



**Energy & Sustainability
Statement**

Mr Greg Hill

**25 Sheldon
Avenue, London,
N6 4JS**

Final

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January 2023

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We are able to advise at all stages of projects from planning applications to handover.

Our emphasis is to provide innovative and cost-effective solutions that respond to increasing demands for quality and construction efficiency.

This report has been prepared by Hodkinson Consultancy using all reasonable skill, care and diligence and using evidence supplied by the design team, client and where relevant through desktop research.

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Executive Summary

The purpose of this Energy & Sustainability Statement is to outline the energy efficiency strategy and sustainable design and construction considerations for the development at 25 Sheldon Avenue in London, N6 4JS. The document will measure these outcomes against relevant local and national planning policies and will follow a balanced approach throughout.

The proposal comprises a single, 6-bedroom dwelling with extended basement accommodation, located within the Highgate Conservation Area, in the London Borough of Haringey. The application is for the demolition of the existing property (retaining front façade) and its replacement with a highly energy efficient dwelling.

The key features outlined in this statement are listed below:

- > **Energy Strategy:** The energy assessment within the report has been prepared following the principles of the London Plan Energy Hierarchy: 'Be Lean', 'Be Clean' and 'Be Green'. The development will be assessed against Part L 2021 Building Regulations. An energy strategy enhancing the property's fabric efficiency and incorporating mechanical ventilation with heat recovery (MVHR) and air source heat pump (ASHP) to provide space and water heating has been developed, to reduce the carbon emissions of the building in line with the local planning policy requirements. An overall carbon emission reduction of 60% over the baseline scenario has been achieved for the building.
- > **Overheating Strategy:** The dwelling will be assessed to ensure that it meets the requirements of Part O 2021 Building Regulations. This will include post-planning design analysis and, if necessary, dynamic simulation modelling, to ensure that the design has limited unwanted solar gains in summer and provide an adequate means of reducing excess heat. Operable windows enabling cross-ventilation, low solar thermal transmittance glazing and MVHR will help reduce the internal temperatures in the dwelling.
- > **Water Efficiency:** Water meters and water efficient fixtures and fittings will be installed in the dwelling to target a maximum internal daily water consumption of 105 litres/person/day.
- > **Materials, Waste & Construction:** Adequate facilities will be provided for domestic and construction related waste, including segregated bins for refuse and recycling. The principles of circular economy will be incorporated into the proposed plans, where possible. Where practical, new building materials will be sourced locally to reduce transportation pollution and support the local economy. New materials will be selected based on their environmental impact and responsible suppliers will be used where possible. The site will be registered with the Considerate Constructors Scheme.
- > **Flood Risk and SUDs:** The site lies in a low flood risk zone. SUDs will be considered where applicable including permeable paving/driveway and rainwater butts for garden irrigation.

- > **Building Quality:** The security and accessibility of the dwelling is not expected to change, with this already sufficient. The sound insulation will be improved with façade and window improvements.
- > **Biodiversity and Ecology:** The existing property has a vast garden, which will be retained and enhanced with new plant species, where suitable.

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1. INTRODUCTION

- 1.1** This document has been prepared by Hodkinson Consultancy, a specialist energy and environmental consultancy for planning and development, on behalf of Mr Greg Hill.
- 1.2** This statement sets out the energy and sustainability strategy included in the design for the proposed development at 25 Sheldon Avenue in the London Borough of Haringey.

Aims

- 1.3** The formulation of the strategy for the proposed development has considered several important objectives, including:
- > To provide a high-quality residential building, considering specific site characteristics that link to the energy strategy, such as acoustics, thermal comfort, and air quality. This will include adaptive measures which take into account future changes in climate;
 - > To achieve a high level of sustainable design and construction, through the incorporation of measures which reflect resource efficiency and mitigation and adaptation to climate change;
 - > To address all relevant national and local planning policies and requirements.
- 1.4** This statement does not duplicate the work of other reports prepared in support of the application but presents the findings in the overall context of sustainability.
- 1.5** The statement represents the scheme submitted for the planning application at the time of writing. Should changes to the scheme be incorporated this report can be updated to reflect them.

2. DEVELOPMENT OVERVIEW

- 2.1** The proposed development site is a detached house, located on 25 Sheldon Avenue, London. The site location is shown in Figure 1 below.
- 2.2** The proposal is to demolish the existing building, retaining its front façade and create a new 6-bedroom house with extensive basement accommodation, with a total GIA of approximately 730m². It is located within the Highgate Conservation Area and is not a listed building.



Figure 1: Site Location - Map data © 2022 Google

3. RELEVANT PLANNING POLICY

- 3.1 The following planning policies and requirements have informed the sustainable design of the proposed development.

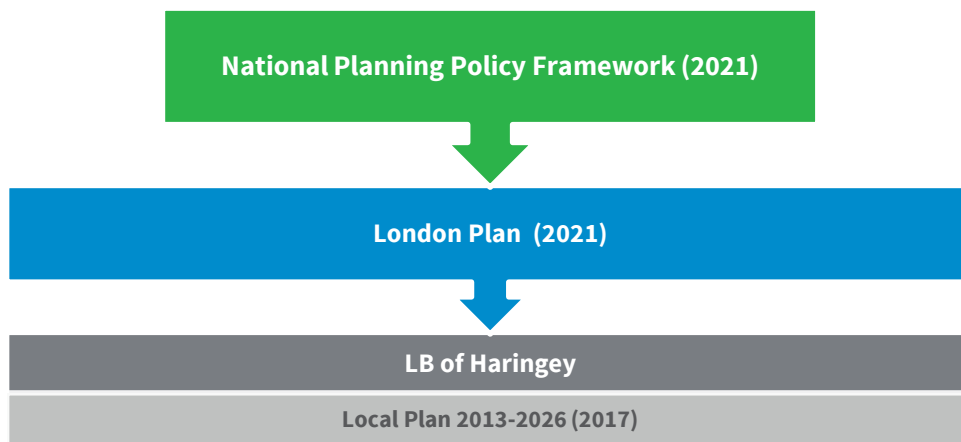


Figure 2: Relevant Planning Policy Documents

National Policy: NPPF

- 3.2 The revised National Planning Policy Framework (NPPF) was published on the 20th July 2021 and sets out the Government's planning policies for England.
- 3.3 The NPPF provides a framework for achieving sustainable development, which has been summarised as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Resolution 42/187 of the United National General Assembly). At the heart of the framework is a **presumption in favour of sustainable development**.
- 3.4 The document states that the planning system has three overarching objectives which are interdependent and need to be pursued in mutually supportive ways:
- 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 a 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

- 3.5** **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.

Regional Policy: The London Plan

London Plan (2021)

- 3.6** The London Plan sets out an integrated economic, environmental, transport and social framework for the development of London. The following policies are considered relevant to the proposed development and this Statement:
- 3.7** **Policy SI2 Minimising Greenhouse Gas Emissions** states that major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand.
- 3.8** The proposed development does not classify as major and therefore the above quoted policy will not apply. However, the development will be designed to meet the requirements of the new Part L 2021 of the Building Regulations and to maximise on renewable energy generation to minimise carbon emissions in line with the principles of the energy hierarchy.
- 3.9** **Policy SI3 Energy Infrastructure** states that energy masterplans should be developed for large-scale development locations which establish the most effective energy supply options.
- 3.10** **Policy SI4 Managing Heat Risk** states that major development proposals should demonstrate through an energy strategy how they will reduce the potential for internal overheating and reliance on air conditioning systems in accordance with the cooling hierarchy.
- 3.11** **Policy SI5 Water Infrastructure** states that in order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner. Development proposals should minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development) achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption).
- 3.12** **Policy SI7 Reducing Waste and Supporting the Circular Economy** states that referable applications should promote circular economy outcomes and aim to be net zero-waste.

Local Policy: Haringey's Local Plan Strategic Policies 2013-2026 (2013 with 2017 alterations)

- 3.13** The London Borough of Haringey Local Plan was adopted in 2013 and subsequently amended in 2017. The following policies are considered relevant to this Statement:

3.14 Policy SP4 Working towards a Low Carbon Haringey: The council will promote and require all new developments to reduce energy use and carbon emissions during design, construction and occupation. The following measures should be considered, where viable:

- > All new residential development to be net zero carbon.
- > All new developments to achieve a reduction in predicted carbon dioxide emissions of 20% from on-site renewable energy generation.

3.15 Policy DM21 Sustainable Design, Layout and Construction: All new development, including building and landscape works, will be expected to consider and implement sustainable design, layout and construction techniques.

4. ENERGY STRATEGY

- 4.1** This section outlines an example energy strategy for the proposed development that will meet the requirements of Building Regulations Part L 2021, and London Borough of Haringey local policy requirements.
- 4.2** This statement first establishes a baseline assessment of the energy demands and associated CO₂ emissions for the development. The energy strategy has been developed using the GLA hierarchy approach of **Be Lean**, **Be Clean** and **Be Green** as guidance, even though this is not required for minor development.
- 4.3** The estimated energy demand for the dwellings has been calculated using Standard Assessment Procedure (SAP) methodology. SAP calculates the regulated energy demands associated with hot water, space heating and fixed electrical items.
- 4.4** The development will be built under Part L 2021 of the Building Regulations, which has significant improved baseline targets compared to Part L 2013. It will meet all the requirements of London Plan policy, aiming to achieve a reduction in CO₂ over a Part L 2021 baseline, as well as meeting Primary Energy and Fabric Energy Efficiency requirements.

Baseline Emissions

- 4.5** Table 1, below shows the Regulated baseline CO₂ emissions rates for Part L 2021. The results are based on the SAP calculation methodology with the fabric and systems' efficiencies reference values as given in the SAP Appendix R for Notional Dwellings. TER worksheets supporting these calculations are presented in Appendix A.

Table 1: Carbon Dioxide Emissions Baseline – Part L 2021

	Regulated [tonnes CO ₂ /year]
Proposed development	5.9

***Be Lean* – Energy Efficiency**

- 4.6** This section sets out potential fabric energy efficiency measures to meet Part L 2021 requirements. This will be reviewed at the detailed design stage. For the ***Be Lean*** stage it is assumed that heating and hot water is supplied by a gas boiler and hot water cylinder only, further renewable options are considered at the ***Be Green*** stage. As this is a single property, a decentralised energy network (***Be Clean***) has not been considered as it would not be technically or financially feasible.
- 4.7** The dwelling will incorporate enhanced insulation in the building envelope (walls, roofs, floors and glazing) to achieve U-values in the region of the below figures, shown for reference. A detailed design stage will focus on achieving or exceeding these values and the specification will be developed to ensure the estimated carbon emission reduction targets are achieved for the completed dwelling.
- > Glazing with a U-value of 0.95 W/m²K, g-value of 0.45,
 - > External wall U-value of 0.17 - 0.18 W/m²K for the new elements and 0.20 W/m²K for the existing wall that is to be retained,
 - > Ground floor U-value of 0.10-0.12 W/m²K;
 - > Roof U-value of 0.09 - 0.12 W/m²K;
 - > 100% energy efficiency lighting throughout the building with a minimum efficacy of 75 lm/W;
 - > Bespoke thermal bridging calculations for 50% of junction types (details in the appended SAP Worksheets).
- 4.8** It is proposed that the dwelling will incorporate a mechanical ventilation with heat recovery system (MVHR) and have a target design air permeability rate of 3m³/h.m² @ 50 Pa.
- 4.9** The MVHR system will be of high efficiency in the region of 90% and with low specific fan power (SFP). The system used for the purpose of the modelling is Vent Axia Sentinel Kinetic Plus BS. The exact model will be chosen when the design develops.

