Energy & Sustainability Statement

44 Bedford Row, London

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Contents

1 Introduction

This report has been prepared by Future Energy Surveys on behalf of *Claridge Architects* and *Westrock Ltd* for the proposed mixed residential and commercial development at 44 Bedford Row, London.

This report includes the following;

- A building regulations baseline energy calculation.
- An energy strategy to reduce carbon emissions by 20%.
- An EcoHomes Pre-assessment

The following documents were considered when formulating this report.

Building Regulations – The Building Regulations, and in particular ADL set minimum fabric efficiency standards and attach a target CO_2 emission rate.

Planning Policy Statement 1 (2007) – PPS 1 strengthens the emphasis on sustainable development, and requires new developments to “secure the highest viable resource and energy efficiency and reduction in emissions.”

Planning Policy Statement 22 (2007) – PPS 22 calls for local authorities to actively encourage renewable energy development through local planning policy.

Camden Local Development Framework (2010) – Policy DP22 details Camdens sustainable design and construction planning policy. DP22 includes a requirement to achieve EcoHomes “Very Good”.

Camden Planning Guidance 3 (2010) – This draft Supplementary Planning Document provides guidance on all matter of sustainability. It compliments planning policy CS13 and DP 22.

London Plan – Policy 5.2 requires all major developments to include a Energy Strategy considering regulated and non-regulated energy consumptions. Paragraph 5.43 states that a 20% reduction in CO_2 emissions over the baseline emissions is required.

2 Energy Consumption

Future Energy Surveys has modelled the proposed dwellings in SAP and SBEM using floor plans and a design specification suggested by *Future Energy Surveys*. Standard Assessment Procedure, or SAP, is the government's approved methodology for the calculation of energy consumption and CO_2 emissions for dwellings. It is a Part L compliance tool. Simplified Building Energy Model, or SBEM, is the governments approved methodology for the calculation of energy consumption and CO_2 for commercial buildings.

2.1 The Baseline

To ascertain the potential of various technologies to achieve a 20% reduction in carbon emissions, it is first necessary to calculate the baseline energy consumption of the development. As mentioned previously the properties were modelled in SAP and SBEM to determine the forecasted energy consumption and CO_2 emissions from all sources of regulated energy consumption (space heating, water heating, lighting, ventilation, pumps & fans).

The London Plan and Camden Council require that the baseline figure also reflects the anticipated energy use from unregulated sources. Unregulated sources include cooking, refrigeration, appliances etc. Unlike SBEM, SAP does not include an allowance for emissions from unregulated sources. However the Code for Sustainable Homes includes a methodology for the calculation of the additional emissions arising from appliances and cooking.

AdE – 99.9 x (TFA x N)$^{0.4714}$ – (3.267 x TFA) + (32.23 x N) + 72.6

AdE – Additional Emissions

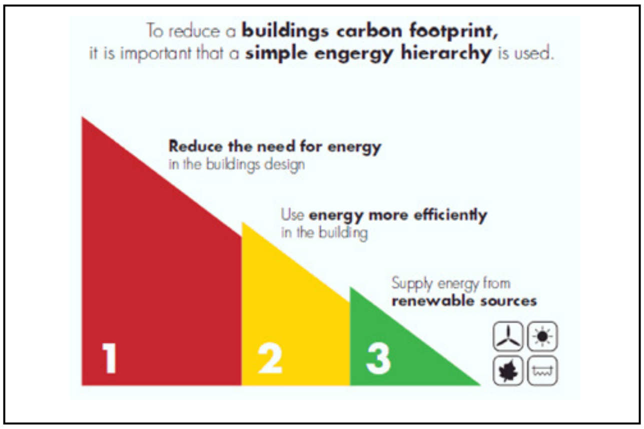
TFA – Total Floor Area

N = 2.844 X (1 – exp(-0.000391 x TFA^2))

Source – ENE 1. Code for Sustainable Homes Technical Guidan, May 2009 v2

In line with best practice and as requested by the London Plan and Camden Council, the proposed energy strategy will adhere to the principles of the *Energy Hierarchy*.

