ENERGY STATEMENT FOR
55 FITZROY PARK, HIGHGATE,
LONDON, N6 6JA.

blyth+blyth

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THIS DOCUMENT HAS BEEN REVIEWED FOR COMPLIANCE WITH PROJECT REQUIREMENTS IN ACCORDANCE WITH BLYTH & BLYTH QUALITY ASSURANCE OPERATIONAL PROCEDURES.

CONTENTS

1 EXECUTIVE SUMMARY

This energy statement has been prepared by Blyth and Blyth in support of a planning application submitted on behalf of Geoffrey and Ryan Springer and Lynne Turner-Stokes MBE for the demolition of the existing property and the construction of five detached homes at 55 Fitzroy Park, Highgate, London, N6 6JA.

This statement has been produced according to the London Plan energy hierarchy: **Be Lean**, **Be Clean**, and **Be Green** and the London Borough of Camden Core Strategy and supporting documentation.

The energy strategy proposed for the development aims to maximise the reductions in CO_2 through the application of the hierarchy, whilst ensuring and considering the specific requirements of the proposed development and the local area.

Be Lean and Be Clean energy efficiency design measures will be applied to the development as described within the relevant section of the report. These contribute to substantial CO_2 reductions in providing a Part L1A Building Regulation compliant development and reduces the estimated CO_2 emissions by 10.1%.

A **Be Green** strategy has been evaluated. It is concluded that the use of Photovoltaic (PV) panels is the only practical and feasible option to utilised on the green roof areas of the development. The use of PV panels reducing the estimated CO_2 emissions by a 61.8%.

Utilising the **Be Lean, Be Clean** and **Be Green** ethos contributes in achieving a 71.9% reduction as compared with a Building Regulations 2013 compliant building.

In line with GLA Zero Carbon policy, the remaining regulated emissions are to be offset using a cash in lieu contribution to the Camden Zero Carbon fund. The current offset price is £60/tonne/year based on 30 years, therefore equal to £1800 per tonne.

Following the efficiency and renewable strategy detailed herein, the scheme is predicted to result in regulated emissions of 5.777 metric tonnes carbon per annual. Therefore, the Zero Carbon Fund contribution will be £10,398.60.

The Energy Strategy seeks to demonstrate commitment to a sustainable development and to provide CO_2 reductions through compliance with Building Regulations 2013 Part L1A and CO_2 reductions sufficient to satisfy Planning Conditions.

