ENERGY STATEMENT

100 Chalk Farm Road

Prepared for Regal Chalk Farm Limited

Document No. 11494-WCL-ZZ-ZZ-RP-SS-0001

Revision P04

29 August 2024

Contents

Revisions:

Rev No:	Date:	Status/Comments:	Prepared by:	Checked by:
P01	10/01/2024	First Issue	BT	EH
P02	22/05/2024	Second issue	BT	EH
P03	05/08/2024	Third issue	EH	AW
P04	27/08/2024	Fourth Issue	BT	EH

Executive Summary

This Energy Statement has been prepared by Whitecode Consulting Ltd on behalf of Regal Chalk Farm Limited ('the Applicant') in support of an application for full planning permission for the redevelopment of 100 Chalk Farm Road ('the Site') within the London Borough of Camden ('LBC').

A listed building consent application accompanies the application for works to the adjacent Roundhouse, which is a Grade II* listed building.

The site is located on the south-western side of Chalk Farm Road and borders the mainline railway into Euston, with the Juniper Crescent Housing Estate to the south. It lies within the Regents Canal Conservation Area, to which the existing building on the site is a neutral contributor. To the west, the site is adjacent to the Grade II* listed Roundhouse theatre and live music venue. Beyond that, to the north-west is Chalk Farm Underground Station. To the east is the Petrol Filling Station site, which forms part of the Camden Goods Yard development and is currently used as a temporary supermarket.

The development will provide 264 student accommodation units, together with c. 1,000 sqm (GIA) of commercial space, 30 affordable residential units, with public realm improvements, new areas of landscaping, amenity and play space, and improved accessibility to the Site ('the Development').

The description of development is as follows:

"Demolition of existing buildings and redevelopment of the site to provide two buildings containing purpose-built student accommodation with associated amenity and ancillary space (Sui Generis), affordable residential homes (Class C3), ground floor commercial space (Class E) together with public realm, access, servicing, and other associated works."

Full details and scope of the planning application are described in the submitted Town Planning Statement, prepared by Gerald Eve LLP.

This report sets out the key energy and carbon performance factors as per the London Plan's Energy Reporting Guidelines.

The residential elements have been assessed against Part L1A 2021 of the Building Regulations using the Standard Assessment Procedure (SAP) 10.2 methodology. The non-residential elements have been assessed under Part L2A 2021 of the Building Regulations using SBEM methodology and IES software. This includes the purpose-built student accommodation.

The London Mayor expects all new developments to fully contribute towards the reduction of CO2 emissions. The targets are highlighted in Planning Policy SI2 Minimising greenhouse gas emissions of the London Plan 2021. These are reflected in the Camden Local Plan (2017) Policies CC1 and CC2.

Major developments are required to achieve net zero carbon by following the energy hierarchy (London Plan Policy SI 2). This means that regulated carbon emissions should be reduced so they are as close as possible to zero. Once on-site reductions have been maximised, the residual emissions should be offset via a payment into the relevant borough's carbon offset fund.

Major developments are required to achieve a minimum of 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 has been set that residential developments should aim to achieve, which is 50 per cent onsite.

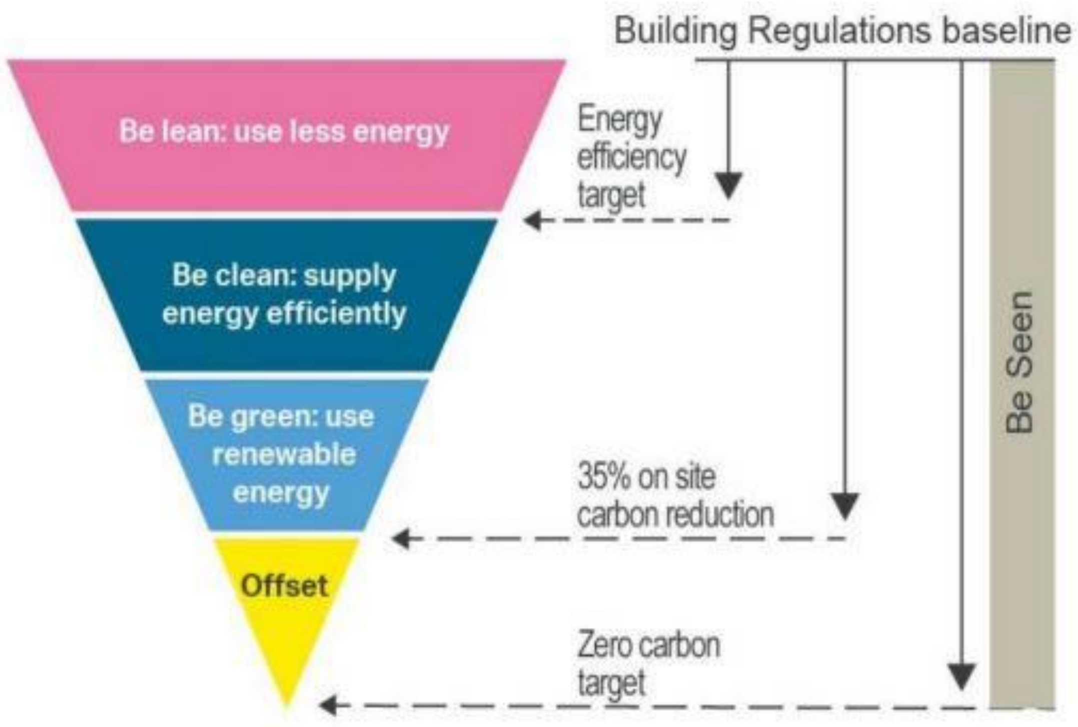
Energy efficiency is the first stage of the energy hierarchy. Energy demand should be reduced as far as possible before the heating strategy and installation of low-carbon and renewable technologies are considered. This is important in protecting consumers from high prices. Developments are expected 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.

The GLA have provided the following guidance in their *15 June 2022 – Note to accompany GLA Energy Assessment Guidance 2022.*

"Initially, non-residential developments may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35 per cent improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments."

The Energy Use Intensity (EUI) and the space heating demand of the development have been reported to ensure that energy efficiency measures are maximised in line with the energy hierarchy.

The report follows the energy hierarchy to ensure a carbon reduction is achieved on site as follows.



- Be Lean – improved building fabric specification to exceed that of the notional building, low air permeability target, thermal bridging details and selection of energy efficient services, meeting a minimum improvement of 10% required for residential and 15% for commercial.
- Be Clean – connection to a district heat network and installation of Combined Heat and Power (CHP) have been investigated for the site and have not been deemed appropriate at this time future connection to a district heat network (DHN) has been accommodated.
- Be Green – air source heat pumps are to be installed and the roof area available has been maximised for photovoltaic (PV) panels, a total of 30.4 kWp will be installed.
- Offset – remaining carbon to meet zero carbon will be paid to the offset fund (£119,386)
- Be Seen – onsite monitoring of energy usage 5 years post-construction.

This report concludes that the proposed development will achieve a 43% improvement over Part L 2021 of the Building Regulations.

The following tables demonstrate the overall reduction in regulated carbon emissions of the development after each stage of the energy hierarchy.

	Carbon dioxide emissions for domestic buildings (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021	28.0	8.3
After energy demand reduction (be lean)	24.5	8.3
After heat network/CHP (be clean)	24.5	8.3
After renewable energy (be green)	6.0	8.3

Table 1: Carbon emissions after each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	3.4	12%
Be clean: savings from heat network/CHP	0.0	0%
Be green: savings from renewable energy	18.5	66%
Cumulative on-site savings	21.9	79%
Annual savings from off-set payment	5.5	-
	(tonnes CO_2)	
Cumulative savings for off-set	180	-
Cash in-lieu contribution (£)	17,102	-

Table 2: Regulated carbon savings after each stage of the energy hierarchy for domestic buildings

	Carbon dioxide emissions for non-domestic buildings (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021	45.0	49
After energy demand reduction (be lean)	40.1	49
After heat network/CHP (be clean)	40.1	49
After renewable energy (be green)	35.9	49

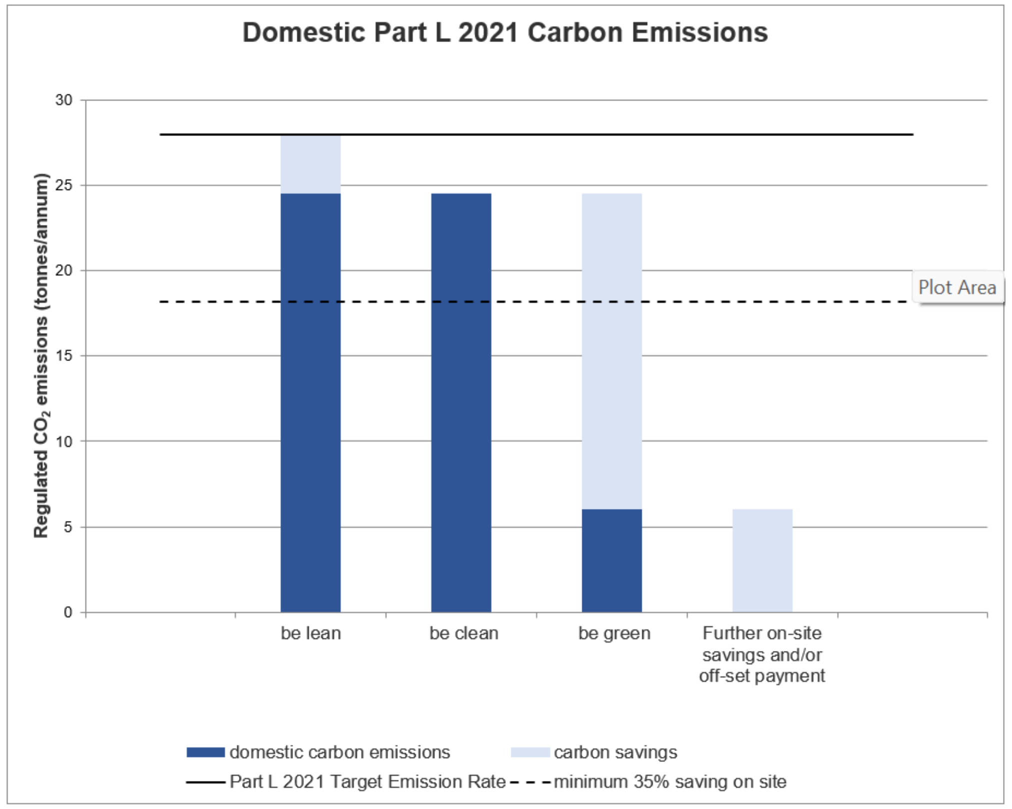
Table 3: Carbon emissions after each stage of the energy hierarchy for non-domestic buildings

