9-13 GRAPE STREET

ENERGY STATEMENT

PROJECT MET

July 2014

Revision 02

CONTENTS

1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This energy statement has been carried out in line with the Camden energy guidance detailed in 'Camden Planning Guidance – CPG 3 Sustainability'. It considers a wide range of CO_2 reduction measures, recommends those most appropriate for the 9-13 Grape Street Development and outlines the proposed energy strategy to comply with Building Regulations Part L 2010, the appropriate planning requirements and the requirements of BREEAM Excellent.

1.2 CARBON SAVINGS

CO_2 reduction measures have been considered following the GLA's hierarchical methodology of 'Be Lean, Be Clean, Be Green'.

1.2.1 'BE LEAN' – REDUCE ENERGY DEMAND

Energy demand reduction measures include both passive and active design features including building fabric performance, glazing strategy, overheating mitigation, air tightness, thermal mass, increased ventilation, low energy lighting and controls and mechanical ventilation with heat recovery. Through the application of these measures a carbon emissions reduction of 55% is achieved when compared to the existing building.

1.2.2 'BE CLEAN' – SUPPLY ENERGY EFFICIENTLY

Although there is an existing district heating network in the area on Euston road it has been determined that the Development should not be connected to it for a number of reasons:

1. At its closest point this potential network is 1,250m from the Development.
2. The demand for heat and electricity for the Development (as it only consists of nine apartments) is relatively small in comparison to a large district heating network.
3. Requirement to lay additional network piping along busy London roads.

As the requirement for heat and electricity is relatively low and would not provide a consistent base load, an on-site CHP system is not suitable for the Development.

1.2.3 'BE GREEN' – USE RENEWABLE ENERGY

Renewable energy technologies considered include:

- Wind turbines
- Solar water heating
- Solar photovoltaics (PV)
- Biomass
- Ground source heat pumps (GSHP)
- Air source heat pumps (ASHP)

An analysis of the building energy demands after 'Lean' measures have been applied showed that the greatest contributor to CO_2 emissions was the requirements for space heating and hot water. For this reason a water based renewable system is best suited to the Development. While solar water heating systems offer hot water they do not provide space heating. They would also require a significant amount of roof space to provide all apartments with individual systems. Air source heat pumps offer a system which can provide both hot water and space heating requirements, when an air to water system is specified. Significant additional savings can be achieved with individual air to water heat pumps provided to each apartment.

The graph below shows the regulated CO_2 emission reduction achieved at each stage of the energy hierarchy.

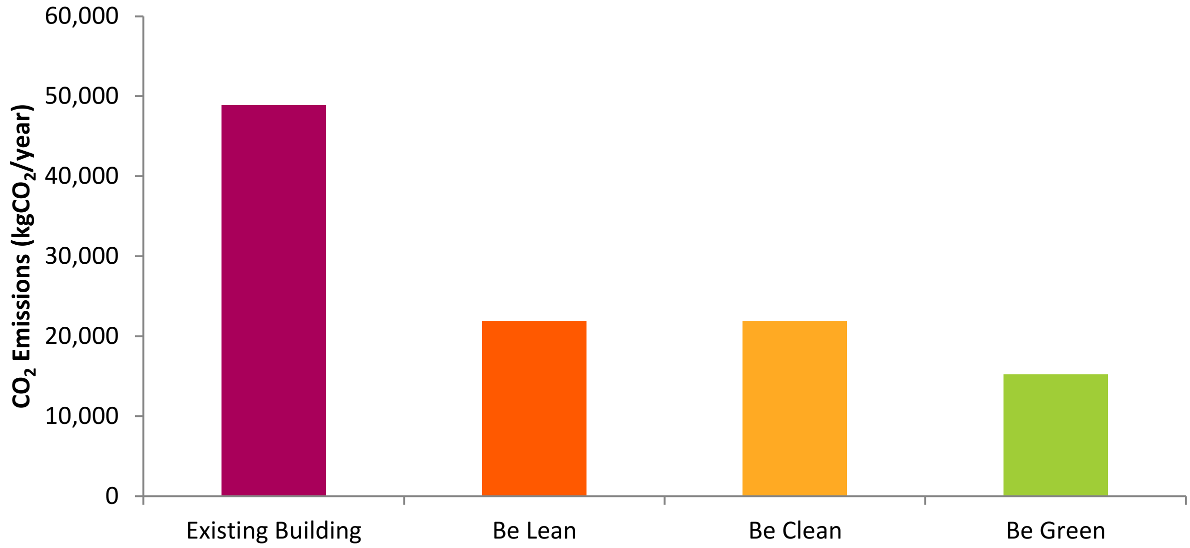

Figure 1 – CO_2 Emissions for whole Development at each stage of energy hierarchy

The table below shows CO_2 emission figures at each stage of the energy hierarchy.

Table 1 – Comparison of CO_2 emissions savings

	CO_2 Emissions ($kgCO_2$/year)
Existing 'Baseline' building	48,883
Building Regulations compliant new build	25,798
After 'Lean' measures	21,904
After 'Clean' measures	21,904
After 'Green' measures	15,235

1.3 COMPLIANCE WITH PLANNING POLICIES

The Development meets all of the planning policy requirements through the application of retrofit passive and active design features and air to water heat pumps.

Table 2 – Compliance check

Authority	Policy	Compliant
Government	NPPF	Yes
London Borough of Camden	'Camden Core Strategy' Policy CS13	Yes
BREEAM	'Excellent', credits targeted under Ene01	Yes
BREEAM	'Excellent', credits targeted under Ene02	Yes
BREEAM	'Excellent', credits targeted under Ene03	Yes

2 INTRODUCTION

2.1 BACKGROUND

This Energy Statement details the proposed design strategies that have been adopted by the project team for the 9-13 Grape Street Redevelopment, hereafter referred to as 'the Development', to minimise primary energy consumption and carbon dioxide emissions to the atmosphere. This report details the outcomes of analysis and calculations performed for a number of energy efficiency measures that have been considered for the Development and describes the resulting energy strategy.