Figure 1: The Energy Hierarchy for the Proposed Development

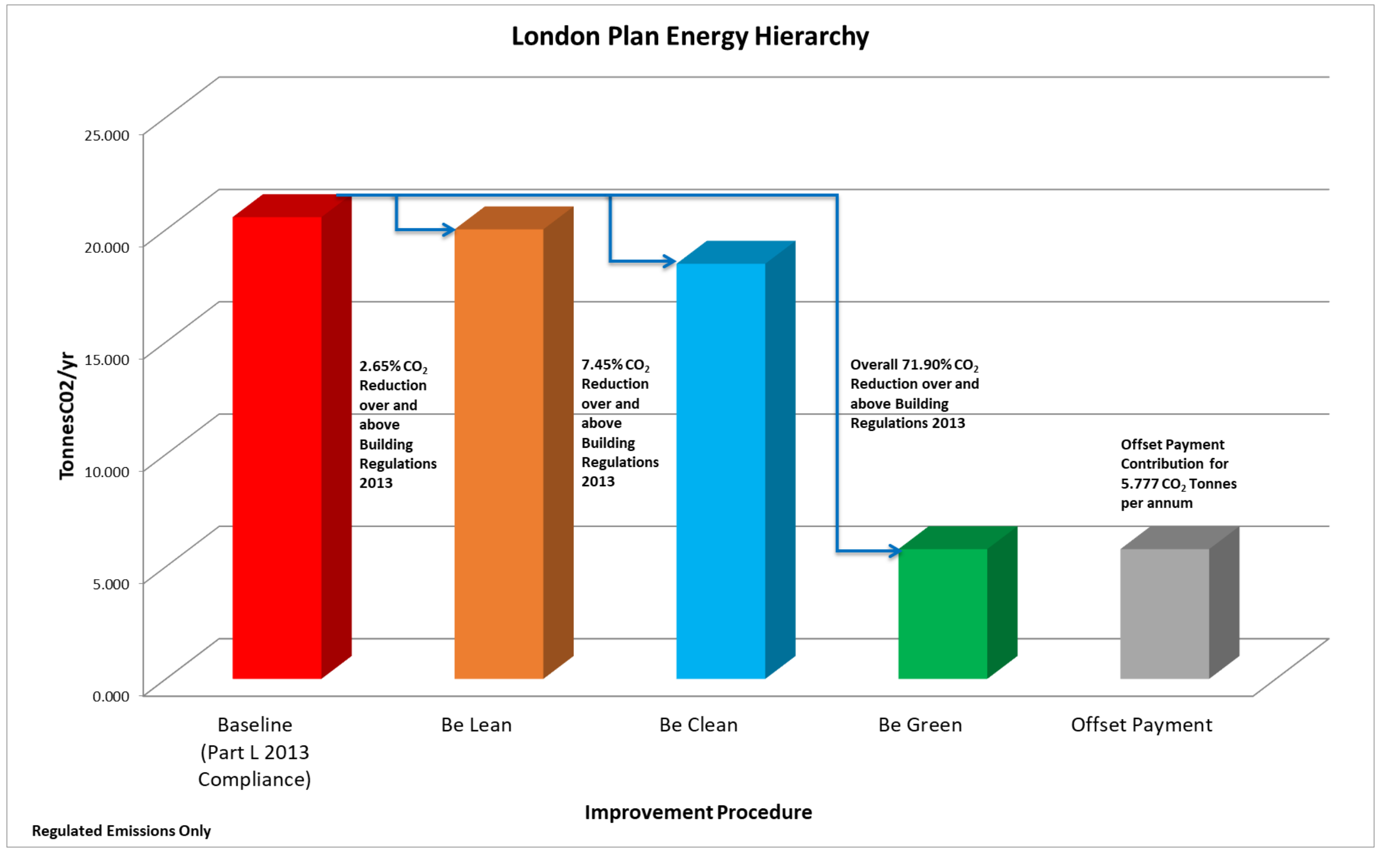


Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy

	CO_2 Emissions (Tonnes CO_2 Annum)
	Regulated
Baseline Part L 2013 Building Regulations Compliant Development	20.555
After Energy Demand Reduction (Be Lean)	20.010
After Energy Efficiencies (Be Clean)	18.480
After Renewable Energy (Be Green)	5.777

Table 2: Regulated Carbon Dioxide savings after each stage of the Energy Hierarchy

REGULATED ONLY	CO_2 Emissions (Tonnes CO_2 Annum)	
	(Tonnes CO_2 per Annum)	(%) Improvement over Part L 2013
After Energy Demand Reduction (Be Lean)	0.545	2.65%
After Energy Efficiencies (Be Clean)	1.530	7.44%
After Renewable Energy (Be Green)	12.703	61.80%
Cumulative on site Saving from Part L 2013	14.778	71.90%
Annual Savings from off-set payment	5.777	
Zero Carbon Fund contribution	£10,398.60	

For the proposed development the financial contribution shall be calculated based on an established price per tonne of CO_2 for Camden. As set out within the Camden's Environmental Design Planning Guidance, the price per annual tonne of carbon is currently set at £1800, based on analysis of the costs and carbon savings of retrofit measures suitable for properties in Camden.

2 INTRODUCTION

This energy statement has been prepared by Blyth and Blyth in support of a planning application submitted on behalf of Geoffrey and Ryan Springer and Lynne Turner-Stokes MBE for the demolition of the existing property and the construction of five detached homes at 55 Fitzroy Park, Highgate, London, N6 6JA.

The report examines and assesses the energy/CO_2 emission profile for the proposed development and continues to review the options for reducing energy consumption/CO_2 emissions in accordance with Local Authority and National requirements.

The Local Authority for this development is The London Borough of Camden.

The Local policies adopted by the Borough are outlined within the London Borough of Camden Core Strategy, which adopts the London Plan approach to carbon saving contributions.

It should be noted that a further review will be required during the subsequent detailed design stages of the project to confirm the CO_2 emissions reductions are maintained and achieved.

Existing Site Location

Proposed Development

3 PLANNING POLICIES CONTEXT

This section summarises the applicable regional and local planning policies that influence the energy strategy for the proposed development. The planning criteria for energy and emissions is generally dictated by the following:

- National Planning Policy Framework (2012)
- GLA Guidance on preparing energy assessments (2016)
- GLA London Plan (2016)
- Building Regulations, Approved Document Part L1A 2013 (incorporating 2016 amendments)
- London Borough of Camden Local Plan (2017)

The most relevant policies for the developments energy strategy are detailed below.

Regional Policy – The London Plan (2016)

The London Plan is the overall strategic plan for London, and it sets out a fully integrated economic, environmental, transport and social framework for the development of the capital to 2031. It forms part of the development plan for Greater London.

Policy 5.2 (Minimising Carbon Dioxide Emissions) states that: “Development proposals should make the fullest contribution to minimizing carbon dioxide emissions in accordance with the following energy hierarchy:

1 – Be lean: use less energy
2 – Be clean: supply energy efficiently
3 – Be green: use renewable energy

The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic from 2019.

Year	Improvement on 2010 Building Regulations
Residential Buildings	
2013-2016	25%
2016-2019	40%
2019-2031	Zero Carbon

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

As a minimum, energy assessments should include the following:

a. Calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy

b. Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services

c. Proposals to further reduce carbon dioxide emissions through the use of decentralized energy where feasible, such as district heating and cooling and combined heat and power (CHP)

d. Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.”

The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring

Policy 5.7 (Renewable Energy) states that: “The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance will be achieved in London.

Within the framework of the energy hierarchy, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.”

All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality

Building Regulations

Part L1a of the Building Regulations, set the minimum standards for all elements for conservation and fuel and power within residential schemes. Its sets minimum building performance requirements, carbon dioxide reduction requirements and identifies the approved calculations methodology/ modelling software to achieve minimum building regulations compliance. These calculations provide the basis in development the overall energy strategy in line with the energy hierarchy.

Local Policy – London Borough of Camden

Camden seek to minimise the Boroughs contribution to climate change by promoting zero carbon developments. The most relevant policies for this energy statement are the following:

Camden Local Plan Policy CC1: Climate change mitigation.

This requires all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

Camden:

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

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

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

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

Camden require all developments involving five or more dwellings and/or more than 500 sqm of (gross internal) any floorspace required to submit an energy statement demonstrating how the energy hierarchy has been applied to make the fullest contribution to CO_2 reduction. All new residential development will also be required to demonstrate a 19% CO_2 reduction below Part L 2013 Building Regulations (in addition to any requirements for renewable energy). This can be demonstrated through an energy statement or sustainability statement.

The 19% reduction is however superseded by the fact the development is considered a major development and therefore The London Plan target of Zero Carbon development is required.

