1. RESIDENTIAL ENERGY STRATEGY NOTES

Details of the proposed energy strategy for the residential element of this development are presented below.

The energy strategy includes an enhanced 'fabric led' approach to emission rate reduction combined with efficient servicing and low carbon technologies. Priority is given to achieving the carbon emissions reductions required by the London Borough of Camden and the London Plan by means of on-site measures through the application of the energy hierarchy.

Having initially assessed the feasibility of several low and zero carbon technologies, the overall energy strategy and associated emissions performance of the residential element of the development are discussed.

Low and Zero Carbon Energy Feasibility

The enhanced fabric specification will be supplemented by low and zero carbon technologies as part of the site wide energy strategy to optimise the on-site dwelling emission rate reductions, as sought by the London Plan policy 5.2. To ensure the selection of the most appropriate solution, a number of low and zero carbon energy technologies have been considered for this site, including:

- Solar Hot Water;
- Photovoltaics (PV);
- Wind;
- Ground Source Heat Pumps;
- Air Source Heat Pumps; and
- Biomass heating.

These options are appraised below:

Solar Hot Water utilises the energy in sunlight and diffuse daylight to heat water for use in buildings. The main component of any solar water heating system is the collector, which absorbs the radiant energy of the sun and converts it to heat energy. This technology is not considered to be a feasible option for this site because, although the flat roof space would enable this technology to be mounted and operate efficiently, these solar thermal technologies only make a relatively limited contribution to reducing the building's energy demand and carbon dioxide emissions – insufficient to meet the emissions reduction target.

Photovoltaic (PV) panels harness solar thermal energy and convert it into electricity which can then be used within a building. The panels may be orientated in a southerly direction in shallow mount, tilted arrays upon the flat roof thereby enabling this technology to operate efficiently. This technology is considered to be a feasible option for this site.

Wind Turbines are considered unsuitable for this site due to a poor wind resource. In order to operate efficiently a wind speed of at least 6m/s is typically required. The wind speed database records a wind speed of approximately 4.5m/s at 10m above ground level for this site.

Ground Source Heat Pumps collect low-grade heat from the ground to supply useful heat for space and water heating requirements. By applying additional energy input (in the form of electricity), it is possible to raise the temperature of the source heat to the temperature required. Such technology is considered unsuitable for this site due to an insufficient area (based upon indicative layouts) to install a horizontal ground collector and the prohibitive costs of installing vertical boreholes.

Air Source Heat Pumps collect low-grade heat from the air to supply useful heat for space and water heating requirements. The pumps are capable of effectively being run in reverse to provide space cooling also. They operate in the same way as a ground source heat pump, by applying additional energy input (in the form of electricity), it is possible to raise the temperature of the source heat to the temperature required. Such technology is considered technically feasible for this development and are proposed to provide cooling within the market sale apartments only within this scheme.

Biomass heating would be capable of delivering the target CO_2 emission reductions, but is considered inappropriate for this type of development in such a location due to the need for constant fuel deliveries, maintenance and relatively high levels of nitrogen oxide emissions.

Proposed Low and Zero Carbon Energy Solution

Photovoltaic (PV) arrays are therefore selected as the appropriate low and zero carbon energy technologies to contribute to the CO_2 emission reduction target. These are discussed in more detail below.

Photovoltaic Array –

PV arrays are relatively straightforward to install, benefit from low maintenance costs and will reduce the operational cost of the building. The integration of PV in general would provide the following benefits:

- Reducing the building electrical energy demand;
- Simple installation and commissioning;
- Low maintenance; and
- Reliable, proven technology

Available Roof Area -

The maximum area above the residential accommodation to install PV modules has been calculated as approximately $400m^2$.

Proposed System Details -

It is proposed that PV panels be shallow mounted in arrays tilted at c.10^o and orientated due south in order to optimise the efficiency of the installed system to meet the net carbon dioxide emissions and also the on-site renewable energy provision.

- Approximately 20kWp PV will be installed for the residential element of the scheme connected to the landlord supply.

An array of this capacity may be accommodated within the available roof area without over shading.

