Energy Statement

29-35 Farringdon Road, London, EC1M 3JF

Prepared by

FHP ESS
Engineering Services Solutions

On behalf of

Paul Heyworth of Malcolm Hollis

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EXECUTIVE SUMMARY

i. This Energy Statement has been prepared on behalf of Malcolm Hollis for the proposed scheme at 29-35 Farringdon Road, London, EC1M 3JF, in support of a full planning application.

ii. The site is located within the London Borough of Camden. Camden is north of central London and just South East of the start of the M1 Motorway.

iii. This document demonstrates how the development will achieve the London Borough of Camden's requirements of meeting the specific CO_2 reduction in order to achieve the London Plan targets. The targets relate to the London Plan policy 5.2. This policy requires a 35% reduction in CO_2 emissions from the 2013 Building Regulations (as from April 2014). Also Camden's policy CS13 includes a target of 20% CO_2 emission reduction by renewable technologies.

iv. This energy statement follows the energy hierarchy: Be Lean, Be Clean, and Be Green, established in the London Plan. A range of low carbon and renewable energy technologies have been assessed in this energy appraisal in order to establish the most suitable energy solution for the site.

v. In line with London Plan policy 5.2 this report shows a significant Dwelling Emissions Rate (DER) over Target Emissions Rate (TER) reduction of 47.2% as a result of the energy efficiency measures specified and Photovoltaic panels. The application of preferred renewable technology (Photovoltaic panels) means that Camden's policy CS13 which requires a 20% reduction in CO_2 emissions due to the specification of renewable is achieved. Using the available flat roof space for 41m^2 of photovoltaic panels a 40.2% carbon reduction is achieved through renewables.

vi. Figure 1 below shows a summary of the CO_2 reductions for the London Plan's sequential stepped approach.

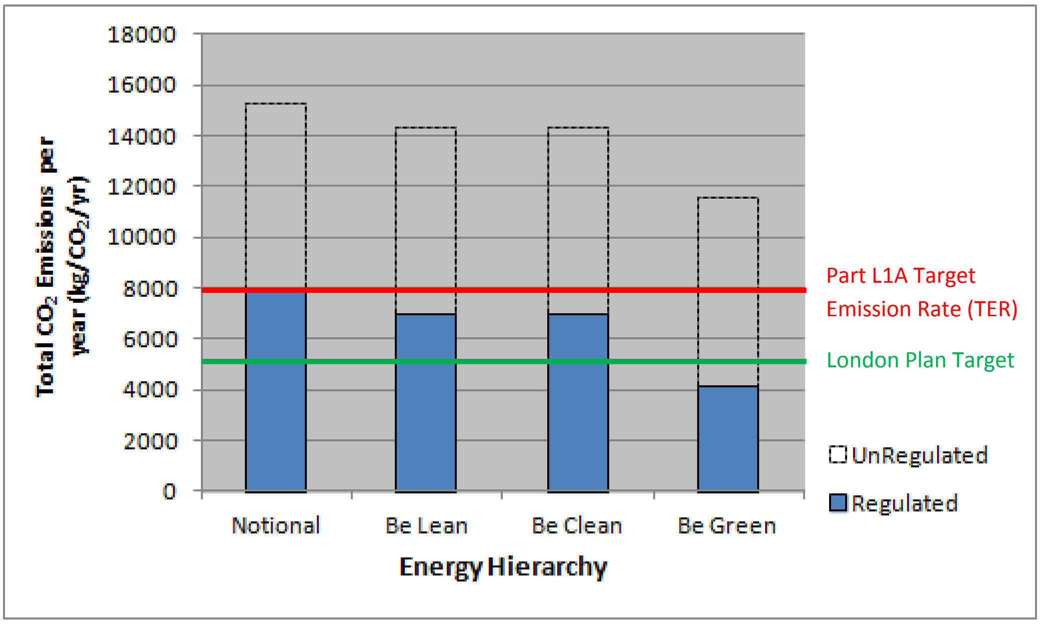

Figure 1 - Energy Hierarchy Results

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1. INTRODUCTION

1.1.1 FHP Engineering Services Solutions Ltd has been appointed by Malcolm Hollis to prepare an energy statement for the proposed scheme at 29-35 Farringdon Road, London, EC1M 3JF, demonstrating how the relevant planning policies will be achieved.

1.1.2 This report firstly assesses the energy efficiency measures of the proposed scheme, and then examines the potential for low carbon options for supplying energy to the development, and then renewable energy technologies to reduce carbon emissions.

2. SITE AND DEVELOPMENT DESCRIPTION

2.1.1 It is proposed to develop 5 no. flats over five storey's from first floor to fifth floor with a total floor area of 410m^2 (excluding stairwell and lift areas).

Figure 2 – Proposed Site Location (©Google Maps)

2.1.2 The Ground floor level includes parking, bike storage and bin store.

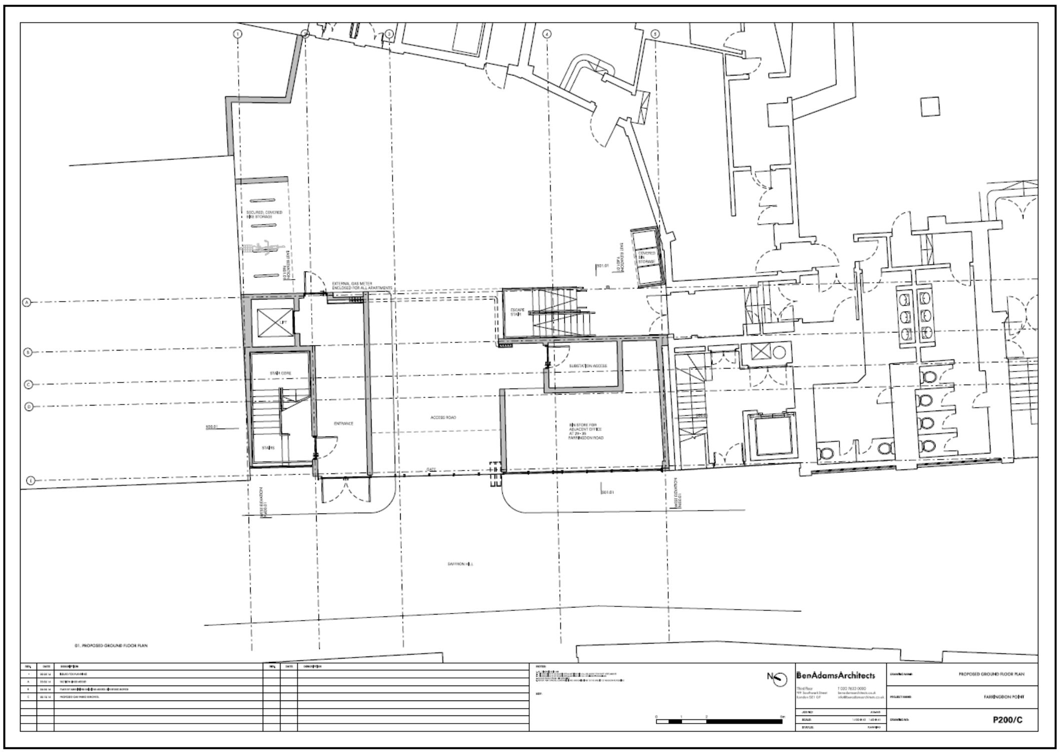

Figure 3 – Proposed Ground Plan (©Ben Adams Architects)

