25 Oakhill Avenue

Energy Statement

Sustainability Services

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5360-CHL-XX-XX-RP-SUS-0004

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Audit Sheet

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Contents

Executive Summary

The purpose of this document is to provide details on the proposed energy strategy for the planning application for the proposed refurbishment and extension at 25 Oakhill Avenue, London Borough of Camden, to form a single residential dwelling. The energy strategy has been established following the London Plan Energy Hierarchy: *Be Lean*, *Be Clean* and *Be Green*. One of the key objectives of the strategy is to maximise the reductions in Regulated CO_2 emissions whilst providing a cost-effective and viable approach which incorporates the Clients wishes.

In line with the most recent changes to Building Regulations, the calculations within this report have been made within SAP 10.2 compliant software, in accordance with Building Regulations Part L1b as applicable to refurbishment and extensions to dwellings.

Energy efficiency measures (Be Lean) have been considered throughout, including enhanced building fabric; insulation; high performance glazing; low energy lighting; and high efficiency ventilation systems. They have enabled the proposed development to exceed the requirements for Building Regulations Part L in terms of emissions, fabric efficiency and primary energy rates.

The Be Clean measures have been carefully but ultimately none of the available technology is applicable to single dwellings.

An extensive range of Be Green of renewable technologies have been considered. With ASHP being proposed to provide heating and hot water, with optional PV electrical generation being a possible addition.

The tables below summarise the Regulated CO_2 emission savings for the proposed development.

Regulated Carbon Emissions Savings at Each Stage		
Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Emissions Reduction at each Stage	**Cumulative**
After Be Lean Measures	6.78	6.78
After Be Clean Measures	0	6.78
After Be Green Measures	7.67	14.45
Total Emissions Reduction	14.45	
Percentage Reduction	**76%**	

Table 1: Emissions Reduction Summary

CO_2 Emissions after each stage of the Energy Hierarchy	
Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**
Baseline: Part L 2013 Compliant Development	18.8
After Be Lean Measures	12.02
After Be Clean Measures	12.02
After Be Green Measures	4.35

Table 2: Regulated Carbon Dioxide Savings and the Energy Hierarchy

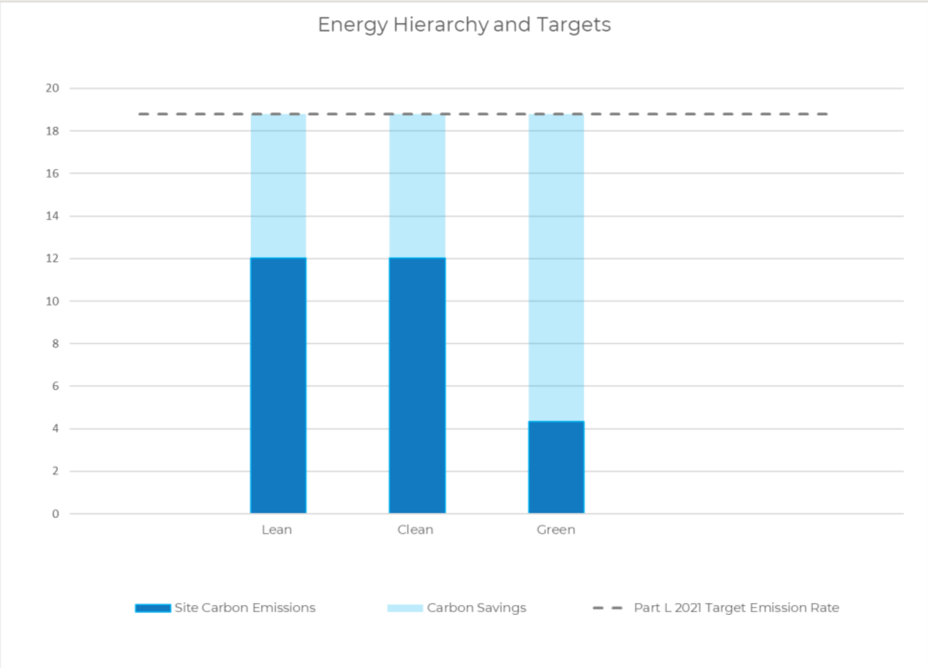


Figure 1: GLA Emissions Reporting Graphs

1.0 Introduction

This Energy Statement has been prepared by Cooper Homewood Ltd (CHL) on behalf of Mrs Lauren Shamoon (the Client) to demonstrate how the Proposed Development 25 Oakhill Avenue will comply with the relevant policies of the London Borough of Camden Core Strategy. The document outlines the design measures that will reduce energy consumption and CO_2 emissions of this development in line with government policy.