CO₂ Emissions at *Be Lean* Stage

- 4.10** Table 3 below shows the Regulated CO₂ reductions following the application of the *Be Lean* measures proposed in this report. These result in an estimated 12% CO₂ reduction over a Part L 2021 baseline. The proposed strategy will also meet Part L 2021 Primary Energy and Fabric Energy Efficiency Targets. DER worksheets supporting these calculations are shown in Appendix A.

Table 2: Regulated Carbon Dioxide Emissions at <i>Be Lean</i> Stage	
Stage	Carbon Dioxide Emissions (tonnes CO ₂ per Annum)
Part L 2021 Baseline	5.9
After <i>Be Lean</i> Measures	5.2
Total Emissions Reduction	0.7
Percentage Reduction	12%

Be Clean – Decentralised Energy

- 4.11** Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The London Plan Policy SI2 and the Local Plan Policy SP4, require development proposals to explore the opportunities to link into an existing or planned decentralised energy network. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken, including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system.
- 4.12** The London Heat Map tool is an interactive tool that allows users to identify opportunities for decentralised energy projects in London. It details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.
- 4.13** The London Heat Map tool indicates the location of a proposed decentralised heat network at Wood Green, approximately 3,000 metres from the proposed development site (Please refer to Figure 3).

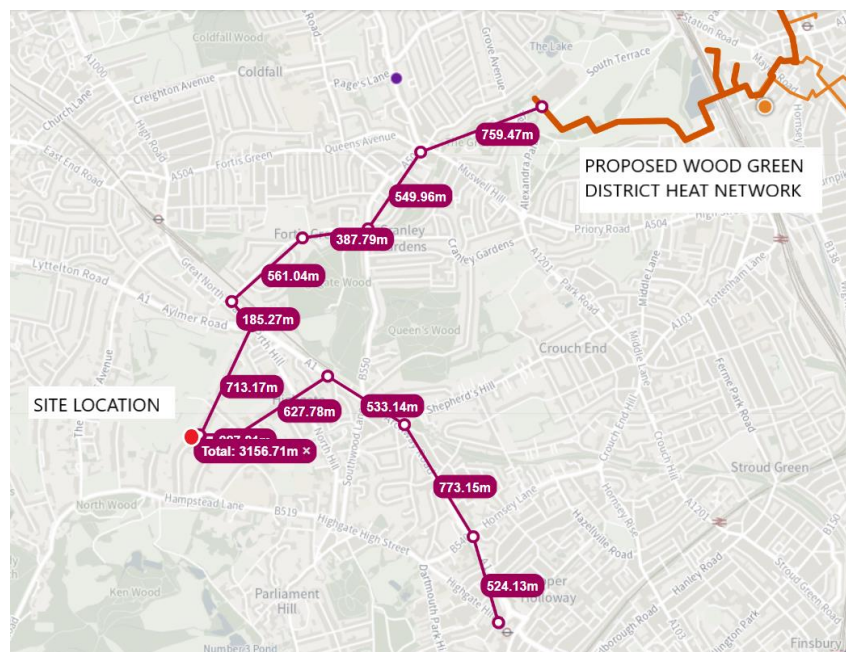


Figure 3: Location of the Site in relation to proposed heat networks (source: London Heat Map).

***Be Green* – Renewable Energy Technologies**

4.14 The next part of the Energy Hierarchy is ***Be Green*** which seeks for renewable energy technologies to be specified to provide, where feasible, a reduction in expected CO₂ emissions. The technical feasibility and viability of a range of renewable technologies have been considered. It is proposed to install a highly efficient air source heat pump providing space and water heating to the dwelling.

Air Source Heat Pump (ASHP)

4.15 ASHP is considered the most suitable option for providing heating to the development. The choice of air source heat pumps was dictated by a number of restrictions and constraints posed by the development. The following low carbon and renewable technologies were considered for the development but discounted based on the site's limitations:

- > PV panels - limited roof areas due to the location of the building in conservation area, which prevents the PV panels to be located on the front facing sloping roof. The rear facing roofs have a very limited capacity for installation of PV panels due to roof structures like dormers and large rooflights mounted on the flat roof.
- > Solar thermal panels – roof limitations as for the PV panels, described above. Additional plumbing complexities and the system's integration with the selected ASHP makes this system less desirable for the assessed property.

- > Wind turbine and biomass engine - location of the development in an urban area offers no space for installation of these systems; additional planning issues add to the complexity of their installation and make the systems technically and economically unviable.
- 4.16** Heat Pumps, utilising low grade heat, provide high efficiency, low carbon heating. The efficiency of a heat pump is rated by its coefficient of performance (CoP).
- 4.17** ASHPs will be used to provide space and water heating for all areas of the development. ASHPs extract energy from the air and therefore require space for external units. The side and rear gardens are suitable for the external units of the system.
- 4.18** It is proposed that heat pumps with heating coefficient of performance (SCoP) of approximately 2.8 be fitted to the building. The efficiency proposed is based on Vaillant unit and will be confirmed at detailed design stage. Careful system selection can increase its efficiency and ensure higher carbon emission reductions.
- 4.19** The heat distribution for the dwelling is proposed to be via underfloor heat pipes to all rooms and the hot water will be stored in a well-insulated tank located in the basement plant room. All hot water distribution pipes will be insulated to avoid heat losses from the system.

CO₂ Emissions at *Be Green* Stage

- 4.20** Table 3 below shows the Regulated CO₂ reductions following the application of the *Be Lean* and *Be Green* measures proposed in this report. The figures confirm that an estimated 63% CO₂ reduction over a Part L 2021 baseline is achievable for the scheme with the application of energy efficient fabric and systems, including ASHP. DER worksheets supporting these calculations are shown in Appendix B.

Table 3: Regulated Carbon Dioxide Emissions at <i>Be Green</i> Stage	
Stage	Carbon Dioxide Emissions (tonnes CO ₂ per Annum)
Part L 2021 Baseline	5.9
After <i>Be Lean</i> Measures	5.2
After <i>Be Green</i> Measures – ASHP only	2.2
Total Emissions Reduction	3.7
Percentage Reduction	63%

- 4.21** The London Plan requirement to reduce CO₂ emissions over the Building Regulations by 35% on-site has been met and exceeded for the development.
- 4.22** The above result provides a robust case for supporting the proposed heating strategy incorporating air source heat pump for the dwelling. This aligns with the local policy strategy supporting clean, low emission fuels.

5. OVERHEATING STRATEGY

- 5.1** This section outlines the overheating mitigation measures discussed and proposed for the development that will ensure it meets the requirements of Building Regulations Part O 2021, and the London Plan Requirements.
- 5.2** Maintaining comfortable thermal comfort conditions in the face of climate change and increasing temperatures is one of the greatest challenges to be addressed by designers. The main objective is to achieve thermal comfort and minimise summertime overheating without the use of conventional air conditioning systems, which typically have associated greenhouse gas emissions and impact on the urban heat island effect.
- 5.3** Requirement O1 in Approved Document O highlights that residential buildings must be designed and constructed to limit unwanted solar gains in summer and provide an adequate means of removing excess heat from the indoor environment. The development at 25 Sheldon Avenue, has addressed these elements through the following:
- > **Minimising solar gains**
 - > By using high performance solar control glazing; likely to be around 0.45 (g-value). This will be balanced to mitigate overheating risk whilst achieving fabric energy efficiency targets and natural daylight provision; and
 - > By default, this development benefits from shading from adjacent buildings.
 - > Shading control systems in the form of individually controlled interior opaque blinds will be considered to be fitted internally. They will offer efficient solar control as they provide both solar shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the dwelling.
 - > **Removing excess heat**
 - > All zones benefit from traditional openable windows.

- > The design allows for cross ventilation placing openable windows on opposite facades of the dwelling.
- > All rooms are proposed to be fitted with mechanical ventilation with heat recovery and summer by-pass to allow the spaces to be purged of hot air during the cooler night hours without compromising on the dwelling's security.

6. SUSTAINABILITY CONSIDERATIONS

- 6.1** This section summarises the sustainability measures that will apply to the development. These will be addressed to align with the requirements of the Local Plan, specifically Policy DM21.

Water Reduction

- 6.2** Internal water consumption will be significantly reduced within this development through a range of practical and hygienic water saving measures outlined below.
- 6.3** The dwelling will target the minimum water efficiency standards of 105 litres/person/day in accordance with London Plan Policy S15 and the Building Regulations Approved Document G requirement (110 litres/person/day).
- 6.4** To achieve the targeted water consumption level of ≤ 105 litres/person/day, a combination of the following water efficient fittings are proposed for the dwelling:
- > Dual flush WCs - cisterns with both a half flush and full flush. The half flush delivers 4 litres for the removal of liquids, whilst the full flush delivers 6 litres for a long flush. These cisterns save over 17% of water when compared to a 6 litre cistern.
 - > Flow restrictors & aerators - restrictors fit within the existing plumbing structure of the shower head or connection pipe to taps to restrict water flow and reduce the outlet flow and pressure. Aerators restrict the flow of water but maintain the pressure by adding air to the water giving a perception of a power shower/taps without the water and energy use.
 - > Appliances - low water consuming appliances will be selected and fitted.
- 6.5** Incoming water will also be metered, allowing for considerate water use within the building. Increasing awareness of the amount and cost of water being used helps to incentivise reduced and mindful consumption.

Waste Management

Construction Waste

- 6.6** The reduction of construction waste not only minimises environmental impacts through ensuring the responsible use of resources and waste disposal, but can also significantly reduce construction costs for the developer.
- 6.7** Prior to construction, the Applicant will develop a Site Waste Management Plan which will establish ways of minimising waste at source, assess the use, reuse and recycling of materials on and off-site and prevent illegal waste activities. This plan will then be disseminated to all relevant personnel on and off-site.
- 6.8** The following waste minimisation actions will be considered:
- > Minimise waste from excavation or groundworks.
 - > Design for standardisation of components and the use of fewer materials.
 - > Return packaging for reuse.
 - > Consider community reuse of surplus materials or offcuts and
 - > Engage with supply chains and include waste minimisation initiatives and targets in tenders and contracts.
 - > Follow the principles of circular economy through conservation of resources and ethical sourcing of materials, resource efficient design, including the selection of robust materials with a potential for reuse.

Residential Waste

- 6.9** The Applicant is committed to following the above waste hierarchy and reducing waste sent to landfill. As such, adequate storage will be provided, where both recyclable and non-recyclable waste can be stored in accordance with Haringey's waste collection services.
- 6.10** In addition, space will be provided for segregated recycling waste bins within the kitchen area. This will involve the installation of recycling bins, where waste can be segregated into paper, glass, cans, plastic and cardboard, if necessary.

Materials

- 6.11** New building materials will be selected, where possible, to ensure that they minimise environmental impact and have low embodied energy – from manufacture, transportation, and operational stages, through to eventual demolition and disposal.
- 6.12** All insulation materials will have an Ozone Depleting Potential (ODP) of zero and a Global Warming Potential (GWP) of less than 5. In addition, all decorative paints and varnishes will meet the relevant standards to reduce the emission levels of volatile organic compounds (VOCs).
- 6.13** Where possible, materials will be selected with a preference given to locally sourced manufacturers. This will benefit the local economy as well as having environmental benefits through reduced transportation.
- 6.14** If possible, the demolition materials will be reclaimed and used again on the new development.

