15 Great James Street, London, WC1N 3DP

Energy & Sustainability Statement

Impact Sustainability Ltd
T: 07792 670 919
E: george@impactsustainability.co.uk

Revision Schedule

Revision No.	Date	Details of Change
Rev 03	06/02/2020	Cover page updated
Rev 02	07/02/2020	Update following comments from team
Rev 01	06/02/2020	First Issue

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1.0 Introduction

Impact Sustainability Ltd has been instructed by 15 Great James Street Ltd to undertake an energy and sustainability statement for the proposed re-development at 15 Great James Street, London. The development involves the major refurbishment of the existing listed building to provide contemporary office space over a basement floor, ground floor and three upper floors. Once completed, the property will be 'knocked through' to the adjacent property Nr 14 Great James Street to create a single premises. Nr 14 Great James Street has recently undergone a major refurbishment and so although included within the planning application this is to be excluded from the energy and sustainability assessments.

Under London Borough of Camden Local Plan Policy CC1 it must be demonstrated that energy efficiency and reduction has been fully evaluated in accordance with the energy hierarchy. This report therefore assesses the performance of the proposed re-development in terms of energy efficiency measures, viability of district heating connection / on site CHP and potential specification of Low and Zero Carbon (LZC) technologies. Under Local Plan Policy CC2 the development must demonstrate resilience to climate change through relevant mitigation measures. This report therefore also includes a sustainability statement to address these issues.

This report has been completed by George Kent of Impact Sustainability Ltd, who is a registered Non-Domestic Low Carbon Energy Assessor (LCEA). George has 12 years continuous experience in energy simulation and consultancy and is not professionally connected or affiliated with any LZC technology or manufacturer. George is therefore considered to be an 'Energy Specialist'.

2.0 Local Policy

The site is located within the London Borough of Camden and so is subject to The London Borough of Camden Local Plan. Within this policy document are two key policies relating to climate change.

Policy CC1 'Climate Change Mitigation' seeks to ensure that development fully consider energy efficiency measures, clean energy delivery and offsetting of CO_2 emissions by following the energy hierarchy:

Be lean: use less energy
Be clean: supply energy efficiently
Be green: use renewable energy

Furthermore, for developments exceeding 500sqm gross internal floor area the use of on-site LZC generation should achieve a 20% reduction in CO_2 emission below the energy efficient 'be lean' scheme unless it can be demonstrated that such provision is not feasible.

The London Plan Spatial Development Strategy for Greater London, March 2015, Chapter 5 London's Response to Climate Change, Policy 5.2 also requires all buildings to reduce their carbon dioxide emissions beyond building regulations, following the Energy Hierarchy.

The London Plan includes strategic targets for carbon dioxide reduction to enable the Mayors Climate Change Mitigation targets to be met (Policy 5.1).

Residential buildings:		**Non-domestic buildings:**	
Year	**Improvement on 2010 Building Regulations**	**Year**	**Improvement on 2010 Building Regulations**
2010 – 2013	25 per cent (Code for Sustainable Homes level 4)	2010 – 2013	25 per cent
2013 – 2016	40 per cent	2013 – 2016	40 per cent
2016 – 2031	Zero carbon	2016 – 2019	As per building regulations requirements
		2019 – 2031	Zero carbon