The Proposed Development consists of the refurbishment and extension of an existing dwelling which is currently partitioned into 2 no. apartments. The proposals are for this building to be re-instated as a single dwelling and extended to meet the needs and requirements of the Client.

Figure 2: Proposed Front Elevation

Energy modelling has been undertaken in accordance with Building Regulations Part L (2022), under SAP 10.2, with the figures presented within this report based on these outputs.

Whilst a minor development in the context of local and regional policy, the Mayor of London's Energy Hierarchy has still been used to maximise efficiency throughout the development with the prioritisation of passive and active efficiency measures.

The Proposed Development exceeds the requirements of Building Regulations Part L1b, and achieves an 76% improvement over a Building Regulations Part L1b baseline.

2.0 Planning Policy

Outlined below is a summary of the Planning Policy used to develop the overall sustainability strategy for the Proposed Development, in addition to the Energy Use and CO_2 emissions reduction strategy.

2.1 Local Policy – London Borough of Camden

2.1.1 Local Plan Policy CC1: Climate Change Mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation. We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

2.1.2 Policy CC2: Adapting to Climate Change

The Council will require development to be resilient to climate change. All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;
b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems;
c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement. Sustainable design and construction measures The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;
g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and
h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

2.2 Policy Analysis and Summary

Based on the above summary of relevant policies, below is an outline of the required performance standards and requirements for the Proposed Development:

- Minimisation of CO_2 emissions in line with the Mayor of London's Energy Hierarchy
- 35% total CO_2 emissions reduction with min. 10% from efficiency measures is preferable, but not mandatory.
- Passive and Active Efficiency measures are to be prioritised.
- BREEAM for Domestic Refurbishment assessment is not required (<500m^2)

3.0 Assessment Methodology

This section outlines the methodology and standards used to formulate the energy use and CO_2 emissions reduction strategy.

3.1 Energy Hierarchy

All energy strategies are required to be formed on the basis of the Mayor of London's Energy Hierarchy as outlined in the London Plan and echoed within local policy. Energy and CO_2 emissions reduction factors must be implemented in line with this hierarchy to demonstrate a fabric first approach has been implemented, and energy sources applied in the most environmentally appropriate way possible.

Mayor of London's Energy Hierarchy forms the basis for the Energy Strategy with improvements made to the proposed design through the implementation of emission reduction measures in line with the following process.

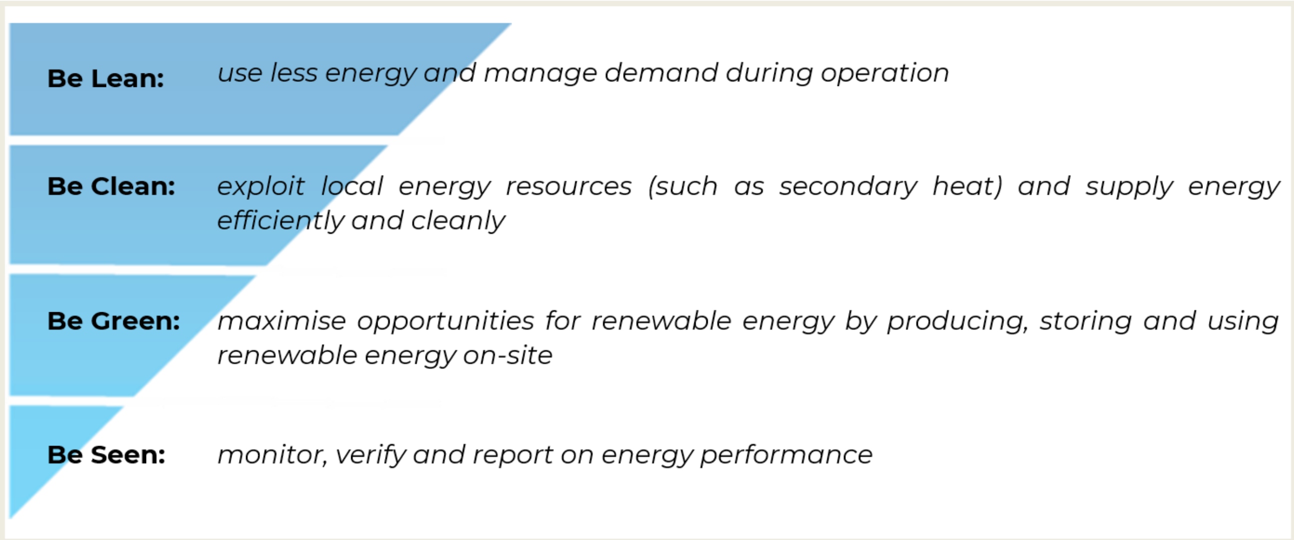


Figure 3: The Energy Hierarchy

3.2 Modelling and Calculations

Modelling has been undertaken on the Proposed Development with certified SAP software in accordance with Building Regulations Part L1b 2021. Models within the SAP software have been based on the latest drawings from the Architectural Team, with a site plan provided within the appendices for reference.