Flood Risk

- 6.15** Developments in low flood risk areas are promoted to, not only protect homes and local communities and reduce the cost implications if flooding occurs, but to protect the environment from the transfer of pollutants during flooding events.
- 6.16** The proposed development lies in a low-risk flood zone (Flood Zone 1), indicating that the land has a less than 1 in 1,000 annual probability of flooding from all sources. Please refer to Figure 4 below for details.

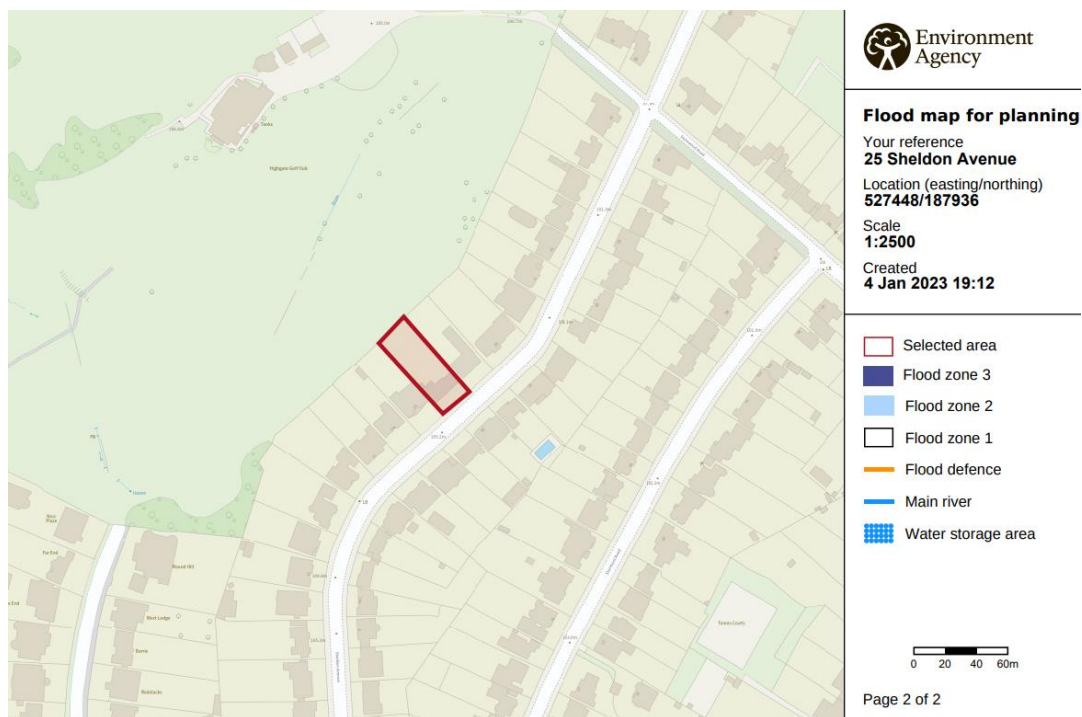


Figure 4: Environment Agency Flood Map – <https://flood-map-for-planning.service.gov.uk>

- 6.17** Due to the small size of the site and the low flood risk, it is not envisaged that the site will contribute to increased surface water run-off, or drainage concerns. However, basic SUDs systems like permeable surfaces and rainwater storage butts for garden irrigation will be incorporated into the design.

Building Quality

- 6.18** The security and access of the site is expected to change within the proposed alterations. As such, it is assumed that the building remains both secure, and accessible for the occupants.
- 6.19** The façade improvements and replacement windows will ensure that the building has a higher quality sound insulation. This will prevent external noises from disturbing the occupants, promoting a healthier internal environment.
- 6.20** The promotion of good daylighting levels contributes to sustainability through improving the occupant's quality of life and reducing the building's energy consumption by minimising the need for artificial lighting. The addition of roof lights above the basement accommodation will provide higher levels of daylight and sunlight into the deeper rooms within the dwelling, reducing demand on artificial lighting.
- 6.21** All internal lighting will be designed to avoid flicker and stroboscopic effects and will be designed to provide an appropriate illuminance (lux) level. Unnecessary light spill will be reduced by

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

Transport and local amenities

- 6.22 Sustainable transport links are central to the sustainability debate. They provide a positive contribution to environment, societal and economic sustainability of the places they serve.
- 6.23 Due to the size of the dwelling and the associated alterations, transport and travel plans have not been completed. The existing parking is to be retained. The travel habits of occupants are therefore not expected to change, and the existing transport links are expected to be appropriate.
- 6.24 The site's location within the London Borough of Haringey that it is well connected to existing transport services.
- 6.25 The dwelling also has access to key local amenities. These include health services, retail services, recreation and leisure facilities, and education facilities, all located within 1.5km from the site.

Sustainable Construction

- 6.26 Sustainable construction involves the prudent use of existing and new resources and the efficient management of the construction process.
- 6.27 The development will be registered with the Considerate Constructors Scheme. This is designed to encourage environmentally and socially considerate ways of working, to reduce any adverse impacts arising from the construction process.
- 6.28 Throughout the construction process, control procedures will be put in place to minimise noise and dust pollution and roads will be kept clean. The management systems will generally comprise procedures and working methods that are approved by the development team together with commercial arrangement to ensure compliance.
- 6.29 Further to the above, additional measures will be adopted to minimise the impact on the local area during construction. This will include the limiting of air and water pollution in accordance with best practice principles, as well as the recording, monitoring, and displaying of energy and water use from site activities during construction.
- 6.30 In terms of construction traffic, this will be minimised by restricting deliveries and arrival times in order to manage potential impacts on existing and future occupants. Work will be limited to appropriate hours to be agreed with the Council, and suppressors will be used to reduce noise from machinery.

- 6.31** The Contractor will provide a Construction Management Plan prior to undertaking the proposed works. The contents of this plan will be agreed upon with the Local Authority and complied with unless otherwise agreed with the Local Authority.

7. CONCLUSIONS

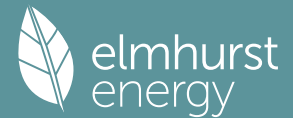
- 7.1** This report has considered the energy and sustainability strategies for the development at 25 Sheldon Avenue in the London Borough of Haringey. The document has summarised these outcomes against relevant local and national planning policies.
- 7.2** The key features outlined in this statement are listed below:
- > **Energy Strategy:** The energy assessment within the report has been prepared following the principles of the London Plan Energy Hierarchy: 'Be Lean', 'Be Clean' and 'Be Green'. The development will be assessed against Part L 2021 Building Regulations. An energy strategy enhancing the property's fabric efficiency and incorporating mechanical ventilation with heat recovery (MVHR) and air source heat pump (ASHP) to provide space and water heating has been developed, to reduce the carbon emissions of the building in line with the local planning policy requirements. An overall carbon emission reduction of 60% over the baseline scenario has been achieved for the building.
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 - > **Building Quality:** The security and accessibility of the dwelling is not expected to change, with this already sufficient. The sound insulation will be improved with façade and window improvements.

- > **Biodiversity and Ecology:** The existing property has a vast garden, which will be retained and enhanced with new plant species, where suitable.

APPENDICES

Appendix A – SAP TER/DER worksheet Baseline and Be Lean Scenario

Full SAP Calculation Printout



Property Reference	v1				Issued on Date	05/01/2023	
Assessment Reference	Be Lean		Prop Type Ref	Be Lean			
Property	25, Sheldon Avenue, London, N6 1JS						
SAP Rating	87 B		DER	9.61		TER	8.12
Environmental	88 B		% DER < TER				-18.35
CO ₂ Emissions (t/year)	6.28		DFEE	45.08		TFEE	46.40
Compliance Check	See BREL		% DFEE < TFEE				2.84
% DPER < TPER	-26.23		DPER	55.16		TPER	43.70
Assessor Details	Miss Alicja Kreglewska					Assessor ID	L728-0001
Client							

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Basement floor	208.7200 (1a)	x 3.0000 (2a)	= 626.1600 (1a) -
Ground floor	278.9400 (1b)	x 3.6000 (2b)	= 1004.1840 (1b) -
First floor	195.8600 (1c)	x 3.0000 (2c)	= 587.5800 (1c) -
Second floor	42.3500 (1d)	x 2.2000 (2d)	= 93.1700 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	725.8700		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 2311.0940 (5)
Dwelling volume			

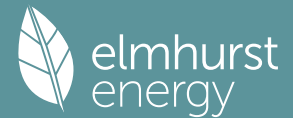
2. Ventilation rate

	m ³ per hour	
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	0 * 10 =	0.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	Air changes per hour	
Pressure test	0.0000 / (5) =	0.0000 (8)
Pressure Test Method	Yes	
Measured/design AP50	Blower Door	
Infiltration rate	3.0000	(17)
Number of sides sheltered	0.1500	(18)
	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1275 (21)
Wind speed	Jan 5.1000	Feb 5.0000
Wind factor	Mar 4.9000	Apr 4.4000
Adj infilt rate	May 4.3000	Jun 3.8000
	Jul 3.8000	Aug 3.7000
	Sep 4.0000	Oct 4.3000
	Nov 4.5000	Dec 4.7000 (22)
	0.1626	0.1594
	0.1562	0.1403
	0.1371	0.1211
	0.1211	0.1179
	0.1275	0.1371
	0.1434	0.1498 (22b)
Balanced mechanical ventilation with heat recovery	0.5000 (23a)	
If mechanical ventilation	0.5000 (23b)	
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	80.1000 (23c)	
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =		
Effective ac	0.2621	0.2589
	0.2557	0.2397
	0.2366	0.2206
	0.2206	0.2174
	0.2270	0.2366
	0.2429	0.2493 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
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Window (Uw = 0.95)			116.3200	0.9152	106.4586			(27)
Door			7.2200	1.0000	7.2200			(26)
rooflight			13.8600	0.9152	12.6850			(27a)
rooflight			2.0000	0.9152	1.8304			(27a)
rooflight			2.0000	0.9152	1.8304			(27a)
Basement floor			208.7200	0.1000	20.8720	110.0000	22959.2000	(28a)
GF			62.3100	0.1200	7.4772	110.0000	6854.1000	(28a)
Above garage			27.8400	0.1152	3.2061	20.0000	556.8000	(28b)
External Wall -retained	112.8600	38.2100	74.6500	0.2000	14.9300	9.0000	671.8500	(29a)
External Wall NEW	278.0000	77.4000	200.6000	0.1700	34.1020	110.0000	22066.0000	(29a)
Basement wall	176.2500		176.2500	0.1800	31.7250	17.0000	2996.2500	(29a)
walls to loft	65.2000		65.2000	0.1800	11.7360	18.0000	1173.6000	(29a)
Dormers	16.5000	7.9300	8.5700	0.1800	1.5426	9.0000	77.1300	(29a)
Wall to garage	40.3200		40.3200	0.1600	6.4512	110.0000	4435.2000	(29a)
Flat roof	96.9100	13.8600	83.0500	0.1200	9.9660	9.0000	747.4500	(30)
Insul. rafters	56.9700	4.0000	52.9700	0.1200	6.3564	9.0000	476.7300	(30)
Insul. joists	104.6900		104.6900	0.0900	9.4221	9.0000	942.2100	(30)
Total net area of external elements Aum(A, m2)			1246.5700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	287.8111			(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 63956.5200 (34)
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 88.1102 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	64.3500	0.1000	6.4350
E3 Sill	61.9500	0.0800	4.9560
E4 Jamb	137.5400	0.0800	11.0032
R1 Head of roof window	4.0000	0.2400	0.9600
R2 Sill of roof window	4.0000	0.2400	0.9600
R3 Jamb of roof window	4.0000	0.2400	0.9600
R11 Upstands or kerbs of rooflights	28.2000	0.2400	6.7680
E22 Basement floor	58.7500	0.0700	4.1125
E5 Ground floor (normal)	77.6500	0.1200	9.3180
E21 Exposed floor (inverted)	11.2000	0.2700	3.0240
E6 Intermediate floor within a dwelling	92.2700	0.1000	9.2270
E19 Ground floor (inverted)	9.5000	0.1000	0.9500
E24 Eaves (insulation at ceiling level - inverted)	29.4900	0.1500	4.4235
E15 Flat roof with parapet	21.0400	0.2000	4.2080
E11 Eaves (insulation at rafter level)	26.5000	0.0600	1.5900
R4 Ridge (vaulted ceiling)	7.2000	0.1200	0.8640
R9 Roof to wall (flat ceiling)	37.0000	0.3200	11.8400
E16 Corner (normal)	12.0000	0.1800	2.1600
E16 Corner (normal)	75.0000	0.0900	6.7500
E17 Corner (inverted - internal area greater than external area)	62.0000	0.0000	0.0000
E20 Exposed floor (normal)	11.2000	0.2700	3.0240

