Sustainability

Energy Statement & BREEAM Pre-assessment

16 Rochester Mews
Camden
NW1 9JB

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1.0 Executive Summary

The proposed 4 storey development at 16 Rochester Mews has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and Camden Council policies, and the relevant Policy documents – specifically, Camden's Planning Guidance 3 - Sustainability

The individual properties are also designed to meet Code for Sustainable Homes Level 4 including achieving over 50% of the unweighted credits in the Energy & Water sections, whilst the commercial element has been designed to meet the Building Research Establishments. Environmental Assessment Model's (BREEAM) "Excellent" Standard, which also includes 70% of the un-weighted credits in the Energy category, 62.5% in the Water category and 71.45% under the Materials section

A 'Lean, Clean, Green' has been adopted and the development achieves an overall improvement (DER/TER) in regulated emissions of >44% over Part L 2013 standards, through the adoption of high standards of insulation, efficient gas fired heating and hot water, with electricity generation via roof mounted PV, way beyond the current London Plan aspirations

This high standard of energy performance has the benefit of off-setting some of the inherent restrictions in achieving some of the desired environmental points in the Code for Sustainable Homes assessment due to the confined nature of the site.

2.0 The Site & Proposal

The proposed site is currently an existing single storey commercial workshop building of circa 1950's construction of very limited architectural merit

The proposed development will consist of a 4 storey property - the project will provide a ground floor commercial space/workshop and 3 floors above providing 4 x 2 bed apartments and 1 x 3 bed apartment.

The apartments will enjoy good open aspects to the north west and south east

2.1 Planning Policy.

The site sits within the Borough of Camden Council:-

Camden Core Strategy CS13 - Tackling climate change through promoting higher environmental
standards:-

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

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:

- ensuring developments use less energy
- making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
- generating renewable energy on-site;"

LDF Policy DP22 - Promoting sustainable design and construction in Camden Development Policies, provides further guidance on what measures can be implemented to achieve an environmentally sustainable building:-

Policy DP22 confirms that

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

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016
e) expecting non-domestic developments of 500sqm of floor space or above to achieve "Very Good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

Finally, in support of the above Policies, Camden provides further details of requirements within their Planning Guide No3 – Sustainability (CPG3):-

"2.5 - Developments involving 5 or more dwellings and/or 500sq m (gross internal) floor space or more are required to submit an energy statement which demonstrates how carbon dioxide emissions will be reduced in line with the energy hierarchy" as well as under 9.8, encouraged to meet the Code for Sustainable Homes, Level 3 with 50% of the unweighted credits under the Energy section

Under Section 6 – "Developments are to target a 20% reduction in carbon dioxide emissions from on-site renewable energy technologies."

This report will demonstrate how the proposed development at 16 Rochester Mews will meet the above Planning Policy requirements by following the methodology set down by the Energy Hierarchy and detailed in Policy 5 of the London Plan 2011:-

LONDON PLAN

Supplementary to the above, The London Plan 2011 requires an improvement in emission rates of 25% over current Part L Building Regulations (the same requirement for and also lays down the methodology for the use of the energy hierarchy :-

- Be Lean – use energy efficiently
- Be Clean – use clean energy
- Be Green – reduce emissions via the use of renewable technologies

As part of this assessment, it must consider unregulated energy use not covered under the Building Regulations at each stage of the Energy Hierarchy i.e. cooking and appliances and use of equipment within the commercial element

Accordingly, this report will be informed by, and be compliant with the above policy requirements.

3.0 Baseline energy results

The first stage of the Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the overall development – the starting point when considering the energy hierarchy.

The energy requirements for space heating, water heating and ventilation within the residential dwellings have been calculated using the Standard Assessment Procedure 2012 (SAP) in line with Approved Document L1A of the Building Regulations 2013 as well as the Domestic Heating Compliance Guide.

To achieve this, it is necessary to determine what the Building Regulations Approved Document Part L (minimum) standard is before the application of energy reduction measures to the design. The following section summarises the energy calculations undertaken in order to determine the Part L Target Emission Rates (TER) to which the planning requirements are applied.

