125 Shaftesbury Avenue

Energy Strategy Report

SEPTEMBER 2016

1. Issue Register

Rev	Reason for Issue	Date	Issued By	Checked By
1.0	Energy Strategy – Draft Stage C	03/08/2016	KH	AG
2.0	Updated following comments for Stage C	12/08/2016	KH	AG
3.0	Updated following comments for Stage C	16/08/2016	KH	AG
4.0	Updated following comments for Stage C	18/08/2016	KH	AG

This document was checked by

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Andrew Galea, Associate Director

2. Contents

3. Executive Summary

This Energy Strategy has been prepared in support of a planning application in relation to the proposed refurbishment and extension of 125 Shaftesbury Avenue. This document responds to planning policy in respect of energy consumption and carbon dioxide emissions and the purpose of this document is to present the inputs and results for the Energy and Carbon Dioxide assessments for the 125 Shaftesbury Avenue development that have been used to create the Energy Strategy. This current Energy Strategy reflects that the development is presently required to comply with Building Regulations Part L 2013.

The proposed 125 Shaftesbury Avenue development will comprise of the remodelling, refurbishment and extension of existing office and retail building (Class B1/A1/A3/Sui Generis), including terraces, a new public route, a relocated office entrance (Charing Cross Road), rooftop plant and flexible retail uses (Classes A1/A3), along with associated highway, landscaping and public realm improvements.

The development is located within the London Borough of Camden. The proposed development is considered to be a major development and as such will be required to adhere to Camden's requirements as well as the London Plan 2015 planning policy requirements which requires a 35% reduction in carbon emissions. In addition, the Client and design team have expressed a wish to at least achieve an "Excellent" rating for BREEAM New Construction 2014.

3.1 Aim of the Analysis

'Base Case'

For this development, Base Case refers to an energy performance compliant with Part L of the Building Regulations, called the Target Emission Rate (TER), as dictated by the London Plan.

Section 6 details the design information utilised to calculate the carbon dioxide emissions of the Base Case. The proposed performance figures are then be reflected in the Be Lean calculation.

Emissions at Base Case stage = 688, 166 kgCO_2/year

'Be Lean'

'Be Lean' refers to all the energy efficiency measures employed to improve the energy performance of the development beyond the minimum requirements of Part L.

The 125 Shaftesbury Avenue development features the following energy-saving measures to reduce the development's energy requirements and to exceed the compliance requirements of Part L of the Building Regulations:

- Improved U-values and G-values as detailed within Section 6
- Improved ventilation performance
- Improved lighting and lighting controls
- Improved system efficiencies

Emissions at Be Lean stage = 553, 301 kgCO_2/year

19.6% improvement over Base Case

'Be Clean'

'Be Clean' refers to community heating, CHP or CCHP incorporated into the building design to improve the development's energy performance, and the use of efficient 'conventional' equipment.

The proposed development energy strategy does not include the provision of community heating, CHP or CCHP. More details about the CHP can be found within Section 7.

Emissions at Be Clean stage = 553, 301 kgCO_2/year

19.6% improvement over Base Case

'Be Green'

Be Green refers to the renewable technologies incorporated into the building design to improve the development's energy performance. This report promotes the installation of Air Source Heat Pumps and PV. This is discussed in Section 8.

The Be Green stage assessment has been taken and utilised to assess the Energy Performance Certificate rating of the proposed development.

Emissions at Be Green stage = 530, 791 kgCO_2/year

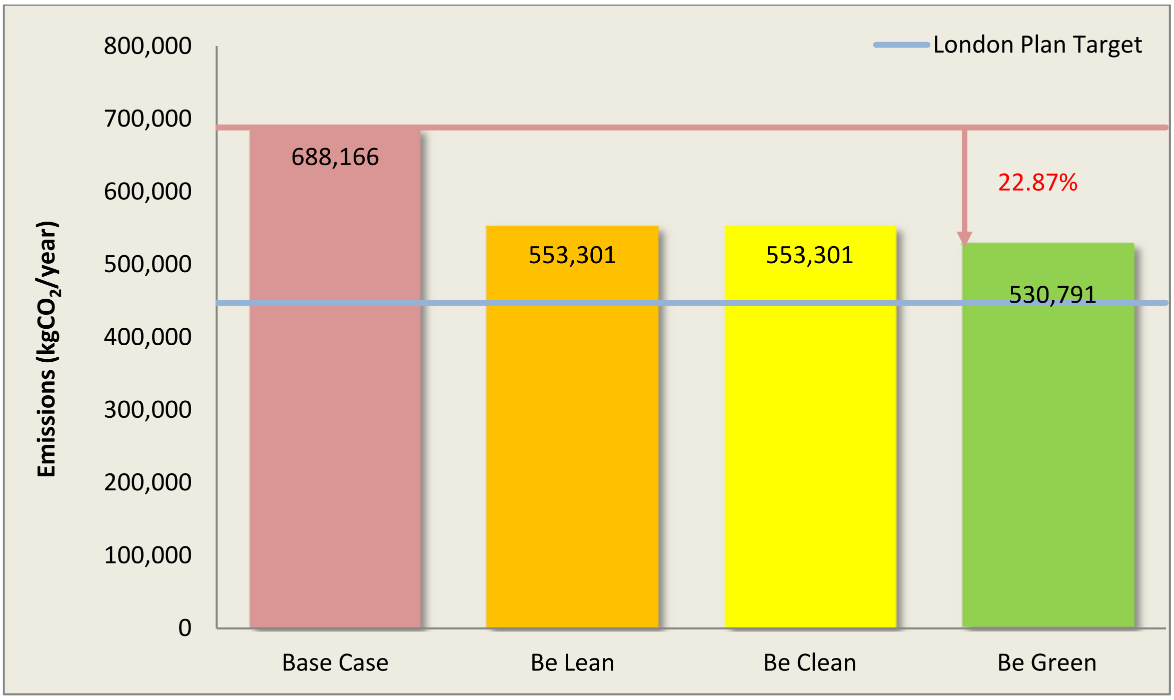
4.07% Green improvement over Lean Case

22.87% Lean and Green improvement over Base Case

Summary of Carbon Dioxide Emission Performance:

	Emissions (kg CO_2/year)	Carbon Dioxide reduction to previous stage (kg CO_2)	% carbon dioxide reduction compared to previous stage
Base Case	688,166	N/A	N/A
Be Lean	553,301	134,865	19.60%
Be Clean	553,301	0	0.00%
Be Green	530,791	22,510	4.07%
Renewable contribution	4.07%		
Overall reduction	22.87%		

Table 1: Summary of Carbon Dioxide Emissions



Graph 1: Summary of Carbon Dioxide Emissions

The annual CO_2 emissions, at this stage in the design process, will be 22.87% below the Base Case with renewable technology providing 4.07% of this reduction as described in Section 3.1.

The development has maximised the potential of the site to provide a 22.87% improvement over Part L 2013 building regulations. Whilst this is short of the 35% London Plan target, this is achieved on a restrictive site, as well as whilst retaining the existing structure. This route to construction means there is a very large embodied carbon saving in terms of the materials used in construction, as shown in Section 6.

The use of the existing structure means that the use of GSHP technology is not feasible whilst the use of CHP is not suitable for an office development do to the low DHW demand. Thus the carbon savings achieved for 125 Shaftesbury Avenue are predominantly through passive design measures with the specification of highly efficient HVAC and lighting equipment. In addition the available roof space is maximised for the installation of PV.

4. Introduction

4.1 Aim of the Analysis

This report forms part of the planning submission. Its aim is to document the design considerations and process undertaken to account for latest design intents regarding the Energy Strategy for the development.

The analysis looks to assess feasibility and incorporate passive design measures, efficient conditioning strategy and Low and Zero Carbon (LZC) technologies.