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 93.5332 (36)
 Point Thermal bridges (36a) = 0.0000
 Total fabric heat loss (33) + (36) + (36a) = 381.3443 (37)

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

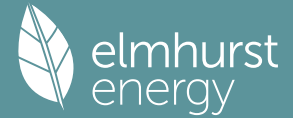
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	199.8649	197.4339	195.0029	182.8480	180.4170	168.2621	168.2621	165.8311	173.1241	180.4170	185.2790	190.1409	(38)
Heat transfer coeff	581.2091	578.7781	576.3472	564.1923	561.7613	549.6064	549.6064	547.1754	554.4683	561.7613	566.6232	571.4852	(39)
Average = Sum(39)m / 12 =												563.5845	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8007	0.7974	0.7940	0.7773	0.7739	0.7572	0.7572	0.7538	0.7639	0.7739	0.7806	0.7873	(40)
HLP (average)												0.7764	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.6856 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	99.2780	97.8036	95.7273	91.8990	89.0324	85.8538	84.1369	86.1987	88.4436	91.8448	95.7519	98.9424	(42b)
Hot water usage for other uses	52.3738	50.4693	48.5648	46.6603	44.7558	42.8513	42.8513	44.7558	46.6603	48.5648	50.4693	52.3738	(42c)
Average daily hot water use (litres/day)												139.6589	(43)
Daily hot water use	151.6518	148.2729	144.2921	138.5593	133.7882	128.7051	126.9882	130.9545	135.1039	140.4096	146.2212	151.3162	(44)
Energy conte	240.1794	211.1387	221.7716	189.6808	180.1047	158.2580	153.5812	162.1490	166.5966	190.5345	208.3189	236.9246	(45)
Energy content (annual)										Total = Sum(45)m =		2319.2381	
Distribution loss (46)m = 0.15 x (45)m	36.0269	31.6708	33.2657	28.4521	27.0157	23.7387	23.0372	24.3224	24.9895	28.5802	31.2478	35.5387	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7614	(55)
Total storage loss	23.6034	21.3192	23.6034	22.8420	23.6034	22.8420	23.6034	23.6034	22.8420	23.6034	22.8420	23.6034	(56)
If cylinder contains dedicated solar storage	23.6034	21.3192	23.6034	22.8420	23.6034	22.8420	23.6034	23.6034	22.8420	23.6034	22.8420	23.6034	(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													

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WVHRS	287.0452	253.4691	268.6374	235.0348	226.9705	203.6120	200.4470	209.0148	211.9506	237.4003	253.6729	283.7904 (62)
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 (63a)
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 (63b)
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 (63c)
Output from w/h	287.0452	253.4691	268.6374	235.0348	226.9705	203.6120	200.4470	209.0148	211.9506	237.4003	253.6729	283.7904 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											2871.0451 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)
Heat gains from water heating, kWh/month	117.3523	104.0679	111.2317	99.3521	97.3774	88.9040	88.5584	91.4072	91.6766	100.8454	105.5492	116.2701 (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	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	383.5704	424.6672	383.5704	396.3561	383.5704	396.3561	383.5704	383.5704	396.3561	383.5704	396.3561	383.5704 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	750.4714	758.2589	738.6346	696.8566	644.1195	594.5540	561.4412	553.6537	573.2780	615.0560	667.7931	717.3586 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278 (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)	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224 (71)
Water heating gains (Table 5)	157.7316	154.8630	149.5050	137.9890	130.8837	123.4777	119.0301	122.8591	127.3286	135.5448	146.5962	156.2770 (72)
Total internal gains	1373.0568	1419.0725	1352.9933	1312.4851	1239.8569	1192.6712	1142.3251	1138.3666	1175.2461	1215.4546	1292.0288	1338.4894 (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				10.3700	11.2829		0.4500		0.8000		0.7700		29.1902 (75)
East				5.9200	19.6403		0.4500		0.8000		0.7700		29.0071 (76)
Southeast				23.0500	36.7938		0.4500		0.8000		0.7700		211.5834 (77)
South				5.9200	46.7521		0.4500		0.8000		0.7700		69.0491 (78)
Southwest				4.6400	36.7938		0.4500		0.8000		0.7700		42.5921 (79)
Northwest				66.4200	11.2829		0.4500		0.8000		0.7700		186.9635 (81)
Northwest				13.8600	26.0000		0.4500		0.8000		1.0000		116.7566 (82)
Northeast				2.0000	26.0000		0.4500		0.8000		1.0000		16.8480 (82)
Southwest				2.0000	26.0000		0.4500		0.8000		1.0000		16.8480 (82)
Solar gains	718.8382	1355.2495	2178.1215	3202.9602	4019.8249	4173.4255	3948.1584	3315.7478	2531.9950	1587.4290	885.3954	599.0816	(83)
Total gains	2091.8949	2774.3220	3531.1148	4515.4453	5259.6818	5366.0968	5090.4835	4454.1144	3707.2410	2802.8836	2177.4242	1937.5710	(84)

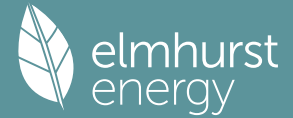
7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, nil _m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.5668	30.6952	30.8247	31.4887	31.6250	32.3244	32.3244	32.4680	32.0410	31.6250	31.3536	31.0869
alpha	3.0378	3.0463	3.0550	3.0992	3.1083	3.1550	3.1550	3.1645	3.1361	3.1083	3.0902	3.0725
util living area	0.9926	0.9823	0.9572	0.8848	0.7540	0.5835	0.4501	0.5206	0.7700	0.9442	0.9863	0.9941 (86)
MIT	18.9079	19.1763	19.5969	20.1545	20.5690	20.7998	20.8688	20.8501	20.6445	20.0575	19.3928	18.8857 (87)
Th 2	20.2527	20.2556	20.2585	20.2731	20.2760	20.2906	20.2906	20.2935	20.2848	20.2760	20.2702	20.2643 (88)
util rest of house	0.9916	0.9800	0.9513	0.8693	0.7224	0.5333	0.3850	0.4529	0.7279	0.9338	0.9842	0.9934 (89)
MIT 2	18.2734	18.5428	18.9619	19.5173	19.9084	20.1225	20.1750	20.1663	19.9930	19.4332	18.7705	18.2600 (90)
Living area fraction	FLA = Living area / (4) =											0.1791 (91)
MIT	18.3871	18.6562	19.0756	19.6314	20.0267	20.2438	20.2992	20.2888	20.1097	19.5450	18.8820	18.3721 (92)
Temperature adjustment												0.0000
adjusted MIT	18.3871	18.6562	19.0756	19.6314	20.0267	20.2438	20.2992	20.2888	20.1097	19.5450	18.8820	18.3721 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9882	0.9734	0.9397	0.8536	0.7106	0.5298	0.3858	0.4525	0.7164	0.9208	0.9786	0.9906 (94)
Useful gains	2067.1244	2700.4537	3318.3143	3854.2886	3737.3509	2843.1113	1964.1166	2015.3533	2655.7918	2580.7787	2130.9355	1919.3219 (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												

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	8187.5305	7961.8139	7247.9258	6054.5735	4677.6306	3101.8647	2033.1235	2127.8374	3332.1798	5024.9578	6675.9414	8099.1415 (97)
Space heating kwh	4553.5822	3535.6340	2923.6309	1584.2051	699.5681	0.0000	0.0000	0.0000	0.0000	1818.4693	3272.4043	4597.7858 (98a)
Space heating requirement - total per year (kWh/year)												22985.2797
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	4553.5822	3535.6340	2923.6309	1584.2051	699.5681	0.0000	0.0000	0.0000	0.0000	1818.4693	3272.4043	4597.7858 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												22985.2797
Space heating per m2										(98c) / (4) =		31.6658 (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 %)												83.8000 (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	4553.5822	3535.6340	2923.6309	1584.2051	699.5681	0.0000	0.0000	0.0000	0.0000	1818.4693	3272.4043	4597.7858 (98)
Space heating efficiency (main heating system 1)	83.8000	83.8000	83.8000	83.8000	83.8000	0.0000	0.0000	0.0000	0.0000	83.8000	83.8000	83.8000 (210)
Space heating fuel (main heating system)	5433.8689	4219.1336	3488.8197	1890.4596	834.8069	0.0000	0.0000	0.0000	0.0000	2170.0111	3905.0170	5486.6178 (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	287.0452	253.4691	268.6374	235.0348	226.9705	203.6120	200.4470	209.0148	211.9506	237.4003	253.6729	283.7904 (64)
Efficiency of water heater	83.2101	83.1351	82.9651	82.5247	81.4126	74.8000	74.8000	74.8000	74.8000	82.6584	83.0853	79.8000 (216)
Fuel for water heating, kWh/month	344.9646	304.8883	323.7956	284.8054	278.7903	272.2085	267.9773	279.4316	283.3564	287.2065	305.3163	341.0059 (219)
Space cooling fuel requirement	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	228.8114	206.6684	228.8114	221.4304	228.8114	221.4304	228.8114	228.8114	221.4304	228.8114	221.4304	228.8114 (231)
Lighting	75.4492	60.5281	54.4989	39.9282	30.8417	25.1979	28.1348	36.5707	47.5017	62.3249	70.3958	77.5461 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	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)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												27428.7347 (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												3573.7466 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9250)												
mechanical ventilation fans (SFP = 0.9250)												2608.0696 (230a)
central heating pump												41.0000 (230c)
main heating flue fan												45.0000 (230e)
Total electricity for the above, kWh/year												2694.0696 (231)
Electricity for lighting (calculated in Appendix L)												608.9181 (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												34305.4689 (238)

