967.9556	2276.0380	2458.3910	2428.0407	2335.5290	2174.5843	1995.7028	1647.3304	1300.4576	1135.9394	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	34.3651	34.4729	34.5814	35.1343	35.2469	35.8214	35.8214	35.9386	35.5894	35.2469	35.0223	34.8004	
alpha	3.2910	3.2982	3.3054	3.3423	3.3498	3.3881	3.3881	3.3959	3.3726	3.3498	3.3348	3.3200	
util living area													

	0.9121	0.8261	0.7168	0.5693	0.4269	0.3004	0.2164	0.2418	0.3903	0.6441	0.8495	0.9273	(86)
MIT	19.8729	20.2326	20.5302	20.7580	20.8599	20.8983	20.9065	20.9054	20.8822	20.7218	20.2793	19.8046	(87)
Th 2	20.1084	20.1110	20.1135	20.1263	20.1288	20.1416	20.1416	20.1442	20.1365	20.1288	20.1237	20.1186	(88)
util rest of house	0.9004	0.8068	0.6902	0.5367	0.3905	0.2612	0.1746	0.1974	0.3445	0.6054	0.8290	0.9173	(89)
MIT 2	18.8011	19.2388	19.5911	19.8586	19.9680	20.0172	20.0236	20.0257	19.9990	19.8297	19.3145	18.7250	(90)
Living area fraction										fLA = Living area / (4) =		0.4508	(91)
MIT	19.2843	19.6868	20.0144	20.2640	20.3701	20.4144	20.4216	20.4223	20.3971	20.2319	19.7495	19.2117	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1343	19.5368	19.8644	20.1140	20.2201	20.2644	20.2716	20.2723	20.2471	20.0819	19.5995	19.0617	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8854	0.7932	0.6823	0.5362	0.3944	0.2669	0.1809	0.2041	0.3505	0.6032	0.8152	0.9031	(94)
Useful gains	1089.2915	1298.9019	1342.7395	1220.3969	969.4825	647.9867	422.5906	443.7319	699.4519	993.6666	1060.1711	1025.8191	(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	1784.2260	1754.9647	1597.3810	1319.2654	999.1287	653.6033	423.6584	445.3572	713.9249	1111.9197	1475.1882	1765.1572	(97)
Space heating kWh	517.0313	306.4742	189.4533	71.1853	22.0568	0.0000	0.0000	0.0000	0.0000	87.9803	298.8123	550.0676	(98a)
Space heating requirement - total per year (kWh/year)												2043.0610	
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	517.0313	306.4742	189.4533	71.1853	22.0568	0.0000	0.0000	0.0000	0.0000	87.9803	298.8123	550.0676	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2043.0610	
Space heating per m2										(98c) / (4) =		16.4763	(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	517.0313	306.4742	189.4533	71.1853	22.0568	0.0000	0.0000	0.0000	0.0000	87.9803	298.8123	550.0676	(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)	560.1639	332.0414	205.2582	77.1239	23.8968	0.0000	0.0000	0.0000	0.0000	95.3199	323.7403	595.9562	(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	315.7454	279.2266	296.1891	258.8444	249.9530	224.1378	220.2007	229.4120	232.4882	260.5915	278.8085	312.0494	(64)
Efficiency of water heater												92.3000	(216)
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month	342.0860	302.5207	320.8982	280.4382	270.8050	242.8362	238.5707	248.5503	251.8832	282.3310	302.0677	338.0817	(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	45.8043	41.3716	45.8043	44.3267	45.8043	44.3267	45.8043	45.8043	44.3267	45.8043	44.3267	45.8043	(231)
Lighting	28.3128	22.7135	20.4510	14.9833	11.5735	9.4557	10.5578	13.7234	17.8253	23.3878	26.4164	29.0997	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												2213.5006	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												92.3000	
Water heating fuel used												3421.0689	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.1000, SFP = 1.2430)													
mechanical ventilation fans (SFP = 1.2430)												498.3088	(230a)
central heating pump												41.0000	(230c)
Total electricity for the above, kWh/year												539.3088	(231)
Electricity for lighting (calculated in Appendix L)												228.5002	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												0.0000	(233)
Wind generation												0.0000	(234)
Hydro-electric generation (Appendix N)												0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)												0.0000	(235)
Appendix Q - special features													
Energy saved or generated												-0.0000	(236)
Energy used												0.0000	(237)
Total delivered energy for all uses												6402.3784	(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	2213.5006	0.2100	464.8351	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3421.0689	0.2100	718.4245	(264)
Space and water heating			1183.2596	(265)
Pumps, fans and electric keep-hot	539.3088	0.1387	74.8088	(267)
Energy for lighting	228.5002	0.1443	32.9796	(268)
Total CO2, kg/year			1291.0480	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			10.4100	(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	2213.5006	1.1300	2501.2556	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3421.0689	1.1300	3865.8079	(278)
Space and water heating			6367.0635	(279)
Pumps, fans and electric keep-hot	539.3088	1.5128	815.8663	(281)
Energy for lighting	228.5002	1.5338	350.4812	(282)
Total Primary energy kWh/year			7533.4110	(286)
Dwelling Primary energy Rate (DPER)			60.7500	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	124.0000	(1b)	x 2.6500	(2b) =	328.6000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	124.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		328.6000	(5)