2.1.3 Floors one to four all have two bedroom flats and follow similar layouts.

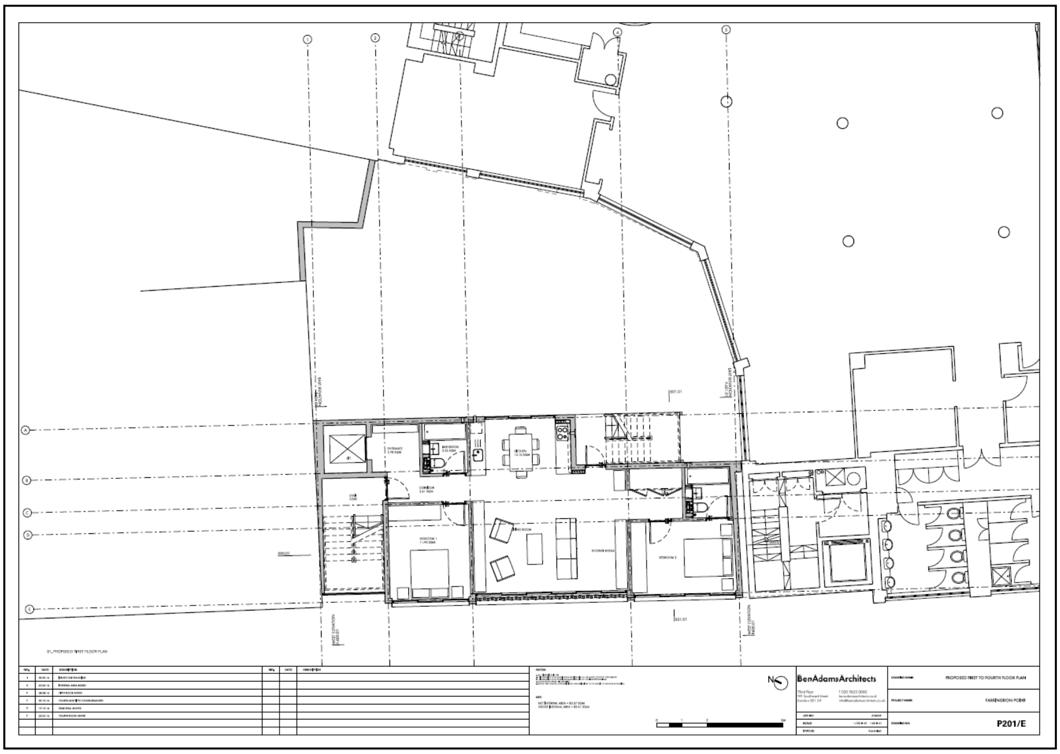

Figure 4 – Proposed First, Second, Third and Fourth Floors (©Ben Adams Architects)

2.1.4 Flat number five is a one bedroom flat on the fifth floor.

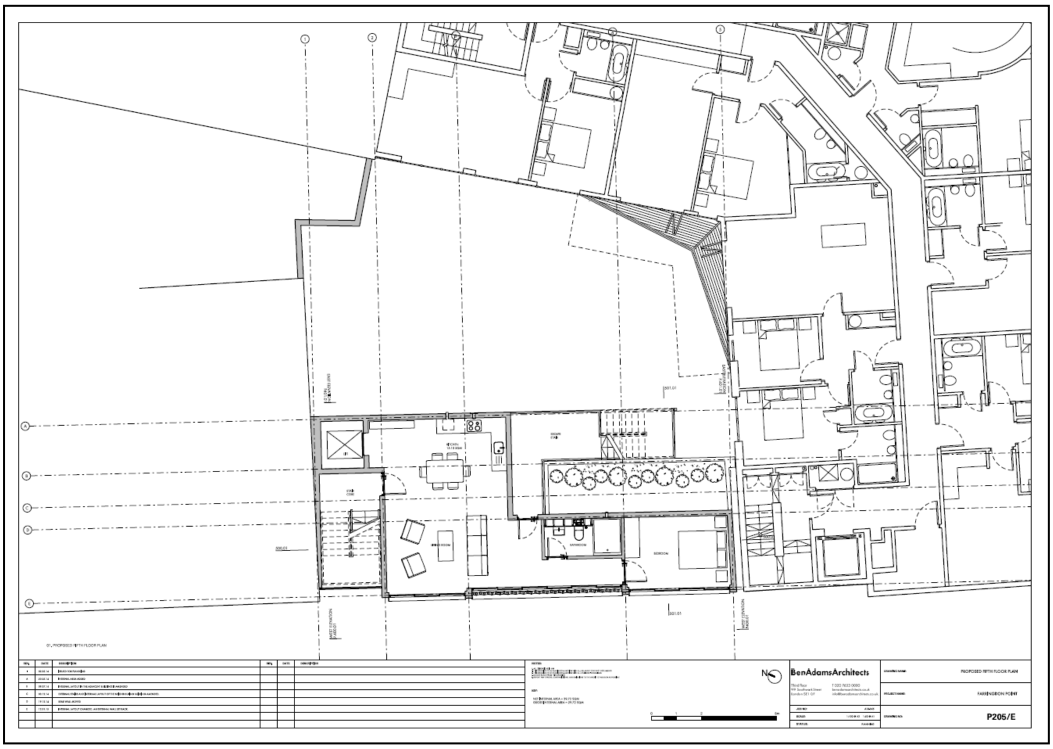

Figure 5 – Proposed Fifth Floor (©Ben Adams Architects)

2.1.5 The flat roof has sufficient space for solar panels.

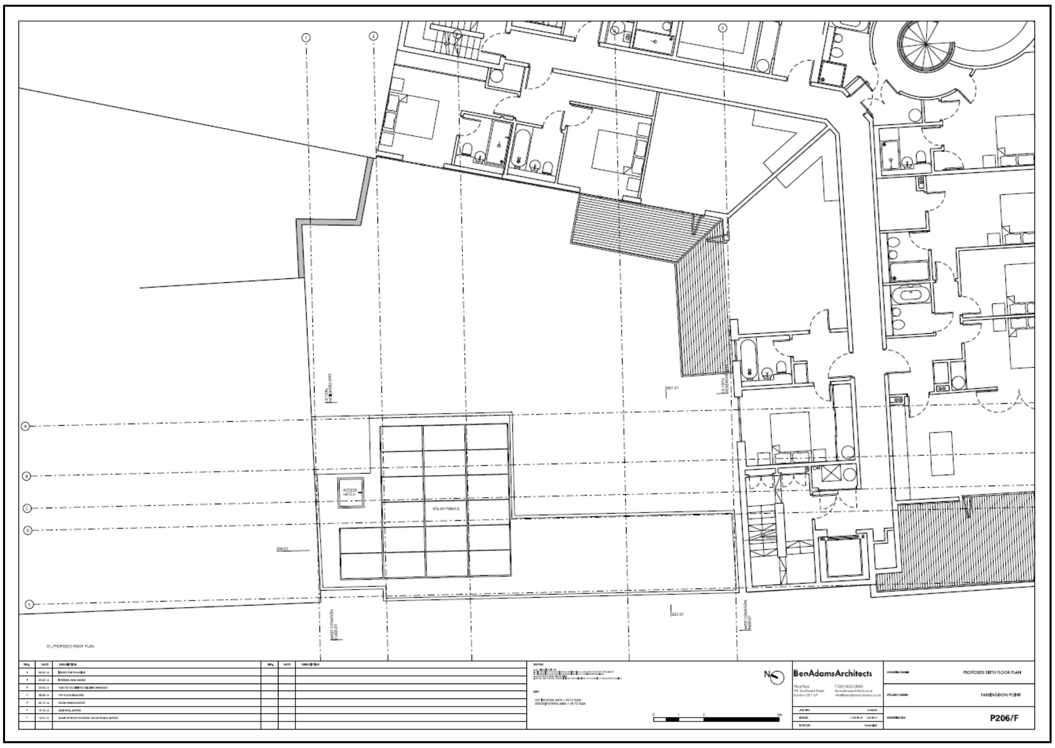

Figure 6 – Proposed Roof (©Ben Adams Architects)

2.1.6 The front elevation faces west onto Saffron Hill.

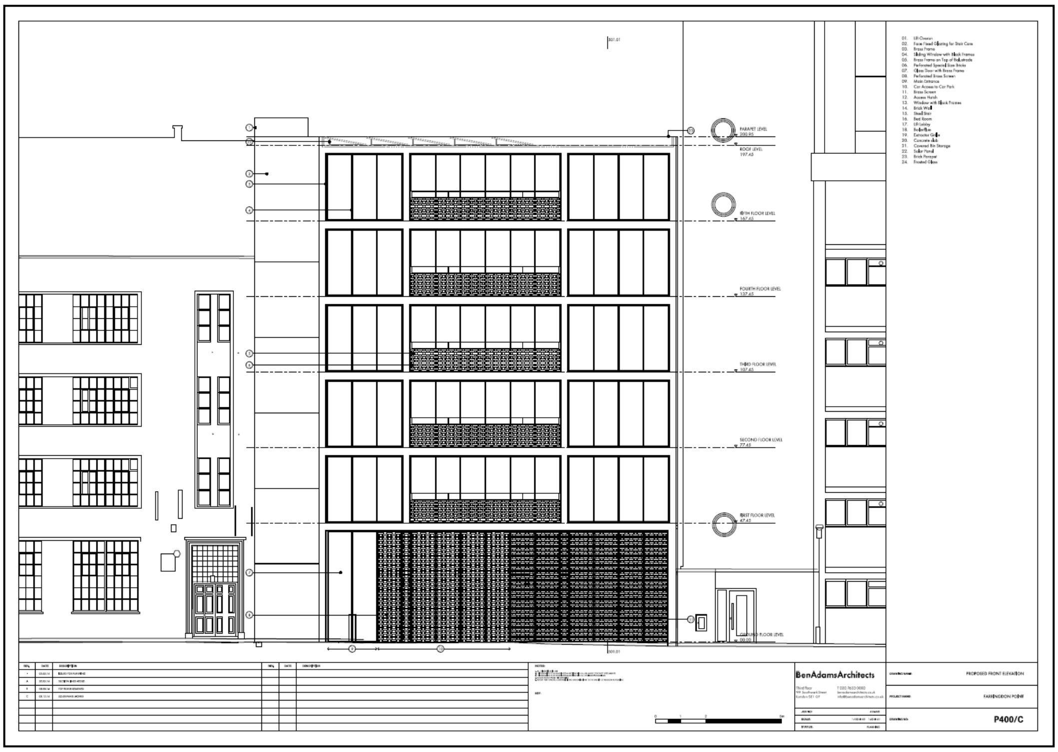

Figure 7 – Proposed Front Elevation (©Ben Adams Architects)