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	27428.7347	0.2100	5760.0343 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3573.7466	0.2100	750.4868 (264)
Space and water heating			6510.5211 (265)
Pumps, fans and electric keep-hot	2694.0696	0.1387	373.7007 (267)
Energy for lighting	608.9181	0.1443	87.8857 (268)
Total CO2, kg/year			6972.1074 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.6100 (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	27428.7347	1.1300	30994.4702 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3573.7466	1.1300	4038.3336 (278)
Space and water heating			35032.8039 (279)
Pumps, fans and electric keep-hot	2694.0696	1.5128	4075.5885 (281)
Energy for lighting	608.9181	1.5338	933.9789 (282)
Total Primary energy kWh/year			40042.3712 (286)
Dwelling Primary energy Rate (DPER)			55.1600 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Basement floor	208.7200 (1a)	x 3.0000 (2a)	= 626.1600 (1a) -
Ground floor	278.9400 (1b)	x 3.6000 (2b)	= 1004.1840 (1b) -
First floor	195.8600 (1c)	x 3.0000 (2c)	= 587.5800 (1c) -
Second floor	42.3500 (1d)	x 2.2000 (2d)	= 93.1700 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	725.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2311.0940 (5)

2. Ventilation rate

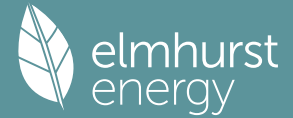
	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0173 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)
Infiltration rate	0.2673	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2272 (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	0.2897	0.2840	0.2783	0.2499	0.2443	0.2159	0.2159	0.2102	0.2272	0.2443	0.2556	0.2670 (22b)
Effective ac	0.5420	0.5403	0.5387	0.5312	0.5298	0.5233	0.5233	0.5221	0.5258	0.5298	0.5327	0.5356 (25)

3. Heat losses and heat loss parameter

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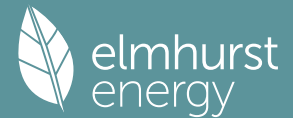


Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opaque door			7.2200	1.0000	7.2200			(26)					
TER Opening Type (Uw = 1.20)			116.3200	1.1450	133.1908			(27)					
rooflight			2.0000	1.5918	3.1835			(27a)					
rooflight			2.0000	1.5918	3.1835			(27a)					
rooflight			13.8600	2.0221	28.0257			(27a)					
Basement floor			208.7200	0.1300	27.1336			(28a)					
GF			62.3100	0.1300	8.1003			(28a)					
Above garage			27.8400	0.1300	3.6192			(28b)					
External Wall -retained	112.8600	38.2100	74.6500	0.1800	13.4370			(29a)					
External Wall NEW	278.0000	77.4000	200.6000	0.1800	36.1080			(29a)					
Basement wall	176.2500		176.2500	0.1800	31.7250			(29a)					
walls to loft	65.2000		65.2000	0.1800	11.7360			(29a)					
Dormers	16.5000	7.9300	8.5700	0.1800	1.5426			(29a)					
Wall to garage	40.3200		40.3200	0.1800	7.2576			(29a)					
Flat roof	96.9100	13.8600	83.0500	0.1100	9.1355			(30)					
Insul. rafters	56.9700	4.0000	52.9700	0.1100	5.8267			(30)					
Insul. joists	104.6900		104.6900	0.1100	11.5159			(30)					
Total net area of external elements Aum(A, m2)			1246.5700					(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	341.9410			(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							88.1102	(35)					
List of Thermal Bridges													
K1 Element				Length	Psi-value		Total						
E1 Steel lintel with perforated steel base plate				64.3500	0.0500		3.2175						
E3 Sill				61.9500	0.0500		3.0975						
E4 Jamb				137.5400	0.0500		6.8770						
R1 Head of roof window				4.0000	0.0800		0.3200						
R2 Sill of roof window				4.0000	0.0600		0.2400						
R3 Jamb of roof window				4.0000	0.0800		0.3200						
R11 Upstands or kerbs of rooflights				28.2000	0.0800		2.2560						
E22 Basement floor				58.7500	0.0700		4.1125						
E5 Ground floor (normal)				77.6500	0.1600		12.4240						
E21 Exposed floor (inverted)				11.2000	0.3200		3.5840						
E6 Intermediate floor within a dwelling				92.2700	0.0000		0.0000						
E19 Ground floor (inverted)				9.5000	0.0700		0.6650						
E24 Eaves (insulation at ceiling level - inverted)				29.4900	0.2400		7.0776						
E15 Flat roof with parapet				21.0400	0.5600		11.7824						
E11 Eaves (insulation at rafter level)				26.5000	0.0400		1.0600						
R4 Ridge (vaulted ceiling)				7.2000	0.0800		0.5760						
R9 Roof to wall (flat ceiling)				37.0000	0.0400		1.4800						
E16 Corner (normal)				12.0000	0.0900		1.0800						
E16 Corner (normal)				75.0000	0.0900		6.7500						
E17 Corner (inverted - internal area greater than external area)				62.0000	-0.0900		-5.5800						
E20 Exposed floor (normal)				11.2000	0.3200		3.5840						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							64.9235	(36)					
Point Thermal bridges						(36a) =	0.0000						
Total fabric heat loss						(33) + (36) + (36a) =	406.8645	(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	413.3330	412.0903	410.8722	405.1509	404.0804	399.0973	399.0973	398.1745	401.0167	404.0804	406.2459	408.5098	(38)
Heat transfer coeff													
	820.1975	818.9548	817.7367	812.0154	810.9449	805.9619	805.9619	805.0391	807.8813	810.9449	813.1104	815.3743	(39)
Average = Sum(39)m / 12 =												812.0102	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1300	1.1282	1.1266	1.1187	1.1172	1.1103	1.1103	1.1091	1.1130	1.1172	1.1202	1.1233	(40)
HLP (average)												1.1187	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)													

Assumed occupancy													3.6856 (42)
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	99.2780	97.8036	95.7273	91.8990	89.0324	85.8538	84.1369	86.1987	88.4436	91.8448	95.7519	98.9424	(42b)
Hot water usage for other uses													
	52.3738	50.4693	48.5648	46.6603	44.7558	42.8513	42.8513	44.7558	46.6603	48.5648	50.4693	52.3738	(42c)
Average daily hot water use (litres/day)													139.6589 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	151.6518	148.2729	144.2921	138.5593	133.7882	128.7051	126.9882	130.9545	135.1039	140.4096	146.2212	151.3162	(44)
Energy conte	240.1794	211.1387	221.7716	189.6808	180.1047	158.2580	153.5812	162.1490	166.5966	190.5345	208.3189	236.9246	(45)
Energy content (annual)													
										Total = Sum(45)m =		2319.2381	
Distribution loss (46)m = 0.15 x (45)m													
	36.0269	31.6708	33.2657	28.4521	27.0157	23.7387	23.0372	24.3224	24.9895	28.5802	31.2478	35.5387	(46)
Water storage loss:													
Store volume													250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.8903 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0208 (55)
Total storage loss													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(56)
If cylinder contains dedicated solar storage													
	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444	(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)

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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												
	295.0862	260.7319	276.6784	242.8164	235.0115	211.3936	208.4880	217.0558	219.7322	245.4413	261.4545	291.8314 (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												
	295.0862	260.7319	276.6784	242.8164	235.0115	211.3936	208.4880	217.0558	219.7322	245.4413	261.4545	291.8314 (64)
Total per year (kWh/year) = Sum(64)m =											2965.7212 (64)	2966 (64)
12Total per year (kWh/year)												
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)	0.0000 (64a)
Heat gains from water heating, kWh/month												
	123.7851	109.8782	117.6645	105.5773	103.8102	95.1293	94.9912	97.8400	97.9018	107.2781	111.7745	122.7029 (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	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	383.5704	424.6672	383.5704	396.3561	383.5704	396.3561	383.5704	383.5704	396.3561	383.5704	396.3561	383.5704 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	750.4714	758.2589	738.6346	696.8566	644.1195	594.5540	561.4412	553.6537	573.2780	615.0560	667.7931	717.3586 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278 (69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												
	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224 (71)
Water heating gains (Table 5)												
	166.3778	163.5092	158.1512	146.6352	139.5299	132.1240	127.6763	131.5053	135.9748	144.1911	155.2424	164.9232 (72)
Total internal gains												
	1381.7030	1427.7188	1361.6396	1321.1313	1248.5032	1201.3174	1150.9714	1147.0128	1183.8923	1224.1008	1300.6750	1347.1356 (73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	10.3700	11.2829	0.6300	0.7000	0.7700	35.7580 (75)
East	5.9200	19.6403	0.6300	0.7000	0.7700	35.5337 (76)
Southeast	23.0500	36.7938	0.6300	0.7000	0.7700	259.1897 (77)
South	5.9200	46.7521	0.6300	0.7000	0.7700	84.5852 (78)
Southwest	4.6400	36.7938	0.6300	0.7000	0.7700	52.1753 (79)
Northwest	66.4200	11.2829	0.6300	0.7000	0.7700	229.0303 (81)
Northeast	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388 (82)
Southwest	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388 (82)
Northwest	13.8600	26.0000	0.6300	0.7000	1.0000	143.0269 (82)

Solar gains	880.5767	1660.1806	2668.1988	3923.6263	4924.2855	5112.4463	4836.4940	4061.7911	3101.6938	1944.6005	1084.6094	733.8749 (83)
Total gains	2262.2797	3087.8994	4029.8384	5244.7576	6172.7887	6313.7637	5987.4654	5208.8039	4285.5861	3168.7013	2385.2844	2081.0106 (84)

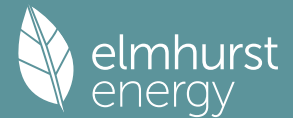
7. Mean internal temperature (heating season)

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	21.6603	21.6931	21.7255	21.8785	21.9074	22.0429	22.0429	22.0681	21.9905	21.9074	21.8491	21.7884
alpha	2.4440	2.4462	2.4484	2.4586	2.4605	2.4695	2.4695	2.4712	2.4660	2.4605	2.4566	2.4526
util living area												
	0.9897	0.9779	0.9518	0.8876	0.7782	0.6369	0.5132	0.5835	0.7978	0.9419	0.9826	0.9916 (86)
MIT	17.5069	17.8990	18.5515	19.4171	20.1613	20.6509	20.8546	20.7960	20.3388	19.3308	18.2589	17.4442 (87)
Th 2	19.9764	19.9778	19.9792	19.9856	19.9868	19.9924	19.9924	19.9934	19.9902	19.9868	19.9844	19.9818 (88)
util rest of house												
	0.9882	0.9745	0.9443	0.8692	0.7406	0.5709	0.4183	0.4890	0.7477	0.9290	0.9795	0.9904 (89)
MIT 2	15.8212	16.3222	17.1523	18.2402	19.1422	19.7002	19.9019	19.8572	19.3783	18.1518	16.7884	15.7436 (90)
Living area fraction												
	16.1231	16.6046	17.4029	18.4510	19.3247	19.8704	20.0726	20.0253	19.5503	18.3629	17.0517	16.0482 (92)
Temperature adjustment												
adjusted MIT	16.1231	16.6046	17.4029	18.4510	19.3247	19.8704	20.0726	20.0253	19.5503	18.3629	17.0517	16.0482 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9780	0.9567	0.9162	0.8331	0.7116	0.5621	0.4264	0.4923	0.7211	0.8989	0.9644	0.9817 (94)
Useful gains	2212.4823	2954.1699	3691.9669	4369.5241	4392.6980	3548.7351	2553.3282	2564.4925	3090.1376	2848.2593	2300.3598	2043.0020 (95)