3.1 New Build Apartments

The baseline emission levels – the Target Emission Rate (TER) - is obtained by applying the design to a reference 'notional' building the characteristics of which are set by regulations – SAP2012; The new Part L Building Regulations 2013 came into force on April 2014 and introduced a completely new notional dwelling as detailed below:-

Table 4 Summary of concurrent notional dwelling specification

Element or System	Values
Opening areas (windows and doors)	Same as actual dwelling up to a maximum proportion of 25% of total floor area [1]
External Walls (including opaque elements of curtain walls) [6]	0.18 W/m^2K
Party Walls	0.0 W/m^2K
Floor	0.13 W/m^2K
Roof	0.13 W/m^2K
Windows, roof windows, glazed rooflights and glazed doors	1.4 W/m^2K [2] (Whole window U-value)
	g-value = 0.63 [3]
Opaque doors	1.0 W/m^2K
Semi glazed doors	1.2 W/m^2K
Air tightness	5.0 $m^3/hr/m^2$
Linear thermal transmittance	Standardised psi values – See SAP Appendix R, except use of y=0.05 W/m^2K if the default value of y=0.15 W/m^2K is used in the actual dwelling
Ventilation type	Natural (with extract fans) [4]
Air conditioning	None

Element or System	Values
Heating System	Mains gas If combi boiler in actual dwelling, combi boiler; otherwise regular boiler Radiators
	Room sealed
	Fan flue
	SEDBUK 2009 89.5% efficient
Controls	Time and temperature zone control [5] Weather compensation
	Modulating boiler with interlock
Hot water storage system	Heated by boiler (regular or combi as above) If cylinder specified in actual dwelling, volume of cylinder in actual dwelling. If combi boiler, no cylinder. Otherwise 150 litres. Located in heated space. Thermostat controlled Separate time control for space and water heating
Primary Pipework	Fully Insulated
Hot water cylinder loss factor (if specified)	Declared loss factor equal or better than 0.85 x (0.2 + 0.051 V2/3) kWh/day
Secondary Space Heating	None
Low Energy Lighting	100% Low Energy Lighting
Thermal Mass Parameter	Medium (TMP=250)

SAP first creates the notional reference building, based upon the same shape and form as the proposed dwelling and applies the above the characteristics as defined in SAP2012.

Once all of the baseline emission rates have been calculated in line with the above Government approved methodologies, they are considered as stage 'zero' of the energy hierarchy as described earlier and sets the benchmark for the worst performing, but legally permissible, development.

3.2 Commercial Space

The energy requirements for space heating, water heating and ventilation within the commercial space have been calculated using the National Calculation Method (NCM) in line with AD L2A of the Building Regulations 2013 and the Non-Domestic Heating Compliance Guide.

The Government approved assessment methodology is the Simplified Building Energy Model (SBEM), eb7 Sustainability Ltd use an advanced modelling software - Design Builder - which enables accurate SBEM models to be created, as well as heat loss and cooling load calculations and full M&E design to be undertaken.

To consider the subject building performance against The Building Regulations (Approved Document L2A) SBEM first creates the notional reference building, the characteristics of which are defined in within NCM and the minimum fabric values and fixed services efficiencies set down by AD L2A and the Non-domestic Compliance Guide.

This creates the target Emission Rate (TER) and should be considered as stage 'zero' of the energy hierarchy as described earlier and sets the benchmark for the worst performing, but legally permissible, development against which, SBEM assesses the "actual" design, fabric values, heating lighting and ventilation systems and creates the Building Emissions Rate (BER).

3.3 Unregulated Energy Use

The baseline un-regulated energy use for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = $E_A = 207.8 \times (TFA \times N)^{0.4714}$

Cooking = (119 + 24N)/TFA

N= no of occupant SAP table 1B

TFA – Total Floor Areas

The unregulated energy use for the commercial unit can be derived from the BRUKL outputs under section "Energy Consumption by End Use" - Equipment

The unregulated energy use per sqm is summarised in Table 1 below

Table 1 – Unregulated Energy Use

Unit	Unregulated Energy Use Kg/sqm
Flat 1	18.12
Flat 2	15.78
Flat 3	19.70
Flat 4	19.80
Flat 5	16.25
Commercial Unit	17.75

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.2 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan 2011 and Ealing Local Plans policies.

3.4 Baseline Results

The baseline building results have been calculated and are presented in Table 2 below.