This Energy Statement should be read in the context of the other planning documents forming the 9-13 Grape Street planning submission.

2.2 DEVELOPMENT OVERVIEW

The Development site is located in the Bloomsbury Ward of Camden, with the principal elevation fronting Grape Street and a secondary rear elevation set back from West Canal Street. The Development proposes the extension, alterations and change of use of the existing building (sui generis) into residential accommodation.

2.3 CARBON EMISSION FACTORS

The carbon emission factors used in this report are based on those within the Governments Standard Assessment Procedure (SAP) 2009 and referenced within Building Regulations Part L 2010 and are detailed in the Table 3.

Table 3 – Carbon emission factors (DECC, 2009)

Fuel	Emission Factor
Natural Gas	0.198 $kgCO_2/kWh$
Grid Supplied Electricity	0.517 $kgCO_2/kWh$
Grid Displaced Electricity	0.529 $kgCO_2/kWh$
Biomass	0.013 $kgCO_2/kWh$

2.4 PLANNING POLICIES

The planning policies that are addressed by the 9-13 Grape Street Development Energy Statement are as follows:

2.4.1 NATIONAL POLICY

The National Planning Policy Framework (NPPF) replaced the suite of Planning Policy Statements and Guidance in 2012. The NPPF identifies three dimensions to sustainable development - economic, social and environmental – which should be applied jointly and simultaneously:

Economic role – contributing to building a strong, responsive and competitive economy by identifying and coordinating development requirements;

Social role – supporting strong, vibrant and healthy communities by creating a high quality built environment, with accessible local services that reflect the community's needs and support its health, social and cultural well-being;

Environmental role – contributing to protecting and enhancing our natural, built and historic environment. This includes helping to improve biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change.

2.4.2 LOCAL PLANNING POLICY – THE LONDON BOROUGH OF CAMDEN

On 8th November 2010 the London Borough of Camden adopted the 'Camden Core Strategy', which sets out the updated criteria to take into account for all developments in the Borough. The specific policy relating to energy and CO_2 emissions is Policy CS13 – Tackling climate change through promoting higher environmental standards. The relevant policy states:

The council will require all developments 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:
   1. Ensuring developments use less energy;
   2. Making use of energy from efficient sources such as the Kings Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
   3. Generating renewable energy on-site;
d) Ensure buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.

(London Borough of Camden, 2010)

To meet these criteria the Development has adopted the energy hierarchy methodology:

- **Be Lean**: use less energy
- **Be Clean**: supply energy efficiently
- **Be Green**: use renewable energy

2.4.3 BREEAM

In accordance with the London Borough of Camden document 'Promoting sustainability and tackling climate change' Policy DP22, the Development is expected to achieve a BREEAM Domestic Refurbishment 'Excellent' rating for the refurbished apartments. To support achievement of the overall score required for an 'Excellent' rating, credits are being sought under 'ENE 01 – Improvement in Energy Efficiency Rating'; targeting an improvement ≥26, 'ENE 02 – Energy Efficiency Rating Post Refurbishment'; targeting a rating of ≥80 (high C), ENE 03 – 'Primary Energy Demand'; targeting ≤120kWh/m^2/year, and ENE04 – 'Renewable Technologies'; targeting 10% onsite low and zero carbon energy generation.

2.5 EMISSIONS REDUCTION TARGETS

While there are no specific numerical targets for reduction in CO_2 emissions, as the Development is a refurbishment rather than new build and only consists of 8No apartments, the Development will target an overall reduction as far as feasible.

3 'BASELINE' BUILDING EMISSIONS

3.1 'BASELINE' BUILDING EMISSIONS

The 'baseline' building is a representative model of the existing building, based on information known and industry standard assumptions from SAP 2009 guidance (DECC, 2009). As the existing building is currently of non-residential use its current energy use and EPC are not comparable to the proposed Development. In order to accurately compare the improvements made the proposed Development to the existing building a reduced data SAP has been undertaken, which uses data known about the building and a number of industry standard assumptions to give a baseline performance level for the building if it were currently residential with the same layout as the proposed Development, without any retrofit improvements.

All residential units were modelled individually to obtain the existing CO_2 emission rate, SAP Rating and Primary Energy use for each unit. These results were then combined and weighted to give a result for the calculation of the whole Development CO_2 emissions. All calculations have been conducted using NHER Plan Assessor version 5.4.1. The apartments are estimated to have a current energy performance rating of E or D, depending on the their location

3.2 TARGET BUILDING EMISSIONS

While there are no specific numerical targets for reduction in CO2 emissions, as the Development is a refurbishment rather than new build and only consists of 9 apartments, the Development will target an overall reduction as far as feasible.

In terms of numerical targets the Development is expected to achieve a BREEAM Domestic refurbishment 'Excellent' rating. To support this, the Development is targeting the credits detailed in Table 4.

Table 4 – Emissions targets

Credit	Credits Targeted	Requirement
ENE01 Improvement in Energy Efficiency Rating	3	SAP Rating Improvement ≥26
ENE02 Energy Efficiency Rating Post Refurbishment	3.5	SAP Rating ≥80
ENE03 Primary Energy Demand	7	≤120 $kWh/m^2/year$
ENE04 Renewable Technologies	1	10% onsite low and zero carbon energy generation

4 BE LEAN – USING LESS ENERGY

4.1 OVERVIEW

Energy efficiency is a key factor in reducing CO_2 emissions from both new and existing developments. As the Development is mainly refurbishment, retrofit measures offer an effective method of improving the energy efficiency of the building and therefore reducing overall CO_2 emissions. The project team recognises the need to reduce the energy demand of the building as far as practicable through the use of both passive and active design measures.

4.2 PASSIVE DESIGN FEATURES

Passive design features incorporate the use of the building structure and façade to minimise heating, cooling and lighting demand through measures such as high performance thermal insulation, improving air tightness and utilising thermal mass.