Figure 2.1 Extract from London Plan, 2016

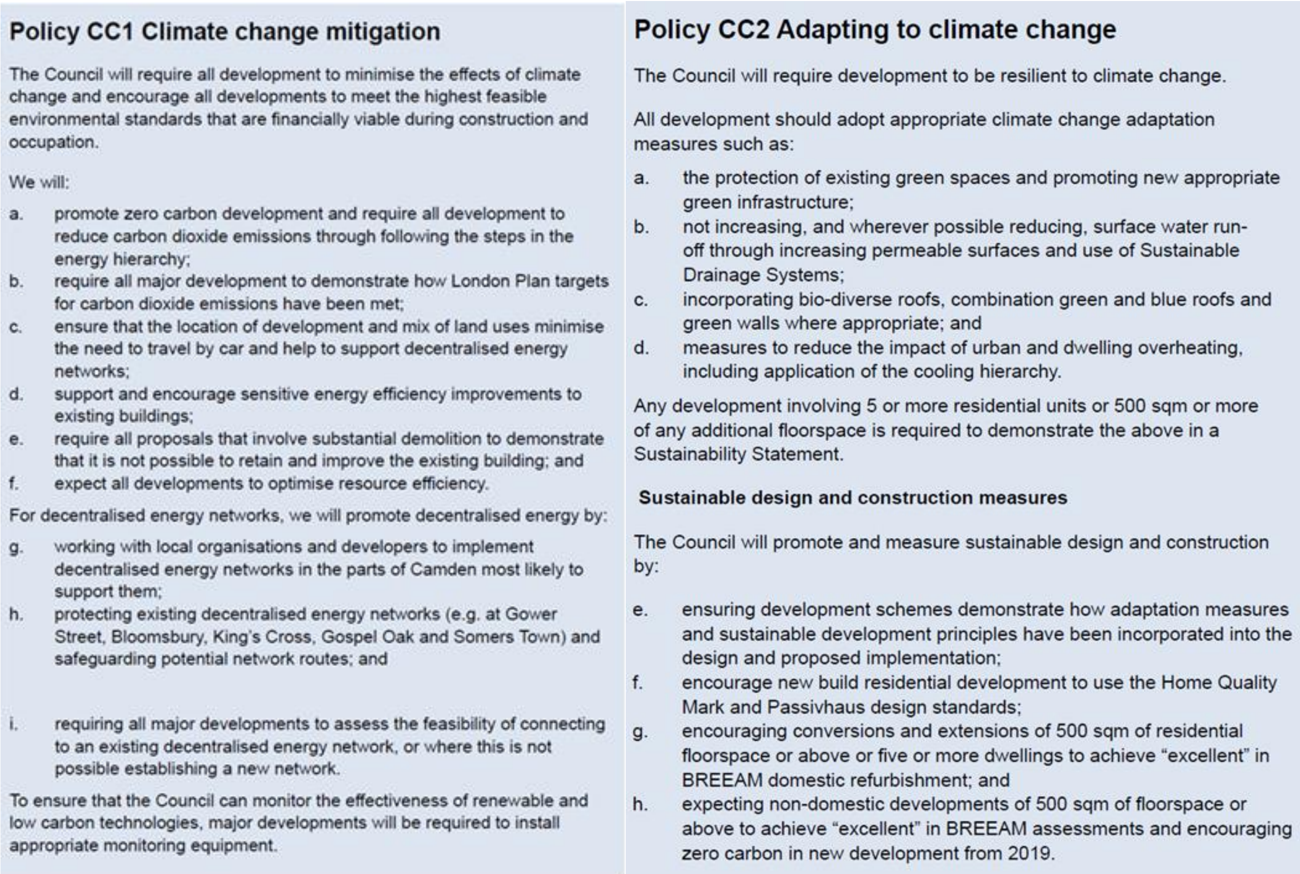
At the time of publication, the target requirement was to reduce carbon dioxide emissions by 40% beyond Building Regulations Part L 2010. However, since AD Part L 2013 has been introduced this has been adjusted accordingly to a target of 35% below Part L 2013 standards.

The London Plan CO_2 reduction targets are applicable to 'major developments' of over 1,000sqm GFA only. Therefore, as the refurbishment of 15 Great James Street falls below this threshold it is not considered to be a 'major development' and as such is not subject to this requirement.

Local Plan policy CC2 'Adapting to Climate Change' seeks to ensure that all development within the borough is resilient to the effects of climate change. This must be demonstrated through submission of a sustainability statement that addresses the following issues:

- Protection of green spaces / promotion of green infrastructure
- Effective management of surface water run-off
- Inclusion of bio-diverse roofs where feasible
- Reduction of overheating risk following the cooling hierarchy

The policy also requires that a BREEAM Target of 'Excellent' is sought for developments over 500sqm GFA. This specific requirement has been previously addressed through the submitted BREEAM pre-assessment report, dated 26th July 2019.



Policy CC1 Climate change mitigation

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

We will:

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

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

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

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

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

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

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

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

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

Figure 2.2 Extracts from London Borough of Camden Local Plan

3.0 Energy Statement

3.1 3D Compliance Model

3.1.1 Geometry

A 3D model of the development has been constructed within IES Virtual Environment software using the ModelIT tool, see figure 3.1. IES VE is a dynamic simulation modeling software, which has been selected and applied in accordance with CIBSE AM11. The geometry of this model has been based upon the following drawings provided by Owen Architects Ltd:

- 406_Sh_2099_J – Proposed Basement Plan
- 406_Sh_2100_H – Proposed Ground Floor Plan
- 406_Sh_2101_I – Proposed First Floor Plan
- 406_Sh_2102_I – Proposed Second Floor Plan
- 406_Sh_2103_I – Proposed Third Floor Plan
- 406_Sh_2104_H – Proposed Roof Plan
- 406_Sh_3100_G – Proposed Front Elevations
- 406_Sh_3101_H – Proposed Rear Elevations
- 406_Sh_4102_J – Proposed Sectional Elevation CC
- 406_Sh_4103_J – Proposed Sectional Elevation DD
- 406_Sh_4104_G – Proposed Sectional Elevation EE