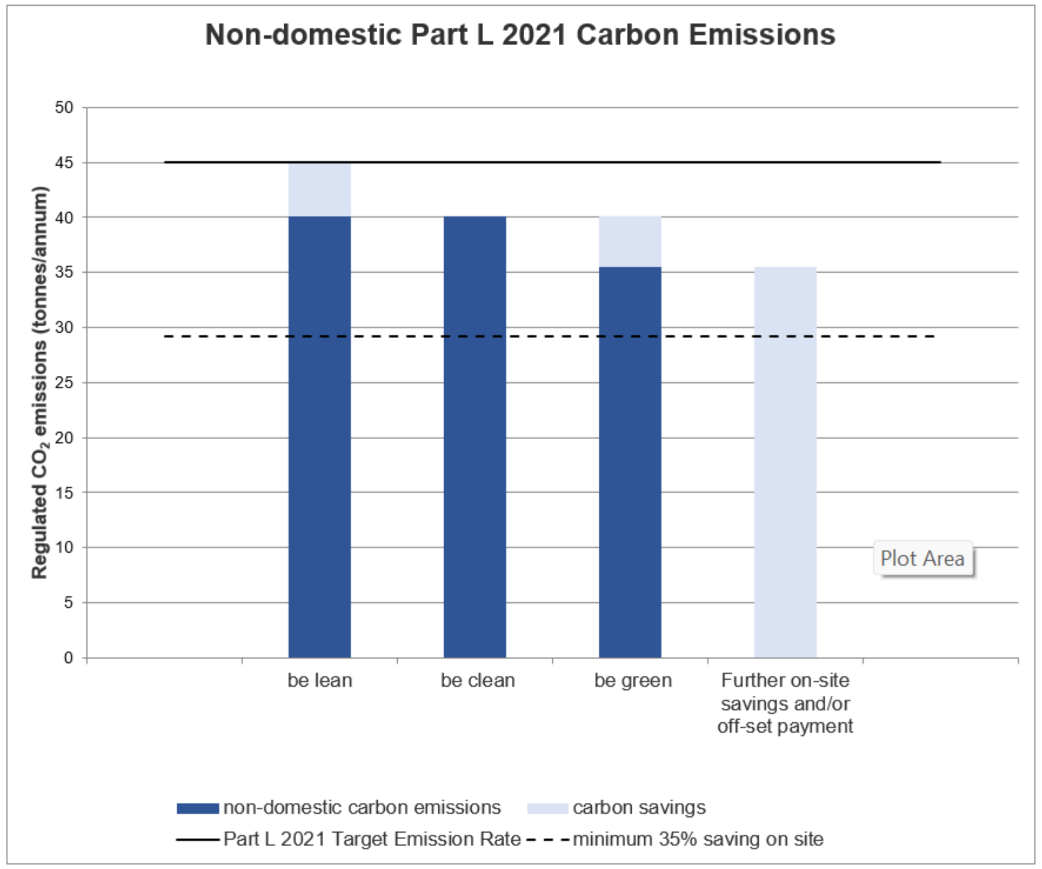
	Regulated non-domestic carbon dioxide savings	
	(tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	4.9	11%
Be clean: savings from heat network/CHP	0	0%
Be green: savings from renewable energy	4.2	9%
Cumulative on-site savings	9.1	20%
Annual savings from off-set payment	35.9	-
(tonnes CO_2)		
Cumulative savings for off-set payment	1,077	-
Cash in-lieu contribution (£)	102,281	-

Table 4: Regulated carbon savings after each stage of the energy hierarchy for non-domestic buildings

	Total regulated emissions (tonnes CO_2/year)	CO_2/year (tonnes CO_2/year)	Percentage saving (%)
Part L 2021 baseline	72.9		
Be lean	64.6	8.3	11%
Be clean	64.6	0	0%
Be green	41.9	22.8	31%
Total savings		31.1	43%
		CO_2savings offset (tonnes CO_2)	
Off-set		1,256.7	

Table 5: Site-wide carbon savings





1. Introduction

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The development will provide 264 student accommodation units, together with c. 1,000 sqm (GIA) of commercial space, 30 affordable residential units, with public realm improvements, new areas of landscaping, amenity and play space, and improved accessibility to the Site ('the Development').

The description of development is as follows:

"Demolition of existing buildings and redevelopment of the site to provide two buildings containing purpose-built student accommodation with associated amenity and ancillary space (Sui Generis), affordable residential homes (Class C3), ground floor commercial space (Class E) together with public realm, access, servicing, and other associated works."

Full details and scope of the planning application are described in the submitted Town Planning Statement, prepared by Gerald Eve LLP.

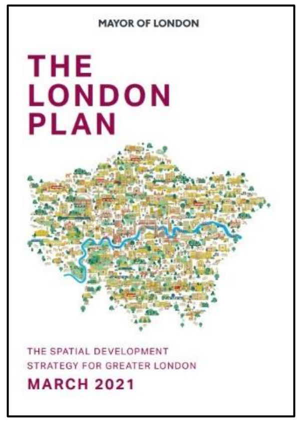
This report sets out the key energy and carbon performance factors as per the London Plan's Energy Reporting Guidelines.

1.1. National Planning Policy and Targets

The proposed development will be constructed to be compliant with Part L 2021 of the Building Regulations. The proposed development consists of new-build dwellings, under Part L1A 2021 of the Building Regulations. They mandate that the design of the building demonstrably causes lower carbon dioxide (CO2) emissions than a notional equivalent of given specifications.

The National Planning Policy Framework (NPPF) was updated in December 2023 and reiterates the Government's commitment to sustainable development and states the need for planning authorities to take an approach based on integrating the four aims of sustainable development. The document also refers to the Government's energy policies and objectives and sets out key principles that regional planning bodies and local planning authorities should adhere to in their approach to planning for renewable energy.

1.2. Regional Spatial Strategy



The proposed development lies in the London Borough of Camden; therefore, the applicable Regional Spatial Strategy is the London Plan (March 2021).

The London Plan draws energy into its major policies. In its strategic priorities, the London Plan addresses issues of the environmental quality raised by the urban heat island effect and realises the unique potential for district energy networks. The London Plan requires all London boroughs to follow the London Plan's energy efficiency guides.

Tackling climate change will also require a move towards more sustainable energy sources and the London Plan seeks to support the development of decentralised energy systems, including the use of low-carbon and renewable technologies and the greater utilisation of energy generated from waste.

Overall, the most substantial emission savings London can make will come from initiatives to decarbonise its energy supply and reduce the emissions from the existing building stock. In addition, the London Mayor expects that all new developments will fully contribute towards the reduction in CO2 emissions, and this will be principally achieved through the application of Policy SI 2 and the London Mayor's energy hierarchy:

Policy SI 2 requires all major development proposals to meet a target for CO2 emission reduction in buildings. The regulated carbon dioxide emissions reduction target for major development is zero carbon with a minimum of 35 per cent on-site.

This report has been prepared in line with the London Plan guidance issued in June 2022 against Part L2021 and SAP10.2.

Be Lean

- minimise energy use by implementing passive design measures, e.g. improve fabric U-values and minimise air permeability - 10% for domestic and 15% for non-domestic

Be Clean

- exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly by connecting to district heating networks

Be Green

- maximise opportunities for renewable energy by producing, storing and using renewable energy on-site

Be Seen

- monitor, verify and report on energy performance through the Mayor's post construction monitoring platform

1.3. Local Planning Policies

The proposed development lies in the London Borough of Camden. The London Borough of Camden Local Plan Adopted in 2017, sets out long-term energy and sustainability-related standards for the Borough as follows:

- Policy CC1 – Climate change mitigation
- Policy CC2 – Adapting to climate change

Tackling climate change will also require a move towards more sustainable energy sources and the local plan seeks to support the development of decentralised energy systems, including the use of low-carbon and renewable technologies and the greater utilisation of energy generated from waste.

1.4. The Development

The Description of the development is as follows:

"Demolition of existing buildings and redevelopment of the site to provide two buildings containing purpose-built student accommodation with associated amenity and ancillary space (Sui Generis), affordable residential homes (Class C3), ground floor commercial space (Class E) together with public realm, access, servicing, and other associated works."

The Development will provide 264 student accommodation units, together with c. 1,000 sqm (GIA) of commercial space, 30 affordable residential units, with public realm improvements, new areas of landscaping, amenity and play space, and improved accessibility to the Site ('the Development').

The two student buildings will comprise ample amenity provision, including lounge and dining areas, quiet study zones, gyms and laundry spaces. The student buildings will be carefully managed by an on-site presence 24 hours a day.

Commercial units are proposed within the basement and ground floors of the North and East drums fronting Chalk Farm Road to maximise active frontages. It is envisaged that these spaces will be operated as a retail/workspace to meet the of new residents and students.

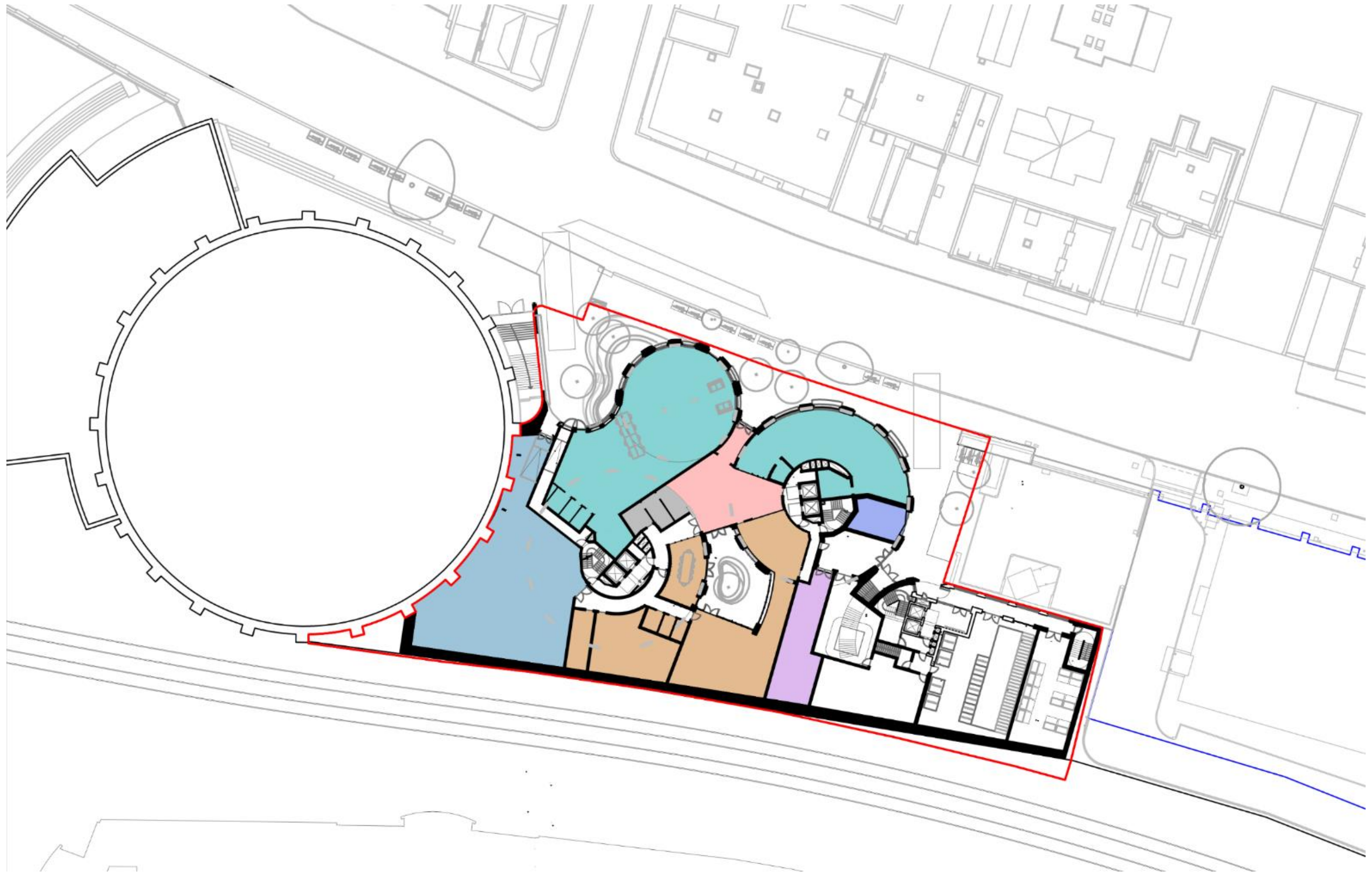


Figure 1.1: Proposed development

The proposed accommodation schedule is as follows:

- 264 student accommodation rooms
  - 24 x cluster rooms
  - 171 x studios
  - 69 x Premium studios
- 30 residential homes
  - 9 x 1B2P
  - 12 x 2B3P
  - 9 x 3B5P

2. Baseline Energy Consumption and Carbon Emissions

An assessment of the site's potential energy use was conducted in compliance with the minimum requirements of Part L1A 2021 of the Building Regulations.

