Energy Statement

192 Haverstock Hill

Sasha Traders Ltd

October 2014

XCO2 energy

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Contents

About us:
XCO2 Energy are a low-carbon consultancy working in the built environment. We are a multi-disciplinary company consisting of both architects and engineers, with specialists including CIBSE low carbon consultants, Code for Sustainable Homes, EcoHomes and BREEAM assessors and LEED accredited professionals.

	Issue 01	Issue 02	Issue 03	
Remarks	Draft			
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Checked by	RM	RM	TS	
Authorised by	RM	RM	RM	
Date	20/04/12	15/06/12	10/10/14	
Project reference	8241	8241	8241	

Executive Summary

This report assesses the predicted energy performance and carbon dioxide emissions of the proposed development at 192 Haverstock Hill, based on the information provided by the design team. The scheme is for 5 new apartments and florist/retail space of 369m^2.

The methodology used to determine the CO_2 emissions is in accordance with the London Plan's three-step Energy Hierarchy (Policy 5.2A) outlined below:

1. Be Lean - use less energy
The first step deals with the reduction in energy use, through the adoption of sustainable design and construction measures.

In accordance with this strategy, the development at Haverstock Hill will incorporate a range of energy efficiency measures including levels of insulation far beyond building regulation requirements, the installation of high performance glazing and energy efficient lighting. The implementation of these measures would potentially reduce regulated CO_2 emissions by 4.4%, when compared to a notional building built to current Part L Building Regulations (2013).

2. Be Clean - supply energy efficiently
The second strategy takes into account the efficient supply of energy, by prioritising decentralised energy generation.

The London Heat Map indicates that no existing district heating networks are situated within close proximity of the site. Therefore it would not be cost effective adopt this solution. A high efficiency gas boiler will be used to supply space heating and hot water for the dwellings.

3. Be Green - use renewable energy
The third strategy covers the use of renewable technologies.

A feasibility study was carried out for this development and a range of renewable technologies were analysed. The analysis included a biomass heating system, ground-source heat pumps, air-source heat pumps, photovoltaics, solar thermal and wind turbines.

The analysis demonstrated that roof mounted photovoltaics were the most suitable renewable technology for this development. The installation of a 51.6m^2 photovoltaic array at 8.26kWp would potentially reduce regulated CO_2 emissions by a further 24.9%.

Conclusion

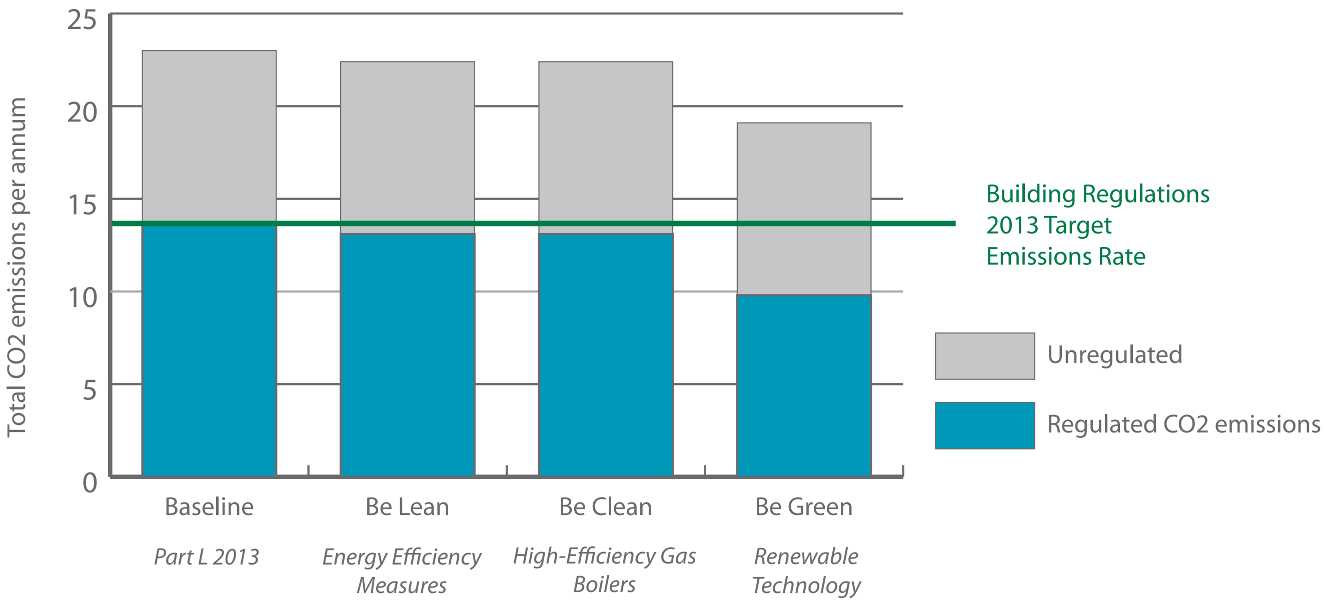
The graph on the following page provides a summary of the regulated and unregulated CO_2 emissions at each stage of the London Plan Energy Hierarchy.

