Energy & Sustainability Statement

36 - 37 Great Russell Street
London
WC1B 3PP

7th July 2022

Prepared for:

Tal Arc Ltd.

Contents

Appendices

1.0 Executive Summary

The proposed development project at Great Russell Street involves the part demolition and part redevelopment of lower floor commercial spaces and the creation of 2 x new 1 bed flats and the creation of an additional flat via change of use.

It has been designed to achieve the highest of environmental performance standards following the Energy Hierarchy as set down by the London Plan and the London Borough of Camden's local plan policies.

The reports take on board the latest GLA guidance on writing energy statements (April 2020) as well as taking into account matters raised with the London Plan.

eb7 Sustainability Ltd have been appointed to develop a strategy and advise how the proposed development of a new build dwellings will comply with these requirements.

A 'Lean, Clean, Green' has been adopted and the development achieves an overall improvement (DER/TER) in regulated emissions at over **75.38%** above Part L 2013 standard, through the adoption of high standards of insulation and zero emission air source heat pumps to provide the heating and hot water to the proposed new dwellings.

2.0 The Site & Proposal

Erection of rear extensions at basement to 2nd floor levels to provide enlarged retail space at basement and ground floor and two new 1-bedroom flats at first and second floors with associated new internal lift; provision of communal

cycle and refuse stores at ground floor and the conversion of two existing 1-bedroom flats to one 2-bedroom flat on third floor.

The project also retains existing office space.

Given the very minor alterations to the commercial space, this report will focus on the newly created dwellings.

2.1 Local Planning Context

The project sits within the London Borough of Camden (Camden).

Camden's Local Plan was adopted in July 2017

Chapter 8 deals with matters of sustainability and climate change:-

Policy CC1 Climate change mitigation

The Council will require all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;

c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;

d. support and encourage sensitive energy efficiency improvements to existing buildings;

e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and

f. expect all developments to optimise resource efficiency.

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure.

b. not increasing, and wherever possible reducing, surface water runoff through increasing permeable surfaces and use of Sustainable Drainage Systems.

c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and

d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

2.3 The New London Plan

Chapter 9 deals with Sustainable Infrastructure:-

Policy SI1 Improving air quality

A London's air quality should be significantly improved and exposure to poor air quality, especially for vulnerable people, should be reduced:

Development proposals should not:

a) lead to further deterioration of existing poor air quality

b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits

c) reduce air quality benefits that result from the mayor's or boroughs' activities to improve air quality

d) create unacceptable risk of high levels of exposure to poor air quality.

5) Air Quality Assessments (AQAs) should be submitted with all major developments, unless they can demonstrate that transport and building emissions will be less than the previous or existing use.

Policy SI2 Minimising greenhouse gas emissions

A Major development should be net zero-carbon. This means reducing carbon dioxide emissions from construction and operation, and minimising both annual and peak energy demand in accordance with the following energy hierarchy:

1) Be lean: use less energy and manage demand during construction and operation.

2) Be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly. Development in Heat Network Priority Areas should follow the heating hierarchy in Policy SI3 Energy infrastructure.

3) Be green: generate, store and use renewable energy on-site.

B Major development should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy and will be expected to monitor and report on energy performance.

C In meeting zero-carbon target a minimum on-site reduction of at least 35 per cent beyond Building Regulations is expected. Residential development should aim to achieve 10 per cent, and non-residential development should aim to achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided:

1) through a cash in lieu contribution to the relevant borough's carbon offset fund, and/or

2) off-site provided that an alternative proposal is identified, and delivery is certain.

Policy SI3 Energy infrastructure

D Major development proposals within Heat Network Priority Areas should have a communal heating system

1) the heat source for the communal heating system should be selected in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks

b) use available local secondary heat sources (in conjunction with heat pump, if required, and a lower temperature heating system)

c) generate clean heat and/or power from zero-emission sources

d) use fuel cells (if using natural gas in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler)

e) use low emission combined heat and power (CHP) (in areas where legal air quality limits are exceeded all development proposals must provide evidence to show that any emissions related to energy generation will be equivalent or lower than those of an ultra-low NOx gas boiler)

f) use ultra-low NOx gas boilers.

2) CHP and ultra-low NOx gas boiler communal or district heating systems should be designed to ensure that there is no significant impact on local air quality.

3) Where a heat network is planned but not yet in existence the development should be designed for connection at a later date.

Policy SI4 Managing heat risk

A Development proposals should minimise internal heat gain and the impacts of the urban heat island through design, layout, orientation and materials.