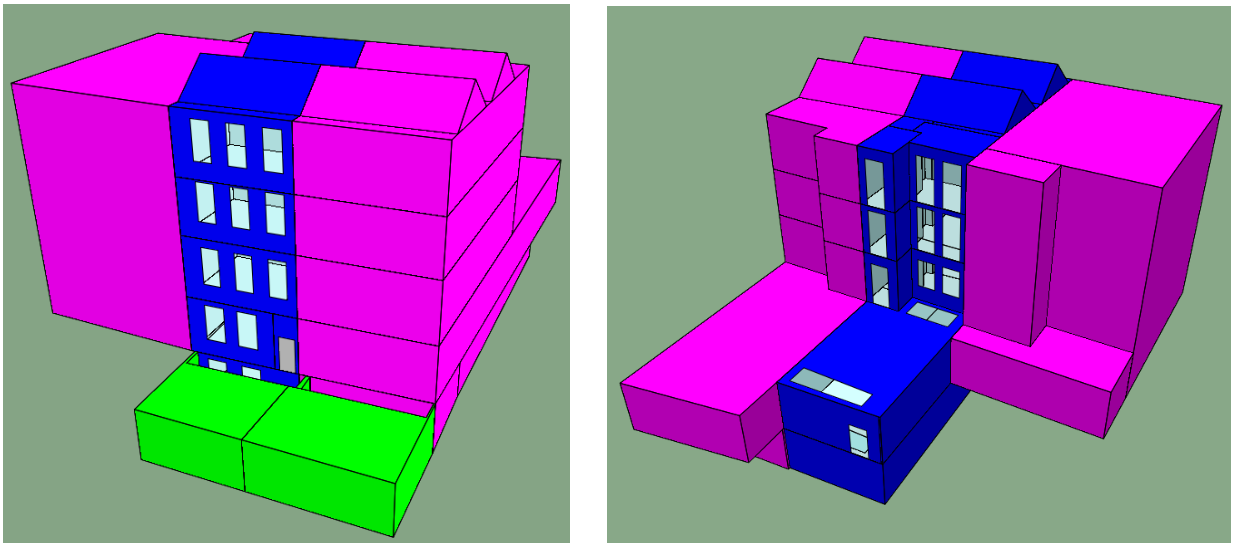


Figure 3.1 3D views of IES model f 15 Great James St

3.1.2 Climate Data

To complete the assessment of the CO_2 savings that proposed refurbishment could achieve an AD Part L2 assessment is completed using the VE Compliance tool within IES Virtual Environment software package. This offers full dynamic simulation of the building using default NCM data sets. To complete this analysis a Test Reference Year (TRY) weather file must be selected and applied to the model.

The TRY is composed of 12 separate months of data, each chosen to be the most average month from the collected data. The TRY is used for energy analysis, compliance with the UK Building Regulations (Part L) and to assess winter thermal comfort. The TRY weather file used within the compliance model is the LondonTRY file.

3.2 Baseline Assessment

3.2.1 Summary

To determine the potential energy and CO_2 savings possible under the development proposals a baseline must first be established. This baseline is derived from an Approved Document Part L2A 2013 compliance calculation and determining the Target Emission Rate (TER). The TER is the maximum permitted annual CO_2 emission level from the building that is taken from an SBEM (Simplified Building Energy Model) or DSM (Dynamic Simulation Model) calculation using NCM (National Calculation Methodology) approved software.

3.2.2 Baseline Assessment Results

Table 3.1 below shows the CO_2 breakdown of the baseline compliance analysis. The target annual CO_2 emissions for the development are 10,549kg.

Energy Breakdown	Electricity		Oil	
	kWh/yr	kgCO_2/yr	kWh/yr	kgCO_2/yr
Heating	3,046	1,581	-	-
DHW	-	-	1,487	474
Cooling	2,925	1,518	-	-
Lighting	12,476	6,475	-	-
Pumps & Fans	965	501	-	-
Total	**19,412**	**10,075**	**1,487**	**474**
Total Site Baseline Energy (kWh/yr)				**20,899**
Total Site Baseline CO_2 Emissions (kgCO_2/yr)				**10,549**

Table 3.1 Annual Baseline CO_2 Emissions

3.3 'Be Lean' Assessment

3.3.1 Summary

The first step of the energy hierarchy is to improve a building's energy demand through the specification of thermally efficient building fabric and services. To reduce this energy demand from the building high performance thermal insulation will be specified where possible to reduce existing envelope u-values significantly below what is required for AD L1A 2013 compliance. As the property is Grade II listed the street facing fenestration and façade cannot be significantly altered, however thermal improvements have been made where it is viable to do so.

The 'Be Lean' fabric specification is shown in table 3.2 below and is based upon information provided by Owen Architects Ltd.