4.2.1 BUILDING FABRIC PERFORMANCE

Building fabric standards are important in reducing heat demand and Building Regulations have successively improved insulation standards. However, a balance is required between reducing heating requirements and increasing summer cooling requirements, particularly in dense urban locations, and this needs to be recognised when setting insulation levels. It is proposed for the existing building fabric insulation to be improved as far as practicable. The roof extension is proposed to improve on the minimum standards defined in Building Regulation Part L1A 2010. The insulation levels (i.e. U-values) adopted for the Development are provided in table 5.

Table 5 – Proposed U value summary

Element	Part L 2010 minimum standard	Existing Target Value	Penthouse Target Value
Exposed Wall	0.30 W/m^{2}K	0.30 W/m^{2}K	0.20 W/m^{2}K
Exposed Ground Floor	0.25 W/m^{2}K	0.25 W/m^{2}K	n/a
Exposed Roof	0.20 W/m^{2}K	0.18 W/m^{2}K	0.15 W/m^{2}K

4.2.2 GLAZING STRATEGY

The building façade balances the factors of daylighting, summertime overheating and beneficial winter solar gains. Glazing to the existing levels of the Development is proposed to be upgraded to double glazing from the existing single glazing to reduce thermal losses. As there is significant shading provided by Sovereign House, located opposite the Development, it is proposed that clear glass will be provided to existing areas of glazing.

4.2.3 OVERHEATING MITIGATION

An analysis of the likelihood of overheating has been carried out as part of the energy modelling. In order to help manage any overheating risk it is proposed to provide light coloured internal blinds/curtains to all apartments and a secure method of increased ventilation to all floors, with the exception of the ground floor. Although the overheating analysis shows that the ground floor apartments may overheat this is very unlikely given the heavy overshading from Sovereign House and the simplicity of the standard assessment procedure.

4.2.4 AIR TIGHTNESS

A second key fabric performance parameter is air tightness, i.e. the rate at which air moves through the building envelope to the outside. Part L 2010 sets a limit of 10 m³/hr per m² at 50 Pa for new buildings. Older buildings typically perform worse than this; the mean air tightness of existing buildings in the UK is estimated to be 11.48 m³/hr per m² (Stephen, 2000) as illustrated in figure 2. A general rule is that the older the building the less airtight it is, although buildings constructed in the period 1900-1920 is typically performs better than those constructed between 1920-1908, as shown in figure 3.

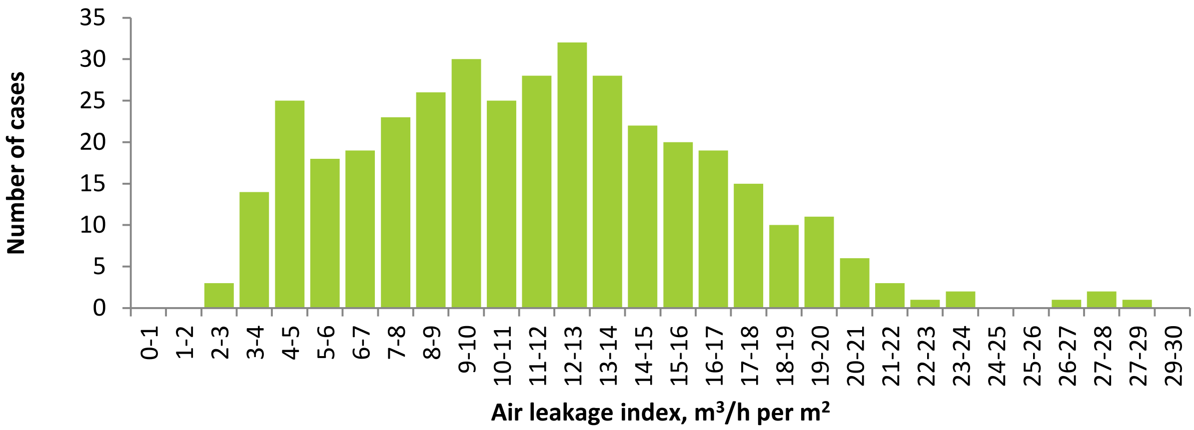

Figure 2 – Air leakage index distribution for dwellings (Stephen, 2000)

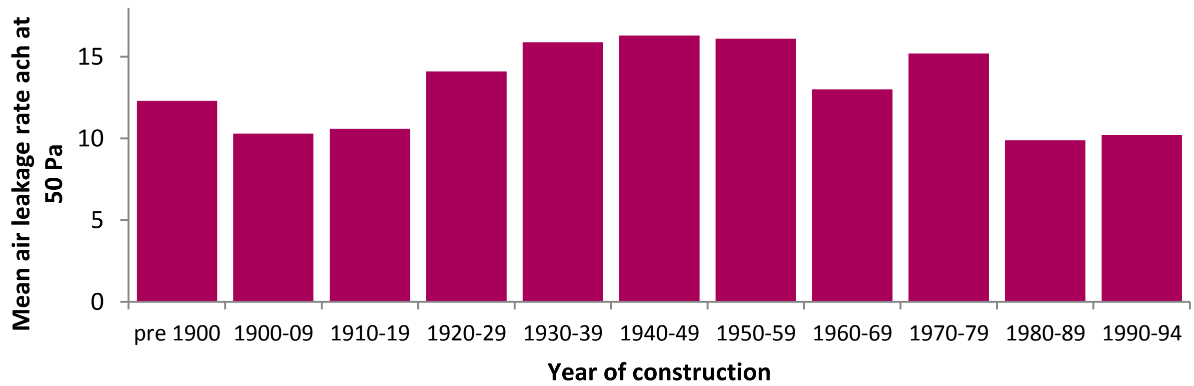

Figure 3 – Effect of dwelling age on air leakage rate in dwellings (Stephen, 2000)

A more stringent standard has been adopted for the Development of 5 m³/hr per m² at 50 Pa, which may be achieved by draught proofing and replacing windows. This reduces the heat loss associated with air infiltration and should also improve occupant comfort by reducing the risk of cold draughts.