B Major development proposals should demonstrate through an energy strategy how they will reduce the potential for overheating and reliance on air conditioning systems in accordance with the following cooling hierarchy:

1) minimise internal heat generation through energy efficient design

2) reduce the amount of heat entering a building through orientation, shading, albedo, fenestration, insulation and the provision of green roofs and walls

3) manage the heat within the building through exposed internal thermal mass and high ceilings

4) provide passive ventilation

5) provide mechanical ventilation

6) Provide active cooling systems.

Policy SI5 Water infrastructure

C Development proposals should:

1) minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

2) achieve at least the BREEAM excellent standard (commercial development)

3) be encouraged to incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future proofing.

It is noted that the 3-unit residential development to rear of Great Russell Street would be considered a minor full planning application and this report is informed accordingly based upon SAP10 calculation methodology.

An update from the GLA in June 2022 confirms the ongoing use of SAP10 and the GLA conversion spreadsheet, pending new software relating to SAP2021.

3.0 Baseline energy results

The first stage of the Mayor's Energy Hierarchy is to consider the baseline energy model.

The following section details the baseline energy requirements for the development – the starting point when considering the energy hierarchy.

3.1 New Build Dwellings

The baseline emission levels – the Target Emission Rate (TER) - is obtained by applying the design to a reference 'notional' building the characteristics of which are set by regulations – SAP10; The new Part L Building Regulations 2022 will introduce a completely new notional dwelling as detailed below:-

Table 1.1 Summary of notional dwelling specification for new dwelling[1]

Element or system	Reference value for target setting
Opening areas (windows, roof windows, rooflights and doors)	Same as for actual dwelling not exceeding a total area of openings of 25% of total floor area[2]
External walls including semi-exposed walls	U = 0.18 W/(m²·K)
Party walls	U = 0
Floors	U = 0.13 W/(m²·K)
Roofs	U = 0.11 W/(m²·K)
Opaque door (less than 30% glazed area)	U = 1.0 W/(m²·K)
Semi-glazed door (30–60% glazed area)	U = 1.0 W/(m²·K)
Windows and glazed doors with greater than 60% glazed area	U = 1.2 W/(m²·K) Frame factor = 0.7
Roof windows	U = 1.2 W/(m²·K), when in vertical position (for correction due to angle, see specification in SAP 10 Appendix R)
Rooflights	U = 1.7 W/(m²·K), when in horizontal position (for correction due to angle, see specification in SAP 10 Appendix R)
Ventilation system	Natural ventilation with intermittent extract fans
Air permeability	5 m³/(h·m²) at 50 Pa
Main heating fuel (space and water)	Mains gas
Heating system	Boiler and radiators Central heating pump 2013 or later, in heated space Design flow temperature = 55 °C
Boiler	Efficiency, SEDBUK 2009 = 89.5%
Heating system controls	Boiler interlock, ErP Class V Either: – single storey dwelling in which the living area is greater than 70% of the total floor area: programmer and room thermostat – any other dwelling: time and temperature zone control, thermostatic radiator valves
Hot water system	Heated by boiler (regular or combi as above) Separate time control for space and water heating
Wastewater heat recovery (WWHR)	All showers connected to WWHR, including showers over baths Instantaneous WWHR with 36% recovery efficiency utilisation of 0.98
Hot water cylinder	If cylinder, declared loss factor = 0.85 × (0.2 + 0.051 $V^{2/3}$) kWh/day where V is the volume of the cylinder in litres
Lighting	Fixed lighting capacity (lm) = 185 × total floor area Efficacy of all fixed lighting = 80 lm/W
Air conditioning	None
Photovoltaic (PV) system	For houses: kWp = 40% of ground floor area, including unheated spaces / 6.5 For flats: kWp = 40% of dwelling floor area / (6.5 × number of storeys in block) System facing south-east or south-west

NOTE:
1. For a dwelling connected to an existing district heat network, an alternative notional building is used. See paragraph 1.8 and SAP 10.
2. See SAP 10 for details.

SAP first creates the notional reference building, based upon the same shape and form as the proposed dwelling and applies the above the characteristics as defined in SAP10.

3.2 Dwelling Created via refurbishment

The baseline model for the 2 x flats combined into one would be considered as refurbishments/extension under AD Part L1B

The baseline parameters are set out under Table 12 (Appendix 4) of the GLA guidance (April 2020)

Table 12: *Domestic notional specification for existing buildings*

Element	Unit	Specification[3]
External Wall	W/m^2K	0.55
Roof	W/m^2K	0.18
Floor	W/m^2K	0.55
Glazing	W/m^2K	1.60
Vision element	g-value	0.63
Air permeability	($m^3/h\ m^2$ @ 50 Pa)	Default - determined by fabric element types
Thermal Bridging	W/m^2K	Default
HVAC type	-	Gas boiler, naturally ventilated
Heating and Hot Water	%	89.5%
Cooling (air-condition)	SEER	None
Lighting	%	75% low energy lighting

Again, SAP creates the notional reference building, based upon the same shape and form as the proposed dwelling.