A 'whole dwelling calculation method' using accredited SAP software has been undertaken to demonstrate that the total carbon dioxide emissions from the residential dwelling with the extension as proposed, is no greater than if the dwelling and extension had been improved and constructed to comply with the standards set out within Part L. This is referred to as the 'Offset Method'.

Due to the Proposed Development being listed, improvements to the building fabric have only been undertaken where permissible, and have been outlined below for clarity.

All new elements of construction have been designed to achieve the area-weighted average U-values stated in 'Table 4.2 – Limiting U-values for new fabric elements in existing dwellings'

4.0 CO_2 Emissions Reduction Strategy

The following section outlines the emissions reduction strategy employed within the Proposed Development to meet the required Planning Policy Requirements.

All improvements in the performance of the Proposed Development are measured from an energy baseline based on a Building Regulations Part L compliant design.

4.1 Baseline Emissions Calculation

The energy baseline forms the basis for which all subsequent improvements are measured and is based on the dimensions and layout of the Proposed Development, but with inputs based on the anticipated U-Values of exiting elements (from Appendix S of the SAP document) and the minimum requirements for extended elements outlined within 'Table 4.2 – Limiting U-values for new fabric elements in existing dwellings'.

The above calculation gives an accurate representation of how the building would perform if constructed to the minimum requirements of Part L of the Building Regulations, as applied to renovations and extensions. All subsequent improvements from the implementation of the Energy Hierarchy will be measured from this baseline.

Baseline CO_2 Emissions (t/yr)	Baseline Primary Energy Rate (kWh/m²/yr)
18.8	305.91

Table 3: Baseline Site-Wide Emissions

5.0 Demand Reduction Measures ('Be Lean')

In line with the Energy Hierarchy, Passive and Active efficiency measures have been prioritised to reduce energy use and associated emissions where this is possible within the confines of a Listed Building.

5.1 Passive Design Measures

The following U values have been used in the energy calculations:

Passive Item	Existing Elements	Proposed New Elements
External Walls	1.6 W/m²K	0.26 W/m²K
Basement Walls	0.26 W/m²K	
Pitched Roof	0.16 W/m²K	0.16 W/m²K
Flat Roof	0.16 W/m²K	0.16 W/m²K
Basement Floor	N/A	0.18 W/m²K
Ground Floor	1.20 W/m²K	0.18 W/m²K
Front Door	N/A	3.1 W/m2K
Windows	4.8 W/m²K	3.1W/m²K
Roof Light	N/A	3.4W/m²K
Glazing Type	Double Glazing low-E	Double Glazing low-E
Air Permeability	15m³/m²/hr@50Pa	

Table 4: Fabric U-Values Summary

Due to being an existing building the orientation is fixed. However, the rear extension to the south has been designed to incorporate large openings to maximise internal daylighting levels and passive solar gains. Roof lights are also proposed.

Additional insulation to the existing fabric is currently not proposed due to the listed nature of the existing building, and space constraints caused by insulation being installed internally. However, replacement thermal elements – such as windows and doors – will be improved through the specification of double glazed units. A Low-E coating to the windows is also proposed to limit excessive heat gain.

Newly constructed elements within the extension will also be highly insulated, and will exceed the requirements of Table 4.2 within Approved Document L 2021.

Construction at this stage is expected to be of traditional build, with concrete ground floors and timber roofing structures. The development has currently been modelled with a 'medium' thermal mass – balancing the management of internal overheating during the summer period, and high response heating in the winter.

Whilst air tightness within the dwelling is anticipated to be good due to the level of works being proposed, no testing is currently proposed and therefore a value of 15 $m^3/hr.m^2$ is currently used within the modelling as the default value. Should, at completion, a pressure test be undertaken, this result can be used in the generation of the EPC.

Thermal bridging – the passage of heat through construction or geometric bridges – is also difficult to quantify in existing buildings, and therefore the default values have been used here.