It can be seen on the graph that the development exceeds Building Regulations compliance through energy efficiency alone, with further reductions made through renewable energy.

The renewable regulated CO_2 savings are above the 20% aspiration set by Camden Council.

In total, the development is expected to reduce regulated CO_2 emissions by 28.2% when compared with a notional building built to current Part L Building Regulations (2013), which is a significant saving for a small development like this.

The Energy Hierarchy



Carbon Dioxide Emissions After Each Stage of the Energy Hierarchy

	Carbon dioxide emissions (tonnes CO_2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L Compliant Development	13.7	9.3
After energy demand reduction	13.1	9.3
After CHP	13.1	9.3
After Renewables	9.8	9.3

Regulated Carbon Dioxide Savings From Each Stage of the Energy Hierarchy

	Regulated Carbon Dioxide Savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	0.6	4.4%
Savings from CHP	0.0	0.0%
Savings from renewable energy	3.3	24.9%
Total Cumulative Savings	3.9	28.2%

Introduction

The 192 Haverstock Hill development is located next to Belsize Park Underground Station within the London Borough of Camden. The development replaces a single storey florist.

The proposed development consists of 5 storeys, including a basement. The ground and basement floors are to be 369m² of A1 (shop) or A3 (food and drink) retail space. Five apartments will be located on the first to fourth floors.

This document discusses the expected energy performance of the development and explains the inclusions and design features that will reduce the energy use and arising CO_2 emissions of the development. These include energy efficiency measures, communal heating systems and low carbon technologies. This is in line with the London Borough of Camden.

The Camden Core Strategy (November 2010) requires Code for Sustainable Homes Level 4, with 50% of the unweighted credits in the Energy category (Development Policy DP22, Camden Planning Guidance paragraph 9.8). Please refer to the supplementary Sustainability Report on how this standard has been met.

The Camden Core Strategy

This report refers to how the development addresses the energy policies of section 5 of the London Plan, including:

- Policy 5.2 Minimising Carbon Dioxide Emissions
- Policy 5.3 Sustainable Design and Construction
- Policy 5.5 Decentralised Energy Networks
- Policy 5.6 Decentralised Energy in Development proposals
- Policy 5.7 Renewable Energy where feasible.

In particular, this report details how an attempt has been made to achieve the following CO_2 reduction targets:

- 35% reduction in CO_2 emissions (London Plan 2011 with 2014 updates, Policy 5.2)
- 20% CO_2 reduction by renewables (Camden Core Strategy, as suggested in paragraph 13.11)

It should be noted that the London plan does not require developments of less than 10 dwellings to meet a 35% reduction in CO_2 emissions.