Once all of the baseline emission rates have been calculated in line with the above Government approved methodologies, they are considered as stage 'zero' of the energy hierarchy as described earlier and Target Emission Rate sets the benchmark for the worst performing, but legally permissible, development.

3.3 Unregulated Energy Use

The baseline un-regulated energy use for cooking & appliances in the residential units have been calculated using the SAP Section 16 methodology; the same calculation used for Code for Sustainable Homes (CfSH) Ene 7.

Appliances = $E_A = 207.8 \times (TFA \times N)^{0.4714}$

Cooking = (119 + 24N)/TFA

N = no of occupant SAP table 1B

TFA – Total Floor Areas

The unregulated energy use per sqm is summarised in Table 1 below

Table 1 – Unregulated Energy Use

Unit	Unregulated Energy Use SAP2012 Kg/sqm	Unregulated Energy Use SAP10 Kg/sqm
FLAT A	15.65	7.04
FLAT B	15.66	7.05
FLAT C	15.19	6.84

The SAP10 conversion spreadsheet is attached at **Appendix E**

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 3.1 above) in order to set the total baseline emission rates before then applying the energy hierarchy in line with The London Plan and Camden policies.

3.3 Baseline Results

The baseline building results have been calculated and are presented in Table 2 below.

The Baseline SAP outputs (which summarise the key data) are attached at **Appendix A**.

The SAP10 conversion tool is attached at **Appendix E.**

Table 2 – Baseline energy consumption and CO2 emissions

Unit	Target Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
FLAT A	22.34	7.04	29.39	1470.24
FLAT C	21.59	7.05	28.64	1415.23
FLAT C	30.66	6.84	37.50	3198.72
Total				**6,084**

4.0 Design for energy efficiency

The first step in the mayor's 'Energy Hierarchy' as laid out in Section 5 of The London Plan, requests that buildings be designed to use improved energy efficiency measures – Be Lean. This will reduce demand for heating, cooling, and lighting, and therefore reduce operational costs while also minimizing associated carbon dioxide emissions.

This section sets out the measures included within the design of the development, to reduce the demand for energy, both gas and electricity (not including energy from renewable sources). The table at the end of this section details the amount of energy used and CO_2 produced by the building after the energy efficiency measures have been included. From these figures the overall reduction in CO_2 emissions, as a result of passive design measures, can be calculated. To achieve reductions in energy demand the following measures have been included within the design and specification of the building:

4.1 Passive Design

The National Planning Policy Framework emphasises the need to take account of climate change over the longer term and plan new developments to avoid increased vulnerability to the range of impacts arising from climate change. The UK Climate Impacts Programme 2009 projections suggest that by the 2080's the UK is likely to experience summer temperatures that are up to 4.2°C higher than they are today.

Accordingly, designers are to ensure buildings are designed and constructed to be comfortable in higher temperatures, without resorting to energy intensive air conditioning.

In line with current GLA Guidance, the project at Great Russell Street has had been designed to ensure the building is not vulnerable to overheating; to instigate consideration of the risk of overheating with the proposed development, the design team have followed the guidance within the London Plan, Section 5.9, which consider the control of overheating using the Cooling Hierarchy:-

1. **minimise internal heat generation through energy efficient design**

The project will be designed to best practice thermal insulation levels as noted, full details of which are noted under 4.3 below.

Not only does good insulation assist in reducing heat losses in the winter, it has a significant impact on preventing heat travelling through the build fabric during the summer.

2. **reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and wall**

The development site is based in a high-rise part of London, with other high rise buildings to the rea offering some considerable topographical shading.

The main living areas have large, glazed areas ensuring good daylight levels, but orientated to the west to avoid any excessive solar gain.

Bedroom areas have reduced glazed areas in line with best practice passive design.

The conversion unit has a fixed north-south orientation, but as retained facades

Glazing specification has been considered as part of the overheating risk and the specified new glazing will have solar control coating to assist in reducing overheating risk from excessive solar gain.

3. **manage the heat within the building through exposed internal thermal mass and high ceilings**

Flats are designed with floor to ceiling heights at circa 2.75m, 2.9m & 3m.

The new build structures are expected to be of traditional brick and block offering significant thermal mass able to absorb heat during the summer months, which can then be ventilated during the evening or overnight.

The high thermal mass of the existing structure will have a very similar impact on the conversion unit.