This is within the context of current building regulations, planning requirements and BREEAM targets.

4.2 The Development

The proposed 125 Shaftesbury Avenue development will comprise of 13 floors (Basement, Ground and First to Eleventh) comprising of mainly office space with retail space at ground.

Below is an image of the Part L2A Dynamic Thermal Model:

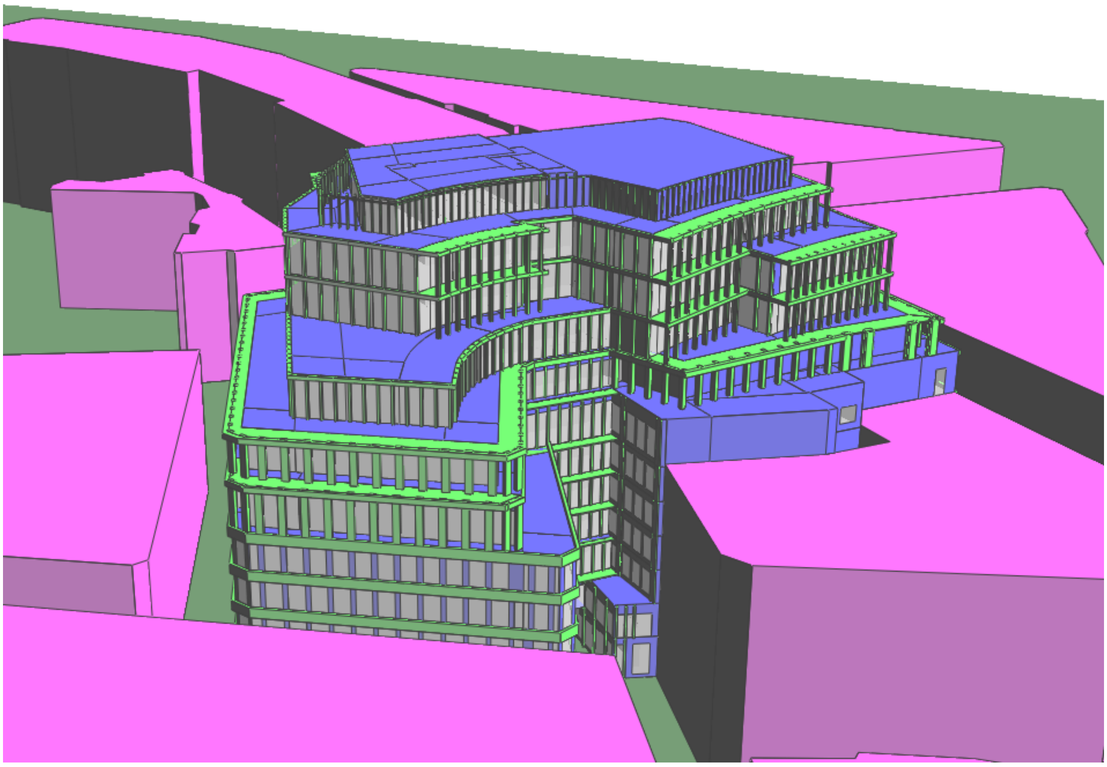


Figure 1: 125 Shaftesbury Avenue

4.3 Planning Policy Context

4.3.1 National Policy

Climate Change Act 2008

The Climate Change Bill was introduced into Parliament on 14 November 2007 and became law on 26 November 2008.The two key aims of the Act are as follows:

I. Improve carbon management, helping the transition towards a low-carbon economy in the UK.
II. Demonstrate UK leadership internationally, signalling we are committed to taking our share of responsibility for reducing global emissions in the context of developing negotiations on a post-2012 global agreement at Copenhagen in December 2009.

The key provision of the Act is a legally binding target of at least an 80% cut in greenhouse gas emissions by 2050, to be achieved through action in the UK and abroad, including a reduction in emissions of at least 34% by 2020. Both targets are against a 1990 baseline. This provision is to be achieved via a carbon budgeting system that caps emissions over five-year periods, with three budgets set at a time, to help us stay on track for our 2050 target. The first three Carbon budgets will run from 2008-12, 2013-17 and 2018-22, and were set in May 2009. The Government must report to Parliament its policies and proposals to meet the budgets. This requirement is fulfilled by the UK Low Carbon Transition Plan. Further measures to reduce emissions are included in the Carbon Reduction Commitment (CRC) Energy Efficiency Scheme.

National Planning Policy Framework (NPPF)

NPPF states that planning should support the “delivery of renewable and low carbon energy and associated infrastructure” (Paragraph 93). More specifically, paragraph 95 requires local planning authorities to:

I. Plan for new development in locations and ways which reduce greenhouse gas emissions;
II. Actively support energy efficiency improvements to existing buildings; and when setting any local requirement for a building’s sustainability, do so in a way consistent with the Government’s zero carbon buildings policy and adopt nationally described standards.

Paragraph 97 of the NPPF requires local planning authorities to:

I. Have a positive strategy to promote energy from renewable and low carbon sources;
II. Design their policies to maximise renewable and low carbon energy development while ensuring that adverse impacts are addressed satisfactorily, including cumulative landscape and visual impacts;
III. Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources;

IV. Support community-led initiatives for renewable and low carbon energy, including developments outside such areas being taken forward through neighbourhood planning; and
V. Identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

4.3.2 Regional Policy

The London Plan published in March 2015 defines the future spatial development strategy for Greater London. The main policies of the London Plan relevant to the energy strategies of new build developments are:

Policy 5.1 Climate Change Mitigation:

The Mayor seeks to achieve an overall reduction in London's carbon dioxide emissions of 60 per cent (below 1990 levels) by 2025. It is expected that the GLA Group, London boroughs and other organizations will contribute to meeting this strategic reduction target, and the GLA will monitor progress towards its achievement annually.

Policy 5.2 Minimizing carbon dioxide emissions:

Development proposals will have to meet the Mayor's energy hierarchy:

For new non-domestic buildings constructed from 2013 to 2016, the policy calls for a 40% overall CO_2 reduction compared to the Target Emission Rate (TER) of Part L 2010 of the Building Regulations. In accordance with the "Energy Planning - GLA Guidance on preparing energy assessments" (April 2015) document, the London Plan requirement for a 40% overall CO_2 reduction compared to the Target Emission Rate (TER) of Part L 2010 is equivalent to a 35% overall CO_2 reduction compared to the Target Emission Rate (TER) of Part L 2013 and it is this target which is being utilised for this proposed development

Major development proposals, defined as developments of 1,000 m^2 or more, 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.

The detailed energy assessments should follow the energy hierarchy:

I. Be Lean: Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
II. Be Clean: 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)
III. Be Green: Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

Where it is demonstrated that the specific target of CO_2 reduction cannot be fully achieved on-site, any shortfall may be provided off-site or through cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

Some developments (such as offices, industrial units and hospitals) have significant carbon dioxide emissions related to energy consumption from electrical equipment and portable appliances that are not accounted for in Building Regulations, and therefore are not included within the calculations for the Target Emissions Rate. These are called unregulated emissions. While planning decisions and monitoring requirements will be based on regulated emissions, there is a requirement in the London Plan to calculate and present the unregulated emissions in an energy assessment.

However, the proposed 125 Shaftesbury Avenue development is neither a new build nor major development and as such is required to adhere to London Plan Policy 5.4:

Policy 5.4 Retrofitting

The environmental impact of existing urban areas should be reduced through policies and programmes that bring existing buildings up to the Mayor’s standards on sustainable design and construction. In particular, programmes should reduce carbon dioxide emissions, improve the efficiency of resource use (such as water) and minimise the generation of pollution and waste from existing building stock.

It should be noted that this policy does not provide a particular carbon dioxide emission target that must be met.

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.