Building Element	Construction	U-Value W/m²K
Existing basement floor	Uninsulated solid concrete slab, screed	0.58
New basement floor	Insulated solid concrete slab, screed	0.20
External Wall (Front façade)	Retained solid brick wall	1.60
External wall (Rear façade)	Insulated timber frame cavity wall with brick slip cladding	0.23
Roof – Existing and new	Lightweight timber joists / rafters & tile	0.15
Roof – 1st floor terrace	Insulation over holorib decking and concrete infill fixed to structural BauBuche beams	0.15
Front facade windows to basement and ground floors (g = 0.60)	Heritage windows 9mm laminated glass	3.60
Front facade windows to upper floors (g = 0.60)	Single glazed heritage windows	5.56
Rear façade windows	Assumed aluminum framed double glazed	1.50

Table 3.2 Building Fabric Constructions

The building services strategy fully considers the opportunities for low regulated energy use within the building. Highly efficient VRF heat pumps are specified to meet the heat demand, which can be reversed to provide cooling during the warmer months. Lighting throughout the building will be low energy LED, which will be automatically controlled where appropriate to ensure lighting is only used when required. The ventilation strategy is primarily 'natural', with fresh air provided via openable windows and trickle vents. Some rooms are internal with no window and in these spaces mechanical ventilation will be used to maintain thermal comfort and air quality. Within subscription desk areas the air handling equipment will include high efficiency heat recovery to minimise the ventilation heat load. All fans will be selected with a low specific fan power (SFP in mind). The hot water demand within the office space will be low and so a dedicated hot water generator with primary and return loop is not considered to be an efficient option due to the pump energy requirements and loop heat losses. Instead instantaneous electric point of use water heaters will be installed to deliver hot water efficiently as required. Table 3.3 below provides details of the 'be lean' services strategy.

System	System Details	Delivery Method / Controls	Zones
Heating	VRF Heat Pump, C.O.P. = 4.34	Local Fan Coils Units, generally concealed or ceiling mounted	Offices, subscription desks and meeting rooms
Cooling	VRF Heat Pump, E.E.R. = 4.15	Local Fan Coils Units, generally concealed or ceiling mounted	Offices, subscription desks and meeting rooms
Ventilation	Natural Ventilation	Openable windows & trickle vents	Rooms where external windows are present
	Mechanical supply & extract, SFP=0.40, heat recovery μ=90.0%	Dedicated AHU	Subscription desks
	Mechanical supply, SFP=0.40	Central in-line supply fan	G.03 meeting room, G.04 meeting room & 3.02 office
	Mechanical extract SFP=0.40	Central in-line extract fan	WCs
Hot water	Direct electric water heaters	Instantaneous point of use	All areas
Lighting	LED, assumed 90 lms/W	Daylight dimming & absence detection	Occupied areas with windows
		Absence detection	Internal offices and subscription desks
		Presence detection	WCs, cupboards, circulation

Table 3.3 Building Services Systems & Performance Data

3.3.2 'Be Lean' Assessment Results

Table 3.4 below shows the energy and CO_2 breakdown of the baseline 'be lean' compliance model. The annual regulated energy use is 900,157 kWh and the total annual CO_2 emissions resulting from this energy use are 269,424kg, which is a 14.4% reduction below the baseline figure.

Energy Breakdown	Electricity		Gas	
	kWh/yr	$kgCO_2$/yr	kWh/yr	$kgCO_2$/yr
Heating	6,420	3,332	-	-
DHW	1,353	702	-	-
Cooling	829	430	-	-
Lighting	8,197	4,254	-	-
Pumps & Fans	607	315	-	-
Total	**17,405**	**9,033**	**-**	**-**
Total Site Baseline Energy (kWh/yr)				**17,405**
Total Site Baseline CO_2 Emissions ($kgCO_2$/yr)				**9,033**

Table 3.4 Annual 'Be Lean' Regulated Energy Use & CO_2 Emissions

3.4 'Be Clean' Assessment

3.4.1 District Heat Networks

In the London Plan Policy 5.5 Decentralised Energy Networks, the Mayor expects 25% of the heat and power used in London to be generated through the use of localised decentralised energy systems by 2025. The London Heat Map shown in figure 3.2 (interactive online map www.londonheatmap.org.uk accessed 6th February 2020) shows there are no existing district heating networks (red) that the proposed scheme could connect to, and no potential networks (orange) in the vicinity are being proposed. The site is shown on the London Heat Map within the red circle and this shows an existing network is located approximately 1km away from the site, which is too distant from the site to be connected to.