The energy assessment must first establish the regulated CO2 emissions baseline assuming the development complied with Part L 2021 of the Building Regulations using Building Regulations approved compliance software. Regulated energy is calculated as follows:

Dwellings: Dwelling CO2 Emissions Rates (DER) have been calculated through Part L 2021 of the Building Regulations methodology SAP 10.2. A representative sample of dwellings has been selected to model covering all unit types, orientations and floor levels.

Non-residential including PBSA: a Building CO2 Emissions Rate (BER) has been calculated through Part L 2021 of the Building Regulations methodology based on the National Calculation Methodology (NCM) and implemented through Simplified Building Energy Model (SBEM) v6.1.b

To determine the CO2 emissions baseline, the Target Emission Rate (TER) from the final proposed building specification is used, i.e. the rate from the modelling results of the 'be green' stage of the energy hierarchy.

Regulated carbon dioxide emissions (tonnes of CO_2 per annum)	Domestic	Non-domestic
Baseline: Part L 2021 of the Building Regulations compliant development	28.0	45.0

Table 2.1: Baseline carbon emissions

Approved Document L1A also includes the fabric energy efficiency (FEE) which is a measure of the amount of energy which would normally be needed to maintain comfortable internal temperatures and can be influenced by fabric U-values, thermal bridging, air permeability and thermal mass.

Fabric energy efficiency	(kWh/year)
Part L1A Target Fabric Energy Efficiency Rate (TFFE)	28.25

Table 2.2: Target fabric energy efficiency

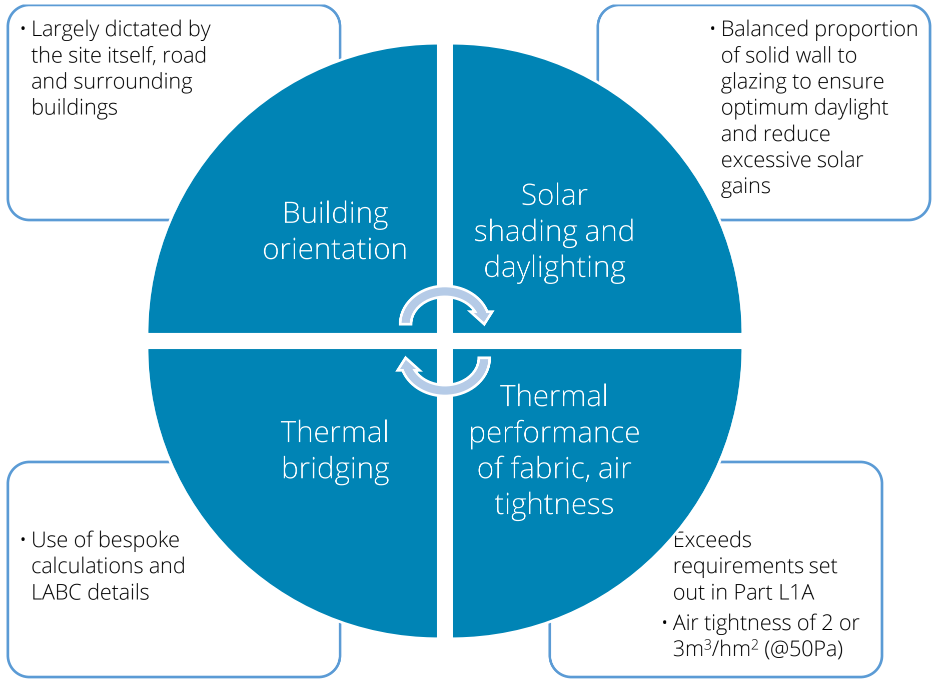
3. 'Be Lean'- Energy Efficient Design

Local planning guidelines require a reduction in the CO2 emissions of the proposed scheme by energy-efficient measures. A number of energy-efficient measures are considered below.

The London Plan 2021 has set new efficiency targets for 'Be Lean' where domestic developments should achieve at least 10 per cent improvements on Building Regulations from energy efficiency and non-domestic developments should achieve at least 15 per cent improvement. It has been noted, however, that non-domestic parts of the scheme will struggle to meet the 15% energy efficiency requirement due to low-carbon heating being included at the baseline.

3.1. Passive Design Measures

Passive design measures involve adapting building massing, layout and glazing to best respond to the local climate and annual sun path in order to reduce energy demands.



The table below shows the proposed building fabric against Part L of the Building Regulations. Approximately 50% of heat is lost through the fabric of a building. This includes walls, floors, windows, roofs and the thermal bridging connecting them. The remaining 50% is lost through uncontrolled ventilation through gaps around doors, windows and any service penetrations.

For applications including shell and core elements, such as the ground floor commercial spaces, the energy efficiency performance of building services is considered to have the same potential for improvement as for other types of applications. The applicant will develop a green lease agreement that tenants will be required to conform to, and which will secure the building services performance assumed.

Element:	Part L 2021 Limiting Values:	Domestic design	Non-domestic design
Floors	0.18 W/m²K	0.12 W/m²K	0.10 W/m²K
External Walls	0.26 W/m²K	0.15 W/m²K	0.15 W/m²K
Common Area Walls (unheated space)	0.30 W/m²K	0.18W/m²K	N/A
Party Walls (between dwellings)	0.20 W/m²K	0.00 W/m²K	0.00 W/m²K
Roofs	0.20 W/m²K	0.12 W/m²K	0.11 W/m²K
Front Doors	1.60 W/m²K	1.0 W/m²K	1.60 W/m²K
Windows	1.60 W/m²K	1.20 W/m²K	0.80 W/m²K
Window g-value	N/A	0.40	PBSE - 0.40 Commercial – 0.25
Air Permeability Rate	8m³/hm² (@50Pa)	3m³/hm² (@50Pa)	2m³/hm² (@50Pa)

Table 3.1: Proposed U-values

Pipework insulation will be based on BS5422 standards for both hot and cold pipework and duct insulation, with high thermal properties.

A thermal bridge, also called a cold bridge, is an area of construction which has a significantly higher heat transfer than the surrounding materials. This is typically where there is either a break in the insulation, less insulation or the insulation is penetrated by an element with a higher thermal conductivity. Where the building is situated in a cold climate (such as the UK) this can result in additional heat loss at these points.

Around 30% of the total heat loss through a building's fabric can be caused by thermal bridging. Indications are that better detailing and improved air tightness can reduce a dwelling's annual CO2 emissions by up to 10%.

This development will use bespoke calculations for the psi values. The selection of thermally broken lintels and cavity closers assists with improving the thermal bridging and focusing on a fabric-first building.

The glazed percentage of the buildings has been calculated as ~15%. This has been calculated from the glazed area divided by the façade area multiplied by 100.

3.2. Active Design Measures

After addressing the passive design measures the next step is to use energy-efficient buildings services, lighting and controls throughout the scheme to reduce fuel consumption.

Space heating and hot water

- A communal heating system will provide heating and hot water in the apartments using Air Source Heat Pumps (ASHP). Note that in line with the GLA June 2022 energy assessment guidance the 'Be Lean' calculations include the notional building system type and performance type specified in the Part L 2021 baseline.
- There will be underfloor heating in the dwellings
- The commercial units will also have heating, hot water and cooling provided by ASHP (added at Be Green stage)
- Waste water heat recovery is included for the PBSA which has high domestic water use

Ventilation

- The dwellings will be provided with mechanical ventilation with heat recovery, this unit removes stale air from wet areas creating a permanent air path through the property through habitable rooms. The air drawn into the dwelling is routed through a high efficiency heat exchanger where warmth from the extracted air is transferred to the incoming fresh air before being supplied to habitable rooms. This lowers the heating requirements of the dwelling.
- Due to acoustic constraints the units do not comply with TM59 through passive measures alone therefore MVHR with tempered air units are to used.
- The student accomodation is to adopt the same strategy as the residential units
- The commercial units have assumed MVHR with 1.6 W/l/s, and 90% efficiency via a plate heat excahnger.

Building services insulation

- All building services, tanks, pipes and ducts will be insulated to a high standard.

Lighting

- Internal lighting has a significant impact on the Dwelling Emission Rate (DER). Therefore, it is recommended that 100% of all internal light fittings will be low energy in order to reduce CO_2 emissions and the overall energy used (typical tungsten bulbs can use up to 300% more energy). Assumed to be 80lm/cW in residential apartments.
- Commercial lighting minimum 120m/cW efficiency with Light Output Ratio (LOR) of 1
- Auto-on-off controls to all zones except bedrooms
- Photoelectric control to all student amenity and commercial areas

3.3. 'Be Lean'- Results

A sample of SAP calculations has been carried out for the proposed development using the 'Be Lean' specification. An SBEM for the non-residential elements has also been completed using the notional building system type and performance values specified in the Part L 2021 baseline as determined by the final proposed building specification.

There has been a 12% reduction in domestic carbon emissions and an 11% reduction in non-domestic carbon emissions at the 'Be Lean' stage due to the passive and active energy efficiency measures listed above. This meets the minimum carbon reduction required by the London Plan at the Be Lean stage for residential. As expected, it has not been possible to achieve the 15% requirement for the non-domestic buildings, however, it can be seen that a fabric-first approach has been adopted with low U-values, triple glazing and an air permeability target of 2m³/hm² (@50Pa).

Regulated carbon dioxide emissions (tonnes of CO_2 per annum)	Domestic tonnes CO_2 per annum	Non-domestic tonnes CO_2 per annum
Baseline: Part L 2021 of the Building Regulations compliant development	28.0	45.0
After energy demand reduction (be lean)	24.5	40.1
Carbon savings over baseline	3.4	4.9
Carbon reduction over baseline	12%	11%

Table 3.2: Be Lean results

The reduction in fabric energy efficiency is 3% as the following table demonstrates:

Fabric energy efficiency	(kWh/m² per annum)
Part L1A Target Fabric Energy Efficiency Rate (TFEE)	28.25
Dwelling Fabric Efficiency (DFEE)	27.54
Reduction over TFEE	3%

Table 3.3: Fabric energy efficiency

3.4. Energy Use Intensity (EUI) and Space Heating Demand

Energy Use Intensity (EUI) is a measure of the total energy consumed in a building annually. It includes both regulated (fixed systems for lighting, heating, hot water, air conditioning and mechanical ventilation) and unregulated (cooking and all electrical appliances, and other small power) energy. It does not include energy use from electric vehicle charging or any reduction in EUI due to renewable energy generation on-site. EUI should be expressed using gross internal area (GIA).