The Baseline SAP TER and BRUKL outputs (which summarise the key data) are attached at **Appendix A.** As noted above - the baseline figure used is the TER for the new build dwellings and commercial unit

Table 2 – Baseline energy consumption & emission levels

Unit	Baseline Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Flat 1	21.53	18.12	39.65	2396
Flat 2	17.51	15.78	33.29	2896
Flat 3	19.60	19.70	39.30	1970
Flat 4	19.97	19.80	39.77	2013
Flat 5	19.33	16.25	35.58	2517
Commercial Unit	14.00	17.75	31.75	6791
Total				**18583**

4.0 Design for energy efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in Section 5 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the dwellings, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO2 produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO2 emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy demand the following measures have been included within the design and specification of the building:

4.1 Orientation

As a new build project on the footprint of existing buildings, the orientation is fixed. The development is located in a medium- high rise urban locale entirely surrounded by other buildings of similar height of lower height.

Large glazed areas have been used to maximise solar gain and thereby reduce heating loads, while the reduced areas of glazing to the aspect reduce the risk of overheating.

4.2 Heating system

The heating system considered for the dwellings will consist of high efficiency condensing gas combination boilers; this will in turn provide domestic hot water. Space heating throughout will be via an underfloor wet heating system.

- High efficiency boiler – (89% + SEDBUK efficiency) & flue gas heat recovery
- Insulated primary pipework

To increase the efficiency in the use of the heating system, the following controls will be used in a 'boiler interlock' system to eliminate needless firing of the boilers.

- Boilers fitted with weather compensation and delayed start thermostats.

For the commercial unit, high efficiency gas radiant heaters are proposed, with point of use hot water boilers with extract ventilation for the workshop/workspace area – assuming a low specific fan power for the selected equipment

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated u values exceed the Building regulations minima, with specific guidance taken from Camden's CPG 3:-

- New wall constructions will be of traditional brick and block and ground and first floor levels, while the floors 1 -3 will be of a light steel frame construction with opaque glazed panel cladding. Each build type will target a u-value of 0.23 or better.
- The Flat Roof/Terrace construction is yet to be specified, but a warm roof construction achieving a u-value of 0.13 will be targeted.

- The ground floor to the commercial unit, as well as the separating floors for the residential units above, will achieve a minimum u value at 2.0

Glazing

- New glazing for windows and doors and have area weighted average U-Values of 1.3w/m^2 K or better

Air Tightness

- The project will be tested for air tightness with a target value of 3m^3/hr/m^2

Construction Details

- Heat loss via non-repeating thermal bridging will be minimised by the use of Accredited Construction Details for these new build units . An overall y value <0.08 is targeted to ensure compliance with the minimum standards for dwelling fabric energy efficiency

4.4 Ventilation

The design team are proposing a natural ventilation strategy with a very high target for air tightness reducing heat losses through the building fabric limited to 3m^3/hr/m^2 in line with Part F of the Building Regulations,

4.5 Lighting and appliances

The commercial space will incorporate high efficiency light fittings utilising T5 lamps with high frequency ballasts and will have PIR and photocell controls to minimise daytime/unnecessary use

In the residential units, 100% of internal light fittings will be dedicated low-energy/compact fluorescent fittings, while low energy/compact fluorescent lighting will be used for circulation areas and toilets. In addition, occupancy sensing will be used to prevent lights being left on in common areas.

It is anticipated that under the Code for Sustainable Homes/BREEAM requirements, all of the electrical appliances will be provided as part of the finished dwelling: Fridge/freezers A+ rated, Dishwasher and washing machines A rated and tumble dryer with a B rating.

In addition, again in line with the Code for Sustainable Homes/BREEAM requirements, all external lighting will be of the low energy type with daylight controls. In addition consideration will be given to the design and location to reduce light pollution.

4.6 Energy efficiency results

The above data has been used to update the SAP and SBEM models, the Building and Dwelling Emission Rate outputs of which are attached at **Appendix B.** The following Table 3 shows the emissions levels achieved by unit, as well as the overall emissions from the building.

