Energy and Sustainability Statement

46 Maresfield Gardens

For Russell Ambrose

February 2025

ecolytik

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Contents

Project number	999
Report status	Revised draft
Revision number	1
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1 Executive Summary

This Energy and Sustainability Statement presents the key measures proposed to meet the London Plan's carbon reduction targets and the sustainability strategy in support of the planning application for 46 Maresfield Gardens in Hampstead, within the London Borough of Camden.

The proposed scheme comprises demolition of the existing dwelling and erection of a replacement dwelling with three above ground storeys. The existing garage at basement level will be retained and utilised for storage.

The energy and sustainability strategy for the proposal has been developed in accordance with relevant policies within the London Plan and Camden's Local Plan (see Table 1 in the following page).

1.1 Energy Strategy

The energy strategy for the project has been developed in line with the London Plan (2021) Policies SI2, SI3 and SI4, and the GLA's Guidance on Energy Assessments (2022). The CO_2 emissions for the development has been assessed using the Standard Assessment Procedure (SAP).

Proposed energy measures for the development includes:

- **Be Lean**: Passive design with a fabric first approach (enhanced u-values, low air tightness target and careful thermal bridging detailing), low energy lighting and installation of Mechanical Ventilation with Heat Recovery (MVHR).
- **Be Clean**: There are no existing or proposed district heat networks in proximity to the proposed development. A standalone heating system is proposed.
- **Be Green**: A high efficiency Air Source Heat Pump (ASHP) system will generate both space heating and domestic hot water for the dwelling. A photovoltaic array will also be provided at roof level.

Overall, the proposed development is anticipated to achieve a 65% reduction in regulated CO_2 emissions over the Part L 2021 baseline. This meets the minimum onsite reduction target of 35% set out by the GLA, as well as the benchmark reduction target of 50% for residential developments stipulated within GLA's Energy Assessment Guidance (2022).

The scheme will also achieve a 21% reduction in regulated CO_2 over the baseline at the Be Lean stage with building fabric and system efficiencies measures alone, which exceeds the 10% Be Lean reduction target set out by the GLA for residential developments.

Carbon offset payments are not deemed applicable for the minor development.

1.2 Sustainability Strategy

The sustainability strategy for the proposal has been developed in accordance with relevant policies within the London Plan and Camden's Local Plan.

The image to the right summarises the sustainability measures integrated into the scheme, and demonstrates the client and design team's aspirations to meet and exceed planning policy requirements.

Climate resilience
- Solar control and natural ventilation are the main measures to mitigate overheating risk. The dwelling will benefit from windows and rooflight with generous openable areas.
- The site is not located in an area at risk of flooding.

Ecology and biodiversity
- Extensive soft landscaping, tree retention and planting, as well as biodiverse/green roofs is proposed to improve ecological value at the site.

Sustainable transport
- Cycle storage will be provided in the front driveway.
- An EV charging point will be installed.
- Future residents will have good access to public transport via overground, underground and local buses.

Health and Wellbeing
- There will be no notable daylight and sunlight impact to neighbouring properties.
- Air, noise and light pollution from proposed development will be limited and mitigated.
- Scheme has been developed with safety and accessibility in mind.
- The extensive private garden will provide valuable external amenity to future residents.

Energy and Carbon
- Fabric first approach together with high efficiency building fabric and systems to minimise energy demand.
- Air Source Heat Pump is proposed as a low/zero carbon technology for the supply of space heating and hot water.
- 2.8 kWp of photovoltaics proposed for the first floor roof, to be integrated with the biosolar roofs.
- Energy strategy to achieve a 65% reduction in regulated CO_2 emissions onsite, exceeding GLA and Camden policies for minor developments.
- A Whole Life Carbon Assessment has been carried out. Strategies are in place to minimise both embodied and operation carbon emissions throughout the lifetime of the building.

Resource efficiency
- Materials will be responsibly sourced.
- Materials with low environmental impact and with recycled content will be prioritised.
- Construction and demolition waste will be limited through reduction/reuse/recycling measures.
- Water efficient sanitary fittings and appliances will be installed to target a consumption of 105 l/p/d.

Figure 1. Summary of Energy and Sustainability Measures at 46 Maresfield Gardens.

Table 1. Planning policies applicable for the proposed development, and the report sections where they are responded to.

	3 Energy Strategy	4.1 Health and Wellbeing	4.2 Nature, Landscape and Biodiversity	4.3 Climate Resilience	4.4 Water and Surface Water Runoff	4.5 Materials and Waste	4.6 Sustainable transport
The London Plan (2021)							
GG2 Making the best use of land							
GG3 Creating a healthy city	◆	◆					
GG6 Increasing efficiency and resilience	◆			◆			
D2 Infrastructure requirements for sustainable densities							◆
D11 Safety, security, and resilience to emergency		◆		◆			
D14 Noise		◆					
G1 Green infrastructure, G5 Urban greening, G6 Biodiversity and access to nature			◆				
SI1 Improving air quality		◆					
SI2 Minimising greenhouse gas emissions, Policy SI3 Energy infrastructure	◆						
SI4 Managing heat risk				◆			
SI5 Water infrastructure					◆		
SI7 Reducing waste and supporting the circular economy						◆	
SI12 Flood risk management, SI13 Sustainable Drainage				◆	◆		
T5 Cycling							◆
Camden Local Plan (2017)							
C1 Health and wellbeing		◆					
C5 Safety and Security		◆					
C6 Access for all		◆					
A1 Managing the impact of development		◆					
A2 Open space		◆					
A3 Biodiversity			◆				
A4 Noise and Vibration		◆					
CC1 Climate change mitigation				◆			
CC2 Adapting to climate change	◆	◆	◆	◆	◆	◆	
CC3 Water and flooding				◆	◆		
CC4 Air Quality		◆					
CC5 Waste						◆	
T1 Prioritising walking, cycling and public transport							◆
T2 Parking and car free development							◆
Camden Planning Guidance – Energy Efficiency and Adaptation (2021)							
Energy hierarchy	◆						
Making buildings more energy efficient	◆						
Energy reduction	◆						

	3 Energy Strategy	4.1 Health and Wellbeing	4.2 Nature, Landscape and Biodiversity	4.3 Climate Resilience	4.4 Water and Surface Water Runoff	4.5 Materials and Waste	4.6 Sustainable transport
Energy efficiency in existing buildings	◆						
Reuse and optimising resource efficiency	◆					◆	
Sustainable design and construction measures	◆			◆			

2 Introduction

2.1 Site

46 Maresfield Gardens is located in Hampstead, in the London Borough of Camden. The site is within a predominantly residential setting and currently comprises a two-storey plus basement mid-century dwelling. Residential properties can be found to the immediate north and east of the site, as well as across Maresfield Gardens to the west. The site closely adjoins an underground railway line and exhaust vent to the south.

The proposed scheme comprises demolition of the existing dwelling and erection of a replacement dwelling with three above ground storeys. The existing garage at basement level will be retained and utilised for storage.

The site location is presented in Figure 2.

Figure 2. Approximate site location of 46 Maresfield Gardens

2.2 Planning policies

A review of the applicable policies for the proposed development has been undertaken. A full summary of the relevant Greater London Authority (GLA) and Camden policies are presented in Appendices A and B.

The proposed development has been designed to meet and exceed (where feasible) the following main policy drivers.

2.2.1 London Plan (2021)

Energy and carbon:

- A minimum of 35% reduction in regulated CO_2 emissions on site compared to Part L 2021 baseline, with an aspiration to meet the 50% reduction benchmark for residential developments, brought in under the Energy Assessment Guidance 2023.
- A minimum of 10% reduction in regulated CO_2 emissions at the Be Lean stage through energy efficiency measures.

Sustainability:

- Enhance health and wellbeing provision of high quality buildings and associated amenity spaces, limiting exposure to sources of air and noise pollution.
- Provision of accessible housing.
- Optimise land use and promote higher density development.
- Design in measures to ensure safety, security and resilience (including resilience to flood risk and overheating).
- Contribute to urban greening, biodiversity and access to nature within the city where feasible.
- Water efficiency – residential schemes to meet a maximum water consumption of 105 l/p/d.
- Waste management and reduction.
- Sustainable urban drainage.
- Sustainable transport.

2.2.2 Camden Local Plan (2017)

Energy and carbon:

- Achieve CO_2 emission targets set out within the London Plan.

Sustainability:

- Contribute to enhancing health and wellbeing, accessibility, safety and security.
- Manage development impacts including daylight/sunlight, privacy, outlook, transport, noise, vibration, air quality etc.
- Provide outdoor amenity.
- Improve biodiversity value where feasible.
- Climate change mitigation/adaptation.
- Water efficiency.
- Waste management.
- Prioritise sustainable transport.

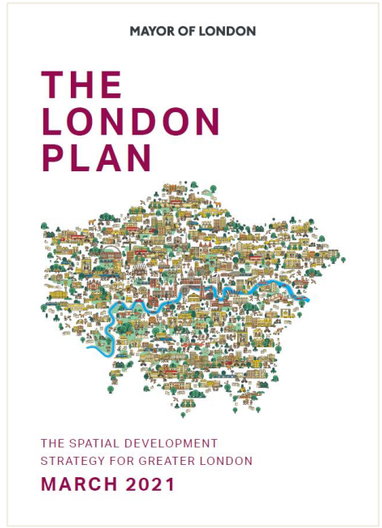
2.2.3 Camden Planning Guidance – Energy Efficiency and Adaptation (2021)

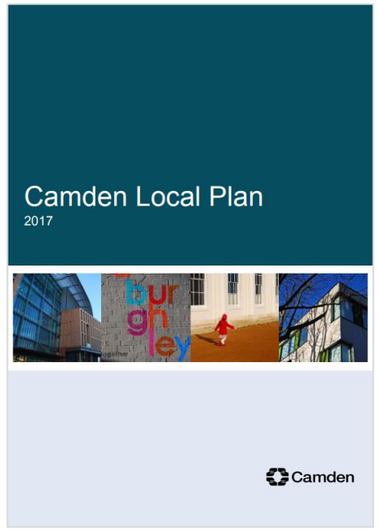
Energy and carbon:

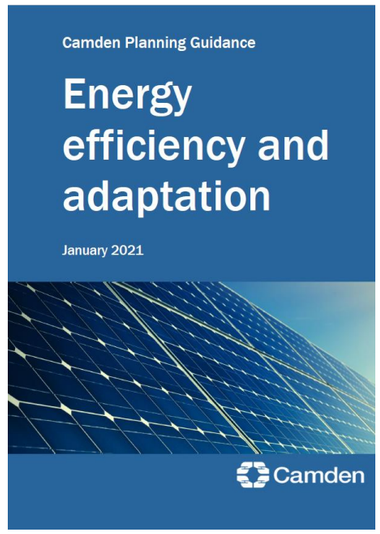
- Reduce carbon dioxide emissions through the application of the energy hierarchy.
- Natural 'passive' measures should be prioritised over active measures.
- All new build residential development (of 1 – 9 dwellings) must meet 19% carbon dioxide reduction.
- A 20% reduction in regulated CO2 emissions from onsite renewable technologies for major developments.

Sustainability:

- Consider and incorporate sustainable design principles.
- Repurpose existing buildings and minimising demolition where feasible.
- Seek to optimise resource efficiency and use circular economy principles.





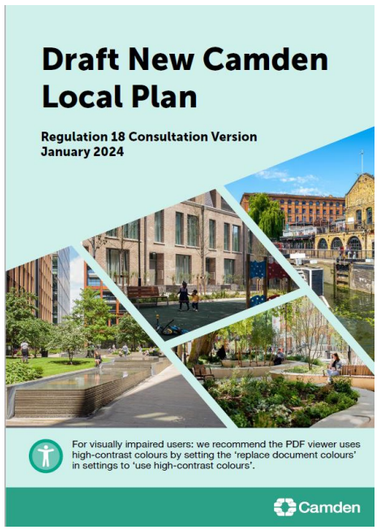


2.2.4 *Emerging Draft New Camden Local Plan (Regulation 18 Consultation Version, 2024)*

The regulation 18 consultation for Camden's Draft Local Plan took place between January and March 2024. Although the Draft Local Plan has not been adopted yet, the client and design team have considered the proposed energy and sustainability related policies during development of the scheme as far as feasible, including:

- Reviewing estimated Space Heating Demand and Energy Use Intensity of development against targets.
- Assessment of Embodied Carbon and Whole Life Carbon performance.
- Following circular economy principles.
- Target net zero carbon in operation.
- Design for climate resilience. Maximise passive cooling in and around buildings.
- Protect and enhance existing ecology.
- Minimise water use. Include means for rainwater re-use on site.

The proposed Energy and Sustainability Strategy for 46 Maresfield Gardens are presented in the following chapters.



3 Energy Strategy

The Energy Strategy for the proposed development at 46 Maresfield Gardens has been developed in line with the Energy Hierarchy set out in Policy SI 2 of the London Plan:

1. Be Lean: use less energy.
2. Be Clean: supply energy efficiently.
3. Be green: access low or zero carbon (LZC) energy sources.
4. Be Seen: monitor and report operational energy.

The CO_2 emissions at each stage of the Hierarchy are compared to a Building Regulations Part L1A 2021 (adopted June 2022) compliant baseline.

It should be noted that the estimations presented within this statement are based on the Part L calculation methodology and the associated standard assumptions regarding occupancy, space/system usage and climatic conditions; and should not be considered as a predictive assessment of the likely in-use energy requirements for the development.

The following sections present the measures adopted at each stage of the Energy Hierarchy at the proposed development.

3.1 Be Lean

A range of energy efficiency measures has been applied to the design of the building fabric and building services systems to minimise energy demand and CO_2 emissions at the Be Lean stage.

3.1.1 Passive Design

The dwelling has generously sized east/south/west facing windows, with good potential for passive solar heating to reduce space heating energy demand from active systems. Low-e glazing will be specified, which promotes heat retention within the dwelling in the cooler months.

The home is quadruple aspect with windows on all facades for natural cross ventilation and passive cooling during the warmer months.

Reasonably sized windows are to enable satisfactory access to natural light for all habitable spaces, reducing the need for artificial lighting during the day. A rooflight is proposed to the stairwell which will bring daylight deeper into the home and also enable the potential for stack driven ventilation on the warmest days.

