Energy Statement

Proposed development of seven dwellings at
10-11, Kings Mews, London, WC1N 2ES

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Report produced by –

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1 Blewburton Limited

Blewburton Limited (BBL) was established in April 2016 and are the follow on company to The Blewburton Partnership (BBP) which was established in 2008 to provide energy and sustainability consultancy to clients in both the private and public sectors. Staffing has remained the same and have been involved in the project management, assessment and consulting on projects involving renewable and sustainable energy for over fifteen years, both with BBL, BBP and in former employment.

BBL is well placed to analyse and assess the potential for low and zero carbon energy technologies to meet the energy demand for new developments and to determine the most cost effective and technically appropriate means of meeting the sustainable energy requirements relating to planning conditions, in the format often known as the 'Merton Rule' (a required percentage of on-site renewable energy generation or carbon offset). BBL are also licensed NHER SAP, BREEAM & Code for Sustainable Homes assessors.

2 Executive Summary

2.1 Background

Blewburton Limited have been commissioned by Barhos Development Ltd. to prepare a report identifying the options for reducing annual carbon emissions by 35% (based against 2013 Building Regulations standards) through the use of low or zero carbon technologies (LZCs - often referred to as 'renewable energy') for a proposed development of seven apartments in a mid-terraced building spread over a basement and three further floors at 10-11, Kings Mews, London.

The site is located within the London Borough of Camden (LBC) and it is a requirement that all new development within LBC demonstrates compliance with the provisions of section 5.2 of the London Plan. This requires that a hierarchy approach to reducing energy consumption and carbon emissions should be taken.

First, measures to reduce energy use should be taken, known as the 'lean' approach, secondly where possible the development should connect to 'clean' energy sources, primarily locally generated heat and electricity in CHP or heat only plant. Finally, the residual carbon emissions should be reduced through the use of on-site low and zero carbon (LZC) energy technologies, with all the measures employed showing a 35% reduction on 2013 Part L of the Building Regulations.

2.2 Calculations & Conclusion

SAP calculations to analyse energy demand for the proposed dwelling designs have been undertaken with NHER Plan Assessor SAP 6.3 software and this produces carbon emission figures for regulated energy use as required in the condition above.

The proposed approach to energy reduction is already better than good practice, in that it exceeds Part L requirements even before the addition of LZC technology.

There is no local supply of district heat or CHP to connect to and none mooted as part of this development, so the remaining carbon offset will be met through LZC technologies and PV technology has been selected by the developer as the most applicable technology option.

This will see the installation of a PV array of 2.00kWp on the flat roof of the building and this, along with the energy efficiency measures, will see carbon emissions for the site exceed the Building Regulations of 2013 by 40.00%.

The CO_2 figures for the 'Energy Hierarchy' are shown in the table below:

CO_2 emissions after each stage of the Energy Hierarchy	CO_2 emissions (Tonnes CO_2 per annum)
Baseline: Part L 2013 of Building Regs Compliant Development	1.00
After energy demand reduction	0.77
After CHP	0.77
After renewable energy	0.60

Therefore, the energy efficiency/reduction proposals outlined, along with the inclusion of the PV array, will comply with the London Borough of Camden requirements for carbon offset for new developments.

3 Introduction

Blewburton Limited have been commissioned by Barhos Development Ltd. to prepare a report identifying the options for reducing annual carbon emissions by 35% (based against 2013 Building Regulations standards) through the use of low or zero carbon technologies (LZCs - often referred to as 'renewable energy') for a proposed development of seven apartments in a mid-terraced building spread over a basement and three further floors at 10-11, Kings Mews, London.

The site is located in central London, approximately 400m north of Chancery Lane London Underground station and 600m northwest of Farringdon railway station. It may be additionally located by National Grid Reference 530900,182000 and is shown on the map below.