4. **passive ventilation**

The conversion unit has the ability for cross ventilation which will overcome the natural north/south configuration, and all glazing is designed to have opening areas to introduce high levels of natural levels of "purge" ventilation to further assist in the reduction of overheating risks in appropriate areas.

5. **mechanical ventilation**

Given the passive ventilation and cooling strategy as out lined above, it is proposed that all houses will be naturally ventilated via window mounted background (trickle) ventilation and opening windows for purge ventilation; there are no proposals to use high energy mechanical ventilation.

4.2 Heating System

The "notional" heating system considered under the "be lean – use less energy" section of the Energy Hierarchy, will consist of high efficiency condensing gas boilers providing under floor heating and domestic hot water to the units.

- A rated boiler systems – (89%+ SEDBUK efficiency) & load compensation.
- Insulated primary pipework

To increase the efficiency in the use of the heating system, the following controls will be used to eliminate needless firing of the boilers.

- Boilers fitted with weather compensation systems

The boiler will deliver domestic hot water via highly insulated unvented cylinders with minimal standing heat losses.

4.3 Fabric heat loss

Insulation measures will be utilised to ensure the calculated U-values exceed the Building Regulations minima, with specific guidance taken from the design team:-

- New wall constructions will be of a brick and block cavity with a full-fill insulation and will target a U-Value of 0.18W/m^2k or better.
- Existing walls will be thermally lined to achieve a U-Value of 0.30W/m^2k
- New Roof constructions are yet to be specified, but a lightweight construction achieving a U-Value of 0.12W/m^2k will be targeted.
- The existing roof will be insulated and seek to achieve a similar value.

Glazing

- The new glazing for windows and doors will be double glazed with an area weighted average U-Value of 1.3W/m^2K or better.

Air Tightness

- The new flats will be tested to 5m^3/hr/m^2 in line with best practice for naturally ventilated dwellings.

Construction Details

- Heat loss via non-repeating thermal bridging within the new build elements will be minimised by the use of Accredited Construction Details for these new build units. An overall Y-Value <0.07 is targeted.

4.5 Ventilation

As noted above, the residential spaces are to utilise a low energy natural ventilation strategy, with trickle ventilation, opening windows and extract fans to wet room areas.

4.6 Lighting and appliances

The development will incorporate high efficiency light fittings utilising LED lamps throughout.

External areas will also have an absence detection systems to ensure lights cannot be left on when not in use.

4.7 Energy efficiency results

The above data has been used to update the SAP models the Building Emission Rate outputs of which are attached at **Appendix B**, which are tabulated below: -

The following Table 3 shows the "be lean" emissions levels, as well as the overall emissions from the building.

Table 3 – Energy Efficient emission levels

Unit	Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total emissions Kg/sqm	Total emissions Kg
FLAT A	20.82	7.04	27.86	1394.08
FLAT C	21.33	7.05	28.38	1402.64
FLAT C	24.19	6.84	31.03	2646.97
Total				**5,444**

The results show that the energy efficiency measures introduced have resulted in the reduction in CO_2 emissions from the development of **10.52%.**

5.0 Supplying Energy Efficiently

The second stage in the mayor's 'Energy Hierarchy' is to ensure efficient and low carbon energy supply – Be Clean. In particular, this concerns provision of decentralised energy where practical and appropriate.

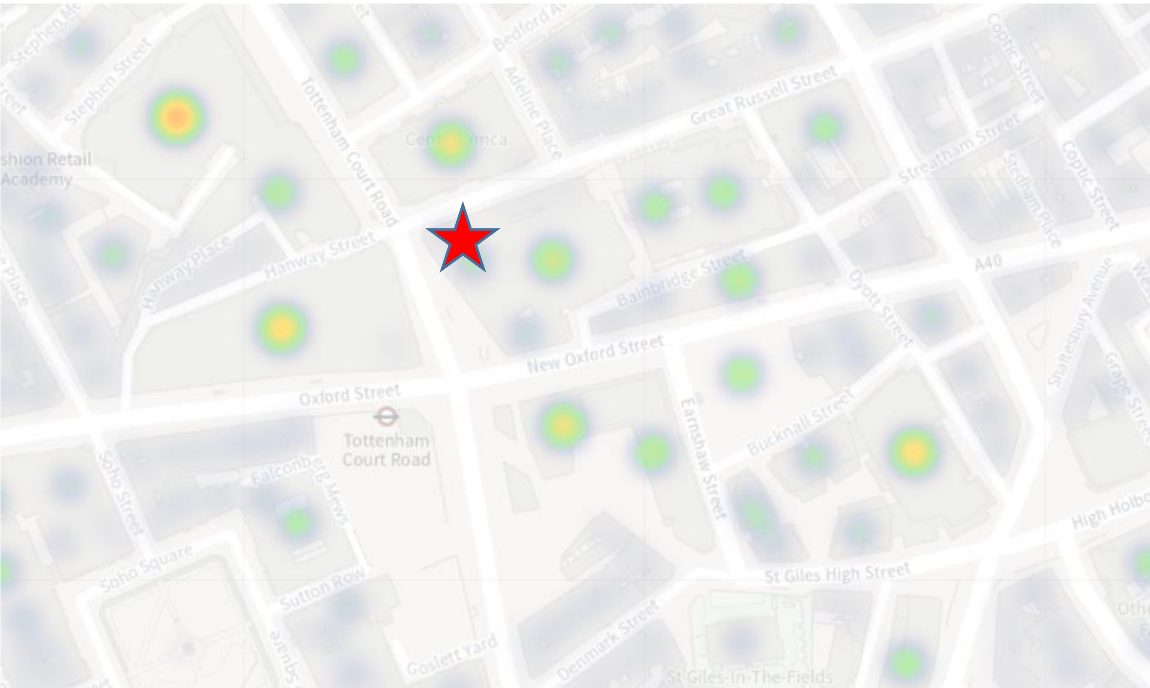
5.1 Community Heating/Combined Heat and Power (CHP)