The Energy Hierarchy



2.1.1 Be Lean

As an existing building the opportunities to significantly better the minimum standards of Approved Document L can be reduced. The fact that the building is listed and is in a conservation zone can restrict this freedom further. It is essential that the works carried out on the building do not harm the historical or aesthetic value of the building. As such further consultation with *Camden Council* and *English Heritage* and a review of *Camden Planning Guidance 1 – Design* is recommended.

The following measures are recommended;

- The air permeability of a dwelling or commercial property is accounted for in SAP and SBEM. As an existing building both calculations must reflect an air permeability of $15m^3/(h.m^2)$@50Pa. This is in line with the conventions of SAP, SBEM and Part L1B and Part L2B. However reasonable provision must be made to making the building as air tight as is possible. This reduces the heat loss of a building and lowers the forecasted energy consumption. As such measures should be taken to draught proof each property.

- Lighting can account for 10-15% of a property's energy consumption. As such it is recommended that all light fittings are dedicated energy efficient. Such fittings only accept lamps with a luminous efficacy of 40 lumens per circuit watt.

- It is recommended that the glazing be upgraded to the standards specified in Part L1B. This will typically require the installation of secondary glazing or the installation of new double glazed units.

- It is recommended that the thermal performance of the roof be upgraded to achieve a u-value of $0.18W/m^2k$.

- It is recommended that the basement floor is upgraded to achieve a u-value of $0.25W/m^2K$. This will typically require a minimum of 75mm of rigid urethane with a r-value of 0.023W/mk or similar.

- It is recommended that the thermal performance of the external walls is upgraded to as high a standard as is feasible. Approved Document L1B recommends a value of $0.30W/m^2k$. The feasibility of this recommendation must be confirmed by the design team to ensure service profession and room sizes are not compromised. The following products are recommended; *Kingspan K18, Celotex PL4000, British Gypsum Gyproc Thermaline Super* or similar.

- It is recommended that highly efficient space and hot water heating systems are installed. These should be accompanied by thermostatic controls, zoned heating and override facilities to ensure that heating is optimally controlled to use the least amount of energy.

2.1.2 Be Clean

In addition to being lean, the energy strategy must also **be clean**, i.e. supply energy efficiently and ensure its most efficient consumption within the development. Some of the measures that are recommended as standard have been listed previously, such as low energy lighting and efficient heating systems. In addition to these, the following measures are also recommended

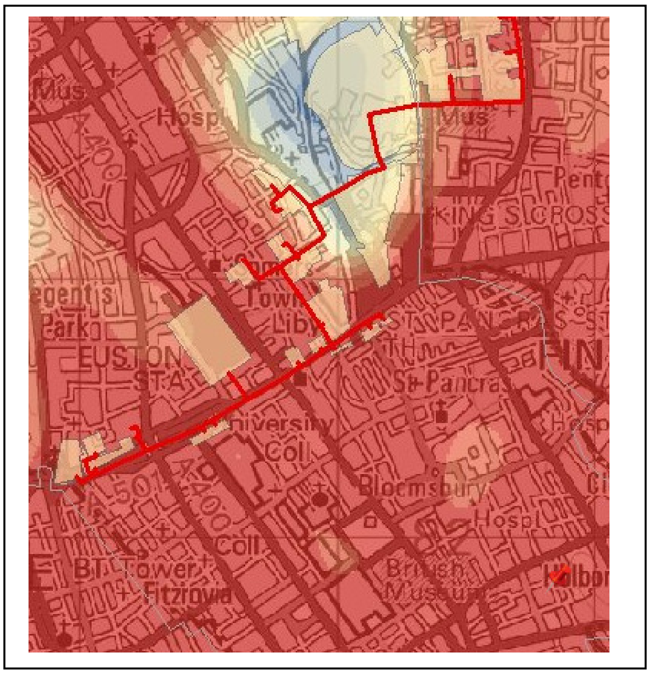
- If white goods are provided to the eventual occupants, these should be A+ rated or A rated where applicable. If white goods are not installed each occupant should be provided with information on the EU Energy Labelling Scheme to allow occupants to make an informed purchase.