The targets for EUI and space heating are shown in Table 3.5 below.

Building type	Energy Use Intensity (kWh/m²/yr)	Space Heating (kWh/m²/yr)
Residential	35	15
School	65	15
Office	55	15
Hotel	55	15
All other non-residential	55	15

Table 3.5: Energy Use Intensity (EUI) targets

The space heating demand has been taken from the regulated energy calculations from the SAP and TM54 calculations for the residential and non-domestic units respectively.

The EUI has been calculated using the 'Be Seen' methodology as follows:

Residential unregulated use – BREDEM calculation for cooking and appliances

Residential common areas –Calculated using TM54 methodology for lighting and lift energy usage

Non-residential energy use – TM54 methodology

Building type	Energy Use Intensity (kWh/m²/yr)	Space Heating (kWh/m²/yr)	Methodology
Residential	53.45	12.51	SAP/BREDEM
Non-residential	82.0	7.09	SBEM/TM54

Table 3.6: Energy Use Intensity (EUI)

3.5. Cost to Occupants

The cost to occupants has been considered. As this is a fully electric scheme the applicant is committed to protecting the consumer from high prices. The careful design based on a fabric-first approach, prioritises energy efficiency and energy demand reduction before the selection of the energy system. The CIBSE Code of Practice will be followed. Occupants will have energy meters and transparent billing to aid their energy use decisions and keep their bills low.

An indicative cost comparison has been completed in line with the GLA guidance, between direct electric heating and ASHP The capital cost of replacement of the ASHP is highest, but the cost to occupants is relative to a gas boiler and cheaper than direct electric which is of a benefit to occupants.

	Fixed cost for operation and maintenance	Fixed cost of capital replacement	Variable cost to residents (based on 3500 kWh/yr)	Total cost per dwelling per year
Direct electric	£210	£200	£1,120	£1,530
ASHP	£410	£1300	£373	£2,083

The following have been considered for the scheme:

- Following quality standards (e.g. CIBSE Code of Practice)
- Aftercare (e.g. BREEAM Man 05 Aftercare)

4. Cooling due to Potential Summer Overheating

4.1. Cooling Hierarchy

The cooling hierarchy has been followed in order to reduce the demand for cooling. The following categories have been considered:

1. Minimising internal heat generation through energy-efficient design – minimised heat distribution infrastructure within the buildings.
2. Reducing the amount of heat entering the building during summer – the location, proportion and specification of the glazing should aim to balance natural light and 'beneficial' solar gain whilst ensuring that levels of heat gain are not excessive.
3. Use of thermal mass and high ceilings to manage heat within the building – higher thermal mass construction enables heat to be absorbed in the day and then released at night, however, a balance must be struck. Lightweight structures without the energy-absorption potential are often at risk of overheating.
4. Passive ventilation – providing openable windows to allow natural ventilation and nighttime cooling to comply with Part F of the Building Regulations. Low-temperature air from external is allowed into the building during the night and circulates throughout the building cooling the building fabric.
5. Mechanical ventilation – this can be used to make use of free cooling when the outside air temperature is below that in the building during summer months, through the use of a summer by-pass on the MVHR. Due to acoustic reasons, mechanical ventilation with tempered air (TMVHR) has been specified.

The glazing will have a g-value of 0.40 and there will be dual-aspect dwellings where possible.

A dynamic thermal model has been produced to support this energy statement, and an overheating assessment in line with TM59 for a sample of dwellings has been undertaken. See the accompanying overheating report.

4.2. Cooling Demand

It is assumed that the ground floor commercial units will have active cooling, the table below shows the average actual and notional cooling demands. This will be provided by the air source heat pumps, with a SEER and EER of 4.00.

	Area weighted average non-domestic cooling demand (MJ/m²)	Total area-weighted average non-domestic cooling demand (MJ/Year)
Actual	176.4	1867440.96
Notional	163.8	1734052

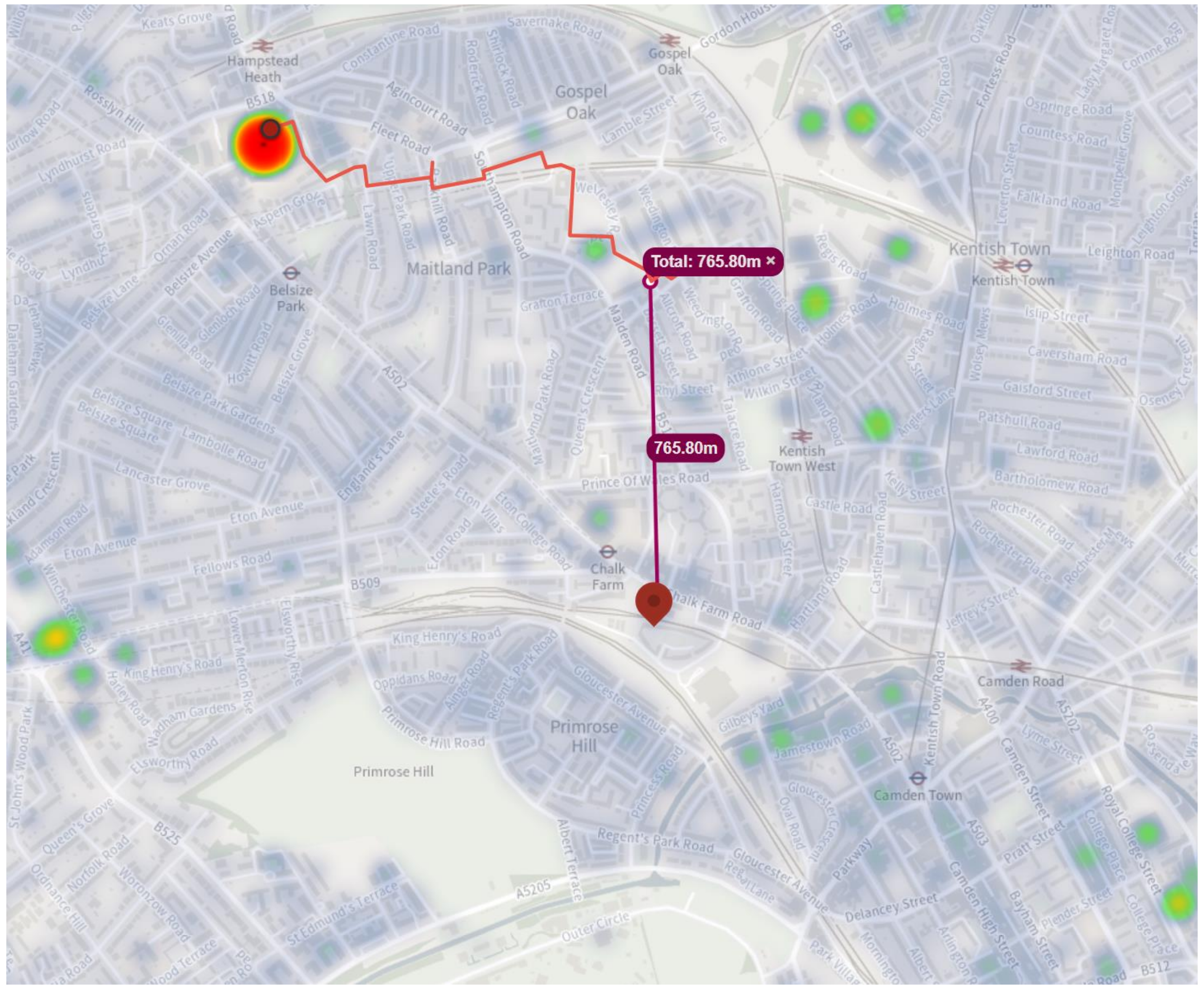
Table 4.1: Cooling demand

5. 'Be Clean'- Heating Infrastructure

In accordance with the London Plan requirement under Policy SI 3 Energy infrastructure, the site will be investigated for connection to an existing or proposed heat network.

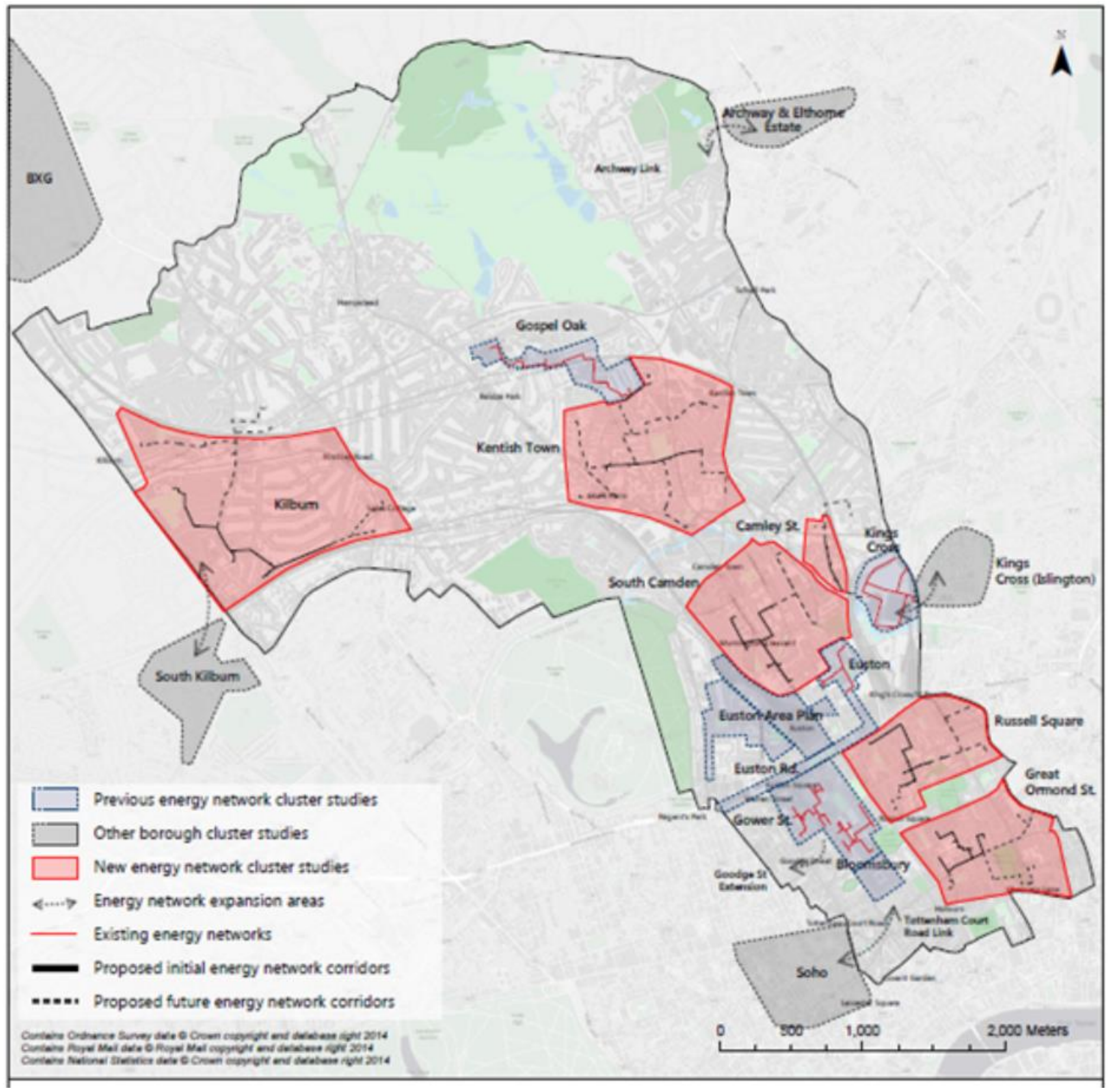
5.1. District Heating- Connection to Existing Scheme

For the first step of the heating hierarchy, the London Heat Map has been investigated. The map below shows the location of the site and any existing or proposed heat networks in the vicinity. The site is located in a heat network priority area (HNPA), however, the nearest existing heat network is the Royal Free Energy Centre approximately 760m away and there are no closer proposed networks.



