THE COTTAGE, HILLTOP ROAD
LONDON, NW6 2QA

Energy & sustainability Statement

Rev 1

09th August 2021

THE DESIGN COLLECTIVE

Contents

1.0 Issue Register

Revision	Reason for Issue	Date of Issue	Issued By
0.0	For Information	22.05.2020	R. Flack
1.0	Revised to Comments	09.08.2021	M. Scales

2.0 Executive Summary

The proposed development project at Hilltop Road involves the redevelopment of the existing site to create a new individual dwelling.

A review of the existing building and its thermal properties have been undertaken by the design team with the summary of values below, the table shows the negative impact the current building structure has against today's proposed standards under Part L1B. to achieve the targets as set out significant adaptations would be required with the existing structure that become unfeasible both in terms of achieving the required thermal improvements and are costs prohibitive: -

Building Element	Existing Building Thermal Conductivity	Current Part L1B Compliance	% Difference
Eternal Walls (Rendered 9-inch Brick Wall)	**2.0 W/m²k**	**0.28 W/m²k**	**86%**
Roof (Uninsulated Flat Roof)	**2.0 W/m²k**	**0.18 W/m²k**	**91%**
Floor (Uninsulated Concrete Slab)	**0.75 W/m²k**	**0.22 W/m²k**	**70%**
Windows (Single Glazed)	**5.2 W/m²k**	**1.6 W/m²k**	**80%**
External Doors (Solid Timber)	**3.0 W/m²k**	**1.8 W/m²k**	**40%**

Table 1 – Statement of Existing Building Fabric Performance

As can be seen from the table above the existing building performs extremely poorly based on the existing building fabric when compared to the current minimum standards expected by Part L1B.

The extent of the requirement to enhance the existing building fabric, to meet compliance presented an obvious case for rebuilding of the property and maximising the energy and thermal performance.

It has been designed to achieve high 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 report takes on board the latest GLA guidance on writing energy statements as well as taking account of matters raised within the new 'London Plan'.

The design Collective have been appointed to develop a strategy and advise how the proposed development of a new build dwelling will comply with these requirements.

A *'Lean, Clean, Green' approach* has been adopted and the development could achieve an overall improvement (DER/TER) in regulated emissions at over **71.65%** above Part L 2013 standard, depending on the measures implemented.

To demonstrate the benefits of new build in the context of thermal performance the table below shows the design values, against each main building element. This combined with energy efficient servicing strategies enables the overall DER/TER improvement as highlighted above.

New Building Element	Proposed New Building Thermal Conductivity	Current Part L1A Compliance – Limiting U-values
Eternal Walls (Rendered 9-inch Brick Wall)	**0.15 W/m²k**	**0.3 W/m²k**
Roof (Uninsulated Flat Roof)	**0.12 W/m²k**	**0.2 W/m²k**
Floor (Insulated Concrete Slab)	**0.14 W/m²k**	**0.25 W/m²k**
Windows (Single Glazed)	**1.4 W/m²k**	**2.0 W/m²k**
External Doors (Solid Timber)	**1.8 W/m²k**	**2.0 W/m²k**

Table 2 – Proposed New Building Fabric Performance

The project at Hilltop Road – being a single dwelling – would be considered a non-major scheme and this report is informed accordingly.

As such, this non-major domestic development will achieve the energy reduction targets in line with London Plan requirements.

The design team are utilising SAP10 emissions data, in line with the latest GLA guidance. The following report demonstrates a path to achieve compliance with the Council's policies as well as the 'London Plan' and exceeding the requirements of 'Approved Document Part L'. The measures within this report are aims and considerations to meet the necessary requirements and will be subject to financial viability that will be developed as part of a cost plan during the detailed design stage.

3.0 The Site & Proposal

The site is currently occupied by a 2-storey dwelling assumed to be of circa 1930's build - an inefficient building with solid walls, single glazed windows and a flat roof. It is reasonable to assume the existing dwelling would perform poorly in terms of air tightness and thermal bridging.

The proposal for the site includes the demolition of the existing building and redevelopment of the site to a new individual 3 storey dwelling offering 2-bedroom accommodation, future proofed for adaptation in line with Lifetime Homes standards.

3.1 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 developments 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 developments 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.

3.2 The 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 the 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 future 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.

4.0 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.