PV arrays will be more fully reviewed in the following Energy Demand Calculation section to demonstrate how these may contribute to meeting the zero-carbon target (i.e. 100% dwelling emission rate reduction) for this site.

Land use -

- There are no land use issues associated with PV technology at this site.

Local Planning Issues -

- There are no planning policy issues associated with this technology. PV is covered under permitted development for existing dwellings and encouraged at all tiers of planning policy.

Feed in Tariff and Payback **-**

- This size of array may be eligible to claim the generation tariff, index linked and fixed for 25 years plus the export tariff based upon the metered value of the electricity exported.
- The typical payback period is around 9 years for installations such as this.

Noise Issues -

- PV is silent in operation.

Whole life cost and lifecycle impact -

- Current installed costs for PV are approximately £1,500 / kWp installed.
- Additional costs throughout the system's 30 year lifecycle are limited to:
    - Cleaning of the arrays;
    - Potential vandal damage to the arrays; and,
    - Replacement of the DC / AC inverter unit which typically have a lifespan of around 10 years.
- Energy payback estimates for rooftop PV systems are between 4 to 2 years for systems using current multi-crystalline, silicon PV modules.
- Financial payback is estimated to be around seven years.
- With energy paybacks of 2 to 4 years and assumed life expectancies of 30 years, 87% to 97% of the energy that PV systems generate will be 'clean' zero carbon energy.

Residential Energy Strategy

Build Fabric and Thermal Performance - Residential

A combination of enhanced building fabric specification (significantly beyond the minimum regulatory compliance standard), efficient servicing and controls plus photovoltaic arrays will achieve compliance with the various emission reduction targets stipulated by the London Plan, the London Borough of Camden Local Plan and Building Regulation Part L1A (2013).

The standard measurement of heat transfer through a given building material or construction type is the U-value (W/m^2K). In buildings, heat loss generally occurs through the following areas and elements of the construction:

- Ground Floor;
- External Walls;
- Roofs;
- Doors and windows;
- Thermal (cold) Bridging (heat loss through construction joints); and
- Uncontrolled ventilation.

The lower the U-value, the more slowly heat transfers and is lost out of a building. Table 1.1 presents the proposed material specification that will be incorporated to limit heat loss and ensure efficient operation of the proposed dwellings.

Table 1.1 – Proposed Residential Specification

Item	Specification
Wall	U=0.20 W/m^2K
Party wall	U=0.0 W/m^2K (full fill & seal)
Corridor Wall	U=0.0 W/m^2K (full fill & seal) – heated corridor
Roof	U=0.12 W/m^2K
Windows	U=1.3 W/m^2K
Air Permeability	3.5m^3/hm^2 (@50Pa.)
Ventilation	Natural Ventialtion
Lighting	100% 'Low E'
Thermal Bridge	Measures to limit cold bridging will be applied throughout the design
Space & Water Heating	Communal high efficiency gas fired condensing combination boiler(s)
Cooling	Variable refrigerant flow, split system heat pump (EER 3.8)
Heating Controls	Heat interface unit + charging system linked to use, programmer & 'stat

This material specification and design will provide the following benefits:

- **High performance thermal insulation** (ensuring very low U-values for all heat loss elements);
- **Thermally efficient windows and doors** will minimise heat loss through the main building elements;
- **Very low air tightness of 3.5m^3/hm^2** (@50Pa.) is targeted for this build in order to minimise uncontrolled ventilation. This will reduce heat losses and provide high levels of occupant comfort;
- **Attention to cold bridging junctions** including the provision of insulation to limit heat transfer will significantly improve the emission rate of the dwellings; and
- **Efficient Form -** apartments are an inherently efficient form of construction, both in terms of the materials required to build the dwellings and the ongoing heat energy demand. This is a result of relatively low areas of external heat loss elements associated with such layouts which enhance the energy efficiency of the dwellings and guarantees low energy demand throughout their occupation.

This specification will deliver an energy efficient development that achieves an emission rate reduction and fabric energy efficiency performance beyond the requirements set by building regulation Part L1A (2013).

Energy Performance Calculations - Residential

In order to demonstrate the environmental benefits associated with the 'fabric led' plus efficient servicing and on site micro generation approach to energy demand and emissions reduction at this development, approved SAP 2012 software (NHER Plan Assessor v6.2.3) has been used to calculate representative energy demand models for the dwellings.