5.2. District Heating- Connection to Future Scheme

Camden Council have been contacted to ascertain whether any heat networks are proposed near to the site. While no future networks are shown on the London Heat Map, the site does fall within the Kentish Town, New Energy Network study area undertaken in 2015.



Provisions will be made in the plant room for possible future connections to a district heating network. Pipework to each of the core's heating risers will be installed and capped off for future connection. The two sets of flow and return pipework entering and leaving the thermal substation will be isolated within an accessible heating pit via a manhole or an alternative access method.

This will be revisited at the detailed design stage and following a response from Camden Council. A drawing to show the future network connection has been included in the appendix.

5.3. Use of Zero Emissions and/or Local Secondary Heat Source

The second step of the heating hierarchy encourages the exploitation of local energy opportunities whilst maximising primary energy demand and carbon emissions. Secondary heat includes environmental sources such as air, water and ground, or waste heat sources.

There are no suitable waste heat sources available to the 100 Chalk Farm Road site. The most appropriate environmental source is air and therefore air air-source heat pumps are proposed for space heating and hot water, as an onsite low-carbon heat source.

As a result of this, the following stages of the heat hierarchy have not been considered. The use of low-emission combined heat and power (CHP) is not appropriate, as there is limited opportunity for the delivery of an area-wide heat network. Ultra-low NOx gas boilers are also not appropriate, as they do not comply with carbon requirements.

5.4. Heat Network Connection

The communal heat network will allow for a single-point connection to an area-wide network. At 100 Chalk Farm Road there is a building-by-building approach for the heating system as there is not enough viable ground floor space to house a centralised plant room. There will however be provision for future connection to potential district heat networks. Therefore, there is no buried pipework included in the current design and the heat losses are not included in the energy calculations.

5.5. 'Be Clean'- Results

Since there are no changes proposed, the 'be clean' results are identical to those at the end of the 'be lean' stage.

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Domestic	Non-domestic
Baseline: Part L 2021 of the Building Regulations compliant development	28.0	45.0
After energy demand reduction (be lean)	24.5	40.1
After heat network/CHP (be clean)	24.5	40.1
% reduction at this stage	0	0

Table 2.1: Be Clean results

6. 'Be Green'- Renewable Energy

The GLA expects all major development proposals to maximise on-site renewable energy generation. The site-specific analysis for those renewable energy technologies considered feasible will be covered below:

6.1. Heat Pumps

Heat pumps collect low-temperature heat from renewable sources and "concentrate" it to a usable temperature. Grid electricity is generally required to operate the pumps and the renewable component of the output is therefore by convention taken as the difference between the output energy and the input energy.

With the decarbonisation of the grid, the carbon factor associated with electricity is much lower, as we rely more heavily on renewable sources such as wind power, over fossil fuel-fired power stations. This makes heat pumps a low-carbon energy source.

A typical heat pump will deliver 4-5 kWh of useful energy for every 1 kWh of input energy. A heat pump operating in this way can therefore be deemed to have delivered 3-4 kWh of renewable energy.

Air source heat pumps have been identified as the most appropriate technology for the site, to provide the heating and hot water for the dwellings. Heating will be delivered via heat pumps located on the roofs to serve both student and residential accommodation. The plant has been split to enable separate management and ownership, however, infrastructure will be designed to accommodate future district heating network connection from a single source to future-proof the scheme. The ASHP will provide heating flow and return temperatures of 55/35ºC to the PBSA and 57/30ºC to the residential element.

The heating flow and return temperatures will run from the water source heat pumps, down a designated heating riser, to tee off at each floor to serve the dwellings at a high level within the common areas.

The plant area located on the roofs will require access via a communal staircase, with lift access to the highest floor of accommodation.

The plant area will consist of the ASHP's, thermal stores, pressurisation units and associated equipment for the network pipework before and after the water source heat pumps.

The following primary heat pump chillers have been specified; all datasheets have been provided in Appendix D. These show the heat pumps comply with minimum performance standards for Enhanced Capital Allowances (ECA) and the MCS heat pump production certification.

	Heat Pump
Student cores - Heating	8 x Mitsubishi CAHV
Student cores - DHW	5 x Mitsubishi QAHV
Resi cores	4 x Mitsubishi CAHV

Table 6.1: Heat pumps

The table below shows the performance of the heat pumps, taken from the datasheets.

	CAHV	QAHV
Seasonal Coefficient of Performance (SCOP)	3.24	3.44
Seasonal Performance Factor (SFP)	-	-

Table 6.2: SCOP

The occupants will be supplied with regular information on how to control and operate the system, at initial occupation and maintenance visits as required.

In line with the Be Seen policy, the client has committed to monitoring the performance of the heat pump system at the post-construction stage and for five years post-occupation.

6.2. Photovoltaic Panels

Photovoltaic (PV) systems convert energy from the sun into electricity via semiconductor cells. There is a wide range of different panels available on the market, from less expensive amorphous silicon with low efficiencies to mono-crystalline silicon with much higher efficiencies (1kWp installation requires approximately 8m2 of free roof area).

Ideally, PV panels need to be positioned within 30° South and at an angle of 30° to achieve optimum performance. It is essential that PV panels are unshaded, as even a small amount of shading dramatically reduces the output of the panel.

There is sufficient space on the roof to provide an array of PV panels. By also allowing space for access hatching as well as maintenance and avoiding areas of the roof which are shaded by other blocks, the available roof area has been maximised. A total of 30.4 kWp is proposed for the roof, which will produce around 24,101 kWh per year. This can be seen on the roof plan in Appendix B.

The applicant will be selecting high-performance PV panels of at least 400 watts per panel. The performance and output of the PV panels will be monitored in line with the Be Seen guidance.

6.3. 'Be Green'- Results

A sample of SAP calculations for the dwellings and SBEM for the non-domestic units have been completed using the 'Be Green' specification of air source heat pumps and photovoltaic panels

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Domestic	Non-domestic
Baseline: Part L 2021 of the Building Regulations compliant development	28.0	45.0
After energy demand reduction (be lean)	24.5	40.1
After heat network/CHP (be clean)	24.5	40.1
After renewable energy (be green)	6.0	35.9
% carbon reduction	79%	20%
% carbon reduction site-wide	43%	

Table 6.3: *Be Green results*

The same building fabric specification has been assumed as per the 'Be Lean' section of the energy hierarchy. When ASHP and PV panels are added to the design, there has been a 31% carbon reduction against the 'Be Lean' results and a 43% carbon reduction compared to baseline (site-wide).

7. Carbon Offsetting

The energy strategy has followed the energy hierarchy as set out in the London Plan, it has maximised on-site carbon reduction through the use of ASHP and PV panels to achieve a site-wide carbon reduction of 43%.

It has been shown that the carbon reduction target of 'zero carbon' cannot be feasibly or viably met on-site. In this case, a commitment is made to ensure the shortfall is met off-site or a payment is made into the borough's carbon offset fund.

The London Borough of Camden has a carbon offset fund set up to assist new developments in complying with the planning policies outlined in the NPPF, the London Plan Policy SI 2, and the LBBD Local Plan.

The Council will secure the financial contribution to the off-set fund through s106 planning obligations, at a cost of £95 per tonne of carbon over a 30-year period.

	Annual shortfall (tonnes CO_2)	Cumulative shortfall (tonnes CO_2)
Carbon shortfall	41.9	1,256.7
Cash-in-lieu contribution	£119,386	

Table 7.1: *Carbon offset*

8. 'Be Seen'- Monitor, Verify, Report

To truly achieve net-zero buildings we need to have a better understanding of their actual operational performance.

The 'Be Seen' calculations have been completed in line with the guidance and the results will be uploaded to the Mayor's post-construction monitoring platform. The applicant has committed to providing the actual performance of the development for at least five years post-occupation.

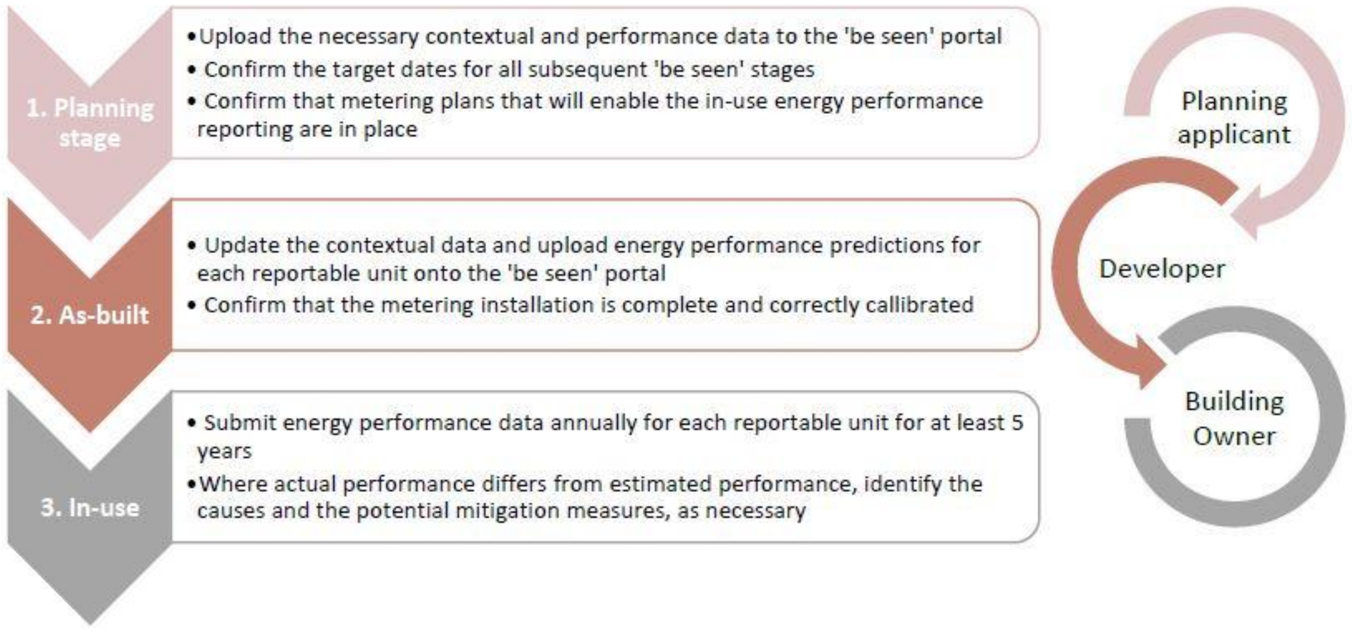


Image from 'Be Seen' consultation draft October 2020

TM54 is a tailored Part L calculation to reflect the expected occupancy and usage of the building, this has been used to complete the predicted energy consumption for the non-residential reportable units.

