9-13 GRAPE STREET

ENERGY STATEMENT

VBL REAL ESTATE 1 LTD

MARCH 2016

REVISION 02

The data used to inform this energy assessment is based on concept design information and drawings provided by the design team. The design data will be subject to change as the design develops. It is the intention of this assessment to provide an initial indication of the potential energy performance of the development.

It is our expectation that further assessments will be carried out for the development at appropriate stages of the design to take account of changes to the design information. This should be used to monitor progress against any targets set by Building Regulations and/or Planning Policy. Subsequent energy calculations will therefore vary from those set out in this document.

Revision History		Date	Prepared By	Check By
R01	Draft	18/03/2016	Inge Oosthuizen	Chris Carter
R02	Issue for planning	30/03/2016	Inge Oosthuizen	Kirsten Elder

CONTENTS

1 EXECUTIVE SUMMARY

1.1 OVERVIEW

The proposed development at 9-13 Grape Street, Camden, consists of erection of a roof extension and change of use from office and photographic studios, gymnasium, and gallery (together comprising a Sui Generis Use), to offices (Class B1a) and associated works. This report summarises the energy strategy for the proposed development that has been developed in line with the planning policy and guidance produced by the London Borough of Camden.

1.2 PLANNING POLICY REQUIREMENTS

Energy policies from the London Borough of Camden development plan[i,ii,iii] include Policy C13 – '*Tackling Climate Change through Promoting Higher Environmental Standards'* and Policy DP22 – '*Promoting Sustainable Design and Construction'*. The targets set out in these policies are as follows:

Developments should minimise carbon emissions from the redevelopment, construction and occupation of buildings by implementing the elements of the energy hierarchy of 'Be Lean', 'Be Clean', and 'Be Green'.

- 'Be Lean' – 60% of unweighted credits in the BREEAM Energy category should be achieved, and further are expected to achieve an overall 'Excellent" in the BREEAM assessment.
- 'Be Clean' – It is expected that the development is capable of connecting to a potential heat network in future, and install CHP or CCHP where appropriate.
- 'Be Green' – Developments are to target a 20% reduction in Carbon Dioxide emissions through installation of on-site renewable energy technologies.

1.3 ENERGY STRATEGY

1.3.1 'BE LEAN' – REDUCE ENERGY DEMAND

Energy demand reduction measures include both passive and active design features including building fabric performance, glazing strategy, air tightness, low energy lighting and controls, intelligent building management systems controls, and mechanical ventilation with heat recovery. Through the application of these measures a carbon emissions reduction of 43% has been demonstrated in regulated emissions when compared to the baseline building energy model.

1.3.2 'BE CLEAN' – SUPPLY ENERGY EFFICIENTLY

The Development falls within a 500m radius of a potential heat network, and within 1km of an existing or emerging heating network. Given the distance of new pipework that would be required across busy roads in this central location in London, and the relatively low heat demand of the development, it has not been deemed feasible to connect to the existing heat network. Instead a renewable heating solution has been pursued. Potential future connection may be possible for hot water production, should the heat network be extended to be in closer proximity to the Development.

1.3.3 'BE GREEN' – USE RENEWABLE ENERGY

An appraisal of various renewable energy technology options has been carried out, which identified variable refrigerant flow air sourced heat pump as the most viable renewable technology to this site. The provision of space heating by the air sourced heat pump results in a further 3% CO_2 emissions reduction over the baseline building energy model.

1.3.4 OVERALL CARBON DIOXIDE SAVINGS

The CO_2 emissions for the site has been evaluated against the performance of the existing building as well as the performance of a notional extension based upon Building Regulations Part L 2013. Simplified Building Energy Model (SBEM) assessments using DesignBuilder version 4.2.0.054 software, has been carried out to predict the energy consumption of the Development at each stage of the energy hierarchy. The results are presented in Figure 1.1, Table 1.1, and Table 1.2.

Figure 1.1 – Development Energy Hierarchy Regulated & Unregulated CO_2 Emissions

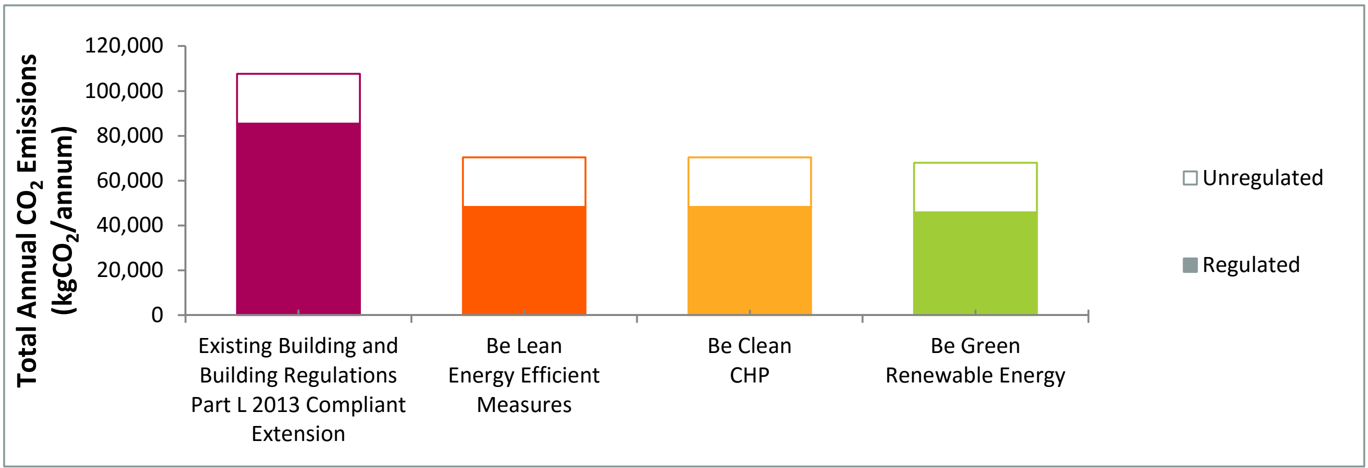


Table 1.1– Development CO_2 Emissions after Each Stage of the Energy Hierarchy

	Annual Carbon Dioxide Emissions (kgCO₂/annum)	
	Regulated	Unregulated
Baseline Existing ad Notional Extension	85,342	22,281
After 'Be Lean' Measures	48,256	22,129
After 'Be Clean' Measures	48,256	22,129
After 'Be Green' Measures	45,870	22,129

Table 1.2 – Regulated CO_2 Emissions Savings from Each Stage of the Energy Hierarchy

	CO_2 Emissions (kgCO₂/annum)	Percentage CO_2 Emissions Savings
Baseline Existing ad Notional Extension	85,342	
After 'Be Lean' Measures	48,256	43%
After 'Be Clean' Measures	48,256	43%
After 'Be Green' Measures	45,870	46%

1.4 PERFORMANCE AGAINST POLICY TARGETS

The energy strategy has been created with the London Borough of Camden policies as key drivers.

BREEAM Assessment results exceed Camden's requirement for 60% of the unweighted credits in the BREEAM Energy category is achieved, and the Development is targeting 76.9% of the available credits.

Camden sets a 20% target reduction in Carbon Dioxide emissions through installation of on-site renewable energy technologies. The proposed air sourced heat pump system achieves a 3% reduction over the 'Be Lean' development.

Through a range of lean measures, and a proposed air sourced heat pump system, the development achieves a reduction in CO_2 emissions of 46.3% over a baseline comprising the existing building and notional Building Regulations Part L 2013 compliant extension.

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 outcome 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 erection of a roof extension and change of use from office and photographic studios, gymnasium, and gallery (together comprising a Sui Generis Use), to offices (Class B1a) and associated works.

2.3 PLANNING POLICY

2.3.1 THE LONDON BOROUGH OF CAMDEN

The council has adopted a number of planning documents that, alongside the Mayor's London Plan, form the 'development plan' for Camden. In preparation of this energy statement reference has been made to the Core Strategy[i], Camden Development Policies[ii], and the CPG 3 Planning Guidance on Sustainability[iii]. The policies that specifically impact on energy performance include policy CS13 "Tackling climate change through promoting higher environmental standards", and policy DP22 "Promoting sustainable design and construction".

The following are extracts from the policy statements which describe the expected approach and requirements in developing the Development's energy strategy.