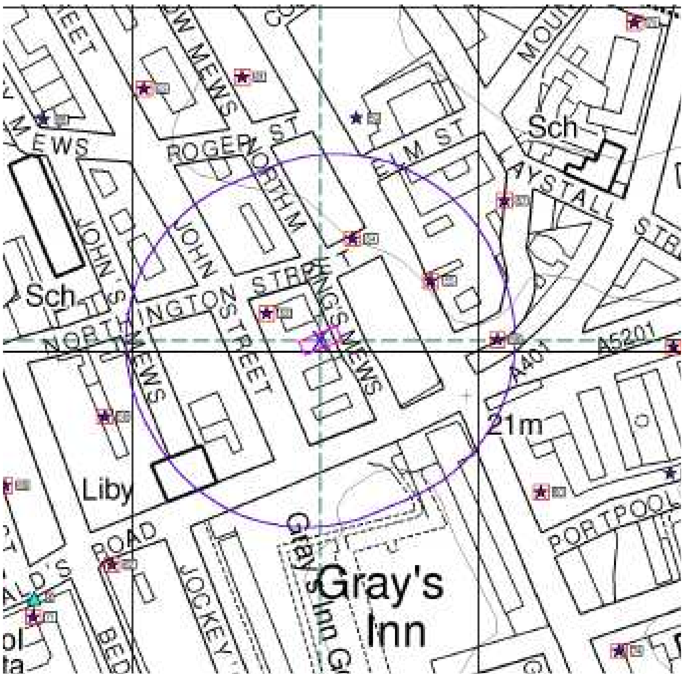

Figure 1: Map showing lcation of the proposed development

The aim of this document is to assess the annual carbon emissions arising from the proposed development and to present the selected options that the developer will undertake to reduce the demand through the introduction of energy efficient design, on-site LZC technologies and communal/district based low carbon heating and power generation systems.

The site is located within the London Borough of Camden (LBC) and it is a requirement that all new development within LBC demonstrates compliance with the provisions of section 5.2 of the London Plan. This requires that a hierarchy approach to reducing energy consumption and carbon emissions should be taken.

First, measures to reduce energy use should be taken, known as the 'lean' approach, secondly where possible the development should connect to 'clean' energy sources, primarily locally generated heat and electricity in CHP or heat only plant. Finally, the residual carbon emissions should be reduced through the use of on-site low and zero carbon (LZC) energy technologies, with all the measures employed showing a 35% reduction on 2013 Part L of the Building Regulations.

It is to the requirements listed above that this report is focused.

4 Energy Demand for the site

4.1 Methodology

All new residential buildings are required to meet certain standards in terms of energy efficiency in order to meet Part L of the Building Regulations. This is demonstrated through a SAP calculation. The proposed dwellings for this site have been modelled using NHER Plan Assessor v6.3 to attain the 2013 Building Regulations benchmark. It is from this modelling and associated SAP calculations that the figures for energy demand have been extrapolated and associated carbon emissions have been taken. The baseline figure is shown below.

CO_2 emissions after each stage of the Energy Hierarchy	CO_2 emissions for whole site (Tonnes CO_2 per annum)
Baseline: Part L 2013 of Building Regs Compliant Development	1.00

4.2 Energy Efficiency Proposals

The developer recognises the need to improve the fabric and overall efficiency of the building and supplied services as the first steps in achieving a sustainable energy solution for the proposed dwellings and proposes the following which will see an uplift over the base case annual carbon emissions across the site of 23.00%:

- A basement floor U-value of 0.137 based on an in-situ concrete slab with 100mm Celotex or similar above, topped with 70mm screed (Part L minimum standard is 0.25);

- An external and basement wall U-value of 0.21 (Part L minimum standard is 0.30);

- Party walls with cavities fully insulated and sealed for a U-value of 0.00 (Part L minimum standard is 0.20);

- Flat and terrace roof U-values of 0.16 (Part L minimum standard is 0.20);

- High specification windows with U-value of 1.2 (Part L minimum standard is 2.0);

- Specification of high efficiency gas fired boiler (Part L minimum standard is 88%), heating an underfloor system – mains gas Ideal Logic Combi ESP1 boiler (89.6% efficiency) used in calculations;

- Best practice heating control systems – time and temperature zone control and delayed start thermostat;

- Use of Accredited Construction Details (ACD) to deal with issues around non-repeat thermal bridging at external wall junctions with sills, jambs, ground floor, upper floors, corners and roofs;

- Non-repeat thermal bridging at external wall junctions with lintels to see use of IG Hi-therm lintels, which have a better value than standard ACD approach;

- Air pressure testing results of 3.0m³/hm² (@50Pa) or lower (Part L allows for a result of up to 10.0m³/hm² (@50Pa)

- Mechanical Ventilation Heat Recovery – Vent Axia Sentinal Kinetic Plus system used in the model:

- All new lights installed will be of the low energy variety

This proposed approach is already beyond good practice, in that it complies with Part L requirements even before the addition of LZC technology.

With the detail above, the extrapolated Target Efficiency Rate (TER) for the site as a whole is calculated to be 16.98kg $CO_2/m^2/yr$, with the Dwelling Efficiency Rate (DER) being 13.07kg $CO_2/m^2/yr$. Therefore, the 'lean' approach – adoption of energy efficiency measures, see a 23.00% reduction in CO_2 emissions across the site. The overall figures for the site are shown below.

CO_2 emissions after each stage of the Energy Hierarchy	CO_2 emissions (Tonnes CO_2 per annum)
Baseline: Part L 2013 of Building Regs Compliant Development	1.00
After energy demand reduction	0.77

However, in order to meet the requirements of the LBE, carbon emissions will need to be reduced by a further 12.00% for the site, either by the connection to 'clean' sources of supply or by the adoption of on-site LZC energy technologies.