For domestic properties, the Fabric Energy Efficiency (FEE) measure within the SAP modelling software offers a good indication on the demand reduction measures incorporated on the site. Current modelling shows the following:

Target Average Fabric Energy Efficiency (kWh/year)	Design Average Fabric Energy Efficiency (kWh/year)	Improvement
156.42	125.91	19.50%

Table 5: Fabric Energy Efficiency Values

5.2 Active Design Measures

Active design measures will also be implemented throughout the site to limit energy using equipment to within acceptable levels – maximising efficiency and minimising waste.

In light of this strategy, energy loads will be reduced through the specification of low energy, LED lighting throughout. External lighting will be fitted with appropriate controls to prevent inappropriate use, with controls applied based on the intended use utilising PIR and photocell sensors as required.

Heating controls will also be optimised with the use of time and temperature zone controls allowing the control of individual zones throughout the dwellings, typically each room being a separate zone which will exceed the requirements of the Domestic Building Services Compliance Guide.

The dwelling will have mechanical ventilation provided to all kitchen and bathroom spaces via a continuous mechanical extract system. This will operate constantly, with boost rates activated based on room occupancy/humidity. This will remove warm, moisture ladened air from kitchen and bathroom spaces, reducing condensation and potential mould growth in high humidity areas. Fresh air will subsequently be brought in to the dwelling via trickle vents or through the building fabric.

Openable windows will also be provided, and will be the primary method of purge ventilation as and when required by the occupant.

The implementation of active and passive efficiency measures results in the following emissions reduction.

Baseline CO_2 Emissions (t/yr)	'Be Lean' CO_2 Emissions (t/yr)	Improvement
18.8	12.02	36%

Table 6: Site-Wide Emissions – Improvement at Lean stage

Baseline Primary Energy Rate (kWh/m²/yr)	'Be Lean' Primary Energy Rate (kWh/m²/yr)	Improvement
305.91	197.24	35.5%

Table 7: Site-Wide Primary Energy Rate – Improvement at Lean stage

6.0 Active Cooling and the Cooling Hierarchy

A dynamic assessment of the dwellings overheating potential has been undertaken and a report assessing the dwelling in relation to the Cooling Hierarchy and the use of active cooling within the dwelling is provided separately in support of this application.

7.0 – Heating Infrastructure (‘Be Clean’)

‘Clean’ energy solutions prioritise the use of available, existing heating networks, community heating and combined heat and power where this is feasible to support and enhance the growing number of heating networks throughout the country.

7.1 District Heating Networks

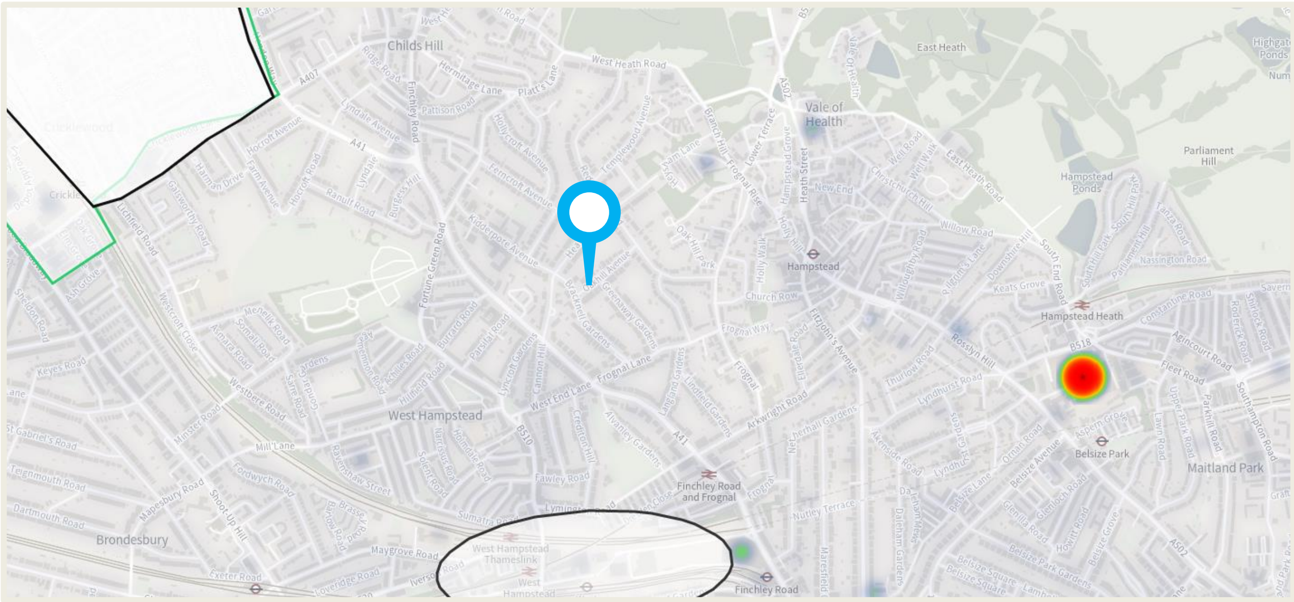


Figure 4: London Heat Map – showing proposed and existing heat networks (maps.london.gov.uk/heatmap/)