POLICY CS13 - TACKLING CLIMATE CHANGE THROUGH PROMOTING HIGHER ENVIRONMENTAL STANDARDS

> *'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.'*

To meet these criteria the Development has adopted the energy hierarchy methodology as shown in Figure 2.1:

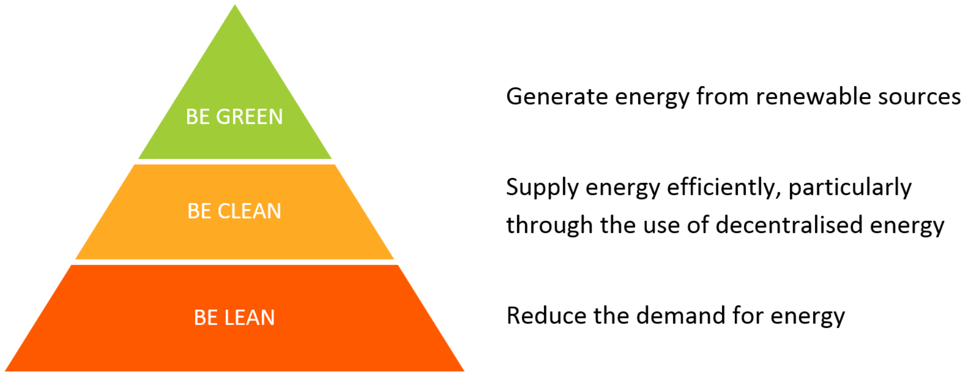


Figure 2.1 – Energy Hierarchy

Further guidance is provided in CPG 3[iii] for each stage of the energy hierarchy as follows:

'Be Lean'

> *'4.3 Development involving change of use or a conversion of … $500m^2$ of any floor space, will be expected to achieve 60% of the unweighted credits in the Energy category in the BREEAM assessment.'*

'Be Clean'

> *'5.11 ...developments will consider the following steps, in the order listed, to ensure energy from an efficient source is used, where possible:*
>
> 1. *Investigating the potential for connection into an existing or planned decentralized energy scheme and using heat*
> 2. *Installing a CHP or CCHP, including exporting heat where appropriate*
> 3. *Providing a contribution for the expansion of decentralized energy networks*
> 4. *Strategic sites are to allow sufficient accessible space for plant equipment to support a decentralized energy network*
> 5. *Designing the development to enable its connection to a decentralized energy network in future'*
>
> *'5.18 Developments which are proposed within 500m of a potential network which have no timetable for delivery should ensure that the development is capable of connecting to network in the future. A financial contribution will be sought to fund the future expansion of the network, unless on-site CHP is feasible and included as part of the development. '*

'Be Green'

> *'All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies.'*

POLICY DP22 - PROMOTING SUSTAINABLE DESIGN AND CONSTRUCTION

The council sets a target for the BREEAM assessment as follows:

> *'The Council will promote and measure sustainable design and construction by:*
>
> *e) Expecting non-domestic developments of $500m^2$ of floor space or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.'*

The relevant energy credits under BREEAM Non Domestic Refurbishment are set out in Table 2.1 below.

Table 2.1 – BREEAM Energy Credits

Issue		Requirement to achieve a BREEAM Excellent Rating
ENE 01	Reduction of energy use and carbon	To achieve an excellent rating a minimum of 6 credits are required.
ENE 02	Energy Monitoring	To achieve a "Very Good" rating or above, the energy consumption associated with all substantial items of building services plant must be recorded and automatically monitored.
ENE 03	External Lighting	These are tradable credits and therefore not necessarily required to achieve an Excellent rating.
ENE 04	Low Carbon Design	
ENE 06	Energy Efficient Transportation Systems	
ENE 08	Energy Efficient Equipment	

2.4 EMISSIONS REDUCTION TARGETS

The London Borough of Camden requires the energy strategy to demonstrate that appropriate measures have been taken to reduce the site's emissions through the application of the energy hierarchy. No overall percentage target reduction is provided and as such a best endeavours approach has been followed in line with the hierarchy to reduce the Development's CO_2 emissions as far as possible.

The targeted credits under BREEAM are summarised in Table 2.2.

Table 2.2 – BREEAM Targeted Energy Credits

Issue		Available Credits	Planning Policy Min Required Credits
ENE 01	Reduction of energy use and carbon	15	6
ENE 02	Energy Monitoring	2	-
ENE 03	External Lighting	1	-
ENE 04	Low Carbon Design	3	-
ENE 06	Energy Efficient Transportation Systems	3	-
ENE 08	Energy Efficient Equipment	2	-
Total		26	16 (60%)

Camden's CPG 3[iii] requires a reduction in CO_2 emissions through the application of on-site renewable energy technologies of 20% to be targeted.

3 ENERGY & CO_2 EMISSIONS ASSESSMENT APPROACH

3.1 METHODOLOGY

Regulated energy use and the associated CO_2 emissions have been calculated using DesignBuilder version 4.2.0.054 SBEM. The CO_2 emissions are evaluated at each stage of the energy hierarchy.

All total development CO_2 savings reported are based on the SBEM BRUKL report output, the Building Emissions Rate (BER).

The CO_2 emissions breakdown by use is not provided in the SBEM output reports, (Appendix 9.4) only the energy demand. As such an estimate is calculated based on the energy demand and the CO_2 emissions factors given in Table 3.1. The total CO_2 emissions estimated in this way may therefore differ from the total emissions determined from the BER values.

BREEAM Non Domestic Refurbishment and Fit-Out technical manual sets out the approach for determining the emissions for 'Extensions to existing buildings and newly constructed thermal elements' under ENE-01 Compliance Note CN6 as follows:

'Where the refurbishment project also includes a newly constructed extension with new thermal elements, the modelled performance of the baseline for new thermal elements should be based upon compliance with the appropriate Building Regulations for new thermal elements as defined for the notional building.

Where the new extension uses existing building services, the modelled baseline performance of the new extension and existing building should be based upon performance of the existing common building services plant. The baseline for any new building services plant servicing the extension only should be modelled based upon compliance with the appropriate Building Regulations as defined for the notional building and the Building Regulations Compliance Guide.'[iv]

Unregulated emissions are based on the 'equipment load' as provided in the BRUKL reports. Since it is intended for the office spaces to be tenanted, the final choice of equipment used is unknown. As such no savings have been reported for unregulated loads and the equipment load for each stage is as per the BRUKL report output.

The inputs and assumptions used to determine the energy performance of the SBEM models have been summarised in Appendix 9.1.

3.2 CARBON DIOXIDE EMISSION FACTORS

The carbon emission factors used in this report are based on those within the Governments Standard Assessment Procedure (SAP) 2012 and referenced within Building Regulations Part L 2013, given in Table 3.1.

Table 3.1 – Carbon dioxide emission factors

Fuel	Emission Factor
Natural Gas	0.216 $kgCO_2/kWh$
Grid Supplied Electricity	0.519 $kgCO_2/kWh$
Grid Displaced Electricity	0.519 $kgCO_2/kWh$

4 BASELINE ENERGY DEMAND AND CO_2 EMISSIONS

4.1 BASELINE DEVELOPMENT EMISSIONS

The ‘baseline’ building is a representative model which estimates the energy consumption of the existing building and notional extension. The existing part of the building is modelled based upon an estimated performance of the existing services and fabric. The extension is modelled as a notional extension which complies with Building Regulations Part L2A minimum requirements.

The percentage emissions reduction for each of the ‘Be Lean’, ‘Be Clean’, and ‘Be Green’ stages of the energy hierarchy is reported against the baseline consumption and emissions outlined here.

4.1.1 BREAKDOWN OF CO_2 EMISSIONS BY USE

Table 4.1 provides a breakdown by use of the regulated and unregulated energy demand and CO_2 emissions for the Development.

Table 4.1 – Baseline CO_2 Emissions Breakdown by Use

	Total CO_2 Emissions ($kgCO_2$/annum)
Electricity	37,871
Heating	27,035
Hot Water	3,731
Cooling	10,795
Unregulated - Equipment	22,281

4.1.2 TOTAL ENERGY CONSUMPTION AND CO_2 EMISSIONS

Table 4.2 details the CO_2 emissions rate based on the Building Emission Rate (BER) as determined from the SBEM BRUKL report for the baseline model. This forms the baseline from which the percentage CO_2 reduction will be determined.

Table 4.2 – Baseline CO_2 Emissions

	Total Floor Area (m^2)	BER ($kgCO_2/m^2$)	Total Regulated CO_2 Emissions ($kgCO_2$/annum)	Total Unregulated CO_2 Emissions ($kgCO_2$/annum)	Total CO_2 Emissions ($kgCO_2$/annum)
Development Baseline Emissions	1,084	78.70	85,342	22,281	107,624

5 'BE LEAN' - REDUCE ENERGY DEMAND

5.1 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.

5.2 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 maintaining levels of daylighting.

5.2.1 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 L2B 2013. The insulation levels (i.e. U-values) adopted for the Development are provided in Table 5.1.

Table 5.1 – Proposed U-value summary

Element	Part L2B Min. Requirement (W/m^2K)	Baseline / Existing Value (W/m^2K)	Proposed Value (W/m^2K)
Refurbished Exposed Walls	0.3	1.6	0.3
Refurbished Basement Walls	0.3	1.6	0.3
Extension Exposed Walls	0.28	0.28	0.18
Exposed Roof	0.18	0.18	0.15
Exposed Floor	0.25	0.58	0.22

5.2.2 GLAZING STRATEGY

Existing building windows and ground floor curtain walling consist of large single glazed panels, to improve the thermal performance all glazing will be replaced with double glazing panels. The building lies in a narrow street, shaded by King Edward Mansions which is located opposite the Development. For this reason it is proposed that clear glass will be provided to the existing floor levels. Solar control glazing is proposed to the top floor extension roof lights and windows, where the overshading is reduced, to lower the demand for cooling in the summer months.

5.2.3 AIR TIGHTNESS

A further key fabric performance parameter is air tightness, i.e. the rate at which air moves through the building envelope to the outside. CIBSE TM 23[v] reports the results of air leakage tests carried out on a large number of commercial properties in the UK. Where 90% of buildings had an air permeability of $35m^3/hm^2$@50Pa or less, 50% had an air permeability of $14m^3/hm^2$@50Pa or less, and the best performing 10% had an air permeability of $7m^3/hm^2$@50Pa or less.

The current building regulations for new buildings set a limiting air permeability of $10m^3/hm^2$@50Pa, it is proposed to target this value for the existing building to be refurbished. It is anticipated that improvement in the building air tightness may be achieved though draught proofing and upgrading windows. This reduces the heat loss associated with air infiltration and should also improve occupant comfort by reducing the risk of cold draughts. For the new roof top extension a more stringent value of 5m³/hm²@50Pa is proposed.

5.2.4 THERMAL MASS

Areas of thermal mass include the existing front, rear and party walls. The use of thermal mass 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.

