100 CHALK FARM ROAD, LONDON, NW1 8EH (5923)

ENERGY ASSESSMENT REPORT

8th November 2013

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1.0 INTRODUCTION

1.1 Thornley & Lumb Partnership Ltd have undertaken the Energy Assessment in relation to the proposed Mixed Use development at 100 Chalk Farm Road, London, NW1 8EH.

This study has been overseen by our In House Registered Low Carbon Consultants and Energy Assessors James Forster and Andrew Jagger both of whom are Registered with the Chartered Institute of Building Services Engineers (CIBSE).

The project comprises the demolition of existing buildings and car parking structure. Redevelopment to provide a residential-led mixed use development comprising :-

- 63 No residential units including 10x1-beds, 40x2-beds and 13x3-beds.
- Replacement office floor space (Use Class B1a) measuring 815sqm (NIA – Net Internal Area).
- Retail (Use Class A1) measuring 365sqm (NIA).
- Restaurant (Use Class A3) measuring 286sqm (NIA).
- Provision of 134 cycle parking spaces and associated highways and landscaping improvements.

The Project consists of 8 floors made up of the following spaces: -

- Level 0 – A1 & A3 Retail Spaces, B1 Office Space, Communal Residential Entrances and Plant Spaces
- Level 1 – B1 Office Space, 11 No Apartments
- Level 2 – 12 No Apartments & B1 Office Space
- Level 3 – 12 No Apartments
- Level 4 – 10 No Apartments
- Level 5 – 10 No Apartments
- Level 6 – 6 No Apartments
- Level 7 – 2 No Apartments

1.2 This report addresses how the design seeks to achieve exemplar carbon emissions reductions through passive design, energy efficiency and Low or Zero Carbon technologies, and how the project responds to national, regional and local planning guidance for achieving carbon reductions.

2.0 POLICY DOCUMENTS & REQUIREMENTS

2.1 The following Documents are relevant to the Sustainability of this development :-

London Plan (July 2011)
Mayor of London – The London Plan Supplementary Planning Guidance, Sustainable Design & Construction.
CPG 3 – Camden Planning Guidance (Sustainability).
Policy DP22 - Promoting sustainable design and construction in line with CPG
Camden Policy CS13 – Tackling Climate Change through Promoting Higher Environmental Standards.
Building Regulations – Approved Documents Part L.

2.2 The London Borough of Camden Planning Guidance Document CPG 3 in Conjunction with the London Plan sets out Best Practice benchmarks that the development should achieve. The London Plan Policy 5.2 (Minimising Carbon Dioxide Emissions) introduces a target to achieve a 25% minimum Carbon Reduction over the Current 2010 Building Regulations.

The development is also required to achieve the following BREEAM requirements :-

Residential

Code for Sustainable Homes		
Time Period	Minimum Rating	Minimum Standard For Categories (% of Un-weighted Credits)
2010 - 2012	Level 3	Energy 50%
2013 - 2015	Level 4	Water 50%
2016 +	Level 6 (Zero Carbon)	Materials 50%

For this development Code for Sustainable Home Level 4 is applicable

Commercial (Non Residential)

BREEAM		
Time Period	Minimum Rating	Minimum Standard For Categories (% of Un-weighted Credits)
2010 - 2012	Very Good	Energy 60% Water 60% Materials 40%
2013 - 2015	Excellent	

For this Development BREEAM Excellent is applicable

2.3 Overview

2.3.1 Designing a good, environmentally sensitive new building can significantly :-

- Improve Comfort which affects user satisfaction, morale & productivity
- Reduce costs associated with energy and water use, maintenance and refurbishment
- Reduce the environmental impact associated with energy and resource use
- Improve the ability of a building to cope with future changes in use and climate
- Improve opportunities to let or sell in a competitive market

2.4 The following document addresses the above points and details the areas where it is felt that environmental benefit can be achieved whilst also being affordable.

3.0 BUILDING FABRIC

3.1 The thermal performance of a building relates to the amount of heat that is retained inside and the amount that is lost to the outside air. Ensuring a high thermal performance is one of the most effective ways to ensure the development is energy efficient.

3.2 Insulation

3.2.1 A high level of insulation is the most effective way to ensure new buildings are energy efficient. Where possible insulation with low overall heat transfer coefficient (U-value) should be used. The lower the U-Value the better the insulator.

3.2.1 Consideration to how the insulation is attached to the building structure or walls can considerably effect the building fabric performance. If a joint is badly insulated or if the material is penetrated by materials that conduct heat such as metal nails, it can cause cold patches and reduce the efficiency of the insulation. Special attention is to be given to these potential heat loss areas to prevent cold bridging and potential points of condensation.

3.3 U-Values

Approved Document Part L stipulates Limiting Fabric Parameter for each element as below :-

Approved Document L1A – Domestic

Element	Minimum U- Value	Proposal for this Development
Roof	0.20 $W/m^2.K$	0.15 $W/m^2.K$
Walls	0.30 $W/m^2.K$	0.20 $W/m^2.K$
Floor	0.25 $W/m^2.K$	0.15 $W/m^2.K$
Party Wall	0.20 $W/m^2.K$	0.20 $W/m^2.K$
Windows & Glazing	2.00 $W/m^2.K$	1.50 $W/m^2.K$
Air Permeability	10.00 $m^3/h.m^2$@ 50 Pa	5.00 $m^3/h.m^2$@ 50 Pa

Approved Document L2A – Non Domestic

Element	Minimum U- Value	Proposal for this Development
Roof	0.25 $W/m^2.K$	0.15 $W/m^2.K$
Walls	0.35 $W/m^2.K$	0.20 $W/m^2.K$
Floor	0.25 $W/m^2.K$	0.15 $W/m^2.K$
Windows & Glazing	2.20 $W/m^2.K$	1.50 $W/m^2.K$
Air Permeability	10.00 $m^3/h.m^2$@ 50 Pa	5.00 $m^3/h.m^2$@ 50 Pa

As can be seen from the above the current fabric proposal provides a significant improvement on the benchmark values and will therefore assist in improving the energy performance of the building and subsequent Carbon Emissions.

4.0 SAP & SBEM CALCULATIONS

4.1 The building will be fully modelled utilising Industry Recognised Software with SAP Calculations for the Domestic Properties and SBEM Calculations for the Communal and Commercial Areas. Preliminary SAP Calculations have been undertaken for the Domestic Dwellings and with the Commercial Areas they are being constructed as Shell Construction for Fit Out by each tenant with each tenant being responsible for obtaining planning approval to meet the same criteria set down within this document and the relevant planning documents applicable at the time of application.