Information from the Mayor of London’s Heat Map has been reviewed and shows that the site is not within the proximity of current or proposed district heat networks, nor is the site on a proposed transmission route. Therefore, the use of district heating systems cannot be implemented.

7.2 Co-Generation

The use of co-generation technologies (such as a Combined Heat and Power (CHP) generator) can be used to supply the buildings heat and hot water demand whilst generating electricity which can be exported back to the grid to provide CO_2 emissions offset, and supplementary income based on an export tariff.

Residential buildings constructed to high thermal standards typically have a low heat demand, with the predominant demand being that of domestic hot water. CHP engines work best at 100% load and where cycling (the turning on and off of the engine to meet demand) is minimised. Generally, a low heat demand is not sufficient to keep the CHP running at maximum efficiency.

The site is located within an Air Quality Management Area due to exceedances of nitrogen dioxide and particulate matter. Being gas fired, the use of CHP at the development is therefore not encouraged within the area and the use of such technology will be contrary to the general, national move away from combustion appliances to provide heating and hot water.

8.0 Low and Zero Carbon Technologies ('Be Green')

This development intends to maximise opportunities in incorporating Low and Zero Carbon (LZC) technologies as part of its energy strategy.

This section outlines the feasibility of a range of renewable energy technologies for the proposed development. The assessment considers each LZC technology for their viability by means of:

- Technical feasibility
- CO_2 savings offered
- Other potential impacts

Local constraints, considerations and restrictions are also considered where these are thought to be relevant to the application of the technology.

8.1 Wind Power

The generation of power through the use of wind turbines has the potential to generate a large quantity of electricity and provide high levels of emissions offset. Due to the location of the Proposed Development, and its listed building status, the use of this technology is not considered appropriate.

8.2 Biomass

A biomass system would offer a heating system fuelled by plant-based materials such as wood, crops or food waste. A biomass system design for this development would consider generation of space heating and domestic hot water through the combustion of biofuels such as woodchip or wood pellets. These fuels offer a high energy content per unit of volume.

A biomass boiler occupies a larger floor area than a conventional gas-fired boiler. The burning of biofuels such as wood pellets expel exhaust gases which contain substantially more NOx emissions and particulate matter than its gas boiler equivalents, which would have a negative impact on the local air quality and would be contrary to planning policy guidance within the borough with regards to the Air Quality Management Area.

Being located in an urban environment, the storage and regular delivery of a biofuel would also be challenging due to lack of local biomass suppliers. Based on the above, biomass is not considered as a viable LZC technology for this project.

8.3 Heat Pumps

Heat pumps use the compression and expansion of a refrigerant to generate useful heat which can be utilised for both space heating and hot water. Some heat pump systems can also be used for cooling where this is required.

The use of heat pumps is becoming increasingly favourable due to reducing costs, and the increasing thermal efficiency of buildings making the application of the technology more viable.

Generally, heat pumps either use air or the ground as the heat source dependant on site limitations.

The Coefficient of Performance of the system is the ratio of heat energy produced, relative to the electrical energy used to operate the heat pump. Typically this is 3:1 or 4:1 and is why heat pumps can be deemed as low carbon, and how energy use and CO_2 emissions savings are made.

Due to the lower flow and return temperatures delivered through heat pumps, these are best accompanied by oversized radiators and/or underfloor heating to maximise emitter area and ensure sufficient heat is delivered to maintain comfortable internal conditions.

8.3.1 Ground Source Heat Pumps

Ground Source Heat Pumps (GSHP) utilise the ground as the collector medium due to the fact of its high thermal mass - the ground below approx. 1m retains a relatively stable temperature of c. 15degC. This is collected either through a ground loop ('slinky') collector, or through boreholes. This heat can be harnessed via the heat pump to supply heating and hot water.

Ground condition heavily affect the efficiency and applicability of a GSHP system and therefore should be thoroughly investigated prior to any further works.

Due to site constraints, the use of a ground loop system would not be viable due to the limited space available for this installation, therefore boreholes would need to be considered.