5.3 ACTIVE DESIGN FEASTURES

5.3.1 LOW ENERGY LIGHTING AND CONTROLS

Low energy LED lighting will be specified throughout the building to minimise the electrical demand for lighting and additional summer cooling load. It is intended that 100% of the light fittings will only be capable of accepting low energy lamps. Intelligent lighting control will be provided where appropriate incorporating PIR absence detection and photoelectric control where appropriate.

Table 5.2 details the reference values and the proposed targeted values as used within the SBEM assessment.

Table 5.2 – Building Lighting Efficacy Summary

Element	Non-Domestic Compliance Guide 2013 Reference standard (lm/W)	Proposed value (lm/W)
General Lighting Efficacy Throughout	60	80

5.3.2 MECHANICAL VENTILATION WITH HEAT RECOVERY

Improved air tightness reduces the amount of energy (and therefore CO_2 emissions) required to heat the building. However this also means that the building is generally less well ventilated. The primary source of ventilation is proposed to be through a decentralised air handling units with high efficiency plate heat exchanger and low specific fan power.

5.3.3 BUILDING MANAGEMENT SYSTEM

A full and comprehensive Building Management System (BMS) will be provided to monitor and report on building systems. The system will allow the energy consumption of the building to be extensively reviewed and will highlight 'out-of-range' values allowing the building management to interrogate and resolve potential issues proactively.

The BMS will also optimise the operation of the building services plant and systems to facilitate occupant comfort and plant is operated at the peak 'as-designed' efficiency.

Sub-metering will be provided on a by-floor and by-unit basis to facilitate this.

5.3.4 ENERGY EFFICIENT SERVICES

Energy efficient plant has been selected where possible with improvements over values as shown in Table 5.3.

Table 5.3 – Building Target Plant Efficiencies

Building Services Plant	Non-Domestic Compliance Guide 2013 Efficiency	Development Target Value
VRF Cooling Efficiency EER	2.6	4
Gas-fired Boilers Efficiency*	84%	90%
Air Handling Units SFP (W/l/s)	2.5	1.6
Fan Coil Units SFP (W/l/s)	0.5	0.5
Extract Fan (W/l/s)	0.5	0.3
Heat Exchanger Efficiency	65%	70%

*Note the 'Be Lean' scenario represents the case where the office heating is provided through natural gas boilers, this is reviewed in section 7.

5.4 'BE LEAN' DEVELOPMENT PERFORMANCE

The 'Be Lean' building takes into account all of the passive and active retrofit design features outlined above and represents the likely performance of the Development using only these lean measures.

As with the baseline building the building energy demand and associated CO_2 emission have been estimated using Designbuilder version 4.2.0.054 SBEM.

The following tables summarise the CO_2 emissions of the Development and the savings achieved as a result of the lean measures proposed.

5.4.1 BREAKDOWN OF CO_2 EMISSIONS BY USE

Table 5.4 provides a breakdown by use of the regulated and unregulated energy demand and CO_2 emissions for the Development after applying lean measures.

Table 5.4 – 'Be Lean' CO_2 Emissions Breakdown by Use

	Total CO_2 Emissions ($kgCO_2$/annum)
Electricity	13,834
Heating	11,208
Hot Water	3,729
Cooling	6,230
Unregulated - Equipment	22,129

5.4.2 TOTAL ENERGY CONSUMPTION AND CO_2 EMISSIONS

Table 5.5 details the CO_2 emissions rate based on the Building Emission Rate (BER) as determined from the SBEM BRUKL report for the 'Be Lean' model.

Table 5.5 – 'Be Lean' CO_2 Emissions

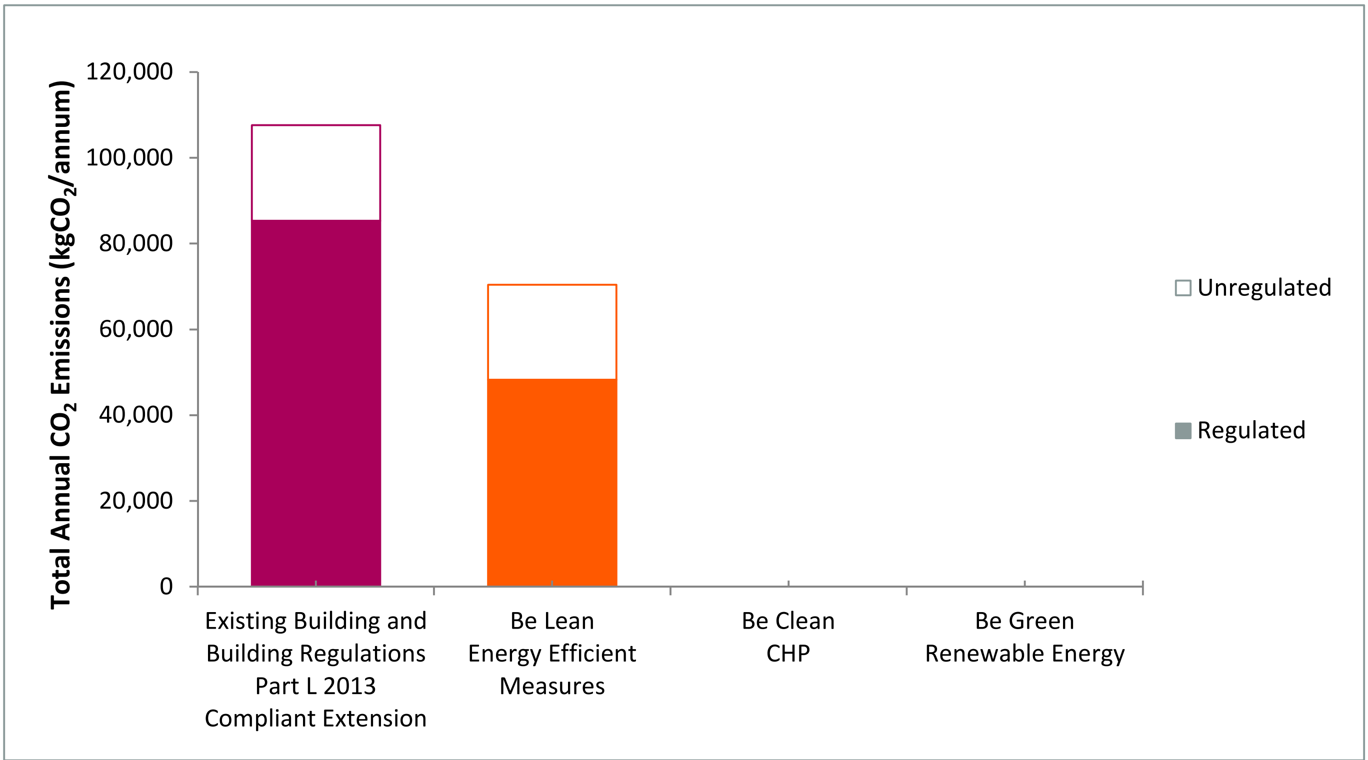
	Total Floor Area (m^2)	BER ($kgCO_2/m^2$)	Total Regulated CO_2 Emissions ($kgCO_2$/annum)	Total Unregulated CO_2 Emissions ($kgCO_2$/annum)	Total CO_2 Emissions ($kgCO_2$/annum)
'Be Lean' Development Emissions	1,084	44.50	48,256	22,129	70,385

The reduction in CO_2 emissions is estimated against the baseline emissions as per section 4, this is demonstrated in Table 5.6 and Figure 5.1.

Table 5.6 – 'Be Lean' CO_2 Emissions

	CO_2 Emissions ($kgCO_2$/annum)	Percentage CO_2 Emissions Savings
Baseline Existing ad Notional Extension	85,342	
After 'Be Lean' Measures	48,256	43%

Figure 5.1 – Comparison Baseline and 'Be Lean' Development (regulated and unregulated emissions)



5.4.3 BREEAM ASSESSMENT

Incorporating the lean measures proposed should result in the Development achieving the BREEAM credits as summarised in Table 5.7.

Table 5.7 – BREEAM Targeted Energy Credits

Issue		Available Credits	Planning Policy Min Required Credits	Development Targeted Credits
ENE 01	Reduction of energy use and carbon	15	6	11
ENE 02	Energy Monitoring	2	-	2
ENE 03	External Lighting	1	-	1
ENE 04	Low Carbon Design	3	-	1
ENE 06	Energy Efficient Transportation Systems	3	-	3
ENE 08	Energy Efficient Equipment	2	-	2
Total		26	16 (60%)	20 (76.9%)