The London Plan requires development to consider the availability of district energy networks (DENs) and the ability of new development to connect to any such network:-

Combined heat and power systems are essentially biomass or fossil fuel fired electricity generators that use the heat by-product to provide space and water heating. The electricity generated can be used directly within the host buildings or sold to electricity suppliers on the national grid. These systems can be employed on a large scale for community schemes or at the micro scale for individual dwellings.

Alternatively larger scale systems operated as a standalone entity can be used to provide heat and power to the local neighbourhood.

The extract from the London Heat Map (reproduced below) identifies that the site is remote from any proposed district energy network but is within a heat network priority area.



Extract from London Heat Map

It is highly unlikely that this minor project will ever have the opportunity to connect to a DEN, however, the proposed LTHW system would be compatible with such a connection.

In the medium term, the project is also required to consider the use of on-site CHP.

5.2 On-site CHP/District Heating

The heat production facility for a DH scheme is generally considered to include heat only boilers (HOB) and/or the production of both electricity and heat i.e., CHP.

CHP systems are essentially biomass or fossil fuel fired electricity generators that use the heat by-product to provide space and water heating. The electricity generated can be used directly within the host buildings or sold to electricity suppliers on the national grid.

CHP is, as a rule of thumb, is only operated as a base load as, depending on the technology, it may be difficult and/or inefficient to operate according to daily variations in demand. In a well-designed district heating network heat from CHP will provide between 60% and 80% of the annual baseline heat (heating and hot water) requirement with heat-only boiler plants providing the peak load and back-up. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat load needs to be present for this period.

Clearly, this small residential scheme with small commercial spaces are not appropriate for a CHP installation, as the baseload is simply not available.

We must also consider the net carbon benefits from such a system as the de-carbonisation of national grid dilutes the benefits obtained from the higher efficiency of larger-scale CHP led system.

Reference is made to the key CIBSE Symposium on the topic; "An operational lifetime assessment of the carbon performance of gas fired CHP led district heating" (2016).

This paper sets out a calculation methodology to determine the greenhouse gas emissions associated with district heat networks which use gas fired CHP as a heat source.

Currently, Part L calculations and CHP emissions savings are based on the grid-based emission rate taken from the SAP 2012 3-year average - 519g/KwhCO_2; SAP 2012 introduced a 15-year average at 381g/KwhCO_2 to assist designers considering the longer term impacts.

Such a difference will markedly affect the relative calculated performance of a gas CHP engine versus a gas boiler, particularly if any DH network losses are removed from the equation through the use of localised boilers.

The CIBSE paper further advises that "Using a typical good practice assumption of 40% thermal efficiency of the CHP, the threshold for net benefit is a grid carbon factor of around 338 gCO_2/kWh. Below that threshold, CHP is found to be worse than a gas boiler and grid electricity."

DECC provides data for treating energy and emissions in their guidance; this provides projections of grid emissions factors over the next 85 years. With the rapid and recent introduction of renewable technologies to the grid – wind power and PV - DECC's "Green Book" guidance projects that grid carbon intensity will reach 338 gCO_2/kWh by 2017/18 and will reach 300 gCO_2/kWh by 2018/19.

The new Part L 2021 utilises a figure at 136 gCO_2/kWh

So it can be surmised, that by the time an CHP led DH network at Great Russell Street has reached maturity in the next 2/3 year, the carbon benefits will already have been lost

Accordingly, the use of a CHP lead community heating network must also be dismissed.