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

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

Demand Reduction (Be Lean)

Our analysis of the energy demand of the development, uses the methodology set in Part L 2013 of the building regulations, by performing preliminary SAP 2012 assessments on some of the dwellings. The results were extrapolated across the other dwellings to obtain the Target Emission Rate (TER) for the 5 apartments within the development. The target energy consumptions were also derived using SAP 2012.

The SAP assessments were also used to calculate the actual energy consumption and Dwelling Emission Rates (DER) of the building taking into account the following energy efficiency measures:

- Improved building fabric
- Reduced air infiltration
- High efficiency condensing boilers
- Passive design features
- Low energy lighting

The emissions and energy consumption of the retail component were based on SBEM modelling of a similar retail space.

The retail emission rates and emission rates of the assessed dwellings for the lean building, are summarised in the following table.

Emission Rates (kgCO_2/m^2)

Element	Area (m^2)	TER	DER or BER
Flat 1	54.4	25.63	25.67
Flat 2	40.5	23.09	22.65
Flat 3/4	75.5	17.05	16.23
Flat 5	86.0	19.28	19.01
Retail	369	19.25	18.07

The energy demand reduction measures which were applied to the SAP assessments are described in more detail under the headings which follow.

Passive Design Measures

Enhanced Building Fabric

The heat loss of different building elements is dependent upon their U-value. The lower the U-value, the better the level of insulation of a particular element. A building with low U-values reduces its heating demand during the cooler months.

The development will achieve the following U-values by incorporating very high levels of insulation (see table below).

U-Values (W/m^{2}K)

Element	Building regulations	Proposed	Improvement
Walls	0.30	0.15	50%
Ground Floor	0.25	0.1	60%
Roof	0.2	0.1	50%
Windows	2.0	1.2	40%

Air Tightness

Heat loss may also occur due to air infiltration. Although this cannot be eliminated altogether, good construction detailing and the use of best practice construction techniques can minimise the amount of air infiltration into a building.

Current Part L Building Regulations (2013) sets a maximum air permeability rate of 10m^3/m^2 at 50Pa. The development is likely to improve upon this to achieve 3m^3/m^2 at 50Pa through the application of best practice construction techniques.

Thermal Bridging

The dwellings will also minimise heat loss through thermal bridging. This will be achieved by following Accredited Construction Details or designing specifically to reduce the thermal bridging y-value down to less than 0.08 W/m^{2}K.

Lighting
Daylight has been considered and maximised in the design of the building, by incorporating large windows within the habitable rooms of the dwellings.

A glass canopy has been installed to the entrance of the ground floor retail, as well as large glazing on the facade to the street. In addition, a translucent glass floor has been incorporated to provide light to part of the basement.

Active Design Measures

High Efficacy Lighting
The development intends to incorporate low energy light fittings throughout the buildings. 100% of all light fittings will be specified as low energy lighting, and will accommodate compact fluorescent (CFL's) or fluorescent luminaries only.

Internal areas of the retail with infrequent use will be fitted with occupant sensors, whereas daylit areas will receive daylight sensors.

High Efficiency Boiler
Gas boilers are available which have efficiencies above 90%. These highly efficient boilers will maximise the amount of energy obtained from the gas supply, thus reducing the amount of gas burned and CO_2 emissions released.

All dwellings will incorporate individual high efficiency gas boilers (SEDBUK rating A).

A further component can be added to domestic boilers which recover some of the heat from the flue gas. Flue gas heat recovery units preheat the mains water before it enters the boiler, with further reductions in gas consumption and CO_2 emissions.

CO_2 Emissions

The table below shows a breakdown of energy consumption and emissions for heating, cooling, and electricity demands. From this table it is possible to see the savings made from each demand at the Lean stage of the energy hierarchy.