6 'BE CLEAN' – SUPPLY ENERGY EFFICIENTLY

6.1 OVERVIEW

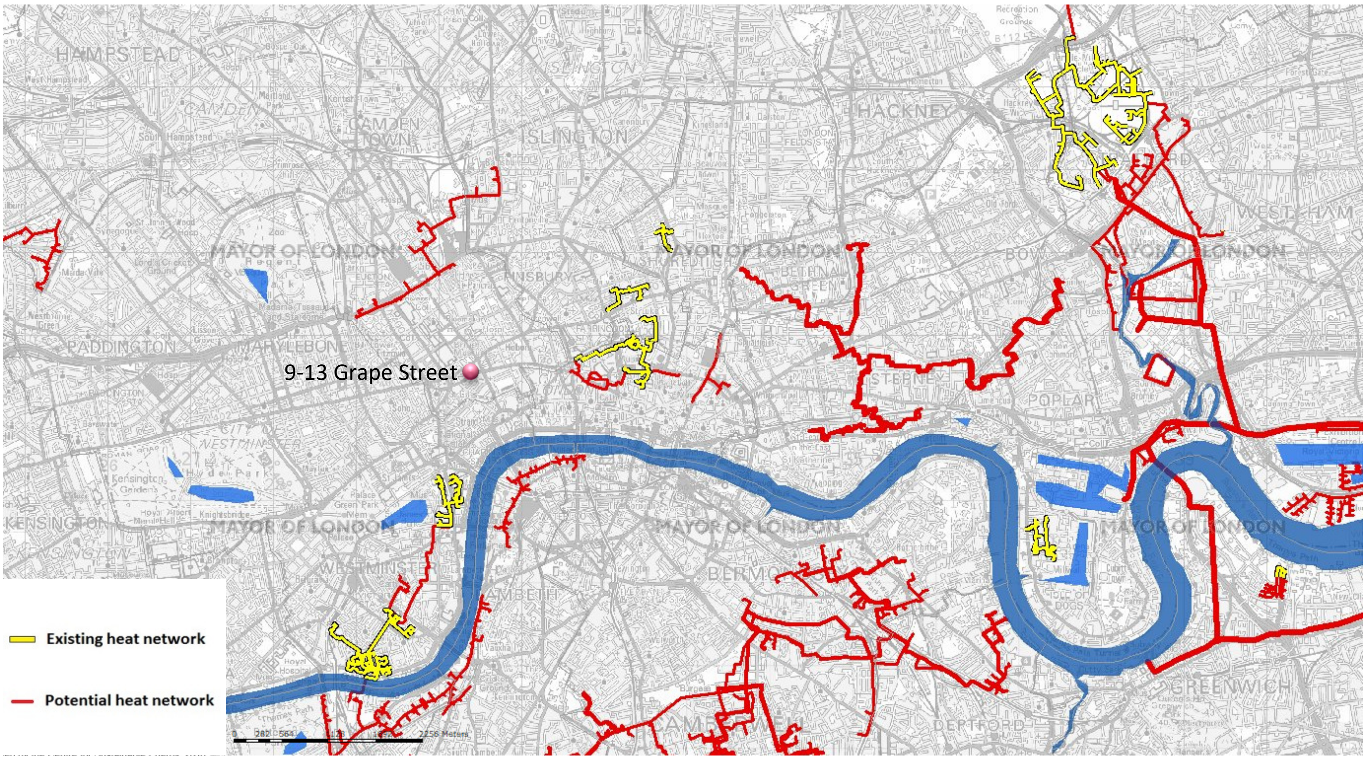
The Development will have a non-diverse heating demand as it consists solely of office space. Centralised heating systems take advantage of a diversity of load profiles, which is not present in the Development. For this reason a system of this type may not be suitable for the Development.

6.2 CONNECTION TO EXISTING DISTRICT HEATING NETWORKS

In accordance with Camden Policy CS13[i] 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, as shown in

Figure 6.1, it has been determined that the closest heat network to the Development is the potential UCL network.

Figure 6.1– Heat network data for area surrounding 9-13 Grape Street[vi]



According to Camden's CPG 3[iii] data the Development lies within a 1km radius of an existing/emerging network, in the form of the aforementioned UCL network as illustrated in Figure 6.2. As shown in Figure 6.3 the Development also falls within a 500m radius of a potential network at the British Museum. Given the distance of new pipework that would be required across busy roads in this central location in London, and the relatively low heat demand of the development, it has not been deemed feasible to connect to the existing UCL network. As the potential network is not yet confirmed and the demand for heat and electricity for the Development is relatively low, it is also not likely to be feasible to connect the Development to it.

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. Variable refrigerant flow air sourced heat pumps are proposed for the development, discussed in section 7, this system is not compatible with a connection to a future heat network. It may however be possible to connect the building in future for hot water production should the network be extended nearer to the Development.

Figure 6.2 – Developments within 1km of an existing or emerging network (London Borough of Camden, 2015)

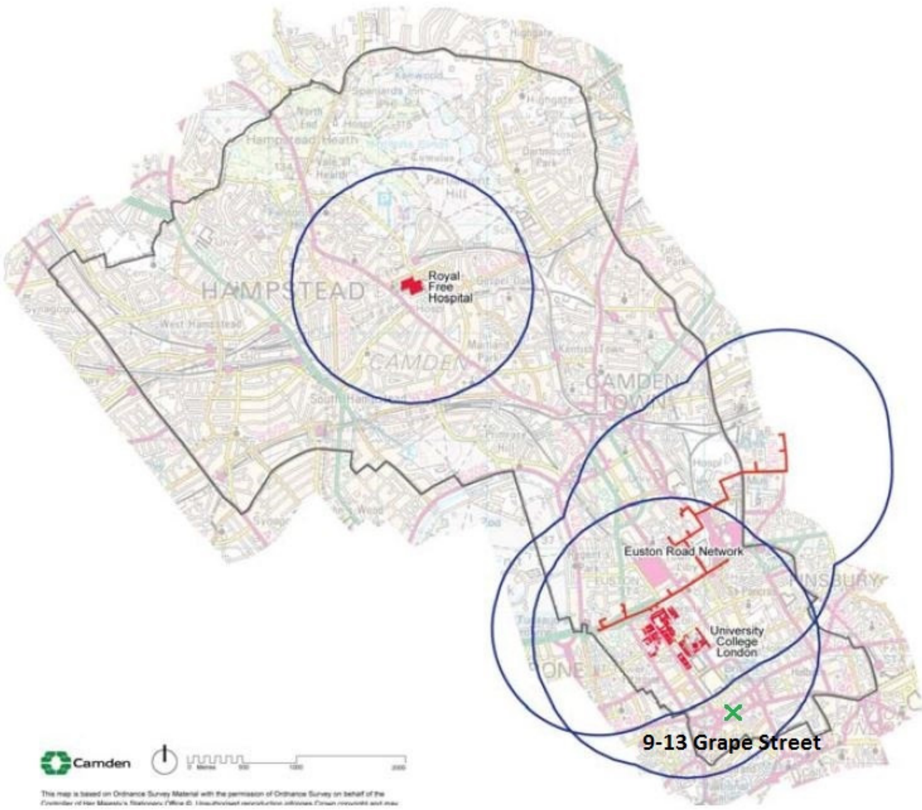
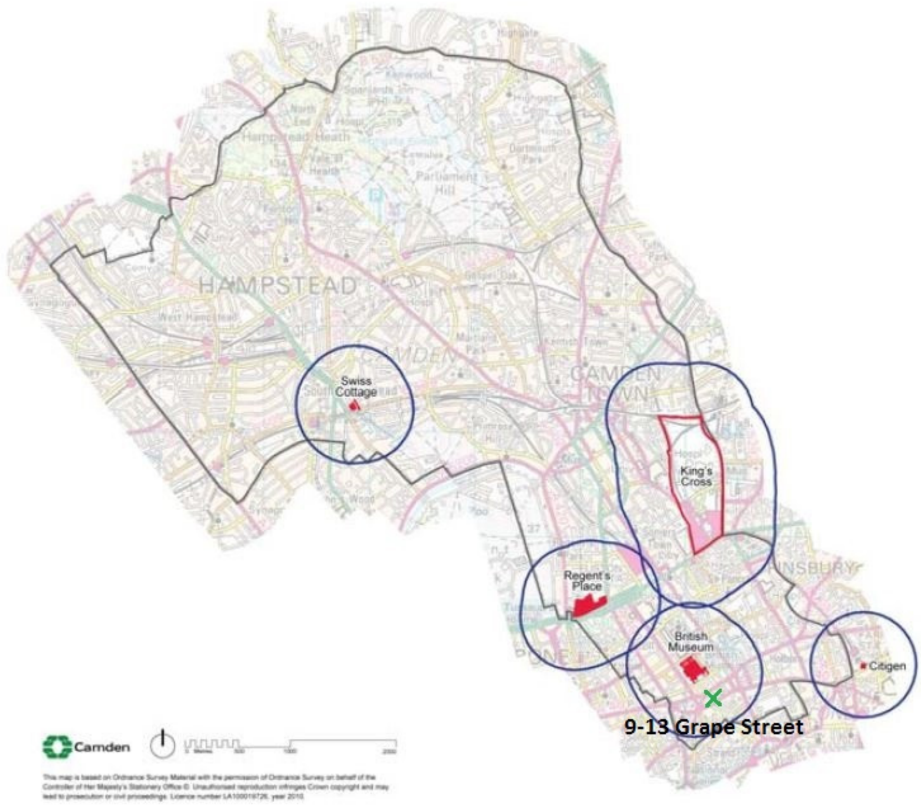


Figure 6.3 – Developments within 500m of a potential network (London Borough of Camden, 2015)



6.3 ON-SITE CHP AND HEATING NETWORK

The small single use 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 base load 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. It is proposed however, that the heating and cooling system will be a centralised system with load sharing across all floors.

6.4 'BE CLEAN' DEVELOPMENT PERFORMANCE

Since 'Be Clean' measures are not 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) there is no change to the energy consumption as reported for the 'Be Lean' development.

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 'Be Clean' measures.

6.4.1 TOTAL ENERGY CONSUMPTION AND CO_2 EMISSIONS

Table 6.1 details the CO_2 emissions rate based on the Building Emission Rate (BER) as determined from the SBEM BRUKL report for the 'Be Clean' model.