5 Connection to Clean Sources of Supply

There are no local sources of supply that could be connected to the proposed development as shown in the map below, taken from the Mayor of London's Heat Map tool.

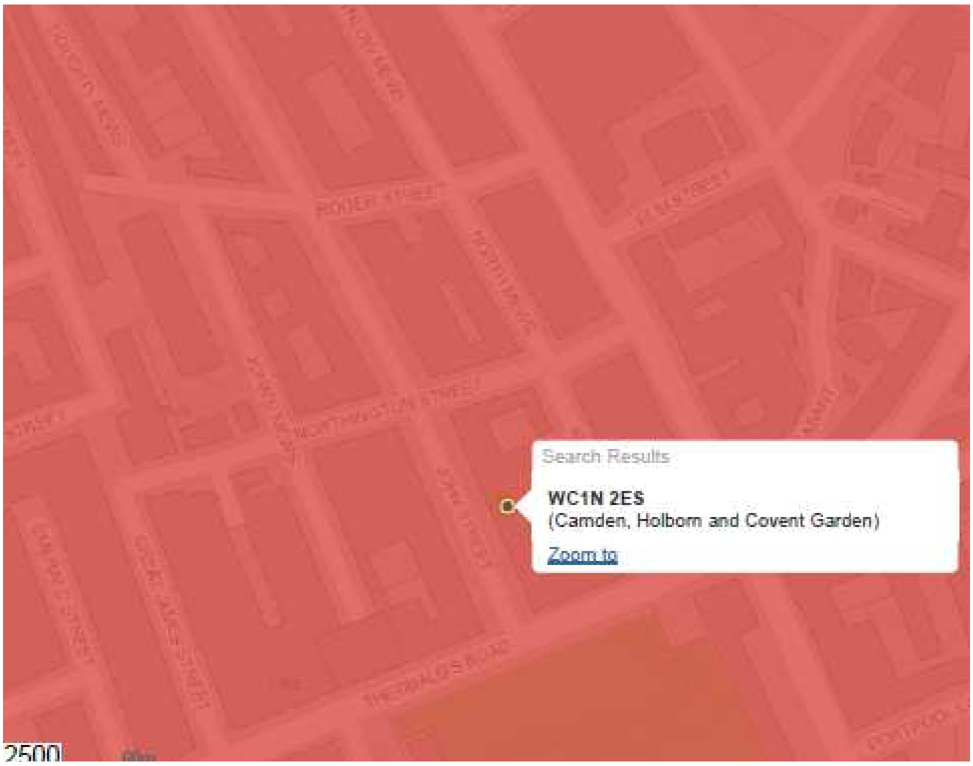

Figure 2: London Heat Map – Kings Mews locale

Communal energy systems are generally attractive where economies of scale can be exploited. Block scale CHP units could be considered on small schemes, but unless they can utilise the technology cost-effectively this is unlikely to offer significant efficiency gains over individual high efficiency gas boilers. Measures to reduce the space heating demand through improved building envelopes will impact on the viability of a CHP system providing heat and power to the development since the heat density decreases and this will be the situation in this instance. Although advances in CHP technology are allowing smaller developments to benefit from the efficiencies of CHP, these small-scale CHP technologies are less efficient than their large-scale counterparts and would incur proportionally higher operation and maintenance costs for every Kg/CO_2 saved. Therefore, this development is considered too small to enable a viable local energy generating facility to be developed.

Therefore, in order to meet the requirements of the LBC, carbon emissions will need to be reduced through the adoption of on-site LZC energy technologies.

6 Renewable energy options appraisal

6.1 Biomass Heating

6.1.1 Background

The CO_2 that is released when wood fuel is burnt is equivalent to that taken from the atmosphere through photosynthesis during tree growth. Even allowing for CO_2 generated during planting, harvesting, processing and transport of the wood, replacement of fossil fuel with wood fuel will typically reduce net CO_2 emissions by over 99%, assuming that the wood is managed sustainably. Whilst wood fuel has been utilised for centuries, technological applications for its use have progressed rapidly in recent years, with Austria and the Scandinavian countries leading the way.

Wood fuel can be split into three categories; wood chips, wood pellets and logs. Woodchips arise mainly from woodland management or dedicated wood-fuel crops, such as short rotation coppice willow. They are best suited to a building or buildings with a consistent '24/7' heat requirement throughout the heating season, such as schools, halls of residence, old peoples' homes, hospitals, prisons etc., or for district heating/CHP schemes.

Wood pellets are mainly produced from untreated wood waste, such as sawdust, pulverised pallets or reclaimed timber. They are more expensive then wood chips, however, they are easier to store and handle, require less storage space and have a higher calorific value. Pellets are typically used in smaller systems, down to the domestic level, but can also be the fuel of choice in larger systems if storage and/or handling issues are a problem. Pellet fuelled systems are also quicker to respond than wood chip systems.