4.2 Preliminary Assessment of the Apartments has been undertaken and the following parameters are considered the most appropriate at this time : -

Table 1: Building Fabric	
Air Permeability	5.00 $m^3/h.m^2$@ 50 Pa
Exposed Wall U Value	0.20 $W/m^2.K$
Exposed Roof U Value	0.15 $W/m^2.K$
Exposed Floor U Value	0.15 $W/m^2.K$
Windows U Value	1.50 $W/m^2.K$
Glazing G Value	
Table 2: Mechanical & Electrical Services	
Proposed Heating Plant	Communal Gas Fired Commercial Combination Boilers
Heating Fuel	Natural Gas
Heating Efficiency	89.70%
Heating Controls	Programmer and TRV's
Room Heating	Underfloor Heating
Domestic Hot Water System	Via Main Heating System
Domestic Hot Water Storage/Return	Integral to Boilers
Metering	Individual Heat Metering to Each Apartment
Photovoltaic Type	Monocrystalline Silicon
Photovoltaic required area	164m (Equivalent to 0.392 Kw / Dwelling)
Photovoltaic Orientation	South
Photovoltaic Angle	30 degree
Whole House Ventilation SPF	0.42 W/l/s with Heat Recovery
Lighting	100% Fixed Low Energy

5.0 ENERGY HIERARCHY BREAKDOWN

Preliminary SAP calculations have been undertaken on sample apartments to demonstrate the reduction of CO^2 the development is likely to achieve and this is broken down into the Energy Hierarchy identified in Camden Planning Guidance 3 – Sustainability (CPG 3). We would therefore summaries the Hierarchy Breakdown as follows :-

5.1 Baseline Energy Demand & Carbon Dioxide Emission

The baseline values are derived from the SAP Calculation which define these as the Target Emission Rate (TER) for the building which if achieved would demonstrate compliance with Building Regulations Part L1A. The following values have been extrapolated from the Preliminary SAP Calculations.

Baseline Energy Demand - 7493.79 Kwh/yr
Baseline Carbon Dioxide Emissions - 15.66 kg/m^2/year (TER)

5.2 Reducing the Demand for Energy

The building has been reviewed by the design team and incorporated measures to maximise the efficiency of the building. This includes the consideration of the following :-

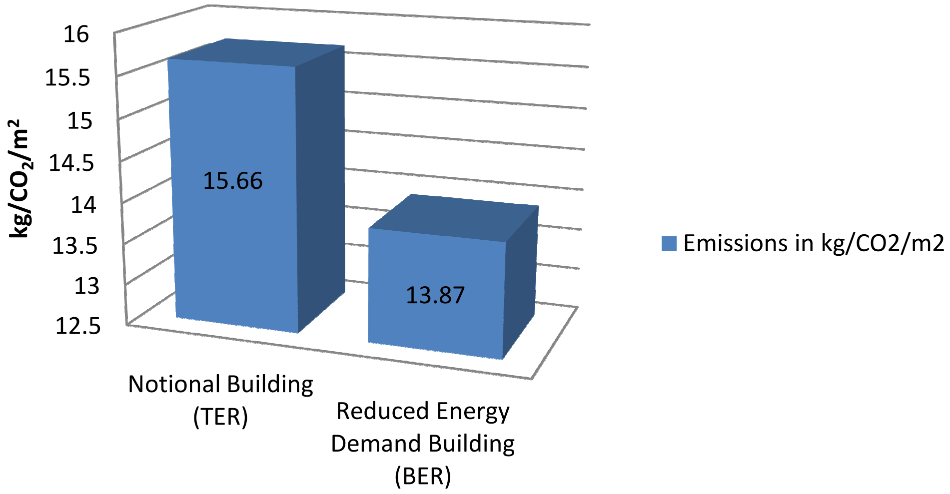
- Maximise Daylight to minimise use of Artificial Lighting.
- Maximise Sunlight to provide solar gain to heat requiring rooms and consider utilising the suns energy for systems such as Solar Water Heating and Solar PV.
- Prevent Overheating by considering the areas of glazing, introducing shading if required etc.
- Provide Natural Ventilation including openable windows.
- Provide a high level of Insulation to ensure improved U-Values of the structure and ensure good jointing to prevent cold bridging etc.
- Consider materials with good thermal mass to absorb heat either from the sun or to regulate internal temperatures to keep indoor spaces cool during the day.
- Consider Thermal Buffers such as porches, lobbies, sheltered courtyards to minimise heat loss from doors and windows by providing a transition between the cold outside and warm inside of the building.
- Maximise air tightness of the building to minimise air leakage / ingress and eliminate draught and reduce heat losses.
- Efficient Heating by utilising more efficient gas boilers with consideration for community heating schemes and Combined Heat & Power (CHP). Avoid electrical heating systems unless there is no access to a gas connection.
- Efficient ventilation and cooling by utilising Mechanical Ventilation & Heat Recovery (MVHR)
- Where cooling is required consider Water based Cooling Systems, Ground Source Cooling, Evaporation Cooling, Exposed Concrete Slabs and Natural Ventilation Stack Effect.

The above has been considered and incorporated into the preliminary SAP Calculations and the following values achieved :-

Table 1 – Reduction in Carbon Dioxide Emissions Comparison (Reduced Energy Demand)

	Kwh/yr	(BER) Kg/CO^2/m^2	Baseline Values (TER) Kg/CO^2/m^2	Overall % Reduction from TER
Baseline kwh/year	7493.79			
Reduced Energy Demand kwh/year	*4159.72*			
Reduced Carbon Dioxide Emissions (BER)		13.87	15.66	11.43 %

Figure 1: Reduced Energy Demand Comparison



5.3 Supply Energy Efficiency

Further Carbon Emission Reductions can be achieved through the use of Decentralised Energy which can be in the form of Combined Heat & Power (CHP) and Decentralised Energy Networks such as a District Heating System.