Table 6.1 – 'Be Clean' CO_2 Emissions

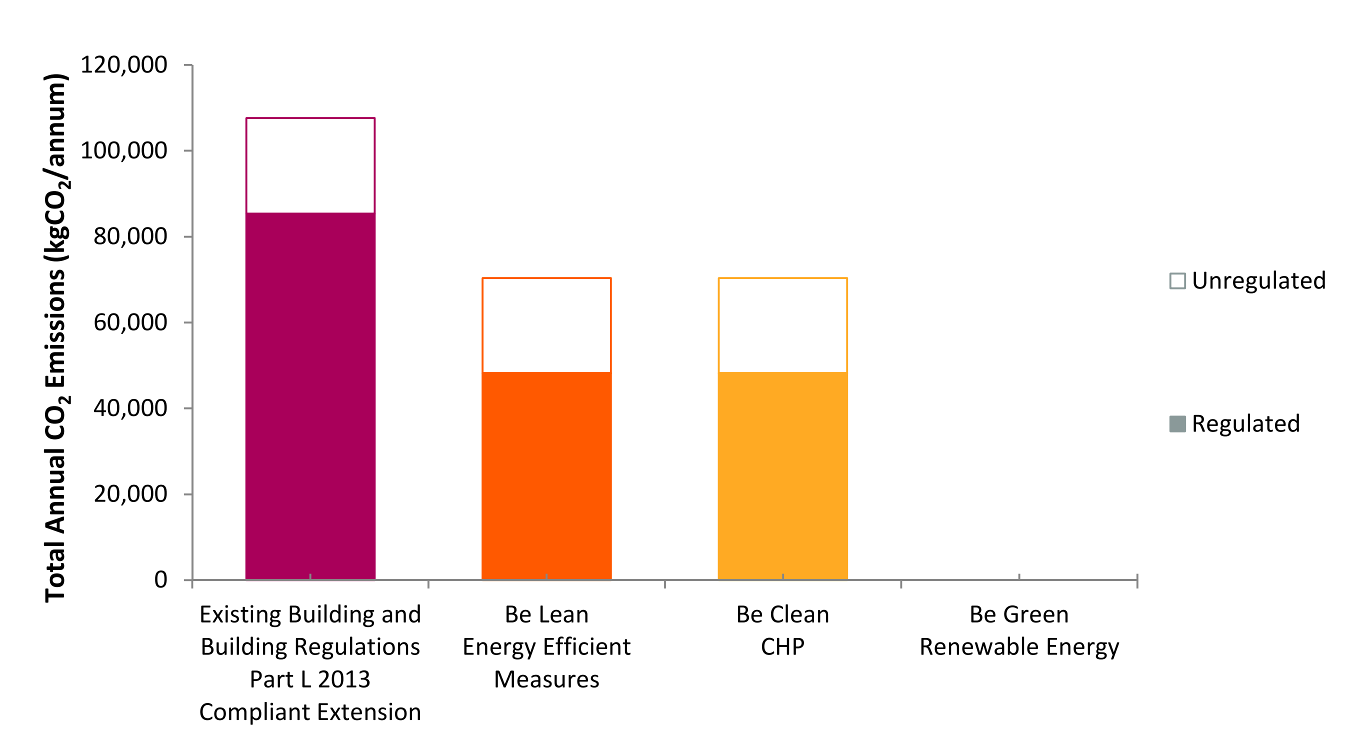
	Total Floor Area (m^2)	BER ($kgCO_2/m^2$)	Total Regulated CO_2 Emissions ($kgCO_2$/annum)	Total Unregulated CO_2 Emissions ($kgCO_2$/annum)	Total CO_2 Emissions ($kgCO_2$/annum)
'Be Clean' Development Emissions	1,084	44.50	48,256	22,129	70,385

The reduction in CO_2 emissions is estimated against the baseline emissions as per section 4, this is demonstrated in Table 6.2 and Figure 6.4.

Table 6.2 – 'Be Clean' CO_2 Emissions

	CO_2 Emissions ($kgCO_2$/annum)	Percentage CO_2 Emissions Savings
Baseline Existing ad Notional Extension	85,342	
After 'Be Lean' Measures	48,256	43%
After 'Be Clean' Measures	48,256	43%

Figure 6.4 – Comparison of Baseline, 'Be Lean' and 'Be Clean' Development (regulated and unregulated emissions)



Where a CHP unit is not feasible Camden's CPG3[iii] sets out the financial contribution that will be sought. Based on the latest figures provided in the guidance document this has been estimated at approximately £10,120 based on 1084m^2 of floor area over 5 floors at a rate of £2800/300m^2.

BREEAM credits remain unchanged from that provided in Table 5.7.

7 'BE GREEN' - USE 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)

7.1 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.

7.2 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 7.1– Evacuated tube and flat plate solar thermal collectors

There is limited roof space 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 King Edward Mansions 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.

7.3 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 7.2 - Monocrystalline and polycrystalline solar photovoltaic panels

The generation profile of solar PV is suited to peak energy consumption during the day and so may be suited to an office development. However, 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 towards King Edward Mansions as the Development has a lower roof level.

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

7.4 BIOMASS

Figure 7.3 – 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.

7.5 GROUND SOURCED 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.

7.6 AIR SOURCED HEAT PUMPS

Air source heat pumps (ASHPs) 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.

Figure 7.4 – VRF Air source heat pump

Since the Development has a requirement for both heating and cooling a heat recovery type variable refrigerant flow air to air heat pump is proposed. The system proposed is a centralised system with load sharing across all floors.

7.7 'BE GREEN' DEVELOPMENT PERFORMANCE

As a result of incorporating a VRF ASHP system to provide heating and cooling to the office spaces, additional CO_2 savings have been predicted. The following tables summarise the CO_2 emissions of the Development and the savings achieved in the SBEM assessment due to ASHPs.

7.7.1 BREAKDOWN OF CO_2 EMISSIONS BY USE

Table 7.1 provides a breakdown by use of the regulated and unregulated energy demand and CO_2 emissions for the Development after applying 'Be Green' measures.

Table 7.1 – 'Be Green' CO_2 Emissions Breakdown by Use

	Total CO_2 Emissions ($kgCO_2$/annum)
Electricity	13,834
Heating	6,992
Hot Water	3,729
Cooling	6,230
Unregulated - Equipment	22,129

7.7.2 TOTAL ENERGY CONSUMPTION AND CO_2 EMISSIONS

Table 7.2 details the CO_2 emissions rate based on the Building Emission Rate (BER) as determined from the SBEM BRUKL report for the 'Be Green' model.

Table 7.2 – 'Be Green' CO_2 Emissions

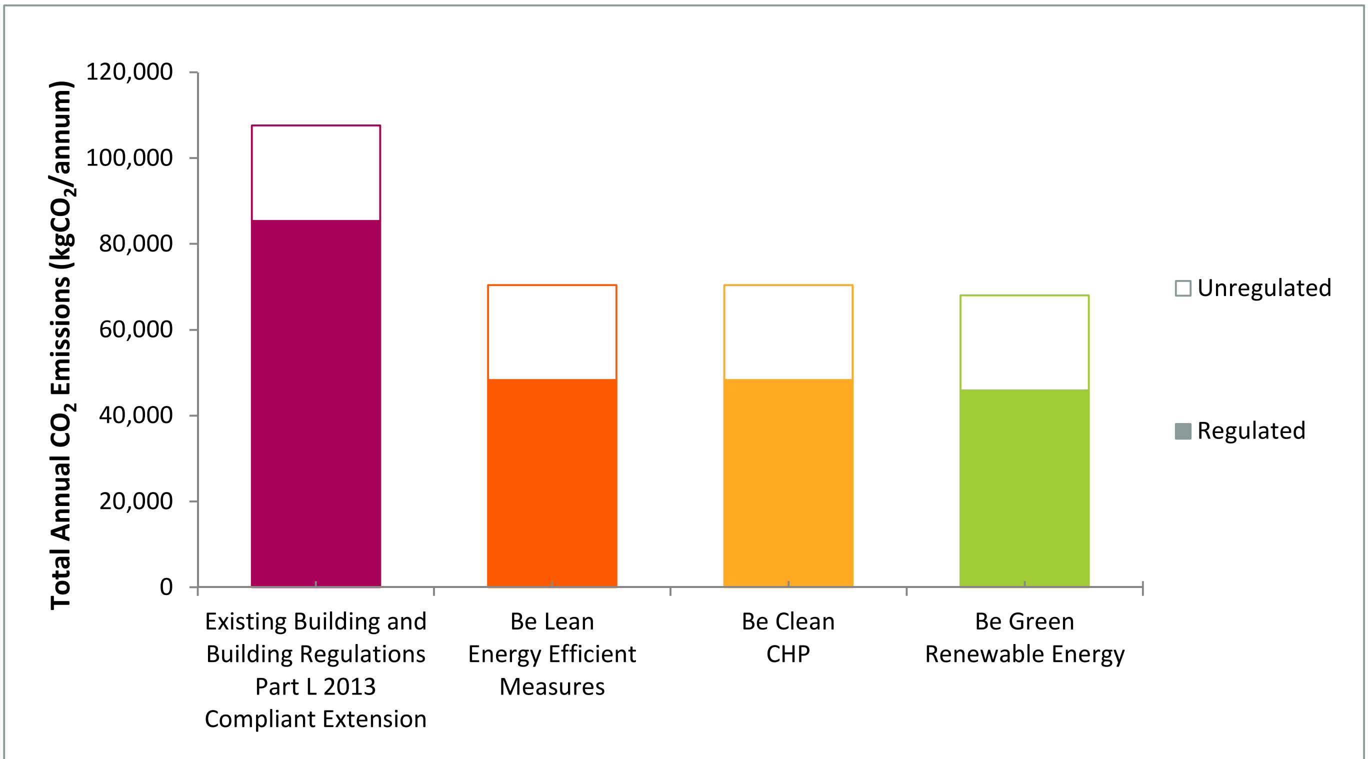
	Total Floor Area (m^2)	BER ($kgCO_2/m^2$)	Total Regulated CO_2 Emissions ($kgCO_2$/annum)	Total Unregulated CO_2 Emissions ($kgCO_2$/annum)	Total CO_2 Emissions ($kgCO_2$/annum)
'Be Green' Development Emissions	1,084	42.30	45,870	22,129	68,000

The reduction in CO_2 emissions is estimated against the baseline emissions as per section 4, this is demonstrated in Table 7.3 and Figure 7.5.