2.1.7 The rear elevation faces east and is enclosed between surrounding buildings.

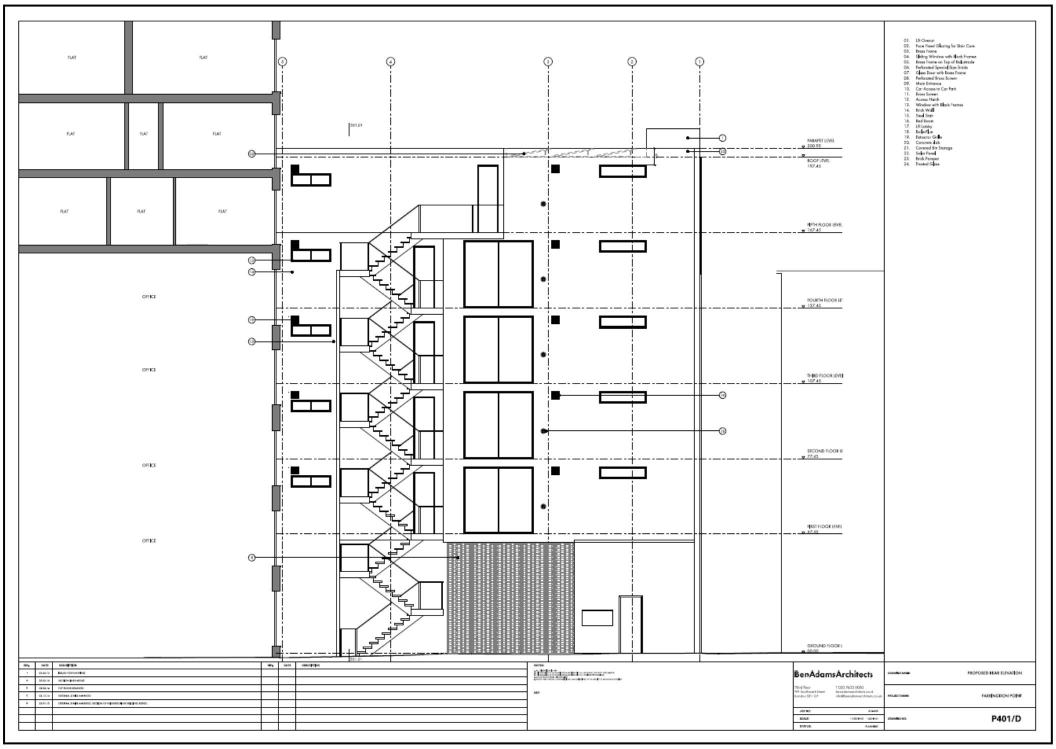

Figure 8 – Proposed Rear Elevation (©Ben Adams Architects)

3. POLICY CONTEXT

3.1.1 Increased development of improvements in energy efficiency is vital to facilitating the delivery of the European, National, Regional and Local commitments on climate change. The relevant policy drivers are as follows:

3.2 European Policy

European Union Energy Performance in Buildings Directive (2002)

3.2.1 The European Parliament passed the Energy Performance in Buildings Directive in December 2002, requiring member states to promote improved energy use in all buildings.

3.2.2 Article 5: requires minimum standards for energy performance and consideration of low/zero-carbon technologies in new buildings. This requirement is to be met through Part L of the 2013 Building Regulations.

3.3 National Policy

3.3.1 Planning Policy Statement notes (PPS's) set out the Government's national land use planning policies for England. The notes, PPS 1 'Delivering Sustainable Development' and the recently published PPS on Planning and Climate Change (supplement to PPS1) are particularly relevant to the development.

PPS1 Delivering Sustainable Development

3.3.2 Promotion of renewables is covered by the following statement: "Development plan policies should seek to minimise the need to consume new resources over the lifetime of the development by making more efficient use or reuse of existing resources, rather than making new demands on the environment; and should seek to promote and encourage, rather than restrict the use of renewable resources (for example, by the development of renewable energy)."

PPS Planning and Climate Change (supplement to PPS1)

3.3.3 Paragraph 20 states that: "Planning Authorities should: expect a proportion of the energy supply of new development to be secured from decentralized and renewable or low-carbon energy sources."

3.3.4 Decentralized is defined as a diverse range of technologies, including micro-renewables, which can locally serve an individual building, development or wider community and includes heating and cooling energy.

3.4 Regional Policy

London Plan

3.4.1 The London Plan (2011) is the Spatial Development Strategy for London. Section 5 of the Plan covers the mitigation of, and adaptation to climate change and the management of natural resources. The London Plan supports the Mayor's Energy Strategy. The key policies regarding energy efficiency are summarised below. Where possible this strategy demonstrated that the principles of policies are applied and where relevant shows how the requirements are achieved or if not achieved gives justification for this.

3.4.2 *Policy 5.2 Minimising Carbon Dioxide Emissions:* Outlines the carbon dioxide emission reduction targets for major development proposals. In accordance with Policy 5.2 both residential and non domestic buildings constructed between the years 2013 – 2016 are required to achieve a 35 per cent improvement over the Target Emission Rate (TER) outlined within the 2013 Building Regulations(as of April 2014).

3.4.3 *Policy 5.3 Sustainable Design and Construction:* Emphasises the requirement for high levels of sustainable design and construction. Proposed developments are required to demonstrate these standards are integral to proposals and considered from the beginning of the design process. For major developments minimum standards are required in the areas of emissions, materials, water consumption, pollution, occupier comfort and ecology.

3.4.4 *Policy 5.5 Decentralised Energy Networks:* The adoption of or connection to a decentralized heating or cooling network should be investigated and adopted if feasible.

3.4.5 *Policy 5.6 Combined Heat and Power (CHP):* All new development proposals should evaluate the feasibility of incorporating combined heat and power systems.

3.4.6 *Policy 5.7 Renewable Energy:* New developments should incorporate renewable energy generation to reduce carbon emissions. Major developments should seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation where feasible.

3.4.7 The methodology employed to determine the potential CO_2 savings for this development, is in accordance with the three step Energy Hierarchy outlined in the London Plan:

- Be Lean - Improve the energy efficiency of the scheme.
- Be Clean - Supply as much of the remaining energy requirement with low-carbon technologies such as combined heat and power (CHP).
- Be Green - Offset a proportion of the remaining carbon dioxide emissions by using low or zero carbon technologies.

3.5 Local Policy

3.5.1 London Borough of Camden supports the implementation of the London Plan with the following requirement: 'In line with Camden's Core Strategy 13 and Chapter 2 Camden's Planning Guidance 3 – Sustainability developments involving 5 or more dwellings and/or 500sqm (gross internal) or more are required to submit an energy statement which demonstrates how carbon dioxide emissions will be reduced in line with the energy hierarchy.'

3.5.2 Paragraph 13.11 of London Borough of Camden's Core Strategy policy CS13 states that developments will be expected to achieve a 20% reduction in carbon dioxide emissions from on-site renewable energy generation unless it can be demonstrated that such provision is not feasible. This requirement matches that of Policy 5.7 - Renewable Energy of the London Plan (2011).

4. METHODOLOGY & CALCULATIONS

4.1 Energy/ Carbon Calculations

4.1.1 The Building Regulations determine compliance for both domestic and non-domestic buildings by comparing the CO_2 emissions of the actual building with a notional building. Carbon emissions from both the notional and actual building are determined based upon the 'National Calculation Methodology' and based upon a building of the same geometry and orientation (although how the services are determined varies between dwellings and non-dwellings). The notional building is used to determine a 'Target Emission Rate' or 'TER'. For a dwelling the actual building's performance is used to determine a 'Dwelling Emission Rate' or 'DER'. For non-domestic buildings the actual building's performance determines a 'Building Emission Rate' or 'BER'. To achieve Part L Building Regulations compliance the DER/BER must be equal to or less than the TER.

