
Energy Assessment Cornwall Road

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Executive Summary

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About the Scheme:

The Cornwall Road project comprises the construction of two residential blocks to provide 9 units in total. The development is located in the London Borough of Haringey. The scheme has a total internal floor area of approximately 603m².

Planning policy:

The scheme has been developed in accordance with the London Plan 2021 and with the Sustainable, Design and Construction SPG. The extent and emerging Development Plan policies require the development to achieve a minimum of 35% carbon reduction (London Plan Policy SI2).

The scheme complies with the Part L 2013 Building Regulations and the minimum energy efficiency targets in the following documents have been followed:

- New build (Part L1A) – The actual building CO₂ emissions rate (DER) is no greater than the notional building CO₂ target emissions rate.

Local Policy and Employer's Requirements

As per Haringey's policy SP4 Working towards a Low Carbon Haringey; all new residential developments will aim to achieve a 100% reduction in total (regulated) CO₂ emissions. Additionally: the scheme should target:

- A maximum space heating demand per unit of 15–20 kWh/m² to be achieved through services design
- A minimum 50% reduction in CO₂ emission (over Building Regulations Part L 2013) should be achieved as a minimum, and a fabric first approach adopted
- Developments should achieve a 40% reduction in CO₂ emissions from onsite renewable energy.

Emission factors:

The Greater London Authority (GLA) Guidance on Energy Assessments published in October 2018 highlights a critical development regarding carbon emission factors. Grid electricity has significantly decarbonised since the last update of Part L in April 2014 and in July 2018 the Government published updated carbon emission factors (SAP10.0) demonstrating this. Although SAP10.0 is not in use yet, the GLA Guidance encourages the use of SAP10.0 carbon emission factors from January 2019. Any applicants proposing to use the SAP 2012 emissions factors is required to provide adequate justification.

While the proposed scheme is expected to comply with SAP 2012, the assessment presents total emissions using both factors. The revised factors are below:

Fuel Type	Carbon Factor (kg CO ₂ /kWh)	
	SAP 2012	SAP10
Natural Gas	0.216	0.210
Grid Electricity	0.519	0.233

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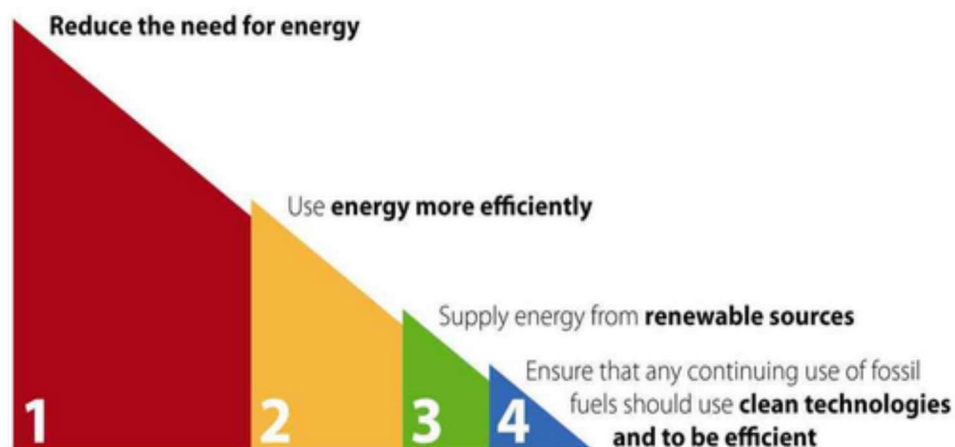
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The Energy Hierarchy

The proposed scheme has followed the energy hierarchy that is illustrated below:



GLA's Energy Hierarchy: Regulated carbon emissions Calculated using SAP 2012 carbon dioxide emission factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO ₂ emissions (tCO ₂ /yr)	13.15	11.61	–	5.46
CO ₂ emissions saving (tCO ₂ /yr)	–	1.54	–	6.16
Saving from each stage (%)	–	11.7	–	46.8
Total CO ₂ emissions saving (tCO ₂ /yr)	7.70			
58.5% total carbon emissions savings over existing building and Part L1A achieved (using SAP 2012 emission factors)				
GLA's Energy Hierarchy: Regulated carbon emissions Calculated using SAP10.0 carbon dioxide emission factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO ₂ emissions (tCO ₂ /yr)	11.86	10.13	–	2.45
CO ₂ emissions saving (tCO ₂ /yr)	–	1.73	–	7.68
Saving from each stage (%)	–	14.5	–	64.8
Total CO ₂ emissions saving (tCO ₂ /yr)	9.41			
80.0% total carbon emissions savings over existing building and Part L1A achieved (using SAP10.0 emission factors)				

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GLA's Energy Hierarchy: Regulated carbon emissions

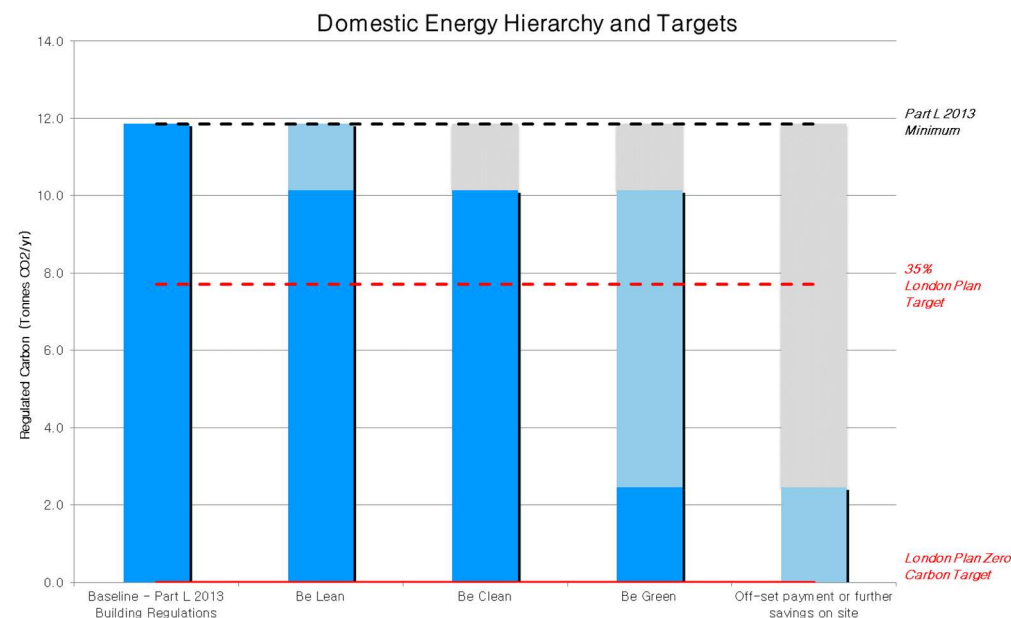
A graphical illustration of how the scheme performs in relation to Building Regulations and the Energy Hierarchy is shown below. Carbon dioxide emission factors for SAP10.0 have been used for the calculation.