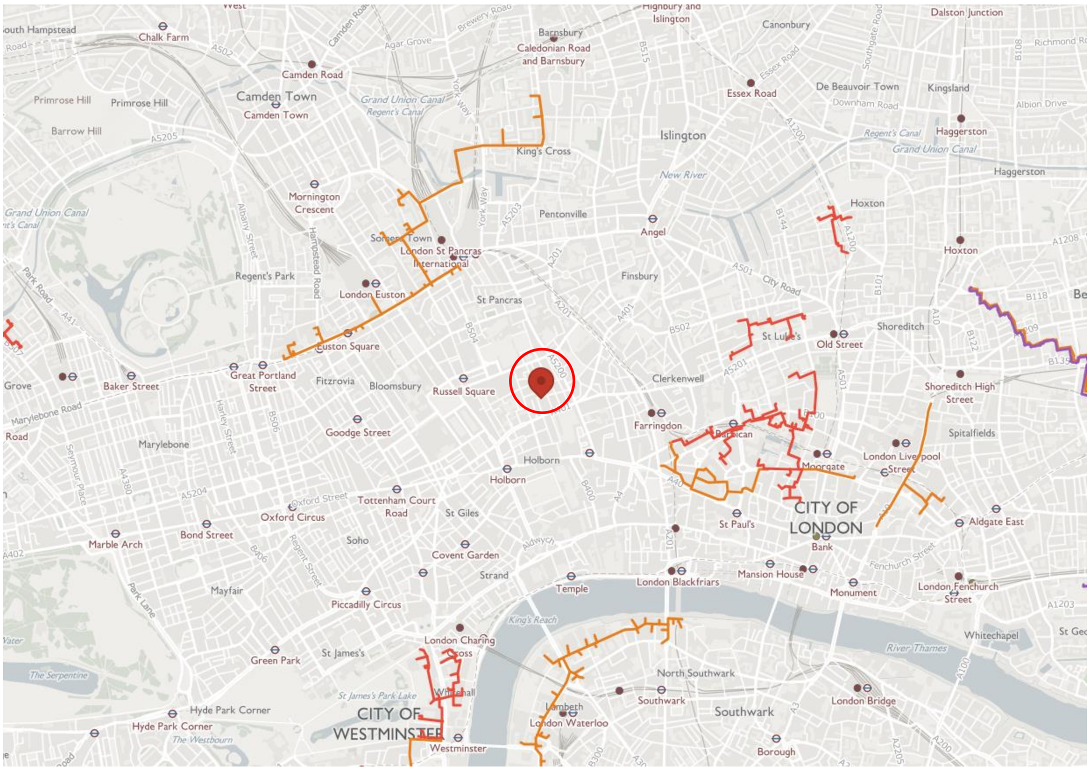


Figure 3.2 London Heat Map of site location (accessed 06/02/2020)

In order to allow provision for connection to a district heating system in the future the heating system would need to be designed with future connection capability in mind. This is not a viable option for a development of this type as the listed nature of the premises restricts the opportunities for available space to install the appropriate plant and internal distribution network.

3.1 Combined Heat & Power

Combined heat and power (CHP), also known as cogeneration, is the simultaneous generation of thermal and electrical energy from a single stream of fuel. A CHP engine burns fuel to run a turbine, which in turn generates electricity. The 'waste' heat from the combustion process is then used to provide heating and hot water within the building. In this way electricity from conventional power stations is displaced and the substantial conversion, transmission and distribution losses are avoided. The resulting efficiency gives typical small-scale CHP installations a simple payback period of between 3 and 5 years, beyond which the units continue to save energy right up until the end of the life of the plant.

Systems must be 'heat lead' for high efficiency, which best suits applications to situations where there is a significant demand for heat for long periods of time, such as hospitals, hotels and leisure centres. As the proposed development is office space it has a very low hot water demand and as such is not well suited to a CHP installation. Furthermore, there is insufficient space available at the site to locate a CHP engine and no opportunity to create the space due to the existing building form and limitations of the listed building status.

Therefore, neither a district heating connection or micro-CHP system is considered to be a viable option for reducing CO_2 emissions within the development and no further reduction in CO_2 emissions can be achieved from the 'be clean' stage of the energy hierarchy.

3.2 'Be Green' Assessment

The commentary below provides an overview of the potential LZC technologies considered for specification within the development and presents the associated opportunities and constraints.

As a detailed HVAC strategy has not yet been finalised by the principle contractor's design team none of the technologies have been discounted on the basis of affecting planning or design.