Table 7.3 – 'Be Green' CO_2 Emissions

	CO_2 Emissions ($kgCO_2$/annum)	Percentage Reduction Contribution	Cumulative Percentage CO_2 Emissions Savings
Baseline Existing ad Notional Extension	85,342		
After 'Be Lean' Measures	48,256	43%	43%
After 'Be Clean' Measures	48,256	0%	43%
After 'Be Green' Measures	45,870	3%	46%

Figure 7.5 – Comparison of Baseline, 'Be Lean', 'Be Clean', and 'Be Green' Development (regulated and unregulated emissions)



It can be seen in Table 7.3 that the ASHP system results in a further 3% reduction in CO_2 emissions over the 'Be Lean' development emissions.

The BREEAM credits remain unchanged from that provided in Table 5.7.

8 CONCLUSION

8.1 PROPOSED ENERGY STRATEGY

Scotch Partners has prepared an energy strategy for the proposed development at 9-13 Grape Street, Bloomsbury in accordance with the Local Borough of Camden's Local Development Plan. The strategy follows the energy hierarchy of 'Be Lean', 'Be Clean', and 'Be Green' ensuring that the main focus is to reduce the demand for energy at source, thereby reducing associated CO_2 emissions.

The existing building fabric performance will be upgraded through the provision of insulation and new curtain walling and windows throughout. This will also improve the air tightness and therefore the associated heating demand. It is proposed that the building services systems will incorporate metering and will be energy efficient and controllable by the end user.

Following an appraisal of various renewable energy technologies, air source heat pumps has been chosen as the most favourable option for the Development. The VRF ASHP will serve the office areas via a centralised heating and cooling system. There are currently no viable options for connection into existing heat networks however the Development is within a 500m radius from a potential planned heat network. Therefore a future connection to the network may be considered for hot water production. Where CHP and connection to a network is not viable, a financial contribution will be sought by Camden, as set out in CPG3[iii]. This has been estimated at approximately £10,120.

8.1.1 SUMMARY OF MEASURES

Appendix 1 in the CPG Sustainability Guidance[iii] provides a checklist for retro-fitting measures. These measures have been reviewed and those applicable to the Development are summarised in Table 8.1.

Table 8.1 – Checklist of Retro-fitting Measures

Measure	Application to the Development
Draught proofing	New windows and doors are to be provided to the ground floor. These will incorporate draught proofing and will achieve an improved u-value.
Overhauling / Upgrading Windows	All ground floor windows will be replaced with new. All other existing windows will be upgraded to double glazing and will incorporate improved draught proofing.
New Boiler	Existing boilers will be replaced with new heating system.
LED Lighting	LED lighting is proposed throughout.
Meters, Timers, Sensors, controls on heating or lighting	Intelligent BMS controls will be used with time clock and temperature control. Lighting control will include PIR or photoelectric control as appropriate. It is proposed that services to the office areas will be metered.
Mechanical Ventilation with Heat Recovery	Decentralised AHUs will incorporate high efficiency plate heat exchanger heat recovery.
Insulation to:	
Hot Water Tank & Pipes	Pipework will be insulated
Roof	New roof is provided throughout to achieve u-value as set out in Table 5.1.
Walls External	Insulation is to be provided throughout to achieve u-values as set out in Table 5.1.
Floor	Basement floor will be insulated to achieve a u-value as set out in Table 5.1.

Renewable Energy Technology	Air Sourced Heat Pump is proposed with an SCOP of 4.
Double glazed windows or secondary glazing	New windows and roof lights provided to the extension will be double glazed and target a u-value of 1.6
CHP	Due to the office nature of the proposed building there is no base demand for heating on this basis CHP is not technically viable for the proposed Development.

8.2 OVERALL CO_2 EMISSIONS REDUCTION

As a result of the ‘Be Lean’, ‘Be Clean’ and ‘Be Green’ measures proposed by the energy strategy, an overall CO_2 emissions reduction of 46% has been estimated compared to an existing notional building.

The application of an air source heat pump results in a 3% renewable energy technology contribution.

As a result of the ‘Be Lean’ and ‘Be Green’ measures the BREEAM target to meet 60% of the Energy credits should be achieved.

9 APPENDICES

9.1 SBEM BASELINE MODEL ASSUMPTIONS

Building Fabric – Existing Floor Levels		
External Walls	1.60W/m²K	Design Builder Library data for solid masonry wall 340mm uninsulated pre-1919
Basement Floor	0.58W/m²K	Library Data - for solid ground floor uninsulated
Flat Roof Over Basement	3.62W/m²K	Inference – solid/glazed blocks 140mm
Glazing (light transmittance/g-value/u-value)	0.71/0.7/4.96W/m²K	Inference - no date uninsulated, single glazing uncoated with softwood frame at 0.38 frame fraction for ground floor. 0.12 frame fraction for upper floors.
Air tightness	14m³/hm² at 50Pa	CIBSE TM23 Figure 11 for the average air leakage of commercial buildings in the UK
Building Fabric – Extension		
External Wall	0.26W/m²K	Part L2A Table 5
Roof	0.18W/m²K	Part L2A Table 5
Glazing (light transmittance/g-value/u-value)	0.71/0.4/1.6 W/m²K, 0.1 Frame Fraction	Part L2A Table 5
Roof Lights - Glazing (light transmittance/g-value/u-value)	0.6/055/1.8 W/m²K, 0.15 Frame Fraction	Part L2A Table 5
Lighting – Existing Floor Levels		
Lighting	Fluorescent with unknown details and no intelligent controls	'Fluorescent (no details)' Template
Lighting – Extension		
Lamp Efficacy	60lm/W	Part L2 2010 Notional Template
Light Output Ratio	0.25	
Lighting Control	Local Manual Switching Photoelectric PH Switching, Addressable	
Auto zoning of daylighting controls	Yes	
Occupancy Sensor	Auto-on-off	
Parasitic power	0.3W/m2	
HVAC – Existing Floor Levels		
HVAC System	Split or multi-split system	Assumed
Heating	LTHW Boiler Natural Gas	
Heating SEER	0.74	
Cooling Type	Electric Heat Pump	
Cooling EER/SEER	3.125/2.5	
DHW heating	Electric point of use	
Ventilation	Natural	
HVAC – Existing Floor Levels		
HVAC System	Split or multi-split system	NCM Guide
Heating	Electric Heat Pump	
Heating SEER	2.43	
Cooling Type	Electric Heat Pump	
Cooling EER/SEER	4.5/4.5	
DHW heating	Electric point of use	
Ventilation – Office Area	Mechanical, 1.8W/l/s SFP, 70% Heat Recovery Efficiency	
Ventilation - Toilet	Mechanical, fan remote from zone, 8.6l/s/m2, 0.5W/l/s SFP	

9.2 SBEM 'BE LEAN' MODEL ASSUMPTIONS

Building Fabric – Existing Floor Levels	
External Walls	0.3W/m^{2}K
Basement Floor	0.22W/m^{2}K
Flat Roof Over Basement	3.62W/m^{2}K
Glazing (light transmittance/g-value/u-value)	0.7/0.7/1.6W/m^{2}K
Air tightness	10m^3/hm^2 at 50Pa
Building Fabric – Extension	
External Wall	0.18W/m^{2}K
Roof	0.15W/m^{2}K
Glazing (light transmittance/g-value/u-value)	0.61/0.3/1.6 W/m^{2}K, 0.1 Frame Fraction
Roof Lights - Glazing (light transmittance/g-value/u-value)	0.61/0.3/1.6 W/m^{2}K, 0.12 Frame Fraction
Lighting	
Lamp Efficacy	80lm/W, LED
Light Output Ratio	1
Lighting Control	Photoelectric PH Switching, Addressable Systems
Parasitic power of control device	0.3W/m^2
Occupancy Sensor	Yes
Occupancy Sensing type	Auto-on-off
Parasitic power	0.3W/m2
HVAC – WCs	
HVAC System	Other local room heater - unfanned
Heating	Electric Room Heater
Heating SEER	1
DHW heating	Electric point of use
Ventilation	0.3W/l/s, extract fan remote from zone
HVAC – Circulation	
HVAC System	Other local room heater - unfanned
Heating	Electric Room Heater
Heating SEER	1
DHW heating	Electric point of use
Ventilation	Natural
HVAC – Offices	
HVAC System	Split or Multisplit
Heating	LTHW Boiler
Heating SEER	0.91
Cooling Type	Electric Heat Pump
Cooling EER	4
Cooling SEER	4
DHW heating	Electric point of use
Ventilation	AHU SFP 1.6, Heat recovery 70% efficiency FCU SFP 0.5W/l/s
HVAC – Reception	
HVAC System	Split or Multisplit
Heating	LTHW Boiler
Heating SEER	0.91
Cooling Type	Electric Heat Pump
Cooling EER	4
Cooling SEER	4
DHW heating	Electric point of use
Ventilation	Natural

9.3 SBEM 'BE GREEN' MODEL ASSUMPTIONS

HVAC – Offices	
Heating	Electric Heat Pump
Heating SEER	4
HVAC – Reception	
Heating	Electric Heat Pump
Heating SEER	4

9.4 SBEM BRUKL REPORTS

9.4.1 BASELINE SBEM BRUKL REPORT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Grape Street

As designed

Date: Mon Mar 14 14:22:53 2016

Administrative information

Building Details

Address: 9-13 Grape Street, London Borough of Camden,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.d.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.2.0