Table 3 – Energy Efficient emission levels

Unit	Dwelling/Building Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total emissions Kg/sqm	Total emissions Kg
Flat 1	20.88	18.12	39.00	2357
Flat 2	16.38	15.78	32.16	2797
Flat 3	19.13	19.70	38.83	1946
Flat 4	19.66	19.80	39.46	1997
Flat 5	18.65	16.25	34.90	2468
Commercial Unit	8.20	17.75	25.95	5551
Total				**17117**

The results show that the energy efficiency measures introduced have resulted in the reduction in CO2 emissions from the development of **7.9 %** and in addition, the SAP outputs at **Appendix B,** clearly demonstrate that Building Regulations Part L 2013 compliance has been achieved through the "fabric first" approach, which includes meeting the new stringent Dwelling Fabric Energy Efficiency requirements

5.0 Supplying Energy Efficiently

The second stage in the Mayor's 'Energy Hierarchy' is to ensure efficient and low carbon energy supply – Be Clean. In particular, this concerns provision of decentralised energy where practical and appropriate.

5.1 Community heating/Combined Heat and Power (CHP)

The London Plan, Policy 5.6 - Decentralised energy in development proposals requires:

- Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

Although the project at 16 Rochester Mews would not be considered a major project, the developers do want to consider the potential to connect to a current, or future district heating net work

The extract from the London Heat Map (reproduced below) identifies an area of decentralised energy potential to the south east of the proposed development:-

Extract from the London Heat Map – Potential Networks

Clearly, with the development site at 16 Rochester Mews some 0.5km distant from a potential future network, connection to an existing, or near future network will not be feasible.

5.2 On-site CHP/District Heating

Feasibility studies can be carried out to different levels of detail and can look more closely at technical and/or financial issues that must be considered when considering on-site CHP or district heating.

Planning and implementation is also often focused early on.

The heat production facility for a district heating scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e. CHP.

CHP is, as a rule of thumb, is only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual heat requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

In a residential scheme, hot water is the only thermal load present throughout the year and during daylight hours this load is very small, with peaks in the morning and evening. By incorporating a thermal store, a correctly sized CHP engine can be operated continuously to provide the thermal energy for the hot water generation.

The key benefit from running a CHP engine is that it produces electricity, which can displace grid supplied electricity, which has significant carbon savings. It is for this reason that CHP is designed to run for as many hours of the year as possible.

The principle issue with introducing any such scheme at 16 Rochester Mews has been touched upon above; it would be inconceivable to consider introducing such a scheme to the new build dwellings due to the lack of scale of development.

6.0 Renewable Energy Options

The final element of the Mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The energy efficiency measures and the sourcing the energy efficiently outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in gas consumption.

It should be noted that each Kwh of gas energy saved reduces emissions by 0.216kgCO_2/kwh (SAP2012 data), whereas, grid based electrical energy has a emissions factor of 0.519kgCO_2/kwh and accordingly, emphasis will be placed upon "off-setting" grid based electricity in order to achieve the optimum use of renewable technologies.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Feed in Tariff

Feed in Tariffs (FiTs) replaced ROCs for renewable energy generators rated at less than 5MW in April 2010. FiTs are payments made for every kilowatt-hour kWh of renewable electricity generated and the level of the payment is laid down by the government, and varies for different renewable energy sources and at different scales. Unlike the flat rates paid for ROCs, FiTs are designed to compensate for less efficient/more expensive sources of renewable energy – and for the first time – make the investment in low and zero carbon technologies viable for both domestic generators and larger companies alike.

6.1.2 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally launched by the UK Government on 10th March 2011. The RHI will pay a tariff payment to renewable technologies that provide heat energy from a renewable source, with the payment relating to the KWh of heat energy provided e.g. if a property has a heat load of 20,000 KWh per annum, and it is 100% provided from a renewable source, then the tariff is paid against the 20,000KWh.

The Government have decided on a two stage delivery - the first stage being for non-domestic schemes, commencing in July 2011, with domestic schemes recently introduced in April 2014.

6.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is surrounded by other properties of similar height in all directions. To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings.

It is inconceivable that a wind turbine of this size would be considered acceptable in this location.

6.3 Solar Energy

The new development at 16 Rochester Mews is orientated to the NW/SE, and has an expanse of flat roofed area that could accommodate solar panels orientated to the south east.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic or water heating equipment at roof level.

6.3.1 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a south east orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

The area of panelling required to achieve 1kWp is dependent upon the efficiency of the system, but in the case of 16 Rochester Mews, with a large area of roof space at 3rd floor level – a high efficiency panel such as the Canadian Solar 310p series, which have a rating of 310w from 1.8m^2 of panel area would optimise the roof space available.