4.1 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 – SAP2012; The new Approved Document 'Part L' Building Regulations 2013 came into force in April 2014 and introduced a completely new notional dwelling as detailed below: -

Table 4 Summary of concurrent notional dwelling specification

Element or System	Values
Opening areas (windows and doors)	Same as actual dwelling up to a maximum proportion of 25% of total floor area [1]
External Walls (including opaque elements of curtain walls) [6]	0.18 W/m²K
Party Walls	0.0 W/m²K
Floor	0.13 W/m²K
Roof	0.13 W/m²K
Windows, roof windows, glazed rooflights and glazed doors	1.4 W/m²K [2] (Whole window U-value)
	g-value = 0.63 [3]
Opaque doors	1.0 W/m²K
Semi glazed doors	1.2 W/m²K
Air tightness	5.0 m³/hr/m²
Linear thermal transmittance	Standardised psi values – See SAP Appendix R, except use of y=0.05 W/m²K if the default value of y=0.15 W/m²K is used in the actual dwelling
Ventilation type	Natural (with extract fans) [4]
Air conditioning	None

Element or System	Values
Heating System	Mains gas If combi boiler in actual dwelling, combi boiler; otherwise regular boiler Radiators
	Room sealed
	Fan flue
	SEDBUK 2009 89.5% efficient
Controls	Time and temperature zone control [5] Weather compensation
	Modulating boiler with interlock
Hot water storage system	Heated by boiler (regular or combi as above) If cylinder specified in actual dwelling, volume of cylinder in actual dwelling If combi boiler, no cylinder. Otherwise 150 litres. Located in heated space. Thermostat controlled Separate time control for space and water heating
Primary Pipework	Fully Insulated
Hot water cylinder loss factor (if specified)	Declared loss factor equal or better than 0.85 x (0.2 + 0.051 V2/3) kWh/day
Secondary Space Heating	None
Low Energy Lighting	100% Low Energy Lighting
Thermal Mass Parameter	Medium (TMP=250)

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 SAP2012.

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.

All emissions data is then converted to SAP10 emissions via the use of the GLA SAP10 conversion spreadsheet – attached at **Appendix D**.

4.2 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 SAP10 emissions associated with unregulated energy use per sqm is summarised in Table 3 below.

Unit	CO_2 emissions - Unregulated Energy Use SAP2012 Kg/sqm	CO_2 emissions - Unregulated Energy Use SAP10 Kg/sqm
Hilltop Road	15.15	6.82

Table 3 – Unregulated Energy Use

The un-regulated emission rates are added to the baseline regulated emission rates (as calculated under 4.1 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.

4.3 Baseline Results

The baseline building results have been calculated, converted to SAP10 emission standards, and are presented in Table 4 below.

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

Unit	Target Emission Rate (Regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Hilltop Road	16.70	6.82	23.55	2121.67
Development Total				**16725**

Table 4 – Baseline energy consumption and CO_2 emissions

5.0 Deign for Energy Efficiency

The first step in the Mayor's 'Energy Hierarchy' as laid out in 'Chapter 9 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 or being evaluated 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 or may be included within the design and specification of the building:

5.1 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 and Camden Local Plan policy, the project at Hilltop Road has 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, 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 5.3 below.

Not only does good insulation assist in reducing heat losses in the winter, but it also 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 in a suburban townscape, with an East-West orientation. To the South is a significant 2 storey dwelling which will offer some topographical shading to the lower floor levels.

To the East and West there are significant trees and planting which will offer some shading from the evening Westerly sun.

The dwelling has only limited South facing glazing to the top floor study space, and none to living or bedroom areas.

The designers have also considered passive design measures to mitigate any residual overheating risk.

The living areas have large-glazed areas offering high levels of natural daylight to reduce reliance on artificial lighting - these same glazed areas are not exposed to the peak summer sun.

Across the scheme, the glazing to the secondary spaces – bedrooms and bathrooms – is much reduced in keeping with the reduced heat demand associated with the glazing.

Glazing specification has been a significant consideration as part of the overheating risk mitigation and the specified new glazing will achieve a g-value of 0.55 or better in order to further assist in reducing overheating risk from excessive solar gain.

3. Manage the heat within the building high ceilings

The house is designed with floor-to-ceiling heights at circa 2.4m, with the main living areas at 2.6m.

The new build structure is expected to be relatively lightweight utilising timber framing.

The proposed main elements are as follows: -

- Concrete Slab over Piles
- Timber beams & columns
- Prefabricated timber cassette walls and floor
- External cork cladding

4. Passive Ventilation

Given the relatively quiet suburban location, most glazing is designed to have opening areas to introduce high levels of natural "purge" ventilation to further assist in the reduction of overheating risks in appropriate areas.