Breakdown of Emissions for the Domestic and Non-Domestic Uses

	Baseline (Part L 2013)			Lean		
	Energy (kWh/year)	CO_2 emissions ($kgCO_2$/year)	CO_2 ($kgCO_2/m^2$)	Energy (kWh/year)	CO_2 emissions ($kgCO_2$/year)	CO_2 ($kgCO_2/m^2$)
Hot Water	10,590	2,290	3.3	10,780	2,330	3.3
Space Heating	18,620	4,020	5.7	14,140	3,050	4.3
Cooling	0	0	0.0	0	0	0.0
Auxiliary	1,400	720	1.0	2,620	1,350	1.9
Lighting	13,130	6,660	9.5	12,530	6,360	9.1
Equipment (not inc. in Part L)	17,890	9,280	13.2	17,890	9,280	13.2
Total Part L	43,730	13,690	19.5	40,070	13,090	18.6
Total (inc Equip)	61,620	22,970	32.7	57,960	22,370	31.9

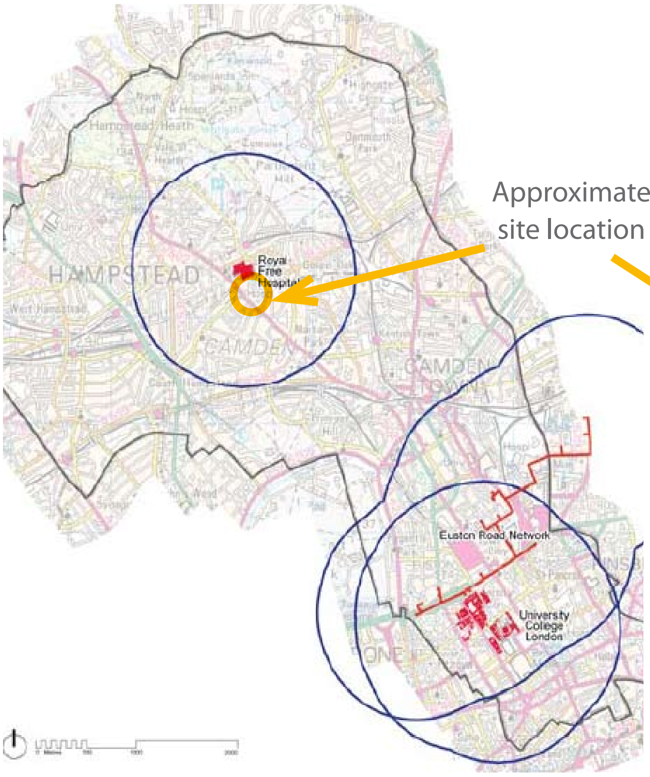
Efficient Supply of Energy (Be Clean)

The energy supply for the development has been considered in accordance with the London Plan decentralised energy hierarchy. The hierarchy listed in Policy 5.6 states that energy systems should be specified in the following order:

1. Connection to existing heating and cooling networks
2. Site wide CHP network
3. Communal heating

This is in line with the flowchart given within the Camden Planning Guidance.

Centralising supply of energy, such as in the above systems, minimises distribution losses and achieves a greater efficiency than installing separate systems and thus, reducing CO_2 emissions.



Sourced from figure 4 in the Camden Planning Guidance indicating existing and emerging heat networks and 1km radius. Approximate location of site is marked.

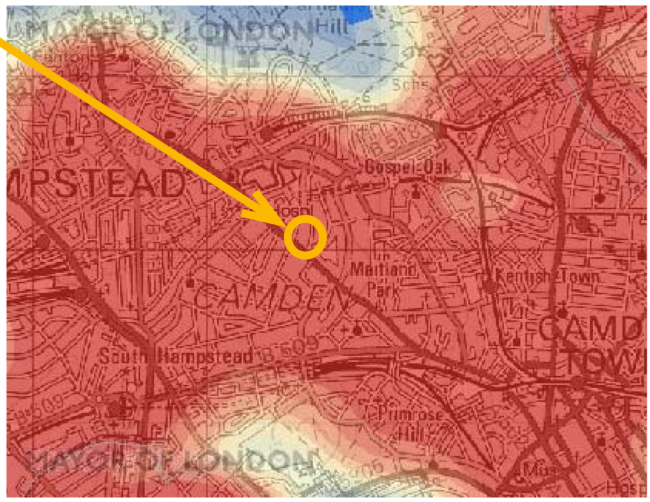
Connection to Existing Low Carbon Heat Distribution Networks

The London Heat Map identifies existing and potential opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study.