4.1.2 In accordance with the London Plan, 2011 the baseline for the calculations will be based on a 2013 Building Regulations compliant development. The development at 29-35 Farringdon Road has been modelled with a SAP 2012 approved software to determine the energy and carbon data for heating, hot-water, lighting and fans and pumps to establish the 2013 Building Regulations 'TER' baseline. The outputs of the SAP Calculations are attached in Appendix A of this report.

4.1.3 The predicted unregulated energy, use and associated CO_2 emissions from appliances and cooking have also been determined in the SAP calculations

4.2 Energy Hierarchy

4.2.1 The 'Energy Hierarchy' as detailed by the London Plan, 2011 and supported by the London Borough of Camden's requirements, outlines a series of sequential steps that should be assessed in order for all new development proposals. Within the framework of the Energy Hierarchy the following opportunities will be explored and their feasibility assessed concluding in a final recommendation for how the development at 29-35 Farringdon Road will meet the energy requirements of the London Plan.

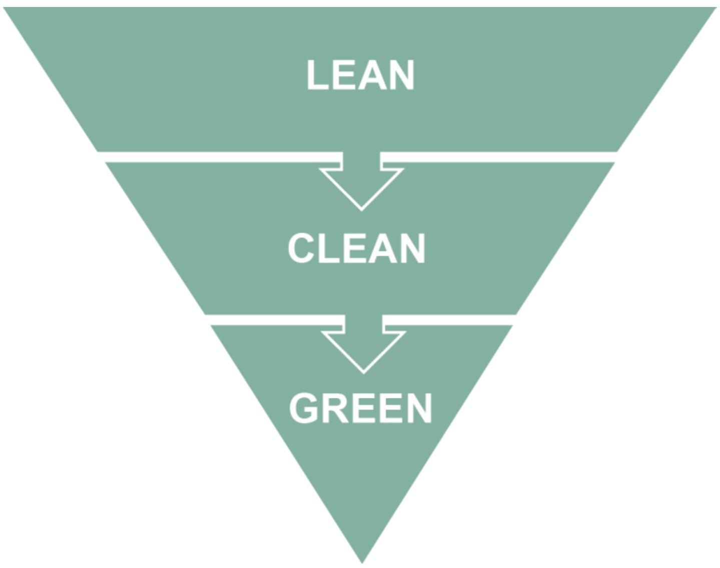

Figure 9 – Energy Hierarchy

Be Lean: Use Less Energy

4.2.2 The energy demand of the proposed development will be reduced by improving the building fabric performance, through the incorporation of energy efficiency measures and through the use of efficient building services and controls. From the Notional Baseline, a new energy demand and carbon baseline is calculated, which will be referred to as the Efficient Baseline.

Be Clean: Supply Energy Efficiently

4.2.3 Opportunities for linking into an existing or planned decentralised energy network will be explored using the London Heat Map tool. Where an existing decentralised energy network is not present, the feasibility of establishing a decentralised energy system for the proposed development will be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system. The inclusion of decentralised energy can reduce the Efficient Baseline further and it is to be referred to as the Low Carbon Baseline.

Be Green: Use Renewable Energy

4.2.4 A percentage reduction in the carbon emissions of the proposed development will be achieved through the use of onsite renewable energy generation. A feasibility study will be undertaken and the most economically viable renewable technology providing the highest overall reduction in carbon dioxide emissions within the proposed development will be recommended.

5. *SITE ENERGY DEMAND & NOTIONAL BASELINE*

5.1.1 The energy and carbon data for heating and hot-water demand, cooling, lighting and fans and pumps for the development at 29-35 Farringdon Road has been calculated with the preferred approach. In addition, the predicated unregulated carbon emissions associated with appliances and cooking have also been calculated.

5.1.2 Table 1 provides a breakdown of the Notional carbon emissions baselines for 29-35 Farringdon Road calculated using SAP 2012. The outputs of the SAP Calculations are attached in Appendix A of this report. The Notional Baseline is shown graphically in Figure 10 below.

Notional Baseline	
Regulated Carbon Emissions KgCO2/yr	**7,896**
Un-Reg Energy KgCO2/yr	7,362
Whole Carbon Emissions (Including Un-reg) KgCO2/yr	15,258

Table 1 – Notional Baseline

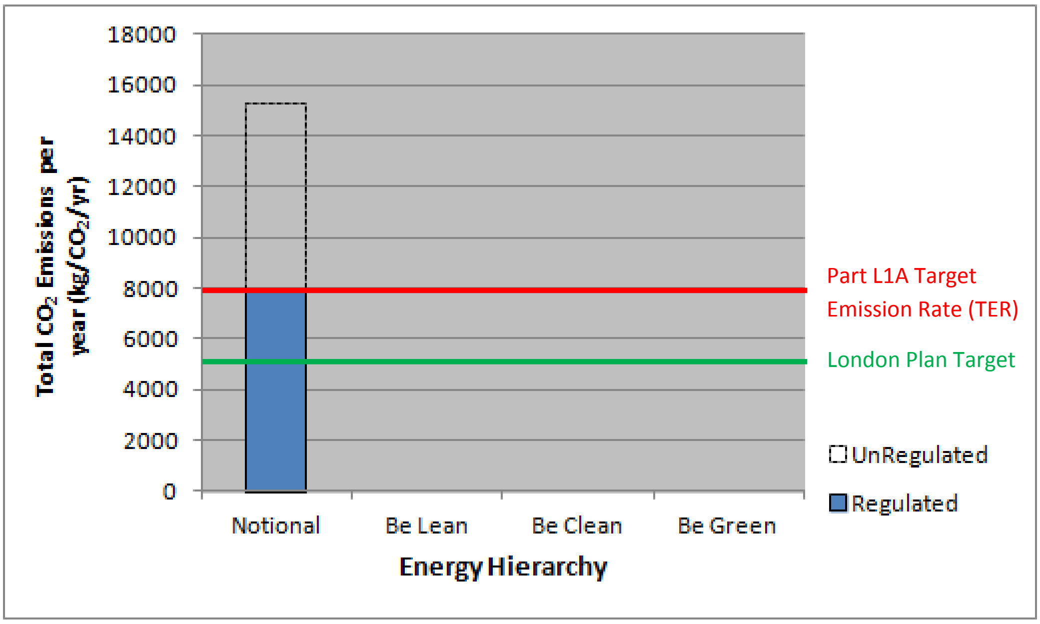

Figure 10 - Energy Hierarchy - Notional

6. *BE LEAN - ENERGY EFFICIENCY MEASURES*

6.1.1 The development will be designed and constructed to reduce energy demand and carbon dioxide emissions. The objective is to reduce the energy demand to an economic minimum by making investment in the parts of the building that have the greatest impact on energy demand and are the most difficult and costly to change in the future, namely the building fabric. Once a cost effective structure has been designed, renewable and/or low carbon technologies will be considered for installation to provide heat, cooling and electricity.

6.2 Building Envelope

6.2.1 Building fabric thermal transmittance is measured by the U-value of each building element in Watts/m²/K. The U-value describes how well a building element conducts heat. It measures the rate of heat transfer through a building element over a given area, under standardized conditions: the lower the U-value, the lower the rate of heat loss. This is beneficial for minimising heating load but very low U values can have the effect of increasing the cooling load of the building. The U-values that have been used to achieve an improvement over the Notional Baseline to the Efficient Baseline are shown in Table 2 below.

6.3 Air-Tightness

6.3.1 Air movements into and out of a building can be divided into ventilation and infiltration. Ventilation is the designed movement of air either via windows and openings (natural ventilation) or via fans and ducting (mechanical ventilation) and is a prerequisite in maintaining occupant comfort and for compliance with Part F of the building Regulations. Infiltration is the unwanted movement of air through cracks/gaps or other pathways in the building fabric and can be responsible for significant energy losses as heated (or cooled) air is lost to the external environment. Air permeability is a measure of infiltration. It indicates how often the entire air quantity in a building is exchanged with outside air within 1 hour without any ventilation in place. Any air exchange with outside air is carrying heat energy away from the building, resulting in a higher heating load or conversely a lower cooling load. Lower air permeability levels are desirable for conserving heat energy.