9. Flexibility and Peak Energy Demand

London Plan Policy SI 2 and SI 3 require investigation into ways to minimise both annual and peak energy demand, specifically to address the following paragraphs:

SI 2 9.2.2. "an important aspect of managing demand will be to reduce peak energy loadings"

SI 2 11A "opportunities to maximise renewable electricity generation and incorporate demand-side response measures"

Smart buildings have been identified and acknowledged as key enablers of future energy systems for which there will be a larger share of renewables, distributed power and heat generation, and demand-side flexibility to match demand to supply and make best use of existing network connection and local generation capacity.

The aim is to encourage applicants to investigate the potential for energy flexibility in new developments, including proposals to reduce the amount of capacity required for each site and to reduce peak demand. The assumption is that, if peak electrical demand is reduced across London, then less power infrastructure and less carbon-intensive electricity-generating plant will be needed to meet that demand.

Demand-side flexibility provides the capability to lower developer and occupier costs in the context of predicted future energy cost rises. It can also enable some buildings to earn income by providing grid and network support services. Reducing peak energy consumption could also allow a developer to negotiate lower connection fees to the electricity grid Distribution Network Operator (DNO). Similarly, buildings that are enabled to modify when they draw energy from networks in real-time through the use of Demand Side Management (DSM) and storage systems increasingly have the potential to take advantage of dynamic pricing in the electricity market, providing opportunities to reduce occupants' energy bills.

	Electrical	Heat student	Heat Residential
Estimated peak demand (MW)	952 kW	500.6 kW	107 kW
Available capacity (MW)	TBC*	n/a**	n/a**
Flexibility potential (MW)	0 MW	0 MW***	0 MW***
Revised peak demand (MW)	952 kW	500.6 kW	107 kW
Percentage flexibility predicted (%)	0%	0%	0%

Table 9.1: Summary of site-wide peak demand, capacity and flexibility potential

*Application to DNO is in process

**ASHP capacity has been designed to cater for peak demand

***the loads calculated consider best practice recommendations for insulation, diversity and system design and therefore the loads are considered to incorporate 'flexibility' potential from the outset.

Flexibility achieved through	Yes/No
Electrical energy storage (kWh) capacity	N
Heat energy storage (kWh) capacity	Y
Renewable energy generation (load matching)	N
Gateway to enable automated demand response	N
Smart systems integration (smart charge points for EVs)	N
Other initiative	N

Table 9.2: Summary of interventions for achieving flexibility

There is a limited amount of renewable energy sources therefore it has not been deemed viable to utilise the smart grid. PV area has been maximised, resulting in 30.4 kWp of PV across the site as indicated on the roof layouts provided.

There have been enquiries made with several smart grid manufacturers, Sneider Electric and Siemens, to seek additional solutions for the site and improve the flexibility of the peak demand of the site.

10. Conclusion

This energy statement outlines the key features and strategies adopted by the design team to reduce energy use and carbon emissions for the scheme. It demonstrates compliance with the London Plan 2021, as well as the London Borough of Camden Local Plan.

The strategy for reducing energy and associated carbon emissions follows the energy hierarchy:

- Be Lean – improved building fabric specification to exceed that of the notional building, low air permeability target, thermal bridging details and selection of energy efficient services.
- Be Clean – connection to a district heat network and installation of Combined Heat and Power (CHP) have been investigated for the site and have not been deemed appropriate at this time, future connection to a district heat network (DHN) has been accommodated.
- Be Green – air source heat pumps are to be installed and the roof area available has been maximised for photovoltaic (PV) panels, a total of 30.4 kWp will be installed.
- Offset – remaining carbon to meet zero carbon will be paid to the offset fund – total cost £119,386
- Be Seen – onsite monitoring of energy usage 5 years post-construction.

This report concludes that the proposed development at 100 Chalk Farm Road will achieve a 43% improvement over Part L1A 2021 of the Building Regulations.

The final specification to meet the 43% carbon reduction on site is as follows:

	Specification	
	Domestic	Non- domestic
Heating	Air Source Heat Pump CAHV SCOP 3.24	
Hot water	HIUs (from above) SCOP 3.44	Mitsubishi QAHV SCOP 3.44
Emitter	Underfloor heating	Radiators
Cooling	N/A	SEER 4.00 EER 4.00
Ventilation	MVHR with tempered air	MVHR (90% efficient) 0.8W/l/s Plate heat exchanger
Lighting	80lm/cW	120lm/cW
Lighting controls (daylighting)	N/A	Dimming/standalone to student amenity and commercial only
Lighting controls (occupancy)	N/A	Auto-on-off controls to all zones except bedrooms Photoelectric control to student amenity areas and commercial areas
Photovoltaics	30.4 kWp	

Table 10.1: Summary of specification to meet London Plan

	Carbon dioxide emissions for domestic buildings (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021	28.0	8.3
After energy demand reduction (be lean)	24.5	8.3
After heat network/CHP (be clean)	24.5	8.3
After renewable energy (be green)	6.0	8.3

Table 10.2: Carbon emissions after each stage of the energy hierarchy for domestic buildings

	Regulated domestic carbon dioxide savings	
	(tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	3.4	12%
Be clean: savings from heat network/CHP	0	0%
Be green: savings from renewable energy	18.5	66%
Cumulative on-site savings	21.9	79%
Annual savings from off-set payment	5.5	-
	(tonnes CO_2)	
Cumulative savings for off-set	180	-
Cash in-lieu contribution (£)	17,102	-

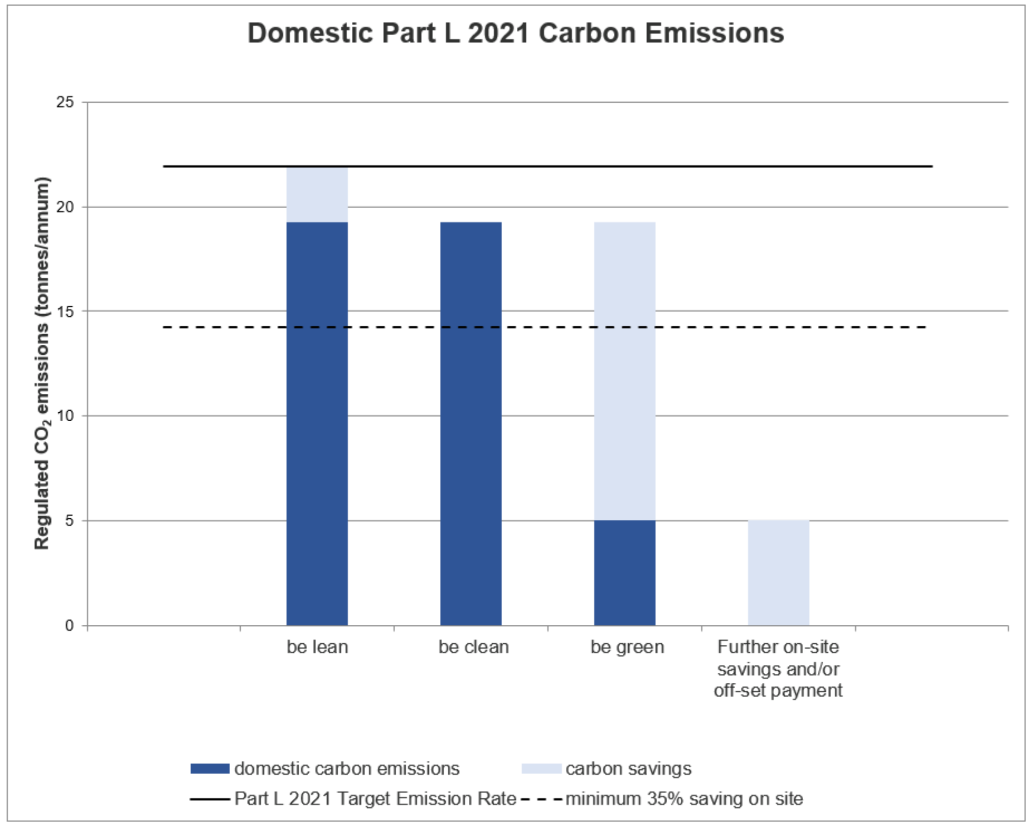
Table 10.3: Regulated carbon savings after each stage of the energy hierarchy for domestic buildings

	Carbon dioxide emissions for non-domestic buildings (tonnes CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2021	45.0	49
After energy demand reduction (be lean)	40.1	49
After heat network/CHP (be clean)	40.1	49
After renewable energy (be green)	35.9	49

Table 10.4: Carbon emissions after each stage of the energy hierarchy for non-domestic buildings

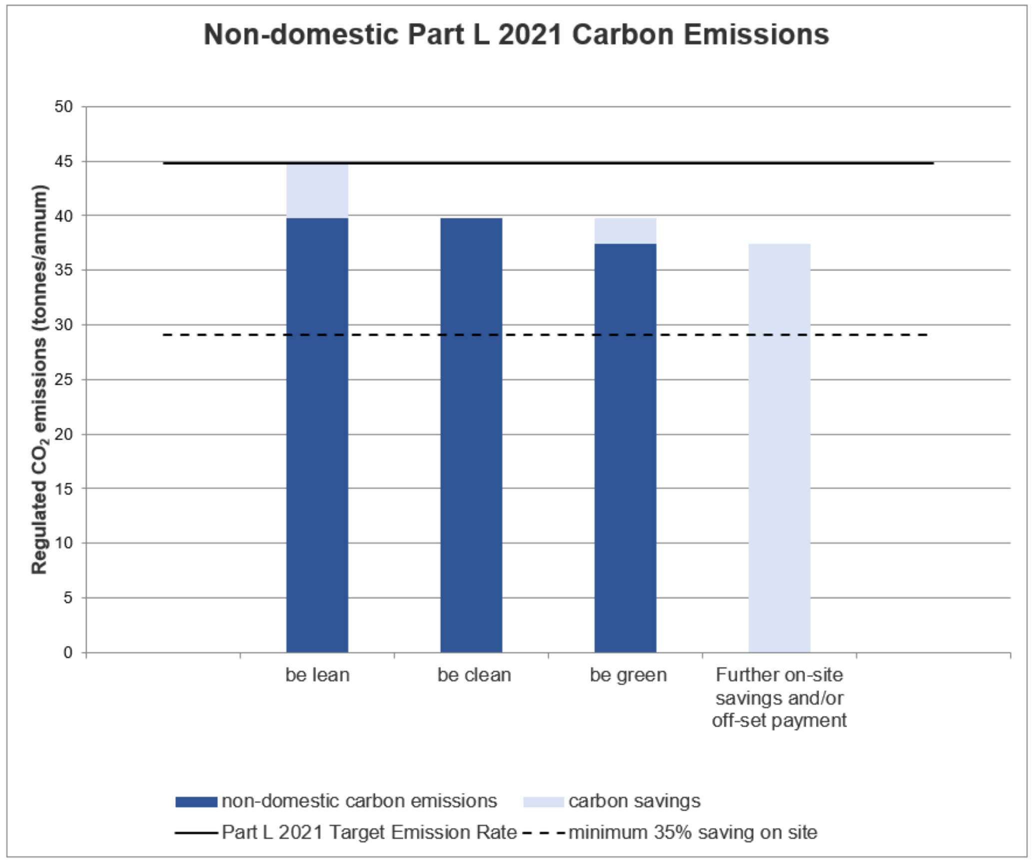
	Regulated non-domestic carbon dioxide savings	
	(tonnes CO_2 per annum)	(%)
Be lean: savings from energy demand reduction	4.9	11%
Be clean: savings from heat network/CHP	0	0%
Be green: savings from renewable energy	4.2	9%
Cumulative on-site savings	9.1	20%
Annual savings from off-set payment	35.9	-
	(tonnes CO_2)	
Cumulative savings for off-set payment	1,077	-
Cash in-lieu contribution (£)	102,281	-