Summary (SAP10.0 factors)

As demonstrated above the proposed scheme will reduce carbon emissions by 14.5% from the fabric energy efficiency measures described in the 'Be Lean' section and will reduce total carbon emissions by 80.0% over Building Regulations (using SAP10.0 carbon factors), with the further inclusion of the proposed ASHP and photovoltaic panels. **Therefore, the scheme meets and exceeds the target of overall 35% carbon reduction over Part L building Regulations as set out in The London Plan Policy SI2 and Haringey's policy SP4.**

In addition, each flat has the following space heating energy consumption.

Flat	Space heating (kWh/m ²)
Unit 1 – Block 1	14.39
Unit 2 – Block 1	10.14
Unit 3 – Block 1	18.11
Unit 1 – Block 2	11.20
Unit 2 – Block 2	10.54
Unit 3 – Block 2	9.86
Unit 4 – Block 2	10.15
Unit 5 – Block 2	14.17
Unit 6 – Block 2	14.34



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Total carbon emissions:

As required by the GLA both the regulated and unregulated emissions of the development must be quantified and demonstrated. The total emissions for the scheme are shown below.

Carbon Dioxide Emissions – Regulated and Unregulated (Tonnes CO ₂ /yr) SAP10.0			
	Regulated Emissions	Unregulated Emissions	Total Emissions
Baseline: Part L 2013	11.86	5.20	17.06
Be Lean: After demand reduction	10.13	5.20	15.33
Be Clean: After CHP	–	–	–
Be Green: After Renewable energy	2.45	5.20	7.65

Carbon Offset Payment Energy Assessment Cornwall Road

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Carbon offset

London plan policy SI2 and Haringey's policy SP4 requires carbon reductions to be achieved as far as possible on-site and a cash in lieu contribution will be considered acceptable only in instances where it has been clearly demonstrated that no further savings can be achieved on-site. The remaining savings to reach zero carbon can be achieved either on site or via a cash in lieu contribution, although savings on site are preferable.

The cumulative savings for offset payment and the cash-in-lieu contribution have been anticipated and tabulated below, using SAP10.0 carbon emission factors and an offset price of £95 per tonne.

	Annual CO ₂ for offset payment	Cumulative CO ₂ for offset payment (over 30 years)	Cash-in-lieu contribution (@£95/tonne)
Cornwall Road	2.45	73.51	£6,984

Methodology

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Aim of this study

The purpose of an energy assessment is to demonstrate that climate change mitigation measures comply with London Plan energy policies, including the energy hierarchy. It also ensures energy remains an integral part of the scheme's design and evolution.

Methodology

The methodology followed in this report follows the guidance set out by the Greater London Authority (GLA) for developing energy strategies as detailed in the document "ENERGY PLANNING: Greater London Authority guidance on preparing energy assessments". The scheme has been developed in accordance with the London Plan 2021.

Under the GLA's guidance (April 2020) applications for major developments should be accompanied by an energy statement. The energy statement should provide information demonstrating how the energy hierarchy has been followed i.e. 'Lean, Clean, Green', including consideration of passive design and decentralised energy options such as CHP/Community CHP.

This report has followed these documents and comprises the following components:

- **BASELINE:** A calculation of the Part L1A CO₂ emission baseline using approved software. The baseline assumes a gas boiler would provide heating and any active cooling would be electrically powered.
- **LEAN:** A calculation of the impact of demand reduction measures. For example, passive design measures, including optimising orientation and site layout, natural ventilation and lighting, thermal mass and solar shading, and active design measures such as high efficacy lighting and efficient mechanical ventilation with heat recovery.
- **COOLING HIERARCHY:** In accordance with London Plan Policy SI4, measures that are proposed to reduce the demand for cooling have been set out such as minimisation of solar and internal gains and night cooling strategies.
- **CLEAN:** In accordance with London Plan Policy SI3, this report has demonstrated how the scheme has selected heating, cooling and power systems to minimise carbon emissions. This comprises an evaluation of the feasibility of connecting to existing low carbon heat networks, planned networks, site-wide and communal heat networks, and CHP.
- **GREEN:** In accordance with London Plan Policy SI2, this report has conducted a feasibility assessment of renewable energy technologies. This comprised a site-specific analysis of the technologies and, if applicable, how they would be integrated into the heating and cooling strategy for the scheme.

Establishing Emissions: The Carbon Profile Energy Assessment Cornwall Road

Part L1A minimum compliance:

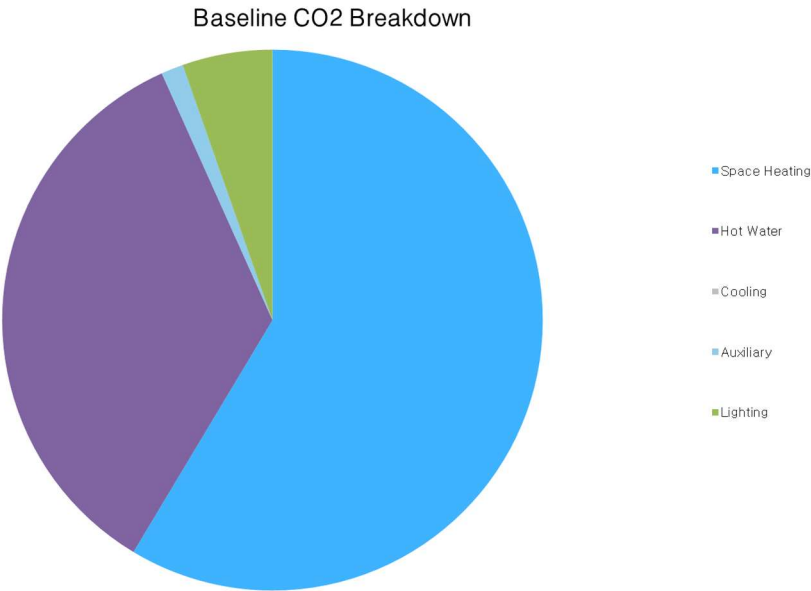
The total baseline carbon emissions for the whole scheme is 11.86 tonnes CO₂/yr (using SAP10.0 factors).