Depending on the heat load, site areas and soil conditions, boreholes can be required to be large to allow sufficient collector area, resulting in greater disruption during construction, increase construction time and capital cost.

For these reasons, the use of this technology has been discounted at this stage.

8.3.2 Air Source Heat Pumps

Air Source Heat Pumps work in a similar way to GSHP systems, but with the collector medium being the air. The heat from the air is collected via an external condenser unit which uses a fan (or fans) to drive air flow over the collector element. This can generate some noise and therefore the location of the condenser is to be carefully considered to prevent disturbance to both surrounding and proposed properties.

There is a marginal drop in performance when compared to GSHP, but the lower capital costs of installation make ASHP more feasible overall, whilst still delivering significant energy and emissions savings.

The implementation of an ASHP system at the development to provide heating and hot water provides the following site-wide performance.

ASHP Coefficient of Performance (CoP)	Predicted CO_2 emissions reduction (tCO_2/yr)	Percentage Reduction over Lean scenario	Percentage Reduction over baseline scenario
1.7 (SAP default)	7.67	63.87%	76.86%

Table 8: Proposed ASHP Performance – emissions reduction

As can be seen above, the use of a heat pump at the above development provides a total emissions reduction of 76% over the energy baseline.

9.0 Photovoltaic Panels

The Client is keen to reduce emissions and running costs as far as possible, and whilst PV is not currently proposed, a scoping exercise has been carried out to investigate the potential PV that could be installed, and the likely impact that this installation may have.

Photovoltaics offer the ability to convert solar radiation into electricity. This comprises the use of photovoltaic (PV) panels which feed electricity to the dwelling via an inverter. This can then be either directed to battery storage, or exported back to the grid for use elsewhere.

PVs operate most efficiently when they are orientated to be south facing on a sloping roof. If installed on a flat roof, they must not be laid horizontally as this will prevent them to be able to self-clean and clear rainwater from the surface – potentially voiding any warranty guarantees regarding generation capacity, longevity and reliability.

PV can be provided in a variety of module sizes depending on budget and supplier/installer preference. However, for the purposes of these initial indicative calculations a 330W module has been assumed with approximate dimensions of 1.7m x 1.0m.

The current roof plan shows that there is limited space for PV on the roof, however there is potential for ~6 no. panels (1.98kWp) to be installed on the proposed extension flat roof, with a south easterly orientation and 30 degree tilt.

An array of this size provides the following performance figures:

Approximate no. Panels (330W)	Proposed Array Output (kWp)	Pitch (degrees)	Orientation	Assumed Shading Factor	Annual Generation (kWh/yr)	Emissions offset (t/yr)
6	1.98	30	South East	<20%	1,304.18	0.168

Table 9: Required PV Generation Summary

The proposed array will provide some emissions offset for the dwelling, but the offset in kWh electricity import from the grid may have more impact – especially in terms of running costs. Coupled with a battery system, the savings could be optimised, allowing more of the energy generated to be used on site, offsetting energy import from the grid and associated costs.

10.0 CO_2 Emissions Reduction Summary

Passive and Active Efficiency measures have been utilised on the site to reduce energy demand in line with the energy hierarchy.

An ASHP system has been proposed to provide high efficiency heating and hot water production whilst eliminating on site emissions.

The potential for an additional PV installation has been assessed, and although limited in scope, there is potential for this to be installed on the rear flat roof, generating approximately 1,300kWh per year. This has not been proposed at this stage.

Regulated Carbon Emissions at Be Green Stage		
Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**	
	Emissions Reduction at each Stage	**Cumulative**
After Be Lean Measures	6.78	6.78
After Be Clean Measures	0	6.78
After Be Green Measures	7.67	14.45
Total Emissions Reduction	14.45	
Percentage Reduction	**76%**	

Table 10: Emissions Reduction Summary

11.0 Zero Carbon Homes

Not being a new dwelling, there is no specific requirement for a Carbon Offset Payment to be made in relation to the Zero Carbon Homes commitment.

12.0 Conclusion

This document outlines the proposed energy strategy for the proposed development at 25 Oakhill Avenue, London Borough of Camden. The energy strategy has been established in line with the Energy Hierarchy: Be Lean, Be Clean, Be Green. The strategy focuses on maximising on site reductions in regulated CO_2 emissions with a cost-effective, viable and technically feasible approach.