2. Ventilation rate

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

	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1217 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3717 (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) =	0.3438 (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	0.4384	0.4298	0.4212	0.3782	0.3696	0.3267	0.3267	0.3181	0.3438	0.3696	0.3868	0.4040	(22b)
Effective ac	0.5961	0.5924	0.5887	0.5715	0.5683	0.5534	0.5534	0.5506	0.5591	0.5683	0.5748	0.5816	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0000	1.0000	2.0000			(26)
TER Opening Type (Uw = 1.20)			29.0000	1.1450	33.2061			(27)
external wall	99.6400	29.0000	70.6400	0.1800	12.7152			(29a)
corridor wall	29.6800	2.0000	27.6800	0.1800	4.9824			(29a)
external roof	124.0000		124.0000	0.1100	13.6400			(30)
Total net area of external elements Aum(A, m2)			253.3200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.5437			(33)
Party Wall 1			5.8300	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	120.0000 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total

E2 Other lintels (including other steel lintels)	21.1000	0.0500	1.0550		
E3 Sill	21.1000	0.0500	1.0550		
E4 Jamb	33.3000	0.0500	1.6650		
E7 Party floor between dwellings (in blocks of flats)	48.8000	0.0700	3.4160		
E14 Flat roof	48.8000	0.0800	3.9040		
E16 Corner (normal)	21.2000	0.0900	1.9080		
E17 Corner (inverted - internal area greater than external area)	15.9000	-0.0900	-1.4310		
E18 Party wall between dwellings	5.3000	0.0600	0.3180		
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				11.8900	(36)
Point Thermal bridges			(36a) =	0.1500	(36a)
Total fabric heat loss			(33) + (36) + (36a) =	78.5837	(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	64.6399	64.2353	63.8386	61.9756	61.6270	60.0044	60.0044	59.7039	60.6294	61.6270	62.3322	63.0694	(38)
Heat transfer coeff	143.2237	142.8190	142.4224	140.5593	140.2108	138.5881	138.5881	138.2876	139.2131	140.2108	140.9159	141.6531	(39)
Average = Sum(39)m / 12 =												140.5577	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1550	1.1518	1.1486	1.1335	1.1307	1.1176	1.1176	1.1152	1.1227	1.1307	1.1364	1.1424	(40)
HLP (average)												1.1335	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.8775 (42)
Hot water usage for mixer showers	72.4666	71.3776	69.7906	66.7543	64.5136	62.0148	60.5944	62.1693	63.8958	66.5787	69.6803	72.1889 (42a)
Hot water usage for baths	31.2862	30.8216	30.1673	28.9608	28.0575	27.0558	26.5147	27.1644	27.8719	28.9437	30.1750	31.1805 (42b)