4.2.5 THERMAL MASS

The use of internal thermal mass within the apartments will help support reductions in heating & cooling-related CO_2 emissions by limiting temperature peaks and allowing summertime heat build-up to be rejected during the night when external temperatures are lower.

4.2.6 INCREASED VENTILATION

A secure means of increased natural ventilation will be provided through openable windows from first floor upwards. Due to security issues, the ground floor units will not have openable windows, but will be provided with an alternative means of increased mechanical ventilation.

4.3 ACTIVE DESIGN FEATURES

4.3.1 LOW ENERGY LIGHTING AND CONTROLS

Low energy linear fluorescent, compact fluorescent and potentially LED lighting will be specified throughout the building in both apartments and communal areas to minimise the electrical demand for lighting and additional summer cooling load. It is anticipated that 100% of the residential light fittings will only be capable of accepting low energy lamps. Intelligent lighting control will be provided where appropriate incorporating PIR absence detection and potentially photoelectric dimming.

4.3.2 MECHANICAL VENTILATION WITH HEAT RECOVERY

Improved air tightness reduces the amount of heat (and therefore CO_2 emissions) required to heat the apartments. However this also means that apartments are generally less well ventilated. Increased natural ventilation is proposed and offers fresh air but can introduce heat loss and is not easily controllable. Mechanical ventilation offers the controlled introduction of fresh air and heat recovery prevents heat loss associated with ventilation.

The primary source of ventilation to the residential units is proposed to be through individual MVHR (mechanical ventilation with heat recovery) units provided to each dwelling. The specified units extract air which is passed through a high efficiency cross flow heat exchanger to provide a balancing tempered supply to the living areas. The units operate in trickle/boost configuration ensuring that only the required quantity of air is delivered to the apartment at any given time. The specified heat exchangers are to be highly efficient to maximise the energy transfer and minimise heat exhausted to the atmosphere.

4.4 'LEAN' BUILDING CO_2 EMISSONS

The 'lean' building takes into account all of the passive and active retrofit design features outlined in the previous sections and represents the likely performance of the Development using only 'be lean' measures.

As with the baseline building the CO_2 emission rate, SAP Rating and Primary Energy use for each unit have been calculated using NHER Plan Assessor version 5.4.1. The results of the modelling show that every apartment can achieve an EPC rating of 'C' through lean measures.

The following tables summarise the CO_2 emissions of the Development as a whole at this stage and the savings achieved as a result of 'Lean' controls.

Table 6 - Comparison of CO_2 emissions savings after 'Lean' measures

	CO_2 Emissions ($kgCO_2$/year)
Existing 'Baseline' building	48,883
Building Regulations compliant new build	25,798
After 'Lean' measures	21,904

Table 7 – CO_2 emissions savings over existing building from 'Lean' measures

	($kgCO_2$/year)	(%)
Savings from 'Lean' measures	26,979	55

A comparison between the CO_2 emissions of the existing Development and the 'Lean' Development is shown in Figure 4.

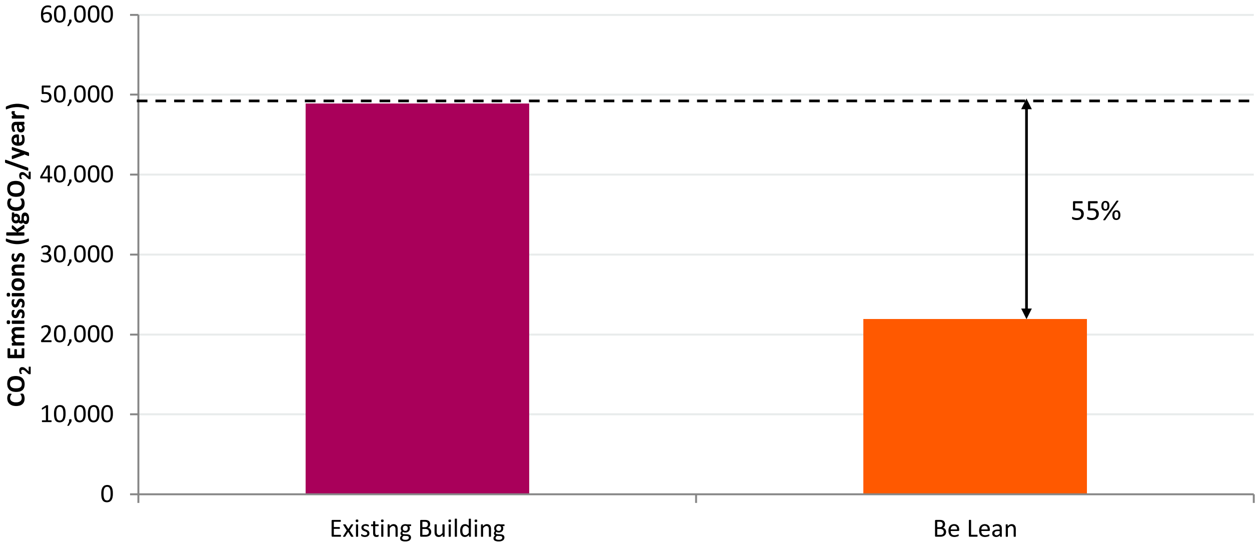

Figure 4 – CO_2 Emissions for whole Development – 'Be Lean'

Table 8 shows the credits achieved under BREEAM Domestic Refurbishment after only 'Lean' measures have been applied.

Table 8 – BREEAM Credits achieved 'Be Lean'

Credit	Credits Targeted	Credits Achieved
ENE01 Improvement in Energy Efficiency Rating	3	2.5
ENE02 Energy Efficiency Rating Post Refurbishment	3.5	3
ENE03 Primary Energy Demand	7	6.5
ENE04 Renewable Technologies	1	0

5 BE CLEAN – SUPPLYING ENERGY EFFICIENTLY

5.1 OVERVIEW

The Development will have a non-diverse heating demand as it consists entirely of residential space (with the exception of the relatively small common areas). Centralised building heating systems take advantage of a diversity of load profiles, which is not present in the Development. For this reason a system of this type may not be suitable for the Development.