Logs are a well known fuel and tend to be used in smaller community and domestic systems. They normally require a higher manual input that pellets and chips, so are not under consideration for this site.

6.1.2 Domestic Wood Fuel Boiler Systems

Wood fuel heating can be undertaken in one of two ways; district/communal heating or individual property based boilers. In this instance, only a communal system could be considered, as the development is a single building and there is no local heat network to connect to. The focus regarding fuel source will be on pellet fired systems as woodchip fired boilers are not suited to smaller buildings such as this.

Wood fuel heating systems typically comprise the boiler (and flue); in some instances, a buffer tank; a circulation/distribution pump & associated mechanical services; electrical services; controls package and a fuel storage facility connected to the boiler, either internal or from a hopper/bunker/underground store via a screw feed auger.

System set up is essentially the same as for a conventional domestic boiler, with a programmer controlling when heat comes on and off. The issues that need addressing at the earliest stage of design are whether to install a buffer tank and how/where fuel will be stored and fed into the boiler.

The buffer tank is included to act as a thermal store and allow the boiler to operate efficiently during the periods when the heat demand is low or experiences unpredictable peaks. This is likely to be the case during the shoulder seasons of spring and autumn and when providing domestic hot water (DHW) only during the summer (if this option is selected over solar thermal or electrical heating options). Most biomass boilers tend to operate at their maximum efficiency when they are working at full load, therefore, a heat distribution with many peaks is not conducive to optimum operational efficiency. A buffer tank will enable the boiler to run at full load until the tank is at the required temperature. The buffer tank will then feed the demand of the central heating system until the temperature of the water in the tank drops below a set point and the boiler needs to fire up again.

It is recognised that buffer tanks are large; normally starting at 800-1,000 litres in capacity and that this may not be an option for most houses due to space constraints. It must be stated, therefore, that inclusion of a buffer tank is not essential (only preferable for more efficient use in most cases) and some domestic pellet boilers will not require them, operating as a conventional boiler, feeding a standard hot water tank and radiators/under-floor heating in the traditional manner.

Figure 3: Standard domestic pellet boiler (Baxi)

There are a number of options for fuel storage and these are governed by space restrictions and desired frequency of delivery. In most cases a prefabricated hopper located adjacent to the building (and boiler) filled by a tanker blowing pellet in directly or an excavated bunker fed the same way would be the preferable solutions. The advantage of these methods is that a hopper or bunker allows for the pellets can be automatically fed into the boiler and, if adequately sized, reduces number of deliveries per annum.

Figure 4: External domestic storage hopper

Figure 5: Pit storage system

6.1.3 Fuel Supply

Pellet supply is a rapidly developing market and there are now several well established suppliers within the south-east of England. Most installation companies will be able to supply details of reputable suppliers. Bulk purchase has good economies of scale over regular deliveries, but additional storage is then required.

6.1.4 Renewable Heat Incentive Scheme

The Renewable Heat Incentive Scheme (RHI) provides home owners, businesses and the public sector with cash back for the generation of renewable heat. It is a government-backed measure, introduced in 2011, to make production of heat through renewable means more financially attractive.

The scheme is intended to work by encouraging users to replace existing fossil fuel heating systems such as oil, coal and gas with one of the supported renewable technologies which includes Ground Source Heat Pumps, Solar Thermal Panels and Biomass Boilers. It also applies to new installations. The onus is on the user/developer to pay for and install the new technology and then register the system with Ofgem. The amount of RHI payment is set at time of registration and will be adjusted upwards for inflation. Payments are then made quarterly for the next 20 years. The scheme should significantly alter the economics of installing the technologies it supports and will lead to an income stream for the system owners over the 20 year lifecycle of the scheme.

6.1.5 Biomass Heating at the Kings Mews Site

If biomass heating were to be used at this development, it would require adequate space being made available for the plant (boiler and potentially, buffer tanks) and a wood pellet storage system and this is not available. Given the high cost of development and operation of a scheme of this nature and the lack of space available, this technology can be deemed to be **UNSUITABLE** for this site and is ruled out as an option to deliver the carbon offset required by LBC planning policy.

6.2 Ground Source Heat Pumps

6.2.1 Background

In the UK, the earth at a depth of 10 metres and below keeps a constant temperature of around 11-12 ºC throughout the year. Because of the ground's high thermal mass, it stores heat from the sun during the summer. A ground source heat pump (GSHP) can upgrade this heat from the ground into a building to provide space heating and, in many cases, pre-heating for hot water provision (HW). For every unit of electricity used to generate the useful heat, 3-4 units of heat are produced. As well as GSHPs, air source (ASHPs) and water source heat pumps (WSHPs) are also available, utilising ambient temperature and water temperatures as their respective heat sources – see section 3.3 for more information on ASHPs.