The estimated CO_2 emissions for the development have been calculated using appropriate SAP modelling software, in accordance with Building Regulations 2021. A 'whole dwelling calculation method' using accredited SAP software has been undertaken to demonstrate that the total carbon dioxide emissions from the residential dwelling with the extension as proposed, is no greater than if the dwelling and extension had been improved and constructed to comply with the standards set out within Part L. This is referred to as the 'Offset Method'.

Energy efficiency measures have been implemented including enhanced building fabric; insulation; high performance glazing; low energy lighting; and high efficiency ventilation systems.

A range of low and zero carbon technologies have been considered at the Be Green staged. ASHP is proposed to supply heating and hot water, saving an estimated 7.67 tonnes of CO_2 per year, over a gas based alternative.

The cumulative Regulated CO_2 emissions reduction over the Building Regulations Part L baseline is estimated to be 76%.

There is also potential for a supplementary PV array to provide further energy generation and emissions offset, albeit this has not been included at this stage.

CO_2 Emissions after each stage of the Energy Hierarchy	
Stage	**Carbon Dioxide Emissions (Tonnes CO_2 per Annum)**
Baseline: Part L 2013 Compliant Development	18.8
After Be Lean Measures	12.02
After Be Clean Measures	12.02
After Be Green Measures	4.35

Table 11: Regulated Carbon Dioxide Savings and the Energy Hierarchy

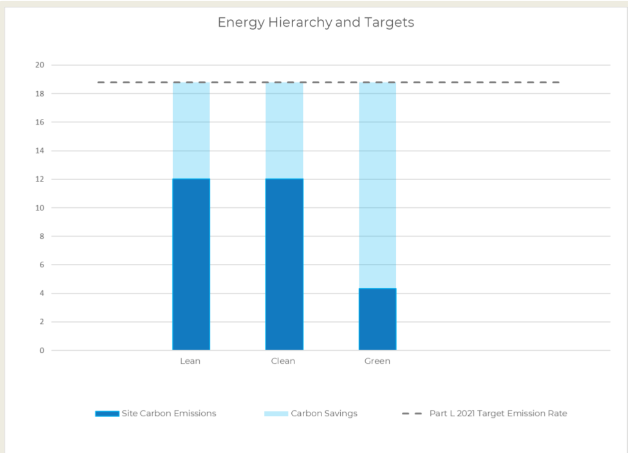
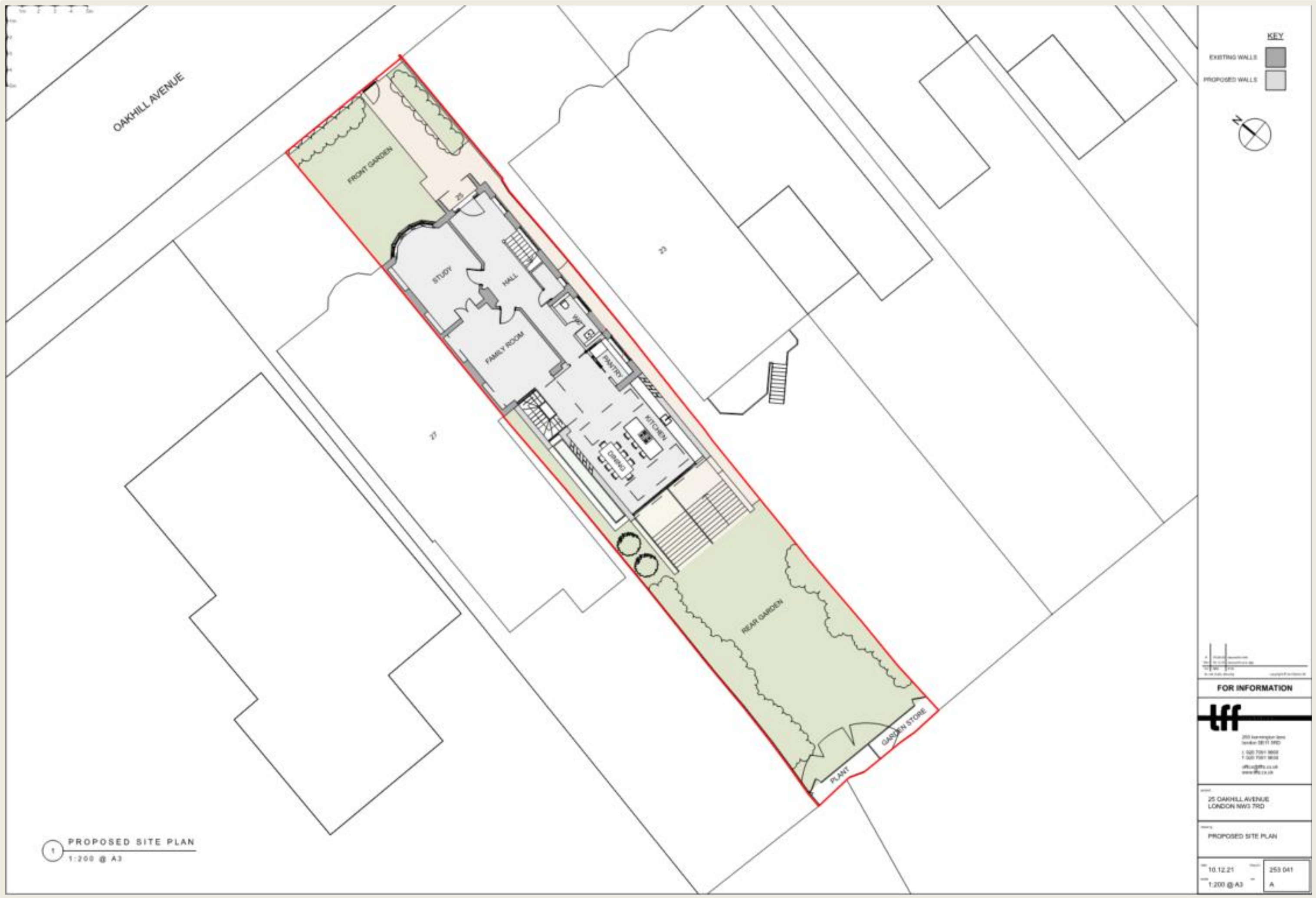