This is further defined on Camden planning website as follows

From October 2016 London Plan policy 5.2 requires major residential developments to achieve zero carbon (with at least 35% reduction achieved through on-site measures). The remaining regulated carbon emissions (to 100%) are to be offset through a cash in lieu contribution.

Camden offset contribution payment is to be base upon £1,800 per tonne of carbon (30 years) (both residential and non-residential development).

Further to the Camden local plan, Camden also provide Planning Guidance documentation to develop energy statements and provide guidance and key information in meeting the relevant policies. CPG3 (July 2015 – updated March 2018) providing the guidance for energy statements.

4 ENERGY/ CO_2 REDUCTION ASSESSMENT

It is a statutory requirement for commercial developments to comply with Building Regulations Part L1A 2013 (incorporating 2016 amendments). The regulations define minimum standards to be adhered to in the building, construction and performance, in the conservation of fuel and power. These regulations require a Part L / SAP calculation to be carried out, to identify the CO_2 emission rate for the development, for the developer then to show compliance.

These regulations and the energy hierarchy approach allows more emphasis to be put onto the building envelope design and efficient building services design, which in many instances can achieve greater energy saving, than the simple introduction of renewable technologies.

5 BASELINE ENERGY DEMAND

To conduct an energy assessment, a baseline energy demand and associated CO_2 emissions has been calculated.

Utilising these baseline figures, the energy statement seeks to demonstrate the CO_2 reductions provided from the energy efficient measures proposed.

The estimated annual energy demand for the development has been calculated using the Standard Assessment Procedure (SAP) methodology utilising the approved software package namely Stroma FSAP 2012 programme (version 1.0.4.14).

6 BUILDING DESIGN – BE LEAN

Developments in general require a high level of servicing to maintain comfortable conditions through providing heating, ventilation, lighting and power to the building. Therefore, to reduce the amount of energy (to be lean), the building form and envelope is a vital part, and initial starting point for to delivering an efficient building.

Building Regulations set various design limitations for the thermal performance of building. This does not mean that satisfying the limiting values will achieve compliance. This in part is due to the stringent design limitations set for a notional building against which the actual building performance will be evaluated. Therefore, it is very important to establish the optimum balance in specifying the design limits for the actual building.

As part of the thermal analysis and construction details, the passive design aspects of the scheme has been reviewed.

Building Massing

The building fabric has been enhanced over and above the building regulations to provide improvements to the scheme from a thermal prospective and also improved upon in most instances against Camden's CPG3 standards, as detailed within the table below:

Table 6: Building Regulations L1A (Residential)

Building Elements	Building Regulations Limiting Values	Camden CPG3 Values	Proposed Values
External Walls	0.30 W/m²K	0.20 W/m²K	0.15 W/m²K
Roof	0.20 W/m²K	0.13 W/m²K	0.13 W/m²K
Exposed Floor	0.25 W/m²K	0.20 W/m²K	0.13 W/m²K
External Glazing (Including Frame)	2.0 W/m²K	1.5 W/m²K	1.1W/m²K @ 0.6 G-value

The air tightness level of the development is also imperative to building design and thermal performance, therefore the following enhanced value for the proposed development shall be as identified in the adjacent table.

Elements	Building Regulations Limiting Values	Camden CPG3 Values	Proposed Values
Design Air Permeability	10 m³/h.m² @ 50 Pa	3 m³/h.m² @ 50Pa	3 m³/h.m² @ 50Pa

The construction shall conform to Accredited Construction details to reduce 'cold bridging' elements of the building fabric. Due to nature of the development some bespoke detailing will be required but will be in the spirit of the accredited construction details.

Adopting the enhanced Fabric U-values and air permeability figures will contribute significantly in reducing energy consumption.

7 ENERGY EFFICIENT SYSTEMS – BE CLEAN

Typically, each dwelling would be provided with standalone building services systems. These form part of baseline calculations and these typically include systems such as

- Domestic gas fired condensing boilers. Either a combination boiler or condensing boiler connected to local hot water cylinder.
- Local intermittent mechanical extract to individual wet rooms.
- Simple lighting switching systems.
- Local controls.

The building services aspect of design has then been reviewed and the development is to be provided with energy efficient systems (Be Clean) in accordance with Building Regulations conservation of fuel and power.

These systems will include:

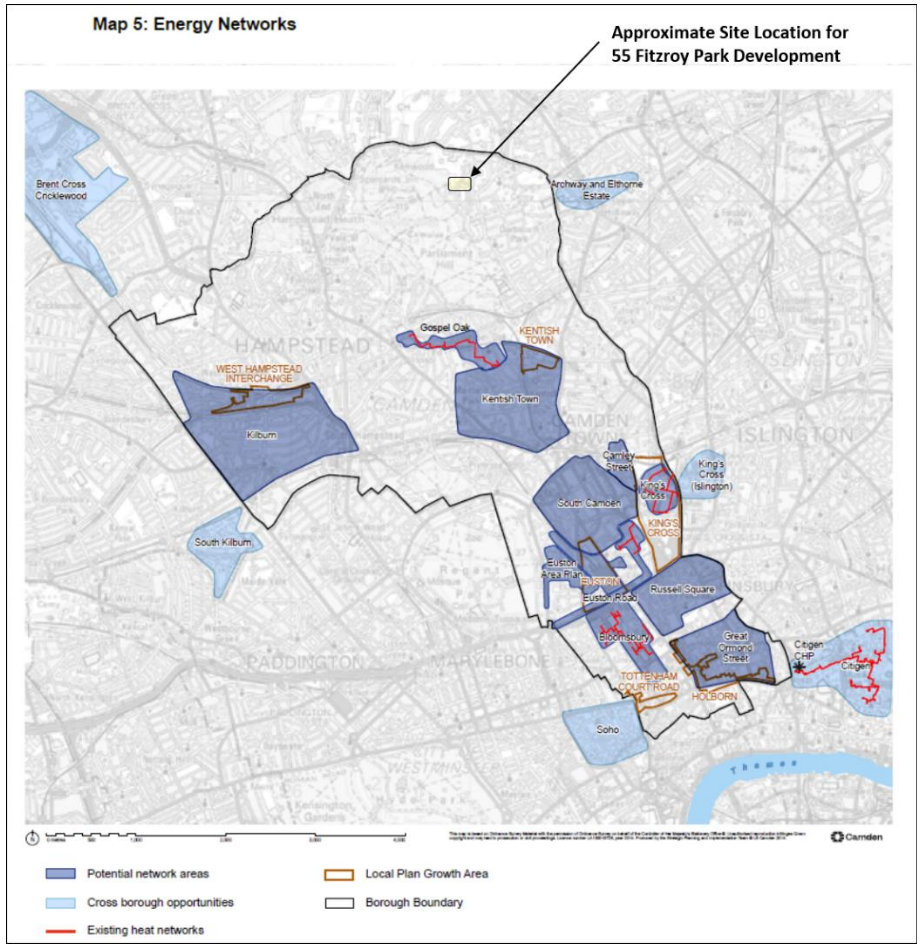
- High efficiency (89.4% SEDBUK / 94% ErP efficiency) condensing boiler heating/hot water cylinder system, complete with intelligent controls.
- Energy efficient whole house heat recovery system (MHVR efficiency 88%). with low specific fan power (0.67w/l/s), providing extract from wet rooms and supply air in to habitable rooms.
- Lighting systems will be based upon high efficiency luminaires (100% of the fittings) and switching systems designed to maximize energy savings and flexibility in use.

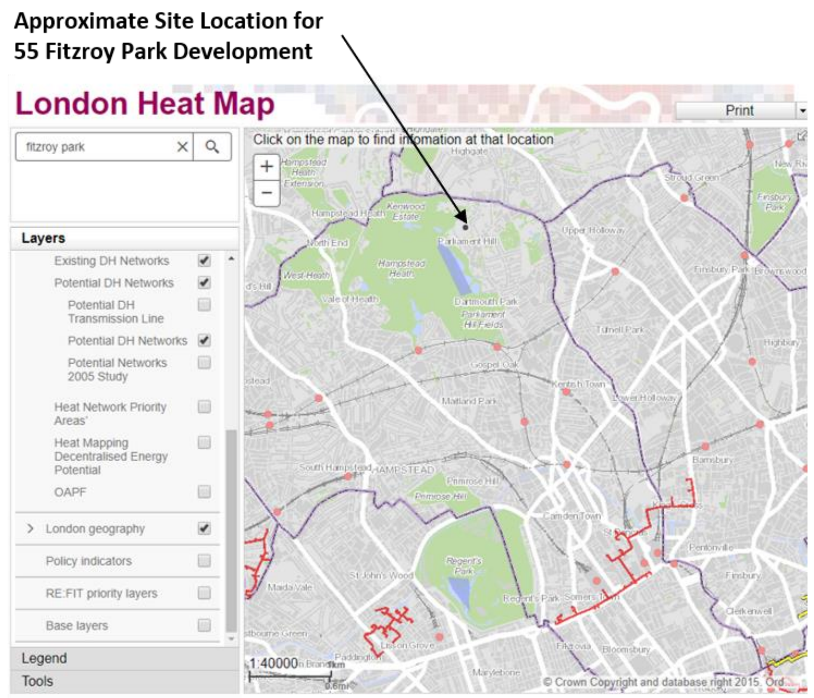
Furthermore, the Camden Local policies require major developments to investigate the feasibility in connecting to local District heating networks.

Map 5 adjacent as taken from the Camden Local Plan and the London Heat Map, indicate existing heat networks within the borough and identifies potential network areas for development.

Currently there is neither an existing network or potential network local within 500m to the proposed development, therefore this has been considered not to be feasible under the energy strategy for the development.

In addition to the above and if it is not considered feasible to connect to a decentralised network, an onsite CHP system is to be considered. However, this also is not considered feasible for the development, as there is not a large enough base load to allow CHP to be effective in either a centralised system capacity or individual property basis.





8 RENEWABLE OPTIONS – BE GREEN

The following options are considered to be renewable/low carbon systems (Be Green) under planning policies:

i. Photovoltaic Cells (PV)

ii. Solar Thermal Hot Water System

iii. Wind Turbines

iv. Geothermal

v. Biomass

The following considers the use and feasibility of the technologies relevant to this particular development.

8.1 Photovoltaic Panels (PV)

Photovoltaic cells utilise sunlight to provide electricity. With no moving parts or chemical emissions, it's an effective way to reduce carbon dioxide emissions pumped into the atmosphere at the power station. Linked cells are encapsulated into modular panels - often a rectangular shape about a metre long. These are then interconnected to provide electrical power, which can be harmonised with grid electricity and fed back into the network. A photovoltaic system never needs refuelling, has no moving parts, emits no pollution, is silent, and requires minimal maintenance. PV applications fall into two categories: standard bolt-on systems and integrated systems. Bolt-on systems literally bolt onto the existing envelope of the building (on top of roof tiles or vertical façade or flat roof systems). This is the system that shall be analysed in greater detail.