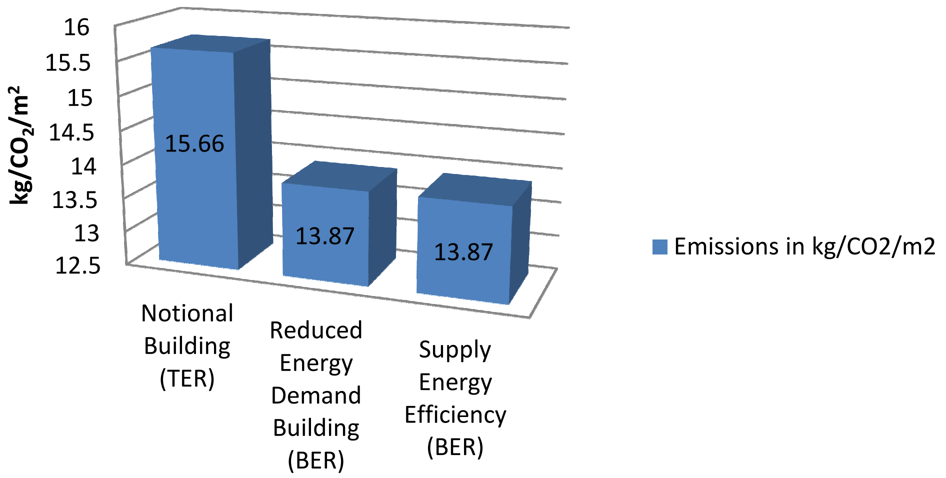
As outlined later within the document CHP is not being considered for this development due to the load characteristics and at the present time there is no District Heating System in operation or proposed in the near future that could be utilised for the developments. The capability to connect to any future District Heating System can be incorporated.

Taking this into account there is no improved in the Building Emission Rate from improved energy supply emissions :-

Table 2 – Reduction in Carbon Dioxide Emissions Comparison (Supply Energy Efficiency)

	Kwh/yr	(BER) Kg/CO²/m²	Baseline Values (TER) Kg/CO²/m²	Overall % Reduction from TER
Baseline kwh/year	7493.79			
Reduced Energy Demand kwh/year	*4159.72*			
Reduced Carbon Dioxide Emissions (BER)		13.87	15.66	11.43 %
Supply Energy Efficiency Energy Demand kwh/year	*4159.72*			
Supply Energy Efficiency CO² Emissions (BER)		13.87	15.66	11.43 %

Figure 2 : Supply Energy Efficiency Comparison



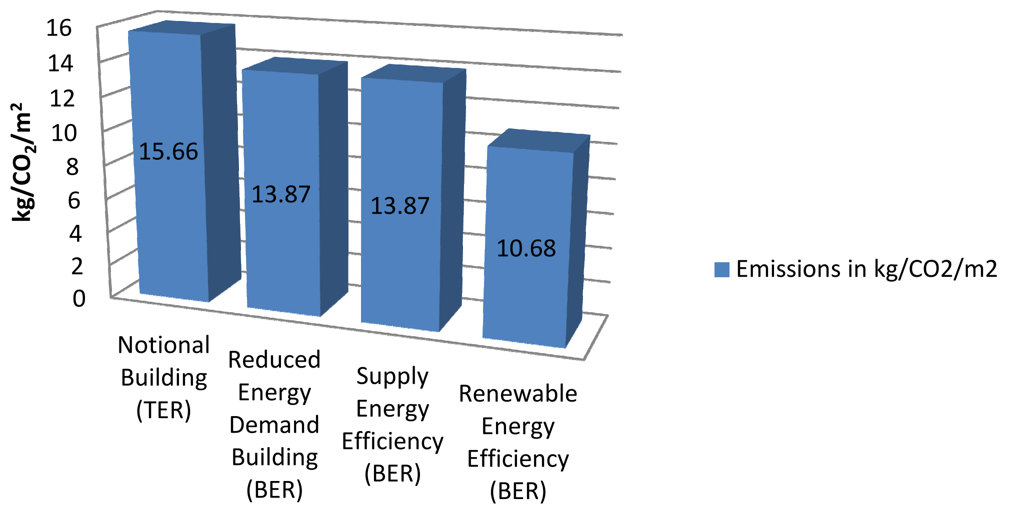
5.4 Renewable Energy

Renewable Energy can be introduced into the development to further reduce the Carbon Dioxide Emissions. A number of technologies have been considered on this development which are outlined later within this document with Solar PV being considered the most appropriate for this scheme.

Table 3 – Reduction in Carbon Dioxide Emissions Comparison (Renewable Energy)

	Kwh/yr	(BER) Kg/CO²/m²	Baseline Values (TER) Kg/CO²/m²	Overall % Reduction from TER
Baseline kwh/year	7493.79			
Reduced Energy Demand kwh/year	*4159.72*			
Reduced Carbon Dioxide Emissions (BER)		13.87	15.66	11.43 %
Supply Energy Efficiency Energy Demand kwh/year	*4159.72*			
Supply Energy Efficiency CO² Emissions (BER)		13.87	15.66	11.43 %
Renewable Energy Demand kwh/year	*3177.16*			
Renewable Energy CO² Emissions (BER)		10.68	15.66	**31.80 %**

Figure 3: Reduced Energy Demand Comparison



5.5 Summary

The Preliminary SAP Calculation shows a 26.40% Dwelling Emission Rate (DER) reduction over the Target Emission Rate (TER). This will achieve a Code for Sustainable Homes Level 4 Compliance. The Renewable Technologies provide a reduction of 20.37 %

6.0 ENERGY STATEMENT

6.1 The Building Form

6.1.1 This section will deal with the following areas detailed that are related to good sustainable design :-

- Daylight & Sunlight
- Building Form
- Low Energy Materials
- Thermal Insulation
- Ventilation – Dwellings
- Ventilation – Commercial Premises
- Natural Daylighting
- Fenestration
- Landscaping
- Refuse, Waste Recycling & Composting
- Water Saving Measures
- Energy Efficient Lighting
- Variable Speed Pumps & Fans
- Local Heating and Cooling Control
- Enhanced Pipework and Ductwork Thermal Insulation

6.1.2 Daylight, Sunlight & Orientation
Refer to TM Architects Layout & Orientation DWGs. The living spaces are orientated to allow for good use of natural daylight whilst avoiding major issues of overheating in the summer months where possible. Within the offices and retail spaces natural light will be maximised to reduce the need for artificial lighting.