6.3.2 The air permeability of the proposed development has been assumed to be $3m^3/m^2$@50PA/hr for all areas. This level has been assumed as it is significantly better than the minimum requirements of the Building Regulations yet it is not so onerous as to be unachievable without excessive extra burden being placed upon the contractor.

6.3.3 The development will utilise a Mechanical Ventilation with Heat Recovery (MVHR) system. The MVHR system will recover waste heat extracted from wet rooms and kitchens to preheat incoming fresh air being supplied to the living areas and bedrooms.

6.4 Thermal Bridging

6.4.1 Thermal bridging of junctions is the loss of heat energy through the junction between different building elements (such as a wall and window) or where a building element changes direction (such as a corner). Such areas can result in breaks in the continuity of insulation that can form ‘bridges’ for heat energy to escape from the building.

6.4.2 To minimise the effects of thermal bridging at the 29-35 Farringdon Road scheme, we propose the use of *‘Accredited Construction Details’* on all junctions.

6.5 Overheating

6.5.1 The possibility of summertime overheating is deemed low as the development is located within a large urban area with shading provided from neighboring buildings and also the South facade is enclosed.

6.6 Heating and Hot Water

6.6.1 Controls will be fitted to heating systems with individual timer controls, optimum start and temperature set back. Individual rooms will have the ability to be set at different temperatures according to use.

6.6.2 Heat losses through the hot water distribution system can be major sources of energy loss. As such the hot water distribution system will be designed to minimise energy losses through the use of highly insulated pipes and intelligent design of the distribution system to minimise the circuit length.

6.7 Lighting and Appliances

6.7.1 The design team have committed to meeting the minimum low energy lighting requirements outlined in SAP and will specify 100% low energy space lighting.

6.8 Input Parameters

6.8.1 The below table is a summary of the Minimum Standards of Part L compared with the proposed standards to be incorporated into the development at 29-35 Farringdon Road which will contribute to the CO_2 reduction savings through energy efficiency improvements over the Notional Baseline.

Building Element/ Characteristic	Building Regulation Part L1A Minimum Standard	Proposed Standard
External Wall U-Value	0.35	0.15
Ground Floor U-Value	0.25	0.15
Roof U-Value	0.25	0.13
Windows U-Values	2.2	1.3
Doors U-Values	2.2	1.0
Building Reg. 2013 Accredited construction details	No	Yes
Air Permeability	10	3

Table 2 - Minimum and Proposed Standards

6.9 Energy and CO2 Reductions

6.9.1 The predicted CO_2 reduction delivered through the efficiency measures equates to 926 kg/CO2/yr, which is an 11.7% reduction from the TER as a result of these efficiency measures. The improvement is illustrated in Figure 11 below. Please note this reduction is measured from the Part L1A Notional Baseline and is across the ‘Regulated Carbon Emissions’ baseline (DER over TER) and does not include unregulated energy use. This is the first step towards achieving the 35% DER over TER reduction required under London Plan policy 5.2 compliance.

Efficient Baseline	
Space Heating Energy kWh/yr	14,901
DHW Energy kWh/yr	9,831
Cooling kWh/yr	0
Electrical Energy kWh/yr	3,142
Regulated Carbon Emissions KgCO2/yr	**6,971**
Un-Reg Energy kWh/yr	7,362
Whole Carbon Emissions (Including Un-reg) KgCO2/yr	14,332
% Energy Eff. Improvement over Notional Baseline	**11.7%**

Table 3 - Efficient Baseline

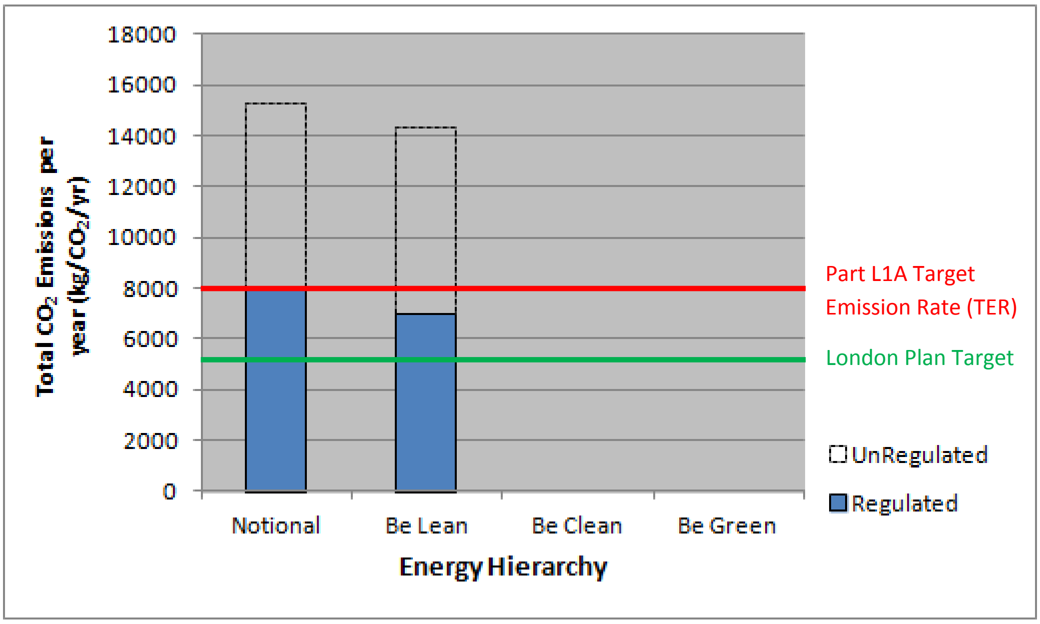

Figure 11 - Energy Hierarchy - Be Lean

7. *BE CLEAN - COMBINED HEAT AND POWER (CHP)*

7.1.1 Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The London Plan and the London Borough of Camden's guidance requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network using the London Heat Map tool.

7.1.2 The feasibility of connecting to an existing network and specification of a Combined Heat and Power system has been assessed within the following sections.

7.2 *Decentralised Energy Networks*

7.2.1 The London Heat Map tool is operated by the London development agency, and details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks. The London Heat Map was consulted during the writing of this report. The output from the London Heat Map with the location of the proposed development can be found below:

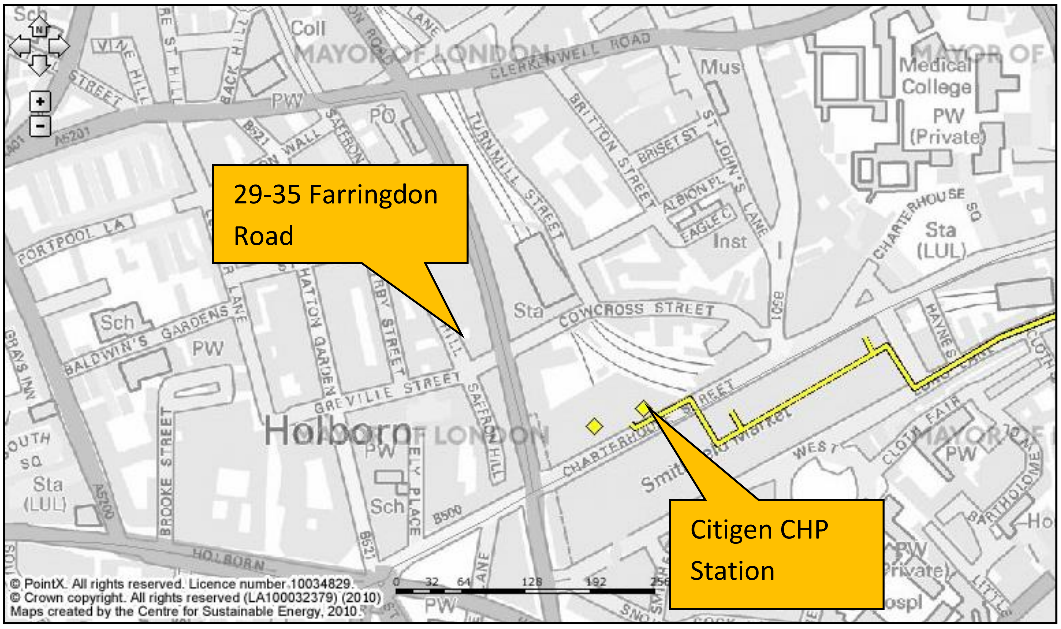

Figure 12 - London Heat Map Indicating CHP Sites and District Heat Networks

<u>Application to Site – Not Suitable</u>

Feasibility

7.2.2 Investigation into existing heat networks in the area using the London Heat Map has shown that the nearest existing CHP installation is located at the Citigen CHP Station. The site is within approximately 750m from the application site. Consideration has been given to connecting to the existing CHP installation; however, given the proposed high levels of building fabric performance being targeted and resulting low space heating and hot water demands the development would not have the sufficient heat load to be technically feasible to connect to the CHP network. Moreover, it has also been determined that connection to the facility is not feasible due the distance between the sites (see Figure 12 above). The cost involved in infrastructure works would be extremely high and would include not only the cost of digging the roads and laying pipes but would be very disruptive to the local area in terms of road closures.