6.0 Renewable Energy Options

The final element of the mayor's 'Energy Hierarchy' requires development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible – Be Green.

Renewable energy can be defined as energy taken from naturally occurring or renewable sources, such as sunlight, wind, wave's tides, geothermal etc. Harnessing these energy sources can involve a direct use of natural energy, such as solar water heating panels, or it can be a more indirect process, such as the use of Biofuels produced from plants, which have harnessed and embodied the suns energy through photosynthesis.

The energy efficiency measures and the sourcing the energy efficiently outlined above have the most significant impact on the heating and hot water energy requirements for the development, and the associated reduction in gas consumption.

This section then sets out the feasibility of implementing different energy technologies in consideration of: -

- Potential for Carbon savings
- Capital costs
- Running costs
- Payback period as a result of energy saved/Government incentives
- Maturity/availability of technology
- Reliability of the technology and need for back up or alternative systems.

6.1 Government incentives

6.1.1 Smart Export Guarantee (SEG)

Introduced in 2020, the SEG will enable solar photovoltaic (PV), wind, hydro and anaerobic digestion (AD) installations up to 5MW and micro-combined heat and power (micro-CHP) up to 50kW will be able to receive an export tariff under the policy.

The SEG is a market-led initiative, requiring electricity supply licensees to offer export tariffs to eligible generators. Suppliers are free to set their own SEG compliant tariff price (provided it is above zero pence at all times) and decide how their tariffs work.

Installation owners are able to shop around and select the Licensee of their choice based upon an offer of the most appropriate tariff.

Payments are made against metered exports only.

The expectation for the project at Central Street is that the vast majority of the PV output will be utilised within the building during the week, so a metered export of weekend energy would enable a further return to the building owners.

6.1.2 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally withdrawn to all applications in March 2022.

6.2 Wind turbines

Wind turbines come in two main types'- horizontal axis and vertical axis. The more traditional horizontal axis systems rotate around the central pivot to face into the wind, whilst vertical axis systems work with wind from all directions.

The potential application of wind energy technologies at a particular site is dependent upon a variety of factors. But mainly these are: -

- Wind speed
- Wind turbulence
- Visual impact
- Noise impact
- Impact upon ecology

The availability and consistency of wind in urban environments is largely dependent upon the proximity, scale and orientation of surrounding obstructions. The site is flanked by other properties in most directions. To overcome these obstructions and to receive practical amounts of non-turbulent wind, the blades of a wind turbine would need to be placed significantly above the roof level of the surrounding buildings and the proposed project at Great Russell Street itself.

It is inconceivable that any wind turbines of this size would be considered acceptable in this location.

6.3 Solar Energy

The proposed development has areas of steep pitched roof that could accommodate solar panels orientated to the south.

In general, the roofs will have an unrestricted aspect, so there is scope therefore to site solar photovoltaic (PV) or water heating equipment at roof level.

6.3.1 Solar water heating

Solar water heating panels come in two main types: flat plate collectors and evacuated tubes. Flat plate collectors feed water, or other types of fluid used specifically to carry heat, through a roof mounted collector and into a hot water storage tank. Evacuated tube collectors are slightly more advanced as they employ sealed vacuum tubes, which capture and harness the heat more effectively.

Both collector types can capture heat whether the sky is overcast or clear. Depending on location, approximately 900–1100 kWh of solar energy falls on each m^2 of unshaded UK roof surface annually. The usable energy output per m^2 of solar panel as a result of this amount of insolation ranges from between 380 – 550 kWh/yr.

Solar hot water systems are of course, displacing gas for DHW provision (as noted above), and due to the low cost of gas as a source of energy, solar thermal systems tend to have a very poor pay back model unless there is a reliable and consultant demand for hot water; a small size residential scheme simply does not provide this

Accordingly, given the limited roof space available and the strategy to off-set the electrical use, solar PV may be a stronger candidate (see below) and offer a greater return in terms of a return on investment.

Accordingly, solar thermal would not be the optimum solution for the proposed development.

6.3.2 Photovoltaics (PV)

A 1kWp (1 kilowatt peak) system in the UK could be expected to produce between 790-800kWh of electricity per year based upon a southeast orientation according to SAP2005 methodology used by the Microgeneration Certification Scheme (MCS). The figure given in the London Renewables Toolkit is 783 kWh per year for a development in London.

Despite the withdrawal of the Feed in Tariff, the returns on PV installations can still achieve 4-5% via the export tariff and in-property energy savings.

However, due to concerns over aesthetics, and the visual impact from the roof terraces – the design team are proposing the use of alternate renewable technologies.