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scotch Partners

Telephone number: 0203 544 5400

Address: 45 Clerkenwell Green, London, EC1R 0HT

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	25.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	25.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	78.7
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	1.49	1.96	0 Basement - -1 Office_P_13
Floor	0.25	0.31	2.07	0 Ground - 0 Bike Entrance_F_8
Roof	0.25	1.2	3.62	0 Basement - -1 Office_R_9
Windows***, roof windows, and rooflights	2.2	4.05	4.96	1 First - 1 Office_G_12
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	12.24

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	NO
Whole building electric power factor achieved by power factor correction	<0.9

1- Extension HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.43	4.5	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

2- Existing HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	0.74	3.13	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

1- Extension DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

2- Existing DHW

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	**Zone**	**Standard**
4 Fourth - 4 Core	-	-	-	-	-	-	-	-	-	-	N/A
4 Fourth - 4 WC	-	-	0.5	-	-	-	-	-	-	-	N/A
4 Fourth - 4 Office	-	-	-	1.8	-	-	-	-	-	0.7	0.5

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
0 Basement - -1 Office	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Lobby	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Plant	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 WC	-	-	-	-	-	-	-	-	-	-	N/A
1 First - 1 Office	-	-	-	-	-	-	-	-	-	-	N/A
1 First - 1 Core	-	-	-	-	-	-	-	-	-	-	N/A
1 First - 1 WC	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Bike Entrance	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 WC & Showers	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Office	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Office Entrance	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Core	-	-	-	-	-	-	-	-	-	-	N/A
2 Second - 2 Office	-	-	-	-	-	-	-	-	-	-	N/A
3 Third - 3 Office	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
4 Fourth - 4 Core	-	60	-	226
4 Fourth - 4 WC	-	60	-	284
4 Fourth - 4 Office	15	-	-	4773
0 Basement - -1 Office	16	-	-	3219
0 Basement - -1 Core	-	25	-	151
0 Basement - -1 Lobby	-	19	-	132
0 Basement - -1 Plant	10	-	-	488
0 Basement - -1 WC	9	-	-	471
1 First - 1 Office	14	-	-	4289
1 First - 1 Core	-	25	-	140
1 First - 1 WC	-	23	-	178
0 Ground - 0 Bike Entrance	9	-	-	98
0 Ground - 0 WC & Showers	-	19	-	139
0 Ground - 0 Office	15	-	-	3207
0 Ground - 0 Office Entrance	-	21	15	454
0 Ground - 0 Core	-	24	-	165
2 Second - 2 Office	14	-	-	4289
3 Third - 3 Office	14	-	-	4289

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
4 Fourth - 4 Office	YES (+91.9%)	NO
0 Basement - -1 Office	N/A	N/A

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0 Basement - -1 WC	N/A	N/A
1 First - 1 Office	NO (-26.8%)	NO
0 Ground - 0 Office	NO (-46.9%)	NO
0 Ground - 0 Office Entrance	YES (+71%)	NO
2 Second - 2 Office	NO (-26.8%)	NO
3 Third - 3 Office	NO (-26.8%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1084.4	1084.4
External area [m²]	1616.7	1616.7
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	12	3
Average conductance [W/K]	2775.31	950.06
Average U-value [W/m²K]	1.72	0.59
Alpha value* [%]	5.83	20.97

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	115.42	26.74
Cooling	19.18	9.34
Auxiliary	0.76	0.49
Lighting	66.53	17.47
Hot water	15.93	18.43
Equipment*	39.59	39.59
TOTAL**	**217.82**	**72.47**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	436.83	205.33
Primary energy* [kWh/m²]	458.91	136.27
Total emissions [kg/m²]	78.7	25.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	120.1	264.1	14.7	23	5.5	2.26	3.2	2.43	4.5
	Notional	59.2	110	6.8	8.5	3.6	2.43	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	326.5	118.7	131.4	18.6	0	0.69	1.78	0.74	2.5
	Notional	88.2	122.9	29.9	9.5	0	0.82	3.6	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.26	4 Fourth - 4 Core_W_5
Floor	0.2	0.23	0 Basement - -1 Lobby_S_6
Roof	0.15	0.18	4 Fourth - 4 Core_R_6
Windows, roof windows, and rooflights	1.5	1.6	4 Fourth - 4 Office_G_11
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
$m^3/(h.m^2)$ at 50 Pa	5	12.24

9.4.2 'BE LEAN' SBEM BRUKL REPORT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Grape Street

As designed

Date: Mon Mar 14 14:46:07 2016

Administrative information

Building Details

Address: 9-13 Grape Street, London Borough of Camden,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.d.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.2.0

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scotch Partners

Telephone number: 0203 544 5400

Address: 45 Clerkenwell Green, London, EC1R 0HT

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	26.7
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	26.7
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	44.5
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.8	1.96	4 Fourth - 4 WC_P_5
Floor	0.25	0.15	1.98	0 Ground - 0 Bike Entrance_F_7
Roof	0.25	1.19	3.62	0 Basement - -1 WC_R_4
Windows***, roof windows, and rooflights	2.2	1.6	1.6	4 Fourth - 4 WC_G_10
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	9.08

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Toilets HVAC

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

2- Entrance HVAC

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	4	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

3- Office HVAC

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	0.91	4	-	-	-
Standard value	0.91*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES
* Standard shown is for gas single boiler systems <=2 MW output. For single boiler systems >2 MW or multi-boiler systems, (overall) limiting efficiency is 0.86. For any individual boiler in a multi-boiler system, limiting efficiency is 0.82.					

4- Circulation & Lobbies HVAC

	Heating efficiency	**Cooling efficiency**	**Radiant efficiency**	**SFP [W/(l/s)]**	**HR efficiency**
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					NO

1- Electric Point of Use

	Water heating efficiency	**Storage loss factor [kWh/litre per day]**
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	**System type in Non-domestic Building Services Compliance Guide**
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
4 Fourth - 4 WC	-	-	0.3	-	-	-	-	-	-	-	N/A
0 Basement - -1 WC	-	-	0.3	-	-	-	-	-	-	-	N/A
1 First - 1 WC	-	-	0.3	-	-	-	-	-	-	-	N/A
0 Ground - 0 WC & Showers	-	-	0.3	-	-	-	-	-	-	-	N/A
0 Ground - 0 Office Entrance	-	-	-	-	-	-	-	-	-	-	N/A
4 Fourth - 4 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
0 Basement - -1 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
1 First - 1 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
0 Ground - 0 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
2 Second - 2 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
3 Third - 3 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
4 Fourth - 4 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Lobby	-	-	-	-	-	-	-	-	-	-	N/A
1 First - 1 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Bike Entrance	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Plant	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
4 Fourth - 4 WC	-	80	-	53
0 Basement - -1 WC	-	80	-	74
1 First - 1 WC	-	80	-	50
0 Ground - 0 WC & Showers	-	80	-	39
0 Ground - 0 Office Entrance	-	80	80	128
4 Fourth - 4 Office	80	-	-	885
0 Basement - -1 Office	80	-	-	1006
1 First - 1 Office	80	-	-	1206
0 Ground - 0 Office	80	-	-	902
2 Second - 2 Office	80	-	-	1206
3 Third - 3 Office	80	-	-	1206
4 Fourth - 4 Core	-	80	-	42
0 Basement - -1 Core	-	80	-	47
0 Basement - -1 Lobby	-	80	-	41
1 First - 1 Core	-	80	-	39
0 Ground - 0 Bike Entrance	80	-	-	28
0 Ground - 0 Core	-	80	-	46
0 Basement - -1 Plant	80	-	-	153

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0 Ground - 0 Office Entrance	NO (-19.5%)	NO
4 Fourth - 4 Office	NO (-3%)	NO
0 Basement - -1 Office	N/A	N/A
1 First - 1 Office	NO (-59.5%)	NO
0 Ground - 0 Office	NO (-56.3%)	NO
2 Second - 2 Office	NO (-59.5%)	NO
3 Third - 3 Office	NO (-59.5%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1083.1	1083.1
External area [m²]	1843.1	1843.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	9	3
Average conductance [W/K]	1620.29	1081.93
Average U-value [W/m²K]	0.88	0.59
Alpha value* [%]	7.91	21.24

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	47.85	25.16
Cooling	11.07	8.52
Auxiliary	5.36	3.15
Lighting	19.22	16.39
Hot water	15.92	18.41
Equipment*	39.32	39.32
TOTAL**	**99.42**	**71.64**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	271.76	203.26
Primary energy* [kWh/m²]	262.1	133.57
Total emissions [kg/m²]	44.5	26.7

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Natural Gas										
	Actual	458.7	25.4	159.3	0	8.8	0.8	0	1	0
	Notional	199.8	142.9	67.8	0	17.7	0.82	0	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	206.9	90.5	64.4	8.4	0	0.89	2.99	0.91	4
	Notional	49.1	142.7	16.6	11	0	0.82	3.6	----	----
[ST] Split or multi-split system, [HS] LTHW boiler, [HFT] Natural Gas, [CFT] Electricity										
	Actual	91.9	152.9	28.6	14.2	6.3	0.89	2.99	0.91	4
	Notional	51.3	140.1	17.4	10.8	2.7	0.82	3.6	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Natural Gas										
	Actual	335.6	42.9	116.5	0	0	0.8	0	1	0
	Notional	169.9	77.6	57.6	0	0	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	**$U_{i\text{-}Typ}$**	**$U_{i\text{-}Min}$**	**Surface where the minimum value occurs***
Wall	0.23	0.18	4 Fourth - 4 WC_W_7
Floor	0.2	0.12	4 Fourth - 4 WC_F_3
Roof	0.15	0.15	4 Fourth - 4 WC_R_9
Windows, roof windows, and rooflights	1.5	1.6	4 Fourth - 4 WC_G_10
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	**Typical value**	**This building**
m³/(h.m²) at 50 Pa	5	9.08