- **Biomass Heating** – Fuel storage / access concerns and high level of maintenance required not suited to this development type. Also concerns surrounding local air quality. Not viable.
- **Ground Source Heat Pump** – Insufficient site area available for horizontal system and vertical system not financially viable on what is a relatively small scale site. Vertical bore holes likely to interfere with existing below ground infrastructure in this urban setting. Not viable.
- **Air Source Heat Pump** – Air source heat pumps are viable and will be utilised to deliver the heating demand to the building. However, these have already been considered within the 'be lean' section. Furthermore, ASHPs cannot be considered as an LZC technology when utilised in reverse to provide cooling. Viable and already included.
- **Wind Turbine** – Urban context of site and location within planning policy area means this technology would not be permitted in this location. Not viable.
- **Solar Thermal Panels** – Energy can only be used when there is a demand in the building, otherwise it is 'dumped' and hot water demand from the property will be low. Furthermore, listed nature of property prohibits the installation of solar thermal collectors at roof level. Not viable.
- **Photovoltaics** – Sufficient roof space is available to install a small array; however, the grade II listed status of the building prohibits this. Not viable.

The findings of the LZC technology appraisal confirm that, due to the urban context, limited existing space, local policy restrictions and listed building status the constraints on site are such that no LZC technologies are considered to be viable. Therefore, no further reductions in CO_2 emissions can be achieved at the 'be green' stage of the energy hierarchy.

3.3 Energy Statement Conclusion

An energy strategy for the proposed development at 15 Great James St, London has been assessed in accordance with London Borough of Camden Local Plan Policy CC1 based upon the energy hierarchy:

Be Lean: use less energy

Be Clean: supply energy efficiently

Be Green: use renewable energy

Following this approach has resulted in an energy efficient scheme that has minimised CO_2 emissions associated with the use of regulated energy through improvements to the thermal performance of the building envelope and high efficiency building services strategy. These measures have resulted in a reduction in annual CO_2 emissions of 14.4% below the Part L baseline.

Connection to a district heat network is not a viable option as the London Heat Map currently indicates that there are no existing or proposed networks within 1km of the site. The space limitations of the existing building and constraints of the listed building status mean that installing a system that was 'network ready' is not feasible. On site micro-CHP is not considered to be a viable option as there is a minimal base heat and hot water demand and there is no space available to locate the engine. A further reduction in CO_2 from 'Be Clean' measures is therefore not possible.

An LZC technology appraisal has been completed, however this concludes that due to a variety of site constraints there are no LZC technologies that are considered to be feasible for inclusion. As such no further reduction in CO_2 emissions can be achieved at the 'be green' stage of the energy hierarchy.

The results of the energy hierarchy analysis followed within this energy statement are shown in table 3.5 and figure 3.3 below.

Energy Hierarchy Stage	CO_2 Emissions (kg/yr)	CO_2 Reduction (kg/yr)	Reduction at each Stage (%)	Reduction from Baseline (%)
Baseline	10,549			
'Be Lean'	9,033	1,516	14.4%	14.4%
'Be Clean'	9,033	0	0.0%	14.4%
'Be Green'	9,033	0	0.0%	14.4%