5.2 CONNECTION TO EXISTING DISTRICT HEATING NETWORKS

In accordance with Camden Core Strategy 2010 Policy CS13 an assessment of the current and proposed heat networks in the area has been carried out to establish the feasibility of connecting the Development to a district heating network. With reference to the London Heat Map it has been determined that the closest heat network to the Development is the potential UCL network. At its closest point this potential network is 1,250m from the Development.

The map below shows the Development location and the heat networks in the area, obtained from the London Heat Map and the site location.

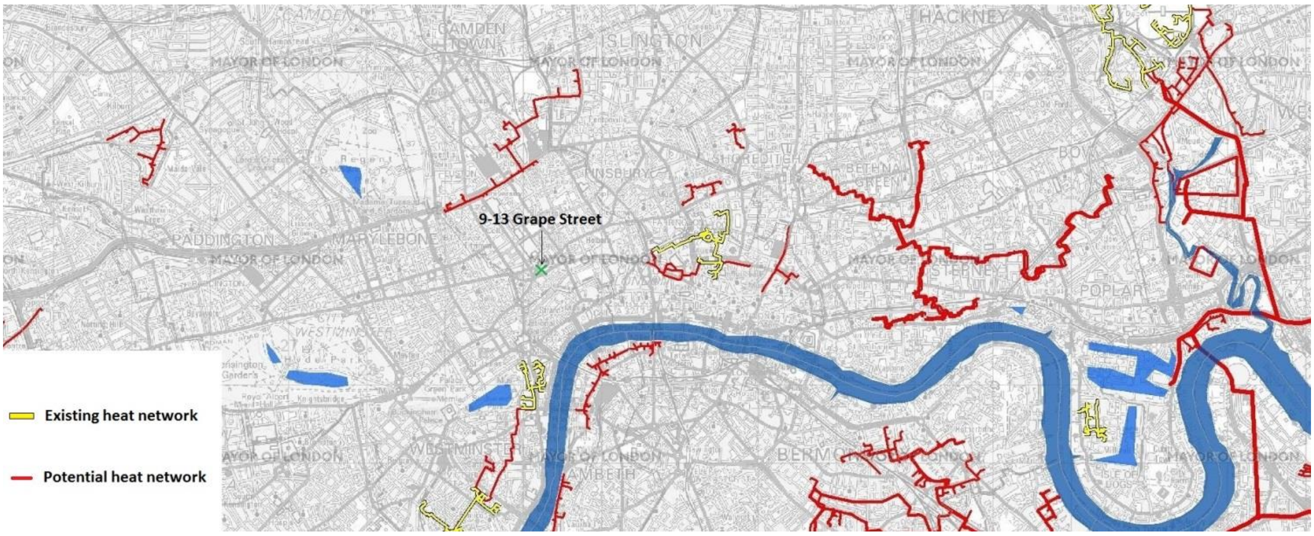

Figure 5 – Heat network data for area surrounding 9-13 Grape Street (Centre for Sustainable Energy, 2010)

According to more recent data the Development is within 1km of an existing/emerging network, in the form of the aforementioned UCL network as illustrated in figure 6. As shown in figure 7 the Development is also 500m of a potential network at the British Museum. It is unlikely to be feasible to connect the Development to the existing network as it is a significant distance away. Its location in central London would mean connecting to this network would be very disruptive to traffic during any laying of piping, considering the distance of pipe would be required. As the potential network is not yet confirmed and the demand for heat and electricity for the Development (as it only consists of nine apartments) is relatively small, it is also not likely to be feasible to connect the Development to it. For these reasons the Development is not proposed to be connected to an existing district heating network.

If the existing heat network serving University College London is extended to the British Museum it may be possible to explore the potential of connecting the Development to this network. As it is proposed to provide heat via a wet radiator heating system this would be compatible with a future district heating network.

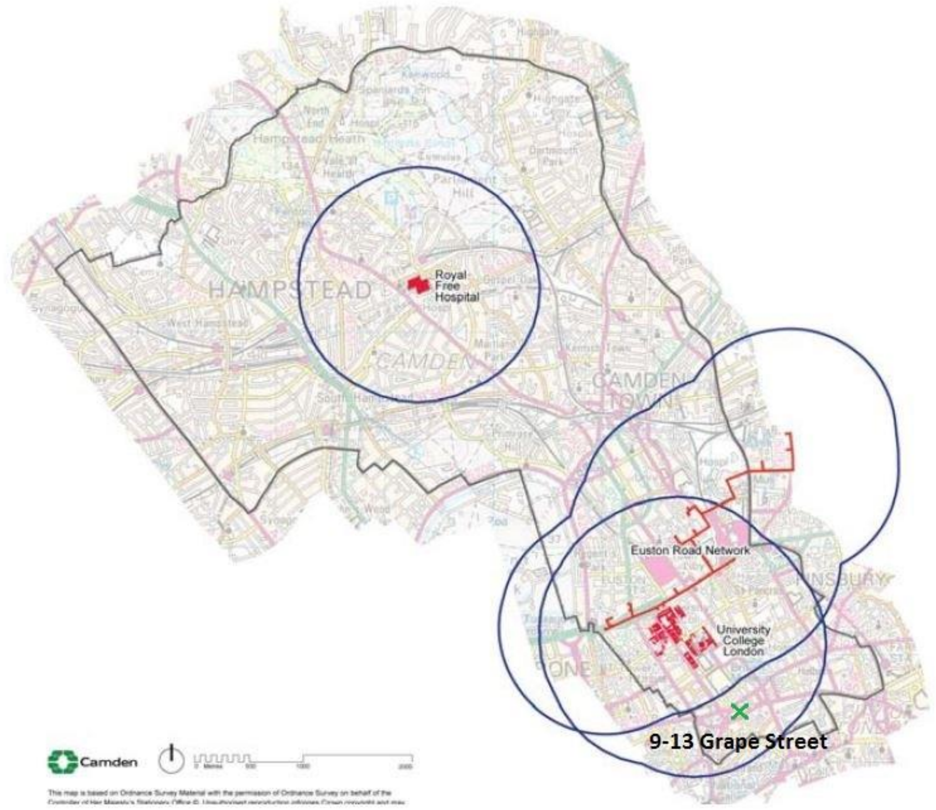

Figure 6 – Developments within 1km of an existing or emerging network (London Borough of Camden, 2013)