Whilst not truly a renewable energy technology because of the requirement to input electricity, heat pumps can still have a significant impact in reducing CO_2 emissions and are cost competitive in terms of running costs against direct electricity, oil and LPG fueled systems and in some instances mains gas. They can therefore be regarded as a sustainable energy solution.

6.2.2 The Technology

In the case of GSHP systems there are three important elements to consider (two for an ASHP as the ground loop is removed from the equation) –

- *Ground loop* - comprises lengths of plastic pipe buried in the ground, either in vertical boreholes or horizontal trenches. The pipe is a closed circuit and is filled with a mixture of water and antifreeze, which is pumped round the pipe absorbing heat from the ground.

- *Heat pump* – these are familiar to us in the form of refrigerators and air conditioners. By vaporising and condensing a refrigerant a heat pump is able to move heat from one place to another. In the case of ground source heat pumps, the evaporator takes heat from the water in the ground loop and consequently, the condenser gives up heat to the heating distribution system. A compressor within the heat pump compresses the gaseous refrigerant to increase the temperature to that needed for the distribution circuit.

- *Heat distribution system* – GSHPs are suited to low temperature heating systems as less energy is needed to upgrade from the source temperature. Under-floor, ducted warm air and low temperature radiator heating systems are therefore particularly suited for heat pumps. Use of conventional radiator systems is possible but needs careful analysis before proceeding, although split systems involving under-floor heating downstairs and radiators upstairs are increasingly popular in new-build properties. Heat pumps can also supply all, or a fraction of DHW and an element of summer cooling, if the installation is designed correctly.

For ground loop based installations there are three main options: borehole (Figure 6 – below right), straight horizontal (Figure 6 – below left) and spiral horizontal, often called 'slinkys'. Each has different characteristics allowing you to choose the most suitable for the site. Horizontal trenches cost significantly less than boreholes, but require greater land area and are less efficient as the ground temperature varies closer to the surface. For a slinky coil, a trench of about 30m length will provide for about 1kW of heating load. Trenches are normally a minimum of 5m apart. Borehole based collectors will be at depths of between 60 – 200m.

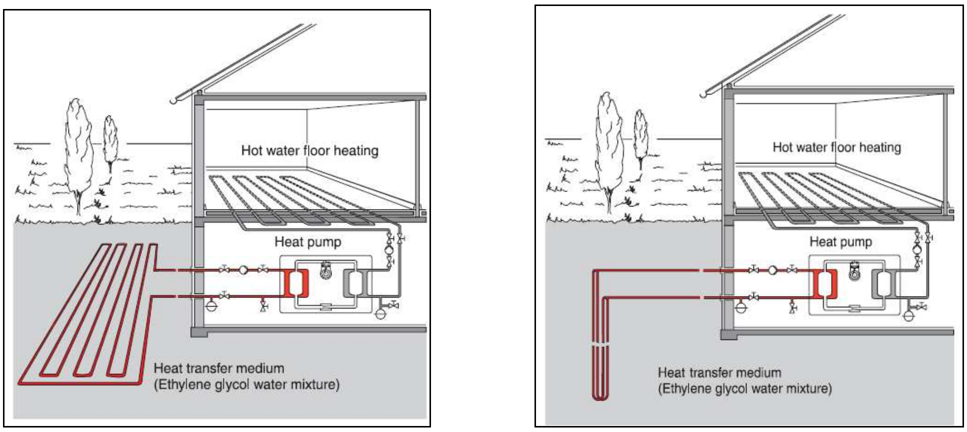

Figure 6: Horizontal Loop and Vertical Borehole GSHP

As already stated, energy is needed to activate the heat pump cycle and to compress the vapour for the production of useful heat. The efficiency of this process is expressed by the ratio between the useful heat delivered and the driving energy used by the compressor. This ratio is called the Coefficient of Performance (CoP). The CoP of the current generation of ground source based heat pumps varies from 2.5 to 5. Since the CoP shows performance at a steady state only, a second parameter is usually used to show the performance of the heat pump over an entire year. It is called the Seasonal Performance Factor (SPF), which is the ratio of annually delivered useful heat over annually used driving energy. When calculating the SPF, it is common to include the annual electricity requirements of auxiliary equipment, such as circulation pumps, fans, etc.

Figure 7: Domestic Scale Heat Pump

6.2.3 GSHPs at the Kings Mews Site

The use of GSHP technology at the Kings Mews site is considered to be difficult as there is no logical location to sink the required boreholes. In addition, as mains gas is available to the site, the running costs of a heat pump system against a conventional gas system would be unattractive to home occupiers. Therefore GSHP technology is regarded as a **POOR** option to deliver the requirements relating to renewable energy as stipulated by LBC.