- It is recommended that display energy devices are installed. These allow the occupant to monitor their primary energy consumption and electricity consumption.

- It is worth noting at this stage that opportunities do exist that allow developers to influence the future energy consumption of a building. However the biggest determinant of a dwelling's future energy use is the behaviour of its occupants. This is something which is beyond the scope of legislators or developers. However developers do have the means to educate future occupants as to how best to operate their heating systems.

- Requirement 2 of Approved Document G sets a minimum water efficiency standard for new dwellings and dwellings formed by a material change of use. The calculated water consumption of a dwelling (as calculated by the *Water Efficiency Calculator for New Dwellings*) must be no more than 125 litres per person per day. Part G has been incorporated into SAP 2009 and is included in the energy consumption calculation. It is recommended that the developer achieve a Part G compliant water consumption or better.

The Mayor of London has set a target that by 2025, 25% of London's energy needs will be meet through the use of decentralised heat and power networks. In recognition of this, Camden Council encourages new developments within the borough to connect to existing district heating systems where functionally and economically feasible. A search of the locality identifies the proposed Euston Road Network as the nearest such system (see below). However the network is not yet operational and is greater than 1 mile from Bedford Row.



Source – London Heat Map

2.1.3 Be Green

The London Plan requests that all developments achieve a 20% reduction in CO_2 emissions through the installation of on-site renewables. This target should be assessed against the energy efficient baseline. This is the anticipated emissions of the development after the **lean** and **clean** measures detailed previously have been incorporated into the energy strategy.

As detailed earlier a representative sample of dwellings were modelled in SAP to determine the energy consumption and CO_2 emissions of the residential component of the development. An SBEM calculation was carried out on the commercial component to establish similar figures. The table below details the emissions of the development prior to **lean** and **clean** measures being adopted.

Table 1 – Baseline Emissions

	Energy Consumption (kWh/annum)	**CO_2 Emissions (kg/annum)**
Space Heating	170,725.30	33,803.7
Water	50,653.5	10,029.4
Pumps & Fans	3,325.0	1,719.0
Lights	6,169.2	3,189.5
Commercial Component	287,312.6	113,254.4
Cooking & Appliances	[redacted]	17,392.2
Total	[redacted]	179,388.2

**The conventions within ENE 7 of the Code for Sustainable Homes and SAP Appendix S were utilised in the calculations.*

The table overleaf details the energy efficient baseline.

Table 2 – Energy Efficient Baseline

	Energy Consumption (kWh/annum)	CO_2 Emissions (kg/annum)
Space Heating	71,913.8	14,238.9
Water	35,713.2	7,071.2
Pumps & Fans	3,325.0	1,719.0
Lights	4,148.9	2,145.0
Commercial Component	70,039.3	24,937.2
Cooking & Appliances	[redacted]	17,392.2
Total	[redacted]	67,503.5

Table 3 – Target Reduction

	CO_2 (kg/annum)
Development Baseline	67,503.5
20% Target	13,500.7

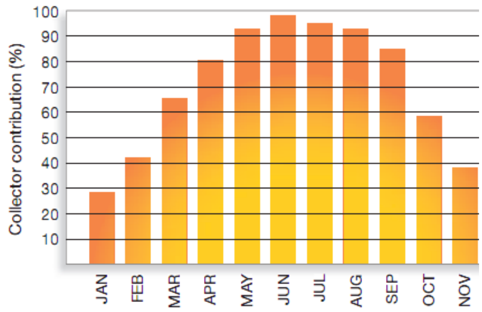
An assessment of each technology is included in section 3.

3 Assessed Renewable Technologies

The following technologies have been assessed to ascertain their potential to reduce the carbon emission rate of the development by 20%.

- Solar Thermal
- Photovoltaic Panels
- Air Source Heat Pumps
- Ground Source Heat Pumps
- Wind Turbine
- Combined Heat & Power
- Community Biomass System

3.1 Solar Thermal



Solar thermal panels use the radiant solar energy to heat water for domestic consumption. The system works successfully across the UK as they can work in diffuse weather conditions. In comparison to other technologies it is considered a reliable and proven technology. The system works most efficiently when the panel or evacuated tube is mounted on a 10-60° pitch facing due south, though other combinations do work successfully. During late spring to early autumn months, the system can be expected to meet some 70-90% of a dwellings domestic hot water needs.