6.1.3 Building Form
The building is new build and designed for the intended use.

6.1.4 Low Energy Materials
With regards to Low Energy Materials further input / design development will be required from the Architects along with the planners to ensure that materials chosen satisfy the local planning regulations. Products such as that detailed below are considered :-

- Recycled Products
- Salvaged Brick & Other Materials
- Concrete Blocks using Recycled Materials or Green Production Methods
- Certified wood products
- Low E Double or Triple Glazing
- Sustainable / Natural or Low Impact Insulation Products
- Renewable Flooring Products
- Natural Paints / Stains & other Wall / Floor coverings

6.1.5 Thermal Insulation
Heat losses and gains through the fabric will be further limited by the optimisation of U-values. Reducing the thermal transmittance of the building envelope by increasing insulation will help to significantly reduce heating demand and result in lower heating energy consumption.
U-values at the 100 Chalk Farm Road Development are predicted to well exceed the requirements of Part L2A 2010:

(See item 2.3 above for specific values)

6.1.6 Natural Daylighting
Natural Daylight is to be maximised within all units to minimise the requirement for the use of natural lighting. In consideration of this care needs to be taken that excessive glazing does not result in Overheat of any spaces. Overheating will be assessed as part of the SAP Calculations to ensure this is within acceptable tolerances.

6.1.7 Fenestration & Glazing
Double Glazing will be chosen that will have a very good Light Transfer % whilst achieving excellent U Values.

6.1.8 Landscaping & Shadowing By Trees
Refer to TM Architects Layout & Orientation DWGs .

6.1.9 Refuse , Waste Recycling & Composting

Refuse Storage Facilities will be detailed on the TM Architects DWGs, these will incorporate Waste Recycling Bins to meet BREEAM & Code for Sustainable Homes requirements. These will be easily accessible by all building users.

6.1.10 Water Saving Measures

A number of water saving measures are to be installed to meet the Code for Sustainable Homes Level 4 requirements which are generally as follows :-

- Install low flush cisterns these use 4.5 litres / 3 Litre DualFlush
- Install Low Flow / Restricted Flow Shower Heads with a usage less than 8 l/min
- Install Time Flow Self Closing Lever Operated Taps to all Wash Hand Basins with Commercial Areas

6.1.11 Energy Efficient Light Fittings

All rooms will be fitted with dedicated low energy or LED fittings to maximise energy efficiency and reduce the energy required for lighting. PIR detection is used to corridors, stores, stairs etc.

6.1.12 Variable Speed Pumps & Fans

Using variable speed drive pumps and fans uses less energy than traditional pumps, which run at a constant speed. The building services systems incorporated into the scheme have been designed to deliver only the volume of air and water necessary to meet the cooling, heating or ventilation load requirement at any instant and no more.

6.1.13 Local Heating & Cooling Control

High efficiency DC motor fan coil terminals in accommodation areas will be controlled by a combination of management and digital user interventions that will seek to deliver heating and cooling only when an absolute requirement and will otherwise be off or “set back”. Local thermostatic and digital time controls will ensure that building services are not in operation when not needed.

6.1.14 Enhanced pipework & Ductwork Thermal Insulation

The thermal distribution network will be insulated to better than 15% beyond the requirements of the relevant standards to reduce distribution losses.

7.0 MECHANICAL AND ELECTRICAL SERVICES OVERVIEW

7.1 Main Heating & Hot Water - Dwellings

It is proposed that the main heating to the residential Apartments will be provided from a Central Boiler System comprising of High Efficiency Gas Fired Commercial Combination Boilers Location within the Plant Area at Level 0. The boilers would provide Heating and Hot Water to all apartments with heat metering within each apartment establishing the usage of each tenant for individual billing by the Building Management Company.

Within the apartments themselves it is proposed that Underfloor Heating will be the main heating source and provided to all rooms. Each room within each Apartment will be a dedicated zone with each apartment having its own manifold to allow full occupant control of their heating. Programmable Timers, Room Thermostats and TRV Actuators will be provided within each apartment to allow maximum user control and minimise energy from unnecessary heating.

7.2 Heating – Commercial Spaces

Although these are being constructed as Shell Construction for fit out by the tenant it is anticipated that within the A1, A3 and B1 Commercial Space Heating and Cooling will be provided from Air Source Heat Pump Systems (ASHP).

7.3 Ventilation - Dwellings

Due to acoustic constraints with the site and proximity to the Railway Line to the South Elevation and Main Road to the North Mechanical Whole House Ventilation is proposed to each apartment. Each apartment is to be provided with an independent Whole House Ventilation System providing supply air to all habitable rooms (Lounge, Bedrooms) and Extract from Bathrooms and Kitchen. Each Unit is to incorporate a high efficiency heat recovery core to minimise waste energy. Ventilation rates will be based on and compliant with Building Regulation Approved Document F. To meet the acoustic requirements attenuated louvers and or in line attenuation will be considered on the inlet and exhaust louvers to outside.

7.4 Ventilation – Commercial Premises

Ventilation will be required to all commercial premises in line with Building Regulations Approved Document F. Although at this stage these are being constructed as shell units for fit out consideration has been given to plant allocation and positions.

7.5 Lighting

The lighting to the residential apartments will all be Low Energy / LED in line with the requirements of the Code for Sustainable Home Assessment. Within the Commercial premises Low Energy / LED Lighting will also be implemented to meet the requirements of BREEAM Excellent.

7.6 Comfort Cooling – Dwellings

There is no proposal to provide comfort cooling to the residential apartments. Overheating will be assessed as part of the SAP Design Calculations to ensure this is within acceptable parameters.

7.7 Comfort Cooling – Commercial Spaces

Due to the proposed use of these spaces and high occupancies it is proposed that heating and cooling will be required to all commercial premises. This is proposed to be in the form of Air Source Heat Pumps (ASHP) incorporating heat recovery which are considered to be a renewable technology. Within each space ceiling cassette Units or Ducted Units will be implemented.

8.0 LOW CARBON & RENEWABLE TECHNOLOGY PROPOSALS

The Camden Planning Guidance CPG 3 with reference to the London Plan sets a target Carbon Dioxide reduction of 25% below the Target Emission Rate (TER) of any New Building. The development is required to achieve a BREEAM Excellent rating to the Commercial and Communal Areas and Code for Sustainable Homes Level 4 to all Dwellings as outlined earlier within this document. To achieve this consideration needs to be given to appropriate Low Carbon / Renewable Technologies that are suitable for this development on the grounds of them being “Technically”, “Practically” and “Economically” viable.

The reduction in Carbon Dioxide Emissions through the use of such technologies goes hand in hand with reduction in the energy demands of the building and in turn the energy costs associated. This in most cases will generate a “payback” period whereby the energy savings offset any additional capital expenditure these systems may have incurred.