6.4 Biomass heating

Biomass is a term given to fuel derived directly from biological sources for example rapeseed oil, wood chip/pellets or gas from anaerobic digestion. It can only be considered as a renewable energy source if the carbon dioxide emitted from burning the fuel is later recaptured in reproducing the fuel source (i.e., trees that are grown to become wood fuel, capture carbon as they grow).

Biomass heating systems require space to site a boiler and fuel hopper along with a supply of fuel – which can be very bulky items. There also needs to be a local source of biomass fuel that can be delivered on a regular basis. There are also issues with fuel storage and delivery which mitigate against this technology. There is inadequate space at ground floor level for a fuel store and limited access for delivery lorries.

Additionally, a boiler of this type would replace the need for a conventional gas boiler and therefore offset all the gas energy typically used for space and water heating. However, biomass releases high levels of NO_x emissions and particulate matters, as well as other pollutants and would therefore have to be considered carefully against the high standard of air quality requirements within the London Boroughs. Accordingly, the use of biomass is not considered appropriate for this project.

6.6 Ground source heat pump

All heat pump technologies utilise electricity as the primary fuel source – in this case displacing gas, as such, the overall reduction in emissions when using this technology can be less effective when opposed to a technology that is actually displacing electricity.

Ground source heating or cooling requires a source of consistent ground temperature, which could be a vertical borehole or a spread of pipework loops and a 'heat pump'. The system uses a loop of fluid to collect the more constant temperature in the ground and transport it to a heat pump. In a cooling system this principle works in reverse and the heat is distributed into the ground.

The heat pump then generates increased temperatures by 'condensing' the heat taken from the ground, producing hot water temperatures in the region of 45°C. This water can then be used as pre-heated water for a conventional boiler or to provide space heating with an under-floor heating system.

The use of a ground source heating/cooling system will therefore require:

- Vertical borehole or ground loop
- Use of under floor heating
- Space for heat pump unit

Clearly, in the case of the proposed development, there is little scope for the locating of the ground collector devices and ground source heating cannot be considered.

6.7 Air source heat pump

Air source heating or cooling also employs the principle of a heat pump. This time either, upgrading the ambient external air temperature to provide higher temperatures for water and space heating, or taking warmth from within the building and dissipating it to the outdoor air.

It must be remembered that heat pumps utilise grid-based electricity and the associated emissions, so that actual the reduction in emissions can be limited. Assuming a seasonal system efficiency of 320% (Coefficient of Performance of 3.2) and that the air source heat pump will replace 100% of the space heating/hot water demand, then the system would reduce the overall CO_2 emissions by approximately 60%. The table below demonstrates, on the assumption of a demand of 1000kWh/year for heating and hot water.

Table 4 – Air Source Heat Pump Performance

Type of Array	Energy Consumption (kWh/yr.)	Emission factor (SAP10) ($kgCO_2/h$)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	11111	0.210	2333
320% efficient ASHP	2813	0.233	655
100% efficient immersion (back-up)	1000	0.233	233

A theoretical carbon saving of 62%

With the above data in mind, clearly an ASHP could be an option, accordingly the design team are assuming the use of air source heat pumps to provide the heat and hot water to the proposed new dwellings at Great Russell Street Farm.

Heat pumps also offer the considerable benefit of emitting zero local NOx or particulate matters emissions to the benefit of the local environment.

6.8 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use the above air soured heat pumps as the primary heat and hot water system. The final table – Table 5 – summarises the final outputs from the SAP models; attached at **Appendix C.**

The GLA SAP10 conversion spreadsheet is attached at **Appendix E**

Table 5 – "Be Green" emission levels

Unit	Emission Rate (regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total emissions Kg/sqm	Total emissions Kg
FLAT A	11.72	7.04	18.77	938.93
FLAT C	15.16	7.05	19.10	944.03
FLAT C	14.69	6.84	18.02	1537.18
Total				**1,883**

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **69.05%** over and above the baseline model, with a **65.41%** reduction in emissions directly from the use of energy generating and renewable technologies, i.e., over and above the energy efficient model.

Excluding the un-regulated use, i.e., considering emissions controlled under AD Part L, then the final reduction in DER/TER equates to **75.38%.**

7.0 Sustainable Design & Construction

The Code for Sustainable Homes (the Code)

The Code was the national standard for the sustainable design and construction of new homes.

This has now been formally withdrawn by DCLG, and planning authorities are no longer able to require developments to meet the technical guidance within the Code for Sustainable Homes

However, the applicants do acknowledge some requirements from the Mayor's Sustainable Design & Construction SPD, which will also be required under Camden's own sustainability SPD and will actively introduce the following elements to the development:-

Materials

New build construction techniques will be considered against the BRE Green Guide to ensure that, where practical, the most environmentally friendly construction techniques are deployed.