Most systems in the UK are two panel systems, typically 4 sq m in size and accompanied with a 180-250 litre cylinder with a dedicated solar storage capacity of 65-110 litres. The typical installation costs for solar thermal vary, especially when large volumes are considered. However a rough estimate is £3500 per plot. Occupants can expect annual savings in the region of £50-85 per year, which is relatively modest. Solar thermal panels do not qualify for feed in tariffs, however it is expected that solar thermal systems will benefit from the Renewable Heat Incentive. Details on the initiative are expected to be published by the Department for Energy and Climate Change before April 2011. A 20-25 year payback can be expected, dependent on usage and dwelling type.

The proposed roof construction and plot orientation would suggest that an A-frame mounted system with one panel for each of the flats may be suitable. However there are a number of points to note.

- The studio flats are too small for a dedicated cylinder.
- The smaller flats may not have the required demand to meet the anticipated supply of hot water. This will undoubtedly cause maintenance problems as some of the systems may “overload”.
- Connecting each apartment to a solar panel will cause servicing problems.

With the above in mind solar thermal would appear to be viable for top floor flats and the commercial unit.

Table 5 – Solar Thermal

	Bedford Row
Energy Reduction	9,340 kWh/annum
CO_2 Reduction	1,849.3 kg/annum

As is clear from the table above solar thermal does not have the potential to achieve a 20% reduction in CO_2 emissions and so must be rejected as a one stop solution. However the technology does have the potential to be a component of a mis technology solution and so is worthy of further consideration.

3.2 Photovoltaic

Photovoltaic panels convert sunlight into electricity for use within a dwelling. PV panels use cells to convert light into electricity. A PV cell usually consists of 1 or 2 layers of a semi-conducting material such as silicon. The greater the intensity of sunlight, the more electricity is generated. PV systems can come in different forms. The most aesthetically pleasing are PV tiles which resemble roof tiles. However the most popular are modules which can either sit on the roof or be integrated into it. The technology is most efficient when oriented due south. However panels orientated south of east or west are suitable. Generally panels orientated away from due south require a greater surface area to generate a set amount of energy.

The cost to install a PV unit is approximately £4500-£5500 per kW. To achieve a total reduction of 20%, a 32.0 kWp system is required. This assumes a southerly orientation with little over-shading. Such a system would cost circa £140-150,000 and require roughly 180-190 sq m of panel. Such systems would be eligible for the feed-in tariff rate announced in February 2010. A system of this size can receive 31.4p per kWh/annum, resulting in an "income" of circa £7500 per annum for 25 years.

There are obvious problems with this solution;

- The initial upfront capital costs are considerable.
- As a listed building in a conservation area, the erection of an A-framed mounted PV system, and a considerable one at that, will require planning persimmon and approval from *English Heritage.*
- The structural strength of the roof must be assessed before committing to such a system.

We do not recommend PV has a one technology solution. Instead we recommend its incorporation into a mixed technology solution.

3.3 Air Source Heat Pumps

Air source heat pumps extract heat from the outside air. The heat is absorbed into a fluid, which is pumped through a heat exchanger. Low grade heat is then extracted by the refrigeration system and after passing through the compressor is concentrated into a higher temperature. This energy is then used to heat water for space and hot water use within the dwelling. While heat pumps use national grid electricity, and so are not a renewable resource, they utilise a heat source which is naturally renewed in our environment and so are considered a low carbon technology.

Heat pumps have stated CoPs in the region of 2-4, though test results outside of the laboratory have produced mixed results.. Typically the heat pump is located on an external wall. It is generally accepted that 1kW in heat pump size will provide enough heating for $20m^2$ of floor space

We do not recommend air source heat pumps as a viable solution. Despite the increased efficiencies heat pumps utilise national grid electricity which has a carbon factor of

0.517kgCO_2/kWh. This is greater than double the carbon factor of gas. When the efficiencies of the pumps are taken into consideration the net reduction over the baseline calculation is negligible.