The introduction of the Feed in Tariff has now rendered such investments viable often achieving annual returns in the region of 7-8%.

Accordingly, the use of PV panels would be recommended for the project at 16 Rochester Mews

6.3.2 Solar water heating

Solar water heating panels come in two main types; flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900–1100 kWh of solar energy falls on each m^2 of unshaded UK roof surface annually. The usable energy output per m^2 of solar panel as a result of this amount of insolation ranges from between 380 – 550 kWh/yr.

Solar hot water systems are of course, displacing gas (as noted above), and due to the low emissions rates of gas as a source of energy, it would require a very large system to compete with the off-setting of electricity use afforded by the PV panels.

In addition, the use of combination boilers within the proposed units would require specific solar storage to be provided with the resultant increase in installation costs and space requirements.

Accordingly, solar thermal would not be the optimum solution for the development at Rochester Mews.

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e. trees that are grown to become wood fuel, capture carbon as they grow).

Unless a community/district heating solution is utilised (which has been discounted under Section 5 above), then biomass is very inflexible for smaller apartment living. Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis.

There are issues with fuel storage and delivery which mitigate against this technology. There is inadequate space at ground floor level for a fuel store and limited access for delivery lorries.

In addition, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements in dense urban development areas with reference to the air quality standards set within the London Plan 2011.

Accordingly, the use of biomass is not considered appropriate for this project.

6.6 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a ‘heat pump’. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by ‘condensing’ the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, in the case of the proposed development at Rochester Mews, there is no scope for the locating of the ground collector devices and as such, ground source heating cannot be considered.

6.7 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid based electricity and the associated emissions, so that actual the reduction in emissions can be limited. Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 25%. The table below demonstrates, on the assumption of a demand of 1000Kwh/year for heating and hot water.

Type of Array	Energy Consumption (Kwh/yr)	Emission factor ($kgCO_2$/Kwh)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	1111	0.216	240
320% efficient ASHP	312.5	0.519	162

A potential saving of– 32.5%

With the above data in mind, clearly an ASHP could be an option, however, it must be born in mind that air source heat pumps can often require immersion back up for peak load times (very cold weather) and for hot water production – this can often affect overall efficiently quite dramatically.

In addition, there is the need to mount the external evaporator units. There is little external space associated with the development - aside from the roof space – which would not cause a vision or noise nuisance to adjacent properties. Mounting the units on the roof space would require significant and expensive refrigerant pipe runs as well as offering a potential noise nuisance to the neighbouring properties.

In this case, the capital costs involved and the additional space required for the heat pump and associated equipment and the difficulties of installation as discussed above, would mean that this system would be less feasible in comparison to other technologies.

6.8 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use of roof mounted A frames to accommodate a 6.2Kwp (20 panel) PV array thereby utilising the whole of the available roof space.

This array can be expected to generate some 5,100Kwh per annum, off-setting approximately 2.65 tonnes CO_2 annually.

The final table – Table 4 – assumes that the PV array is installed as noted above, with the benefits allocated to the new build apartment units via a central "landlords" supply to that element and the final outputs from the SAP/SBEM models are attached at **Appendix C**

Table 4 – "Be Green" emission levels

Unit	Dwelling Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Flat 1	12.54	18.12	30.66	1853
Flat 2	8.08	15.78	23.86	2075
Flat 3	10.86	19.70	30.56	1532
Flat 4	11.39	19.80	31.19	1578
Flat 5	10.32	16.25	26.57	1879
Commercial Unit	8.20	17.75	25.95	5551
Total				**14469**

The data at Table 4 confirms that overall emissions – including unregulated energy use - have been reduced by **22.1%** over and above the baseline model and **15.5%** reduction in emissions directly from the use of renewable technologies, i.e. over and above the energy efficient model

Excluding the un-regulated use, i.e. considering emissions controlled under AD L1A & ADL2A, then the reduction equates to **44.8%**

7.0 Sustainable Design & Construction

The sustainable assessment criteria as developed by BRE are utilised within this report to confirm that the development meets with the requirements of Ealing's Development Management DPD

7.1 Code for Sustainable Homes

The Code for Sustainable Homes (the Code) is the national standard for the sustainable design and construction of new homes. The Code aims to reduce our carbon emissions and create homes that are more sustainable. It applies in England, Wales and Northern Ireland. It is entirely voluntary, and is intended to help promote higher standards of sustainable design above current Building Regulations minima.