6.3 Air Source Heat Pumps

6.3.1 Background

ASHPs work on the same principal as a GSHP, however, the medium from which heat is extracted is the external/internal air rather than the ground. ASHPs will generally have a lower seasonal CoP compared to GSHPs due to the generally lower air temperatures compared to the ground. They may require additional backup in extremely cold conditions and this facility is normally provided by electric heating built into the system. Its requirement will be limited, but it can provide peace of mind to the end user, although this can lead to high electricity bills in the winter months.

ASHPs can either be internal modules, ideally installed in a garage, basement or utility room (normally linked to whole house ventilation systems), or external modules, normally next to a wall of the building they serve. The location of an external unit is important for performance as exposure to high winds can cause defrosting problems. It is therefore advisable to create a fence or hedge around the unit to protect it from high winds. In addition, the fans and compressors do make a small noise (typically imperceptible and akin to an oil/gas boiler firing up), so it is worth considering locating the plant away from windows and adjacent buildings. It is also possible to reduce this noise by mounting the unit on a noise-absorbing base. Manufacturers should display the noise levels of the units to enable an informed selection.

The image below shows a typical system, which in this instance comes with three key components; the absorber, the boiler and the cylinder, although fully external, all-in-one units and other variations are also available.

Figure 8: Standard domestic ASHP system layout

The weather-proofed outdoor absorber unit (A) can be located up to 30-70 meters away from the indoor hydro-box boiler (B). It contains the heart of the heat pump system, absorbing low grade heat from the ambient air, upgrading it to high grade heat, which is transferred via refrigeration pipe-work to the hydro-box boiler (B). Absorbers will be between 80 – 120cm high, 90cm wide and 30 - 40cm deep. Acoustically, they tend to have noise levels of around 50dB, but are normally mounted on rubber matting to counter any issues of disturbance.

The indoor hydro-box boiler is a wall mounted compact unit that can be located anywhere in the house. It does not require flues or ventilation. Its main function is to transfer the absorbed heat from the outdoor unit (A) to the house heating and hot water system. Dimensions are typically 90 – 120cm high, 500 – 650cm wide and 350 – 600cm deep. The domestic hot water tank (C) is the final key component and is normally complete with recirculation connection, 1.2m tank sensor, tank heater overload and controls. Figure below shows both an internal and external ASHP module.

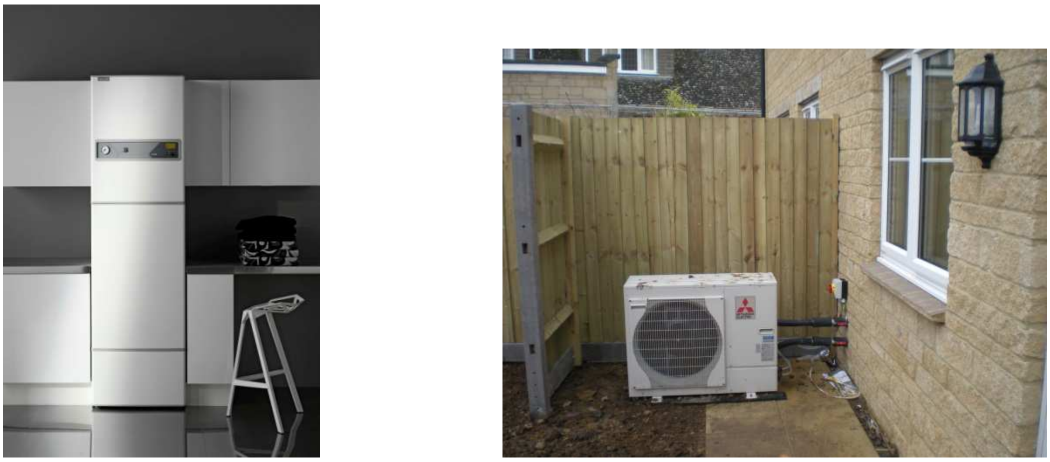

Figure 9: Internal (left) and External (right) Air Source Heat Pump Modules

6.3.2 ASHPs at the Kings Mews Site

The use of ASHP technology at the Kings Mews site is technically possible, particularly if internal systems were to be specified, however, this technology on its own could not deliver the carbon savings required in line with LBC requirements, so ASHP technology is therefore regarded as an **UNSUITABLE** option for compliance with LBC planning policy.

6.4 Solar Photovoltaics

6.4.1 Background

Solar generated electricity is created by the technology of photovoltaics (PV) – solid state semi-conductors that convert light into electricity. When light (a photon) is incident on a PV cell it gives energy to an electron. The electron moves away from the cell into an electrical circuit. The electricity created is direct current (DC). This can either be used to charge batteries or power DC devices; however in the UK it would normally be converted to alternating current (AC) via an inverter to meet the electrical demands of the site/building and tied into the grid.