7.3 Site-wide CHP

7.3.1 Combined Heat and Power (CHP) is the simultaneous generation of both electricity and heat in the same process. The CHP process can be applied to both renewable and fossil fuels. Sizing a CHP system is a complex undertaking and is highly dependent upon a developments heat usage profile. Typically a CHP system would be sized to the base heat load (the heat load present all year round) in order to maximise the running time, and therefore the efficiency of the system.

Application to Site – Not Suitable

Feasibility

7.3.2 Due to the improved level of building fabric performance being targeted the space heating demand and hot water demand for the development has resulted in low to moderate heating loads.

7.3.3 After assessment for suitability to the site and calculations to determine energy and CO_2 reductions it has been determined that high efficiency, gas combination boilers for space heating and hot water provision is the most viable alternative to CHP on the site.

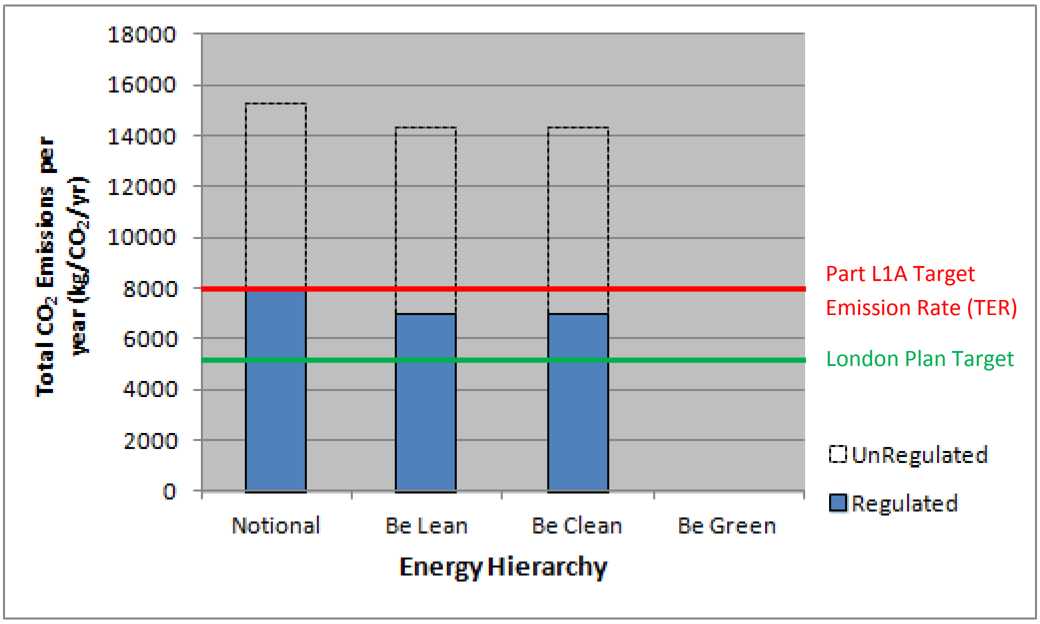

Figure 13 - Energy Hierarchy - Be Clean

8. BE GREEN - RENEWABLE ENERGY TECHNOLOGY

8.1.1 The third stage of the energy hierarchy refers to the production of renewable energy, which relates to London Borough of Camden and London Plan policies.

8.1.2 Each of the approved renewable energy technologies have been appraised, examining the size and cost of each system required to maximise CO_2 reductions. The feasibility of each technology at the proposed site is also discussed in the following sections in order to determine the most suitable solution for the site.

London Plan approved renewable energy technologies include:

- Wind
- Photovoltaics
- Solar Water systems
- Biomass Heating / Biomass CHP
- Ground Sourced Heating / Cooling

8.1.3 The choice of technology will be dependent upon a range of factors including: orientation, height, window size, surrounding buildings and environment, site size and layout, geology, conservation and biodiversity.

8.1.4 London Plan Policy 5.7 and London Borough of Camden's policy requirements are for a 20% reduction in CO_2 emissions where feasible due to the specification of renewables. This target has been meet, with a 40.2% reduction been achieved through the use of the Photovoltaic panels.

8.2 Solar Photovoltaic (PV)

8.2.1 Photovoltaic systems convert solar energy directly into electricity through semiconductor cells. The panels generate electricity from both direct light and diffuse light. Photovoltaic panels can either be mounted external to the building or be integrated into the building cladding (known as Building Integrated Photovoltaic or BIPV).

Application to Site – Suitable

Feasibility

8.2.2 PV panels are the most feasible option for this site, offering the greatest CO_2 reduction in the space available.

Energy and CO_2 Reduction

8.2.3 It has been determined that with a total of $41m^2$ of high efficiency monocrystalline PV panels at 29-35 Farringdon Road the electricity consumption of the development has been offset by a total of 5,398 kWh/yr, hence lowering the carbon emissions of the development by 2,801 $kgCO_2$/year from the Efficient baseline (Figure 14). This is a 40.2% CO_2 reduction over the Energy Efficient baseline. In turn, this contributes to a 47.2% reduction of the Dwelling Emissions Rate (DER) over Target Emissions Rate (TER) through both energy efficiency and renewable therefore meeting the London Plan 5.2 policy.

8.2.4 Using the available roof space, The London Plan Policy 5.7 requirement for a 20% reduction in CO_2 emissions through the specification of renewable has been met and exceeded. The 2,801 $kgCO_2$/year savings from the Photovoltaic panels achieves a 40.2% carbon reduction from the Efficient Baseline and a total 'whole energy' CO_2 percentage reduction from the Whole Carbon Emissions Baseline of 19.5%.

Green Baseline	
Space Heating Energy kWh/yr	14,901
DHW Energy kWh/yr	9,831
Cooling kWh/yr	0
Electrical Energy kWh/yr	3,142
PV Offset KgCO2/yr	-2,801
Regulated Carbon Emissions KgCO2/yr	**4,169**
% Improvement over Notional Baseline	**47.2%**
Un-Reg Energy kWh/yr	7,362
Whole Carbon Emissions (Including Un-reg) KgCO2/yr	11,530
% Renewable Contribution over EE Building	**40.2%**

Table 4 – Proposed Building Results

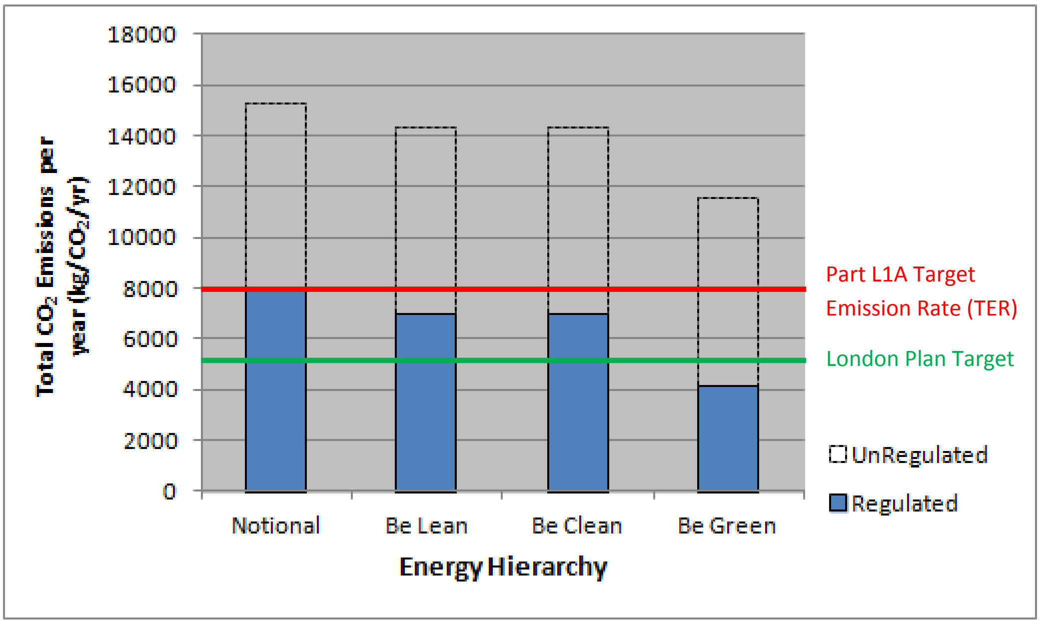

Figure 14 - Proposed Building Results

Plant Selection

8.2.5 Careful consideration has been given to maximising the use of PV onsite to both provide affordable renewable energy to the site and to meet the London Plan and the London Borough of Camden's policy targets.