The Code measures the sustainability of new homes against nine categories of sustainable design, rating the 'whole home' as a complete package. It covers energy/CO_2, water, materials, surface water runoff (flooding and flood prevention), waste, pollution, health and well-being, management and ecology.

The Code uses a one to six star rating system to communicate the overall sustainability performance of a new home against these nine categories. The Code sets minimum standards for energy and water use at each level and, within England, replaces the EcoHomes scheme, developed by the Building Research Establishment (BRE).

The London Plan also considers Sustainable design and Construction under Section Policy 5.3:-

"Major development proposals should meet the minimum standards outlined in the Mayor's supplementary planning guidance and this should be clearly demonstrated within a design and access statement. The standards include measures to achieve other policies in this Plan and the following sustainable design principles:

- *minimising carbon dioxide emission across the site, including the building and services (such as heating and cooling systems)*
- *avoiding internal overheating and contributing to the urban heat island effect*
- *efficient use of natural resources (including water), including making the most of natural systems both within and around buildings*
- *minimising pollution (including noise, air and urban run-off)*
- *minimising the generation of waste and maximising reuse or recycling*
- *avoiding impacts from natural hazards (including flooding)*
- *ensuring developments are comfortable and secure for users, including avoiding the creation of adverse local climatic conditions*
- *securing sustainable procurement of materials, using local supplies where feasible, and*
- *promoting and protecting biodiversity and green infrastructure."*

In order to demonstrate the sustainability credentials for the new build apartments at 16 Rochester Mews, the developers will achieve a 4 star rating (Code for Sustainable Homes - Level 4) as well as achieving 50% of the unweighted credits in the energy section.; a Code for Sustainable Homes pre-assessment for the proposed development is attached at **Appendix D.**

7.2 BREEAM New Construction 2014

BREEAM (Building Research Establishment's Environmental Assessment Method) is the world's leading and most widely used environmental assessment method for buildings, with over 115,000 buildings certified and nearly 700,000 registered. It sets the standard for best practice in sustainable design and has become the de facto measure used to describe a building's environmental performance. Credits are awarded in nine categories according to performance. These credits are then added together to produce a single overall score on a scale of Pass, Good, Very Good, Excellent and Outstanding. The operation of BREEAM is overseen by an independent Sustainability Board, representing a wide cross-section of construction industry stakeholders.

AIMS OF BREEAM:

- To mitigate the impacts of buildings on the environment
- To enable buildings to be recognised according to their environmental benefits
- To provide a credible, environmental label for buildings
- To stimulate demand for sustainable buildings

OBJECTIVES OF BREEAM:

- To provide market recognition to low environmental impact buildings
- To ensure best environmental practice is incorporated in buildings
- To set criteria and standards surpassing those required by regulations and challenge the
  market to provide innovative solutions that minimise the environmental impact of buildings
- To raise the awareness of owners, occupants, designers and operators of the benefits of
  buildings with a reduced impact on the environment
- To allow organisations to demonstrate progress towards corporate environmental objectives

There is a requirement under LDF Policy DP22 that; non-domestic developments of 500sqm of floor space or above to achieve "Very Good" in BREEAM assessments. However, in this case, following the guidance in CPG3, BREEAM "Excellent" is to be achieved

The BREEAM assessment is considered the most appropriate manner in which to demonstrate the Sustainable Design and Construction credentials of the newly constructed non-domestic development in order to fully comply with local plan policy.

The project would be considered within the Scope of BREEAM New Construction 2014 – Simple Buildings and would be assessed again the criteria set down under "Commercial – Industrial – Industrial Unit".

A pre-assessment estimator is attached at **Appendix E** which demonstrates how the project will meet the "Excellent" criteria.

8.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO_2 reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO2 emissions would be **18583Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as
detailed in section 4, the total amount of CO2 emissions would be reduced to **17117Kg/year**, a reduction of **7.9%.**

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources. Therefore the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO_2 emissions would be via the use of photovoltaic (PV) panels.

The developer has indicated the installation of a 6.2Kwp system consisting of 20 x 310w panels mounted on A-frames orientated to the south east on the top floor flat roof element.