Table 10.5: Regulated carbon savings after each stage of the energy hierarchy for non-domestic buildings



	Total regulated emissions (tonnes CO_2/year)	CO_2/year (tonnes CO_2/year)	Percentage saving (%)
Part L 2021 baseline	72.9		
Be lean	64.6	8.3	11%
Be clean	64.6	0	0%
Be green	41.9	22.8	31%
Total savings		31.1	43%
		CO_2savings offset (tonnes CO_2)	
Off-set		1,256.7	

Table 10.6: Site-wide carbon savings



Appendix A- Renewable Energy Considerations

Solar hot water heating

Solar water heating is an excellent renewable energy source as it can cater for almost 80% of the hot water load of a dwelling. A South-facing 1m^2 highly efficient evacuated tube solar array will provide approximately 520-850kWh/m2/year of hot water, saving approximately 103kgCO2 /m^2/year. Depending on the system size, type and nature of installation solar water heating can cost approximately £1,000/m^2.

For a block of apartments, there are a number of design complications. If solar water heating systems are required to serve dwellings other than those on the top floor, there is a requirement for long runs of pipework to serve them. This results in access issues adds to the long-term maintenance of the system and reduces efficiencies due to pipe losses.

Also, if a communal system is to be implemented, then a buffer vessel, expansion vessels and commercial pumps will be required, all of which require a large amount of plant space and maintenance. Within the dwellings themselves, a large solar hot water cylinder will be required.

There is sufficient space on the roof of the development to install solar hot water panels, however, the carbon saving and overall benefit to the development is limited. Therefore, this technology has been considered as not feasible for the proposed development.

Wind turbines

Wind turbines convert the wind's kinetic energy into electrical power. They can be building-mounted or free-standing. Where large wind turbines work they can deliver the best CO2 emission savings for the initial investment.

The installation of a large wind turbine at 100 Chalk Farm Road is practically impossible, as there is no available space to position or mount such a large piece of equipment. Opting for smaller roof-mounted turbines, such as those manufactured by Quiet Revolution (which are more aesthetically pleasing) could be an option.

A typical 6kW large turbine in a suburban environment could generate 6,765kWh/year and hence save 3,843kgCO2/year. 6 turbines are required to achieve the 20% renewables target, and with a minimum of 10m between each turbine this would account for a significant alteration to the development. A 6kW turbine can cost between £21,000-£30,000, equating to an estimated total cost of £150,000 for the proposed development.

Due to the space required for both pole-mounted and building-mounted wind turbines, this type of technology is considered not feasible for the proposed development. They can also cause "flickering" to neighbouring buildings which can cause discomfort.

Biomass boiler

Whilst traditionally most suited to lower-density situations (mainly due to the supply and storage of the fuel), more high-density developments are considering this technology. A biomass boiler is best incorporated within a district heating scheme. However, there are issues regarding fuel storage and air pollution.

A separate area would be required for the fuel store. Woodchip is the preferred fuel as opposed to pellets due to the embedded energy involved in transporting pellets from the continent – there are doubts as to whether wood pellets are in fact a carbon-neutral fuel. Woodchips can be sourced locally and therefore are more readily available, as well as being more carbon-friendly. The store would need to be adjacent to the plant room where the biomass boiler is located.

This type of technology is considered as not feasible for 100 Chalk Farm Road as there is not sufficient space required for the boiler and the delivery and storage of fuel and waste ash. The use of biomass fuel would also release high levels of NOx emissions, impacting the local air quality.

Ground source heat pump

Ground Source Heat Pumps (GSHPs) absorb heat from the ground at low temperatures into a fluid inside a loop of pipe buried underground. This fluid then passes through a compressor that raises it to a higher temperature used for heating the water for the space heating and hot water circuits. GSHPs perform better when connected to heating systems that have been specifically designed for low-temperature hot water.

GSHPs can provide very high efficiencies, with COPs over 5 in most applications. It also removed the need for roof plant located at roof level.

The pipe in the ground can be buried horizontally or vertically. They cannot be placed underneath the building or an impermeable area, due to heat transfer and access requirements. A 50m x 1.5m horizontal loop trench can produce 39,600kWh/year of heat, saving approximately 7,680kgCO2/year, depending on the suitability of the ground in the local area.

Vertical loop systems also require a lot of space, especially for the drilling equipment to produce the borehole. Boreholes are also very expensive costing between £16,000 to £20,000 per borehole.

Due to the location of the proposed development and the limited space required for this type of technology, GSHPs are considered as not feasible.

Some other reasons why these are not suitable for the Development are as follows. Ground source heat pumps can cause energy imbalance within the ground. This basically means that if there is a local site also being developed with ground source heat pumps, then it could absorb all the heat and not allow enough heat for this site. The environmental agency could restrict the ground use at any time, meaning you cannot extract energy from the scheme. The boreholes would require significant coordination between all below-ground services, landscape, structure, TFL services, etc.

The system would require specialist design to ensure the system is balanced with the environmental injection and abstraction of the ground. Very expensive dig costs, installation, equipment, and maintenance required.

Technology	Lifetime (years)	O&M impacts	Simple payback (years)	Planning – land use and noise	Aesthetic impact and land use	Site feasibility	Export potential for heat or energy	Comments
Biomass	20	High	15	Med	High	3	3	Not adopted – burning of wood pellets releases high NOx, storage and delivery limitations
PV	25	Low	7	Low	Med	5	8	Adopted
Solar thermal	25	Low	5	Low	Med	3	1	Not adopted – additional piping and hot water tanks are not viable
GSHP	20	Med	25	Low	Low	1	1	Not adopted – ground loop requires significant space, deep borehole required
ASHP	30	Med	20	High	Med	8	1	Adopted
Wind	25	Med	25	High	High	2	8	Not adopted – visual impact, site too enclosed
Energy storage	10	Med	>10	Low	Low	1	5	Not adopted – no compatible energy generators on site

Grants

The Renewable Heat Incentive (the RHI) is a payment system in England, Scotland and Wales, for the generation of heat from renewable energy sources.

The RHI operates in a similar manner to the Feed-in Tariff system and was introduced through the same legislation - the Energy Act 2008. In the first phase of the RHI cash payments are paid to owners who install renewable heat generation on a quarterly basis over 7 years and in many instances can far outweigh the installation costs. Combine this with the savings on heating bills and it gives an excellent return on investment which is usually re-paid in 4-5 years.

Life cycle costing

Air source heat pumps have been selected as the most feasible technology for this development, they offer long-term carbon reduction as the grid continues to decarbonise.

ASHP	
Indicative installed cost per flat	£4,300
Annual savings per flat	£215
Simple payback	Approx. 20 years

Solar Shading Study

A solar shading study has been completed to determine whether the installation of additional PV panels would be feasible. Figure 0.1 shows the annual hours of solar exposure of the current proposals as well as three additional arrays to the north of the PBSA drums, and four additional panels to the residential areas. While there is a slight difference in the solar exposure to the north-facing arrays of the PBSA drums, this translates to a large difference in solar irradiance when compared to panels that are not overshaded as is evident in Figure 0.2. As a result, the northern arrays to the PBSA drums are not proposed, but the 4 additional panels to the residential element will be retained.