The pie chart provides a breakdown of the specific carbon emissions by system over the course of one year.

Overview

The chart shows that space heating is the primary source of carbon dioxide emissions, and hot water is the second largest, across the scheme as a whole.

	Heating	Hot Water	Cooling	Auxiliary	Lighting
Carbon Emissions in tonnes CO ₂ /yr.	6.95	4.11	0.00	0.16	0.64



'Be Lean': Demand Reduction Measures

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Be Lean: summary

Demand reduction measures have reduced the scheme's carbon emissions by 11.7% (using SAP 2012 figures) and by 14.5% (using SAP10.0 figures) over Part L1A baseline.

Building fabric: passive design measures

Element	Part L1A required U-value W/m ² K	Proposed / assumed U-value W/m ² K
Ground floor	0.25	0.11
Wall	0.30	0.14
Wall -Corridor	0.30	0.14
Roof	0.20	0.11
Window	2.00	1.3 (g-value 0.5)
Door	2.00	1.4
Air Permeability in m ³ /hr/m ² @ 50 Pa		
Whole Building	10	3

This will require careful attention to two key areas:

- Structural leakage
- Services leakage

Structural leakage occurs at joints in the building fabric and around window and door openings, loft hatches and access openings. There will also be some diffusion through materials such as cracks in masonry walls typically caused by poor perpends in blockwork inner leaf's. Structural leakage is hard to remedy retrospectively therefore good detailing at the design stage is essential.

Services leakage occurs at penetrations from pipes and cables entering the building. These can be sewerage pipes, water pipes and heating pipes. As well as electricity cables there may also be telecommunication cables. Attention, therefore, needs to be paid to sealing all penetrations during construction.

Thermal Bridging:

The scheme will be designed in line with the accredited construction details (ACD) and therefore it has been indicatively modelled with the accredited thermal bridge Psi-values for the following junctions:

- Lintels (E2)
- Sill (E3)
- Jambs (E4)
- Ground floor (E5)
- Party floor between dwellings (E7)
- Corners (E16)
- Corners inverted (E17)

A bespoke thermal bridging calculation will be required for the following junctions in order to achieve the specified Psi-values:

- Flat Roof with Parapet (E15); 0.30 W/mK
- Balcony (E23); 0.30 W/mK

The default psi-value has been used for the remaining junctions.

Thermal Mass:

Thermal mass of the scheme has been indicatively modelled as 250 kJ/m²K (medium).

'Be Lean': Demand Reduction Measures

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Heating:

For the 'Be Lean' scenario, the scheme has been modelled with a gas boiler with an efficiency of 89.5% (as required by the GLA).

For the 'Be Green' final scenario, an air source heat pump with a minimum COP of 2.90 will be proposed as the main heating system. Heat will be provided via radiators and will be controlled with a charging system linked to use of community with programmer and TRVs.

Hot Water:

For the 'Be Lean', the hot water will be provided by the main gas heating system (gas boilers with an efficiency of 89.5%).

For the 'Be Green' final scenario, hot water will be provided by the air source heat pump, with a minimum COP of 2.90. A top-up electric immersion heater will provide less than 20% of the hot water demand.

Ventilation:

Mechanical ventilation with heat recovery has been specified for the apartments. All apartments contain one toilet. Therefore, each dwelling has been modelled with a SFP of 0.53 W/l/s and a heat recovery efficiency of 89%.

Cooling:

Cooling has not been specified for the development.

Lighting:

High efficiency lighting has been specified for the dwellings with a minimum efficacy of 75 lumens/W.

Equipment:

All appliances will have a minimum rating of A+.

Controls:

The proposed scheme sets out to address demand side response to energy efficiency, including smart meters, to provide more consumption data to inform control which will allow the running of some equipment at a lower capacity during times of peak demand. The design team will also explore the possibility of energy storage, smart controls, to optimise heating and power systems at a later stage of the project.

Energy demand following energy efficiency measures (MWh/year)						
Space Heating	Hot water	Lighting	Auxiliary	Cooling	Unregulated gas	Unregulated electricity
23.9	19.6	2.7	1.5	0.0	0.0	11.6

Target Fabric Energy Efficiency (MWh/year)	Design Fabric Energy Efficiency (MWh/year)	Improvement (%)
39.66	33.16	16%

'Be Lean': Heating Infrastructure & CHP Energy Assessment Cornwall Road

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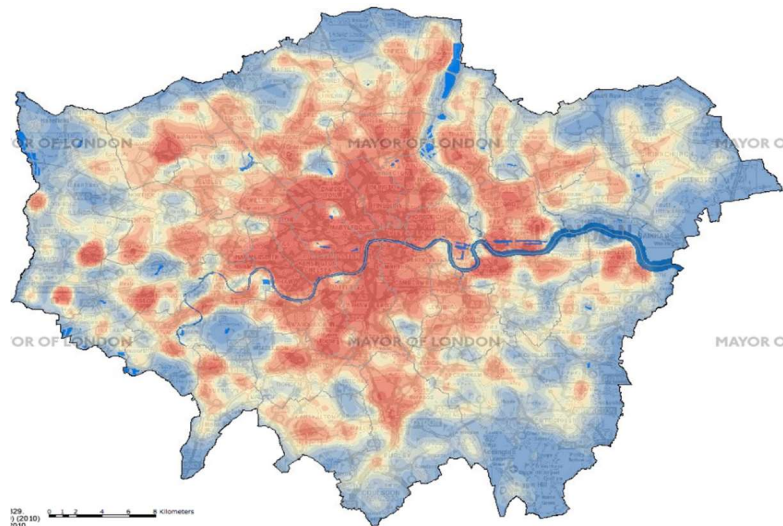
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Heating infrastructure including CHP

Once demand for energy has been minimised, schemes must demonstrate how their energy systems have been selected in accordance with the order of preference in London Plan Policy SI3. This has involved a systematic appraisal of the potential to connect to existing or planned heating networks and on site communal and CHP systems.