5. Mechanical Ventilation

Given the strategy outlined above, there is no requirement to introduce mechanical ventilation: the project is to be naturally ventilated in line with AD Part F System 1, with the exception of the kitchens and bathrooms that will be ventilated via mech extract ventilation.

5.2 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 boiler providing heating and domestic hot water to the project

- High efficiency boiler – (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 load compensation and delayed start thermostats.

5.3 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 timber prefabricated wall cassette with external cork cladding and will target a **U-Value of 0.15W/m²k** or better.

- New flat roof constructions are to be of a warm-roof type, achieving a **U-Value of 0.12W/m²k**

- The newly laid floors will achieve a minimum **U-value of 0.14/0.15W/m²k** subject to perimeter/area ratios

Glazing

- The new glazing for windows and doors will be double glazed with an area weighted average **U-Value of 1.4W/m²K or better.**

Air Tightness

- The project be tested to **5m³/hr/m² @ 50Pa** 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.

5.4 Ventilation

As noted above, the project is to be 100% naturally ventilated in line with AD Part F System 1; background (trickle) ventilation, with purge ventilation via opening windows and intermittent extracts to wet rooms.

5.5 Lighting and Appliances

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

The use of LED lighting will also minimise the internal gains commonly associated with tungsten and fluorescent lighting systems and thereby further reduce the potential for the property to overheat.

5.6 Energy Efficiency Results

The above data has been used to update the SAP models, the Dwelling Emission Rate outputs of which are attached at **Appendix B**, whilst Table 5 sets out the total emissions using SAP10 data.

Unit	Emission Rate (Regulated energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Hilltop Road	14.70	6.82	21.52	1,938.37
Development Total				**15,280**

Table 5 – Energy Efficient Emission Levels

The results show that the energy efficiency measures introduced have resulted in the reduction in CO_2 emissions from the development of **8.64%.**

Regulated emissions have been reduced by **12.23%** via the passive design measures highlighted above.

6.0 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.

6.1 Community Heating/Combined Heat and Power (CHP)

The 'London Plan', Chapter 9, requires that major developments 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.

Therefore, this report must consider the availability of heat networks in the Camden area.

The extract from the London Heat Map (reproduced below) identifies that the site is close to a heat map study area and within the Heat Network Priority Area.

Extract from London Heat Map

Clearly there is some potential for the project site to connect to a DEN at some point in the future

As a non-major scheme, there is no obligation to be designed to be DEN connection ready, however, the chosen wet heating system would be compatible with a DEN connection; in particular, the LTHW heating system would provide the necessary flow and (low) return temperatures compatible with DEN connections.

As a single dwelling, this is not an option - the potential for communal heating systems and the use of in-house CHP will not be considered further.

7.0 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, waves, 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.

Efficiencies in the sourcing and the use of energy 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.

7.1 Government Incentives

7.1.1 Renewable Heat Incentive

The Renewable Heat Incentive (RHI) was formally launched by the UK Government on 10th March 2011.

Although now closed to non-domestic applications, it is still available to domestic "self-build" developments.

7.2 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 at minimum of 2-3 stories in all 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 Hilltop Road itself.

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

7.3 Solar Energy

The proposed development has a small area of flat roof at top floor level that could accommodate solar panels orientated to the south.

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

7.3.1 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 poor pay back model unless there is a reliable and consistent demand for hot water; a medium 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.

7.3.2 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 South-East 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 financial returns on PV installations can still achieve levels at 3-4% via the reduction in electricity consumption – becoming more significant as electricity costs rise. This return is, however, subject to the level of electricity use and the cost of purchasing electricity from the individual's supplier.

Accordingly, the design team are proposing the use of 3 x PV panels utilising the top floor roof space; a total array at 0.99Kwp, producing some 1,000kWh/annum.

7.4 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 on site 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 Camden's Borough wide AQMA. Accordingly, the use of biomass is not considered appropriate for this project.

7.5 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, there is insufficient land area to install low level collector loops, leaving deep bore GSHP as the only potential option.

Normally the boreholes would need to be 6 to 8 metres apart and a 100-metre-deep borehole will only provide about 5kw of heat. The borehole should also be formed around 3m away from the perimeter of the building and most specialists do not recommend using the structural boreholes.

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

7.6 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, so calculations base the benefits on SAP10 emissions data

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 1,000kWh/year for heating and hot water.