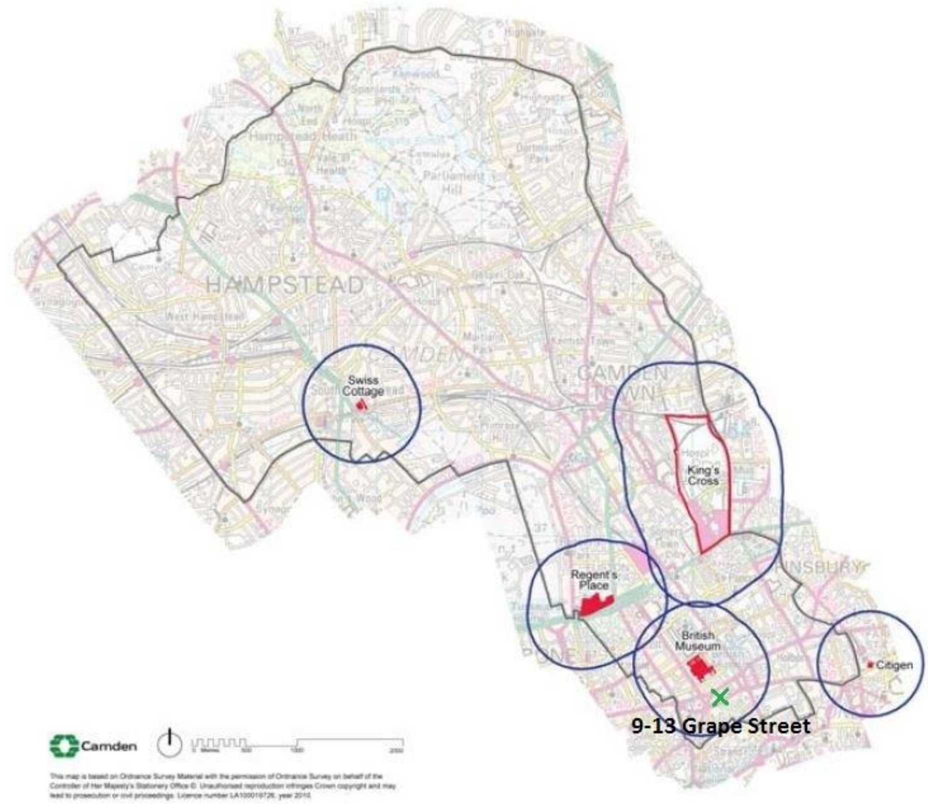

Figure 7 – Developments within 500m of a potential network (London Borough of Camden, 2013)

5.3 ON SITE HEATING NETWORK

The residential-only nature of the Development results in little diversity in the demands for heat and electricity. CHP systems rely on a diversity of loads and a consistent demand for both heat and electricity in order to operate at optimum efficiency. For this reason an on-site CHP system is not suitable for the Development.

5.4 'CLEAN' BUILDING CO_2 EMISSIONS

Since 'clean' measures are applicable in this instance (it is not feasible or suitable to connect to an existing district heating network or to provide and on-site CHP system) the modelling carried out on each apartment results in the same energy performance as those in section 4.4.

For consistency, the following tables summarise the CO_2 emissions of the Development as a whole at this stage and the savings achieved as a result of 'Clean' measures.

Table 9 - Comparison of CO_2 emissions savings after 'Clean' measures

	CO_2 Emissions (kgCO_2/year)
Existing 'Baseline' building	48,883
Building Regulations compliant new build	25,798
After 'Lean' measures	21,904
After 'Clean' measures	21,904

Table 10 – CO_2 emissions savings over existing building from 'Clean' measures

	(kgCO_2/year)	(%)
Savings from 'Lean' measures	26,979	55
Savings from 'Clean' measures	0	0

A comparison between the CO_2 emissions of the existing Development, the 'Lean' Development and the 'Clean' Development is shown in Figure 8.

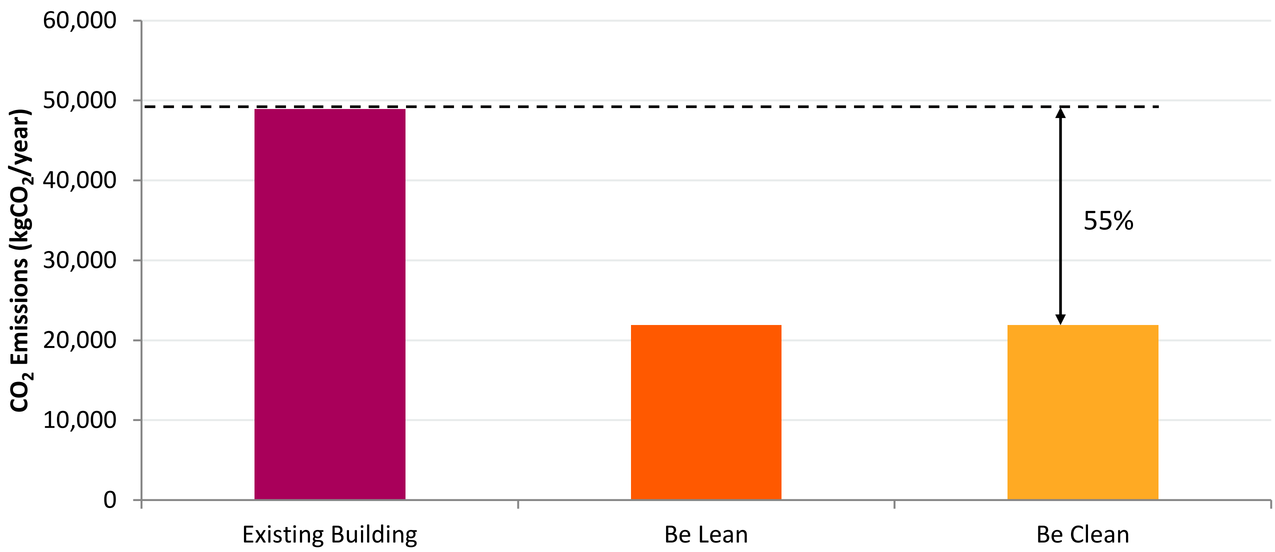

Figure 8 – CO_2 Emissions for whole Development – 'Be Clean'