9.4.3 'BE GREEN' SBEM BRUKL REPORT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Grape Street

As designed

Date: Mon Mar 14 14:41:04 2016

Administrative information

Building Details

Address: 9-13 Grape Street, London Borough of Camden,

Certification tool

Calculation engine: SBEM

Calculation engine version: v5.2.d.2

Interface to calculation engine: DesignBuilder SBEM

Interface to calculation engine version: v4.2.0

BRUKL compliance check version: v5.2.d.2

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Scotch Partners

Telephone number: 0203 544 5400

Address: 45 Clerkenwell Green, London, EC1R 0HT

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

The building does not comply with England Building Regulations Part L 2013

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	26.1
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	26.1
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	42.3
Are emissions from the building less than or equal to the target?	BER > TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and the building services should achieve reasonable overall standards of energy efficiency

Values not achieving standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.8	1.96	4 Fourth - 4 WC_P_5
Floor	0.25	0.15	1.98	0 Ground - 0 Bike Entrance_F_7
Roof	0.25	1.19	3.62	0 Basement - -1 WC_R_4
Windows***, roof windows, and rooflights	2.2	1.6	1.6	4 Fourth - 4 WC_G_10
Personnel doors	2.2	-	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	-	"No external vehicle access doors"
High usage entrance doors	3.5	-	-	"No external high usage entrance doors"

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	9.08

Building services

The standard values listed below are minimum values for efficiencies and maximum values for SFPs.
Refer to the Non-Domestic Building Services Compliance Guide for details.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Toilets HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

2- Entrance HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	4	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

3- Office HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4	4	-	-	-
Standard value	2.5*	2.6	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	YES				
* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps. For types <=12 kW output, refer to EN 14825 for limiting standards.					

4- Circulation & Lobbies HVAC

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system	NO				

1- Electric Point of Use

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	-
Standard value	1	N/A

Local mechanical ventilation, exhaust, and terminal units

ID	System type in Non-domestic Building Services Compliance Guide
A	Local supply or extract ventilation units serving a single area
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal supply and extract ventilation units serving a single room or zone with heating and heat recovery
E	Local supply and extract ventilation system serving a single area with heating and heat recovery
F	Other local ventilation units
G	Fan-assisted terminal VAV unit
H	Fan coil units
I	Zonal extract system where the fan is remote from the zone with grease filter

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	1.9	1.6	0.5	1.1	0.5	1	Zone	Standard
4 Fourth - 4 WC	-	-	0.3	-	-	-	-	-	-	-	N/A
0 Basement - -1 WC	-	-	0.3	-	-	-	-	-	-	-	N/A
1 First - 1 WC	-	-	0.3	-	-	-	-	-	-	-	N/A
0 Ground - 0 WC & Showers	-	-	0.3	-	-	-	-	-	-	-	N/A
0 Ground - 0 Office Entrance	-	-	-	-	-	-	-	-	-	-	N/A
4 Fourth - 4 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
0 Basement - -1 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
1 First - 1 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
0 Ground - 0 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
2 Second - 2 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
3 Third - 3 Office	-	-	-	1.6	-	-	-	-	-	0.7	0.65
4 Fourth - 4 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Lobby	-	-	-	-	-	-	-	-	-	-	N/A
1 First - 1 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Bike Entrance	-	-	-	-	-	-	-	-	-	-	N/A
0 Ground - 0 Core	-	-	-	-	-	-	-	-	-	-	N/A
0 Basement - -1 Plant	-	-	-	-	-	-	-	-	-	-	N/A

General lighting and display lighting	Luminous efficacy [lm/W]			
Zone name	Luminaire	Lamp	Display lamp	General lighting [W]
Standard value	60	60	22	
4 Fourth - 4 WC	-	80	-	53
0 Basement - -1 WC	-	80	-	74
1 First - 1 WC	-	80	-	50
0 Ground - 0 WC & Showers	-	80	-	39
0 Ground - 0 Office Entrance	-	80	80	128
4 Fourth - 4 Office	80	-	-	885
0 Basement - -1 Office	80	-	-	1006
1 First - 1 Office	80	-	-	1206
0 Ground - 0 Office	80	-	-	902
2 Second - 2 Office	80	-	-	1206
3 Third - 3 Office	80	-	-	1206
4 Fourth - 4 Core	-	80	-	42
0 Basement - -1 Core	-	80	-	47
0 Basement - -1 Lobby	-	80	-	41
1 First - 1 Core	-	80	-	39
0 Ground - 0 Bike Entrance	80	-	-	28
0 Ground - 0 Core	-	80	-	46
0 Basement - -1 Plant	80	-	-	153

Criterion 3: The spaces in the building should have appropriate passive control measures to limit solar gains

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
0 Ground - 0 Office Entrance	NO (-19.5%)	NO
4 Fourth - 4 Office	NO (-3%)	NO
0 Basement - -1 Office	N/A	N/A
1 First - 1 Office	NO (-59.5%)	NO
0 Ground - 0 Office	NO (-56.3%)	NO
2 Second - 2 Office	NO (-59.5%)	NO
3 Third - 3 Office	NO (-59.5%)	NO

Criterion 4: The performance of the building, as built, should be consistent with the calculated BER

Separate submission

Criterion 5: The necessary provisions for enabling energy-efficient operation of the building should be in place

Separate submission

EPBD (Recast): Consideration of alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m²]	1083.1	1083.1
External area [m²]	1843.1	1843.1
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	9	3
Average conductance [W/K]	1620.29	1081.93
Average U-value [W/m²K]	0.88	0.59
Alpha value* [%]	7.91	21.24

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
100	**B1 Offices and Workshop businesses**
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Inst.: Hospitals and Care Homes
	C2 Residential Inst.: Residential schools
	C2 Residential Inst.: Universities and colleges
	C2A Secure Residential Inst.
	Residential spaces
	D1 Non-residential Inst.: Community/Day Centre
	D1 Non-residential Inst.: Libraries, Museums, and Galleries
	D1 Non-residential Inst.: Education
	D1 Non-residential Inst.: Primary Health Care Building
	D1 Non-residential Inst.: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others - Stand alone utility block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	29.85	16.08
Cooling	11.07	8.52
Auxiliary	5.36	3.15
Lighting	19.22	16.39
Hot water	15.92	18.41
Equipment*	39.32	39.32
TOTAL**	**81.42**	**62.56**

* Energy used by equipment does not count towards the total for calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	271.76	203.26
Primary energy* [kWh/m²]	249.96	130.68
Total emissions [kg/m²]	42.3	26.1

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Natural Gas										
	Actual	458.7	25.4	159.3	0	8.8	0.8	0	1	0
	Notional	199.8	142.9	67.8	0	17.7	0.82	0	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	206.9	90.5	14.6	8.4	0	3.92	2.99	4	4
	Notional	49.1	142.7	5.6	11	0	2.43	3.6	----	----
[ST] Split or multi-split system, [HS] Heat pump (electric): air source, [HFT] Electricity, [CFT] Electricity										
	Actual	91.9	152.9	6.5	14.2	6.3	3.92	2.99	4	4
	Notional	51.3	140.1	5.9	10.8	2.7	2.43	3.6	----	----
[ST] Other local room heater - unfanned, [HS] Room heater, [HFT] Electricity, [CFT] Natural Gas										
	Actual	335.6	42.9	116.5	0	0	0.8	0	1	0
	Notional	169.9	77.6	57.6	0	0	0.82	0	----	----
[ST] No Heating or Cooling										
	Actual	0	0	0	0	0	0	0	0	0
	Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

Key Features

The BCO can give particular attention to items with specifications that are better than typically expected.

Building fabric

Element	$U_{i\text{-}Typ}$	$U_{i\text{-}Min}$	Surface where the minimum value occurs*
Wall	0.23	0.18	4 Fourth - 4 WC_W_7
Floor	0.2	0.12	4 Fourth - 4 WC_F_3
Roof	0.15	0.15	4 Fourth - 4 WC_R_9
Windows, roof windows, and rooflights	1.5	1.6	4 Fourth - 4 WC_G_10
Personnel doors	1.5	-	"No external personnel doors"
Vehicle access & similar large doors	1.5	-	"No external vehicle access doors"
High usage entrance doors	1.5	-	"No external high usage entrance doors"

$U_{i\text{-}Typ}$ = Typical individual element U-values [W/(m²K)] $U_{i\text{-}Min}$ = Minimum individual element U-values [W/(m²K)]

* There might be more than one surface where the minimum U-value occurs.

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	9.08

10 REFERENCES

[i] Camden Core Strategy 2010-2025 Local Development Framework
[ii] Camden Development Policies 2010-2025 Local Development Framework
[iii] Camden Planning Guidance on Sustainability CPG 3 – July 2015

[iv] BREEAM UK Refurbishment and Fit-out 2014 Non-domestic buildings, Technical Manual Version SD216 1.0-2014, Issue 1.0, BRE Global Ltd. 2014 p.143

[v] CIBSE Technical Memoranda TM23 – Testing Buildings for Air Leakage, 2000, Figure 11, p6.

[vi] Centre for Sustainable Energy. (2010). *London Heat Map*. Retrieved November 12, 2013, from London Heat Map: http://www.londonheatmap.org.uk/Mapping/

SCOTCH

Partners

Scotch Partners LLP
Clerkenwell House
45 Clerkenwell Green
London EC1R 0HT

T: 0203 544 5400
E: enquiries@scotchpartners.com