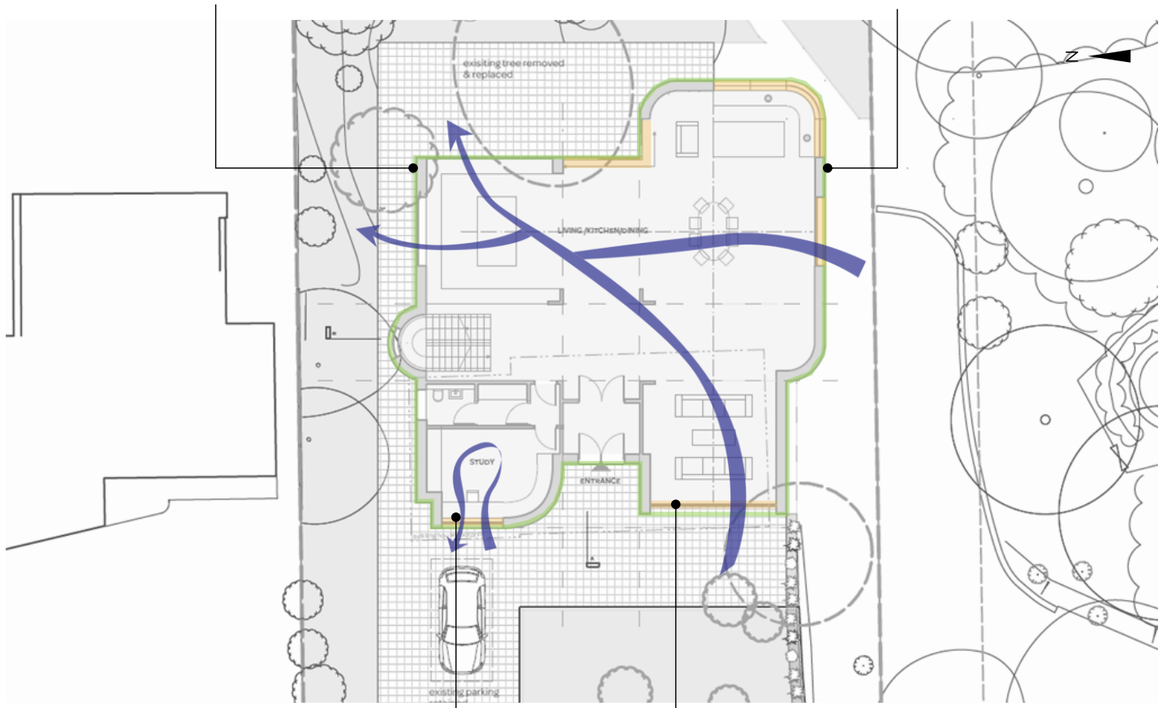
3.1.2 Fabric Performance

A fabric first approach has been undertaken to minimise unwanted heat loss through the building fabric and reduce heating energy demand over the cooler months.

The proposed building fabric specification will go beyond the notional building standards set out within Building Regulations Part L1 2021. Details regarding targeted u-values, air permeability and thermal bridging are presented in Appendix C.

U-values beyond Part L 2021 levels, low air-tightness and provision of MVHR to limit unwanted fabric and ventilative heat losses.

G-value of 0.4 targeted for all glazing to achieve a balance between passive heating, solar protection and daylight access.



Satisfactory levels of operable glazed areas across the development to enable good daylight penetration and potential for passive cooling through natural ventilation.

Generous glazed areas on east, south and west façades to facilitate passive heating and reduce space heating demand during the cooler months.

Figure 3. Passive design measures considered for the proposed development.

Table 2. Proposed fabric specification at 46 Maresfield Gardens

Element	Part L 2021 limiting specification	Part L 2021 Notional Building specification	Proposed specification
External walls u-value (W/m².K)	0.26	0.18	0.15
Roof u-value (W/m².K)	0.16	0.11	0.1
Floor u-value (W/m².K)	0.18	0.13	0.1
Windows u-value (W/m².K)	1.6	1.2	1.2
Windows g-value	-	0.63	0.4
Doors u-value (W/m².K)	1.6	1.0	1.0
Air permeability (m³/m².hr)	8	5	3

3.1.3 Efficient lighting

All light fittings within the proposed dwelling will be specified as low energy lighting, and will incorporate LEDs with an average efficacy of more than 100 lm/W.

3.1.4 Heat Recovery Ventilation

Mechanical Ventilation with Heat Recovery (MVHR) is proposed to provide good levels of fresh air supply whilst reducing ventilative heat loss during the cooler months.

3.1.5 Controls and Energy Monitoring

Time and temperature zone control will be provided for space heating the dwelling. Hot water will be independently controlled from space heating.

Where feasible, a smart meter will also be installed at an accessible location to enable occupants to monitor and reduce their energy consumption.

3.1.6 The Cooling Hierarchy

The scheme has been designed in line with the 6 steps of the Cooling Hierarchy in Policy SI4 of the London plan and Policy CC2 of the Local Plan.

1. **Reduce the amount of heat entering the building**
   - Reasonably sized glazed areas are proposed for all facades to enable good daylight ingress without excessive solar gains. Full height glazing has been limited to where access to external amenity spaces is required.
   - Solar control glazing will be specified to all windows.
2. **Minimise internal heat generation through energy efficient design**
   - All heat sources (e.g. cylinders) will be factory insulated to reduced heat loss. Lateral heat distribution pipework will be minimised as far as feasible.
   - All light fixtures will be low energy and will not result in notable internal lighting heat gains.
3. **Manage the heat within the building through exposed internal thermal mass and high ceilings**
   - Exposed internal thermal mass is more effective for non-domestic buildings when it is possible to significantly pre-cool spaces during night-time when they are unoccupied.
   - The inclusion of exposed internal thermal mass will result in notably higher space heating demand for domestic developments.
   - Exposed internal thermal mass (at ceiling level) also requires exposed building services and is not deemed suitable for a scheme of this nature.
4. **Provide passive ventilation**
   - Natural ventilation through openable windows will be the main strategy for fresh air provision and passive cooling.
   - Generous openable areas are provided to all glazing. Windows are present on all orientations and the dwelling will have good natural cross ventilation potential.
   - An openable roof window is proposed above the stairwell to facilitate stack ventilation across the dwelling.
5. **Provide mechanical ventilation**
   - Mechanical ventilation with heat recovery will be provided as part of the overall energy strategy. The system will have boost and bypass modes available as a back-up to reduce overheating risks during the summer.
6. **Provide active cooling systems**
   - Cooling is not currently proposed for the home.

3.1.7 Overheating Risk Assessment

An Overheating Assessment has been undertaken in line with the Part O methodology to inform design at planning stage.

Please refer to the accompany Overheating Report for further information.

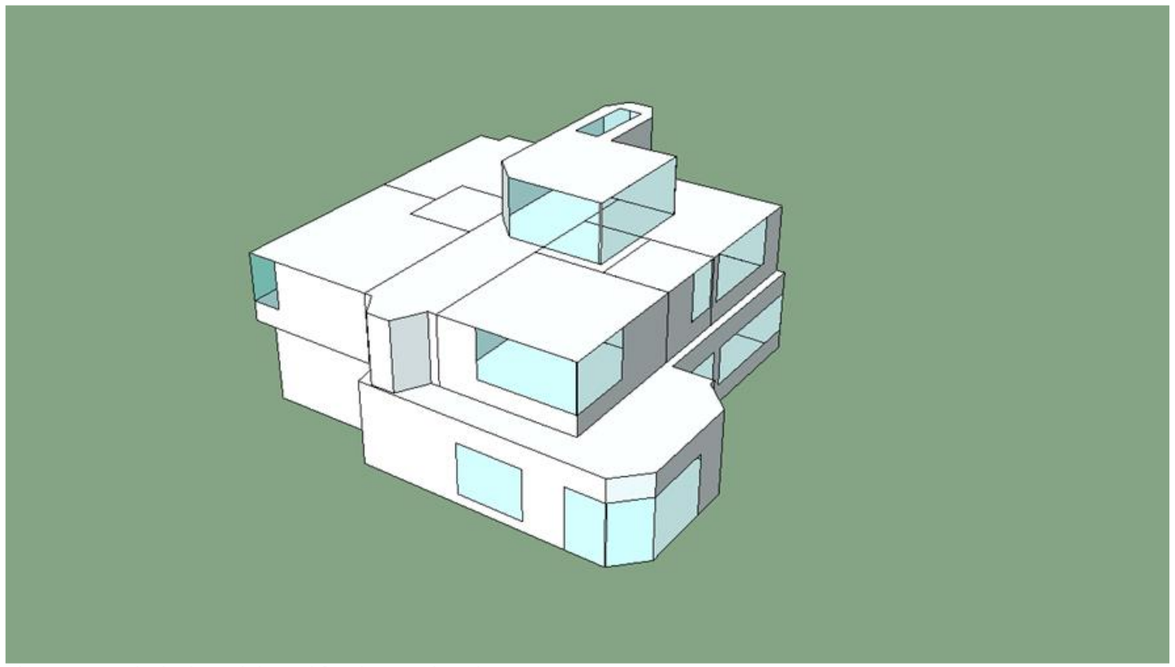


Figure 4. Technical model used for the overheating assessment.

3.2 Be Clean

Policy SI 3 of the London Plan stipulates that major development proposals within Heat Network Priority Areas should have a communal heating system connected to local existing or planned heat networks, or to low/zero emission local heat sources.

A review of the London Heat Map (Figure 5) shows that there are no existing or proposed district heating network in proximity to the site.

The application of a standalone heating system is therefore considered as the most suitable heating strategy for the proposed dwelling.

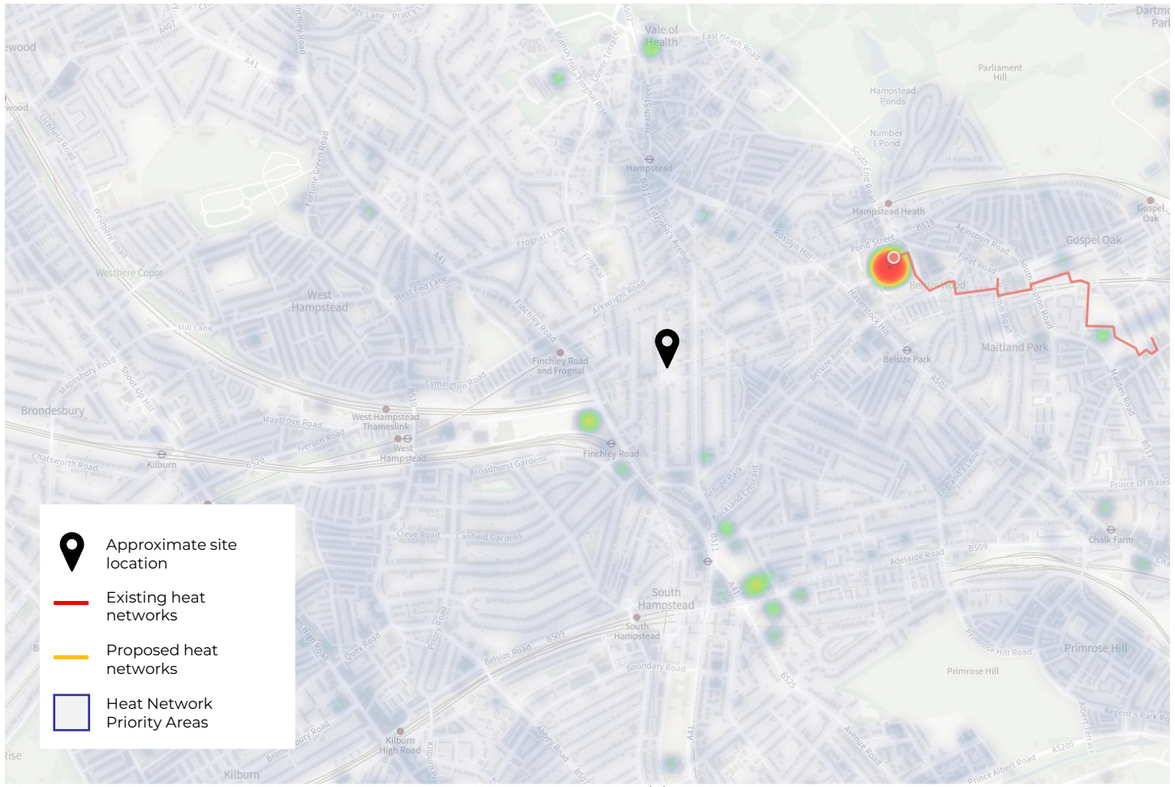


Figure 5. London Heat Map for site and surroundings (accessed 13/1/2025).

3.3 Be Green

The opportunity for producing and utilising renewable energy onsite will be maximised for the proposed dwelling, in line with Policy SI 2 of the London Plan.

An outline feasibility study has been undertaken (see Table 3), which identified an air source heat pump system and photovoltaics as the most suitable low/zero carbon technologies for the scheme.

A PV array of 2.8 kWp is proposed at roof level as part of a biosolar roof application in conjunction with biodiverse roof planting.

The roof plan in Figure 6 shows the proposed indictive PV array.

Table 3. Outline LZC feasibility

LZC Technology	Feasibility
Photovoltaics (adopted)	Photovoltaics are deemed suitable for the scheme and are proposed on the roof above the first floor.
Solar thermal (not adopted)	Roofs are prioritised for PV installation. Solar thermal panels not fully compatible with air source heat pump without the need for additional plumbing systems.
Wind turbines (not adopted)	The installation of wind turbines at the proposed building/site will have a significant visual impact on the site and surroundings. The site is also relatively sheltered and is anticipated to experience low wind speeds.
Ground source heat pump (GSHP) (not adopted)	The installation of ground source borehole systems requires notable space, time and cost, and is not deemed feasible for a scheme of this scale and nature. Ground trenches are not seemed feasible due to the extent of trees present onsite.
Air source heat pump (ASHP) (adopted)	Air source heat pump is an effective way of providing low carbon heating and hot water for the home.
Biomass (not adopted)	Biomass systems emit high NOx levels and are not supported within urban areas. There is also no suitable space onsite for the storage of biomass.

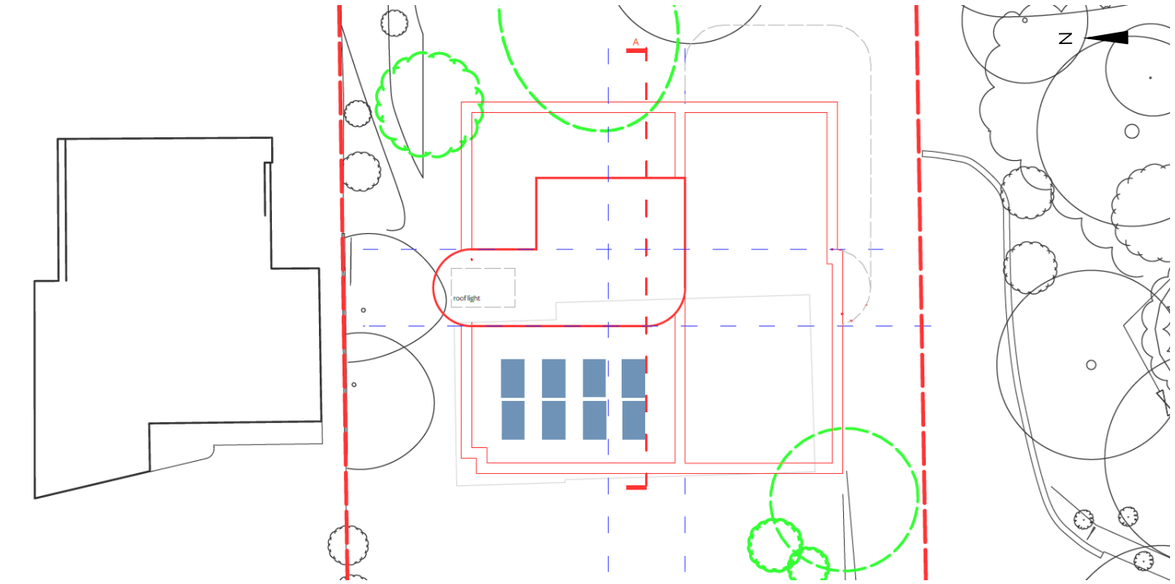


Figure 6. Roof plan showing indicative PV provision.

3.4 Results

Through the measures outlined for each stage of the Energy Hierarchy, it is anticipated the proposed development can achieve a 65% reduction in regulated CO_2 emissions over the Part L1 2021. This meets the minimum onsite reduction target of 35% set out by the GLA, as well as the benchmark reduction target of 50% for residential developments stipulated within GLA's Energy Assessment Guidance (2022).

The scheme is also anticipated to achieve a 21% reduction in regulated CO_2 over the Part L1 2021 at the Be Lean stage with building fabric and system efficiencies measures alone, which exceeds the 10% Be Lean reduction target set out by the GLA for residential developments.