There are a number of Renewable Energy options available, these being :-

- Solar Energy
  ~ Photovoltaic Cells
  ~ Solar Thermal
- Wind Energy
- Combined Heat & Power (CHP)
- Ground Source Heat Pumps
- Air Source Heat Pump
- Bio Fuel Boilers

8.1 SOLAR ENERGY

8.1.1 Photovoltaic System (PV)

8.1.1.1 A photovoltaic array (also called a solar array) consists of multiple photovoltaic modules, commonly referred to as solar panels, to convert solar radiation (sunlight) into usable direct current (DC) electricity. A photovoltaic system for residential, commercial, or industrial energy supply normally contains an array of Photovoltaic (PV) modules, one or more DC to alternating current (AC) power converters (also known as an inverter), a support system that supports the solar modules, electrical wiring and interconnections, and mounting for other components. The amount of modules in the system determines the total DC watts capable of being generated by the solar array; however, the inverter ultimately governs the amount of AC watts that can be distributed for consumption. For example: A PV system comprised of 11 kilowatts DC (kWDC) worth of PV modules paired with one 10 kilowatt AC (kWAC) inverter, will be limited by the maximum output of the inverter--10 kWAC.

8.1.1.2 Commonly two types of Solar Collector are utilised which are Monocrystalline or Polycrystalline modules. Monoscrystalline is significantly more efficient producing higher outputs and would be the panel type under consideration for this project.

Monocrystalline Silicon PV

To produce monocrystalline silicon a crystal of silicon is grown from highly pure molten silicon. This single crystal cylindrical ingot is cut into thin slices between 0.2 and 0.3mm thick- this is the basis of a solar PV cell. The edges are cut off to give a hexagonal shape so more can be fitted onto the module. These PV cells have efficiencies of 13-17% and are the most efficient type of the of silicon PV cell. However, they require more time and energy to produce than polycrystalline silicon PV cells, and are therefore more expensive.

Polycrystalline Silicon PV

Polycrystalline silicon is also produced from a molten and highly pure molten silicon, but using a casting process. The silicon is heated to a high temperature and cooled under controlled conditions as a mould. It sets as an irregular poly- or multi-crystal form. The square silicon block is then cut into 0.3mm slices. The typical blue appearance is due to the application of an anti-reflective layer. The thickness of this layer determines the colour- blue has the best optical qualities. It reflects the least and absorbs the most light. More chemical processes and fixing of the conducting grid and electrical contacts complete the process. Mass-produced polycrystalline PV cell modules have an efficiency of 11-15%.

8.1.1.3 **Summary Table**

Photovoltaic System (PV)		
Item	*Consideration*	*Comment*
1	Energy Generated	Dependant on System Size.
2	Payback	In Suitable location South Facing 8 – 10 Years.
3	Can Heat / Electricity be Exported	Yes. Connection to Grid can be provided.
4	Land Use	Roof Mounted so no land use required.
5	Planning Requirements	None.
6	Noise	None.
7	Grants Available	None. But system may be eligible for Feed In Tariff & Enhanced Capital Allowance.
8	Life Cycle Cost	Minimal Maintenance. Periodic Cleaning. Replacement required after approximately 25 Years.
9	Specific Considerations	Assess Available Roof Area. Check for Shading from Adjacent Buildings, Trees etc which would impact on system efficiency.
10	System appropriate for this scheme	Yes. Large roof areas South Facing. Large Electricity Usage. Unused electricity can be exported to the grid.
	Under Consideration / Not Under Consideration	Under Consideration.

8.1.2 Solar Thermal

8.1.2.1 Solar Water Heating System use solar panels (Collectors) which are fitted to the roof of the building to collect heat from the sun, this heat can be used to heat water which can be used for Domestic Hot Water purposes ie Showers & Taps for a significant period of the year.

There are 2 types of solar panel :-

Evacuated Tube

An evacuated-tube collector contains several rows of glass tubes connected to a header pipe. Each tube has the air removed from it (evacuated) to eliminate heat loss through convection and radiation. Inside the glass tube, a flat or curved aluminium or copper fin is attached to a metal pipe. The fin is covered with a selective coating that transfers heat to the fluid that is circulating through the pipe. There are two main types of evacuated tube collectors :-

Direct-flow evacuated-tube collectors

Direct-flow evacuated tube collector has two pipes that run down and back, inside the tube. One pipe is for inlet fluid and the other for outlet fluid. Since the fluid flows into and out of each tube, the tubes are not easily replaced.

Heat pipe evacuated-tube collectors

Heat pipe evacuated tube collectors contain a copper heat pipe, which is attached to an absorber plate, inside a vacuum sealed solar tube. The heat pipe is hollow and the space inside is also evacuated. Inside the heat pipe is a small quantity of liquid, such as alcohol or purified water plus special additives. The vacuum enables the liquid to boil at lower temperatures than it would at normal atmospheric pressure. When sunlight falls the surface of the absorber, the liquid in the heat tube quickly turns to hot vapour and rises to the top of the pipe. Water or glycol, flows through a manifold and picks up the heat. The fluid in the heat pipe condenses and flows back down the tube. This process continues, as long as the sun shines.

Since there is a "dry" connection between the absorber and the header, installation is much easier than with direct flow collectors. Individual tubes can also be exchanged without emptying the entire system of its fluid and should one tube break, there is little impact on the complete system.

Flat Plate Collector

Flat-plate collectors are the most common solar collectors for use in solar water-heating systems in homes and in solar space heating. A flat-plate collector consists basically of an insulated metal box with a glass or plastic cover (the glazing) and a dark-coloured absorber plate. Solar radiation is absorbed by the absorber plate and transferred to a fluid that circulates through the collector in tubes. In an air-based collector the circulating fluid is air, whereas in a liquid-based collector it is usually water.

Due to the orientation and space availability at roof level Solar Thermal Collectors are to be considered for this project.

8.1.2.2 **Summary Table**

Solar Thermal		
Item	*Consideration*	*Comment*
1	Energy Generated	Dependant on System Size.
2	Payback	In Suitable location South Facing 8 – 10 Years.
3	Can Heat / Electricity be Exported	Yes. Connection to Grid can be provided.
4	Land Use	Roof Mounted so no land use required.
5	Planning Requirements	None.
6	Noise	None.
7	Grants Available	None. But system may be eligible for Renewable Heat Incentive & Enhanced Capital Allowance.
8	Life Cycle Cost	Minimal Maintenance. Periodic Cleaning. Replacement required after approximately 25 Years.
9	Specific Considerations	Assess Available Roof Area. Check for Shading from Adjacent Buildings, Trees etc which would impact on system efficiency. Plant Space for Hot Water Storage.
10	System appropriate for this scheme	No. Hot water usage sporadic within the Residential Development which would not maximise the efficiency of the system. Distance from Roof to Plant area significant.
	Under Consideration / Not Under Consideration	Not Under Consideration.