The detailed energy assessments should follow the energy hierarchy:

I. Be Lean: Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services
II. Be Clean: 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)
III. Be Green: Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

Other London Plan policies relevant to the sustainability in the built environment are presented below:

I. Policy 5.5 Decentralised energy networks
II. Policy 5.6 Decentralised energy in development proposals

Major development proposals should select energy systems in accordance with the following hierarchy:

I. Connection to existing heating or cooling networks

II. Site wide CHP network
III. Communal heating and cooling

Policy 5.7 Renewable Energy:

Within the framework of Policy 5.2, major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

Development proposals should seek to utilize renewable energy technologies such as: biomass heating, cooling and electricity, renewable energy from waste, photovoltaics, solar water heating, wind and heat pumps.

There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20 per cent through the use of on-site renewable energy generation wherever feasible.

Policy 5.8 Innovative energy technologies:

The Mayor supports and encourages the more widespread use of innovative energy technologies such as hydrogen fuel cells, anaerobic digestion, gasification and pyrolysis.

4.3.3 Local Policy – Camden Council

Camden Council Planning Guidance 3, "Sustainability"

Adopted September 2013, Section 4, September 2013

- *All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included. As a guide, at least 10% of the project cost should be spent on the improvements.*
- *Development involving a change of use or a conversion of 5 or more dwellings or 500sq m of any floor space, will be expected to achieve 60% of the un-weighted credits in the Energy category in their EcoHomes or BREEAM assessment, whichever is applicable. (See the section on Sustainability assessment tools for more details).*

Camden Development Policies 2010-2025 "Local Development Framework"

DP22, Adopted November 2010, Section 4, September 2013

The Council will promote and measure sustainable design and construction by:

- *expecting new build housing to meet Code for Sustainable Homes Level 3 by*
- *2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016;*

- *expecting developments (except new build) of 500 sq m of residential floor space or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;*
- *expecting non-domestic developments of 500sqm of floor space or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019*

Camden Core Strategy CS13 "Tackling Climate Change Through Promoting Higher Environmental Standards

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) *ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;*
b) *promoting the efficient use of land and buildings;*
c) *minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:*
    a. *ensuring developments use less energy,*
    b. *making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;*
    c. *generating renewable energy on-site; and*
d) *ensuring buildings and spaces are designed to cope with, and minimise the effects of climate change.*

The Council will promote local energy generation and networks by:

e) *working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them,*
f) *protecting existing local energy networks where possible*

4.4 Part L Building Regulations

Part L of Building Regulations 2013 refers to the Conservation of Fuel and Power.

Part L1 relates to residential development; Part L2 relates to non-domestic. The suffix A relates to new construction; B relates to existing buildings.

This development will be required to adhere to Part L2A of the Building Regulations 2013.

4.5 BREEAM New Construction 2014

Camden Council requires that a BREEAM New Construction assessment is undertaken for the proposed development which, from 2016 is to achieve an Excellent rating. A BREEAM assessment, which includes the design route and result, is contained in the separate BREEAM Report for which, the Client and design team have also expressed a wish to achieve an "Excellent" rating for BREEAM New Construction 2014.

5. Methodology

5.1 Energy Hierarchy

This report draws on the information and approach set out in the Greater London Authority (GLA) three stages process “Be Lean, Be Clean, Be Green”. The aim of the study is carbon dioxide reduction.

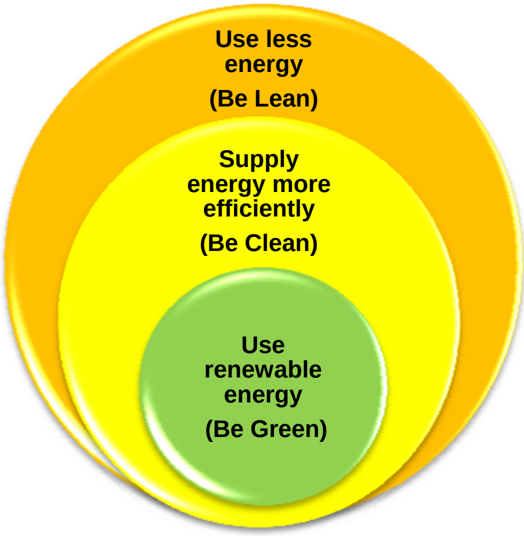


Figure 2: London Mayor’s Energy Hierarchy

‘Base Case’

A full dynamic thermal analysis has been conducted for the proposed development using software that is accredited for use with Part L 2013 in order to calculate the energy consumption and carbon dioxide emissions of the proposed development.

From this assessment, the software creates Target Emissions Rates (TER) for the development against which compliance with Part L 2013 is assessed. The TER is the maximum allowable carbon emission for the development and is used as the Base Case from which carbon emission savings are calculated.

‘Be Lean’

The full dynamic thermal analysis used for the base case assessment has been taken and updated for a Lean Design analysis.

This model has been created by modelling the proposed development geometry and inputting construction and systems information. Where new elements are to be built, the U-Values that are utilised for the Be Lean assessment reflect the proposed U-Values.

The next stage is to input the details of the HVAC and lighting systems. Since all systems and lighting are to be replaced as part of the works, the systems and lighting performance values are based on the proposed design intent as shown in Section 6. The exception to this is the heating from the proposed heat pumps. Since these are counted as a renewable technology, the heating cycle of the heat pumps is included with the Be Green Results. For the Be Lean Assessment, any heating that is associated to the heat pumps is dealt with by a gas fired boiler.

The inputs used for the Be Lean assessment and the associated results are shown in Section 6.

'Be Clean'

As discussed in Section 7, no Clean design measures are deemed to be suitable for the proposed development.

'Be Green'

A renewable energy assessment has been undertaken based upon the results of the Dynamic Thermal Modelling process (detailed below) and renewable technology data from manufacturers. The strategic issues relating to each technology are also considered in the context of the proposed development, and preferred options are short-listed. These are then considered in more detail in terms of technical feasibility and its effect on energy reduction.

The Calculations are presented in Section 8.

5.2 Thermal Modelling

A simulation model of the design proposal has been constructed to investigate the response of the building system to its surrounding environment.

The energy use and carbon dioxide performance analysis is calculated using IES VE 2015, an accredited dynamic thermal modelling tool.

The results contained in this report are based on the simulation of all parts of the development.

6. 'Be Lean'

6.1 Passive Design and Energy Efficiency Measures

'Be Lean' refers to all the energy efficiency measures employed to improve the energy performance of the development.

A Passive Design Analysis has been undertaken during the Concept Design stage in accordance with BREEAM New Construction 2014 and the proposed 125 Shaftesbury Avenue development features the following passive design and energy-saving measures to reduce the development's carbon emissions:

Passive Design Measure	Applicability	Conclusion
Site Location	The proposed development consists of the retention of existing structure on which to base the refurbishment and extension and as such the site location is fixed and no changes can be made.	Not Applicable
Site Weather	The calculations and results contained in this report are based on a CIBSE weather file for London and is the most appropriate data set for this development.	Applicable
Microclimate	The proposed development is located in central London with heavy local pedestrian and traffic flow. Whilst a building with a form of natural ventilation would be preferable, the local noise and air pollution means that such a solution is not viable and a full HVAC solution is required. However, all aspects of the HVAC system have been specified with energy efficiency in mind to reduce the overall carbon emissions of the development.	Not Applicable
Building Layout	The proposed development consists of the retention of existing structure along with an extension. As such the building layout is relatively fixed.	Not Applicable
Building Orientation	The proposed development consists of the retention of existing structure along with an extension and as such the site orientation is fixed and no changes can be made.	Not Applicable
Building Form	The proposed development consists of the retention of existing structure along with an extension and as such the building form is relatively fixed and no changes can be made.	Not Applicable
Building Fabric	The proposals for the development include a new thermal envelope. As such, the U-values of the envelope, the glazing performance and the air permeability have been improved over the minimum Building Regulations requirements in order to minimise	Applicable

	energy consumption	
Thermal Mass/Thermal Storage	A thermal mass system depends not only of the ability of the building to store energy through the day, but also on its ability to be able to efficiently purge the stored energy overnight, usually through the use of either natural ventilation or localised extract. The proposed development is located in central London with heavy local pedestrian and traffic flow and so natural ventilation is not an option. Whilst mechanical ventilation may work, this would require the plant to be on overnight which is not only an additional energy consumption but also presents additional noise issue requirements. As such, the use of thermal mass storage has not been utilised at the proposed development.	Not Applicable
Building Occupancy Type	The proposed development is to be predominantly an office development with occupancy appropriate to the requirements appropriate to a central London office. Whilst a low density office may help to reduce energy consumption, a low density occupation is not financially or spatially appropriate in a central London location	Not Applicable
Daylighting Strategy	The proposed development is to utilise both daylight management and PIR controls to minimise energy consumption.	Applicable
Ventilation Strategy	The ventilation plant has been selected to be efficient in order to minimise energy consumption.	Applicable
Heating and Cooling Plant Strategy	The heating, cooling and DHW plant has been selected to be efficient in order to minimise energy consumption.	Applicable
Adaption to Climate Change	The heating and cooling plant will be selected to have a capacity margin to enable the building to cope with changes in external temperature.	Applicable

6.1.1 'Be Lean' Specification

External wall U-value (W/m^2.K)	0.25
Roof U-value	0.15
Floor U-value	0.15
Window U-value	1.5 (inc frame)
Window G-valve	0.30
Window light transmittance	0.55
Air permeability (m^3/h/m^2)	3.5
System type (e.g. FCU, VRF ….)	ASHP fed FCU to office and retail LTHW radiators to Landlord spaces
Heat source (Boilers, Heat pumps…)	FCU: Boilers (for establishing carbon dioxide emissions without the heat pumps) LTHW Radiators: Boilers
Heat fuel type	FCU: Natural gas – for Lean Design Only LTHW Radiators: Gas
Effective heat generating seasonal efficiency	FCU: 92.0% - for Lean Design Only LTHW Radiators: 92%
Pack chiller type (air cooled, water cooled...)	ASHP
Generator seasonal energy efficiency ratio (SEER)	5.5
Generator nominal energy efficiency ratio (EER)	3.5
Ventilation type (NV, MV or mixed mode)	Mechanical ventilation
Ventilation heat recovery type & efficiency	Thermal Wheel = 67% efficiency
Variable speed pump	Variable Speed with differential pressure across pump
Has ductwork been leakage tested? Which class?	Class B
Does AHU meet CEN leakage standards? Which class?	Class L2
Specific fan power for ventilation system	Office AHU 1.6W/(l/s) Supply and Extract Office FCU: 0.2W/l/s Retail Mechanical Vent: 1.6W/(l/s) Supply and Extract Extract only spaces: 0.5 W/(l/s)
Demand control ventilation?	No
Renewable energy	Not included at this stage
DHW fuel type	From main boiler
Effective heat generating seasonal efficiency?	92%
Is the system a storage system? Storage volume?	Office: 2,000 litre Retail: 300 litre
Insulation/Heat Loss	Office: 0.0026kWh/l/day Retail: 0.007kWh/l/day

Does the system have secondary circulation?	No
Dead leg DHW pipe in rooms	Not applicable
Separate time switch	Not applicable
Does lighting system have provision for metering?	Yes
Is Monitor & Target equipment alarm for "out of range values"?	Yes
What is the electric power factor of the building?	0.9-0.95
Does HVAC system have provision for metering?	Yes
Is Monitor & Target equipment alarm for "out of range values"?	Yes
Lighting design	Office = 1.6 W/m^2/100 lux Reception = 2.5W/m^2/100 lux WC, Shower, Store and Circulation = 3.0W/m^2/100 lux Plant = 3.75W/m^2/100 lux Retail: General Lighting: 2.5 W/m^2/100 lux Retail Display Lighting 40 lamp- lumens/circuit –watt
Daylight sensor type, stand alone or addressable?	Office: Photocell to office perimeter zone
Photoelectric switching or dimming?	Office: Dimming
Occupancy sensing?	Manual On/Absence Detection PIR in Office Auto On/Off PIR in circulation area, toilets and stores
Parasitic power of photoelectric/PIR device?	0.10W/m^2

Table 3: Summary of Be Lean Inputs

6.1.2 Embodied Carbon

In order to further reduce the carbon and economic burden of the development there has a conscious decision to take the route of retaining structure where suitable. This is estimated by the AKT II to equate to:

- 1st to 7th slabs = 4,095m^3
- Ground floor slab = 450m^3
- Basement slab, pile caps = 1,000m^3
- Retaining walls = 210m^3
- Columns and walls, all floors = 500m^3
- Total = 6,255m^3

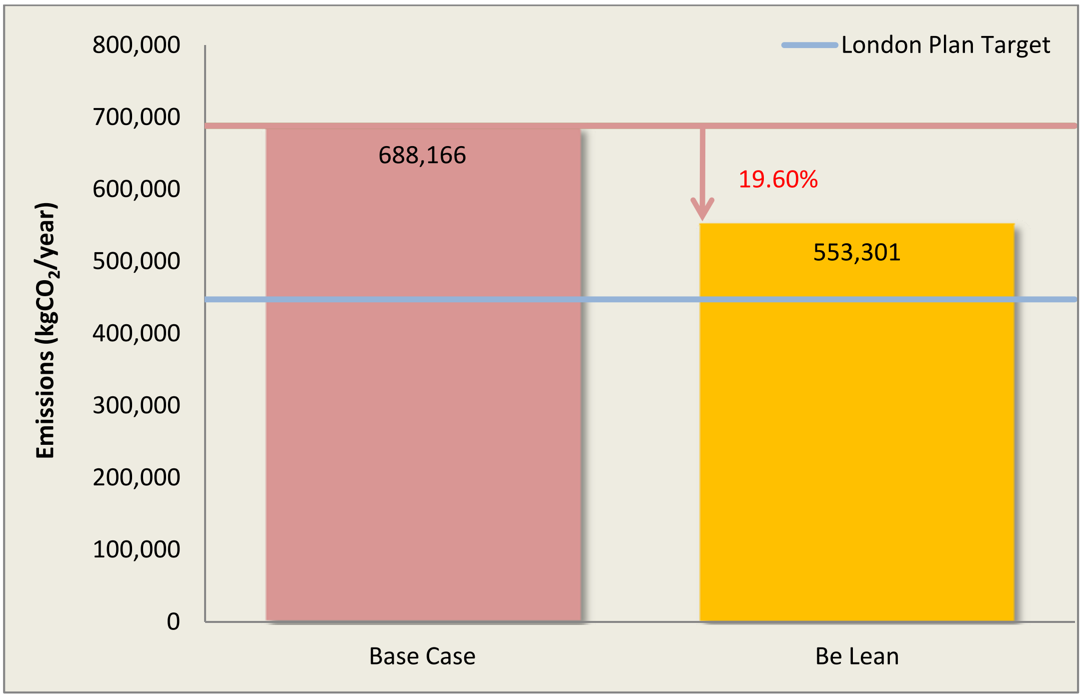
The Sustainable Concrete Forum estimates the embodied CO_2 of concrete as between 316 – 369 kgCO_2/m^3 for structural concrete. The 'Inventory of Carbon & Energy (ICE)' V2.0 estimates 381 kgCO_2/m^3.

Even assuming Ground Granulated Blast furnace Slag (GGBS) concrete were used to rebuild, these figures are reduced to 197 – 231 $kgCO_2/m^3$ for structural concrete, according to the sustainable concrete forum.