Systems are easily retrofitted or incorporated into new and existing roofs, facades and glazing, the technology being extremely versatile. The panels themselves when arranged and connected together form an array with electrical generating capacity measured in kilowatts peak (kW_p - a rating calculated using a defined theoretical set of conditions rather than maximum or typical output).

Figure 10: Standard PV panels installed on a houses in Berkshire and Oxfordshire

Solar PV panels are available in a variety of different forms including;

- Mono-crystalline
- Poly-crystalline
- Thin film
- Hybrid

Mono-crystalline and hybrid panels are the most efficient at turning daylight into energy, but it may be easier to install thin film panels in the form of solar roof tiles rather than fitting a standard roof and then retrofitting panels. This is, however, more costly and whilst solar roof tiles come in a variety of different physical sizes and capacities, they do not currently vary much from a grey/blue/black colour.

Other mounting options exist for flat roof applications, such as using weighted cassettes or roof integration kits, as shown in the images below. Installation of these options relies on adequate load factors for the host roof being available.

Figure 11: PV roof tiles and slates

Figure 12: PV mounting options for flat roofs

The key locational requirements for a PV array are to avoid shading and to face within 45° of south, although they will work at a reduced efficiency facing east/west. A tilt of between 30-45° is also preferable, but not essential.

6.4.2 Generation and Tariffs

In terms of generation capability, 1kWp installed of PV should produce between 900 - 950 units/kWhs of electricity per annum situated in a southerly-facing, un-shaded location in the south of England. This will drop by 25% for east or west facing arrays. A 1kWp array made up of conventional panels will need around $6m^2$ of space on a roof, with around $1m^2$ of internal wall space required for the inverter and associated equipment.

The host building will have first call on any electricity generated and this will offset electrical requirements, leading to savings for the occupiers. In addition to this, payment can be received from utilities for the simple fact of generating renewable electricity.

This was formalized into law from April 2010 and is known as the feed-in tariff (FIT). This will guarantee a payment for every unit generated by a newly installed PV system for a period of 25 years. The current rate of this tariff for sub-10.0kWp rated arrays is £0.0439 per kWh generated, but this is subject to periodic review.

6.4.3 Solar PV at the Kings Mews site

The use of a PV at the Kings Mews site is considered a technically viable option, as there is an area of un-shaded, flat roof space available on the building on to which an array can be installed.

In order to reduce carbon emissions by the additional 12.00% required for the site, an array of 2.00kWp facing south and mounted at an angle of 30° is proposed, feeding into the dwellings landlords supply.

The Plan Assessor software v6.3 states that arrays of this size, in addition to the energy efficiency options previously outlined will lead to a carbon offset of 40.00% and therefore over the 35.00% saving of site based annual carbon emissions required by the LBC.

The proposed designs have been reviewed to establish if it is actually possible to install the required number of PV panels to meet the stated target above. Calculations have been undertaken using Sharp manufactured PV panels rated at 250kWp each (as an example) and with dimensions of 1,652mm by 994mm. The result is that it considered feasible to install the 8 panels required on the flat roof of the building.

The total estimated installed cost for this array is £3,500.00 + vat, although this, and the outline design parameters above, will need final confirmation from qualified installer companies.

In summary, PV technology is a technically viable solution at this site and is capable of delivering the carbon saving required after energy efficiency measures have been adopted, to meet the 35% carbon offset required by the LBC. This technology is the **PREFFERED** solution for this site.

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6.5 Solar Thermal

6.5.1 Background

Solar thermal heating systems (STHS) utilise energy from the sun, in the form of light and heat, to supply heat to hot water systems. This is achieved by using a solar collector filled with a liquid medium, which absorbs heat from the radiation of the sun (it does not have to be sunny to work) and transfers this heat, via a heat exchange system to a dual coil hot water tank. Collector technology is split between flat plate collectors and evacuated tube systems. The former are cheaper per m² than the latter, but are not as efficient.

STHS will provide a portion of the annual domestic hot water requirements depending on the details of the end use and size of solar collector system installed, and is generally around 50% of hot water requirements over the course of a year, although in many instances this is often higher. This will be around 95% of hot water requirements from the end of May through to mid-September, whilst in winter a 20% contribution can be expected on average.

Figure 13: Flat Plate Solar Collector

Figure 14: Evacuated Tube Solar Collectors

There are now a number of solar thermal tile products entering the market and these allow for total roof integration options, although, like PV, the product is still only available in a traditional grey/blue slate type colouring and is more expensive than both flat-plate and evacuated tube systems.

The hot water from a solar thermal system is normally supplied as a pre-heat to a twin coil hot water storage tank linked to the main heating system for the home. There will also be a drain-back unit (on some systems), pumps, controllers and pipe-work to interface with the existing boiler system.