Table 11 shows the credits achieved under BREEAM Domestic Refurbishment after 'Lean' and 'Clean' measures have been applied.

Table 11 – BREEAM Credits achieved 'Be Clean'

Credit	Credits Targeted	Credits Achieved
ENE01 Improvement in Energy Efficiency Rating	3	2.5
ENE02 Energy Efficiency Rating Post Refurbishment	3.5	3
ENE03 Primary Energy Demand	7	6.5
ENE04 Renewable Technologies	1	0

6 BE GREEN – USING RENEWABLE ENERGY

A feasibility study has been carried out to assess the suitability of various renewable technologies. The following renewable energy sources have been considered:

- Wind turbines
- Solar water heating
- Solar photovoltaics (PV)
- Biomass
- Ground source heat pumps (GSHP)
- Air source heat pumps (ASHP)

6.1 WIND TURBINES

Wind turbines harness the power in the wind to generate electricity, which can then be fed to the building or exported to the national grid. There are two main types of wind turbines: horizontal axis and vertical axis. Horizontal turbines are more suited to rural areas with high wind speeds to operate at optimal efficiency. Vertical turbines are generally much smaller and can be sited on buildings; however they are typically more expensive and less efficient.

Since there is inadequate space available at the site and the average wind speed is too low to make wind turbines cost effective, they have been discounted as a potential renewable energy technology for the Development.

6.2 SOLAR WATER HEATING

Solar water heating uses solar energy to heat water as it slowly passes either through evacuated tubes or over a flat plate collector and are an effective renewable technology in the UK as they work in diffused light conditions. The water provided by solar water heating systems is generally used for domestic hot water only and not for space heating. The most efficient type of solar water heating system is the evacuated tube, however these are generally more expensive and as a result the flat plate collector systems are more widely used.

Figure 9 – Evacuated tube and flat plate solar thermal collectors

The requirement for hot water in the Development may be enough to justify a small solar hot water system, however there is limited roofspace available due to the mansard roof extension. The contribution that a small number of solar hot water collectors could make to the building CO_2 emissions reduction would be minimal. In addition to this there may reflectance towards Sovereign House as the Development has a lower roof level.

On the basis of these constraints solar water heating is not considered a viable option for the Development.

6.3 SOLAR PHOTOVOLTAICS

Solar Photovoltaics (PV) have a well-established record in the UK as a reliable source of renewable electricity. PV output can be estimated with reasonable accuracy, and is generally guaranteed for 15 years or more. They operate by exploiting the band gap present in semiconductors to generate electricity.

Figure 10 – Monocrystalline and polycrystalline solar photovoltaic panels

The generation profile of solar PV is suited to peak energy consumption during the day. Given that the electricity demand profile of the entirely residential Development may not similar to the generation profile of solar PV, it may not be a viable option. In addition to this the available space on the roof is limited due to the mansard roof extension and would restrict the total collector aperture area that could be installed. As with solar hot water collectors there may be a level of reflectance from any panels to Sovereign House as the Development has a lower roof level.

On the basis of these constraints solar PV is not proposed for the Development.

6.4 BIOMASS

Figure 11 –Domestic scale biomass boiler

A biomass boiler could be used to provide the buildings' space heating and hot water demand in place of gas fired boilers and water heaters. Biomass boilers have a reasonably established track record in the UK and modern technologies are resulting in heat generation efficiencies approaching those of natural gas boilers.

Biomass boilers require a solid fuel, usually in the form of wood chips or wood pellets for which a reliable supply would need to be identified. This should be delivered to site on a regular basis by a large delivery vehicle (adding to the indirect emissions associated with the Development): as the site is in a central London location, reliability and promptness of delivery may be an issue.

The location of the site puts it within a high risk Air Quality Management Area, with specific controls on Nitrogen Dioxide NO_2 and particulate matter PM_{10}. As biomass boilers contribute to this type of emission it would come under the GLA requirements in relation to biomass application and biomass emission standards which states:

> *'Development proposals should be at least 'air quality neutral', not lead to further deterioration of existing poor air quality (such as areas designated as Air Quality Management Areas (AQMAs)), and create opportunities to improve local air quality. They should minimise exposure to existing poor air quality and make provision to address local problems of air quality (particularly within AQMAs and where development is likely to be used by large numbers of those particularly vulnerable to poor air quality).'*

On the basis of these constraints biomass is not considered a viable option for the Development.

6.5 GROUND SOURCE HEAT PUMPS

Ground source heat pumps take heat from the ground and raise it to a higher temperature. This enables the heat pump to have a greater thermal output than the electrical energy input and typically the heat output from a GSHP is three or four times greater than the electrical input. This can result in large energy cost savings and carbon savings. The cost savings are tariff dependent and the carbon savings are dependent on the generation method.

As the Development is a refurbishment and proposes no additional space for excavation or car park outside the building footprint there may be little potential opportunity for a ground source heat pump collector.

On the basis of these constraints ground source heat pumps are not considered a viable option for the Development.