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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	9697.2468	9585.5586	8915.6974	7755.5484	6183.2029	4247.7735	2798.7451	2918.5274	4403.2212	6295.3199	8091.8666	9660.7217 (97)
Space heating kWh	5568.6648	4456.2932	3886.4555	2437.9375	1332.1357	0.0000	0.0000	0.0000	0.0000	2564.6131	4169.8849	5667.5835 (98a)
Space heating requirement - total per year (kwh/year)												30083.5681
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	5568.6648	4456.2932	3886.4555	2437.9375	1332.1357	0.0000	0.0000	0.0000	0.0000	2564.6131	4169.8849	5667.5835 (98c)
Space heating requirement after solar contribution - total per year (kwh/year)												30083.5681
Space heating per m2										(98c) / (4) =		41.4448 (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	5568.6648	4456.2932	3886.4555	2437.9375	1332.1357	0.0000	0.0000	0.0000	0.0000	2564.6131	4169.8849	5667.5835 (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)	6033.2230	4828.0533	4210.6777	2641.3191	1443.2672	0.0000	0.0000	0.0000	0.0000	2778.5624	4517.7518	6140.3938 (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	295.0862	260.7319	276.6784	242.8164	235.0115	211.3936	208.4880	217.0558	219.7322	245.4413	261.4545	291.8314 (64)
Efficiency of water heater (217)m	88.2988	88.2499	88.1394	87.9020	87.3231	79.8000	79.8000	79.8000	79.8000	87.9338	88.2130	79.8000 (216)
Fuel for water heating, kWh/month	334.1904	295.4474	313.9102	276.2352	269.1286	264.9042	261.2632	271.9997	275.3536	279.1206	296.3900	330.4540 (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	79.6984	63.9370	57.5682	42.1769	32.5787	26.6170	29.7193	38.6303	50.1770	65.8349	74.3604	81.9134 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-208.8701	-271.4789	-359.7146	-371.2079	-373.4783	-338.3827	-332.9883	-326.1059	-312.1530	-292.0844	-220.6708	-183.2757 (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	-199.5529	-406.6367	-785.7220	-1149.5813	-1492.4475	-1490.7196	-1474.2328	-1261.5595	-942.1243	-572.2604	-263.1106	-158.9503 (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												32593.2482 (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												3468.3972 (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)												643.2114 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-13787.3084 (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												23003.5484 (238)

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

	Energy kwh/year	Emission factor kg CO2/kwh	Emissions kg CO2/year
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Space heating - main system 1	32593.2482	0.2100	6844.5821 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3468.3972	0.2100	728.3634 (264)
Space and water heating			7572.9455 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	643.2114	0.1443	92.8353 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3590.4105	0.1365	-489.9935
PV Unit electricity exported	-10196.8979	0.1267	-1291.6416
Total			-1781.6351 (269)
Total CO2, kg/year			5896.0750 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.1200 (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	32593.2482	1.1300	36830.3705 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3468.3972	1.1300	3919.2888 (278)
Space and water heating			40749.6593 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	643.2114	1.5338	986.5790 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3590.4105	1.5045	-5401.7130
PV Unit electricity exported	-10196.8979	0.4650	-4741.5442
Total			-10143.2572 (283)
Total Primary energy kWh/year			31723.0820 (286)
Target Primary Energy Rate (TPER)			43.7000 (287)

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Appendix B – SAP TER/DER worksheet Be Green Scenario

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Property Reference	v1				Issued on Date	05/01/2023
Assessment Reference	Be Green	Prop Type Ref	Be Lean			
Property	25, Sheldon Avenue, London, N6 1JS					
SAP Rating	82 B	DER	2.99	TER	8.12	
Environmental	96 A	% DER < TER				63.18
CO ₂ Emissions (t/year)	2.02	DFEE	45.28	TFEE	46.40	
Compliance Check	See BREL	% DFEE < TFEE				2.42
% DPER < TPER	28.81	DPER	31.11	TPER	43.70	
Assessor Details	Miss Alicja Kreglewska				Assessor ID	L728-0001
Client						

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Basement floor	208.7200 (1a)	x 3.0000 (2a)	= 626.1600 (1a) -
Ground floor	278.9400 (1b)	x 3.6000 (2b)	= 1004.1840 (1b) -
First floor	195.8600 (1c)	x 3.0000 (2c)	= 587.5800 (1c) -
Second floor	42.3500 (1d)	x 2.2000 (2d)	= 93.1700 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	725.8700		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 2311.0940 (5)
Dwelling volume			

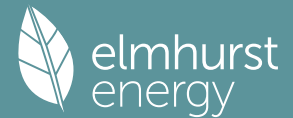
2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	0 * 10 = 0.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	3.0000 (17)
Infiltration rate	0.1500 (18)
Number of sides sheltered	2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.1275 (21)
Wind speed	Jan 5.1000 Feb 5.0000 Mar 4.9000 Apr 4.4000 May 4.3000 Jun 3.8000 Jul 3.8000 Aug 3.7000 Sep 4.0000 Oct 4.3000 Nov 4.5000 Dec 4.7000 (22)
Wind factor	1.2750 1.2500 1.2250 1.1000 1.0750 0.9500 0.9500 0.9250 1.0000 1.0750 1.1250 1.1750 (22a)
Adj infilt rate	0.1626 0.1594 0.1562 0.1403 0.1371 0.1211 0.1211 0.1179 0.1275 0.1371 0.1434 0.1498 (22b)
Balanced mechanical ventilation with heat recovery	
If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	81.9000 (23c)
Effective ac	0.2531 0.2499 0.2467 0.2307 0.2276 0.2116 0.2116 0.2084 0.2180 0.2276 0.2339 0.2403 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
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Window (Uw = 0.95)			116.3200	0.9152	106.4586		(27)
Door			7.2200	1.0000	7.2200		(26)
rooflight			13.8600	0.9152	12.6850		(27a)
rooflight			2.0000	0.9152	1.8304		(27a)
rooflight			2.0000	0.9152	1.8304		(27a)
Basement floor			208.7200	0.1000	20.8720	110.0000	22959.2000 (28a)
GF			62.3100	0.1200	7.4772	110.0000	6854.1000 (28a)
Above garage			27.8400	0.1152	3.2061	20.0000	556.8000 (28b)
External Wall -retained	112.8600	38.2100	74.6500	0.2000	14.9300	9.0000	671.8500 (29a)
External Wall NEW	278.0000	77.4000	200.6000	0.1700	34.1020	110.0000	22066.0000 (29a)
Basement wall	176.2500		176.2500	0.1800	31.7250	17.0000	2996.2500 (29a)
walls to loft	65.2000		65.2000	0.1800	11.7360	18.0000	1173.6000 (29a)
Dormers	16.5000	7.9300	8.5700	0.1800	1.5426	9.0000	77.1300 (29a)
Wall to garage	40.3200		40.3200	0.1600	6.4512	110.0000	4435.2000 (29a)
Flat roof	96.9100	13.8600	83.0500	0.1200	9.9660	9.0000	747.4500 (30)
Insul. rafters	56.9700	4.0000	52.9700	0.1200	6.3564	9.0000	476.7300 (30)
Insul. joists	104.6900		104.6900	0.0900	9.4221	9.0000	942.2100 (30)
Total net area of external elements Aum(A, m2)			1246.5700				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	287.8111		(33)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 63956.5200 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 88.1102 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	64.3500	0.1000	6.4350
E3 Sill	61.9500	0.0800	4.9560
E4 Jamb	137.5400	0.0800	11.0032
R1 Head of roof window	4.0000	0.2400	0.9600
R2 Sill of roof window	4.0000	0.2400	0.9600
R3 Jamb of roof window	4.0000	0.2400	0.9600
R11 Upstands or kerbs of rooflights	28.2000	0.2400	6.7680
E22 Basement floor	58.7500	0.0700	4.1125
E5 Ground floor (normal)	77.6500	0.1600	12.4240
E21 Exposed floor (inverted)	11.2000	0.2700	3.0240
E6 Intermediate floor within a dwelling	92.2700	0.1000	9.2270
E19 Ground floor (inverted)	9.5000	0.1000	0.9500
E24 Eaves (insulation at ceiling level - inverted)	29.4900	0.1500	4.4235
E15 Flat roof with parapet	21.0400	0.2000	4.2080
E11 Eaves (insulation at rafter level)	26.5000	0.0600	1.5900
R4 Ridge (vaulted ceiling)	7.2000	0.1200	0.8640
R9 Roof to wall (flat ceiling)	37.0000	0.3200	11.8400
E16 Corner (normal)	12.0000	0.1800	2.1600
E16 Corner (normal)	75.0000	0.0900	6.7500
E17 Corner (inverted - internal area greater than external area)	62.0000	0.0000	0.0000
E20 Exposed floor (normal)	11.2000	0.2700	3.0240

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

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 384.4503 (37)

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

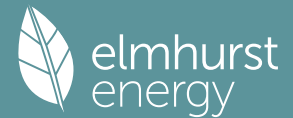
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	193.0009	190.5699	188.1389	175.9840	173.5530	161.3981	161.3981	158.9672	166.2601	173.5530	178.4150	183.2770	(38)
Heat transfer coeff	577.4512	575.0202	572.5892	560.4343	558.0033	545.8484	545.8484	543.4174	550.7104	558.0033	562.8653	567.7273	(39)
Average = Sum(39)m / 12 =												559.8266	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7955	0.7922	0.7888	0.7721	0.7687	0.7520	0.7520	0.7486	0.7587	0.7687	0.7754	0.7821	(40)
HLP (average)												0.7712	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													3.6856 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	99.2780	97.8036	95.7273	91.8990	89.0324	85.8538	84.1369	86.1987	88.4436	91.8448	95.7519	98.9424	(42b)
Hot water usage for other uses	52.3738	50.4693	48.5648	46.6603	44.7558	42.8513	42.8513	44.7558	46.6603	48.5648	50.4693	52.3738	(42c)
Average daily hot water use (litres/day)												139.6589	(43)
Daily hot water use	151.6518	148.2729	144.2921	138.5593	133.7882	128.7051	126.9882	130.9545	135.1039	140.4096	146.2212	151.3162	(44)
Energy conte	240.1794	211.1387	221.7716	189.6808	180.1047	158.2580	153.5812	162.1490	166.5966	190.5345	208.3189	236.9246	(45)
Energy content (annual)										Total = Sum(45)m =		2319.2381	
Distribution loss (46)m = 0.15 x (45)m	36.0269	31.6708	33.2657	28.4521	27.0157	23.7387	23.0372	24.3224	24.9895	28.5802	31.2478	35.5387	(46)
Water storage loss:													
Store volume												250.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.4100	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7614	(55)
Total storage loss	23.6034	21.3192	23.6034	22.8420	23.6034	22.8420	23.6034	23.6034	22.8420	23.6034	22.8420	23.6034	(56)
If cylinder contains dedicated solar storage	23.6034	21.3192	23.6034	22.8420	23.6034	22.8420	23.6034	23.6034	22.8420	23.6034	22.8420	23.6034	(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													