Carbon offset payments are not considered applicable for this minor development.

The Space Heating Demand and Energy Use Intensity (without inclusion of PVs) are 31.6kWh/m^2.yr and 41.8 kWh/m^2.yr respectively.

Table 4, Table 5 and Figure 7 present the anticipated CO_2 emissions and savings at each stage of the Energy Hierarchy.

Table 4. Carbon emissions after each stage of the Energy Hierarchy

	Carbon Dioxide Emissions (tCO_2/yr)	
	Regulated	**Unregulated**
Baseline: Part L 2021 Compliant Development	3.4	1.2
After energy demand reduction (be lean)	2.7	1.2
After heat network connection (be clean)	2.7	1.2
After renewable energy (be green)	1.2	1.2

Table 5. Regulated carbon savings from each stage of the Energy Hierarchy

	Regulated domestic carbon dioxide savings	
	(Tonnes CO_2 per annum)	**(%)**
Be lean: Savings from energy demand reduction	0.7	21%
Be clean: Savings from heat network	0.0	0%
Be green: Savings from renewable energy	1.5	44%
Cumulative on-site savings	2.2	65%

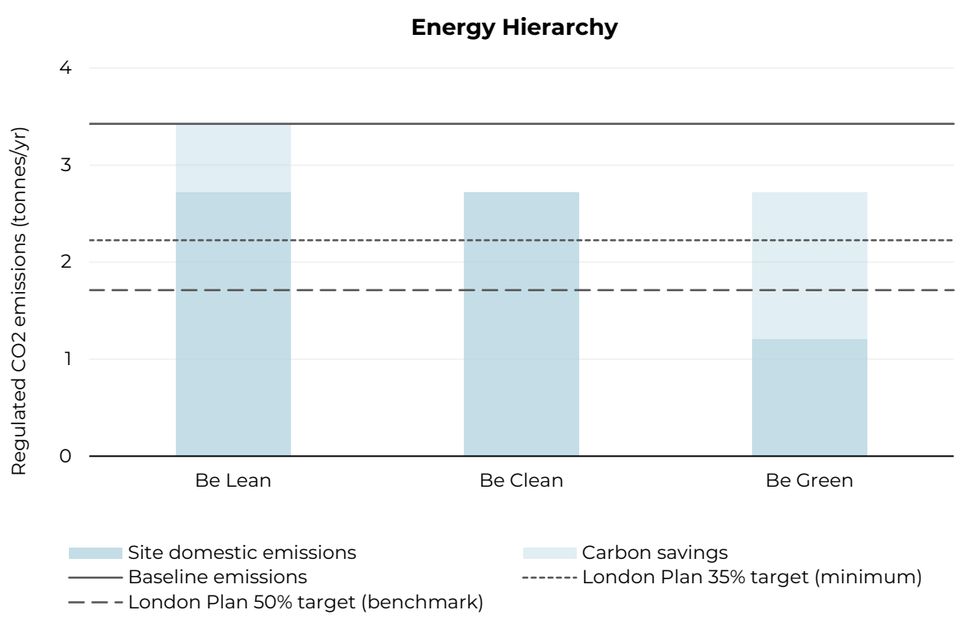


Figure 7. Regulated carbon emissions at each stage of the Energy Hierarchy.

4 Sustainability Strategies

This section of the report presents the key elements of the development which responds to the sustainable development policies set out within the London Plan and Camden's Local Plan.

4.1 Health and Wellbeing

4.1.1 Air Quality

In line with GLA's SPG on The Control of Dust and Emissions during Construction and Demolition, any potential dust and stationary plant emissions during the construction period, and any potential impact from traffic flows on the local road network, during and after construction will be mitigated.

The proposed scheme is not anticipated to result in greater traffic flows compared to the existing use. It will therefore will not result in notable air quality impact from operational traffic. A heat pump system driven by electricity will supply space heating and hot water at the proposed dwelling. There will be no PM and NOx emissions associated with fossil fuel combustion from the operation of the building services systems at the scheme.

4.1.2 Noise

The development will incorporate building fabric measures to ensure the impact of any external sources on internal ambient noise levels are within acceptable limits, in line with BS8233:2014 or latest standards. Any potential noise impact during demolition and construction will be mitigated accordingly.

All external building services plant will be acoustically attenuated where required

4.1.3 Daylight and Sunlight

The proposed scheme will not result in any notable daylight and sunlight impact to neighbouring properties. Surrounding residential windows, rooms and amenity spaces are anticipated to retain good daylight and sunlight levels with the proposed scheme in place. Further details can be found in the accompanying Daylight and Sunlight Assessment Report.

Well sized windows and rooflight are provided to the proposed home.

4.1.4 External Lighting

The external lighting design and specification will be in accordance with the ILP's Guidance Note for The Reduction of Obtrusive Light (2021).

The scheme will limit the amount of up-lighting and all external lighting (aside from security lighting) will be connected to daylight sensors and be time controlled.

4.1.5 Safety and Security

Secure by Design principles have been incorporated into the design to ensure safe and secure spaces are provided to all users.

4.1.6 Accessibility and Inclusiveness

The property, while being on a steeply sloping street, is accessed via a level crossover from the public highway. The approach to the house is step/ramp free within the curtilage of the site, and the threshold from the front garden into the entrance hall is level also.

Within the house, doorways and openings are purposefully wide. The proposed house will be designed in detail to comply with the DDA and Part M4(3) of the Building Regulations Approved Documents.

4.1.7 External Amenity

Carefully landscaped areas are proposed for the front and rear gardens. The occupants will have access to plenty of external spaces at the dwelling.

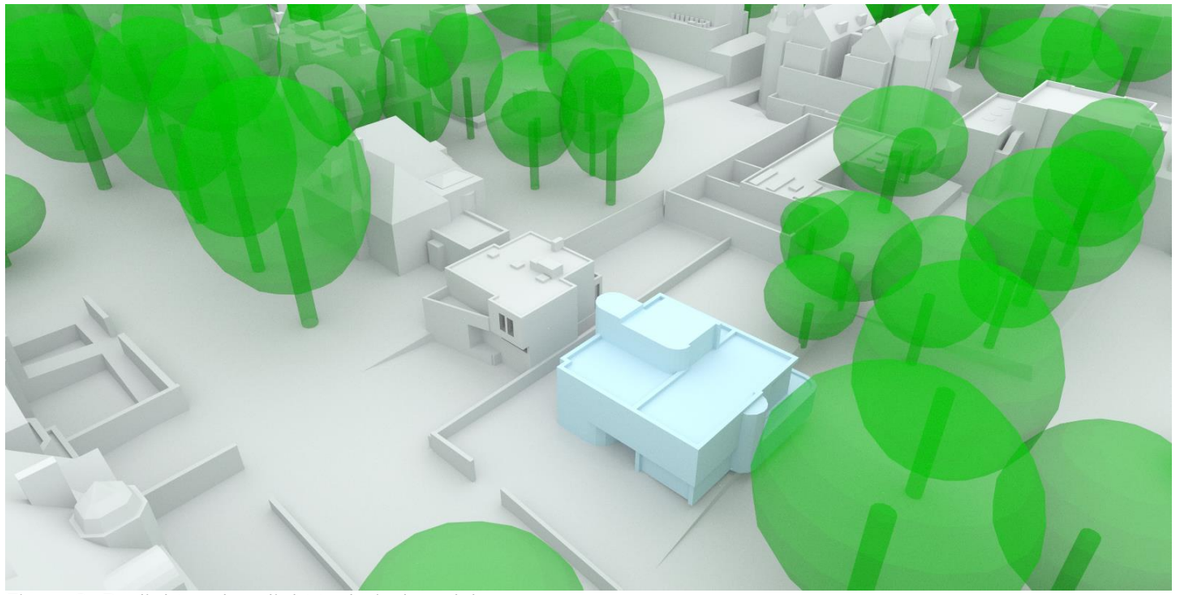


Figure 8. Daylight and sunlight technical model.

4.2 Nature, Landscape and Biodiversity

Any features of ecological value currently present on site will be retained and protected as far as feasible. Any new soft landscaping will comprise native plant species where appropriate. A biodiversity roof integrated with PV panels is proposed.

Only trees that are of low public visual amenity value or are structurally compromised will be removed.

Further information can be found in the Tree Survey and Arboricultural Method Statement prepared by Tretec.

4.3 Climate Resilience

4.3.1 Managing risk of overheating

The proposed development has been designed in line with GLA's Cooling Hierarchy. Refer to the Energy Strategy section and the accompanying Overheating Assessment Report for further details.

4.3.2 Managing flood risk

The site is located in an area with a low probability of flooding from rivers and seas (see Figure 10).

4.4 Water and Surface Water Runoff

4.4.1 Water Efficiency

The proposed development will target a mains water consumption of less than 105 litres/person/day. This is consistent with Building Regulations Part G(2) requirement and London Plan policy SI5.

The following suggested flow rates shall be considered during detailed design of the development to achieve the water consumption target:

- WCs: 6 litre / 3 litre dual flush.
- Wash basin taps: 4 litres/min.
- Kitchen sink taps: 6 litres/min.
- Showers: 8 litres/min.
- Baths: 180 litres to overflow;
- Dishwasher: 1.25 litres/place setting.
- Washing Machine: 8.17 litres/kg dry load.

A rainwater collection butt will also be installed for landscape irrigation to reduce potable water use.

4.4.2 Surface water runoff

Sustainable drainage systems will be considered, including the biodiverse roof proposed above the first floor.

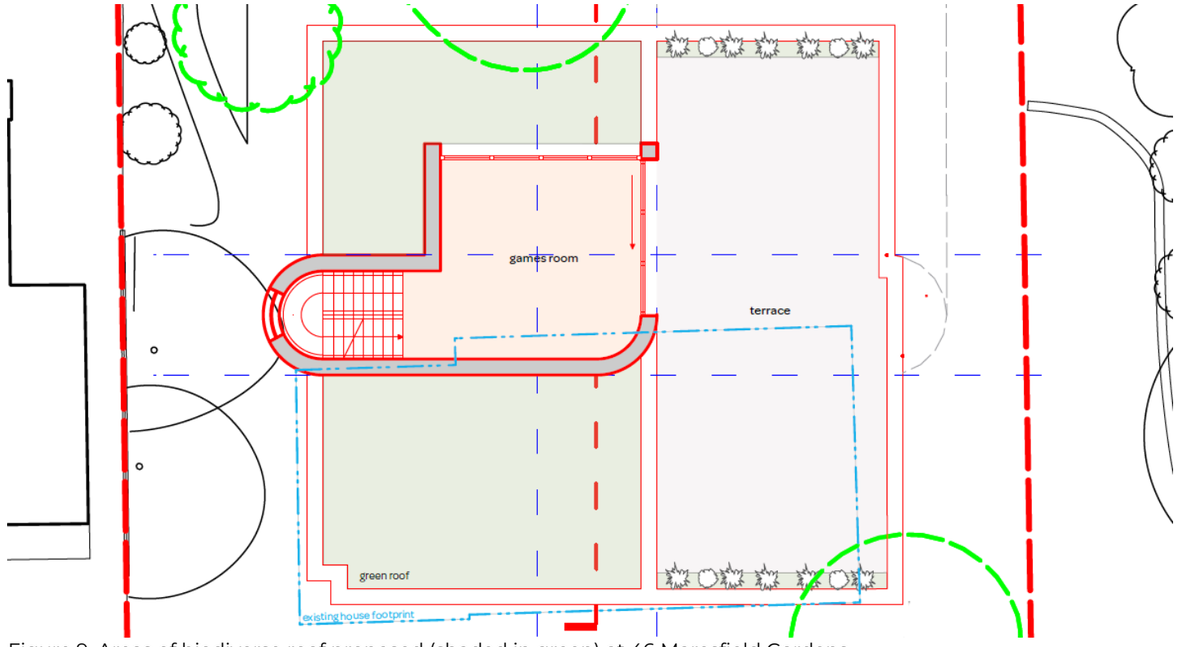


Figure 9. Areas of biodiverse roof proposed (shaded in green) at 46 Maresfield Gardens.

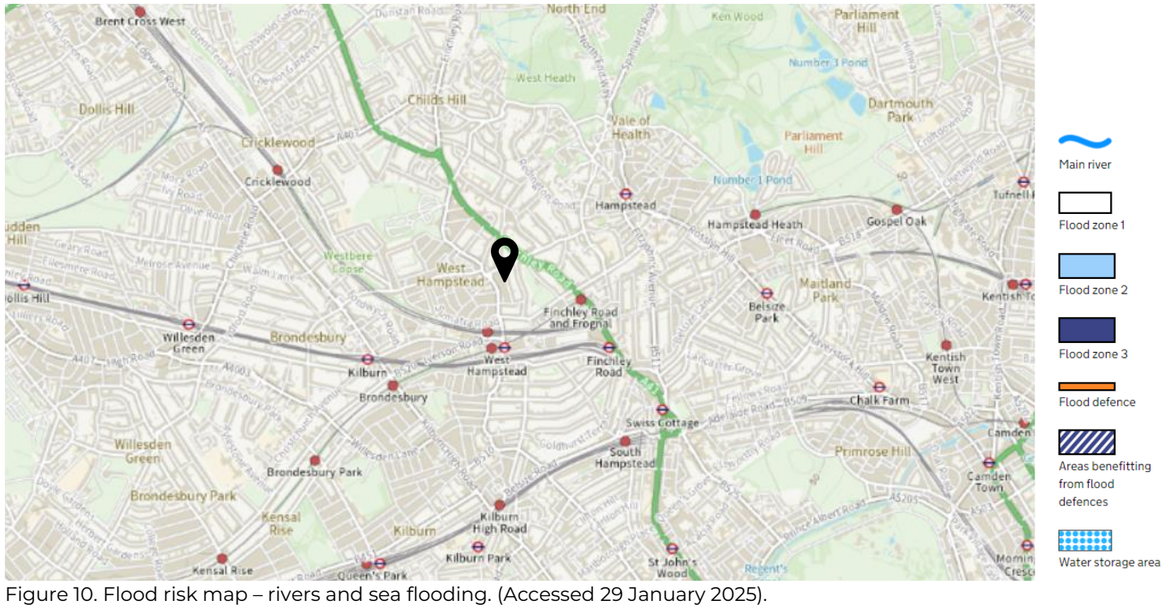


Figure 10. Flood risk map – rivers and sea flooding. (Accessed 29 January 2025).

4.5 Materials and Waste

4.5.1 Whole Life Carbon

The proposed development will aim to minimise use of the materials with high embodied carbon as far as possible. It is proposed that the above ground structure be mainly constructed from pre-fabricated Structural Insulated Panels (SIPs).

The structure grid of the proposed building has been rationalised and stacked to minimise the associated structural requirements.

To reduce embodied carbon of the proposed development, materials with recycled content will be prioritised during detailed design stage specification.

Whole Life Carbon assessment has been carried out which indicates that the proposed scheme can meet GLA's residential benchmark for embodied carbon emissions.

Further assessments were carried out to compare the proposed development with alternative design options for the site. These included carrying out minor upgrades to the existing building as well as an option where part demolition, refurbishment and extension was explored to create an equivalent scheme to the one proposed for the application site.

The assessment indicated that the proposed development which entails mainly retention of the front façade would outperform the other two options from a whole life carbon emissions perspective, as shown in Figure 11. For further details, please refer to the Whole Life Carbon Assessment for the planning application.