On this basis, approximately 1,251 tonnes of CO_2 have been saved over the life of the building. Assuming a 30 year life of the building in line with GLA guidance, **this is a saving of approximately 42 tonnes of CO_2 per year.**

6.2 Results

The results from the "Be Lean" Stage Calculation are presented in the graph below:



Graph 3: Be Lean Stage Results

The overall 'Base Case' BER is **688, 166 $kgCO_2$/year.**

The overall 'Be Lean' BER is **553, 301 $kgCO_2$/year.**

The development at the 'Be Lean' stage improves upon the Base Case by **19.60%.**

7. Be Clean

Following the implementation of the energy reduction ('lean') measures, the second step in providing a sustainable design is to deliver heating, cooling (if applicable) and power to the development as efficiently as possible. The savings made by efficient energy delivery ('clean') methods, as with the 'lean' measures, also have the advantage of reducing the 'baseline' energy demand, meaning less or smaller renewable energy technologies are required to meet the carbon dioxide emission reduction target.

Efficient energy delivery strategies and methods that have been considered for this development include:

- Off-site (district) heating systems
- Combined heat & power (CHP)
- Combined cooling, heat and power (CCHP)

7.1 District Heat Networks

London Plan policy regarding Heat networks is, as a priority to connect to existing heating or cooling networks where relevant.

Using the London Heat Map, the potential for this has been assessed:

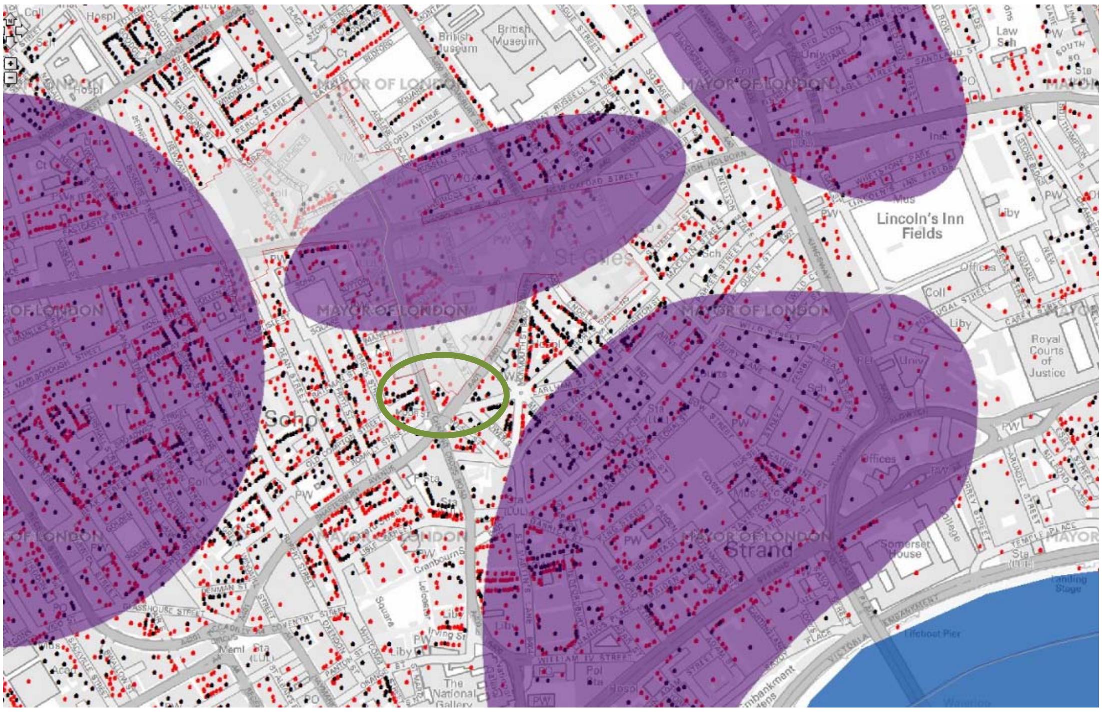


Figure 3: London Heat Map

I. Existing District Heat Networks are highlighted in yellow
II. Potential District Heat Networks are highlighted in Red
III. Areas with potential for Heat Networks are highlighted in purple
IV. Opportunity Area Planning Framework (OAPF) regions are greyed-over.

The 125 Shaftesbury Avenue development sits roughly in the middle green circle. Given the location of the site, there is no scope for the development to be served with heat from, or export heat to an off-site community heating scheme. However, whilst there are no community heating systems currently within a reasonable distance of the 125 Shaftesbury Avenue development it is prudent for the development to make provision for future connection to a district heat network by including a soft punch point in the structure to allow easy connection in the future. The possibility of such a connection will be reviewed on the future replacement of current proposed plant.

7.2 Combined Heat and Power (CHP)

The operation of a site wide Combined Heat and Power plant should be based on the presence of a base heating load on site. Domestic Hot Water (DHW) demand is considered an optimal base load for such an operation since it is stable, relatively constant through the year, and largely independent of weather variations.

As the development contains office and retail units with no residential dwellings, the subsequent DHW demand would be low meaning that it would not be practicably or financially feasible to operate a CHP unit and therefore it is not proposed to use a CHP unit at this development.

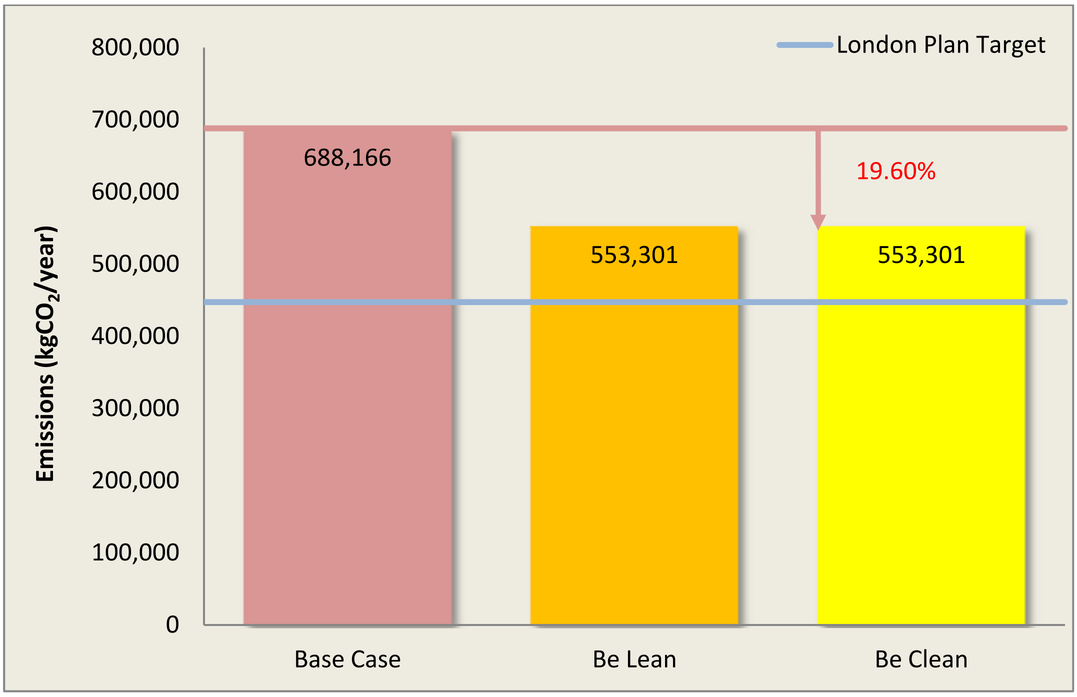
7.3 Combined Cooling, Heat and Power (CCHP)

As per Section 7.2, a site wide Combined Cooling Heat and Power plant should be based on the presence of a base heating load on site. Domestic Hot Water (DHW) demand is considered an optimal base load for such an operation since it is stable, relatively constant through the year, and largely independent of weather variations.