3.4 Ground Source Heat Pumps

Ground source heat pump's (GSHPs) have been developed specifically for the housing market and are now considered to be an established reliable technology. GSHPs harness the energy from the ground and upgrade it for use within a building. Whereas ambient air temperatures can have a large swing throughout the year the temperature of the ground a few metres below the surface stays relatively stable at around 14°C.This makes it possible to use the heat in the ground during the winter months to meet our heating needs.

The efficiency of ground source heat pumps is measure by Co-efficient of Performance (CoP), this is the ratio of units of heat output for each unit of electricity used to drive the compressor and pump for the ground loop. Average CoP is around 2-4 although some systems may produce a greater rate of efficiency. If grid electricity is used for the compressor and pump, then there is the opportunity to consider a range of energy suppliers to benefit from the lowest running costs, for example by choosing an economy 10 or economy 7 tariff.

Ground source heat pumps, like air source heat pumps, are disadvantaged in that they utilise grid electricity. The anticipated carbon reductions over the baseline are moderately better than those for air source heat pumps, however they fall considerably short of the 20% requirement.

In addition to the valid point listed above, as an existing dwelling in a dense urban environment installing a ground loop or drilling bore holes are simply not workable options. As such we do not recommend the installation of ground source heat pumps.

3.5 Micro-Wind Generation

The wind resource in the United Kingdom is stated to be a major source of renewable power. However this is not universally true across all of the UK. The urban location and the dense nature of the site would appear to rule out the use of micro wind generation. DECC's wind speed database confirms a wind speed of 5.6m/s for 10m above ground level. This is greater than the 3.5m/s suggested by the London Toolkit as being necessary for building mounted wind turbines. However anecdotal evidence would suggest that wind as an energy resource in an urban environments is problematic. As such we do not recommend the incorporation of micro-wind technology into the energy strategy.

3.6 Combined Heat & Power

Micro-CHP is a small combined heat and power unit which generates electricity and has a HW jacket around the engine which utilises the engine's heat to provide hot water. The uptake of this technology has been slow in the UK, however Baxi in partnership with British Gas have been marketing the technology for some time. For the moment however this technology cannot be correctly modelled in SAP 2005 or SAP 2009, as such the carbon benefit cannot be correctly calculated. In addition to this, the small nature of many of the flats would appear to rule out the use of this technology.

3.7 Biomass Community System

In the context of energy generation, the term "biomass" can refer to any organic substance that can be processed to produce energy, either solid matter or liquid bio-fuel. Biomass fuels are an alternative to conventional fossil fuels and are often near carbon neutral. This is because the growing plant or tree absorbs the same quantity of CO2 in its lifetime as is released upon energy conversion. There will still be some emissions, albeit much less significant, due to the processing and transport of the fuels.

Biomass is a renewable form of energy as it can be replaced over a short period of time. Biomass or biofuels are currently being produced from plantations of a variety of plant types, as well as from waste materials like cooking oil and waste wood. If waste wood is used, care must be taken to maintain fuel standards and exclude wood treatments such as preservatives and paint.

Biomass has a carbon factor of 0.009 kg of CO_2/kWh/annum. This is considerably less than the carbon factor of gas; 0.198kg of CO_2/kWh/annum. As such one can conclude that a biomass centred system will exceed the 20% requirement. However it is extremely doubtful that such a system can be successfully installed, given the space constraints in the basement. As such we do not recommend a biomass community system.

4 Conclusions

All technologies have their advantages and disadvantage. Many of these have been detailed previously. Following a detailed appraisal of each technology it has been found that no single technology has the potential to achieve a 20% reduction in carbon emissions. Indeed we can conclude with a high degree of confidence that a 20% renewable target is unachievable for the development. The following briefly details the constraints of the site;

- The building is listed and situated in a conservation zone, thus renewable technologies must not compromise or intrude upon the aesthetic and historical value of the building or its setting.
- As an existing dwelling it is extremely difficult to retro-fit renewable technologies, given the space constraints.
- It is proposed that the development be a mixed use development, i.e. residential and commercial. As a result of this the baseline energy efficiency target is disproportionately large.
- As an existing listed dwelling it is not possible to significantly enhance the fabric of the dwelling beyond minimum Part L1B and Part L2B standards. As such the energy efficient baseline figure is disproportionately large in comparison to new build developments.