Construction materials will be sourced from suppliers capable of demonstrating a culture of responsible sourcing via environmental management certification, such as BES6001

Insulation materials will be selected that demonstrate the use of blowing agents with a low global warming potential, specifically, a rating of 5 or less. Additionally, all insulants used will demonstrate responsible sourcing of material and key processes.

The principal contractor with be required to produce a site waste management plan and sustainable procure plan, in line with BREEAM standards – this will include a pre-demolition audit to identify demolition materials to reuse on-site or salvage appropriate materials to enable their reuse or recycling off-site. The procurement plan will follow the waste hierarchy Reduce; Reuse & Recycle.

A Site Waste Management Plan (SWMP) will be developed prior to commencement of development stage to inform the adoption of good practice waste minimisation in design. This will set targets to minimise the generation of non-hazardous construction waste using the sustainable procurement plan to avoid over-ordering and to use just-in-time delivery policies.

Waste and recycling – appropriate internal and external storage space will be provided to ensure that residents can sort, store and dispose of waste and recyclable materials in line with Camden's collection policies.

Pollution

The contractor will also monitor the use of energy and water use during the construction phase and incorporate best site practices to reduce the potential for air (dust) and ground water pollution.

The completed dwellings will use zero emission heat pumps to generate the LTHW systems for heating and DHW.

The main contractor will be required to register the site with the Considerate Constructors Scheme and achieve a best practice score of 25 or more.

To void the issue of noise pollution, the development will comply with Building Regulations Part E, providing a good level of sound insulation between the proposed development and surrounding buildings.

Energy

The dwelling will incorporate renewables technologies as noted in the main report above.

The new home will also be supplied with a Home User Guide offering practical advice on how to use the home economically and efficiently.

This will be further enhanced by the installation of smart energy metering, enabling occupants to accurately assess their energy usage and thereby, manage it.

Water

The development minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. The applicants will ensure that the dwelling meet the required level of 105 litres maximum daily allowable usage per person in accordance with Level 4 of the Code for Sustainable Homes.

A sample Part G internal water use calculation is attached at **Appendix D.**

8.0 Conclusions

This report has detailed the baseline energy requirements for the proposed development, the reduction in energy demand as a result of energy efficiency measures and the potential to achieve further CO_2 reductions using renewable energy technologies.

The baseline results have shown that if the development was built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO_2 emissions would be **6,084Kg/year**.

Following the introduction of passive energy efficiency measures into the development, as detailed in section 4, the total amount of CO_2 emissions would be reduced to **5,444Kg/year**

There is also a requirement to reduce CO_2 emissions across the development using renewable or low-carbon energy sources. Therefore, the report has considered the feasibility of the following technologies:

- Wind turbines
- Solar hot water
- Photovoltaic systems
- Biomass heating
- CHP (Combined heat and power)
- Ground & Air source heating

The results of the assessment of suitable technologies relative to the nature, locations and type of development suggest that the most suitable solution to meeting reduction in CO_2 emissions would be via the use of air source heat pumps to deliver the scheme heating and hot water requirements.

This has been used in the SAP models (reproduced at **Appendix C**) for the development which have also been detailed above in Table 5, which show a final gross emission level of **1,883Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **69.05%.**

In addition, the final SAP outputs at Appendix C demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of 75.4%.

Tables 6 & 7 Demonstrate how the Great Russell Street project complies with the London Plan requirements and the GLA guidance relating to zero carbon development.

Table 6 – Carbon Emission Reductions – Domestic Buildings

Key	Tonnes/annum
Baseline CO_2 emissions (Part L 2013 of the Building Regulations Compliant Development)	4.80
CO2 emissions after energy demand reduction (be lean)	4.16
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	4.16
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	1.18

Table 7 – Regulated Emissions Savings – Domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per annum)	%
Savings from energy demand reduction	0.64	13.33
Savings from heat network	0.00	0.00
Savings from renewable energy	2.98	62.08
Total Cumulative Savings	3.62	75.42
	(Tonnes CO_2)	
Carbon Shortfall	1.18	
Cumulative savings for off-set payment	35.4	
Cash-in-lieu Contribution	£N/A	

Appendix A

Baseline/Un-regulated Energy Use:-

SAP Outputs & Target/Dwelling Emission Rates

Appendix B

Energy Efficient Design:-

SAP Outputs & Dwelling Emission Rates

Appendix C

Generating energy on-site:-

SAP Outputs Dwelling Emission Rates

Appendix D

Part G

Sample Internal Water Use Calculation

Appendix E

SAP10

GLA Conversion Spreadsheet