Table 3.5 Results of energy hierarchy analysis using Part L 2013

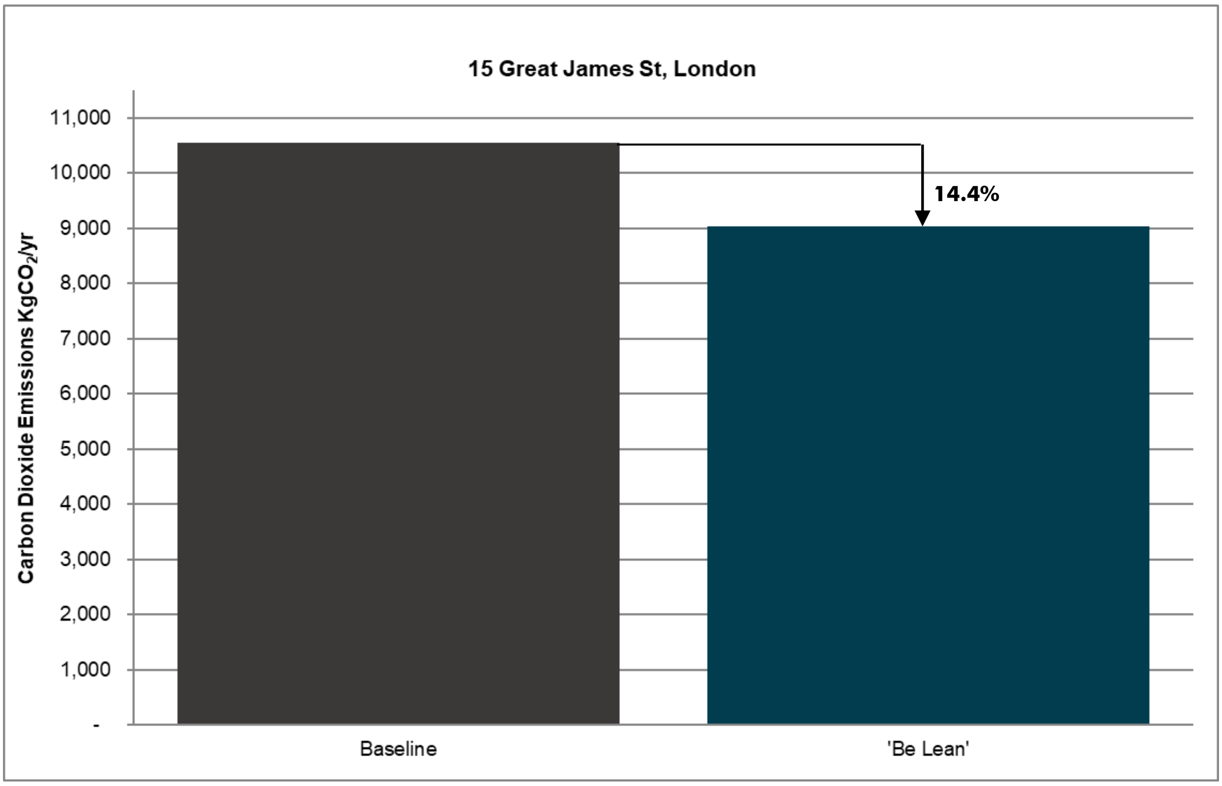


Figure 6.1 Graphical results of energy hierarchy analysis Part L 2013

4.0 Sustainability Statement

4.1 Summary

Under the London Borough of Camden Local Plan policy CC2 'Adapting to Climate Change' all development within the borough should demonstrate that it is resilient to the effects of climate change, with climate change mitigation measures proposed where required. This sustainability statement aims to address these climate change issues and to confirm how local policy will be met by the proposed development or give sufficient reasons as to why it cannot. These sustainability issues are also discussed within the BREEAM pre-assessment report Rev02, issued 26th July 2019. The design proposals demonstrate a robust consideration of sustainability issues to ensure the lowest possible impact of the development upon both the local and wider environment.

4.2 Green Spaces

The existing property at 15 Great James Street has no green amenity areas within the site boundary, which is entirely occupied by the building footprint. There are also no green areas within or surrounding the proposed construction zone. Therefore, the proposed refurbishment works will have no impact on existing green spaces and no ecology will be disturbed or displaced.

As the property occupies the whole site footprint there is not an opportunity on site to create a new dedicated green area. Notwithstanding this constraint, under the current proposals two new amenity areas will be created for the occupants of the building to enjoy. An external terrace will be created at first floor level on the roof of the ground floor rear extensions, with a second created at roof level above the rear section of the third floor. Both of these areas will include planters and bird boxes to create a pleasant green environment in which occupants can relax. Therefore, the proposals will increase the green areas when compared to the existing building.

4.3 Surface Water

As mentioned, the proposed development involves the major refurbishment of a grade II listed property. The listed nature of the property presents a number of constraints as the property must be preserved in its present form as far as practicable. There is not sufficient space on site to allow infiltration to be installed and it is unlikely that ground conditions would be favourable in any case. Inclusion of on-site attenuation measures is not a viable option as again there is nowhere to locate this without major disruption that would unlikely be acceptable to English Heritage.

However, as the existing property comprises entirely of building footprint and hard standing and the site area will not increase there will be no increase in surface water run-off from the site. Therefore, the proposed strategy to retain and reuse the combined sewer connection complies with policy CC2.

4.4 Bio-diverse Roofs and Walls

The existing property does not currently include a bio-diverse, 'green' or 'blue' roof or wall. Whilst desirable on new build projects, such features would not be in keeping with this period property and would likely be in conflict with listed building requirements. Furthermore, it is unlikely that the current roof structure could support the additional load of a 'green' or 'blue' roof. For these reasons such a design feature is not considered to be viable for this development.

4.5 Overheating

The front façade of the property at 15 Great James Street is West-Southwest facing and it is therefore possible that rooms on this side will be subject to solar gain in the afternoons, particularly during the Spring and Autumn months when the Sun is low in the sky. The intended use of the building as office space also potentially creates a large internal heat gain from lighting, dense occupancy and I.T. equipment. It is therefore important that thermal comfort is fully considered during the design stages to address any potential overheating risks.

Within Camden Planning Guidance 'Energy Efficiency and Adaptation', March 2019, section 10.4 a requirement is set out for dynamic thermal modelling to be completed to demonstrate that any overheating risk has been mitigated through the design. However, it is understood that in an email from Planning Officer Thomas Sild to Bettina Hente of Owen Architects on 29th January 2020 it is confirmed that dynamic simulation modelling is not required for this application due to the scale of the development. However, the principles of the Cooling Hierarchy must still be followed to ensure the lowest energy cooling strategy is adopted and to justify any active cooling solutions. Consideration of the Cooling Hierarchy at each stage is therefore given below.