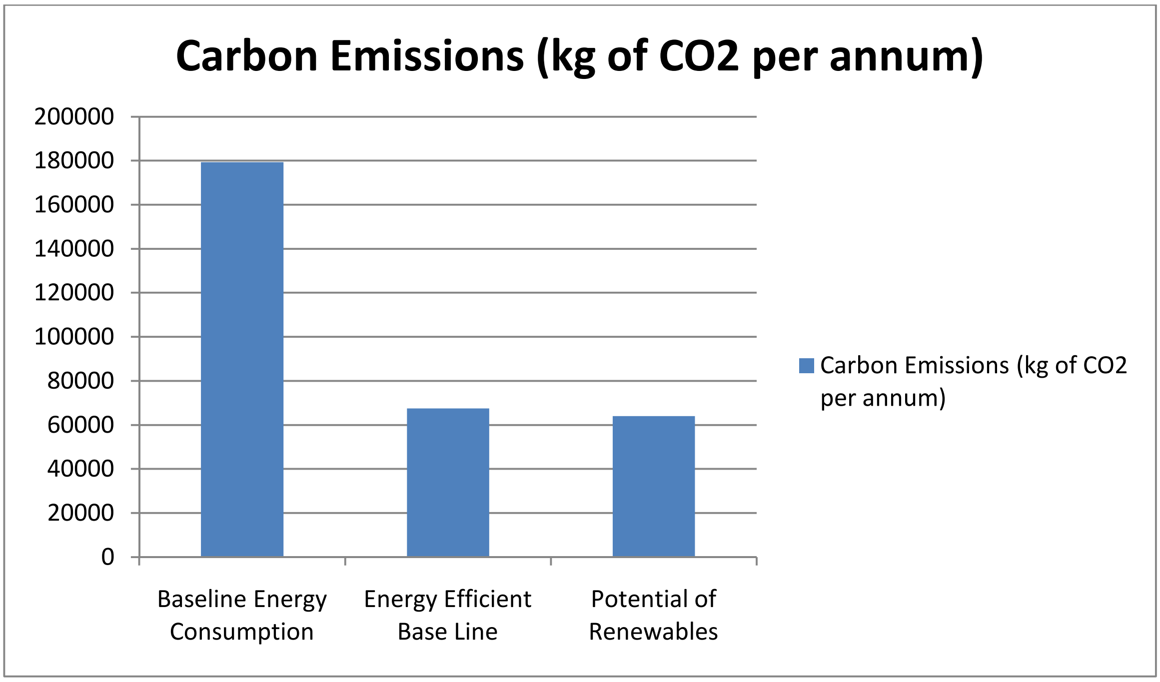
While recognising that the target and this development are not compatible we can make recommendations to reduce the carbon footprint of the development in line with the energy strategy. These measures have been detailed previously but can be summarised as follows;

- Enhance the energy efficiency standard of the fabric of the building. The minimum standards of Part L1B and Part L2B 2010 should be adhered to. Where it is not possible to achieve the minimum standards due to space constraints, the best possible enhancement should be achieved, in line with the guidance published in the approved documents.
- Highly efficient space heating systems should be installed. These should have full time and zone control, thus allowing for optimal efficiency.
- Install energy display devices.
- Adhere to the requirements of Approved Document G.

While it is not possible to install renewables with the potential to offset 13,500kg of CO_2 it is possible to install an element of renewable technologies which does not intrude upon the historic nature of the building. This could include either or both of the following;

- A small solar thermal array, providing hot water to the top floor flats and potentially catering the needs of the commercial units.
- A small PV array such as a 3kWp system.

The graph below demonstrates the total CO_2 reductions thought achievable.



Disclaimer

This report is based on the information provided by the client. Should any of this information prove incorrect then findings and conclusions of this report will be invalid.