Hot water usage for other uses	44.0988	42.4952	40.8916	39.2880	37.6844	36.0808	36.0808	37.6844	39.2880	40.8916	42.4952	44.0988 (42c)
Average daily hot water use (litres/day)												135.9089 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	147.8516	144.6944	140.8495	135.0032	130.2555	125.1514	123.1900	127.0182	131.0557	136.4141	142.3505	147.4682	(44)
Energy conte	234.1608	206.0428	216.4805	184.8126	175.3489	153.8882	148.9876	157.2751	161.6048	185.1126	202.8044	230.8996	(45)
Energy content (annual)										Total = Sum(45)m =		2257.4179	
Distribution loss (46)m = 0.15 x (45)m	35.1241	30.9064	32.4721	27.7219	26.3023	23.0832	22.3481	23.5913	24.2407	27.7669	30.4207	34.6349	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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	285.9074	252.7817	268.2270	234.8899	227.0955	203.9656	200.7342	209.0217	211.6821	236.8592	252.8817	282.6462	(62)
WWHRS	-33.1287	-29.2993	-30.6805	-25.4047	-23.6763	-20.2599	-18.9905	-20.1945	-20.9617	-24.7116	-27.9952	-32.5152	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	252.7787	223.4824	237.5465	209.4852	203.4193	183.7056	181.7437	188.8272	190.7204	212.1477	224.8865	250.1310	(64)
										Total per year (kWh/year) = Sum(64)m =		2558.8743	(64)
12Total per year (kWh/year)												2559	(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	119.2558	105.9003	113.3770	101.5121	99.7008	91.2297	90.9356	93.6912	93.7955	102.9472	107.4943	118.1714	(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	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	143.8766	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	146.4397	162.1297	146.4397	151.3211	146.4397	151.3211	146.4397	146.4397	151.3211	146.4397	151.3211	146.4397	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.3331	293.3459	285.7539	269.5913	249.1890	230.0137	217.2035	214.1907	221.7828	237.9453	258.3476	277.5229	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	37.3877	(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)	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	-115.1013	(71)
Water heating gains (Table 5)	160.2900	157.5898	152.3885	140.9890	134.0064	126.7079	122.2253	125.9291	130.2715	138.3699	149.2977	158.8325	(72)
Total internal gains	666.2258	682.2283	653.7450	631.0643	598.7982	574.2057	552.0315	552.7225	569.5383	591.9179	628.1293	651.9581	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	2.3300	11.2829	0.6300	0.7000	0.7700	8.0343	(75)
Southeast	17.6700	36.7938	0.6300	0.7000	0.7700	198.6934	(77)
Southwest	9.0000	36.7938	0.6300	0.7000	0.7700	101.2021	(79)