Advantages

- The system has low maintenance cost of the life span of the installation.
- Contribute to security of energy supply to the development
- Available Grants: Feed in tariffs enhances the economics of PV installations

Disadvantages

- A green roof arrangement has been proposed for the development. Incorporation of a solar photovoltaic system will need to be installed in conjunction with green roof areas where feasible.

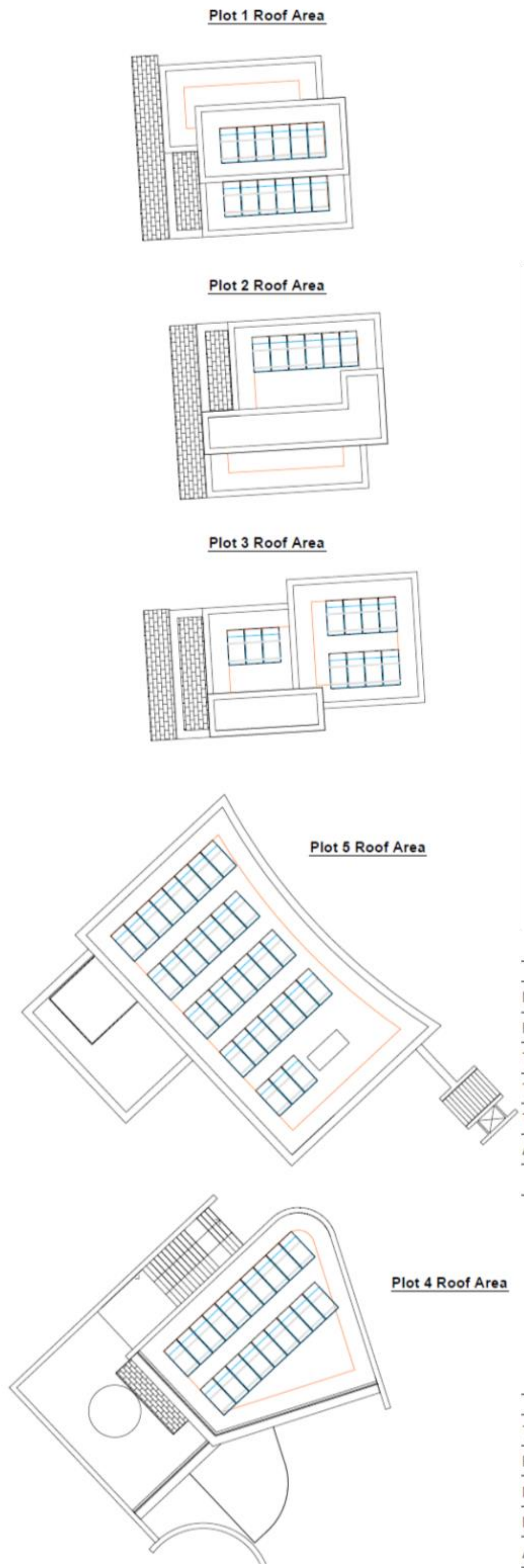
Feasibility

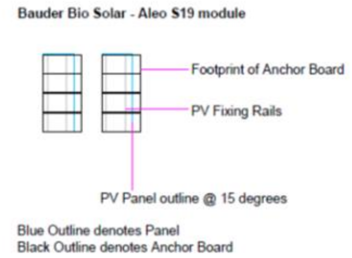
There is scope to locate a number of PV panels on the flat roofs of each plot on the development.

To accord with Camden's local policies on biodiversity, each plot has a green roof incorporated into the landscaping design. In conjunction with PV specialist / manufacturer a suitable framing and PV arrangement has been initially reviewed to provide the balance between maintaining an effective PV arrangement and achieving ecological / sustainable targets.

In additional to limit visual impact on surrounding areas, the positioning and angle of the PV panel has had to be considered and resulted with the layout adjacent and the panels designed to an angle of 15^{O}.

High efficiency PV Panels are to be utilised resulting in a total installed power load of 29.2kWp for the whole development. This equating to a substantial CO_2 reduction for the development of circa 61.8%, meeting Camden's minimum onsite contribution from renewables of 20%.

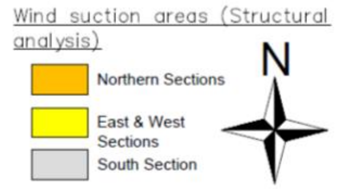




PHOTOVOLTAIC GREEN ROOF CONSTRUCTION

Mounted photovoltaic panel prior to the installation of the ballasting green roof and vegetation.

Design Information	
No. Achor Boards:	80
Rail Length Required:	176.0 lm
Type of Inverter:	Solaredge - Various
Type of Optimizer:	Various
Type of Panel:	Monocrystalline
Area of PV Panels:	131.20m2



General Information	
Total power DC	24.80 kWp
BAUDER System type	Bauder Bio Solar
Module type	Aleo S19 (310wp)
Module amount	80 Units
Azimuth	3 & 43 Degrees SE

8.2 Solar Water Heating

Solar Water Heating (SWH) is a system for heating water using energy from the sun. Solar energy is collected by a panel, which is connected by pipes to a hot water storage device such as a hot water cylinder.

A conventional central heating pump forces water through a coiled pipe in the solar panel where it is heated by the sun. The heated water then flows down and through a second coil in the hot water cylinder. The hot water passing through this coil pre- heats the water serving the hot water calorifier.

As long as the water in the hot water cylinder is at the required temperature, the boiler will not switch on.

There are two basic types of collector: flat-plate and evacuated tube.