Figure 5: GLA Emissions Reporting Graphs

Appendix A – Site Plan



Appendix B – SAP Modelling Specification Summary

SAP Modelling Specification Summary

COOPERHOMEWOOD SUSTAINABILITY
Building a sustainable future

Document reference: 5360-CHL-ZZ-XX-SP-SUS-0001

Building Regulations L1B 2021 | Rev. P01 | Ver. V01 | Date 05.10.2022

Project Number & Name: 5360 25 Oakhill Avenue, Camden

Building Specification

Element	U Values	Description
External Wall (Existing)	1.60	SAP Appendix S value for 1900 building
External Walls (New/Extension)	0.26	Min requirements of Building Regulations Part L
New Flat Roof	0.16	New roof - minimum requirements of Building Regulations Part L
Pitch Roof (Insulation at Rafters)	0.16	Upgraded existing roof - min requirements based on Building Regulations Part L
Basement Floor	0.18	Min requirements of Building Regulations Part L
Basement Walls	0.26	
Ground Floor (New)	0.18	Min requirements of Building Regulations Part L
Ground Floor (Existing)	1.20	SAP Appendix S value for 1900 building
Windows (New)	3.10	Min requirements of Building Regulations Part L
Windows (existing/retained)	4.80	SAP Appendix S value for 1900 building
Roof Lights (velux)	3.40	Min requirements of Building Regulations Part L
External Door	3.10	Timber Door (TBC)

Building Services, Performance and Renewables

Item	Description
Construction Details (PSI values)	Y = 0.200 SAP default
Boiler	ASHP - SAP default - COP: 170%
Controls	Time and Temperature Zone Control
Compensation	N/A
Heating Emitters	Underfloor and radiators (ASHP Option)
Hot Water Cylinder	520 litre strorage cylinder. Fully Insulated Primary pipework. Min. 35mm foam insulation. Cylinder Stat and Independent Time Control
Secondary Heating	N/A
Mechanical Ventilation	centralised mechanical extract - continuous. Nuaire MEV-ECO (SFP: 0.35)
Lighting	Assume 67 lm/W or better. TBC
Renewables	ASHP to provide heating and hot water.
Overheating	Dynamic overheating assessment has been undertaken - see separate report.
Air Permeability	15m3.hr/m2 - SAP default
Cooling	A+ rated cooling via VRF to all habitable spaces totalling 265m2.
Additional Notes	See separate dynamic overheating assessment for justifcation of cooling specification.

SAP Modelling Results Summary

	Emissions Rate			Fabric Energy Efficiency			Primary Energy Rate		
Modelled Floor Area (m2)	Target Emissions Rate (TER)	Dwelling Emissions Rate (DER)	Improvement	Target Fabric Energy Efficiency (TFEE)	Dwelling Fabric Energy Efficiency (DFEE)	Improvement	Target Primary Energy Rate (TPER)	Dwelling Primary Energy Rate (DPER)	Improvement
336.5	56.01	12.53	78%	156.42	125.9	20%	305.91	129.3	58%