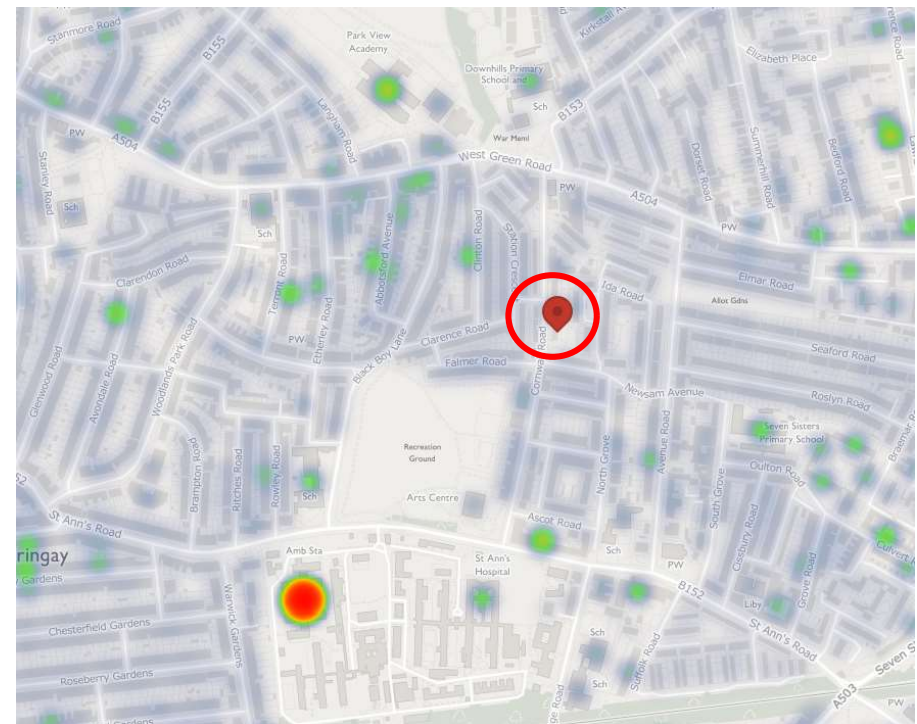
Heating infrastructure

The London Heat Map (shown below) has been consulted to establish the possibility of connecting to heating infrastructure.



Existing and planned networks

A review of the London Heat Map demonstrates that there are no existing networks present within the connectable range of the scheme. A map of the existing and potential networks in the scheme's location is shown below.



There are no existing or potential networks within the vicinity of the scheme as per the London Heat Map, therefore a connection is not possible.

‘Be Clean’: Site Wide Networks and CHP Energy Assessment Cornwall Road

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Site-wide heat networks

In accordance with section 8.2 of the GLA guidance for Energy Planning, where it is demonstrable that a site wide network is not feasible then an individual heating strategy can be implemented. A site-wide communal heating system has been adopted for the proposed development.

Combined Heat and Power (CHP)

In accordance with section 8.3 of the GLA guidance for Energy Planning where connection to an area wide heat network will not be available in the foreseeable future i.e. 5 years following completion, or the development is of such a scale that it could be the catalyst for an area wide heat network, applicants should evaluate the feasibility of on-site CHP

GLA guidance stipulates that small, or purely residential developments of less than 350 dwellings will not be expected to include on-site CHP. CHP systems are best utilised where there is a consistent and high demand for heat. Because of the small electricity supplies and demand of this scheme, a CHP installed to meet the base heat load would typically require the export of electricity to the grid. The administrative burden of managing CHP electricity sales at a small scale without an active energy service companies (ESCOs) is prohibitive for smaller operators of residential developments.

The heat demand profile of this scheme is not suitable to CHP. The implemented fabric improvements from the ‘Be Lean’ scenario have also reduced the energy demand from space heating to hot water. For CHP systems to be economically viable they need to run for at least 5,000 hours per year. Therefore, a CHP system would most likely be oversized, and as a result less efficient and economic.

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Overheating and cooling

The aim of this section is to reduce the impact of the urban heat island effect in London and encourage the design of spaces to avoid overheating and excessive heat generation, and to mitigate overheating due to the impact of climate change.

Where design measures and the use of natural and/or mechanical ventilation are not enough to guarantee the occupant's comfort, in line with the cooling hierarchy the development's cooling strategy must include details of the active cooling plant being proposed, including efficiencies, and the ability to take advantage of free cooling and/or renewable cooling sources.

Where appropriate, the cooling strategy should investigate the opportunities to improve cooling efficiencies through the use of locally available sources such as ground cooling and river/dock water-cooling.

The Cooling Hierarchy

Major developments should reduce potential overheating and reliance on air conditioning systems and demonstrate this with the Cooling Hierarchy:

- 
1. Minimise internal heat generation through energy efficient design
 2. Reduce the amount of heat entering the building in summer (e.g. shading and fenestration)
 3. Manage the heat within the building through thermal mass, room height and green roofs
 4. Passive ventilation
 5. Mechanical ventilation
 6. Active cooling systems (ensuring the lowest carbon option)

Avoiding overheating: measures taken

The following measures have been taken in accordance with the cooling hierarchy to reduce overheating and the need for cooling:

1. Minimise internal heat generation through energy efficient design

Internal heat gains have been minimised where possible. Energy efficient appliances with A+ rating, will help reduce internal heat gain.

Energy efficient lighting will also be specified with an average lumen efficacy of more than 75 lumens per circuit watt for the development.

2. Reduce the amount of heat entering the building in summer (e.g. shading and fenestration)

Direct solar gains will be controlled in the following ways:

- Light-coloured reflective blinds will be specified to limit solar gain to all spaces.
- Solar control: The type of glazing has been optimised and reduced solar gain factors from low emissivity windows with a g-value of 0.5 have been specified for building.

Heat transfer and infiltration of the new build envelope has been controlled in the following ways:

- Insulation levels have been maximised for the new elements and the proposed resulting U-values are lower than required by Building Regulations. The build-ups therefore prevent the penetration of heat as much as practically possible. See the 'Be Lean' section of this report for target U-values.
- A reduced air permeability rate of $3 \text{ m}^3/(\text{hr.m}^2) @ 50 \text{ Pa}$ has been targeted for the development to minimise uncontrolled air infiltration. This will require attention to detailing and sealing. See 'Be Lean' section of this report for details of how this will be achieved.