8.2 WIND POWER

8.2.1 A wind turbine is a device that converts Kinetic Energy from the wind, also called wind energy, into mechanical energy in a process known as wind power wind which in turn is then converted into electricity.

Turbines used in wind farms for commercial production of electric power are usually three-bladed and pointed into the wind by computer-controlled motors. These have high tip speeds of over 320 km/h (200 mph), high efficiency, and low torque ripple, which contribute to good reliability. The blades are usually colored white for daytime visibility by aircraft and range in length from 20 to 40 metres (66 to 130 ft) or more. The tubular steel towers range from 60 to 90 metres (200 to 300 ft) tall. The blades rotate at 10 to 22 revolutions per minute. At 22 rotations per minute the tip speed exceeds 90 metres per second (300 ft/s) A gear box is commonly used for stepping up the speed of the generator, although designs may also use direct drive of an annular generator. Some models operate at constant speed, but more energy can be collected by variable-speed turbines which use a solid-state power converter to interface to the transmission system. All turbines are equipped with protective features to avoid damage at high wind speeds, by feathering the blades into the wind which ceases their rotation, supplemented by brakes.

For this type of system to be considered the average speed at the Hub Height needs to be assessed. This is the centre of the wind turbine. For this site the values taken for postcode NW1 8EH all as detailed within the British Wind Energy Association Guidance notes using the DTI Wind Database we get average wind speed values as follows :-

4.9 m/s ~ 10m
5.6 m/s ~ 25m
6.1 m/s ~ 45m
Based on Location NW1 8EH (100 Chalk Farm Road Postcode)

Viability is taken as being between 5 & 6m/s Ave as a minimum, this is at the bottom end of the viability scale and 7m/s+ is preferred.
The min height to be approaching viability is greater than 45 m and would therefore not consider this appropriate for this development which is located within a highly populated area.

8.2.2 **Summary Table**

Wind Power		
Item	*Consideration*	*Comment*
1	Energy Generated	Dependant on System Size.
2	Payback	With suitable location and wind speeds from 10 years upwards.
3	Can Heat / Electricity be Exported	Yes. Connection to Grid can be provided.
4	Land Use	For an appropriate system for this site a self supporting system would be required which will require land to be available. Due to the tight site this is unlikely to be available with adequate clearance for buildings, railway line etc.
5	Planning Requirements	Yes. Full planning submission would be required.
6	Noise	Yes. Can be significant for larger system which may impact on the local residential properties.
7	Grants Available	None. But system may be eligible for Feed in Tariff.
8	Life Cycle Cost	Full annual maintenance required with replacement of major components 10 yearly minimum.
9	Specific Considerations	Appropriate wind speeds in the location.
10	System appropriate for this scheme	No. No considered appropriate due to low average wind speeds. Planning Implications, Visual Implications and Noise Impact.
	Under Consideration / Not Under Consideration	Not Under Consideration.

8.3 COMBINED HEAT & POWER (CHP)

8.3.1 Combined heat and power (CHP) is the use of a heat engine to simultaneously generate electricity and useful heat. CHP is a thermodynamically efficient use of fuel. In separate production of electricity, some energy must be discarded as waste heat, but in CHP this thermal energy is put to use. All thermal plants emit heat during electricity generation, which can be released into the natural environment through cooling towers, flue gas, or by other means. In contrast, CHP captures some or all of the by-product for heating, either locally within the building or by connection to a District Heating System if present locally.

A Base all year round heating load would be required to utilize the heat generated by the CHP, heating loads of the apartments are seasonal ie. Mid Season & Winter (Oct – April), we would anticipate hot water demand would generally be 07.00 – 10.00 and around 17.00 – 22.00 daily when the residents are home. Due to the relatively short demand cycles CHP would generally not be considered for this development.

Although CHP cannot be considered a renewable source unless biofuel is utilised they can reach much higher efficiencies (up to 85%) than traditional electricity generation methods (nearer 30%) where the heat produced is wasted.

8.3.2 **Summary Table**

Combined Heat & Power		
Item	*Consideration*	*Comment*
1	Energy Generated	Dependant on System Size.
2	Payback	Dependant on System Size, usage etc.
3	Can Heat / Electricity be Exported	Yes. Connection to Grid can be provided along with heat input to a district heating system if available.
4	Land Use	None. Although internal plant space required.
5	Planning Requirements	Yes. Full planning submission would be required.
6	Noise	Yes. But can be managed through correct plant sizing, positioning and attenuation.
7	Grants Available	None. But system may be eligible for Enhance Capital Allowance.
8	Life Cycle Cost	Full annual maintenance required with full replacement likely in 10 – 15 years depending on usage.
9	Specific Considerations	Must have adequate heat load to ensure CHP runs.
10	System appropriate for this scheme	No. Insufficient base heating load and fluctuating usage. No local District Heating Scheme for heat rejection.
	Under Consideration / Not Under Consideration	Not Currently Under Consideration.

8.4 GROUND SOURCE HEAT PUMPS (GSHP)

8.4.1 A geothermal heat pump or ground source heat pump (GSHP) is a central heating and / or cooling system that pumps heat to or from the ground. It uses the earth as a heat source (in the winter) or a heat sink (in the summer). This design takes advantage of the moderate temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling.

Ground Source Heat Pumps harvest heat absorbed at the Earth's surface from solar energy. The temperature in the ground below 6 metres (20 ft) is roughly equal to the mean annual air temperature at the surface.
Depending on latitude, the temperature beneath the upper 6 metres (20 ft) of Earth's surface maintains a nearly constant temperature between 10 and 16 °C if the temperature is undisturbed by the presence of a heat pump. These systems use a heat pump to force the transfer of heat from the ground. Heat pumps can transfer heat from a cool space to a warm space, against the natural direction of flow, or they can enhance the natural flow of heat from a warm area to a cool one. The core of the heat pump is a loop of refrigerant pumped through a vapor-compression refrigeration cycle that moves heat. Air-source heat pumps are typically more efficient at heating than pure electric heaters, even when extracting heat from cold winter air, although efficiencies begin dropping significantly as outside air temperatures drop below 5 °C (41 °F). A ground source heat pump exchanges heat with the ground. This is much more energy-efficient because underground temperatures are more stable than air temperatures through the year. Seasonal variations drop off with depth and disappear below 7 metres (23 ft) due to thermal inertia. A ground source heat pump extracts ground heat in the winter (for heating) and transfers heat back into the ground in the summer (for cooling). Systems can be designed to operate in just one mode ie either heating or cooling.