8.2.6 Efforts have been made to ensure the visual impact of PVs is minimised, and to ensure the appropriate placement for optimal orientation and functionality of the panels. Figure 15 below indicates the areas of roof that will carry PV.

8.2.7 Review of the roof has shown that it has sufficient space and is suitable for efficient placement and operation of the PV array.

8.2.8 The modelled PV system consists of 25no. high efficiency monocrystalline 250Wp PV panels with an efficiency of 15.2%. This equates to a total PV system size of 6.25kWp. Specification of the type of PV panels to be used is attached in Appendix B of this report.

Plant Location / Land Use

8.2.9 Orientation and layout of the PV panels on the available roof space has been carefully investigated, and the number of PV panels has been maximised to make the best possible use of the space. As there is a flat roof, the panels will be place on A-Frames and an optimum South orientation can be used for PV array allocation. As all panels will be situated on the roof of the building, there is no additional land use associated with this technology.

8.2.10 The modules should be tilted at an optimum angle of 30° in order to capture the maximum amount of solar energy. The minimum tilt angle is 10°, any less and the modules will not self clean, invalidating their warranty.

8.2.11 The modules will also need to be spaced appropriately to avoid over shading on neighbouring modules and to provide a walkway for safe installation and access. The final layout is subject to specialist sub contractor design.

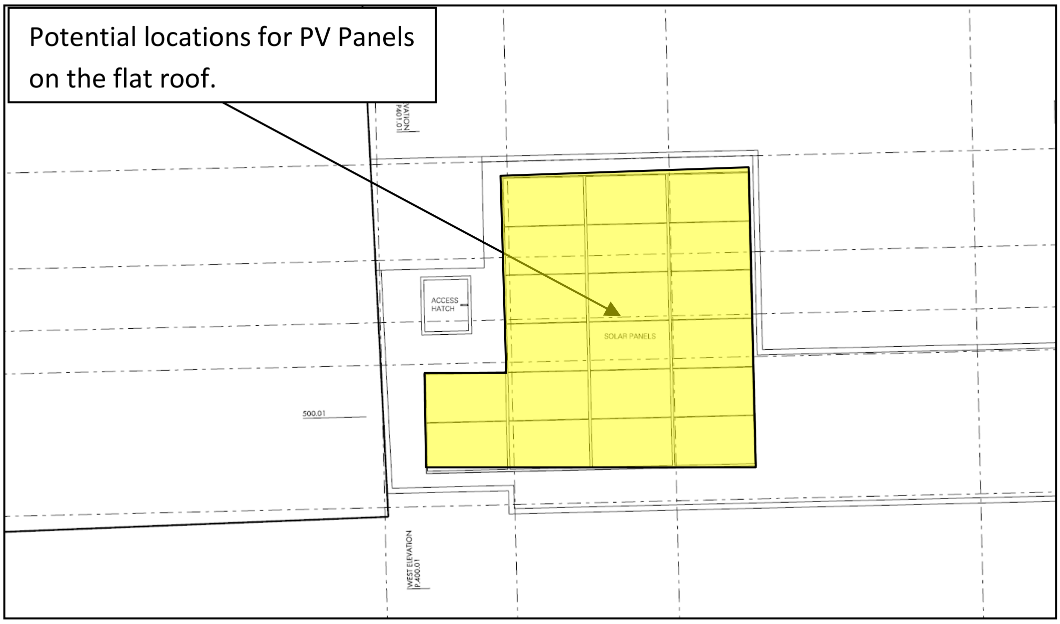

Figure 15 – Potential location of PV panels

Backup Systems

8.2.12 Backup systems are not required as minimal maintenance is required to the PV panels and ancillary equipment. Should a total system failure occur, the grid will maintain the electrical supply.

Ancillary Equipment

8.2.13 PV systems require an inverter which converts the low voltage direct current electricity produced by the array of panels into 240V 50/60Hz alternating current. Inverters will be housed inside the plant room/ electrical services cupboards.

8.2.14 Please also note that it is a legal requirement to use an Ofgem approved meter in order to collect revenue from the meter readings displayed or transmitted to a data collection system. In addition, for electricity supplies to new customers by a licensed supplier, an Ofgem approved and certified meter must be used.

8.2.15 All ancillary equipment will be sited to ensure ease of access for maintenance or repair.

8.2.16 Please note these arrangements are subject to change as the design progresses and will be finalised once a specialist contractor produces detailed designs at the detailed design stage.

Plant Maintenance

8.2.17 PV systems require minimal maintenance, as long as the panels are installed at or above the recommended angle they will self clean, there are no regular maintenance requirements for PV panels or the inverters. If panels are positioned at 30 degrees they will self clean, and monitoring of the system output will identify any panel problems or failures (monitoring can be remote/web based).

8.2.18 Inverters would be expected to be replaced after 12-13 years (we are working on a 20 year life based on feed in tariff incomes but PV panels will continue to provide output for up to 40 years (at a reduced level as output degrades over time)).

8.2.19 Inspection of the mechanical fixings to ensure that panels have not come loose due to fixings corroding etc will be required but does not require a specialist to undertake this and could be absorbed into the building inspection/maintenance programme.

Additional Information

Noise / Disturbance Impact

8.2.20 Due to the nature of this technology there will be no noise disturbance to occupants or neighbours caused by PV panels. Manufacturer's information for inverters indicates operational noise levels of 33dB if installed correctly, that will ensure no noise disturbance to occupants or neighbours.

Capital and Life Cycle Costs

8.2.21 The total capital cost of the PV panels, inverters, installation, miscellaneous electrical components etc, can be estimated once detailed designs have been prepared and quotes should be obtained from PV suppliers/installers for accurate system costs. An indicative cost at current market rates is approximately £2,000 per kWp installed(excluding A-Frames). This would mean an indicative capital cost of £12,500.

Exporting Electricity and Feed in Tariff (FiT)

8.2.22 The annual income that can be generated by the PV panels includes a Feed-In Tariff (FIT) generation tariff rate of 13.03p/kWh (current at time of writing). Tariffs will be linked to the Retail Price Index (RPI) which ensures that each year they follow the rate of inflation. The rate payable is set at the year of entering the FIT and the entrance rate will reduce annually. The Feed-In Tariff is payable for 20 years.

8.2.23 In addition to the generation tariff a micro generation export rate of 4.77p/kWh(current at time of writing) for the electricity exported to the grid, this rate is payable by the electricity provider and will also be RPI linked. The electricity export rate is collected from electricity utility provider.

8.2.24 All electrically used on site will offset having to buy off the grid at an approximate rate of 13.5p/kWh (current at time of writing).

8.2.25 A payback period calculation and profit forecast has been carried with the outputs attached in Appendix C of this report. The calculation is based on 50% of the electricity generated being used on site with 50% exported to the grid.

This results shows a payback period of 9 years and 4 months based on an approximate capital coat of £12,500. The results also show a profit forecast of £18,381 over the 20 year lifespan of the Feed in Tariff, however the PV array will continue to generate electricity past this date resulting in further savings and further income from the electricity offset and electricity exported to the grid respectively.

Carbon Life Cycle Costs

8.2.26 PV panels and inverters have relatively high embodied energy, but studies show that appropriately sited systems will recuperate their embodied carbon within a few years.

Other Appraised Technologies

8.3 Solar Thermal

8.3.1 Solar Thermal hot water heating systems harvest energy from the sun to heat water. The solar heating collectors are generally positioned on the roof of a building, they can also be wall mounted, although with reduced efficiency. A fluid within the panels, heats up by absorbing solar radiation. The fluid is then used to heat up new water which is stored in a separate water cylinder.

8.3.2 As an alternative to PVs, implementing Solar Water Heating (SWH) can deliver carbon saving to new hot water generation for space heating as well as for new hot water production.

Application to Site – Feasible - not optimal

Feasibility

8.3.3 Solar thermal provides hot water as all or a proportion of the base load hot water demand. Solar thermal would therefore be offsetting the energy supplied by gas boilers which has much lower carbon intensity than electricity and as such the carbon reductions available for this technology are much lower than for PV which is availing of all the available roof space. Therefore solar thermal water heating option is a feasible solution for the development at 29-35 Farringdon Road but due to carbon reduction targets is not the optimal solution as PV panels has been selected ahead of it for the available roof space.