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Avoiding overheating: measures taken (continued)

3. Manage the heat within the building through thermal mass and room height.

The following measures have been specified to manage heat accumulation within the building:

- Room heights – The proposed building has floor to ceiling heights of approximately 2.5m or higher. As the roof will be well insulated to achieve a U-value of 0.11 W/m²K, there will be minimal penetration of heat through the roof.
4. High thermal mass: dense building fabric materials such as concrete floors and masonry external walls have been specified. These materials act as 'thermal batteries'; they absorb heat gains during the day when the building is occupied and 'store' it for an extended period, thereby helping to stabilise daytime temperatures. At night this heat can be dissipated, which 'resets' the heating cycle. A 'ground coupled' system that uses the thermal storage capacity of the ground has not been specified as a passive ventilation approach has been selected instead.
5. Passive ventilation: Natural ventilation has been maximised wherever possible, with dual aspect rooms and at least two fully openable windows.
- Cross ventilation will be achieved by opening windows on two facades and ensuring there is a clear path for airflow.
 - Night time passive cooling will also be utilised. This will work in tandem with high thermal mass materials specified. The larger temperature differential that exists between internal and external temperatures at night will allow effective stack ventilation and purging of heat accumulated within the structure during the day.

6. Mechanical ventilation: Passive ventilation will not be adequate to cool then building to the required temperature. Mechanical ventilation will be utilised in the following forms:
- The mechanical systems will have the following efficiencies which are in compliance with the Domestic Building Services Compliance Guide
 - The apartments contain one toilet and have been modelled with an SFP of 0.53 W/l/s and a heat recovery efficiency of 89%.

Overheating risk

The overheating risk considering all the above described passive measures have been assessed for the scheme:

Areas	Overheating risk from SAP
Unit 1 – Block 1	Medium
Unit 2 – Block 1	Medium
Unit 3 – Block 1	Slight
Unit 1 – Block 2	Slight
Unit 2 – Block 2	Slight
Unit 3 – Block 2	Slight
Unit 4 – Block 2	Slight
Unit 5 – Block 2	Slight
Unit 6 – Block 2	Slight

According to the GLA guidance on preparing energy assessments (April 2020) Section 9, a dynamic modelling to assess the risk of overheating should be carried out. This has been undertaken as a separate report by Eight Associates (July 2020) and confirms that all rooms comply with TM 59.

'Be Green': Renewable Energy

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Renewable energy feasibility

In line with London Plan Policy SI2, the feasibility of renewable energy technologies has been considered. A detailed site-specific analysis and associated carbon saving calculations has also been provided for renewable energy technologies considered feasible.

Renewable energy technology comparison

Each technology has been assessed under 5 broader categories. There are key criteria for each category on which the technology is evaluated. The key criteria have been given a weighting based on a tick-system, a graphical representation of this is shown below:

✓✓✓✓✓ = 1 scored out of a possible 5

The weighting of each of the criteria within the categories is shown below:

- Local, site-specific impact: (Maximum score of 4)
 - Local planning criteria = ✓✓
 - Land used by all components = ✓
 - Noise impact from operation = ✓
- Suitability and design impact: (Maximum score of 4)
 - Interaction on the current building design = ✓✓
 - Building orientation suitability = ✓
 - Buildability of installation = ✓
- Economic viability: (Maximum score of 5)
 - Capital cost of all components = ✓✓
 - Grants and funding available = ✓
 - Payback periods (years) 3-5, 5-10, 10-15 = ✓✓

- Operation and maintenance: (Maximum score of 3)
 - Servicing requirements (low or high) = ✓
 - Maintenance costs (low or high) = ✓
 - Resource use from future maintenance (low or high) = ✓
- CO₂ and sustainability: (Maximum score of 10)
 - Carbon saving per year = ✓✓✓✓
 - Impact of future grid decarbonisation (gas vs. electric) = ✓✓
 - Local air quality/pollution = ✓✓
 - Resource use of installation = ✓✓

Key comments on each of the criteria and the corresponding score will be provided in a table (example below) for each of the technologies. The score for each of the criteria will be summed and each of the technologies will then be ranked. The assessment of each technology is undertaken on the following pages.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓
					✓✓✓✓✓

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Biomass & Biofuel – Rejected

Biomass is normally considered a carbon 'neutral' fuel, as the carbon dioxide emitted on burning has been recently absorbed from the atmosphere by photosynthesis. Although some form of fossil fuel derived inputs is required in the production and transportation of the fuel.

Wood is seen as a by-product of other industries and the small quantity of energy for drying, sawing, pelleting and delivery are typically discounted. Biomass from coppicing is likely to have external energy inputs from fertiliser, cutting, drying etc. and these may need to be considered. In this toolkit, all biomass fuels are considered to have zero net carbon emissions.

Biomass can be burnt directly to provide heat in buildings. Wood from forests, urban tree pruning, farmed coppices or farm and factory waste, is the most common fuel and is used commercially in the form of wood chips or pellets. Biomass boilers can also be designed to burn smokeless to comply with the Clean Air Acts.

Boilers can be fed automatically by screw drives from fuel hoppers. This typically involves daily addition of bagged fuels.

A biomass boiler could be installed on site for supplementary LTHW heating; however, a major factor influencing the suitability of a biomass boiler is the availability of the biomass fuel. A local and reliable fuel source would be essential for the biomass boiler to be an efficient replacement for a conventional boiler system. Therefore, a very comprehensive feasibility assessment needs to be undertaken to understand the practicalities of such a system.

It is estimated that the heating and hot water demand of the site is too large to meet the required CO₂ emissions reduction if a biomass boiler was a standalone system. Therefore, a biomass boiler would need to be combined with energy demand reduction measures and/or CHP. In order to meet the 35% CO₂ emissions reduction a biomass boiler would need to be installed. The likely installed cost would be

circa £20,000. The additional cost of providing and storing the biofuel also needs to be accounted for. The site is likely to be unsuitable for biomass boilers due to site constraints such as limited space for storage of the biomass fuel. A detailed feasibility study would be required to investigate the suitability.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
Biomass Boiler	 Local air quality impacts, increased transport usage on the restricted site, increased plant space.	 Increase in plant space required, orientation fine, slightly increased buildability issues.	 Increased capital costs of installation, typical payback of 8 years	 Increased maintenance relative to gas boiler, resource use not significantly increased if well serviced.	  Very low carbon intensity of feedstock if properly procured. Decarbonisation impact not applicable, air quality issues.

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Photovoltaic Panels (PV) – Accepted

Photovoltaic systems convert energy from the sun into electricity through semi-conductor cells. Systems consist of semi-conductor cells connected and mounted into modules. Modules are connected to an inverter to turn the direct current (DC) output into alternating current (AC) electricity for use in buildings.

Photovoltaic panels supply electricity to the building and are attached to electricity grid or to any other electrical load. Excess electricity can be exported to the National Grid when the generated power exceeds the local need. PV systems require only daylight, not sunlight to generate electricity (although more electricity is produced with more sunlight), so energy can still be produced in overcast or cloudy conditions.