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WVHRS	287.0452	253.4691	268.6374	235.0348	226.9705	203.6120	200.4470	209.0148	211.9506	237.4003	253.6729	283.7904 (62)
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 (63a)
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 (63b)
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 (63c)
Output from w/h	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)
12Total per year (kWh/year)	287.0452	253.4691	268.6374	235.0348	226.9705	203.6120	200.4470	209.0148	211.9506	237.4003	253.6729	283.7904 (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 =												2871 (64)
Heat gains from water heating, kWh/month	117.3523	104.0679	111.2317	99.3521	97.3774	88.9040	88.5584	91.4072	91.6766	100.8454	105.5492	116.2701 (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	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	383.5704	424.6672	383.5704	396.3561	383.5704	396.3561	383.5704	383.5704	396.3561	383.5704	396.3561	383.5704 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	750.4714	758.2589	738.6346	696.8566	644.1195	594.5540	561.4412	553.6537	573.2780	615.0560	667.7931	717.3586 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278 (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)	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224 (71)
Water heating gains (Table 5)	157.7316	154.8630	149.5050	137.9890	130.8837	123.4777	119.0301	122.8591	127.3286	135.5448	146.5962	156.2770 (72)
Total internal gains	1370.0568	1416.0725	1349.9933	1309.4851	1236.8569	1192.6712	1142.3251	1138.3666	1175.2461	1212.4546	1289.0288	1335.4894 (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				10.3700	11.2829	0.4500	0.8000	0.7700	29.1902 (75)			
East				5.9200	19.6403	0.4500	0.8000	0.7700	29.0071 (76)			
Southeast				23.0500	36.7938	0.4500	0.8000	0.7700	211.5834 (77)			
South				5.9200	46.7521	0.4500	0.8000	0.7700	69.0491 (78)			
Southwest				4.6400	36.7938	0.4500	0.8000	0.7700	42.5921 (79)			
Northwest				66.4200	11.2829	0.4500	0.8000	0.7700	186.9635 (81)			
Northwest				13.8600	26.0000	0.4500	0.8000	1.0000	116.7566 (82)			
Northeast				2.0000	26.0000	0.4500	0.8000	1.0000	16.8480 (82)			
Southwest				2.0000	26.0000	0.4500	0.8000	1.0000	16.8480 (82)			
Solar gains	718.8382	1355.2495	2178.1215	3202.9602	4019.8249	4173.4255	3948.1584	3315.7478	2531.9950	1587.4290	885.3954	599.0816 (83)
Total gains	2088.8949	2771.3220	3528.1148	4512.4453	5256.6818	5366.0968	5090.4835	4454.1144	3707.2410	2799.8836	2174.4242	1934.5710 (84)

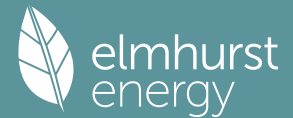
7. Mean internal temperature (heating season)

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

Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	30.7657	30.8958	31.0270	31.6999	31.8380	32.5469	32.5469	32.6925	32.2596	31.8380	31.5630	31.2927
alpha	3.0510	3.0597	3.0685	3.1133	3.1225	3.1698	3.1698	3.1795	3.1506	3.1225	3.1042	3.0862
util living area	0.9926	0.9824	0.9571	0.8842	0.7525	0.5811	0.4477	0.5181	0.7684	0.9441	0.9864	0.9942 (86)
Living	18.3603	18.7178	19.2774	20.0167	20.5648	20.8666	20.9564	20.9317	20.6629	19.8853	19.0024	18.3294
Non living	17.0610	17.5194	18.2327	19.1673	19.8287	20.1774	20.2650	20.2481	19.9638	19.0187	17.8936	17.0281
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	18	0	0	0	0	0	0	0	0	0	0	0
16 / 9	13	28	24	0	0	0	0	0	0	0	0	31
MIT	20.3731	19.7074	19.8557	20.0167	20.5648	20.8666	20.9564	20.9317	20.6629	19.8853	19.0024	19.4875 (87)
Th 2	20.2572	20.2601	20.2630	20.2776	20.2805	20.2951	20.2951	20.2981	20.2893	20.2805	20.2747	20.2688 (88)
util rest of house	0.9916	0.9800	0.9512	0.8687	0.7210	0.5312	0.3832	0.4510	0.7263	0.9337	0.9842	0.9934 (89)
MIT 2	19.6656	19.0504	19.1108	19.1673	19.8287	20.1774	20.2650	20.2481	19.9638	19.0187	17.8936	18.8385 (90)
Living area fraction	19.7923	19.1681	19.2442	19.3194	19.9606	20.3008	20.3888	20.3705	20.0890	19.1739	18.0922	0.1791 (91)
MIT	19.7923	19.1681	19.2442	19.3194	19.9606	20.3008	20.3888	20.3705	20.0890	19.1739	18.0922	18.9547 (92)
Temperature adjustment	19.7923	19.1681	19.2442	19.3194	19.9606	20.3008	20.3888	20.3705	20.0890	19.1739	18.0922	0.0000
adjusted MIT	19.7923	19.1681	19.2442	19.3194	19.9606	20.3008	20.3888	20.3705	20.0890	19.1739	18.0922	18.9547 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9758	0.9414	0.8442	0.7056	0.5316	0.3921	0.4582	0.7130	0.9125	0.9744	0.9916	(94)
Useful gains	2069.9175	2704.2126	3321.4035	3809.4005	3709.0895	2852.6644	1995.7635	2040.9748	2643.3001	2555.0058	2118.7670	1918.3781	(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	8946.0546	8204.4400	7297.1815	5839.4039	4609.4266	3111.7736	2068.1179	2157.6425	3298.1884	4784.2647	6187.1184	8376.6438	(97)
Space heating kWh	5115.8460	3696.1529	2957.9789	1461.6024	669.8508	0.0000	0.0000	0.0000	0.0000	1658.5686	2929.2130	4804.9497	(98a)
Space heating requirement - total per year (kWh/year)												23294.1623	
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	5115.8460	3696.1529	2957.9789	1461.6024	669.8508	0.0000	0.0000	0.0000	0.0000	1658.5686	2929.2130	4804.9497	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												23294.1623	
Space heating per m2										(98c) / (4) =		32.0914	(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 %)													266.6907 (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	5115.8460	3696.1529	2957.9789	1461.6024	669.8508	0.0000	0.0000	0.0000	0.0000	1658.5686	2929.2130	4804.9497	(98)
Space heating efficiency (main heating system 1)	266.6907	266.6907	266.6907	266.6907	266.6907	0.0000	0.0000	0.0000	0.0000	266.6907	266.6907	266.6907	(210)
Space heating fuel (main heating system)	1918.2691	1385.9322	1109.1420	548.0514	251.1714	0.0000	0.0000	0.0000	0.0000	621.9071	1098.3557	1801.6935	(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	287.0452	253.4691	268.6374	235.0348	226.9705	203.6120	200.4470	209.0148	211.9506	237.4003	253.6729	283.7904	(64)
Efficiency of water heater	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	198.0134	(216)
Fuel for water heating, kWh/month	144.9625	128.0060	135.6663	118.6964	114.6238	102.8274	101.2290	105.5559	107.0385	119.8910	128.1090	143.3188	(219)
Space cooling fuel requirement	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	314.3009	283.8847	314.3009	304.1621	314.3009	304.1621	314.3009	314.3009	304.1621	314.3009	304.1621	314.3009	(231)
Lighting	81.5445	65.4181	58.9017	43.1539	33.3333	27.2336	30.4078	39.5252	51.3393	67.3599	76.0829	83.8109	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	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)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												8734.5224	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												198.0134	
Water heating fuel used												1449.9247	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 1.3125)													
mechanical ventilation fans (SFP = 1.3125)													3700.6393 (230a)
Total electricity for the above, kWh/year													3700.6393 (231)
Electricity for lighting (calculated in Appendix L)													658.1112 (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													14543.1976 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	8734.5224	0.1557	1359.7588 (261)
Total CO ₂ associated with community systems			0.0000 (373)
Water heating (other fuel)	1449.9247	0.1410	204.4380 (264)
Space and water heating			1564.1968 (265)
Pumps, fans and electric keep-hot	3700.6393	0.1387	513.3243 (267)
Energy for lighting	658.1112	0.1443	94.9858 (268)
Total CO ₂ , kg/year			2172.5069 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.9900 (273)

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

	Energy kWh/year	Primary energy factor kg CO ₂ /kWh	Primary energy kWh/year
Space heating - main system 1	8734.5224	1.5763	13768.5051 (275)
Total CO ₂ associated with community systems			0.0000 (473)
Water heating (other fuel)	1449.9247	1.5214	2205.8692 (278)
Space and water heating			15974.3743 (279)
Pumps, fans and electric keep-hot	3700.6393	1.5128	5598.3271 (281)
Energy for lighting	658.1112	1.5338	1009.4329 (282)
Total Primary energy kWh/year			22582.1343 (286)
Dwelling Primary energy Rate (DPER)			31.1100 (287)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Basement floor	208.7200 (1a)	x 3.0000 (2a)	= 626.1600 (1a) -
Ground floor	278.9400 (1b)	x 3.6000 (2b)	= 1004.1840 (1b) -
First floor	195.8600 (1c)	x 3.0000 (2c)	= 587.5800 (1c) -
Second floor	42.3500 (1d)	x 2.2000 (2d)	= 93.1700 (1d) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	725.8700		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	2311.0940 (5)

2. Ventilation rate

	m ³ per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)

Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0173 (8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000 (17)	
Infiltration rate		0.2673 (18)	
Number of sides sheltered		2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2272 (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	0.2897	0.2840	0.2783	0.2499	0.2443	0.2159	0.2159	0.2102	0.2272	0.2443	0.2556	0.2670 (22b)
Effective ac	0.5420	0.5403	0.5387	0.5312	0.5298	0.5233	0.5233	0.5221	0.5258	0.5298	0.5327	0.5356 (25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			7.2200	1.0000	7.2200		(26)
TER Opening Type (Uw = 1.20)			116.3200	1.1450	133.1908		(27)
rooflight			2.0000	1.5918	3.1835		(27a)
rooflight			2.0000	1.5918	3.1835		(27a)
rooflight			13.8600	2.0221	28.0257		(27a)
Basement floor			208.7200	0.1300	27.1336		(28a)
GF			62.3100	0.1300	8.1003		(28a)
Above garage			27.8400	0.1300	3.6192		(28b)
External Wall -retained	112.8600	38.2100	74.6500	0.1800	13.4370		(29a)
External Wall NEW	278.0000	77.4000	200.6000	0.1800	36.1080		(29a)
Basement wall	176.2500		176.2500	0.1800	31.7250		(29a)
walls to loft	65.2000		65.2000	0.1800	11.7360		(29a)
Dormers	16.5000	7.9300	8.5700	0.1800	1.5426		(29a)
Wall to garage	40.3200		40.3200	0.1800	7.2576		(29a)
Flat roof	96.9100	13.8600	83.0500	0.1100	9.1355		(30)
Insul. rafters	56.9700	4.0000	52.9700	0.1100	5.8267		(30)
Insul. joists	104.6900		104.6900	0.1100	11.5159		(30)
Total net area of external elements Aum(A, m2)			1246.5700				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 341.9410		(33)