Figure 15: Solar thermal slates

Both flat-plate and evacuated tube collectors tend to be guaranteed for around 20 years but are known to last well over 30 years. Other parts such as pumps have standard time guarantees associated with standard plumbing products. Annual maintenance requirements are minimal and it would be reasonable to check the system on a 5 year cycle, although it could be included with standard annual boiler servicing.

STHS collectors are best located on un-shaded, pitched roofs, facing south for optimum performance, although other orientations within 45° either direction from due south or horizontal mounting do not significantly affect output. Even at east/west facing alignments, the system will still perform to around 75% of efficiency.

6.5.2 Solar Thermal at the Kings Mews Site

STHSs have the same locational requirements as solar PV, although shading issues are not as critical and space requirements are significantly less. As discussed in the PV section of this report, there is adequate flat roof space available on the building to host the collector systems.

However, the carbon offset is not sufficient on its own to meet The LBC planning requirements. Therefore, although this technology is an attractive proposition due to potential savings for occupiers and install costs, it can only be regarded as **POOR** option to meet the offset target required by LBC.

6.6 Small Scale Wind Turbines

6.6.1 Background

A building mounted turbine is one that, rather than sitting on a free standing mast, will instead be attached to the side of a building. They typically range in rated output from 100W to 1.5kW. They should always be several meters above the roof line and preferably have a clear, unimpeded draw on the wind coming from the south west, which is the prevailing direction of the wind in the UK. The amount of energy generated is determined by the nature and velocity of the wind and the area swept by the blades. Blade shape and rotation speed determine efficiency.

Grid connection is as for PV with generation and tariff issues covered under section 6.4.1.

It is important to be sure that a building structure can handle the additional stresses that will be placed upon it from the mounting of a turbine. Additionally, wind eddies and gusts around buildings, making it very difficult to accurately state quite what power any of this type of turbine will generate over a given year.

6.6.2 Products

There is an increasing selection of products on the market and this is in no way a definitive list. Those listed below are the main players in this market, but other, innovative products are being developed.

1. Swift – produced by Renewable Devices and rated at 1.5kW, this is the largest of these horizontal axis turbines. It has three blades and a 2.1m diameter
2. Windsave – as with the Swift, a UK manufactured product rated at 1.0kW. The turbine has three blades and is 1.7m in diameter.
3. Stealthgen – a five bladed, 1,1m diameter, 400W turbine produced by Eclectic Energy.
4. Air Dolphin – a 1kW turbine and the lightest on the market, which, it is claimed, allows it to be most responsive to turbulent wind conditions, thus improving efficiency of generation.

Figure 16: Stealthgen on house in Bedfordshire

6.6.3 Planning issues

Planning permission will nearly always be an issue and despite media reported statements, the government has yet to relax planning permission requirements for this product.

6.6.4 Maintenance requirements

Most turbines on the market come with a one to two year guarantee, depending on manufacturer and it is recommended that they undergo annual maintenance for the first few years of operation and more intermittently thereafter. This is simple and mainly involves checking the bearings. Costs for this will need to include either scaffolding or the hire of a ‘cherry-picker’ to allow for the lowering or the turbine and is likely to cost £100 – £500. It is considered that this will not be something that home buyers will find an attractive proposition.

6.6.5 Wind Power at the Kings Mews Site

We consider this technology to be wholly inappropriate in most locations, other than on the coast or in very exposed locations, as the nature of wind movement around trees and buildings in most inland locations tends to render output potential as minimal and it is impossible to accurately say what this will be. This technology is therefore **UNSUITABLE** as a viable option for this site.

7 CONCLUSIONS

The proposed approach to energy reduction is already beyond good practice, in that it complies with Part L requirements even before the addition of LZC technology. With just the energy reduction measures calculated for the site as a whole, a carbon offset of 23.00% is delivered.

There is no local supply of district heat or CHP to connect to and none mooted as part of this development, so the remaining carbon offset will be met through LZC technologies and PV technology has been selected by the developer as the most applicable and cost-effective technology option.

This will see the installation of a PV array rated at 2.00kWp on the flat roof of the building and this, along with the energy efficiency measures, will see carbon emissions for the site exceed the Building Regulations of 2013 by 40.00%.

The site wide CO_2 figures for the 'Energy Hierarchy' are shown in the table below:

CO_2 emissions after each stage of the Energy Hierarchy	CO_2 emissions (Tonnes CO_2 per annum)
Baseline: Part L 2013 of Building Regs Compliant Development	1.00
After energy demand reduction	0.77
After CHP	0.77
After renewable energy	0.60

Therefore, the energy efficiency/reduction proposals outlined, along with the inclusion of the PV arrays, will comply with the London Borough of Camden requirements for carbon offset for new developments.

Finally, it is recommended that specialist suppliers are contacted at an early stage to confirm feasibility and price. In all cases it is recommended that suppliers accredited under the Renewable Energy Assurance scheme are used. Details can be found at http://www.realassurance.org.uk/.