The cost of PV cells is heavily dependent on the size of the array. There are significant cost reductions available for larger installations.

The most suitable location for mounting photovoltaic panels is on roofs as they usually have the greatest exposure to the sun. However, a significant portion of the roof will be required for the location of the ASHPs. It is proposed to have four PV panels with a peak output of 0.33kWp each per unit. This equates to 3.96kWp (20.4m²) for Block 1 and 7.92kWp (40.8m²) for Block 2.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
Photovoltaic	 No local air quality impacts, use of unutilised roof space, no noise issues.	 Can be added to the roof, good orientation, and slightly increased buildability issues for wiring and metering.	 Increased capital costs of installation, typical payback of 8–10 years, Feed in Tariff available.	 Limited servicing and maintenance i.e. 1 visit per year, inverter will require replacement.	 High carbon saving from electricity, uses minimal grid electricity, no local air impact, high embodied energy of panels.

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Solar Thermal – Rejected

Solar water heating systems use the energy from the sun to heat water for non-domestic hot water needs. The systems use a heat collector, generally mounted on the roof in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate hot water cylinder or a twin coil hot water cylinder inside the building. The systems work very successfully in all parts of the UK, as they can work in diffuse light conditions.

Like photovoltaic panels the most suitable location for mounting solar hot water panels is on roofs as they usually have the greatest exposure to the sun.

It is estimated that the CO2 emissions reduction that would be produced by solar hot water as a standalone system would not be adequate to achieve the required CO2 emissions reduction target. Therefore, a solar hot water system would need to be combined with more energy efficiency strategies, a CHP or additional renewable technologies to achieve the carbon reduction target. Therefore, solar thermal system has not been specified.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
Solar Thermal	✓✓✓✓ No local air quality impacts, use of unutilised roof space, no noise issues.	✓✓✓✓ Can be added to the roof, good orientation, and slightly increased buildability issues for piping and cylinders.	✓✓✓✓ Increased capital costs of installation, typical payback of 8 years, Renewable Heat Incentive available.	✓✓✓ Limited servicing and maintenance i.e. 1 visit every two years, heat transfer fluid requires replacing every 10 years.	✓✓✓✓✓ Lower carbon saving as primarily displacing gas, uses minimal grid electricity, no local air impact, medium embodied energy of panels.

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Wind Energy – Rejected

Wind energy is a cost-effective method of renewable power generation. Wind turbines can produce electricity without carbon dioxide emissions in ranges from watts to megawatt outputs. The most common design is for three blades mounted on a horizontal axis, which is free to rotate into the wind on a tall tower.

The blades drive a generator either directly or via a gearbox to produce electricity. The electricity can either be linked to the grid or charge batteries. An inverter is required to convert the electricity from direct current (DC) to alternating current (AC) for feeding into the grid.

Modern quiet wind turbines are becoming viable in low density areas where ease of maintenance and immediate connection to the grid or direct use of the electricity in a building, may make them cost effective, despite lower wind speeds than open areas.

Wind turbines are generally less suited to dense urban areas as their output will be affected by potentially lower and more disrupted wind speeds, and their use of much more cost-effective machines may be prohibited by their proximity to some building types. Small turbines can be used in inner city areas mounted on buildings, although there are relatively few installations.

Typically, a 2kW turbine can provide 4,000 kWh of electrical power annually. To achieve the required CO₂ emissions reduction target approximately 2kW would be required as a standalone solution. The indicative cost of multiple smaller roof mounted turbine is £2,500/kW so achieving the required CO₂ emissions reduction would cost approximately £5,000.

A detailed wind resource evaluation would be required for the site to fully understand the generation potential and payback period. Also, it is likely that planning restrictions and resistance from groups within the local community could also dramatically affect the viability of wind energy for the project. Therefore, wind energy is not considered viable for this scheme.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
Wind Energy	✓✓✓✓ No local air quality impacts, use of unutilised roof space, minor noise issues.	✓✓✓✓✓ Can be added to the roof, relatively limited wind speeds in local area, increased buildability issues for wiring and metering.	✓✓✓✓✓ Medium capital costs of installation, typical payback of 5 years, Feed in Tariff available.	✓✓✓ Limited servicing and maintenance, costs of 2–3% typical.	✓✓✓✓✓ ✓✓✓✓✓ High carbon saving from electricity, output limited from urban installation, consumes little grid electricity, no local air impact, low embodied energy of panels.

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Ground Source Heat Pump – GSHP – Rejected

Geo-thermal energy is essentially heat collected from the ground. Heat obtained from the ground may be considered it as a source of heating and cooling within the UK by the use of a geo-thermal heat pump or ground source heat pumps.

A ground source heat pump is a device for converting energy in the form of low-level heat to heat at a usable temperature. The heat pump consists of five main parts: ground collector loop/or bores, heat exchanger, compressor, condenser heat exchanger and expansion valve.

At approximately 1.2–1.5 metres down below ground level the temperature is a constant 10 to 12°C. Any bores would need to be sunk to an effective depth of 50 – 120m and a ground feasibility report would be required to ascertain if this method of heat source were viable.

From the bores pre-insulated pipework is laid in the ground to the heat exchanger device. The system is filled with water and antifreeze. The cooled water is pumped around the loop / bore gathering energy as it circulates. The water that has been heated to 10–12°C is returned to the ground source heat exchanger where the energy is transferred to the refrigerant gas. For every 1kW of energy used to compress the refrigerant, the process 'gives up' 4 kW of energy for use in the system being used to heat the building.

Typical costs for an installation of this scale are in the region of £100,000 with general installation costs being approx. £1500–2000 /kW of energy produced.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
GSHP	 No local air quality impacts, not visible so conservation friendly, no noise issues, however the constrained site may prohibit its installation.	 Increased buildability issues for pipework and heating emitters internally.	 High capital costs of installation, typical payback of 15 years where gas is displaced, Renewable Heat Incentive available.	 Limited servicing and maintenance i.e. 1 visit per year, mechanical parts may require replacement over lifespan.	  Limited carbon saving from gas displacement, consumes some electricity so benefits from decarbonisation, no local air impact, high embodied energy of equipment.

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Air Source Heat Pump – Accepted

Air source heat pump systems work on the same principle as a ground source heat pump although they use the outside air as the heat source.