As the development contains office and retail units with no residential dwellings, the subsequent DHW demand would be low meaning that it would not be practicably or financially feasible to operate a CCHP unit and therefore it is not proposed to use a CCHP unit at this development.

7.4 Results

The results from the “Be Clean” Stage C calculation are presented in the graph below:



Graph 4: Be Clean Stage Results

The overall ‘Base Case’ BER is **688, 166 kgCO_2/year.**

The overall ‘Be Clean’ BER is **553, 301 kgCO_2/year.**

The development at the ‘Be Clean’ stage improves upon the Base Case by **19.60%.**

8. Be Green

8.1 Technical Assessment

The first step of the analysis examines the suitability of all the renewable technologies which are set by the GLA and approved as renewable from all the local Boroughs in England and Wales. This has been examined by the design team in terms of technical feasibility.

Renewable Technology		Applicability	Conclusion
Wind turbine		The proposed development is in an urban environment and is surrounded by other buildings meaning that the wind flow will be turbulent and non continuous. The electricity production is proportionate to the cube of the wind speed, thus a low and turbulent wind speed will diminish the electricity production. Large stand alone wind turbines require large open areas and increase the noise levels of the development which is not acceptable to the Environmental Health Department. Therefore, this technology is not proposed for this development.	Not Applicable
Solar Water Heating		Solar water heating requires extensive distribution pipe work with buffer vessels and requires a reasonable DHW demand. The available roof area is limited for this development and can be utilised more efficiently with the installation of Photovoltaics	Not Applicable
Ground Source Heat Pump (GSHP)		There may be some suitability of the site for a closed-loop borehole system. However there are a number of risk items: – The 125 Shaftesbury Avenue development is to retain an existing structure and constructing piles in an existing structure can be both practically and financially very difficult. – The site is located in central London where underground tunnels/services may pass underneath/near to the site. – The constraints and density of the site. – The depth of boreholes required – A potential system must be balanced, reducing the effectiveness. – The local geology would need to be assessed to guarantee the potential output Therefore, this technology is not proposed for this development.	Not Applicable

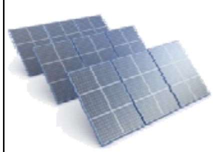
Air Source Heat Pump (ASHP)		Air Source Heat Pumps are suitable for the development to serve 100% of space heating and cooling demand for the office as well as the heating, cooling and DHW for the retail. This technology is proposed for this development.	Applicable
Biodiesel CCHP		Biodiesel CHP can potentially offer higher CO2 savings compared to other renewable technologies. However, this option comes with considerable issues: I. Frequent supply and delivery of biodiesel is required to the site. II. A biodiesel storage tank is required. III. Biodiesel CHP emits high NOx emissions unless fitted with expensive Selective Catalytic Reduction (SCR) technology. The NOx emissions are not acceptable from a local air quality perspective. The limited site does not have the required space for deliveries and fuel storage required.	Not Applicable
Photovoltaics		Photovoltaics can be installed on the available roof area of the 125 Shaftesbury Avenue development. The technology is straightforward to install in any development and does not require any integration or create any conflict with the main building services plant. The CO2 emission savings can be substantial due to the high grid electricity displacement carbon factor. This technology is proposed for this development.	Applicable

Table 4: Summary of LZC Technologies

The technical feasibility assessment carried out by the design team and documented above give a clear route forward for the most efficient and technically feasible solution to maximise carbon dioxide emission reduction, that being the use of ASHP to provide the heating to the development in addition to the cooling.

The calculation in the next section assesses ASHP in detail as the technology to be taken through for the ‘Be Green’ stage of the carbon dioxide emissions hierarchy.

The following points cover all the information required to be provided for each renewable technology as part of a Low Zero Carbon (LZC) feasibility study in accordance with BRE:

I. Energy generated from LZC energy source per year
II. Payback
III. Land use
IV. Local planning requirements
V. Noise
VI. Feasibility of exporting heat/electricity from the system

VII. Life cycle cost/lifecycle impact of the potential specification in carbon dioxide emissions
VIII. Grants
IX. All technologies appropriate to the site and energy demand of the development.
X. Reasons for excluding other technologies.

8.2 Detailed Feasibility Analysis - ASHP

Description

Air source heat pumps (ASHP) is a system which transfers heat from outside to inside a building. Using vapour compression refrigeration, an ASHP uses a system involving a compressor and a condenser to absorb heat at one place and release it at another.

Advantages: - ASHP can be run in reverse cycle to provide both heating and cooling

Technical Information

Heating SCOP of ASHP	3.5– for office and retail heating 2.5 for retail DHW (office DHW to remain as gas boiler)
Life span (years)	25
Noise	Minimal to Moderate dependant on location
Visual Impact	Minimal – this technology is normal low profile.
Land of use	Roof mounted
General cost (Estimation)	
Capital cost (£)	£0[1]
Annual Cost (£) from Gas (Lean Design)	£30,399
Annual electricity cost for ASHP[2]	£27,448
Annual Fuel Saving (£)	£2,951
Maintenance (£)	£1,200
Payback period (years)	0

Table 5: ASHP Technical Information

[1] Based on there being no cost difference in the Base Case ASHP cooling system also being able to provide heating.

[2] Based on office ASHP heating with gas fired DHW ventilation and ASHP heating and DHW for retail.

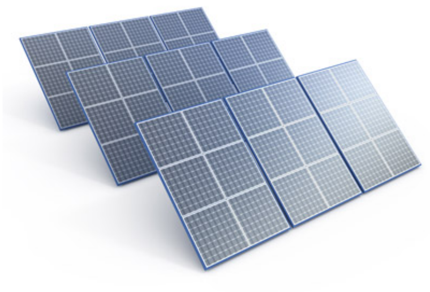
Carbon Dioxide Savings

Annual Energy Saving (kWh)	498,306
Annual carbon dioxide saving (kg CO_2)	10,407
Total Renewable contribution over Lean (%)	1.88%

Table 6: ASHP Carbon Dioxide Savings

8.3 Detailed Feasibility Analysis – PV

Description



Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect.

Advantages: - Green statement on the building

- Feed in Tariff (FIT) scheme

General information

Height of the building (m)	~46 m
Access to solar radiation	Yes
Angle of the roof	Horizontal
Orientation of the collector	South
Over shading factor	None or Very Little <20%
Total energy exported per year (%)	0%
Type of integration	Framed

Table 1: PV General Information

Technical information

Total area of PVs (m^2)	150.0
Efficiency	20.1%
Area of one PV panel (m^2)	1.63
Tilt of collector (^{o})	10° (for self cleaning)
Number of PV panels	92
Type of PV panels	Monocrystalline
Output per PV panel (W)	327
Total PV capacity (kW)	30.08
Life span (years)	20
Noise	None
Land of use	Roof mounted PV panels