6.6 AIR SOURCE HEAT PUMPS

Figure 12 –Domestic air source heat pump

Air source heat pumps extract heat from the outside air to provide heat to internal spaces. This heat can be used to heat radiators, underfloor heating and hot water, in the case of air to water heat pumps, or to a warm air convector, in the case of air to air heat pumps. ASHPs could be used to offset some or all of the heating and potentially cooling demands (if required) of the Development. Unlike ground source heating and cooling ASHPs do not rely on a balanced heat transfer to and from the air as there is an essentially unlimited source of heat. This makes them more flexible and allows them to cater more effectively for unbalanced heating and cooling demands.

As the majority of the predicted CO_2 emissions are as a result of space heating and hot water air source heat pumps offer an applicable and effective method of reducing CO_2 emissions. They must be sited outside to extract heat from the outside air and as such require an amount of roof space, though this would be quite small for 9 apartments.

As the Development proposes to provide heating via radiators an air to water heat pump system would be compatible. Air to water heat pumps are generally more efficient than their air to air counterparts and they work best with a large surface area to emit heat, this is because they provide lower grade heat than that produced by conventional boilers. For this reason it is proposed to provide large radiators for heat delivery.

Space heating and hot water demands to all apartments are proposed to be provided by individual air to water heat pumps of 4kW each with a coefficient of performance of 3.

6.7 'GREEN' BUILDING CO_2 EMISSIONS

As a result of applying an air to water ASHP system to all apartments, additional CO_2 savings have been made. The modelling shows that the majority of apartments could achieve an EPC rating of 'B', which exceeds the minimum energy requirements for a BREEAM Excellent rating.

The following tables summarise the CO_2 emissions of the Development as a whole at this stage and the savings achieved as a result of 'Clean' controls.

Table 11 - Comparison of CO_2 emissions savings after 'Clean' measures

	CO_2 Emissions ($kgCO_2$/year)
Existing 'Baseline' building	48,883
Building Regulations compliant new build	25,798
After 'Lean' measures	21,904
After 'Clean' measures	21,904
After 'Green' measures	15,235

Table 12 – CO_2 emissions savings over existing building from 'Clean' measures

	($kgCO_2$/year)	(%)
Savings from 'Lean' measures	26,979	55
Savings from 'Clean' measures	0	0
Savings from 'Green' measures	6,669	14

A comparison between the CO_2 emissions of the existing Development, the 'Lean' Development and the 'Clean' Development is shown in Figure 13 on the following page.

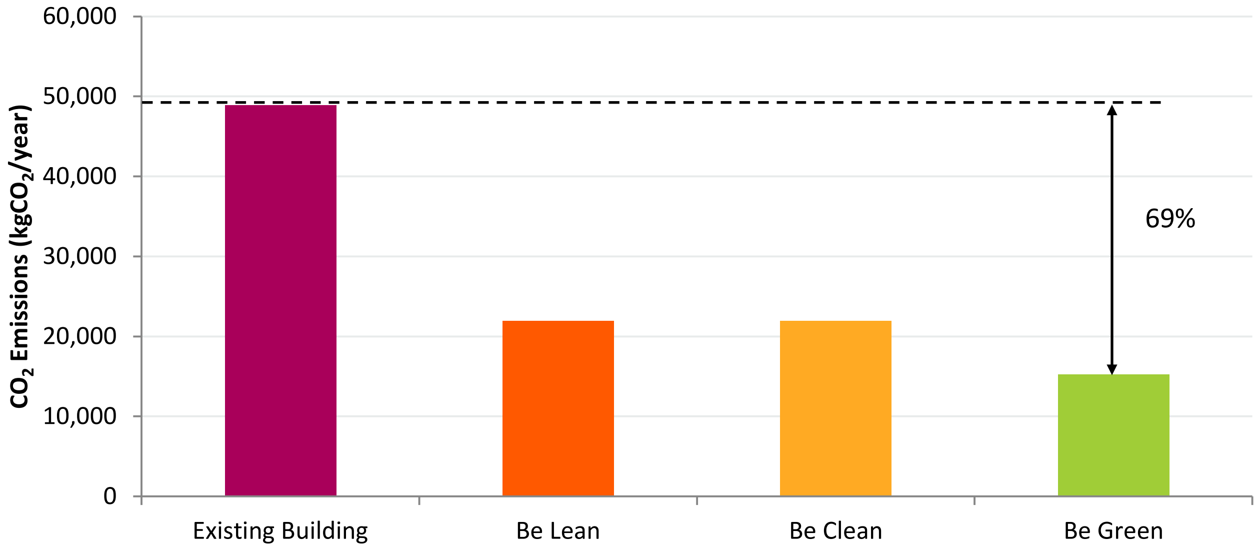

Figure 13 – CO_2 Emissions for whole Development – 'Be Green'

Table 13 shows the credits achieved under BREEAM Domestic Refurbishment after all measures have been applied.

Table 13 – BREEAM Credits achieved 'Be Green'

Credit	Credits Targeted	Credits Achieved
ENE01 Improvement in Energy Efficiency Rating	3	3
ENE02 Energy Efficiency Rating Post Refurbishment	3.5	3.5
ENE03 Primary Energy Demand	7	7
ENE04 Renewable Technologies	1	1

7 CONCLUSION

By far the largest user of energy (and hence contributor of CO_2 emissions) in the existing building is the space heating. As such this area must be targeted to achieve the desired reduction in CO_2 emissions.

Energy demand reduction measures are the most effective method of reducing CO_2 emissions. Through the application of a variety of active and passive measures a carbon emissions reduction of 55% is achieved when compared to the existing notional building.

In order to further reduce the CO_2 emissions from the Development a system of air to water heat pumps are proposed to be provided. As the majority of the predicted CO_2 emissions are as a result of space heating and hot water air source heat pumps offer an effective method of reducing CO_2 emissions. Through the application of this system an additional reduction of 14% is achieved, taking the total CO_2 reduction to 69% when compared to the existing notional building.

As a result of these measures the Development achieves all the credits targeted under BREEAM Domestic Refurbishment and supports the achievement of an 'Excellent' rating.

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