Ground Source heat Pump systems reach fairly high Coefficient of Performance (CoP) of 3 - 6, on the coldest of winter nights, compared to 1.75-2.5 for air-source heat pumps on cool days. The setup costs can be considerably higher than for conventional systems due to requirement for external ground loops through boreholes or horizontal loops.

Generally two forms of ground collector / rejectors are utilised :-

Horizontal Boreholes "Slinkies"
These are laid horizontally within the ground in trenches as shallow as 1200mm spaced 5 metres apart. A large area of land is generally required for this system with land requiring to be permeable to allow rainwater percolation and prevent drying out of the ground. This is the most cost effective system if the land is available.

Borehole System
This arrangement requires vertical boreholes to be installed to suitable depths based on a geotechnical survey of the site. These are typically between 25 – 150 metres deep. Although required land space is reduced borehole costs can be significant.

8.4.2 **Summary Table**

Ground Source Heat Pump		
Item	*Consideration*	*Comment*
1	Energy Generated	Full heating duty delivered.
2	Payback	No payback period. Savings on gas consumptions outweighed by initial capital expenditure and electrical costs associated with running of the GSHP.
3	Can Heat / Electricity be Exported	Not Applicable. Unit would be sized to maximum heat demand and only run and modulate to the required heating load.
4	Land Use	Significant area required particularly for the "Slinky" ground loop arrangement.
5	Planning Requirements	None.
6	Noise	Minimal from internal plant which can be controlled with attenuation etc.
7	Grants Available	None. But system may be eligible for Enhance Capital Allowance and Renewable Heat Incentive.
8	Life Cycle Cost	Full annual maintenance required with full replacement on internal plant likely after 15 – 20 years years depending on usage.
9	Specific Considerations	Requires land which is permeable. Produces on low temperature heat 35-45°c.
10	System appropriate for this scheme	No. Insufficient land area for boreholes / slinkie ground loops. Not appropriate for hot water generation.
	Under Consideration / Not Under Consideration	Not Under Consideration.

8.5 AIR SOURCE HEAT PUMP (ASHP)

8.5.1 An Air Source Heat Pump (ASHP) is a system which transfers heat from outside to inside a building, or vice versa. Under the principles of vapor compression refrigeration, an ASHP uses a refrigerant system involving a compressor and a condenser to absorb heat at one place and release it at another. They can be used for space heating and / or cooler and are sometimes called "reverse-cycle air conditioners".

Heating and cooling is accomplished by pumping a refrigerant through the heat pump's indoor and outdoor coils. Like in a refrigerator, a compressor, condenser, expansion valve and evaporator are used to change states of the refrigerant between colder liquid and hotter gas states. When the liquid refrigerant at a low temperature and low pressure passes through the outdoor heat exchanger coils, ambient heat causes the liquid to boil (change to gas or vapor): heat energy from the outside air has been absorbed and stored in the refrigerant as latent heat. The gas is then compressed using an electric pump; the compression increases the temperature of the gas. Inside the building, the gas passes through a pressure valve into heat exchanger coils. There the hot refrigerant gas condenses back to a liquid and transfers the stored latent heat to the indoor air, water heating or hot water system. The indoor air or heating water is pumped across the heat exchanger by an electric pump or fan. The cool liquid refrigerant then re-enter the outdoor heat exchanger coils to begin a new cycle. Most heat pumps can also operate in a cooling mode where the cold refrigerant is moved through the indoor coils to cool the room air.

Heating Only ASHP can provide heating to the space by transfer of heat to a Low Pressure Hot Water Loop from the outdoor unit into the building to serve the main heating system. As the optimum efficiency of the ASHP is achieved at lower heat outputs (35 - 45°c) they are ideally suited to Underfloor Heating and other low temperature systems.

The 'Efficiency' of air source heat pumps is measured by the Coefficient of performance (COP) in heating and Seasonal Energy Efficiency Ratio (SEER) for cooling . A COP of 3 means the heat pump produces 3 units of heat energy for every 1 unit of electricity it consumes. Within temperature ranges of -3°C to 10°C, the COP for many machines is fairly stable at 3-3.5.
In mild weather, the COP of an air source heat pump can be up to 4. However, on a very cold winter day, it takes more work to move the same amount of heat indoors than on a mild day. The heat pump's performance is limited by the Carnot cycle and will approach 1.0 as the outdoor-to-indoor temperature difference increases, which for most air source heat pumps happens as outdoor temperatures approach −18 °C / 0 °F.

ASHP can incorporate heat recovery by extracting waste heat from one space and utilising this to heat an adjacent space or vice versa in cooling mode. ASHP optimum efficiencies are at lower supply temperatures and therefore when utilised for heating are best suited to Underfloor Heating or other similar low temperature systems.

8.5.2 **Summary Table**

Air Source Heat Pump	
Consideration	*Comment*
Energy Generated	Full heating duty delivered.
Payback	Whilst due to their high efficiencies these systems are accepted as being a renewable technology their primary energy is electricity and therefore payback is unlikely when the energy costs are factored in.
Can Heat / Electricity be Exported	Not Applicable. Unit would be sized to maximum heating / cooling demand and only run and modulate to the required heating & cooling load.
Land Use	Plant Area for External Condensers required.
Planning Requirements	The location of the condensers would require planning consent
Noise	Some noise from the external condensers but this can be treated locally if required with attenuation / acoustic housings.
Grants Available	None. But system may be eligible for Enhance Capital Allowance and Renewable Heat Incentive.
Life Cycle Cost	Full annual maintenance required with full replacement of plant likely after 15 – 20 years years depending on usage.
Specific Considerations	Is Heating and Cooling Required. Condenser Space.
System appropriate for this scheme	Yes. This system is appropriate for Heating and Cooling within the commercial premises. It would not be considered for the Domestic Dwellings as the low water temperatures are not suited to hot water generation and no cooling is proposed to the Residential Apartments.
Under Consideration / Not Under Consideration	Under Consideration (For Commercial Premises Only)

8.6 BIOFUEL BOILERS (BIOMASS / BIODIESEL)

8.6.1 The use of Biofuel in heating systems is beneficial because it uses agricultural, forest, urban and industrial residues and waste to produce heat and electricity with less effect on the environment than fossil fuels. This type of energy production has a limited long term effect on the environment because the carbon in biomass is part of the natural carbon cycle, while the carbon in fossil fuels is not, and permanently adds carbon to the environment when burned for fuel. Historically, before the use of fossil fuels in significant quantities, biomass in the form of wood fuel provided most of humanity's heating.