The coefficients of performance given by air source heat pump systems are inferior to that of ground source systems due to varying air temperatures. In the depth of winter, the energy efficiency of an air source system will be lower than that of a ground source system, and it is likely that more back-up heat will be required if an air source unit is fitted. This back-up heat often comes from a direct electric heater. They operate over a varying temperatures range of -15°C to $+25^{\circ}\text{C}$, however, the performance will reduce to below the required 3 to 1 carbon saving ratio in winter, and they also require a defrosting mechanism to melt ice that forms on the air heat exchanger.

ASHPs are cheaper to install than ground source heat pumps but carbon dioxide emission savings will typically be less than that of a ground source heat pump. Typical costs for an installation of this scale are in the region of £60,000.

Air source heat pumps would provide a suitable HVAC solution for commercial spaces, such as offices which have relatively low heating demands as well as a regular need for cooling given the higher internal gains of these use classes. Having a system which is able to both, heat and cool provides versatility and reduces the amount installed plant.

The residential space has a relatively large domestic hot water demand which could be met with heat pumps if combined with another heating source to achieve the required DHW temperatures. The scheme could meet 80% of its hot water heating consumption via air source heat pumps, with the remaining 20% demand being met by electric immersion heater. Long-term plant coverage should be maximised through either of the seeded or 'biodiverse' roof types, to maximise the evapotranspiration performance of the green roof. It is acknowledged that the 'biodiverse' roof type would result in an initial lack of plant coverage but would be achieved once the indigenous plant species become established.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability
ASHP	 No local air quality impacts, use of unutilised roof space, over visual impact, no noise issues.	 Can be added to the roof, good airflow on roof, increased buildability issues for pipework and heating emitters internally.	 Medium-high capital costs of installation, typical payback >15 years where gas is displaced, Renewable Heat Incentive available.	 Limited servicing and maintenance i.e. 1 visit per year, mechanical parts may require replacement over lifespan.	 Limited carbon saving from gas displacement, less efficient in winter, consumes electricity so benefits from decarbonisation, no local air impact, high embodied energy of equipment.

'Be Green': Summary of Renewable Technologies Energy Assessment Cornwall Road

Summary comparison matrix

An assessment of the feasibility of each of the technologies is shown below.

Renewable Technology	Local, site-specific impact	Suitability and design impact	Economic viability	Operation and maintenance	CO ₂ and sustainability	Total Score
Biomass Boiler	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓ ✓✓✓✓✓	14 out of 26
Photovoltaic	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓ ✓✓✓✓✓	18 out of 26
Solar Thermal	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓ ✓✓✓✓✓	17 out of 26
Wind Energy	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓ ✓✓✓✓✓	14 out of 26
GSHP	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓ ✓✓✓✓✓	15 out of 26
ASHP	✓✓✓✓	✓✓✓✓	✓✓✓✓✓	✓✓✓	✓✓✓✓✓ ✓✓✓✓✓	17 out of 26

Renewable technology conclusion & specifications

Photovoltaic panels, solar thermal panels and air source heat pumps have scored the best. It is assumed that wind energy would be considered unsuitable for the area and that the local residents would raise concerns over potential noise and turbulence.

Air source heat pumps have scored well due to their economic viability, low maintenance after installation, but primarily their CO₂ reduction potential. After the initial investment is made these systems keep the running costs to a minimum. Also, ASHP provides more versatility as it can provide both heating and hot water for this scheme.

Air source heat pumps and photovoltaic panels have been proposed for the scheme.

'Be Green': ASHP

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Air Source Heat Pump

A detailed summary of the lifecycle cost, revenue, and payback for ASHP is given below.

Lifecycle Cost

The lifecycle of the proposed system is 25 years. To calculate the lifecycle cost of the ASHP, the maintenance of the system and cost of electricity to run the pumps will be included.

Revenue and payback parameters

The following tables summarise the reduction in carbon emissions and the life cycle cost of the ASHP system compared to a gas boiler.

Proposed System		
	Heating + Hot Water	Heating + Hot Water
System Type	Gas Boiler	Air Source Heat Pump
Installation Cost	15,000	60,000
Maintenance and replacement cost	15,000	10,000
Total	30,000	70,000
Extra Over cost:	40,000	

The heating system has been modelled to supply both the heating and the hot water demand. The scheme has a total heating and hot water demand of 52,683 kWh per year using a gas boiler. The cost of gas is 5 p/kWh; therefore, the annual operational cost would be £2,634. With the use of an air source heat pump with 2.90 COP, the heating and hot water demand is reduced to 16,386 kWh per year. The cost of electricity is 13 p/kWh, therefore the annual operational cost would be £2,048

It should be noted that the figures above are based on SAP modelling for CO₂ compliance. Compliance models are not well suited to investment appraisals because they do not accurately estimate energy consumption. It is estimated that the lifecycle saving for ASHP will be greater than boiler under 'real-life' operating conditions and consumption.

Moreover, the servicing strategy has been proposed based on sustainability aspirations and compliance with GLA requirements, which is intended to supersede simple economic payback appraisals for purposes of energy strategies.

Summary performance calculations

Cost Performance Criteria	Value
Extra Cost Over Life Cycle (£)	40,000
Predicted Annual Savings (£)	586
Payback Period (years)	68.3

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Photovoltaic panels

A photovoltaic panel system of 11.88 kWp (36 panels of 330W each) has been specified for the whole development, a detailed summary of the lifecycle cost, revenue and payback for the photovoltaic panels is presented in this section.

Location

There are 196m² of available roof. The proposed PV panel system will cover a total of 61.2m². PV panels will be located on the flat roof, facing south with 30 degrees tilt, as shown in the image.

Lifecycle Cost

The lifecycle of the proposed high efficiency panels is 25 years. To calculate the lifecycle cost of the panels, the maintenance of the system and replacement cost will be included. The total costs for the proposed system's lifetime are:

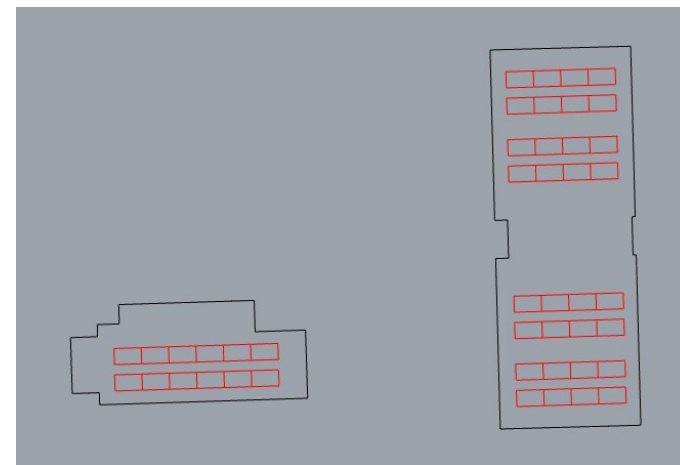
- Capital cost = £14,300
- Maintenance cost = £1,900
- Operational costs = £600
- Total costs = 16,800

Revenue and payback parameters

- The cost of electricity to be displaced is 12.5p/kWh.
- The 11.88 kWp system is estimated to generate 10,260 kWh/yr. Based on the assumption that 50% of the electricity will be used on site, an offset savings of £641/year will be achieved.
- With the current system, a tariff of 5.38p/kWh will be received for export, which gives an additional savings of £276.