Table 2: PV Technical Information

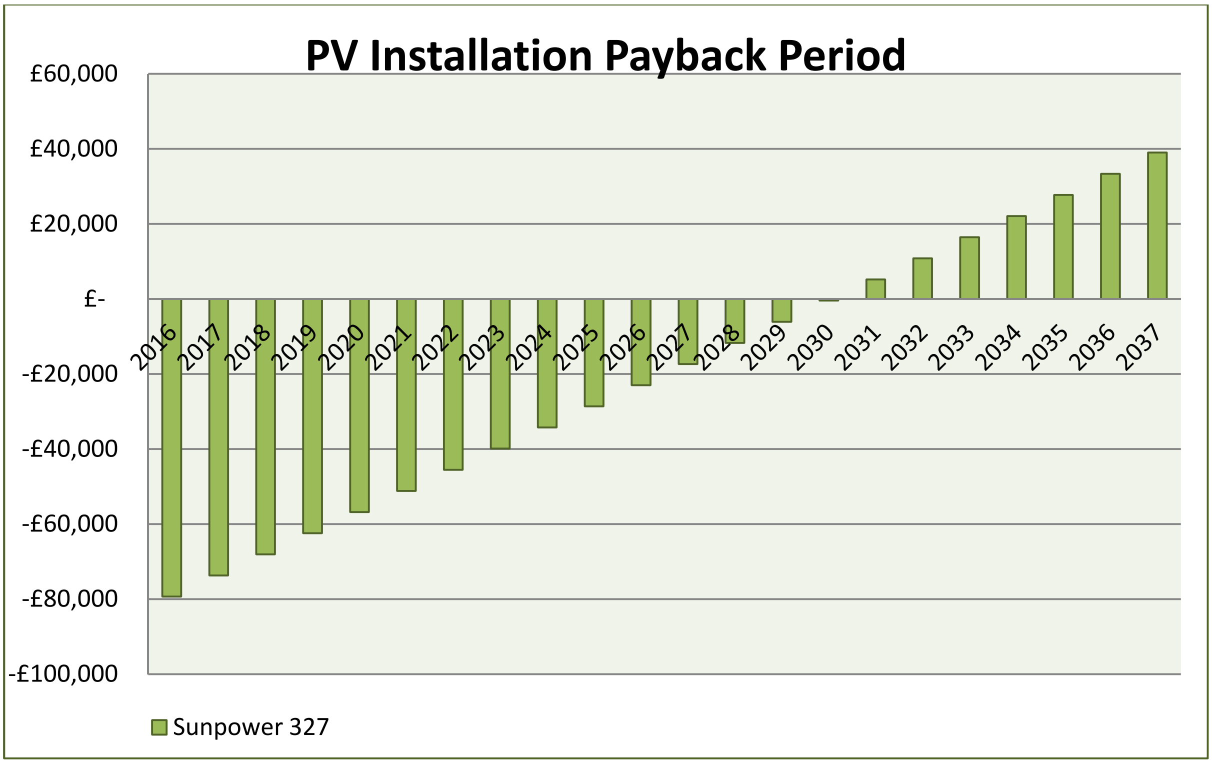
Feasibility of exporting electricity from the system

All the electricity generated by the PV panels will be used within the site where possible with excess being exported thus an export meter and agreement is required.

General cost (Estimation)

Capital cost (£)	£52,900(excluding maintenance)
Annual saving (£) from use of PV electricity	£4,253
Annual saving (£) from FIT	£1,153
LCC maintenance (£)	£794
Payback period (years)	15

Table 3 : PV General Cost Information



Graph 5: PV Payback Period

General cost (Estimation)

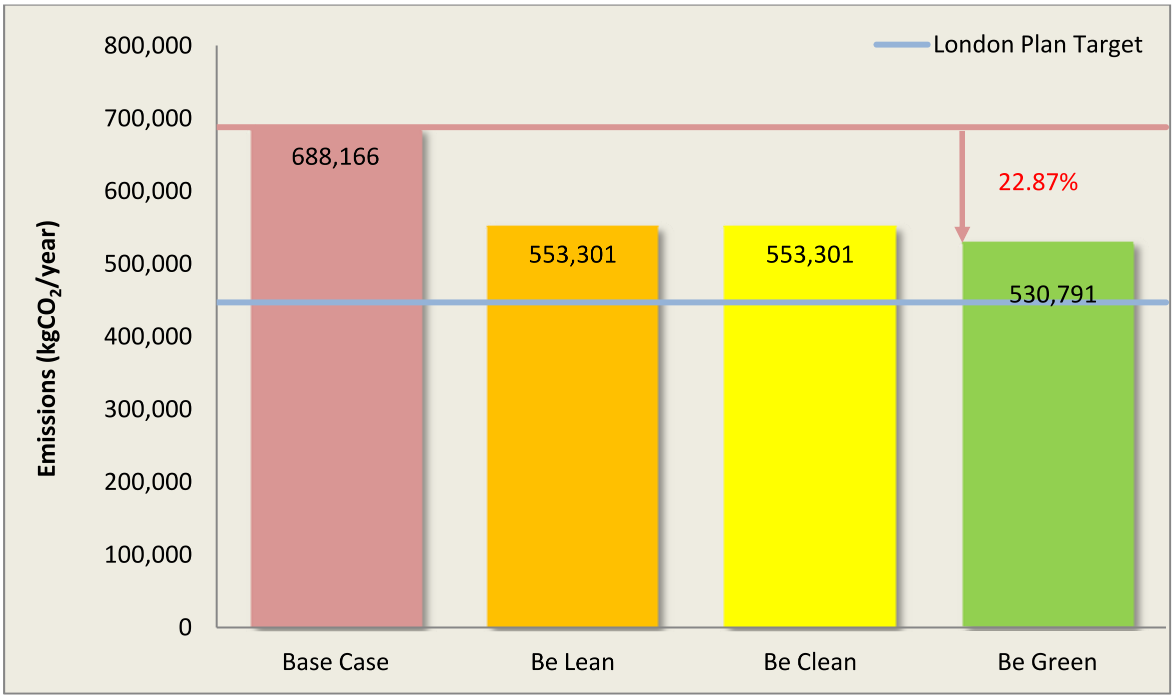
Annual Energy Saving (kWh)	25,125
Annual carbon saving (kg CO_2)	13,290
Life cycle analysis (kg CO_2) (for 1 module)	1,210
Total Renewable contribution over Lean and ASHP (%)	2.19%

Table 4 PV General Cost Information

* Calculations are based on a SunPower E20-327 model with a price of £575 (inc. VAT).

8.4 Results

The results from the 'Be Green' Stage C calculation are presented in the Graph below:



Graph 5: Be Green Stage Results

The overall 'Base Case' BER is **688, 166 $kgCO_2$/year.**

The overall 'Be Green' BER is **530, 791 $kgCO_2$/year.**

The development at the 'Be Green' stage improves upon the Base Case by **22.87%.**

The annual CO_2 emissions, at this stage in the design process, will be 22.87% below the Base Case with renewable technology providing 4.07% of this reduction.

9. Summary of Solution

This report identifies the energy strategy proposed for the 125 Shaftesbury Avenue development, the main points of this report are summarised below:

'Be Lean'

- Improved U-Values
- Improved U-values and G-values to the glazing
- Improved air permeability
- Improved ventilation performance
- Improved lighting and lighting controls
- Improved heating, cooling and DHW system efficiencies

'Be Clean'

- Not Applicable to this development

'Be Green'

- Air Source Heat Pump for office heating and retail heating and DHW
- 150m^2 PV

Camden Council requires that a BREEAM New Construction assessment is undertaken for the proposed development which, from 2016 is to achieve a Excellent rating. A BREEAM assessment, which includes the design route and result, is contained in the separate BREEAM Report for which, the Client and design team have also expressed a wish to achieve an "Excellent" rating for BREEAM New Construction 2014.

The development has maximised the potential of the site to provide a 22.87% improvement over Part L 2013 building regulations. Whilst this is short of the 35% London Plan target, this is achieved on a restrictive site, as well as whilst retaining the existing structure. This route to construction means there is a very large embodied carbon saving in terms of the materials used in construction, as shown in Section 6.

The use of the existing structure means that the use of GSHP technology is not feasible whilst the use of CHP is not suitable for an office development do to the low DHW demand. Thus the carbon savings achieved for 125 Shaftesbury Avenue are predominantly through passive design measures with the specification of highly efficient HVAC and lighting equipment. In addition the available roof space is maximised for the installation of PV.