4.5.2 Material Selection and Procurement

All materials utilised for the scheme will be selected for longevity and durability as well as recoverability and recyclability at end of life. To minimise potential sources of indoor air pollution, low VOC materials, paints and finishes will be prioritised where possible.

All timber used on the site will be FSC or PEFC certified. Where feasible, all other construction materials utilised at the development will be certified under BES6001 and EMS or other similar responsible sourcing certification schemes.

Where practicable, the contractor will source items locally, and where possible amalgamate deliveries to reduce the overall number of vehicle movements taking place.

4.5.3 Waste Management and Circular Economy

Waste streams will be efficiently segregated (offsite) and processed during both construction and operation stages, with a target to maximise potential re-use of materials and diversion from landfill in line with GLA and Camden policies.

All waste that cannot be reused or recycled will be disposed of in accordance with legislation and best practice.

4.6 Sustainable transport

The site is within walking distance to Finchley Road and Frognal Overground Station and Finchley Road Underground Station. There are also numerous buses available along Finchley Road circa 250m to the west with connections into Central London and other national destinations.

4.6.1 Cycle Parking

Cycle storage spaces will be installed within the front garden of the dwelling.

4.6.2 Car Parking

The existing car parking space along the driveway will be retained. An EV charging point will be installed in line with Part S of the Building Regulations.

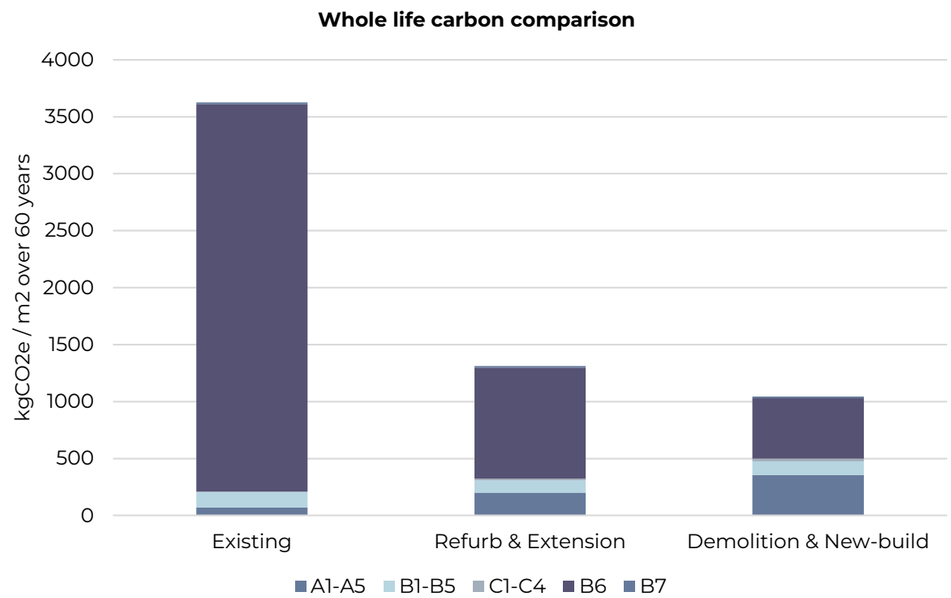


Figure 11. Whole Life Carbon Assessment results for three development options at 46 Maresfield Gardens. The lifecycle assessment study period is 60 years.

5 Conclusions

Through the adoption of the energy and sustainability strategies presented in this report, the client and design team demonstrated that the proposed development at 46 Maresfield Gardens will fulfil the relevant policy requirements stipulated by the London Plan, and by Camden's Local Plan.

Appendix A – GLA policies

London Plan (March 2021)

The London Plan is part of the statutory development plan for London and sets out a framework for how for how the city will develop sustainably over the next 20-25 years.

The energy and sustainability policies within the London Plan relevant to the proposed development at 46 Maresfield Gardens are summarised below.

Policy GG2 Making the best use of land

- enable the development of brownfield land, particularly in Opportunity Areas, on surplus public sector land, and sites within and on the edge of town centres, as well as utilising small sites.
- proactively explore the potential to intensify the use of land, promoting higher density development.
- protect and enhance London's open spaces, and promote the creation of new green infrastructure and urban greening, including aiming to secure net biodiversity gains where possible.
- plan for good local walking, cycling and public transport connections.

Policy GG3 Creating a healthy city

- promote more active and healthy lives for all Londoners and enable them to make healthy choices, utilise the Healthy Streets Approach
- seek to improve London's air quality and green spaces.
- ensure that new buildings are well-insulated and sufficiently ventilated to avoid the health problems associated with damp, heat and cold.
- seek to create a healthy food environment.

Policy GG6 Increasing efficiency and resilience

- seek to improve energy efficiency and support the move towards a low carbon circular economy, contributing towards London becoming a zero carbon city by 2050.
- ensure buildings and infrastructure are designed to adapt to a changing climate.

Policy D2 Infrastructure requirements for sustainable densities

- density of development proposals should consider, and be linked to, the provision of future planned levels of infrastructure rather than existing levels.
- density of development should be proportionate to the site's connectivity and accessibility by walking, cycling, and public transport to jobs and services.

Policy D11 Safety, security, and resilience to emergency

- maximise building resilience and minimise potential physical risks, including those arising as a result of extreme weather, fire, flood and related hazards.
- Include measures to design out crime.

Policy D14 Noise

- avoiding significant adverse noise impacts on health and quality of life.
- mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on existing noise-generating uses.
- improving and enhancing the acoustic environment and promoting appropriate soundscapes.

Policy G1 Green infrastructure

- incorporate appropriate elements of green infrastructure that are integrated into London's wider green infrastructure network.

Policy G5 Urban greening

- contribute to the greening of London by including urban greening as a fundamental element of site and building design, and by incorporating measures such as high-quality landscaping (including trees), green roofs, green walls and nature-based sustainable drainage.

Policy G6 Biodiversity and access to nature

- manage impacts on biodiversity and aim to secure net biodiversity gain.

Policy SI1 Improving air quality

- demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.
- ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.

Policy SI2 Minimising greenhouse gas emissions

- Major development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand in accordance with the following energy hierarchy:
  1. be lean: use less energy and manage demand during operation
  2. be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly
  3. be green: maximise opportunities for renewable energy by producing, storing and using renewable energy on-site
  4. be seen: monitor, verify and report on energy performance.
- A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:
  - through a cash in lieu contribution to the borough's carbon offset fund, or
  - off-site provided that an alternative proposal is identified and delivery is certain.

Policy SI3 Energy infrastructure

- identify the need for, and suitable sites for, any necessary energy infrastructure requirements including energy centres, energy storage and upgrades to existing

infrastructure. Identify existing heating and cooling networks, identify proposed locations for future heating and cooling networks and identify opportunities for expanding and inter-connecting existing networks as well as establishing new networks.

Policy SI4 Managing heat risk

- minimise adverse impacts on the urban heat island through design, layout, orientation, materials and the incorporation of green infrastructure.
- 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.

Policy SI5 Water infrastructure

- to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.
- <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)>
- seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided

Policy SI7 Reducing waste and supporting the circular economy

- promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
- encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products.
- design developments with adequate, flexible, and easily accessible storage space and collection systems that support, as a minimum, the separate collection of dry recyclables (at least card, paper, mixed plastics, metals, glass) and food.

Policy SI12 Flood risk management

- ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.

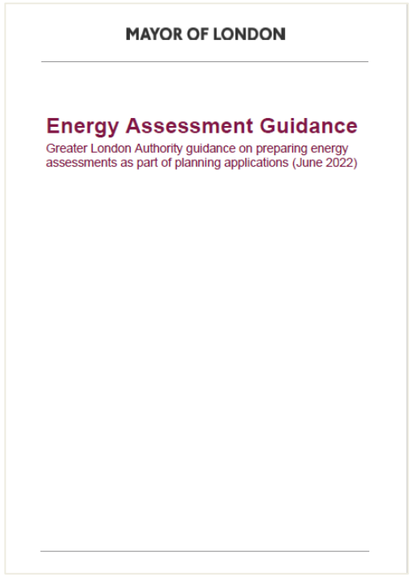
Policy SI13 Sustainable Drainage

- aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the drainage hierarchy.

Policy T5 Cycling

- securing the provision of appropriate levels of cycle parking which should be fit for purpose, secure and well-located. Developments should provide cycle parking at least in accordance with the minimum standards set out in Table 10.2 and Figure 10.3 the London Plan.
- Cycle parking should be designed and laid out in accordance with the guidance contained in the London Cycling Design Standards.

Energy Assessment Guidance (June 2022)



This document provides guidance on how to prepare energy statements that meets London Plan Policy SI2 for GLA referable projects. It is also useful reference for Major Developments (>10 dwellings or >1,000m^2 non-domestic space) proposed for within Greater London.

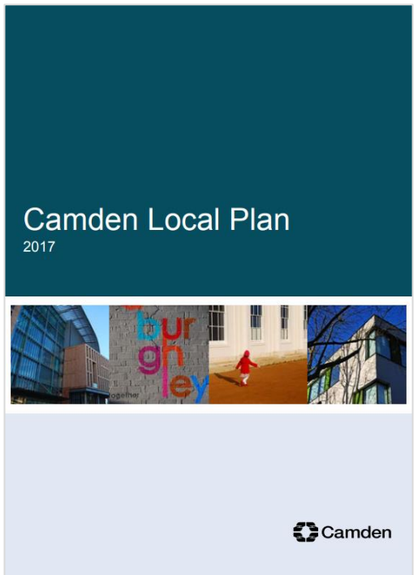
The main requirements relevant to the proposed scheme at 46 Maresfield Gardens are summarised below:

- Major developments are required to achieve a minimum 35 per cent on-site carbon reduction over Part L 2021. Residential developments are expected to be able to exceed this, and so an additional benchmark (50 per cent reduction) has been set that residential developments should be aiming to achieve.
- Energy demand should be reduced as far as possible before the heating strategy and installation of low carbon and renewable technologies is considered. This is important in protecting consumers from high prices. Developments are expected to achieve carbon reductions beyond Part L 2021 of 10 per cent for residential developments and 15 per cent for non-residential developments through energy efficiency measures alone, before other measures are applied.
- Applicants should also report the Energy Use Intensity (EUI) and the space heating demand of the development. These metrics will help applicants to demonstrate that they have maximised energy efficiency measures in line with the energy hierarchy, in addition to the percentage improvement target.

Although the scheme at 46 Maresfield Gardens do not fall under the threshold for major development, the principles of the energy assessment guidance have been followed when developing the energy strategy.

Appendix B – Camden policies

Camden Local Plan (2017)



The Local Plan sets out the sets out the Council's vision for the borough and help deliver the objectives of creating the conditions for harnessing the benefits of economic growth, reducing inequality and securing sustainable neighbourhoods. The Local Plan will cover the period from 2016-2031.

The energy and sustainability policies within the Camden Local Plan relevant to the proposed development at 46 Maresfield Gardens are summarised below.

Policy C1 Health and wellbeing

- Measures that will help contribute to healthier communities and reduce health inequalities must be incorporated in a development where appropriate.
- Developments to positively contribute to creating high quality, active, safe and accessible places.

Policy C5 Safety and Security

- Developments to demonstrate the incorporation of design principles which contribute to community safety and security, particularly in wards with relatively high levels of crime.
- Provide appropriate security and community safety measures in buildings and spaces.

Policy C6 Access for all

- All buildings to meet the highest practicable standards of accessible and inclusive design so they can be used safely, easily and with dignity by all.
- Spaces, routes and facilities between buildings to be designed to be fully accessible.
- Developments to meet the principles of lifetime neighbourhoods.

Policy A1 Managing the impact of development

- Developments to contribute towards strong and successful communities by balancing the needs of development with the needs and characteristics of local areas and communities.
- The following will be considered:
  - Visual privacy and outlook
  - Sunlight, daylight and overshadowing
  - Artificial lighting levels
  - Transport impacts
  - Impacts of the construction phase
  - Noise and vibration levels
  - Odour, fumes and dust
  - Microclimate
  - Contaminated land
  - Impact upon water and wastewater infrastructure

Policy A2 Open space

- Protect all designated public and private open spaces as shown on the policy map unless equivalent or better provision of open space in terms of quality and quantity is provided within the local catchment area.
- Apply a standard of 9m2 per occupant for residential schemes and 0.74m2 for commercial and higher education developments while taking into account any funding for open spaces through the CIL.
- Developments to seek opportunities for providing private amenity space.

Policy A3 Biodiversity

- Developments will be assessed against their ability to realise benefits for biodiversity through the layout, design and materials used in the built structure and landscaping elements.
- Improve opportunities to experience nature, in particular where such opportunities are lacking.
- Require the demolition and construction phase of development, including the movement of works vehicles, to be planned to avoid disturbance to habitats and species and ecologically sensitive areas, and the spread of invasive species.
- Secure management plans, where appropriate, to ensure that nature conservation objectives are met.
- Developments should incorporate additional trees and vegetation where possible.

Policy A4 Noise and Vibration

- Planning permission will not be granted for developments likely to generate unacceptable noise and vibration impacts.
- Developments sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.

Policy CC1 Climate change mitigation

- Developments are encouraged to meet the highest feasible environmental standards that are financially viable during construction and operation.
- All developments to reduce carbon dioxide emissions through following the steps in the energy hierarchy.
- All major developments to demonstrate how London Plan targets for carbon dioxide have been met.
- Location of developments and mix of land uses to minimise the need to travel by car and help to support decentralised energy networks.
- All proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building.
- All developments to optimise resource efficiency.

Policy CC2 Adapting to climate change

- Developments should adopt appropriate climate change adaptation measures including:
  - Protection of existing green spaces and promoting new appropriate green infrastructure.
  - Not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of SuDs.
  - Incorporate biodiverse roofs, combination of green and blue roofs and green walls where appropriate.
  - Implementing measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.
- Developments to demonstrate how adaptive measures and sustainable development principles have been incorporated into the design and proposed implementation.

Policy CC3 Water and flooding

- Developments to:
  - Incorporate water efficiency measures.
  - Avoid harm to the water environment and improve water quality.
  - Consider the impact of development in areas at risk of flooding.
  - Incorporate flood resilient measures in areas prone to flooding.
  - Utilise SuDs in line with drainage hierarchy to achieve greenfield runoff rate where feasible.
  - Not locate vulnerable development in flood-prone areas.

Policy CC4 Air Quality

- Developments that introduce sensitive receptors in locations of poor air quality will not be acceptable unless designed to mitigate the impact.
- Development that involves significant demolition, construction or earthworks will be required to access the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan.

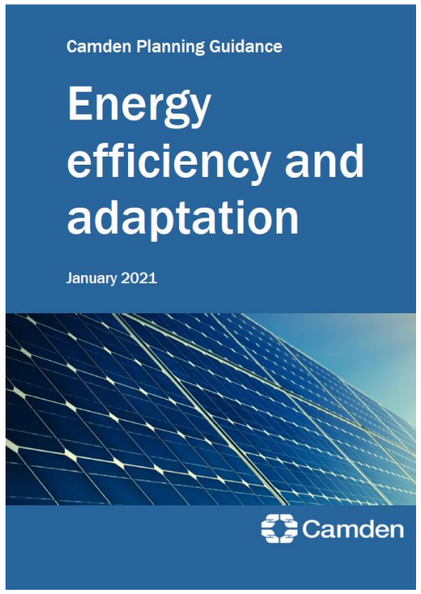
Policy CC5 Waste

- Developments to include facilities for the storage and collection of waste and recycling.