Flat Plate Collectors use an absorber plate with a specially developed coating to maximise the collection of solar energy whilst simultaneously limiting re-radiation of energy back to the atmosphere. The collector is usually covered with a transparent material such as glass and insulated behind to prevent heat losses. Heat is transferred to the water via pipes lying along the plate or through channels within the collector. They tend to be a simpler and cheaper form of panel.

Evacuated Tube Collectors use an evacuated glass tube to enclose each absorber plate. Convection losses are almost eliminated by the vacuum in the tube, making this type of collector more efficient than the flat plate, especially in marginal weather conditions. This technology normally uses a very low boiling point fluid as the transfer medium, which takes the heat to the water within the manifold. This type reacts far quicker to incoming solar radiation making it more efficient in cloudy weather.

Identified below are the advantages and disadvantages associated with solar hot water system for this development:

<u>Advantages</u>

- The system has low maintenance cost for the life span of the installation.
- Solar hot water panels would provide saving on hot water fuel bills, as this system would provide buffered hot water and therefore reduced the requirements for fuel input.

<u>Disadvantages</u>

- Continuous HWS thermal profiles and usage required.
- Compatibility issues associated with using solar hot water systems with other low carbon technologies that utilise the same roof space i.e. PV Panel installation, or systems that utilise a base load i.e. CHP
- Capital costs against running cost (payback period)

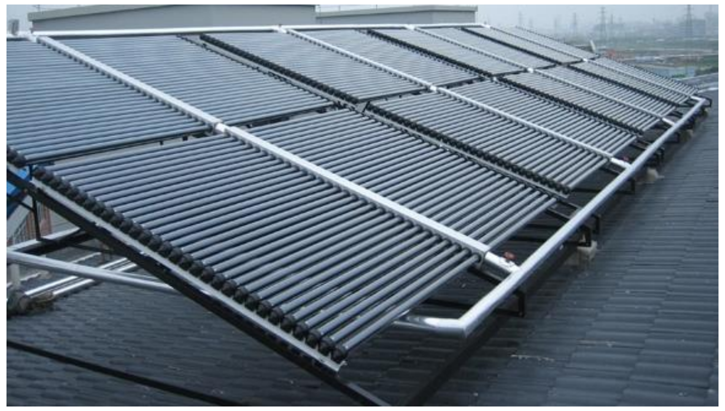
<u>Feasibility</u>

There is scope to locate a number of solar thermal panels on the building's similar to that indicated on the PV Panel proposal.

Due to changes in the Building Regulations calculations, the incorporation of photovoltaic panels provides a greater percentage reduction in carbon dioxide than a solar thermal system, and therefore the proposed strategy of photovoltaic panels is considered to be the most appropriate solution to achieve required carbon reduction.

The recent cost reductions and funding incentives in other technologies would therefore make PV a more attractive option.

Therefore, as this system is not economically viable for the development, and as a standalone system would not provide a significant contribution in carbon reductions to satisfy the carbon reduction target, this technology has been excluded from the assessment.



<u>Evacuated Panels</u>

8.3 Wind Turbine

Wind turbines utilise the kinetic energy within the wind and converts it to electrical energy which can be distributed around the country.

As the wind passes across the blades and the minimum wind speed is satisfied the wind turbine begins to turn. This rotation of the blades turns a shaft that is located within the nacelle; a gearbox is required to increase the rotational speed so that the generator can convert the kinetic energy into electrical energy via the use of magnetic fields within the generator.
The electrical power is distributed through a transformer which converts the electricity to the correct voltage and frequency.

If the direction of the wind changes the nacelle would detect these changes in direction and speed and would rotate the nacelle via motors to suit.

The data adjacent is taken from the wind speed database for the postcode of the development and details the average mean wind speeds for the site. If wind speeds do not exceed 5m/s for the height of the development. (Threshold value as stated in CIBSE TM38) this technology would not be suitable for this development.

Advantages

- Wind Turbine installation would provide saving on fuel bills, without contributing to global climate change.
- Contribute to security of energy supply to the development.
- Feed in tariffs enhances the economics of small scale wind turbines.