Type of Array	Energy Consumption (kWh/yr.)	Emission factor ($kgCO_2/kWh$)	Total CO_2 emissions (kg/annum)
90% efficient gas boiler	11,111	0.210	2,333
320% efficient ASHP	2,813	0.233	655
100% efficient immersion (back-up)	1,000	0.233	233

Table 6 – ASHP Performance

A theoretical carbon saving of 60%

Accordingly, the design team are proposing the use of air source heat pump systems; and air to water heat pump, located on one of the upper floor roof areas, to service the heating and hot water requirements for the proposed new dwelling. This could form an enhancement to the scheme and could replace the gas condensing boiler identified as part of a possible base scheme analysis.

7.7 Final Emissions Calculation

Given the outcome of the feasibility study above, the developer is proposing the use the above noted air source heat pump system for the heating and DHW requirements as well as the 3 panel PV array at top floor level.

The final table – Table 7 – summarises the final outputs from the SAP models; attached at **Appendix C.**

Unit	Emission Rate (Regulated Energy use) Kg/sqm	Unregulated Energy Use Kg/sqm	Total baseline emissions Kg/sqm	Total baseline emissions Kg
Hilltop Road	4.70	6.82	11.52	1038.04
Development Total				**8258**

Table 7 – "Be Green" emission levels

The data at Table 5 confirms that overall emissions – including unregulated energy use - have been reduced by **50.62%** over and above the baseline model, with a **45.96%** 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 **71.65%.**

8.0 Sustainable Design & Construction

The Sustainability credentials of the proposed residential development are set out below; based on the assessment criteria developed by the Building Research Establishment

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.

More specifically, the design team have undertaken a pre-demolition audit on the existing structure to confirm the reasoning behind the proposal for demolition and redevelopment, as well as to identify materials that can be re-used/re-purposed within the new construction and utilise same accordingly.

New 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 will be required to produce a site waste management plan and sustainable procurement plan, in line with BREEAM requirements, which will reference the pre-demolition audit; this will enable the procurement plan to 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.

Operational 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 pump systems for heating and hot water.

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 avoid 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.

The heat pump external unit will be housed within an acoustic enclosure.

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, including specific advice on how to reduce unregulated energy uses.

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 will minimise water use as far as practicable by incorporating appropriate water efficiency and water recycling measures. The applicants will ensure that the dwelling meets the required level of 105 litres maximum daily allowable usage per person.

Sustainable Urban Drainage (SuDs)

The existing site is predominantly made up entirely of building and hard surfaces. Accordingly, the introduction of new planted areas and no increase in hard standing will help to reduce the levels of surface water run-off.

Ecology and Biodiversity

Clearly, the existing site is 100% previously developed, so any improvement on this situation would increase biodiversity.

The development will incorporate a new landscaping plan to optimise site ecology.

9.0 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 were built to a standard to meet only the minimum requirements of current building regulations, the total amount of CO_2 emissions would be **16,725 Kg/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 **15,280 Kg/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 heat pump technology for the generation of heating and hot water for the project, alongside a 0.99kwp PV array.

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 **8,258 Kg/year**, representing a total reduction in emission over the baseline model, taking into account unregulated energy, of **50.62%.**

In addition, the final SAP outputs at **Appendix C**, with the associated SAP10 calculations at **Appendix D** demonstrate that the building achieves an overall improvement in regulated emissions over the Building Regulations Part L standards for regulated emissions of minimum of **71.65%.**

Tables 8 & 9 Demonstrate how the Hilltop Road project complies with the London Plan requirements and the GLA guidance relating to zero carbon development.

Key	Tonnes/annum
Baseline CO_2 emissions (Part L 2013 of the Building Regulations Compliant Development)	11.82
CO2 emissions after energy demand reduction (be lean)	10.37
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean)	0.00
CO2 emissions after energy demand reduction (be lean) AND heat network (be clean) AND renewable energy (be green)	3.35

Table 8 – Carbon Emission Reductions – Domestic Buildings

	Regulated Carbon Dioxide Savings	
	(Tonnes CO2 per annum)	%
Savings from energy demand reduction	1.45	12.28
Savings from heat network	0.00	0.00
Savings from renewable energy	7.02	59.39
Total Cumulative Savings	8.47	71.66
	(Tonnes CO_2)	
Carbon Shortfall	3.35	
Cumulative savings for off-set payment	100.5	
Cash-in-lieu Contribution	£N/A	

Table 9 – Regulated Emissions Savings – domestic Buildings

Appendix A - Baseline/Un-regulated Energy Use: - SAP Outputs & Target Emission Rates

Appendix B - Energy Efficient Design: - SAP Outputs & Dwelling Emission Rates

Appendix C - Generating energy on-site: - Final SAP Outputs & Dwelling Emission Rates

Appendix D - SAP10 - GLA SAP10 Conversions Spreadsheet