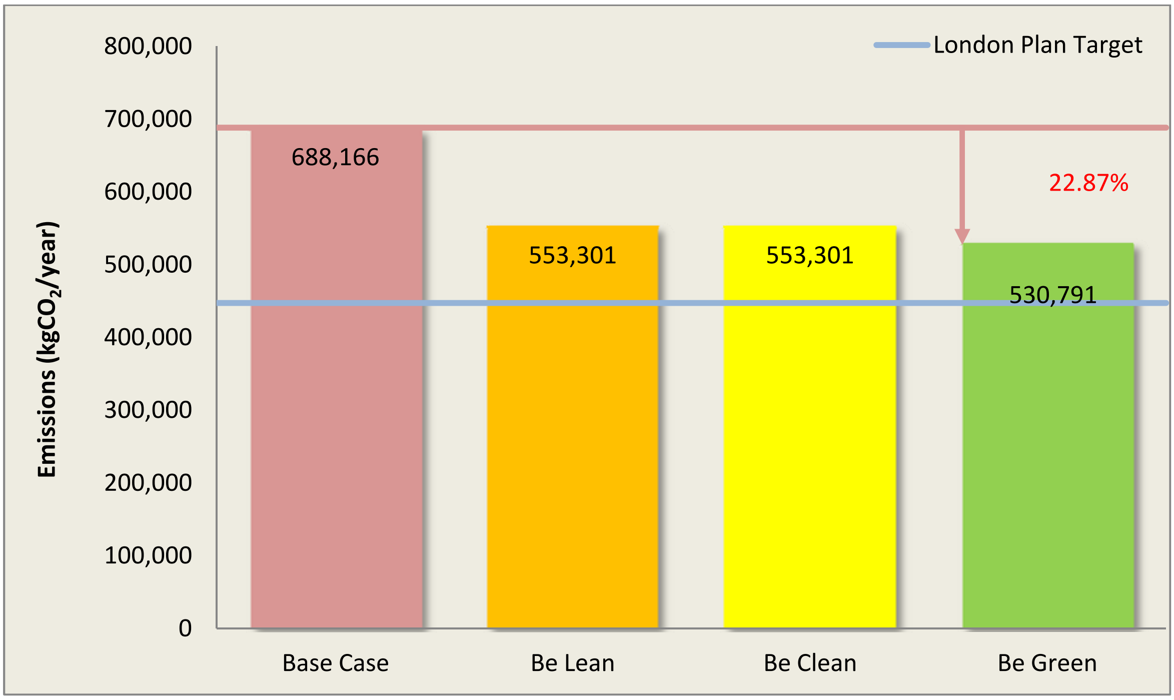
The tables below summarises the total regulated carbon and energy consumption for each stage for the development as a whole:

9.1 Results – Regulated Carbon Emissions

The table below summarises the regulated carbon dioxide emission results at each stage.

	Emissions (kg CO_2/year)	Carbon Dioxide reduction to previous stage (kg CO_2)	% carbon dioxide reduction compared to previous stage
Base Case	688,166	N/A	N/A
Be Lean	553,301	134,865	19.60%
Be Clean	553,301	0	0.00%
Be Green	530,791	22,510	4.07%
Renewable contribution	4.07%		
Overall reduction	22.87%		

Table 7: Summary of Carbon Dioxide Emissions



Graph 8: Summary of Carbon Dioxide Emissions

The annual CO_2 emissions, at this stage in the design process, will be 22.87% below the Base Case with renewable technology providing 4.07% of this reduction.

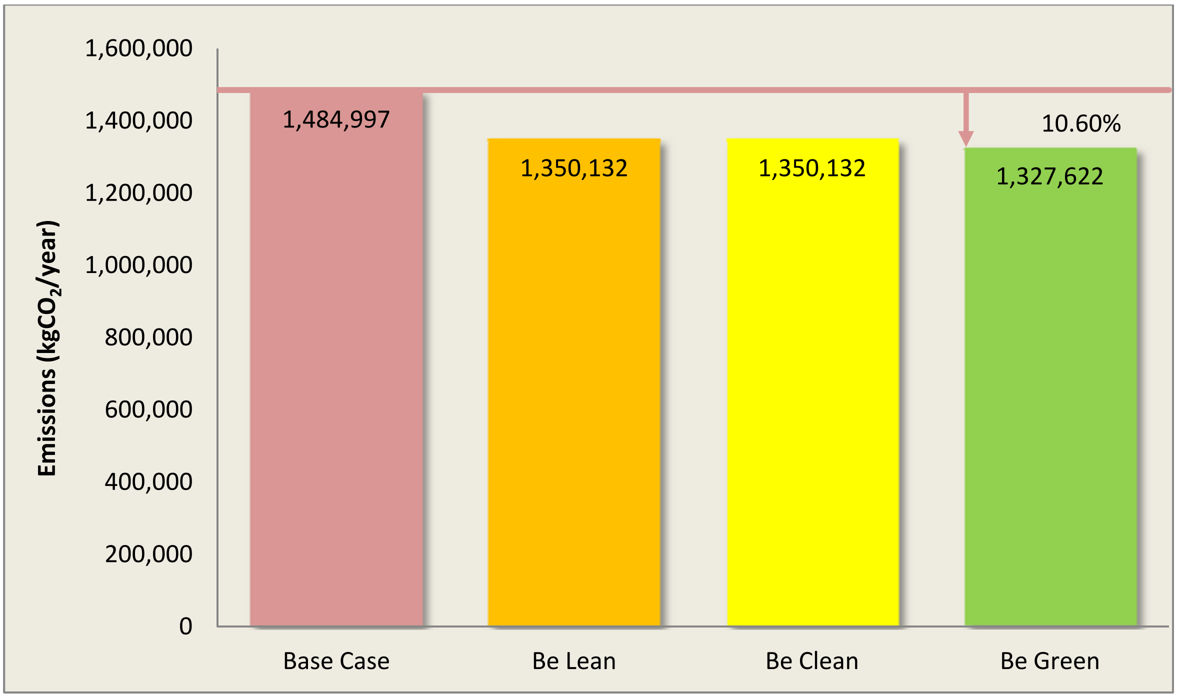
9.2 Results – Regulated Energy Consumption

The table below summarises the total regulated energy consumption for each stage for the development as a whole:

	Energy Consumption (kWh/year)	Consumption Reduction to previous stage (kWh/year)	% Consumption reduction compared to previous stage
Base Case	1,484,997	N/A	N/A
Be Lean	1,350,132	134,865	9.08%
Be Clean	1,350,132	0	0.00%
Be Green	1,327,622	22,510	1.67%
Renewable Contribution	1.67%		
Overall Reduction	10.60%		

Table 9: Summary of Regulated Energy Consumptions

The results in the table above are visualised in the graph below:



Graph 10: Summary of Regulated Energy Consumptions

The annual regulated energy consumption, at this stage in the design process, will be 10.6% below the Base Case with renewable technology providing 1.67% of this reduction.

10. Conclusion

This Energy Strategy demonstrates that the 125 Shaftesbury Avenue development is able to achieve a 22.87% reduction in carbon emissions over a Part L 2013 Target Emission Rate.

Whilst this is short of the 35% London Plan target, this is achieved on a restrictive site which requires that the existing structure is retained. This route to construction means there is a very large embodied carbon saving in terms of the materials used in construction, in addition to the 22.87% reduction in emissions.

The 22.87% reduction in emissions is achieved by the inclusion of an enhanced thermal envelope, improved glazing, reduced air permeability, high performance HVAC systems and a low energy lighting design. In addition an Air Source Heat Pump is to provide heating to the office as well as heating and DHW to the retail units. A 150m^2 PV installation further reduces the carbon emissions to the final 22.87% reduction result.

Given the additional embodied carbon saved by the retention of the existing structure, we feel that the 22.87% reduction in emissions achieved in this report maximises the carbon reduction for this site.