Biofuel for commercial heating systems comes in two main forms Biomass and Biodiesel.

Biomass

The most common form of this fuel is wood chip pellets which are normally stored externally in a pellet store and transferred into the plant room under gravity to serve the Biofuel Boiler. They require a large storage area easily accessible for wood chip pellet deliveries. The pellet can be transferred by blowing them down a transfer tube but cannot be blown great distances as the turbulence and impact of bends damages the pellets and effects the efficiency of the combustion process.

Biodiesel

This comes in many forms and is either made from Plant Oil or Animal Fats. Most Biodiesel used in heating is derived from Rapeseed Oil. The purity of the Biodiesel is denoted by a B rating from 0 to 100 with the number denoting to percentage of Biodiesel present. Therefore B100 is pure Biodiesel ie 100% Rapeseed Oil. B20 would have 20% Biodiesel blended with 80% heating oil. As with Biomass a large storage tank is required that can be accessed for deliveries but unlike Biomass the Biodiesel can be transfer through and Oil Transfer Point to more isolated tank positions. Suppliers of B100 Biodiesel are limited and often require bulk orders which potentially further increases the storage requirements.

Problems have been encountered with the use of Biodiesel particularly on smaller boiler type through blocking up of jets to the burners with combustion products, normally glycerine (sugars within the rapeseed oil). Biodiesel is better suited to larger output boilers where the jet burner orifices are larger and less prone to clogging.

8.6.2 **Summary Table**

Biofuel Boilers	
Consideration	*Comment*
Energy Generated	Full heating duty delivered.
Payback	Payback not applicable. Similar if not higher fuel costs.
Can Heat / Electricity be Exported	Not Applicable. Unit would be sized to maximum heating demand and only run and modulate to the required heating load.
Land Use	External Bulk Fuel Storage Required.
Planning Requirements	Air Quality Impact will need to be assessed.
Noise	Minimal.
Grants Available	None. But system may be eligible for Renewable Heat Incentive.
Life Cycle Cost	Full annual maintenance required with full replacement of plant likely after 15 – 20 years years depending on usage.
Specific Considerations	Bulk Storage Location and proximity to plant room and delivery point.
System appropriate for this scheme	No. The restricted site has limited spaces suitable for bulk fuel storage and would not be adjacent to the main plant area or be easily accessible for deliveries.
Under Consideration / Not Under Consideration	Not Under Consideration

8.7 SUSTAINABLE DRAINAGE

8.7.1 There are a number of roof constructions that can be implemented to control and manage rainwater run off and discharge rates into the local surface water drainage system. The benefit of this is by reducing the outflow from a site the likelihood of overloading the system is reduced and minimises the risk of flooding.

The main forms of roof construction are :-

Green Roof

A green roof or living roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It may also include additional layers such as a root barrier and drainage and irrigation systems. Container gardens on roofs, where plants are maintained in pots, are not generally considered to be true green roofs, although this is debated.
Green roofs serve several purposes for a building, such as absorbing rainwater, providing insulation, creating a habitat for wildlife, and helping to lower urban air temperatures and mitigate the heat island effect. There are two types of green roofs: intensive roofs, which are thicker and can support a wider variety of plants but are heavier and require more maintenance, and extensive roofs, which are covered in a light layer of vegetation and are lighter than an intensive green roof.

Brown Roof

Industrial brownfield sites can be valuable ecosystems, supporting rare species of plants, animals and invertebrates. Increasingly in demand for redevelopment, these habitats are under threat. "Brown roofs", also known as "biodiverse roofs can partly mitigate this loss of habitat by covering the flat roofs of new developments with a layer of locally sourced material. Construction techniques for brown roofs are typically similar to those used to create flat green roofs, the main difference being the choice of growing medium (usually locally sourced rubble, gravel, soil, etc...) to meet a specific biodiversity objective. The original idea was to allow the roofs to self-colonise with plants, but they are sometimes seeded to increase their biodiversity potential in the short term.

Blue Roof

A blue roof is a roof design that is explicitly intended to store rainfall. Blue roofs can provide a number of benefits depending on design. These benefits include temporary storage of rainfall to mitigate runoff impacts, storage for reuse such as irrigation or cooling water makeup, or recreational opportunities. Blue roofs can include open water surfaces, storage within or beneath a porous media or modular surface, or below a raised decking surface or cover. Blue roofs that are used for temporary rooftop storage can be classified as "active" or "passive" depending on the types of control devices used to regulate drainage of water from the roof.

8.7.2 On this development it is proposed that a Blue Roof will being considered to minimise surface water run off and that Green Roof Areas will be consider to the Penthouse Roof Areas only as on the other roof areas it proposed to utilise Photovoltaics (PV) and therefore Green and Brown roofs are not considered appropriate under these areas.

8.7.3 **Summary Table**

Sustainable Drainage / Roof	
Consideration	*Comment*
Energy Generated	Not applicable
Payback	Not applicable
Can Heat / Electricity be Exported	Not applicable
Land Use	Adequate Roof Area required
Planning Requirements	None
Noise	None
Grants Available	None
Life Cycle Cost	No or low maintenance
Specific Considerations	Available Roof area and increase on structure weight
System appropriate for this scheme	Yes. A Blue Roof is to be considered to minimise and control surface water run off. A Green Roof is to be considered to the Penthouse Roof Areas
Under Consideration / Not Under Consideration	Under Consideration

9.0 CLOSING STATEMENT

9.1 Having assessed the available renewable technologies for the site and assessed their suitability the following technologies are proposed for further consideration:-

1) Photovoltaic System (PV)

2) Air Source Heat Pump (ASHP) – To Commercial Premises Only

3) Sustainable Drainage – Blue Roof & Green Roof

Further detailed design will be undertaken to finalise the technologies to be installed and the size of these systems in conjunction with the building design.

9.2 With the Renewable Technologies under consideration and reviewing the energy performance of the building as a whole it is predicted that the building will achieve the following:-

1) Code for Sustainable Home Level 4 (Residential Apartments)

2) BREEAM Excellent (Commercial and Communal Areas)

9.3 The building will be fully compliant with Building Regulations Approved Documents L1A 2010 (Domestic) and L2A 2010 (Non Domestic) and go beyond these benchmark targets with a further 25% reduction in Carbon Emissions in line with the London Plan, LDF Core Strategy Policy CS15 and Camden Planning Guidance Document CPG 3.

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