Summary performance calculations

Energy and Carbon Performance Criteria	Value
Predicted Annual Energy Saved (kWh/yr)	10,260
Annual Carbon Emissions Reductions (kg CO ₂ /year) using SAP10.0.0 carbon factors	2,391
CO ₂ Emissions Reduction (%) with SAP10.0.0	20.2%
Cost Performance Criteria	Value
Extra Cost Over Life Cycle (£)	16,800
Predicted Annual Savings (£)	917
Payback Period (years)	18.3



Annual Cost

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Controls

The proposed scheme sets out to address demand side response to energy efficiency, including smart meters, to provide more consumption data to inform control which will allow the running of some equipment at a lower capacity during times of peak demand. The design team will also explore the possibility of smart controls, to optimise heating and power systems at a later stage of the project.

Running costs

Maximum operational energy expenses come from heating and hot water. The scheme is being serviced by a system breakup of 80% hot water demand being met by air source heat pumps and 20% from electric immersion heater.

The scheme wide demand figures below have been derived from SAP file

Electricity demand	kWh/year
Heating	7,434
Hot water	8,952
Lighting	2,744
Auxiliary	1,647
Electricity generation (PV panels)	-10,260
Unregulated	11,572
Total	22,089
Fuel	Price
Electricity	13p/kWh
Fuel	Cost/year
Electricity	£2,872
Annual cost per flat	£319 /flat/year

Conclusion

Energy Assessment

Cornwall Road

Summary

The baseline carbon emissions for the whole scheme are 13.15 tonnes CO₂/yr (using SAP 2012 carbon dioxide emission factors) and 11.86 tonnes CO₂/yr (using SAP10.0 carbon dioxide emission factors).

As demonstrated, the scheme will reduce carbon emissions by 58.5% (using SAP 2012 carbon dioxide emission factors) and 80.0% (using SAP10.0 carbon dioxide emission factors) over existing building and Part L1A, with the further inclusion of the proposed ASHP and photovoltaic panels.

Therefore, the scheme meets Building Regulations and exceeds the target of 35% carbon reduction over Part L building Regulations as set out in London Plan Policy SI2 and Haringey's policy SP4.

The carbon offset payment to meet zero carbon is £6,984.

GLA's Energy Hierarchy: Regulated carbon emissions Calculated using SAP 2012 carbon dioxide emission factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO ₂ emissions (tCO ₂ /yr)	13.15	11.61	–	5.46
CO ₂ emissions saving (tCO ₂ /yr)	–	1.54	–	6.16
Saving from each stage (%)	–	11.7	–	46.8
Total CO ₂ emissions saving (tCO ₂ /yr)		7.70		
58.5% total carbon emissions savings over existing building and Part L1A achieved (using SAP 2012 emission factors)				
GLA's Energy Hierarchy: Regulated carbon emissions Calculated using SAP10.0 carbon dioxide emission factors				
	Baseline:	Be lean:	Be clean:	Be green:
CO ₂ emissions (tCO ₂ /yr)	11.86	10.13	–	2.45
CO ₂ emissions saving (tCO ₂ /yr)	–	1.73	–	7.68
Saving from each stage (%)	–	14.5	–	64.8
Total CO ₂ emissions saving (tCO ₂ /yr)		9.41		
80.0% total carbon emissions savings over existing building and Part L1A achieved (using SAP10.0 emission factors)				

Appendix A – Input Sheet

Energy Assessment

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Building fabric: passive design measures

Element	Part L1A required U-value W/m ² K	Proposed / assumed U-value W/m ² K
Ground floor	0.25	0.11
Wall	0.30	0.14
Wall – Corridor	0.30	0.14
Roof	0.20	0.11
Window	2.00	1.3 (g-value 0.5)
Door	2.00	1.4
Air Permeability in m ³ /hr/m ² @ 50 Pa		
Whole Building	10	3

Thermal Bridging:

The scheme will be designed in line with the accredited construction details (ACD) and therefore it has been indicatively modelled with the accredited thermal bridge Psi-values for the following junctions:

- Lintels (E2)
- Sill (E3)
- Jambs (E4)
- Ground floor (E5)
- Party floor between dwellings (E7)
- Corners (E16)
- Corners inverted (E17)

A bespoke thermal bridging calculation will be required for the following junctions in order to achieve the specified Psi-values:

- Flat Roof with Parapet (E15); 0.30 W/mK
- Balcony (E23); 0.30 W/mK

The default psi-value has been used for the remaining junctions.

Thermal Mass:

Thermal mass of the scheme has been indicatively modelled as 250 kJ/m²K (medium).

Ventilation:

Mechanical ventilation with heat recovery has been specified for the apartments. All apartments contain one toilet. Therefore, each dwelling has been modelled with a SFP of 0.53 W/l/s and a heat recovery efficiency of 89%.

Heating:

Air source heat pump with a minimum COP of 2.90 will be proposed as the main heating system. Heat will be provided via radiators and will be controlled with a charging system linked to use of community with programmer and TRVs.

Hot Water:

Hot water will be provided by the air source heat pump, with a minimum COP of 2.90. A top-up electric immersion heater will provide less than 20% of the hot water demand.

Lighting:

High efficiency lighting has been specified for the dwellings with a minimum efficacy of 75 lumens/W.

Cooling

No cooling specified.

Photovoltaic panels

36 PV panels in total with a peak output of 0.33kWp per panel located on the flat roof facing south with 30°C.

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Further information

The emission figures and details of the calculations and methodology used to determine the figures provided within the report can be found in the following pages:

Baseline domestic – TER from the TER SAP worksheet

Be Lean domestic – DER from the Be Lean scenario DER SAP worksheet

Be Green domestic – DER from the Be Green scenario DER SAP worksheet

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Baseline –Domestic

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Be Lean –Domestic

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Be Green –Domestic