4.5.1 Minimise internal heat generation through energy efficient design

The three primary forms of internal heat gain within the office space will be occupants, lighting and I.T. equipment. The internal layout of the office space will consider occupancy density to ensure that thee are no areas with unnecessarily high occupation level. The proposed lighting design incorporates low energy LED lighting, which will achieve performance in the region of 10-12W/m^2. Gains from lighting will further be reduced through effective use of automatic lighting controls, ensuring lighting is only switched on when required. All equipment will be procured with low energy use being a key consideration. Heating pipework to each of the fan coils will be insulated to the highest possible standards.

However, due to the nature of the intended use internal heat gains within the building will inevitably be considerable.

4.5.2 Reduce the amount of heat entering the building in summer

The building has windows on both the front (West-Southwest facing) and rear (East-Northeast facing) elevations. Whilst there may be an element of solar gain to the rear of the property during the early morning hours, the larger risk of solar gain will be to the front of the property. The adjacent four-storey properties on the opposite side of the road are approximately 16m away and so will certainly assist in reducing the effects of solar gain to this façade, however in early afternoon hours during spring and autumn months this could still present a problem.

Due to the listed status of the property there is not an opportunity to install any external shading on the front facade. Existing windows are recessed and so the form of the existing building offers some solar control during the summer months. The solar transmittance (g-value) of the glazing will be reduced to around 0.4 where this has no conflict with the requirement for heritage windows and blinds will also be installed wherever possible to effectively control solar gain and glare. Blinds and internal spaces will be light in colour to reflect solar gains and avoid the infrared absorption associated with darker colours.

4.5.3 Manage the heat within the building through exposed internal thermal mass and high ceilings

Unfortunately the existing building does not have any significant exposed thermal mass and so there is no opportunity to attenuate internal temperature fluctuations in this way. The constraints associated with the listed status mean that additional thermal mass cannot be introduced internally.

4.5.4 Passive Ventilation

Whilst it is not possible to introduce new windows to the front façade, the existing building form does allow a predominantly natural ventilation strategy to be adopted through the use of openable windows. This strategy will be adopted in all areas with windows and will likely be sufficient to maintain the required thermal comfort conditions during much of the year. However, as the window openings are pre-defined and cannot be altered there is only a limited level of single sided ventilation that can be achieved through their use. Windows on upper levels will need to be restricted for safety reasons and this will reduce the available 'free area' for fresh air, which may present an issue during warmer months when external conditions are calmer. The property does not have sufficient thermal mass for a night cooling strategy to be viable.

Therefore, whilst a natural ventilation strategy will be adopted where feasible to meet air quality requirements this may fall short of meeting thermal comfort conditions during warmer periods of the year.

4.5.5 Mechanical Ventilation

Mechanical ventilation will be utilised within some areas of the building such as internal offices / meeting rooms and the subscription desks as these areas do not benefit from openable windows. Ventilation rates within these areas will be designed primarily to meet air quality requirements as higher ventilation rates will result in noisier ventilation equipment, increased spatial requirement of air handling plant and reduced energy efficiency, the latter of which directly conflicts with the findings of the energy assessment.

The proposed ventilation equipment will have very low specific fan powers and so will be a low energy installation. The AHU serving the subscription desk areas will also benefit from a high efficiency heat recovery heat exchanger to avoid thermal losses during the colder months.

Due to the space constraints and listed status of the building it will not be possible to install a mechanical ventilation system throughout the building to address the overheating risk in all occupied spaces. Therefore an active cooling strategy must be adopted.

4.5.6 Active Cooling

As discussed in the previous sections, whilst every effort will be made to reduce internal and solar gains, utilise passive measures and, where necessary, mechanical ventilation to meet thermal comfort conditions, due to the constraints of the existing building it is likely that overheating could still be a risk on certain days of the year. It is therefore considered that an active cooling strategy is the only option available to ensure that thermal comfort conditions are maintained in accordance with the requirements of CIBSE TM52. As discussed within the energy statement section, for energy and practicality purposes the primary heating strategy is to utilise air source heat pumps. Not only are these an energy efficient solution but they have the benefit that they can be reversed to provide energy efficient active cooling during warmer periods. These will therefore form part of a mixed mode cooling strategy that will generally rely on natural or mechanical ventilation and will only rely on the active systems during periods of extreme heat gain.

4.6 Sustainable Design and Construction Measures

The current design proposals include a variety of sustainable measures, all of which are detailed within the BREEAM pre-assessment report that has been submitted with the application. The pre-assessment report also discusses the sustainable construction methods that will be adopted by the principle contractor once on site.

Within the BREEAM pre-assessment report it is confirmed that the development is committed to achieving a BREEAM Refurbishment and Fit Out assessment rating of 'Very Good', which is the highest BREEAM rating considered possible given the constraints of the site location and listed building.