Disadvantages

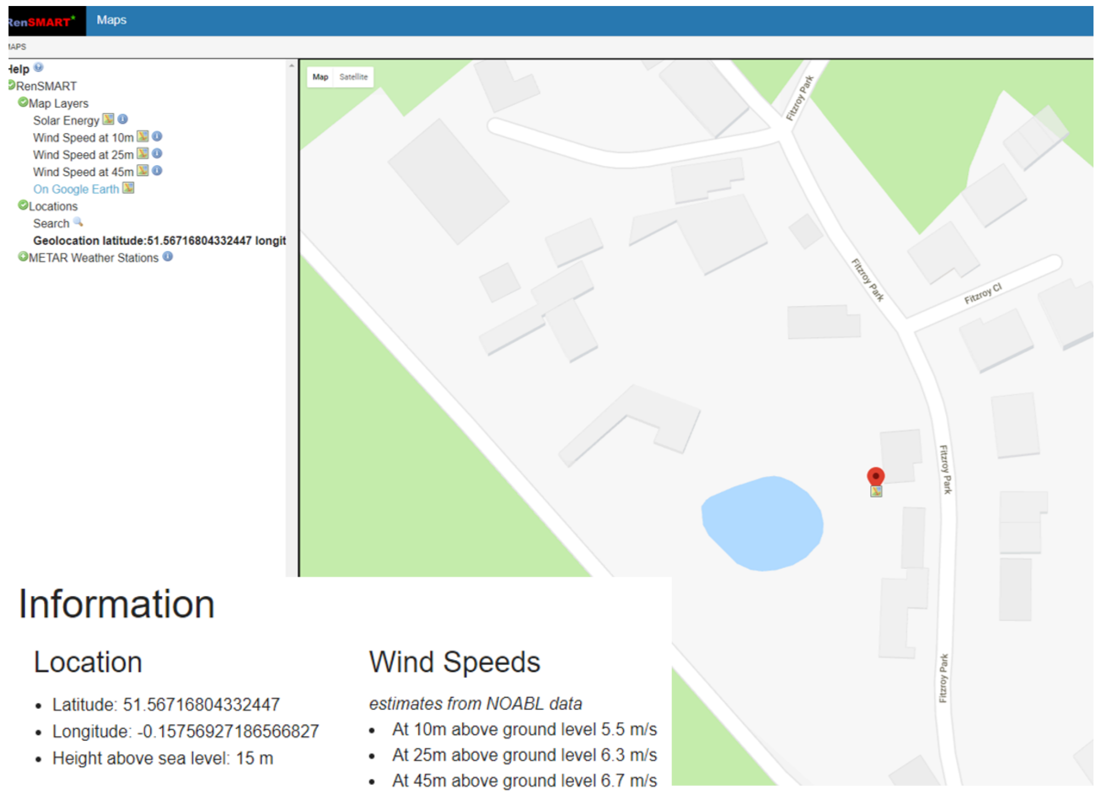
- The location of the development would minimise gain from the wind turbine system. Based on the wind speed data.
- The uneven and turbulent wind patterns that could occur due to surrounding buildings and other obstacles would impact system performance.
- The available space for a turbine, as they must be placed a minimum distance from residential and surrounding developments buildings due to noise generation, reflected light and shadow flicker, which varies according to their height
- Capital costs against running cost (payback period)
- The system has high maintenance costs over the life span of the installation.

Feasibility

This proposal is deemed not to be feasible / appropriate, with the development being located within a residential area and an area of high ecological value.

As identified in the table adjacent, the wind speed values for the site are above the threshold value of 5m/s as stated with CIBSE TM38 at a height of 10m, however to install a wind turbine at this height would impact the site visually and together with the associated noise issues this technology has been excluded from the assessment.

Wind Speed Data



8.4 Geothermal system in conjunction with heat pumps

Geothermal energy technologies use the heat energy stored in ground which is used in conjunction with a geothermal heat pump system to upgrade the low-grade heat from the ground or ground water to a higher-grade heat, where it can be used for heating purposes.

The ground is able to provide free cooling and heating during the summer and winter months respectively. At depths of 4 meters below the surface, the temperature only varies by 1 degree in the summer and winter months, whereas the ambient air temperatures varies considerably between 0 to 30 degrees depending on the time of year. This underground temperature is approximately 10^{o}C.

The suitability of a ground source system depends heavily on the type of earth coupling heat exchange system used (which will require a geology survey):

During the summer month's heat generated is rejected into the ground and is stored within the earth's crust. This stored heat can then be utilised in the winter months when heat is required. This process would maximise the efficiency of the heating season and hence reduce carbon dioxide emissions being released into the environment.

This process can also be reversed because as heat is absorbed and replaced with colder temperatures it gives free cooling capabilities and higher coefficient of performance within the summer months. Below is a description of the different types of geothermal systems which may be viable for this development.

Horizontal Closed Loop System

Horizontal closed loop heat exchangers are usually applied to small projects such as individual houses, which usually require a relatively low heat output. Consisting of horizontal trenches 1.5-2m deep, with either straight pipes or 'slinky' coiled pipes, these require significant excavation work and significant site area to achieve appreciable outputs as such are not normally suited to medium to large projects.

Vertical Closed Loop System

A frequently used and simple ground source heat exchanger, for a small to medium size project, is a closed loop vertical system. The system comprises of vertically drilled boreholes, usually up to 100 m deep, into which are inserted two polyethylene pipes with a U-shape connector at the base of the hole – effectively providing a flow down to the bottom of the hole and return back up to the surface. All the flow and return loops are connected together across the site - completing the entire heat exchange loop. Water is pumped around the loop and is then circulated around the heat pump to achieve the required heat exchange. The distance between boreholes is dependent on ground conditions but is typically a minimum of a 6mx6m grid, to prevent overlapping of the heat exchange process between loops.

Vertical Open Boreholes System

A further option is a vertical open borehole system. The system involves the abstraction and discharge of natural ground water using boreholes; into which pumps are inserted, connected to collapsible pipework. Each borehole pump abstracts ground water, circulates it around the heat pump and then discharges the water back to the ground via an absorbing well, some distance from the original abstraction borehole. The system is capable of providing very high rates of heat exchange for a relatively small number of boreholes, which makes it very efficient in terms of site area required. However, this depends greatly on the availability of ground water, which in turn varies according to location. A major downside of this system is that the extraction of water from deep boreholes via pumps consumes a lot of energy, as the water has to be physically lifted to the surface by the pump – this in effect reduces the carbon emissions saved by this system as a whole.

Advantages

- The geothermal heat pumps do have a high capital cost of investment in comparison with the alternative renewable systems, but this technology does provide saving on fuel consumption due to the increased coefficient of performance of the heat pump compared to a conventional heating system, and hence this reduction can reduce payback periods.
- Geothermal heat pump system would provide a reduction in carbon emissions.

Disadvantages

- Environmental Agency approval and geological surveys would be required to identify the suitability of the ground make up. It is also understood that the site could potentially be located on contaminated soil, which although would be remediated could present risks of contaminating the system.
- Flow and Return temperatures that can be achieved from the geothermal system would impose restrictions on the proposed heating system selections. Typically low grade heat / temperatures are provided from these types of systems, which require potential top up/ boost from more traditional gas fired boilers or electrical alternatives, thus providing some system inefficiencies.
- Additional plant space for the integration for the geothermal heat pump system.