8.4 Wind Turbines

8.4.1 Wind is one of the most cost-effective methods of generating renewable electricity. However wind is more suited to low density areas where there is more space necessary for maintenance, less turbulent wind patterns, and they are less likely to be the cause of noise and vibration to nearby properties. High density areas are not ideal with current wind turbine technology.

Application to Site – Not Feasible

Feasibility

8.4.2 Modelling indicates wind turbines at this site will not able to achieve the significant level of carbon emission reductions.

8.4.3 Installation of wind turbines are neither feasible or suitable for 29-35 Farringdon Road, there are a number of concerns with wind turbines in an urban environment including; visual impact, noise, cost, maintenance, space, as well as mechanical loading implications for installation of turbines 'on building'. Although calculations for the modelled systems indicate that wind systems contribute to carbon reductions, it must be noted that under dense urban environments the energy outputs generated by wind turbines can be quite unpredictable. This is mainly due to the neighbouring buildings acting as obstructions causing turbulence to the incoming wind flow. The site would need to be evaluated appropriately (over a period of 12 months) using wind speed monitoring & recording devices in order to give an accurate prediction in terms of energy output derived by the real wind speed measurements recorded on site.

8.4.4 In addition to these concerns, the actual energy output of any turbines installed is likely to be much lower than the modelled outputs due to turbulence created in the urban environment. Turbulence can be overcome by installing turbines on minimum 30m high towers but this will exacerbate the concerns/impacts listed above.

8.4.5 The year on year energy output is unpredictable. And in addition, roof structures at 29-35 Farringdon Road would need to be properly assessed in order to determine whether it will be able to withstand the loading on the building caused by the turbines. Therefore, wind turbines have been determined to be unsuitable for the site.

8.5 Biomass Heating

8.5.1 Wood is the most commonly used form of biomass fuel, and can either be burned in solid fuel boilers for central heating applications, or for raising steam for power generation in large installations.

8.5.2 Typically, biomass installations are sized to meet a base heat load with peak load and load variations to be met from gas-fired boilers. Biomass boilers operate most efficiently and are therefore most cost effective when working continuously at full load, they do not respond well to rapidly fluctuating demand. When assessing the feasibility of a biomass installation, storage space and biomass delivery requirements need to be taken into account.

Application to Site – Not Feasible

Feasibility

8.5.3 Although calculations show that a Biomass Boiler operating for no less than 8320 hours (continuous annual operation with downtime allowed for maintenance and repair) could provide a high level of carbon reductions, the main operational concerns are raised in relation to air quality, storage capacity and logistics of parking for delivery of wood pellets/chips etc.

8.5.4 Air quality is a major concern with biomass heating due to NOx (Nitrogen Oxides) and Particulate Matter (PM10) emissions.

8.5.5 The entire London Borough of Camden is designated as an Air Quality Management Area (AQMA), with current technology, biomass boilers or biomass fuelled CHP may negatively impact on air quality which is deemed inappropriate in an Air Quality Management Area unless abatement technology can provide sufficient mitigation.

8.5.6 Biomass systems also require space for storage and delivery of fuel, additionally fuel delivery carries implications for parking, increased emissions and pressure from transport. In the context of the current layout, there is no sufficient space for the biomass storage or plant facility. Therefore, it is determined that biomass heating solution cannot be practically implemented and it is not a suitable renewable energy technology for the site.

8.6 Ground Source Heat Pump (GSHP)

8.6.1 In the UK, soil temperatures stay at a constant temperature of around 11-12°C, throughout the year. Ground source heat pumps take this low temperature energy and concentrate it into more useful, higher temperatures, to provide space heating and water heating. The process is similar to that used in refrigerators. A fluid is circulated through pipes in the ground absorbing the heat from the soil, the fluid is passed through a heat exchanger in the pump which extracts the heat from the fluid and increases it via a compression cycle. This is then used to provide underfloor heating and heat new hot water.

Application to Site – Not Feasible

Feasibility

8.6.2 It has been determined that connection to existing or installation of new Ground Source Heat Pump plant is not a feasible option for the 29-35 Farringdon Road scheme, this is due to the large area required for boreholes exterior to the building. There is a lack of available suitable space for boreholes.

8.6.3 Energy modelling and cost analysis show that installation of a GSHP, is one of the most costly options for this site and would require further detailed analysis of conflicts with existing utilities, ground conditions and soil conductivity before determining whether or not the required levels of carbon savings could be achieved.

8.6.4 Land use, plant space and physical security for the ground collectors and the heat pump units also need to be taken into consideration. For horizontal collector systems, a potentially large area is required for the collector pipework. This area should be free of trees which will cause problems for installation of the pipework. It can be beneath the building but it is most effective in an open area. For borehole or vertical collectors, land requirements are reduced but still significant as the boreholes must be a minimum of five metres apart.

8.6.5 Noise impact of heat pumps is considered to be negligible although concerns have been raised where older systems are poorly maintained and become noisy.

8.6.6 Taking all of these considerations into account, it is judged that GSHP is not a suitable or affordable technology for 29-35 Farringdon Road.

8.7 Renewables Summary

8.7.1 Each of the London Plan approved renewable technologies have been appraised in terms of their suitability for the proposed development at 29-35 Farringdon Road.

8.7.2 The implementation of a PV system has been found to be the most feasible solution for the site.

8.7.3 A solar thermal system is not technically optimal for the site as it could not achieve significant carbon reductions across the site compare to the PV system.

8.7.4 Wind is not a feasible renewable technology for the site, due to space constraints, perceived planning issues and uncertainty surrounding expected energy output, roof loading, height restrictions and conservation sensitivity issues.

8.7.5 A biomass boiler or a biomass fuelled CHP system providing heating, hot-water and electricity has been deemed not to be feasible. This is due to efficiency management and plant space availability issues. Additionally, as the London Borough of Camden is within an Air Quality Management Area, concerns are raised relating to the impact on local air quality. Also due to concerns relating to parking, fuel deliveries and plant room space constraints limiting fuel storage capacity at the site, it was determined that this option cannot be practically implemented.

8.7.6 A Ground Source Heat Pump System is not feasible due to a lack of available suitable space for boreholes and substantial costs associated with implementation of the system.

8.7.7 Figure 14 above provides a summary of the overall carbon reductions and improvement of DER over TER for the modelled technologies.

8.7.8 This strategy also achieves a 47.2% improvement in DER over TER, ensuring that the development meet the criteria the London Plan 5.2 policy targets.

8.7.9 The London Plan 5.7 policy requirement for 20% reduction in CO_2 emissions due to the specification of renewable has been met with the 40.2% reduction, by using all the availability roof space for PV panels.

9. CONCLUSION

9.1.1 Following the energy hierarchy has enabled significant DER over TER percentage improvements and carbon reductions to be calculated for the proposed development at 29-35 Farringdon Road. The total overall carbon reduction is predicted to be 47.2% DER over TER improvement.

9.1.2 In accordance with the London Plan energy hierarchy methodology requirements, 'whole energy' figures have also been used in this energy strategy, including: heating, hot-water, lighting, pumps and fans and un-regulated energy and associated carbon emissions. The proposed development at 29-35 Farringdon Road is calculated to have a 'whole energy' Notional Baseline of 15,528 kgCO2/yr.

9.1.3 In the first stage of the energy hierarchy (Be Lean), calculations to determine the Efficient Baseline predict an 11.7% carbon reduction through the proposed improvements of fabric and service efficiencies over the Notional baseline (Regulated Emissions).

9.1.4 The second stage (Be Clean) calculations to determine the Low Carbon Baseline have shown that specification of CHP is not suitable/ viable for this site. Research found that there connection to the local DHN was not feasible. It was found that while an on-site CHP system many result in better CO_2 reductions compared to high efficiency gas combination boilers, the much higher capital cost of implementing the CHP system did not make it enough of a viable option for the extra CO_2 reductions it may provide. The design team has specified highly efficient gas combination boilers which offer significant carbon reductions and contribute to meeting the London Plan policy and energy hierarchy requirements.

9.1.5 In the final stage of the energy hierarchy (Be Green), calculations have determined Photovoltaic panels to be the most suitable renewable energy technology for the site and contribute to a 47.2% DER over TER improvement.

9.1.6 The London Plan policy 5.7 and Camdens CS13 policy requires a 20% reduction in CO_2 emissions due to the specification of renewables. This target has been met with a 40.2% carbon reduction through the specification of PV panels.