Policy T1 Prioritising walking, cycling and public transport

- Developments to improve the pedestrian environment by supporting high quality public realm improvement works.
- Developments should be adequately lit.
- Accessible and secure cycle parking facilities exceeding minimum standards outlined in the London Plan and Camden's Planning Guidance on Transport should be provided. Higher levels of provision may also be required in areas well served by cycle route infrastructure, taking into account the size and location of the development.

Camden Planning Guidance – Energy Efficiency and Adaptation (2021)



This planning guidance provides information on key energy and resource issues within the borough and supports Local Plan Policies CC1 Climate change mitigation and CC2 Adapting to climate change.

Main requirements and guidance elements from the document are summarised below.

Energy hierarchy

- All development in Camden is expected to reduce carbon dioxide emissions by following the energy hierarchy in accordance with Local Plan policy CC1.

Making buildings more energy efficient

- Natural 'passive' measures should be prioritised over active measures to reduce energy.

Energy reduction

- All development in Camden is expected to reduce carbon dioxide emissions through the application of the energy hierarchy.
- All new build residential development (of 1 – 9 dwellings) must meet 19% carbon dioxide reduction.
- The 20% carbon reduction target (using on-site renewable energy technologies) applies for developments of five or more dwellings and/or more than 500 sqm of any gross internal floorspace.
- For minor developments, renewables should be incorporated where feasible.

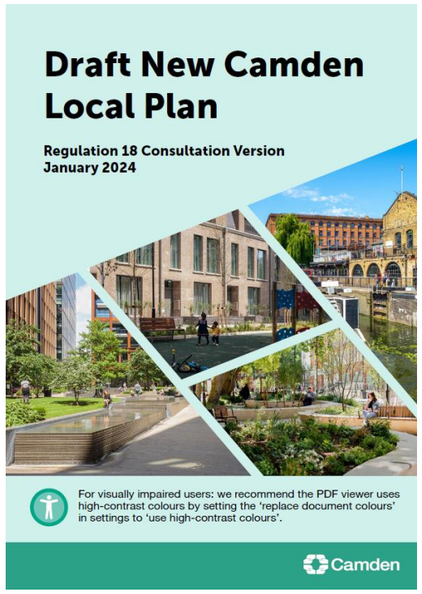
Reuse and optimising resource efficiency

- All development should seek to optimise resource efficiency and use circular economy principles.

Sustainable design and construction measures

- Active cooling (air conditioning) will only be permitted where its need is demonstrated and the steps in the cooling hierarchy are followed (Local Plan policy CC2).
- Development is expected to reduce overheating risk through following the steps in the cooling hierarchy. All new development should submit a statement demonstrating how the cooling hierarchy has been followed (Local Plan policy CC2).
- All developments should seek opportunities to make a positive contribution to green space provision or greening.

Emerging Draft New Camden Local Plan (Regulation 18 Consultation Version, January 2024)



The Council has started preparing a new Local Plan for Camden to replace the current Camden Local Plan (2017) and Site Allocations Plan (2013). Consultation for the Regulation 18 Draft Local Plan was undertaken between January to March 2024.

Although the Draft Local Plan has not been adopted yet, the client and design team have considered the proposed energy and sustainability related policies during development of the scheme as far as feasible.

Policy CC1 - Responding to the climate emergency

The Council will prioritise the provision of measures to mitigate and adapt to climate change and require all development in Camden to respond to the climate emergency by:

- Supporting the retrofitting of existing buildings to make them more energy efficient.
- Prioritising and enabling the repurposing and re-use of existing buildings.
- Following circular economy principles, minimising waste and increasing re-use.
- Reducing whole life carbon emissions, by taking a whole life carbon approach.
- Being designed and constructed to be net zero carbon in operation.
- Utilising low carbon technologies and maximising opportunities for renewable energy generation, and heat networks.
- Being designed to be resilient to climate change and meet the highest standards of sustainable design and construction.
- Minimising the risk of overheating through design and avoiding reliance on air conditioning.
- Improving water efficiency.
- Minimising and avoiding the risk of flooding from all sources, and incorporating multifunctional SuDs to reduce surface water run-off.
- Protecting and enhancing existing green spaces and water sources, enhancing biodiversity, strengthening nature recovery and providing multi-functional green infrastructure.
- Prioritising sustainable transport.

Policy CC2 - Repurposing, Refurbishment and Re-use of Existing Buildings

The Council will only permit proposals that involve the partial or substantial demolition of existing building/s, where it can be demonstrated to the Council's satisfaction that:

- The applicant has comprehensively explored a range of alternative development options, informed by the condition and feasibility assessment, prior to considering full or partial demolition.
- The proposal constitutes the best use of the site, when considered against alternative options involving the retention, repurposing, refurbishment and/or re-use of the existing building/s.

Where it is demonstrated to the Council's satisfaction that the partial or full demolition of existing building/s is justified, the applicant will be required to submit a pre-demolition audit. This should demonstrate that the re-use of materials has been explored on site; identify all materials within the building and document how they will be managed; show how building material waste will be minimised; and demonstrate that circular economy principles have been applied in accordance with Policy CC3 Circular Economy and Reduction of Waste.

Policy CC3 - Circular economy and reduction of waste

The Council will require all developments to optimise resource efficiency by:

- Reducing waste through the application of the waste hierarchy (Prevention, Preparing for reuse, Recycling, Other recovery, Disposal);
- Reducing energy and water use during demolition and construction, whilst effectively mitigating air quality impacts;
- Minimising the amount of materials required;
- Using materials with low embodied carbon content; and
- Enabling low energy and water demands once the building is in use.

Require all developments to be designed for:

- easy maintenance and renovation;
- flexibility and adaptation; and
- longer life and facilitating deconstruction for future re-use.

Policy CC4 - Minimising carbon emissions

The Council will seek to ensure that all development minimises carbon emissions over the lifespan of the building(s). The Council will:

- Require applicants for all new build development and all development proposing substantial demolition to submit a whole life carbon emissions assessment (including operational and embodied carbon), following the GLA Whole Life Cycle Carbon Assessment template, as part of the planning application; and demonstrate that they have done all they can to minimise carbon emissions over the lifespan of the building/s, targeting the GLA Whole Life Carbon aspirational benchmarks in modules B – C.
- Require new build developments to meet embodied carbon limits of less than 500kg CO2/m2 for residential.
- Require applicants to demonstrate what action they have taken to reduce embodied carbon in the development, as part of the Energy or Sustainability Statement.

Policy CC6 - Energy reduction in new buildings

The Council will ensure that all new buildings are designed and built to be net zero carbon in operation. The Council will:

- Require new buildings to be fossil fuel free, ultra-low energy, use low carbon heat, and contribute to the generation of renewable energy on-site.
- Require new buildings to use as little energy as possible to heat them. The Council will require all new residential and non-residential buildings to achieve a space heating demand of 15 or less kWh/m2 GIA/yr.
- Require new buildings to use as little (total) energy as possible (expressed as EUI – Energy Use Intensity). Residential buildings must achieve an EUI of no more than 35 kWh/m2GIA/yr.
- Require renewable energy generation on-site to match, or be in excess of, the predicted total annual energy demand of the building (EUI), in accordance with the following requirements:
  - the proposed building must not use fossil fuels on-site;
  - it must have a level of space heating demand and energy use intensity (EUI) compliant with levels in this policy; and
  - on-site renewable energy generation (e.g. through photovoltaics (PVs) has been maximised and achieves at least

80 kWh/m2 building footprint for all building types.

- Require applicants/landowners to monitor the total energy use and renewable energy generation of the development for the first 5 years of occupation and submit the annual figures to the Local Planning Authority.
- Require applicants to demonstrate that the development will deliver all the requirements of this policy through the provision of a detailed Energy Statement and through the use of an energy assured performance method.

Policy CC8 - Overheating and cooling

The Council will ensure that development is designed to minimise overheating and promote cooling. The Council will:

- Support proposals which seek to adapt and improve existing buildings, to improve ventilation, and address overheating and promote cooling, where they are in accordance with the other policies in this Plan.
- Require all development to minimise the adverse impacts of overheating through the application of the London Plan cooling hierarchy. Applicants should include information demonstrating that the risk of overheating has been mitigated through the incorporation of design measures in the Sustainability Statement.
- Require applicants to incorporate measures to cool buildings through the use of materials and finishes. The Council will expect materials and finishes to have the ability to reflect sunlight.
- Require applicants to incorporate measures to cool the spaces around and between buildings using appropriate materials, finishes, and greening. Trees should provide adequate canopy cover for greater cooling effect.

Policy CC9 - Water efficiency

To maximise water efficiency in Camden the Council will:

- Require all new development to be designed to be water efficient;
- Require all residential developments to meet the optional requirement for water efficiency set out in Part G of the Building Regulations of 110 litres per person per day (including 5 litres for external water use). Proposals will be strongly encouraged to reduce daily water use even further than this (to, for example, 85 litres per day per person) where possible;
- Require all new buildings to include rain water harvesting appropriate to the scale and nature of the proposed .

Appendix C – Energy calculation assumptions

The items listed below are assumptions only, based on a combination of best judgement at <planning stage> and information from the design team where appropriate. Throughout the design and construction stages the fabric and system requirements (including provisions of renewable technologies) may change whilst the building designs are being progressed. All information detailed in this summary sheet is preliminary recommendation at the Planning Stage. It should be noted that this document is not exhaustive and the design and construction teams should allow for flexibility on site where necessary.

Building fabric parameter	Part L 2021 notional	Proposed specification	Unit	Note
Walls				
External walls	0.18	0.15	W/m2K	1
Floors				
Ground floors	0.13	0.10	W/m2K	1
Exposed floors	0.13	0.10	W/m2K	1
Roofs/ceilings				
Roofs	0.11	0.10	W/m2K	1
Openings				
Flat entrance doors	1.0	1.0	W/m2K	1
New windows (inc. rooflights) - pane and frame	1.2	1.2	W/m2K	1
Windows solar transmittance factor (g-value)	0.63	0.4	W/m2K	1, 2
Windows frame factor	0.7	0.8	W/m2K	1
Air permeability				
Maximum average air permeability across units	5	3	m3/m2.h	1
Air permeability test required prior to handover.				

Building fabric parameter	Part L 2021 notional	Proposed specification	Unit	Note
Thermal Bridging				
The following psi values are recommended. All junctions should either be thermally modelled or meet enhanced construction details and other accredited details with psi values below those outlined below.				
E1 lintels	0.05	0.05	W/mK	1
E3 Sill	0.05	0.05	W/mK	1
E4 Jambs	0.05	0.05	W/mK	1
E5 Ground Floor	0.16	0.08	W/mK	1
E6 Inter floor within dwelling	0	0	W/mK	1
E14 Flat roof to terrace	0.08	0.08	W/mK	1
E15 Flat roof with parapet	0.56	0.28	W/mK	1
E24 Eaves (ins. at ceiling level - inverted)	0.24	0.16	W/mK	1
E16 Corner (normal)	0.09	0.09	W/mK	1
E17 Corner (inverted)	-0.09	-0.09	W/mK	1
E19 Ground floor (inverted)	0.07	0.07	W/mK	1
E20 Exposed floor (normal)	0.32	0.32	W/mK	1
E21 Exposed floor (inverted)	0.32	0.32	W/mK	1
E1 lintels	0.05	0.05	W/mK	1

Building Services Systems	Proposed specification	Unit	Note
Ventilation			
Type	Mechanical ventilation with heat recovery		1
Installed Specific Fan Power	<0.54	W/l/s	1, 3, 4
Heat recovery efficiency	>88	%	1, 3, 4
MVHR duct type	Rigid		1
MVHR duct installation specification	Level 1		1
Installer commissioning certificate	Assumed		1
MVHR unit modelled	MRXBOX-ECO2		1, 4
Heating			
Type	Air source heat pump		1, 3, 4
COP - space heating	>300	%	1, 3, 4
COP - domestic hot water	>200	%	1, 3, 4
Heat emitter	Underfloor or Radiators		1, 3, 4
Fuel type	Electricity		1, 3, 4
Electricity tariff	Standard		1, 3, 4
Installed to Microgeneration Installation Standard	Yes		1, 3, 4
Heating controls	Time and temperature zone control by arrangement		1, 3, 4
Pump in heated space	Yes		1, 3, 4
Hot Water			
From main heating system	Yes		1
Cylinder volume (per dwelling)	150	Litres	1, 4
Insulation	Factory – 100mm		1, 4
Cylinder in heated space	Yes		1, 4
Cylinderstat	Yes		1, 4

Building Services Systems	Proposed specification	Unit	Note
Water consumption			
Part G Water consumption	<105	l/p/d	1
Showers flow rate	<8	l/min	1
Photovoltaics			
Capacity of PV system	2.8	kWp	1, 4
No. of panels	8		1, 4
Panel capacity	350 W/panel		1, 4
Orientation	South		1, 4
Tilt from horizontal	10° from horizontal		1, 4
Export capable meter	Yes		1, 4
Battery	Not currently assumed		1, 4
Waste water heat recovery	Not currently assumed		1, 4

Notes	
1	Planning stage assumption to achieve planning policy or Building Regulations targets
2	Subject to detailed overheating assessment to be carried out where required
3	Building regulations requirement
4	subject to MEP design by others

NB. Please refer to Approved Document L1 2021 for all requirements to comply with Building Regulations Part L.

Appendix B – Planning stage SAP output

Planning stage SAP output the dwelling is included in this appendix. The Lean Stage DER has been adjusted to include the PV allowance included in the Notional Building and to enable calculation of Be Lean stage savings as per GLA's methodology.

Table 6. Planning stage SAP results.