Modelling of the entire residential development at this stage in the development cycle is impractical. To provide an accurate representation of the proposed scheme representative SAP models of each of the dwellings to provide energy and emissions data that reflects the energy performance of the proposed development.

The London Plan stipulates that energy assessments should include the following details:

- Calculation of the energy demand and carbon dioxide emissions covered by the Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment, that are not covered by the Building Regulations at each stage of the energy hierarchy;

- Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services; and,

- Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.

In order to maximise the contribution that development can make to tackling climate change and deliver zero carbon dwellings as required by the London Plan guidance the London Borough of Camden requires developments, where further on-site measures are unfeasible, to offset any shortfall in required CO_2 emissions reduction through a financial contribution. **The financial contribution is based on an agreed price per tonne of carbon (set at £60 per tonne CO_2 for a 30 year period, which equates to £1,800 per tonne carbon dioxide)** and funds measures that reduce CO_2 emissions. The SAP data and calculation results which respond to these requirements are presented in the following sections.

SAP software calculates the regulated energy demand of the dwellings and associated carbon dioxide emissions, in accordance with the requirements of Building Regulation, Part L (2013) that this development will be constructed in compliance with. SAP calculations determine the regulated energy demand and dwelling emission reductions achieved by the enhanced material specification, efficient servicing and renewable energy solution.

Block compliance (multi dwelling) SAP calculations have been applied to the residential accommodation proposed for this scheme in accordance with guidance provided within Approved Document L1A (see Appendices for details).

The estimated emissions and energy demand reductions associated with the three steps of the energy hierarchy (i.e. be lean and clean, be green) are presented in Table 1.3.

Table 1.3 – Calculated Regulated Multi Dwelling Emission Rates – Residential

	Be Lean & Clean	Be Lean, Clean & Green
Multi Dwelling DER ($kgCO_2/m^2/yr.$)	14.11	9.35
Multi Dwelling TER ($kgCO_2/m^2/yr.$)	14.63	14.63
% Dwelling Emission Rate Reduction	3.5	36.1

These calculations demonstrate that the residential element of the scheme achieves an estimated 36.1% emission rate through on site measures via the enhanced fabric plus the proposed PV specification:

Be Lean and Clean -

- The fabric led and efficient servicing specification alone (i.e. prior to the integration of renewable energy technologies) will deliver the significant dwelling emission rate reduction - **a 3.5% Dwelling Emission Rate reduction has been calculated.**

Be Lean, Clean and Green -

- The enhanced fabric, efficient servicing *plus* PV combined energy strategy will deliver a calculated **36.1% Dwelling Emission Rate reduction** over Building Regulation Part L, 2013 standards.

Residential Carbon Offset Payment

To maximise the contribution that development can make to tackling climate change, the London Borough of Haringey requires developments, where further on-site measures are unfeasible, to offset any shortfall in required CO_2 emissions reduction through a financial contribution. The financial contribution is based on an agreed price per tonne of carbon and funds measures that reduce CO_2 emissions from the existing building stock.

Calculating the carbon to be offset -

The amount of CO_2 to be offset is determined by the shortfall between actual regulated carbon emissions performance of the development and the carbon performance of the development had it met the required zero carbon targets, based upon baseline information submitted in the development energy strategy.
The cost of offsetting -

The financial contribution is calculated based on the nationally recognised price of carbon. This price of carbon is currently set the London Borough of Camden at £1,800/tCO_2.

The enhanced fabric, efficient servicing plus PV energy strategy will secure a 35.3% dwelling emission rate reduction over Part L1A (2013). The calculation steps to determine the total carbon offset payment are as follows:

- The remaining regulated emissions equate to 9.35$kgCO_2/m^2$ per year
- The total floor area of the residential dwellings is 1,888m^2

  9.35$kgCO_2/m^2$ x 1,888 m^2 = 17,653$kgCO_2$ per year

  = 17.7tCO_2 per year

  17.7tCO_2 per year x £1,800 = £31,775

The total carbon offset payment for the proposed residential development is £31,775.