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

88.1102 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	64.3500	0.0500	3.2175
E3 Sill	61.9500	0.0500	3.0975
E4 Jamb	137.5400	0.0500	6.8770
R1 Head of roof window	4.0000	0.0800	0.3200
R2 Sill of roof window	4.0000	0.0600	0.2400
R3 Jamb of roof window	4.0000	0.0800	0.3200
R11 Upstands or kerbs of rooflights	28.2000	0.0800	2.2560
E22 Basement floor	58.7500	0.0700	4.1125
E5 Ground floor (normal)	77.6500	0.1600	12.4240
E21 Exposed floor (inverted)	11.2000	0.3200	3.5840
E6 Intermediate floor within a dwelling	92.2700	0.0000	0.0000
E19 Ground floor (inverted)	9.5000	0.0700	0.6650
E24 Eaves (insulation at ceiling level - inverted)	29.4900	0.2400	7.0776
E15 Flat roof with parapet	21.0400	0.5600	11.7824
E11 Eaves (insulation at rafter level)	26.5000	0.0400	1.0600
R4 Ridge (vaulted ceiling)	7.2000	0.0800	0.5760
R9 Roof to wall (flat ceiling)	37.0000	0.0400	1.4800
E16 Corner (normal)	12.0000	0.0900	1.0800
E16 Corner (normal)	75.0000	0.0900	6.7500
E17 Corner (inverted - internal area greater than external area)	62.0000	-0.0900	-5.5800
E20 Exposed floor (normal)	11.2000	0.3200	3.5840

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

64.9235 (36)

Point Thermal bridges

(36a) = 0.0000

Total fabric heat loss

(33) + (36) + (36a) = 406.8645 (37)

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

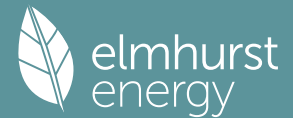
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	413.3330	412.0903	410.8722	405.1509	404.0804	399.0973	399.0973	398.1745	401.0167	404.0804	406.2459	408.5098 (38)
Heat transfer coeff	820.1975	818.9548	817.7367	812.0154	810.9449	805.9619	805.9619	805.0391	807.8813	810.9449	813.1104	815.3743 (39)
Average = Sum(39)m / 12 =												812.0102

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.1300	1.1282	1.1266	1.1187	1.1172	1.1103	1.1103	1.1091	1.1130	1.1172	1.1202	1.1233 (40)
HLP (average)												1.1187
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												3.6856 (42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (42a)
Hot water usage for baths	99.2780	97.8036	95.7273	91.8990	89.0324	85.8538	84.1369	86.1987	88.4436	91.8448	95.7519	98.9424 (42b)
Hot water usage for other uses	52.3738	50.4693	48.5648	46.6603	44.7558	42.8513	42.8513	44.7558	46.6603	48.5648	50.4693	52.3738 (42c)
Average daily hot water use (litres/day)												139.6589 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	151.6518	148.2729	144.2921	138.5593	133.7882	128.7051	126.9882	130.9545	135.1039	140.4096	146.2212	151.3162 (44)
Energy content (annual)	240.1794	211.1387	221.7716	189.6808	180.1047	158.2580	153.5812	162.1490	166.5966	190.5345	208.3189	236.9246 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 2319.2381
	36.0269	31.6708	33.2657	28.4521	27.0157	23.7387	23.0372	24.3224	24.9895	28.5802	31.2478	35.5387 (46)
Water storage loss:												
Store volume												250.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8903 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0208 (55)
Total storage loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236	31.6444 (56)

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If cylinder contains dedicated solar storage											
Primary loss	31.6444	28.5820	31.6444	30.6236	31.6444	30.6236	31.6444	31.6444	30.6236	31.6444	30.6236 (57)
Combi loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120 (59)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	295.0862	260.7319	276.6784	242.8164	235.0115	211.3936	208.4880	217.0558	219.7322	245.4413	261.4545 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
FGHRS	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63d)
	295.0862	260.7319	276.6784	242.8164	235.0115	211.3936	208.4880	217.0558	219.7322	245.4413	261.4545 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =										2965.7212 (64)
Electric shower(s)											2966 (64)
	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											
	123.7851	109.8782	117.6645	105.5773	103.8102	95.1293	94.9912	97.8400	97.9018	107.2781	111.7745 (65)
											122.7029 (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	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781	184.2781 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	383.5704	424.6672	383.5704	396.3561	383.5704	396.3561	383.5704	383.5704	396.3561	383.5704	396.3561	383.5704 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	750.4714	758.2589	738.6346	696.8566	644.1195	594.5540	561.4412	553.6537	573.2780	615.0560	667.7931	717.3586 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278	41.4278 (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)	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224	-147.4224 (71)
Water heating gains (Table 5)	166.3778	163.5092	158.1512	146.6352	139.5299	132.1240	127.6763	131.5053	135.9748	144.1911	155.2424	164.9232 (72)
Total internal gains	1381.7030	1427.7188	1361.6396	1321.1313	1248.5032	1201.3174	1150.9714	1147.0128	1183.8923	1224.1008	1300.6750	1347.1356 (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	10.3700	11.2829	0.6300	0.7000	0.7700	35.7580 (75)
East	5.9200	19.6403	0.6300	0.7000	0.7700	35.5337 (76)
Southeast	23.0500	36.7938	0.6300	0.7000	0.7700	259.1897 (77)
South	5.9200	46.7521	0.6300	0.7000	0.7700	84.5852 (78)
Southwest	4.6400	36.7938	0.6300	0.7000	0.7700	52.1753 (79)
Northwest	66.4200	11.2829	0.6300	0.7000	0.7700	229.0303 (81)
Northeast	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388 (82)
Southwest	2.0000	26.0000	0.6300	0.7000	1.0000	20.6388 (82)
Northwest	13.8600	26.0000	0.6300	0.7000	1.0000	143.0269 (82)

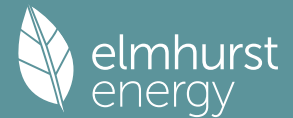
Solar gains	880.5767	1660.1806	2668.1988	3923.6263	4924.2855	5112.4463	4836.4940	4061.7911	3101.6938	1944.6005	1084.6094	733.8749 (83)
Total gains	2262.2797	3087.8994	4029.8384	5244.7576	6172.7887	6313.7637	5987.4654	5208.8039	4285.5861	3168.7013	2385.2844	2081.0106 (84)

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	21.6603	21.6931	21.7255	21.8785	21.9074	22.0429	22.0429	22.0681	21.9905	21.9074	21.8491	21.7884
alpha	2.4440	2.4462	2.4484	2.4586	2.4605	2.4695	2.4695	2.4712	2.4660	2.4605	2.4566	2.4526
util living area	0.9897	0.9779	0.9518	0.8876	0.7782	0.6369	0.5132	0.5835	0.7978	0.9419	0.9826	0.9916 (86)
MIT	17.5069	17.8990	18.5515	19.4171	20.1613	20.6509	20.8546	20.7960	20.3388	19.3308	18.2589	17.4442 (87)
Th 2	19.9764	19.9778	19.9792	19.9856	19.9868	19.9924	19.9924	19.9934	19.9902	19.9868	19.9844	19.9818 (88)
util rest of house	0.9882	0.9745	0.9443	0.8692	0.7406	0.5709	0.4183	0.4890	0.7477	0.9290	0.9795	0.9904 (89)
MIT 2	15.8212	16.3222	17.1523	18.2402	19.1422	19.7002	19.9019	19.8572	19.3783	18.1518	16.7884	15.7436 (90)
Living area fraction	fLA = Living area / (4) =											0.1791 (91)
MIT	16.1231	16.6046	17.4029	18.4510	19.3247	19.8704	20.0726	20.0253	19.5503	18.3629	17.0517	16.0482 (92)
Temperature adjustment												0.0000
adjusted MIT	16.1231	16.6046	17.4029	18.4510	19.3247	19.8704	20.0726	20.0253	19.5503	18.3629	17.0517	16.0482 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9780	0.9567	0.9162	0.8331	0.7116	0.5621	0.4264	0.4923	0.7211	0.8989	0.9644	0.9817	(94)
Useful gains	2212.4823	2954.1699	3691.9669	4369.5241	4392.6980	3548.7351	2553.3282	2564.4925	3090.1376	2848.2593	2300.3598	2043.0020	(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	9697.2468	9585.5586	8915.6974	7755.5484	6183.2029	4247.7735	2798.7451	2918.5274	4403.2212	6295.3199	8091.8666	9660.7217	(97)
Space heating kWh	5568.6648	4456.2932	3886.4555	2437.9375	1332.1357	0.0000	0.0000	0.0000	0.0000	2564.6131	4169.8849	5667.5835	(98a)
Space heating requirement - total per year (kWh/year)												30083.5681	
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	5568.6648	4456.2932	3886.4555	2437.9375	1332.1357	0.0000	0.0000	0.0000	0.0000	2564.6131	4169.8849	5667.5835	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												30083.5681	
Space heating per m2										(98c) / (4) =		41.4448	(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	5568.6648	4456.2932	3886.4555	2437.9375	1332.1357	0.0000	0.0000	0.0000	0.0000	2564.6131	4169.8849	5667.5835	(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)	6033.2230	4828.0533	4210.6777	2641.3191	1443.2672	0.0000	0.0000	0.0000	0.0000	2778.5624	4517.7518	6140.3938	(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	295.0862	260.7319	276.6784	242.8164	235.0115	211.3936	208.4880	217.0558	219.7322	245.4413	261.4545	291.8314	(64)
Efficiency of water heater	88.2988	88.2499	88.1394	87.9020	87.3231	79.8000	79.8000	79.8000	79.8000	87.9338	88.2130	88.3123	(216)
Fuel for water heating, kWh/month	334.1904	295.4474	313.9102	276.2352	269.1286	264.9042	261.2632	271.9997	275.3536	279.1206	296.3900	330.4540	(219)
Space cooling fuel requirement	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	79.6984	63.9370	57.5682	42.1769	32.5787	26.6170	29.7193	38.6303	50.1770	65.8349	74.3604	81.9134	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-208.8701	-271.4789	-359.7146	-371.2079	-373.4783	-338.3827	-332.9883	-326.1059	-312.1530	-292.0844	-220.6708	-183.2757	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)	-199.5529	-406.6367	-785.7220	-1149.5813	-1492.4475	-1490.7196	-1474.2328	-1261.5595	-942.1243	-572.2604	-263.1106	-158.9503	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												32593.2482	(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												3468.3972	(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)												643.2114	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-13787.3084	(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												23003.5484	(238)

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

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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	32593.2482	0.2100	6844.5821 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3468.3972	0.2100	728.3634 (264)
Space and water heating			7572.9455 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	643.2114	0.1443	92.8353 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3590.4105	0.1365	-489.9935
PV Unit electricity exported	-10196.8979	0.1267	-1291.6416
Total			-1781.6351 (269)
Total CO2, kg/year			5896.0750 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			8.1200 (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	32593.2482	1.1300	36830.3705 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3468.3972	1.1300	3919.2888 (278)
Space and water heating			40749.6593 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	643.2114	1.5338	986.5790 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-3590.4105	1.5045	-5401.7130
PV Unit electricity exported	-10196.8979	0.4650	-4741.5442
Total			-10143.2572 (283)
Total Primary energy kWh/year			31723.0820 (286)
Target Primary Energy Rate (TPER)			43.7000 (287)

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