Solar gains	307.9298	527.1870	728.4088	914.4152	1035.0660	1032.3512	993.3116	902.5714	792.7118	584.5652	369.3149	263.2093	(83)
Total gains	974.1556	1209.4154	1382.1538	1545.4795	1633.8642	1606.5569	1545.3431	1455.2939	1362.2501	1176.4831	997.4442	915.1673	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	28.8593	28.9411	29.0217	29.4063	29.4794	29.8246	29.8246	29.8894	29.6907	29.4794	29.3319	29.1793	
alpha	2.9240	2.9294	2.9348	2.9604	2.9653	2.9883	2.9883	2.9926	2.9794	2.9653	2.9555	2.9453	
util living area	0.9558	0.9215	0.8718	0.7821	0.6584	0.5059	0.3794	0.4156	0.6074	0.8216	0.9282	0.9623	(86)
MIT	18.8591	19.2617	19.7368	20.2740	20.6630	20.8899	20.9651	20.9537	20.8028	20.2741	19.4774	18.7941	(87)
Th 2	19.9561	19.9588	19.9614	19.9735	19.9758	19.9864	19.9864	19.9884	19.9823	19.9758	19.9712	19.9664	(88)
util rest of house	0.9486	0.9095	0.8525	0.7501	0.6097	0.4382	0.2976	0.3319	0.5405	0.7877	0.9152	0.9561	(89)
MIT 2	17.4770	17.9808	18.5688	19.2216	19.6648	19.9057	19.9686	19.9632	19.8254	19.2408	18.2670	17.4016	(90)
Living area fraction									fLA = Living area / (4) =			0.4508	(91)
MIT	18.1001	18.5582	19.0954	19.6960	20.1148	20.3494	20.4179	20.4097	20.2660	19.7066	18.8127	18.0294	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1001	18.5582	19.0954	19.6960	20.1148	20.3494	20.4179	20.4097	20.2660	19.7066	18.8127	18.0294	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9317	0.8894	0.8336	0.7406	0.6167	0.4632	0.3331	0.3676	0.5601	0.7776	0.8966	0.9404	(94)
Useful gains	907.5922	1075.6845	1152.1005	1144.6270	1007.6239	744.1851	514.7691	534.9565	763.0154	914.7771	894.2932	860.6277	(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	1976.4950	1950.6494	1793.8616	1517.4839	1179.8427	796.7934	529.1111	554.4916	858.3945	1276.8466	1650.5031	1958.9726	(97)
Space heating kWh	795.2637	587.9764	477.4703	268.4570	128.1308	0.0000	0.0000	0.0000	0.0000	269.3797	544.4711	817.1686	(98a)
Space heating requirement - total per year (kWh/year)												3888.3175	
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	795.2637	587.9764	477.4703	268.4570	128.1308	0.0000	0.0000	0.0000	0.0000	269.3797	544.4711	817.1686	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												3888.3175	
Space heating per m2											(98c) / (4) =	31.3574	(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	795.2637	587.9764	477.4703	268.4570	128.1308	0.0000	0.0000	0.0000	0.0000	269.3797	544.4711	817.1686	(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)	861.6075	637.0275	517.3026	290.8526	138.8199	0.0000	0.0000	0.0000	0.0000	291.8523	589.8928	885.3398	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	252.7787	223.4824	237.5465	209.4852	203.4193	183.7056	181.7437	188.8272	190.7204	212.1477	224.8865	250.1310	(64)
Efficiency of water heater												79.8000	(216)
(217)m	86.4484	86.1249	85.5929	84.6171	83.0530	79.8000	79.8000	79.8000	79.8000	84.5965	85.9660	86.5133	(217)
Fuel for water heating, kWh/month	292.4041	259.4865	277.5306	247.5684	244.9269	230.2075	227.7490	236.6256	238.9980	250.7759	261.5994	289.1242	(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	30.4273	24.4099	21.9784	16.1023	12.4379	10.1619	11.3463	14.7483	19.1566	25.1345	28.3893	31.2730	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-89.6649	-115.0730	-150.7193	-153.9064	-153.8763	-139.4095	-137.4796	-135.2578	-130.2876	-123.3131	-94.3423	-78.9051	(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	-91.8955	-186.3766	-358.4731	-522.1453	-675.6025	-673.6997	-665.9026	-570.5230	-427.2889	-260.9227	-120.7179	-73.2280	(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 4212.6951 (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 3056.9961 (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) 245.5656 (232)

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

PV generation	-6129.0107	(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	1472.2461	(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	4212.6951	0.2100	884.6660	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3056.9961	0.2100	641.9692	(264)
Space and water heating			1526.6351	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	245.5656	0.1443	35.4427	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1502.2350	0.1367	-205.3185	
PV Unit electricity exported	-4626.7757	0.1268	-586.7670	
Total			-792.0856	(269)
Total CO2, kg/year			781.9216	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			6.3100	(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	4212.6951	1.1300	4760.3454	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3056.9961	1.1300	3454.4056	(278)
Space and water heating			8214.7510	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	245.5656	1.5338	376.6567	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1502.2350	1.5052	-2261.2266	
PV Unit electricity exported	-4626.7757	0.4656	-2154.0223	
Total			-4415.2490	(283)
Total Primary energy kWh/year			4306.2596	(286)
Target Primary Energy Rate (TPER)			34.7300	(287)