Figure 0.1 Annual solar exposure in hours

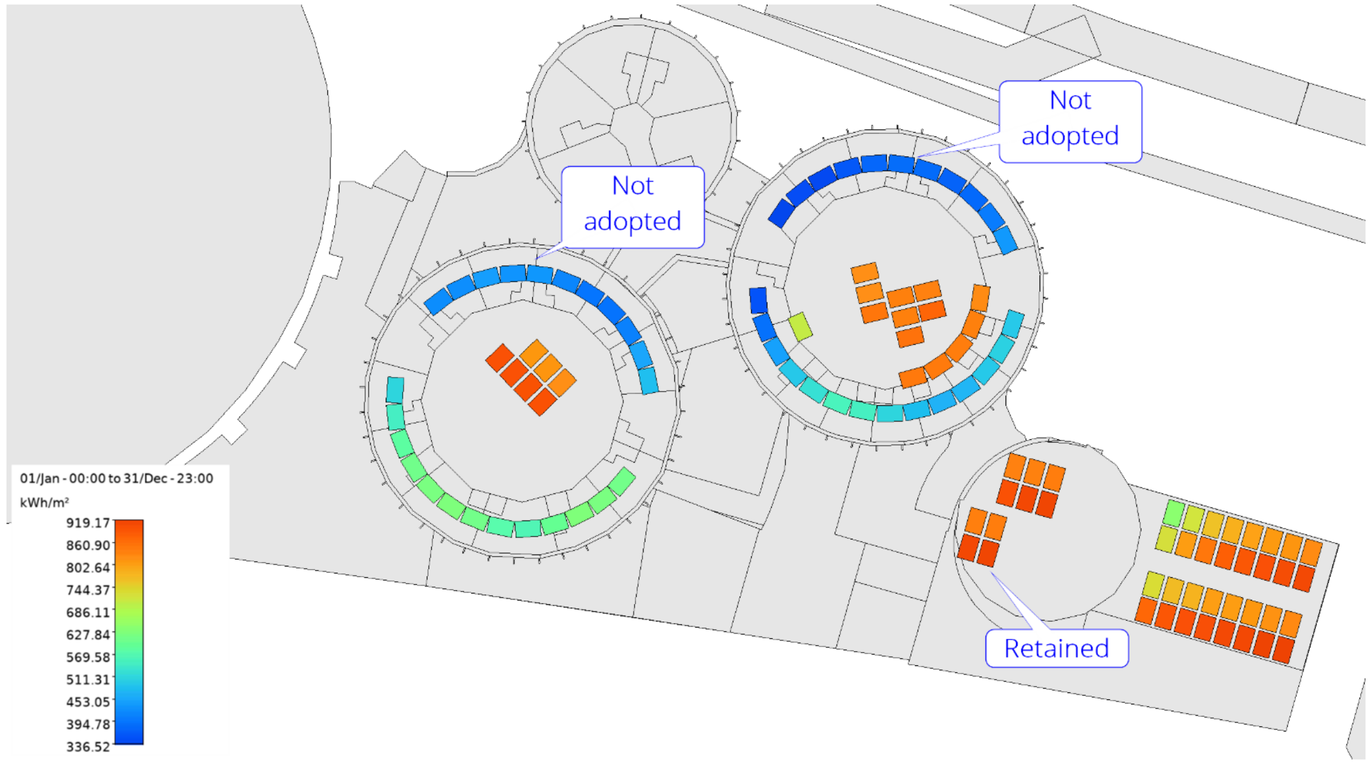
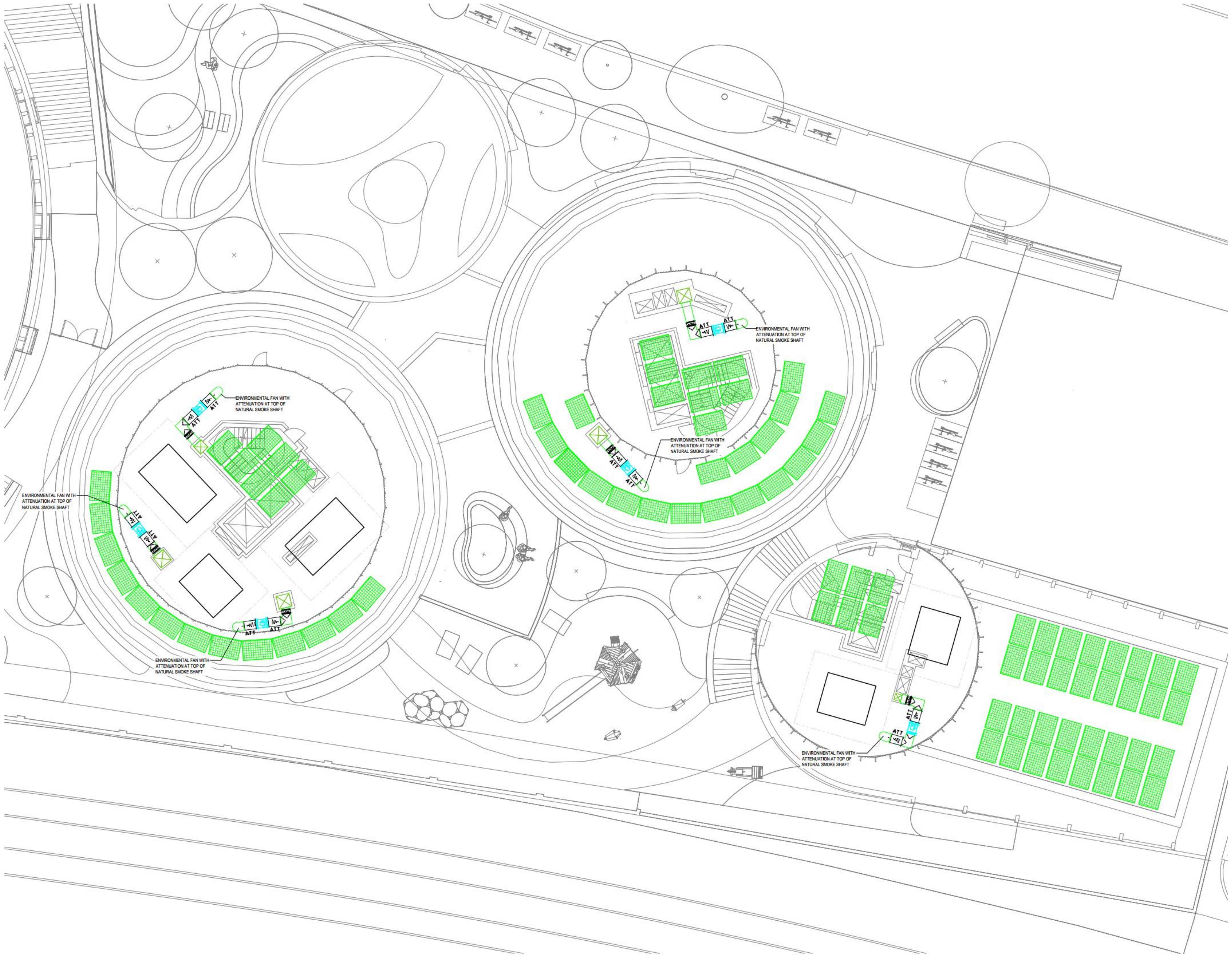


Figure 0.2 Annual solar irradiance in kWh/m²

Appendix B - Proposed Roof Layout



Appendix C - ASHP Data Sheets

CAHV-R450YA-HPB

Project Reference: TBC

Design Conditions		
Application		Community / District Heating
Outdoor Temperature Condition	°C	-4
Water Inlet Temperature	°C	50
Water Outlet Temperature	°C	55
Glycol		Ethylene
Concentration of Glycol	%	25
Freeze Protection Temperature	°C	-7
Number of Units	No.	8

Selection Results		
Total Deliverable Capacity by Units	kW	257.2
COP (at design condition & 100% load)		1.9
SCOP (Low/Medium)		3.57/3.24
Number of Controllers (PAR-W31MAA)	No.	1

QAHV-N560YA-HPB

High Temperature Heat Pump for Sanitary Hot Water

SCOP and COP data has been produced at the selected design conditions. SCOP data has been generated using BIN data from the approximate project location, as shown in the graph below.

Data		
Inlet Water Temperature to QAHV for SCOP/COP	°C	10
Outlet Water Temperature from QAHV for SCOP/COP	°C	65
External Ambient for COP	°C	-4
Approximate Project Location for SCOP		London
COP		2.14
SCOP		3.44

Appendix D - Future Connection Provision

Camden Council have been contacted regarding connection to a future District Heat Network (DHN). While there currently are no DHNs in the vicinity of the site, a development of this size is expected to include connection for a future DHN. This will be implemented at the Site.

From: Ellen Huelin
Sent: Wednesday, January 10, 2024 2:20 PM
To: Christopher Winters <Christopher.Winters@camden.gov.uk>
Cc: Ben Talbutt <ben.talbutt@whitecode.co.uk>
Subject: RE: 2022/4141/PRE - 100CFR - Energy, Sustainability, Air Quality, Flood and SuDS Comments

Hi Christopher

Hope you are well, I am not sure if you are the right person to ask but I was wondering if there had been any developments on the DHN proposals within Camden from https://www.camden.gov.uk/supplying-low-carbon-energy?

We are just considering DHN connections for the energy strategy.

Kind regards

Ellen

From: Christopher Winters <Christopher.Winters@camden.gov.uk>
Sent: Thursday, February 1, 2024 5:09 PM
To: Ellen Huelin <ellen.huelin@whitecode.co.uk>
Cc: Ben Talbutt <ben.talbutt@whitecode.co.uk>
Subject: RE: 2022/4141/PRE - 100CFR - Energy, Sustainability, Air Quality, Flood and SuDS Comments

Hi Ellen,

There currently aren't any District Heat Networks in the immediate vicinity of the site. We expect developments of this size to have heating infrastructure designed to be compatible with a potential future connection to a low-carbon heat network.

Kind regards,
Chris

Chris Winters
Sustainability Officer – Planning

Appendix E – WWHR Assumptions

It is proposed that the PBSA will be fitted with Water Water Heat Recovery (WWHR) to reduce energy demand. This has been accounted for using the WWHR Energy Saving Calculator developed by Recoup and their "workaround" for inclusion into an IES thermal model[1]. 265 showers fitted with Recoup's "Pipe HEX" units were calculated to reduce DHW energy demand by 89,373.3 kWh/year. Following Recoup's guidance, the efficiency of the system serving the DHW was manually adjusted to account for this in the model.

2. Artificially increase the efficiency of the DHW plant

Manually increasing the system efficiency of the DWH plant, will reduce the kWh required to produce DHW. You can, therefore, increase the DHW plant efficiency, to the point that the kWh required to produce DHW is, reduced by the energy reduction as shown in the calculation (yellow box)

Figure 0.1 Recoup's guidance on accounting for WWHR within IES from https://knowledge.recoup.co.uk/how-do-you-model-wwhrs-in-dsm-ies-ve-tas-apache-hvac

Shower Energy Consumption Calculator

Duration (Minutes)	Flow rate (L/Min)	Total Water used (Litres)	Total Energy (kWh)	Recoverable Energy (kWh)
7.5	9	67.5	2.27614	1.96

Number of Showers

No. of showers present	265.0	Total Showers Per Day	225.3
Occupancy rate	0.85	Total Showers Per Year	82216
Users per shower present	1.000		

	Total Energy Required (kWh)	Total Recoverable Energy (kWh)	Direct Energy Recovered (kWh)	Energy Required for DHW (kWh)	Effective COP of WWHRS Unit	WWHRS System Efficiency
Per Day	512.7	442.0	244.9	267.8	1.91	47.8%
Per Year	187135.5	161323.7	89373.3	97762.2	1.91	

Recoup Unit			Pipe HEX
Installation Method			B
Efficiency of unit			55.4%
Assumed Efficency			
Budgetary cost			£240
Project budget cost			£31,800
Shower temperature (°C)			41
Incoming Mains Cold Water Temp. (°C)			12
Temperature loss to atmosphere (°C)			4
DHW Cylinder Present	No		
Volume (Litres)	300	150	
Heat Loss per year (kWh)	620.5	438	

Average Costs Per Year

Fuel	Price per kWh*	Cost without WWHRS	Average Cost Per Year with Heat recovery	Saving	ROI (years)
Natural Gas	£0.1030	£21,417	£12,211	£9,205	3.45
LPG	£0.1210	£25,159	£14,345	£10,814	2.94
Electric (Direct)	£0.3400	£63,626	£33,239	£30,387	1.05
Electric (Heat Pump)	£0.3400	£30,886	£16,136	£14,751	2.16

CO_2 Savings associated with Showering

Fuel	Carbon Dioxide Factor ($kgCO_2$ per kWh)*	Primary Energy Factor**	$kgCO_2$ per year (No WWHRS)	$kgCO_2$ per year (With WWHRS)	$kgCO_2$ Saving per year	%Saving	tCO_2 Savings per year	WWHRS serviceable lifetime (y)	WWHRS savings over lifetime (tCO2)
Natural Gas	0.208	1.13	54302	30961	23340	43.0%	23.34	40	**933.61**
LPG	0.241	1.14	63474	36191	27283	43.0%	27.3	40	**1091.31**
Electric (Direct)	0.286	1.501	80335	41968	38367	47.8%	38.37	40	**1534.67**
Electric (Heat Pump)	0.286	1.501	38997	20373	18625	47.8%	18.62	40	**744.98**

*** Values taken from the Energy Saving Trust Website - Values correct as of October 2022**
https://energysavingtrust.org.uk/about-us/our-calculations
**Values taken from the BRE Website - Values correct for SAP 10.2
*** https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1000108/EHS_19-20_Energy_report.pdf
**** https://www.ncm-pcdb.org.uk/sap/filelibrary/pdf/WWHRS-Instantaneous_Shower-Method_Statement_24_09_2021.pdf

$$F_{mix} = 1 - \frac{(T_{setTemp} - T_{mix})}{(T_{setTemp} - T_{inletTemp})}$$

Figure 0.2 Image of the WWHR energy savings calculation

[1] https://knowledge.recoup.co.uk/how-do-you-model-wwhrs-in-dsm-ies-ve-tas-apache-hvac

Appendix F – SAP Outputs

Sent as a separate submission.

Appendix G – BRUKL Documents

Sent as a separate submission.

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