Unit Reference	TER ($kgCO_2/m^2$)	Lean DER ($kgCO_2/m^2$)	Green DER ($kgCO_2/m^2$)	TFEE (kWh/m^2)	DFEE (kWh/m^2)
46 Maresfield Gardens	7.85	6.78	2.93	46.21	44.60

Full SAP Calculation Printout

Property Reference	House	**Issued on Date**	29/01/2025
Assessment Reference	Lean	**Prop Type Ref**	
Property			

SAP Rating	88 B	**DER**	9.30	**TER**	7.85
Environmental	89 B	**% DER < TER**			-18.47
CO_2 Emissions (t/year)	3.56	**DFEE**	42.50	**TFEE**	46.21
Compliance Check	See BREL	**% DFEE < TFEE**			8.03
% DPER < TPER	-25.44	**DPER**	52.99	**TPER**	42.24

Assessor Details	Ms. Sherleen Pang	**Assessor ID**	BA17-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	209.2300 (1b)	x	3.0000 (2b)	=	627.6900	(1b) - (3b)
First floor	194.2300 (1c)	x	3.0000 (2c)	=	582.6900	(1c) - (3c)
Second floor	32.9100 (1d)	x	2.5800 (2d)	=	84.9078	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	436.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1295.2878	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2952	0.2915	0.2877	0.2690	0.2652	0.2465	0.2465	0.2427	0.2540	0.2652	0.2727	0.2802	(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	
Windows (Uw = 1.20)			115.9000	1.1450	132.7099			(27)
Doors			3.6000	1.0000	3.6000			(26)
Ground floor or to storage			209.2300	0.1000	20.9230	20.0000	4184.6000	(28a)
Exposed floor			12.7200	0.1000	1.2720	20.0000	254.4000	(28b)
External Wall 1	441.9000	119.5000	322.4000	0.1500	48.3600	9.0000	2901.6000	(29a)
All roofs	220.8900		220.8900	0.1000	22.0890	9.0000	1988.0100	(30)
Total net area of external elements Aum(A, m2)			884.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	228.9539			(33)
Internal Wall 1			438.1800			9.0000	3943.6200	(32c)
Internal Ceiling 1			194.2300			9.0000	1748.0700	(32e)
Internal Ceiling 2			32.9100			9.0000	296.1900	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			15316.4900	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 35.0998 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	57.7800	0.0500	2.8890
E3	Sill	38.3900	0.0500	1.9195
E4	Jamb	80.1800	0.0500	4.0090
E5	Ground floor (normal)	67.9700	0.0800	5.4376
E6	Intermediate floor within a dwelling	31.4900	0.0000	0.0000
E14	Flat roof	26.5900	0.0800	2.1272
E15	Flat roof with parapet	72.4700	0.2800	20.2916
E24	Eaves (insulation at ceiling level - inverted)	39.3700	0.1600	6.2992
E16	Corner (normal)	35.1600	0.0900	3.1644
E17	Corner (inverted - internal area greater than external area)	20.5800	-0.0900	-1.8522
E19	Ground floor (inverted)	7.9500	0.0700	0.5565
E20	Exposed floor (normal)	10.5100	0.3200	3.3632
E21	Exposed floor (inverted)	13.3800	0.3200	4.2816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 52.4866 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 281.4405 (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	126.2031	124.6002	122.9973	114.9827	113.3798	105.3652	105.3652	103.7623	108.5710	113.3798	116.5856	119.7915	(38)
Heat transfer coeff	407.6437	406.0407	404.4378	396.4232	394.8203	386.8057	386.8057	385.2028	390.0115	394.8203	398.0261	401.2320	(39)

Average = Sum(39)m / 12 = 396.0225

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9342	0.9305	0.9268	0.9085	0.9048	0.8864	0.8864	0.8827	0.8938	0.9048	0.9121	0.9195	(40)
HLP (average)												0.9075	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3092 (42)
Hot water usage for mixer showers

79.7045	78.5067	76.7613	73.4217	70.9572	68.2088	66.6466	68.3788	70.2777	73.2286	76.6399	79.3992	(42a)

Hot water usage for baths

34.3988	33.8879	33.1685	31.8420	30.8488	29.7474	29.1525	29.8669	30.6448	31.8232	33.1770	34.2825	(42b)

Hot water usage for other uses

48.5196	46.7553	44.9909	43.2266	41.4622	39.6979	39.6979	41.4622	43.2266	44.9909	46.7553	48.5196	(42c)

Average daily hot water use (litres/day) 149.4868 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	162.6229	159.1499	154.9207	148.4903	143.2682	137.6541	135.4970	139.7080	144.1490	150.0428	156.5722	162.2013	(44)
Energy conte	257.5550	226.6274	238.1074	203.2758	192.8666	169.2618	163.8719	172.9876	177.7501	203.6066	223.0658	253.9680	(45)
Energy content (annual)										Total = Sum(45)m =		2482.9441	
Distribution loss (46)m = 0.15 x (45)m	38.6332	33.9941	35.7161	30.4914	28.9300	25.3893	24.5808	25.9481	26.6625	30.5410	33.4599	38.0952	(46)

Water storage loss:
Store volume 150.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0103 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 0.7736 (55)
Total storage loss

23.9825	21.6616	23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(56)

If cylinder contains dedicated solar storage

23.9825	21.6616	23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(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

304.7999	269.3002	285.3522	248.9967	240.1114	214.9826	211.1168	220.2325	223.4710	250.8515	268.7867	301.2129	(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

304.7999	269.3002	285.3522	248.9967	240.1114	214.9826	211.1168	220.2325	223.4710	250.8515	268.7867	301.2129	(64)

Total per year (kWh/year) = Sum(64)m = 3039.2142 (64)
12Total per year (kWh/year) 3039 (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

123.4329	109.4918	116.9666	104.1659	101.9240	92.8562	92.2833	95.3143	95.6786	105.4951	110.7461	122.2403	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	283.0502	313.3770	283.0502	292.4852	283.0502	292.4852	283.0502	283.0502	292.4852	283.0502	292.4852	283.0502	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	561.1787	567.0020	552.3275	521.0873	481.6521	444.5886	419.8279	414.0046	428.6791	459.9193	499.3545	536.4180	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	(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)	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	(71)
Water heating gains (Table 5)	165.9045	162.9343	157.2132	144.6748	136.9947	128.9670	124.0367	128.1106	132.8869	141.7945	153.8140	164.3014	(72)
Total internal gains	1085.7715	1118.9514	1068.2290	1033.8855	977.3351	938.6790	899.5530	897.8036	926.6894	960.4022	1021.2919	1059.4078	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W	
North	12.6900	10.6334	0.4000	0.8000	0.7700	29.9238	(74)
East	40.0200	19.6403	0.4000	0.8000	0.7700	174.3041	(76)
South	37.6800	46.7521	0.4000	0.8000	0.7700	390.6564	(78)
West	25.5100	19.6403	0.4000	0.8000	0.7700	111.1069	(80)

Solar gains	705.9912	1255.3048	1831.6383	2418.2020	2813.5689	2831.1870	2714.3726	2419.0401	2037.5752	1420.6497	855.8498	597.2171	(83)
Total gains	1791.7627	2374.2562	2899.8674	3452.0875	3790.9040	3769.8660	3613.9256	3316.8438	2964.2646	2381.0519	1877.1417	1656.6249	(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	10.4370	10.4782	10.5197	10.7324	10.7760	10.9993	10.9993	11.0450	10.9089	10.7760	10.6892	10.6038	
alpha	1.6958	1.6985	1.7013	1.7155	1.7184	1.7333	1.7333	1.7363	1.7273	1.7184	1.7126	1.7069	
util living area	0.9212	0.8781	0.8207	0.7301	0.6220	0.4975	0.3935	0.4321	0.6024	0.7868	0.8904	0.9297	(86)
MIT	17.5080	17.9536	18.5721	19.3343	19.9632	20.4281	20.6416	20.6019	20.2275	19.3592	18.3020	17.4443	(87)
Th 2	20.1386	20.1417	20.1448	20.1603	20.1634	20.1791	20.1791	20.1822	20.1728	20.1634	20.1572	20.1510	(88)
util rest of house	0.9151	0.8690	0.8073	0.7097	0.5917	0.4535	0.3348	0.3733	0.5609	0.7659	0.8808	0.9243	(89)
MIT 2	16.0853	16.6296	17.3828	18.3076	19.0528	19.5941	19.8210	19.7871	19.3778	18.3563	17.0686	16.0109	(90)
Living area fraction									fLA = Living area / (4) =			0.4044	(91)
MIT	16.6606	17.1650	17.8638	18.7228	19.4210	19.9314	20.1528	20.1166	19.7214	18.7619	17.5674	16.5906	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6606	17.1650	17.8638	18.7228	19.4210	19.9314	20.1528	20.1166	19.7214	18.7619	17.5674	16.5906	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8811	0.8280	0.7631	0.6692	0.5619	0.4392	0.3328	0.3682	0.5356	0.7231	0.8415	0.8923	(94)
Useful gains	1578.6748	1965.9200	2213.0284	2310.0220	2130.1944	1655.7425	1202.6584	1221.3544	1587.7194	1721.8492	1579.6407	1478.2569	(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	5038.7324	4980.1037	4595.9407	3893.9768	3048.4072	2062.2162	1374.2538	1431.6490	2192.4082	3222.4684	4166.2920	4971.4871	(97)
Space heating kWh	2574.2829	2025.5314	1772.8867	1140.4474	683.1503	0.0000	0.0000	0.0000	0.0000	1116.4607	1862.3889	2598.9633	(98a)
Space heating requirement - total per year (kWh/year)												13774.1117	
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	2574.2829	2025.5314	1772.8867	1140.4474	683.1503	0.0000	0.0000	0.0000	0.0000	1116.4607	1862.3889	2598.9633	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13774.1117	
Space heating per m2											(98c) / (4) =	31.5652	(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	2574.2829	2025.5314	1772.8867	1140.4474	683.1503	0.0000	0.0000	0.0000	0.0000	1116.4607	1862.3889	2598.9633	(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)	2789.0389	2194.5086	1920.7874	1235.5877	740.1412	0.0000	0.0000	0.0000	0.0000	1209.5999	2017.7561	2815.7782	(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	304.7999	269.3002	285.3522	248.9967	240.1114	214.9826	211.1168	220.2325	223.4710	250.8515	268.7867	301.2129	(64)
Efficiency of water heater												92.3000	(216)
(217)m	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	92.3000	(217)
Fuel for water heating, kWh/month	330.2274	291.7661	309.1574	269.7689	260.1424	232.9172	228.7289	238.6051	242.1137	271.7784	291.2098	326.3411	(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	94.0760	84.9719	94.0760	91.0413	94.0760	91.0413	94.0760	94.0760	91.0413	94.0760	91.0413	94.0760	(231)
Lighting	69.6495	55.8754	50.3096	36.8590	28.4710	23.2610	25.9722	33.7596	43.8504	57.5341	64.9846	71.5853	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)													
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												14923.1979	(211)

Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	92.3000	
Water heating fuel used	3292.7565	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6750)		
mechanical ventilation fans (SFP = 0.6750)	1066.6695	(230a)
central heating pump	41.0000	(230c)
Total electricity for the above, kWh/year	1107.6695	(231)
Electricity for lighting (calculated in Appendix L)	562.1117	(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	19885.7356	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	14923.1979	0.2100	3133.8716	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3292.7565	0.2100	691.4789	(264)
Space and water heating			3825.3504	(265)
Pumps, fans and electric keep-hot	1107.6695	0.1387	153.6474	(267)
Energy for lighting	562.1117	0.1443	81.1301	(268)
Total CO2, kg/year			4060.1279	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.3000	(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	14923.1979	1.1300	16863.2136	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3292.7565	1.1300	3720.8148	(278)
Space and water heating			20584.0285	(279)
Pumps, fans and electric keep-hot	1107.6695	1.5128	1675.6824	(281)
Energy for lighting	562.1117	1.5338	862.1857	(282)
Total Primary energy kWh/year			23121.8966	(286)
Dwelling Primary energy Rate (DPER)			52.9900	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	209.2300 (1b)	x	3.0000 (2b)	=	627.6900	(1b) - (3b)
First floor	194.2300 (1c)	x	3.0000 (2c)	=	582.6900	(1c) - (3c)
Second floor	32.9100 (1d)	x	2.5800 (2d)	=	84.9078	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	436.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1295.2878	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	4 * 10 =	40.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0309	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.2809	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2809	(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	0.3581	0.3511	0.3441	0.3090	0.3019	0.2668	0.2668	0.2598	0.2809	0.3019	0.3160	0.3300 (22b)
Effective ac	0.5641	0.5616	0.5592	0.5477	0.5456	0.5356	0.5356	0.5338	0.5394	0.5456	0.5499	0.5545 (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			3.6000	1.0000	3.6000			(26)
TER Opening Type (Uw = 1.20)			105.5000	1.1450	120.8015			(27)
Ground floor or to storage			209.2300	0.1300	27.1999			(28a)
Exposed floor			12.7200	0.1300	1.6536			(28b)
External Wall 1	441.9000	109.1000	332.8000	0.1800	59.9040			(29a)
All roofs	220.8900		220.8900	0.1100	24.2979			(30)
Total net area of external elements Aum(A, m2)			884.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		237.4569			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 35.0998 (35)

List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	57.7800	0.0500	2.8890
E3 Sill	38.3900	0.0500	1.9195
E4 Jamb	80.1800	0.0500	4.0090
E5 Ground floor (normal)	67.9700	0.1600	10.8752
E6 Intermediate floor within a dwelling	31.4900	0.0000	0.0000
E14 Flat roof	26.5900	0.0800	2.1272
E15 Flat roof with parapet	72.4700	0.5600	40.5832
E24 Eaves (insulation at ceiling level - inverted)	39.3700	0.2400	9.4488
E16 Corner (normal)	35.1600	0.0900	3.1644
E17 Corner (inverted - internal area greater than external area)	20.5800	-0.0900	-1.8522
E19 Ground floor (inverted)	7.9500	0.0700	0.5565
E20 Exposed floor (normal)	10.5100	0.3200	3.3632
E21 Exposed floor (inverted)	13.3800	0.3200	4.2816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 81.3654 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 318.8223 (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	241.1329	240.0685	239.0252	234.1249	233.2080	228.9400	228.9400	228.1496	230.5840	233.2080	235.0628	237.0019	(38)
Heat transfer coeff	559.9552	558.8909	557.8476	552.9472	552.0304	547.7623	547.7623	546.9719	549.4063	552.0304	553.8851	555.8242	(39)

Average = Sum(39)m / 12 = 552.9428

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2832	1.2808	1.2784	1.2672	1.2651	1.2553	1.2553	1.2535	1.2590	1.2651	1.2693	1.2737	(40)
HLP (average)												1.2671	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3092 (42)

Hot water usage for mixer showers

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
79.7045	78.5067	76.7613	73.4217	70.9572	68.2088	66.6466	68.3788	70.2777	73.2286	76.6399	79.3992	(42a)

Hot water usage for baths

34.3988	33.8879	33.1685	31.8420	30.8488	29.7474	29.1525	29.8669	30.6448	31.8232	33.1770	34.2825	(42b)

Hot water usage for other uses

48.5196	46.7553	44.9909	43.2266	41.4622	39.6979	39.6979	41.4622	43.2266	44.9909	46.7553	48.5196	(42c)

Average daily hot water use (litres/day) 149.4868 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	162.6229	159.1499	154.9207	148.4903	143.2682	137.6541	135.4970	139.7080	144.1490	150.0428	156.5722	162.2013	(44)
Energy conte	257.5550	226.6274	238.1074	203.2758	192.8666	169.2618	163.8719	172.9876	177.7501	203.6066	223.0658	253.9680	(45)

Energy content (annual) Total = Sum(45)m = 2482.9441

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

38.6332	33.9941	35.7161	30.4914	28.9300	25.3893	24.5808	25.9481	26.6625	30.5410	33.4599	38.0952	(46)

Water storage loss:

Store volume 150.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3938 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7527 (55)

Total storage loss

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)

If cylinder contains dedicated solar storage

23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss 23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)

Total heat required for water heating calculated for each month

304.1499	268.7131	284.7023	248.3677	239.4615	214.3536	210.4668	219.5825	222.8420	250.2015	268.1577	300.5629	(62)
WWHRS -36.4376	-32.2257	-33.7449	-27.9421	-26.0410	-22.2835	-20.8872	-22.2115	-23.0554	-27.1797	-30.7913	-35.7628	(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												
267.7123	236.4874	250.9574	220.4256	213.4204	192.0701	189.5796	197.3711	199.7866	223.0218	237.3663	264.8001	(64)

Total per year (kWh/year) = Sum(64)m = 2692.9986 (64)

12Total per year (kWh/year) 2693 (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

122.9130	109.0222	116.4466	103.6627	101.4041	92.3530	91.7633	94.7943	95.1754	104.9751	110.2429	121.7203	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	(66)

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

	283.0502	313.3770	283.0502	292.4852	283.0502	292.4852	283.0502	283.0502	292.4852	283.0502	292.4852	283.0502	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	561.1787	567.0020	552.3275	521.0873	481.6521	444.5886	419.8279	414.0046	428.6791	459.9193	499.3545	536.4180	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	(71)
Water heating gains (Table 5)													
	165.2056	162.2354	156.5143	143.9760	136.2958	128.2681	123.3378	127.4117	132.1880	141.0956	153.1151	163.6025	(72)
Total internal gains													
	1085.0727	1118.2525	1067.5302	1033.1866	976.6363	937.9801	898.8541	897.1047	925.9905	959.7033	1020.5930	1058.7089	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	11.5500	10.6334	0.6300	0.7000	0.7700	37.5341	(74)
East	36.4300	19.6403	0.6300	0.7000	0.7700	218.6645	(76)
South	34.3000	46.7521	0.6300	0.7000	0.7700	490.0797	(78)
West	23.2200	19.6403	0.6300	0.7000	0.7700	139.3739	(80)