Feasibility

Due to the nature of development and the location there would be limited site area available for horizontal/vertical loops. Therefore, this technology is not considered appropriate for the development.

8.5 Biomass Boilers

The term 'Biomass Energy' describes heat and power produced from wood generated by forestry and agricultural residues/wastes, and a wide range of organic wastes; such as animal slurry and kitchen waste. In the context on normal buildings, biomass is usually limited to the burning of wood; either in the form of wood chips or as processed pellets.

The use of biomass is generally classed as a 'carbon-neutral' process, that is to say the carbon dioxide released when biomass is burnt is equal to that absorbed by their leaves via photosynthesis during their growth. However, other energy inputs may affect this carbon balance, for example: the energy used to process the fuel, such as chipping the wood or for transport from the production area to its point of use – this is known as its 'embodied energy'. Even allowing for this embodied energy, replacing fossil fuel with wood fuel will typically reduce net CO_2 emissions by over 90%. As biomass becomes more widespread in the UK, and is thus more locally available, this embodied energy is likely to reduce for renewable fuels.

Recently wood pellets have been embraced by many boiler manufacturers, which have produced a high efficiency pellet boiler, with efficiencies up to 90%.

The quantity of fuel stored is a compromise between maximizing the duration between deliveries and minimizing the volume of fuel stored. At peak, during the maximum pellet boiler heat demand, a delivery frequency of every three to four weeks would be required, and so this would form the basis of sizing the pellet store volume.

Ash is also produced by burning wood fuels (about 1% by fuel volume) which could be disposed of simply by spreading on grass and landscaping – so waste disposal costs is minimal.

Wood pellets need to be stored in a fire-rated store/room - ideally next to the boiler.

The modern high quality pellet boilers require low maintenance. However the boiler has to be serviced, say, twice a year. The only intervention on a regular basis would be ash disposal: say every 10 days.

Advantages

- Biomass is considered carbon neutral and therefore provides significant savings on CO2 generation, however fuel factors impede savings.

Disadvantages

- Availability of the fuel source and the requirement for regular deliveries of the fuel. This has been reflected within the new building regulation and fuel factors enhanced accordingly, which consequently lowers the Target Emission rate.
- The feasibility of this proposal is subject to accommodating additional plant space for storage of the fuel and would require building control/fire consultant approval
- Enhanced requirements to comply with the Air Quality Management Area.
- Increased maintenance requirements compared to a conventional boiler installation, to ensure that efficiencies of the plant and system are maintained.

Feasibility

Due to the availability of the fuel source, delivery requirements into a city location, storage requirements and the importance of air quality which would be jeopardised due to the combustion process, this technology has been discounted. The site is located in an Air Quality Management Area (AQMA) and therefore a license would be required in London to satisfy regulatory requirements.

Biomass Boiler

Typical Wood Pellet Feeder

9 DEVELOPMENT STRATEGY

The Proposed Development features improved insulation and air tightness standards, when compared against the compliance requirements of Part L 2013 of the Building Regulations and Camden's CPG3 guidance.

The proposal of utilising PV panels in conjunction with energy efficiency design measures implemented as part of the energy hierarchy ensures that significant CO_2 emissions reductions across the entire development is achieved.

This approach to carbon reduction will ensure:

- Building Regulation 2013 Compliance Part L1A (incorporating 2016 amendments)
- An overall 71.9% CO_2 emission reduction in comparison with total emission rate from a building which complies with building regulations 2013.

With this shortfall in achieving the zero carbon target and in line with GLA Zero Carbon policy, the remaining regulated emissions are to be offset using a cash in lieu contribution to the Camden Zero Carbon fund. The current offset price is £60/tonne/year based on 30 years, therefore equal to £1800 per tonne.

Following the efficiency and renewable strategy detailed herein, the scheme is predicted to result in regulated emissions of 5.777 metric tonnes carbon per annual. Therefore, the Zero Carbon Fund contribution will be £10,398.60

It should be noted that a further review will be required during the subsequent detailed design stages of the project to confirm the CO_2 emissions reductions are maintained and achieved.

SAP Calculation Summary Table

Carbon Tonnes per Annum	Plot 1	Plot 2	Plot 3	Plot 4	Plot 5	Totals
Zero Carbon Target	0	0	0	0	0	0
Building Regulations Minimum (BR)	3.77	3.71	3.77	4.20	5.11	20.55
Calc 1 - (be lean)	3.60	3.75	3.79	4.01	4.85	20.01
Be lean % reduction from Building Regulations	4.45%	-1.04%	-0.63%	4.43%	4.96%	2.65%
Calc 2 - (be clean)	3.28711	3.43371	3.49284	3.7126	4.55367	18.48
Be clean % reduction from be lean	8.78%	8.41%	7.92%	7.47%	6.15%	7.65%
Calc 3 - (be green)	1.32391	2.45211	1.691	0.74701	-0.4374	5.78
Be green % reduction from be clean	59.72%	28.59%	51.59%	79.88%	109.61%	68.74%
Total % reduction from TER	64.90%	33.91%	55.14%	82.21%	108.57%	71.90%
Total KG/CO2/Year (from SAP sheets)	1323.91	2452.11	1691	747.01	-437.4	5776.63
Total TONNES/CO2/Year	1.324	2.452	1.691	0.747	-0.437	5.777
Total offset payment £1800 per tonne	£2,383.04	£4,413.80	£3,043.80	£1,344.62	-£787.32	£10,398.60

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