This has be used in the SAP/BRUKL models (reproduced at **Appendix C**) for the development which have also been detailed above in Table 4, which show a final gross emission level of **10565Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **22.1%.**

In addition, the SAP/BRUKL outputs at Appendix C demonstrate that the building achieves an overall improvement of DER/TER for Building Regulations of minimum **44.8%**.

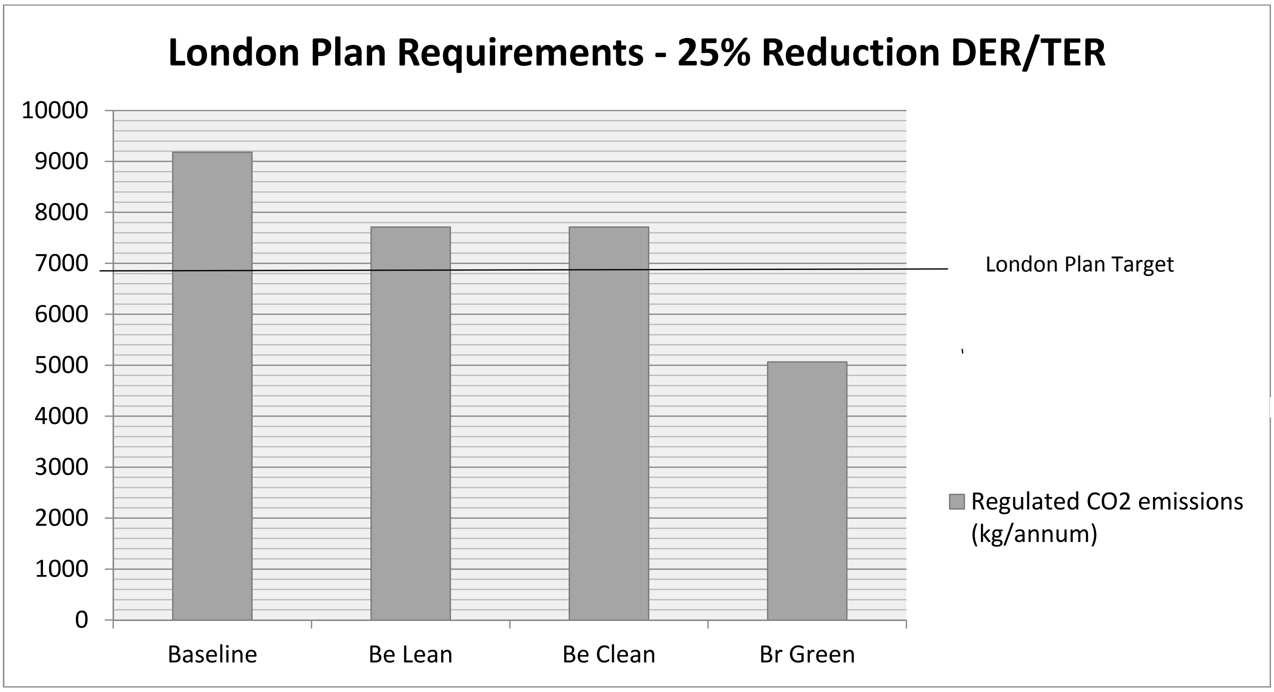
Tables 5 & 6 Demonstrate how the project complies with the London Plan requirements;

Table 5 – Carbon Emission Reductions

	Carbon Dioxide Emissions (Kg CO_2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L Compliant Development	9179	5607
After Energy Demand Reduction	7714	5607
After Community Heating	7714	5607
After renewable energy	5065	5607

Table 6 – Regulated Emissions Savings

	Regulated Carbon Dioxide Savings	
	Kg CO_2/annum	%
Savings from energy demand reduction	1465	16.0
Savings from Community Heating	0	0.0
Savings from renewable energy	2649	34.3
Total Cumulative Savings	**4114**	**44.8**



Appendix A

Baseline/Un-regulated Energy Use:-

SAP Target Emission Rate & BRUKL Output

Appendix B

Energy Efficient Design:-

SAP Dwelling Emission Rate and BRUKL Building Emission Rate

Appendix C

Generating energy on-site:-

Final SAP Dwelling Emission Rates & BRUKLoutputs

Appendix D

Code for Sustainable Homes – Pre-assessment Estimator

Appendix E

BREEAM New construction 2014 – Pre-assessment Estimator