Solar gains	885.6522	1574.7529	2297.7444	3033.5642	3529.5320	3551.6299	3405.0916	3034.6123	2556.0838	1782.1727	1073.6465	749.1976	(83)
Total gains	1970.7248	2693.0054	3365.2746	4066.7508	4506.1683	4489.6100	4303.9457	3931.7170	3482.0743	2741.8760	2094.2395	1807.9065	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	7.5981	7.6125	7.6268	7.6944	7.7071	7.7672	7.7672	7.7784	7.7440	7.7071	7.6813	7.6545	
alpha	1.5065	1.5075	1.5085	1.5130	1.5138	1.5178	1.5178	1.5186	1.5163	1.5138	1.5121	1.5103	
util living area	0.9229	0.8805	0.8251	0.7413	0.6409	0.5273	0.4269	0.4667	0.6280	0.7978	0.8943	0.9313	(86)
MIT	15.8992	16.5057	17.3920	18.4859	19.4621	20.2156	20.6053	20.5300	19.8972	18.5663	17.0206	15.7864	(87)
Th 2	19.8540	19.8559	19.8578	19.8667	19.8683	19.8760	19.8760	19.8775	19.8731	19.8683	19.8650	19.8615	(88)
util rest of house	0.9155	0.8695	0.8086	0.7160	0.6024	0.4683	0.3445	0.3850	0.5743	0.7720	0.8827	0.9248	(89)
MIT 2	14.1502	14.8779	15.9383	17.2356	18.3684	19.2138	19.6138	19.5504	18.8896	17.3611	15.5127	14.0164	(90)
Living area fraction										fLA = Living area / (4) =		0.4044	(91)
MIT	14.8575	15.5362	16.5262	17.7412	18.8107	19.6189	20.0147	19.9466	19.2971	17.8485	16.1225	14.7322	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.8575	15.5362	16.5262	17.7412	18.8107	19.6189	20.0147	19.9466	19.2971	17.8485	16.1225	14.7322	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8639	0.8078	0.7430	0.6564	0.5603	0.4533	0.3555	0.3905	0.5421	0.7104	0.8243	0.8763	(94)
Useful gains	1702.5900	2175.4456	2500.5637	2669.3210	2524.6014	2035.2982	1530.1906	1535.4735	1887.5467	1947.8690	1726.2489	1584.3223	(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	5911.7217	5944.4487	5593.0795	4888.7350	3925.2990	2749.1585	1870.4632	1939.8790	2855.2989	4001.3907	4997.4357	5854.0558	(97)
Space heating kWh	3131.5940	2532.7701	2300.8318	1597.9781	1042.1190	0.0000	0.0000	0.0000	0.0000	1527.8201	2355.2545	3176.6818	(98a)
Space heating requirement - total per year (kWh/year)												17665.0494	
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	3131.5940	2532.7701	2300.8318	1597.9781	1042.1190	0.0000	0.0000	0.0000	0.0000	1527.8201	2355.2545	3176.6818	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17665.0494	
Space heating per m2											(98c) / (4) =	40.4818	(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	3131.5940	2532.7701	2300.8318	1597.9781	1042.1190	0.0000	0.0000	0.0000	0.0000	1527.8201	2355.2545	3176.6818	(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)	3392.8429	2744.0629	2492.7755	1731.2872	1129.0563	0.0000	0.0000	0.0000	0.0000	1655.2764	2551.7384	3441.6920	(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	267.7123	236.4874	250.9574	220.4256	213.4204	192.0701	189.5796	197.3711	199.7866	223.0218	237.3663	264.8001	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.0182	87.9529	87.8259	87.6024	87.1296	79.8000	79.8000	79.8000	79.8000	87.5424	87.8924	88.0360	(217)
Fuel for water heating, kWh/month	304.1556	268.8796	285.7443	251.6206	244.9458	240.6894	237.5684	247.3322	250.3591	254.7587	270.0645	300.7860	(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	58.8122	47.1814	42.4816	31.1238	24.0409	19.6417	21.9310	28.5067	37.0274	48.5819	54.8731	60.4468	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-156.9101	-204.0693	-270.6265	-279.6150	-281.7192	-255.5188	-251.5589	-246.2121	-235.3601	-219.8512	-165.8769	-137.6794	(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	-149.4438	-304.5783	-588.5536	-861.1132	-1117.8924	-1116.4719	-1104.0189	-944.6792	-705.4603	-428.4849	-197.0025	-119.0207	(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	19138.7317	(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	3156.9042	(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)	474.6485	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-10341.7170	(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	12514.5675	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	19138.7317	0.2100	4019.1337	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3156.9042	0.2100	662.9499	(264)
Space and water heating			4682.0835	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	474.6485	0.1443	68.5064	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2704.9974	0.1364	-369.0690	
PV Unit electricity exported	-7636.7196	0.1267	-967.3591	
Total			-1336.4282	(269)
Total CO2, kg/year			3426.0911	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.8500	(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	19138.7317	1.1300	21626.7668	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3156.9042	1.1300	3567.3018	(278)
Space and water heating			25194.0686	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	474.6485	1.5338	728.0317	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2704.9974	1.5044	-4069.2872	
PV Unit electricity exported	-7636.7196	0.4650	-3551.1238	
Total			-7620.4110	(283)
Total Primary energy kWh/year			18431.7901	(286)
Target Primary Energy Rate (TPER)			42.2400	(287)

Full SAP Calculation Printout

Property Reference	House	**Issued on Date**	29/01/2025
Assessment Reference	Green	**Prop Type Ref**	
Property			

SAP Rating	84 B	**DER**	2.77	**TER**	7.85
Environmental	97 A	**% DER < TER**			64.71
CO_2 Emissions (t/year)	1.04	**DFEE**	42.50	**TFEE**	46.21
Compliance Check	See BREL	**% DFEE < TFEE**			8.03
% DPER < TPER	30.12	**DPER**	29.52	**TPER**	42.24

Assessor Details	Ms. Sherleen Pang	**Assessor ID**	BA17-0001
Client			

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	209.2300 (1b)	x	3.0000 (2b)	=	627.6900	(1b) - (3b)
First floor	194.2300 (1c)	x	3.0000 (2c)	=	582.6900	(1c) - (3c)
Second floor	32.9100 (1d)	x	2.5800 (2d)	=	84.9078	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	436.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1295.2878	(5)

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2. Ventilation rate

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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	0 * 10 =	0.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)
	Air changes per hour		
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		3.0000	(17)
Infiltration rate		0.1500	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1500	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.1912	0.1875	0.1837	0.1650	0.1612	0.1425	0.1425	0.1388	0.1500	0.1612	0.1687	0.1762	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation	0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)	0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.2000 (23c)

Effective ac	0.2952	0.2915	0.2877	0.2690	0.2652	0.2465	0.2465	0.2427	0.2540	0.2652	0.2727	0.2802	(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	
Windows (Uw = 1.20)			115.9000	1.1450	132.7099			(27)
Doors			3.6000	1.0000	3.6000			(26)
Ground floor or to storage			209.2300	0.1000	20.9230	20.0000	4184.6000	(28a)
Exposed floor			12.7200	0.1000	1.2720	20.0000	254.4000	(28b)
External Wall 1	441.9000	119.5000	322.4000	0.1500	48.3600	9.0000	2901.6000	(29a)
All roofs	220.8900		220.8900	0.1000	22.0890	9.0000	1988.0100	(30)
Total net area of external elements Aum(A, m2)			884.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	228.9539			(33)
Internal Wall 1			438.1800			9.0000	3943.6200	(32c)
Internal Ceiling 1			194.2300			9.0000	1748.0700	(32e)
Internal Ceiling 2			32.9100			9.0000	296.1900	(32e)
Heat capacity Cm = Sum(A x k)				(28)...(30) + (32) + (32a)...(32e) =			15316.4900	(34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 35.0998 (35)
List of Thermal Bridges

	K1 Element	Length	Psi-value	Total
E2	Other lintels (including other steel lintels)	57.7800	0.0500	2.8890
E3	Sill	38.3900	0.0500	1.9195
E4	Jamb	80.1800	0.0500	4.0090
E5	Ground floor (normal)	67.9700	0.0800	5.4376
E6	Intermediate floor within a dwelling	31.4900	0.0000	0.0000
E14	Flat roof	26.5900	0.0800	2.1272
E15	Flat roof with parapet	72.4700	0.2800	20.2916
E24	Eaves (insulation at ceiling level - inverted)	39.3700	0.1600	6.2992
E16	Corner (normal)	35.1600	0.0900	3.1644
E17	Corner (inverted - internal area greater than external area)	20.5800	-0.0900	-1.8522
E19	Ground floor (inverted)	7.9500	0.0700	0.5565
E20	Exposed floor (normal)	10.5100	0.3200	3.3632
E21	Exposed floor (inverted)	13.3800	0.3200	4.2816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 52.4866 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 281.4405 (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	126.2031	124.6002	122.9973	114.9827	113.3798	105.3652	105.3652	103.7623	108.5710	113.3798	116.5856	119.7915	(38)
Heat transfer coeff	407.6437	406.0407	404.4378	396.4232	394.8203	386.8057	386.8057	385.2028	390.0115	394.8203	398.0261	401.2320	(39)

Average = Sum(39)m / 12 = 396.0225

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9342	0.9305	0.9268	0.9085	0.9048	0.8864	0.8864	0.8827	0.8938	0.9048	0.9121	0.9195	(40)
HLP (average)												0.9075	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3092 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	79.7045	78.5067	76.7613	73.4217	70.9572	68.2088	66.6466	68.3788	70.2777	73.2286	76.6399	79.3992	(42a)
Hot water usage for baths	34.3988	33.8879	33.1685	31.8420	30.8488	29.7474	29.1525	29.8669	30.6448	31.8232	33.1770	34.2825	(42b)
Hot water usage for other uses	48.5196	46.7553	44.9909	43.2266	41.4622	39.6979	39.6979	41.4622	43.2266	44.9909	46.7553	48.5196	(42c)

Average daily hot water use (litres/day) 149.4868 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	162.6229	159.1499	154.9207	148.4903	143.2682	137.6541	135.4970	139.7080	144.1490	150.0428	156.5722	162.2013	(44)
Energy conte	257.5550	226.6274	238.1074	203.2758	192.8666	169.2618	163.8719	172.9876	177.7501	203.6066	223.0658	253.9680	(45)

Energy content (annual) Total = Sum(45)m = 2482.9441
Distribution loss (46)m = 0.15 x (45)m

	38.6332	33.9941	35.7161	30.4914	28.9300	25.3893	24.5808	25.9481	26.6625	30.5410	33.4599	38.0952	(46)

Water storage loss:
Store volume 150.0000 (47)
b) If manufacturer declared loss factor is not known :
Hot water storage loss factor from Table 2 (kWh/litre/day) 0.0103 (51)
Volume factor from Table 2a 0.9283 (52)
Temperature factor from Table 2b 0.5400 (53)
Enter (49) or (54) in (55) 0.7736 (55)
Total storage loss

	23.9825	21.6616	23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(56)

If cylinder contains dedicated solar storage

	23.9825	21.6616	23.9825	23.2088	23.9825	23.2088	23.9825	23.9825	23.2088	23.9825	23.2088	23.9825	(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

	304.7999	269.3002	285.3522	248.9967	240.1114	214.9826	211.1168	220.2325	223.4710	250.8515	268.7867	301.2129	(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

	304.7999	269.3002	285.3522	248.9967	240.1114	214.9826	211.1168	220.2325	223.4710	250.8515	268.7867	301.2129	(64)

Total per year (kWh/year) = Sum(64)m = 3039.2142 (64)
12Total per year (kWh/year) 3039 (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

	123.4329	109.4918	116.9666	104.1659	101.9240	92.8562	92.2833	95.3143	95.6786	105.4951	110.7461	122.2403	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	283.0502	313.3770	283.0502	292.4852	283.0502	292.4852	283.0502	283.0502	292.4852	283.0502	292.4852	283.0502	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	561.1787	567.0020	552.3275	521.0873	481.6521	444.5886	419.8279	414.0046	428.6791	459.9193	499.3545	536.4180	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	(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)	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	(71)
Water heating gains (Table 5)	165.9045	162.9343	157.2132	144.6748	136.9947	128.9670	124.0367	128.1106	132.8869	141.7945	153.8140	164.3014	(72)
Total internal gains	1085.7715	1118.9514	1068.2290	1033.8855	977.3351	938.6790	899.5530	897.8036	926.6894	960.4022	1021.2919	1059.4078	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W	
North	12.6900	10.6334	0.4000	0.8000	0.7700	29.9238	(74)
East	40.0200	19.6403	0.4000	0.8000	0.7700	174.3041	(76)
South	37.6800	46.7521	0.4000	0.8000	0.7700	390.6564	(78)
West	25.5100	19.6403	0.4000	0.8000	0.7700	111.1069	(80)

Solar gains	705.9912	1255.3048	1831.6383	2418.2020	2813.5689	2831.1870	2714.3726	2419.0401	2037.5752	1420.6497	855.8498	597.2171	(83)
Total gains	1791.7627	2374.2562	2899.8674	3452.0875	3790.9040	3769.8660	3613.9256	3316.8438	2964.2646	2381.0519	1877.1417	1656.6249	(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	10.4370	10.4782	10.5197	10.7324	10.7760	10.9993	10.9993	11.0450	10.9089	10.7760	10.6892	10.6038	
alpha	1.6958	1.6985	1.7013	1.7155	1.7184	1.7333	1.7333	1.7363	1.7273	1.7184	1.7126	1.7069	
util living area	0.9212	0.8781	0.8207	0.7301	0.6220	0.4975	0.3935	0.4321	0.6024	0.7868	0.8904	0.9297	(86)
MIT	17.5080	17.9536	18.5721	19.3343	19.9632	20.4281	20.6416	20.6019	20.2275	19.3592	18.3020	17.4443	(87)
Th 2	20.1386	20.1417	20.1448	20.1603	20.1634	20.1791	20.1791	20.1822	20.1728	20.1634	20.1572	20.1510	(88)
util rest of house	0.9151	0.8690	0.8073	0.7097	0.5917	0.4535	0.3348	0.3733	0.5609	0.7659	0.8808	0.9243	(89)
MIT 2	16.0853	16.6296	17.3828	18.3076	19.0528	19.5941	19.8210	19.7871	19.3778	18.3563	17.0686	16.0109	(90)
Living area fraction									fLA = Living area / (4) =			0.4044	(91)
MIT	16.6606	17.1650	17.8638	18.7228	19.4210	19.9314	20.1528	20.1166	19.7214	18.7619	17.5674	16.5906	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.6606	17.1650	17.8638	18.7228	19.4210	19.9314	20.1528	20.1166	19.7214	18.7619	17.5674	16.5906	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8811	0.8280	0.7631	0.6692	0.5619	0.4392	0.3328	0.3682	0.5356	0.7231	0.8415	0.8923	(94)
Useful gains	1578.6748	1965.9200	2213.0284	2310.0220	2130.1944	1655.7425	1202.6584	1221.3544	1587.7194	1721.8492	1579.6407	1478.2569	(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	5038.7324	4980.1037	4595.9407	3893.9768	3048.4072	2062.2162	1374.2538	1431.6490	2192.4082	3222.4684	4166.2920	4971.4871	(97)
Space heating kWh	2574.2829	2025.5314	1772.8867	1140.4474	683.1503	0.0000	0.0000	0.0000	0.0000	1116.4607	1862.3889	2598.9633	(98a)
Space heating requirement - total per year (kWh/year)												13774.1117	
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	2574.2829	2025.5314	1772.8867	1140.4474	683.1503	0.0000	0.0000	0.0000	0.0000	1116.4607	1862.3889	2598.9633	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												13774.1117	
Space heating per m2											(98c) / (4) =	31.5652	(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 %)	219.3000 (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	2574.2829	2025.5314	1772.8867	1140.4474	683.1503	0.0000	0.0000	0.0000	0.0000	1116.4607	1862.3889	2598.9633	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	1173.8636	923.6349	808.4299	520.0399	311.5141	0.0000	0.0000	0.0000	0.0000	509.1020	849.2425	1185.1178	(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	304.7999	269.3002	285.3522	248.9967	240.1114	214.9826	211.1168	220.2325	223.4710	250.8515	268.7867	301.2129	(64)
Efficiency of water heater												190.4000	(216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(217)
Fuel for water heating, kWh/month	160.0840	141.4392	149.8699	130.7756	126.1089	112.9110	110.8807	115.6683	117.3692	131.7497	141.1695	158.2000	(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	90.5938	81.8267	90.5938	87.6715	90.5938	87.6715	90.5938	90.5938	87.6715	90.5938	87.6715	90.5938	(231)
Lighting	69.6495	55.8754	50.3096	36.8590	28.4710	23.2610	25.9722	33.7596	43.8504	57.5341	64.9846	71.5853	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-30.5904	-53.8393	-97.5760	-132.3405	-157.5877	-140.5205	-137.7949	-121.1755	-94.0886	-68.0183	-36.4220	-25.0182	(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	-4.0740	-11.1888	-30.4158	-61.1955	-98.3960	-117.5275	-114.1890	-88.1444	-54.2890	-19.9761	-6.1559	-2.9800	(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												6280.9447	(211)

Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.4000	
Water heating fuel used	1596.2260	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.6750)		
mechanical ventilation fans (SFP = 0.6750)	1066.6695	(230a)
Total electricity for the above, kWh/year	1066.6695	(231)
Electricity for lighting (calculated in Appendix L)	562.1117	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1703.5039	(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	7802.4480	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	6280.9447	0.1543	968.9444	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1596.2260	0.1411	225.1535	(264)
Space and water heating			1194.0978	(265)
Pumps, fans and electric keep-hot	1066.6695	0.1387	147.9602	(267)
Energy for lighting	562.1117	0.1443	81.1301	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1094.9719	0.1318	-144.2923	
PV Unit electricity exported	-608.5320	0.1180	-71.8198	
Total			-216.1120	(269)
Total CO2, kg/year			1207.0761	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			2.7700	(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	6280.9447	1.5711	9868.1186	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1596.2260	1.5216	2428.7740	(278)
Space and water heating			12296.8926	(279)
Pumps, fans and electric keep-hot	1066.6695	1.5128	1613.6576	(281)
Energy for lighting	562.1117	1.5338	862.1857	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1094.9719	1.4869	-1628.0953	
PV Unit electricity exported	-608.5320	0.4327	-263.2875	
Total			-1891.3827	(283)
Total Primary energy kWh/year			12881.3532	(286)
Dwelling Primary energy Rate (DPER)			29.5200	(287)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	209.2300 (1b)	x	3.0000 (2b)	=	627.6900	(1b) - (3b)
First floor	194.2300 (1c)	x	3.0000 (2c)	=	582.6900	(1c) - (3c)
Second floor	32.9100 (1d)	x	2.5800 (2d)	=	84.9078	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	436.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	1295.2878	(5)

2. Ventilation rate

	m3 per hour	
Number of open chimneys	0 * 80 = 0.0000	(6a)
Number of open flues	0 * 20 = 0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000	(6d)
Number of flues attached to other heater	0 * 35 = 0.0000	(6e)
Number of blocked chimneys	0 * 20 = 0.0000	(6f)
Number of intermittent extract fans	4 * 10 = 40.0000	(7a)
Number of passive vents	0 * 10 = 0.0000	(7b)
Number of flueless gas fires	0 * 40 = 0.0000	(7c)
	Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.0309	(8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	5.0000	(17)

Infiltration rate 0.2809 (18)
Number of sides sheltered 0 (19)

Shelter factor (20) = 1 - [0.075 x (19)] = 1.0000 (20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.2809 (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	0.3581	0.3511	0.3441	0.3090	0.3019	0.2668	0.2668	0.2598	0.2809	0.3019	0.3160	0.3300	(22b)
Effective ac	0.5641	0.5616	0.5592	0.5477	0.5456	0.5356	0.5356	0.5338	0.5394	0.5456	0.5499	0.5545	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			3.6000	1.0000	3.6000			(26)
TER Opening Type (Uw = 1.20)			105.5000	1.1450	120.8015			(27)
Ground floor or to storage			209.2300	0.1300	27.1999			(28a)
Exposed floor			12.7200	0.1300	1.6536			(28b)
External Wall 1	441.9000	109.1000	332.8000	0.1800	59.9040			(29a)
All roofs	220.8900		220.8900	0.1100	24.2979			(30)
Total net area of external elements Aum(A, m2)			884.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		237.4569			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 35.0998 (35)
List of Thermal Bridges

	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	57.7800	0.0500	2.8890
E3 Sill	38.3900	0.0500	1.9195
E4 Jamb	80.1800	0.0500	4.0090
E5 Ground floor (normal)	67.9700	0.1600	10.8752
E6 Intermediate floor within a dwelling	31.4900	0.0000	0.0000
E14 Flat roof	26.5900	0.0800	2.1272
E15 Flat roof with parapet	72.4700	0.5600	40.5832
E24 Eaves (insulation at ceiling level - inverted)	39.3700	0.2400	9.4488
E16 Corner (normal)	35.1600	0.0900	3.1644
E17 Corner (inverted - internal area greater than external area)	20.5800	-0.0900	-1.8522
E19 Ground floor (inverted)	7.9500	0.0700	0.5565
E20 Exposed floor (normal)	10.5100	0.3200	3.3632
E21 Exposed floor (inverted)	13.3800	0.3200	4.2816

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 81.3654 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 318.8223 (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	241.1329	240.0685	239.0252	234.1249	233.2080	228.9400	228.9400	228.1496	230.5840	233.2080	235.0628	237.0019	(38)
Heat transfer coeff	559.9552	558.8909	557.8476	552.9472	552.0304	547.7623	547.7623	546.9719	549.4063	552.0304	553.8851	555.8242	(39)
Average = Sum(39)m / 12 =												552.9428	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2832	1.2808	1.2784	1.2672	1.2651	1.2553	1.2553	1.2535	1.2590	1.2651	1.2693	1.2737	(40)
HLP (average)												1.2671	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 3.3092 (42)
Hot water usage for mixer showers

79.7045	78.5067	76.7613	73.4217	70.9572	68.2088	66.6466	68.3788	70.2777	73.2286	76.6399	79.3992	(42a)

Hot water usage for baths

34.3988	33.8879	33.1685	31.8420	30.8488	29.7474	29.1525	29.8669	30.6448	31.8232	33.1770	34.2825	(42b)

Hot water usage for other uses

48.5196	46.7553	44.9909	43.2266	41.4622	39.6979	39.6979	41.4622	43.2266	44.9909	46.7553	48.5196	(42c)

Average daily hot water use (litres/day) 149.4868 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	162.6229	159.1499	154.9207	148.4903	143.2682	137.6541	135.4970	139.7080	144.1490	150.0428	156.5722	162.2013	(44)
Energy conte	257.5550	226.6274	238.1074	203.2758	192.8666	169.2618	163.8719	172.9876	177.7501	203.6066	223.0658	253.9680	(45)
Energy content (annual)										Total = Sum(45)m =		2482.9441	
Distribution loss (46)m = 0.15 x (45)m	38.6332	33.9941	35.7161	30.4914	28.9300	25.3893	24.5808	25.9481	26.6625	30.5410	33.4599	38.0952	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	304.1499	268.7131	284.7023	248.3677	239.4615	214.3536	210.4668	219.5825	222.8420	250.2015	268.1577	300.5629	(62)
WWHRS	-36.4376	-32.2257	-33.7449	-27.9421	-26.0410	-22.2835	-20.8872	-22.2115	-23.0554	-27.1797	-30.7913	-35.7628	(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	267.7123	236.4874	250.9574	220.4256	213.4204	192.0701	189.5796	197.3711	199.7866	223.0218	237.3663	264.8001	(64)
										Total per year (kWh/year) = Sum(64)m =		2692.9986	(64)
12Total per year (kWh/year)												2693	(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	122.9130	109.0222	116.4466	103.6627	101.4041	92.3530	91.7633	94.7943	95.1754	104.9751	110.2429	121.7203	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	165.4605	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	283.0502	313.3770	283.0502	292.4852	283.0502	292.4852	283.0502	283.0502	292.4852	283.0502	292.4852	283.0502	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	561.1787	567.0020	552.3275	521.0873	481.6521	444.5886	419.8279	414.0046	428.6791	459.9193	499.3545	536.4180	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	39.5461	(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)													
	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	-132.3684	(71)
Water heating gains (Table 5)													
	165.2056	162.2354	156.5143	143.9760	136.2958	128.2681	123.3378	127.4117	132.1880	141.0956	153.1151	163.6025	(72)
Total internal gains													
	1085.0727	1118.2525	1067.5302	1033.1866	976.6363	937.9801	898.8541	897.1047	925.9905	959.7033	1020.5930	1058.7089	(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	
North	11.5500	10.6334	0.6300	0.7000	0.7700	37.5341	(74)
East	36.4300	19.6403	0.6300	0.7000	0.7700	218.6645	(76)
South	34.3000	46.7521	0.6300	0.7000	0.7700	490.0797	(78)
West	23.2200	19.6403	0.6300	0.7000	0.7700	139.3739	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	885.6522	1574.7529	2297.7444	3033.5642	3529.5320	3551.6299	3405.0916	3034.6123	2556.0838	1782.1727	1073.6465	749.1976	(83)
Total gains	1970.7248	2693.0054	3365.2746	4066.7508	4506.1683	4489.6100	4303.9457	3931.7170	3482.0743	2741.8760	2094.2395	1807.9065	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	7.5981	7.6125	7.6268	7.6944	7.7071	7.7672	7.7672	7.7784	7.7440	7.7071	7.6813	7.6545	
alpha	1.5065	1.5075	1.5085	1.5130	1.5138	1.5178	1.5178	1.5186	1.5163	1.5138	1.5121	1.5103	
util living area													
	0.9229	0.8805	0.8251	0.7413	0.6409	0.5273	0.4269	0.4667	0.6280	0.7978	0.8943	0.9313	(86)
MIT	15.8992	16.5057	17.3920	18.4859	19.4621	20.2156	20.6053	20.5300	19.8972	18.5663	17.0206	15.7864	(87)
Th 2	19.8540	19.8559	19.8578	19.8667	19.8683	19.8760	19.8760	19.8775	19.8731	19.8683	19.8650	19.8615	(88)
util rest of house													
	0.9155	0.8695	0.8086	0.7160	0.6024	0.4683	0.3445	0.3850	0.5743	0.7720	0.8827	0.9248	(89)
MIT 2	14.1502	14.8779	15.9383	17.2356	18.3684	19.2138	19.6138	19.5504	18.8896	17.3611	15.5127	14.0164	(90)
Living area fraction										fLA = Living area / (4) =		0.4044	(91)
MIT	14.8575	15.5362	16.5262	17.7412	18.8107	19.6189	20.0147	19.9466	19.2971	17.8485	16.1225	14.7322	(92)
Temperature adjustment												0.0000	
adjusted MIT	14.8575	15.5362	16.5262	17.7412	18.8107	19.6189	20.0147	19.9466	19.2971	17.8485	16.1225	14.7322	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8639	0.8078	0.7430	0.6564	0.5603	0.4533	0.3555	0.3905	0.5421	0.7104	0.8243	0.8763	(94)
Useful gains	1702.5900	2175.4456	2500.5637	2669.3210	2524.6014	2035.2982	1530.1906	1535.4735	1887.5467	1947.8690	1726.2489	1584.3223	(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													
	5911.7217	5944.4487	5593.0795	4888.7350	3925.2990	2749.1585	1870.4632	1939.8790	2855.2989	4001.3907	4997.4357	5854.0558	(97)
Space heating kWh													
	3131.5940	2532.7701	2300.8318	1597.9781	1042.1190	0.0000	0.0000	0.0000	0.0000	1527.8201	2355.2545	3176.6818	(98a)
Space heating requirement - total per year (kWh/year)												17665.0494	
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													
	3131.5940	2532.7701	2300.8318	1597.9781	1042.1190	0.0000	0.0000	0.0000	0.0000	1527.8201	2355.2545	3176.6818	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												17665.0494	
Space heating per m2											(98c) / (4) =	40.4818	(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													
	3131.5940	2532.7701	2300.8318	1597.9781	1042.1190	0.0000	0.0000	0.0000	0.0000	1527.8201	2355.2545	3176.6818	(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)													
	3392.8429	2744.0629	2492.7755	1731.2872	1129.0563	0.0000	0.0000	0.0000	0.0000	1655.2764	2551.7384	3441.6920	(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

	267.7123	236.4874	250.9574	220.4256	213.4204	192.0701	189.5796	197.3711	199.7866	223.0218	237.3663	264.8001 (64)
Efficiency of water heater												79.8000 (216)
(217)m	88.0182	87.9529	87.8259	87.6024	87.1296	79.8000	79.8000	79.8000	79.8000	87.5424	87.8924	88.0360 (217)
Fuel for water heating, kWh/month												
	304.1556	268.8796	285.7443	251.6206	244.9458	240.6894	237.5684	247.3322	250.3591	254.7587	270.0645	300.7860 (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	58.8122	47.1814	42.4816	31.1238	24.0409	19.6417	21.9310	28.5067	37.0274	48.5819	54.8731	60.4468 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-156.9101	-204.0693	-270.6265	-279.6150	-281.7192	-255.5188	-251.5589	-246.2121	-235.3601	-219.8512	-165.8769	-137.6794 (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	-149.4438	-304.5783	-588.5536	-861.1132	-1117.8924	-1116.4719	-1104.0189	-944.6792	-705.4603	-428.4849	-197.0025	-119.0207 (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	19138.7317	(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	3156.9042	(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)	474.6485	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-10341.7170	(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	12514.5675	(238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	19138.7317	0.2100	4019.1337	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	3156.9042	0.2100	662.9499	(264)
Space and water heating			4682.0835	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	474.6485	0.1443	68.5064	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2704.9974	0.1364	-369.0690	
PV Unit electricity exported	-7636.7196	0.1267	-967.3591	
Total			-1336.4282	(269)
Total CO2, kg/year			3426.0911	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			7.8500	(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	19138.7317	1.1300	21626.7668	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	3156.9042	1.1300	3567.3018	(278)
Space and water heating			25194.0686	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	474.6485	1.5338	728.0317	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-2704.9974	1.5044	-4069.2872	
PV Unit electricity exported	-7636.7196	0.4650	-3551.1238	
Total			-7620.4110	(283)
Total Primary energy kWh/year			18431.7901	(286)
Target Primary Energy Rate (TPER)			42.2400	(287)

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