An excerpt from the London Heat Map below shows the energy demand for the area surrounding the site. Darker shades of red signify areas where heat demand is high and lighter colours where heat demand is low. The map indicates that there are no existing or proposed networks near to the development.

An excerpt from the Camden Planning Guidance is shown (bottom left) indicating the proximity of the Royal Free Hospital future heat network. All developments should consider connection to a heat network if they are within 1km.

A connection to this network would be costly given the road and rail disruption due to laying the network extension. Works of this size would be unreasonable for a small development such as 192 Haverstock Hill.



London Heat Map image of area surrounding development

Combined Heat and Power

CHP, or Cogeneration, is the production of electricity and useful heat from a single plant, improving the overall energy conversion efficiency from between 25-35% to around 80%.

For a wide range of buildings, CHP can offer an economical method of providing heat and power which is less environmentally harmful than conventional methods.

However, the economic viability of CHP is heavily dependent on the demand for heat and power. For small scale residential and retail developments, the use of a CHP engine is not likely to be feasible.

For a communal CHP system at this development to operate for more than 6,000 hours per year, it would have a thermal output of approximately 3 kW, this is well below the output of commercially available CHP units and therefore CHP is not viable for the site.

Smaller units, designed for individual dwellings, are only just coming to market now and are yet to be proven. Studies from the Carbon Trust have shown that they may not be effective at reducing CO_2 emissions and have a much higher capital cost than conventional gas boilers.

As residential heat loads tend to be concentrated in the early morning, due to the hot water demand for showering, a large thermal store would have to be installed on site. Limited space on site and the small heat requirements deem CHP unsuitable for this development.

Communal Heating

Another form of communal heating could be considered, instead of CHP.

In a communal energy system, energy is generated in a central plant room and distributed via a small scale network to the surrounding residencies and commercial units. Possible communal heating systems could be a gas boiler or a biomass boiler which is discussed further within the renewables section.

This system is not considered suitable for the development due to the space requirements. A small heating network would result in heat loss from the pipes. Placing a plant room on one of the roofs has been considered, but this would limit roof space options, such as green roofs and photovoltaic arrays.

Ener-G 150kW CHP. The development will not have enough hours of demand to run a CHP system efficiently

Renewable Energy (Be Green)

Once energy demand has been minimised, methods of generating low and zero carbon energy can be assessed.

As previously discussed, individual high efficiency gas boilers are to be installed within each dwelling and the retail. The development will incorporate renewable energy technology to further reduce or offset it's CO_2 emissions.

The renewable technologies to be considered for the development are:

- Biomass
- Photovoltaic panels
- Solar thermal panels
- Ground source heat pumps
- Air source heat pump
- Wind energy

In order to determine the feasibility of the above technologies, their suitability for the site and compatibility with the measures already implemented through the Lean step has been appraised. The technologies deemed suitable will be assessed in more detail.

Where possible, each system has been sized to meet a 20% CO_2 reduction in line with Camden Council's aspirations.

A summary and comparison of the technologies is provided at the end of this document.

Biomass

A biomass system designed for this development would be fuelled by wood pellets due to their high energy content. Wood pellets also require less volume of storage than other biomass fuels, less maintenance and produce considerably less ash residue.

Realistically, individual biomass boilers located in each apartment would not be feasible due to cost, space and technical limitations. Therefore, as with communal systems (see page 9), a small heating network would be required to distribute hot water to each dwelling from a centralised biomass plant.

Analysis shows that there are several reasons why biomass is not an appropriate technology for this development:

- there are concerns over local air quality and the increase of NOx emissions as a result of burning wood as fuel;
- no available central plant room space is available on site;
- there is narrow access down the side street adjacent to 192 Haverstock Hill which is potentially problematic for biomass pellet deliveries;
- there may be issues in finding a local biomass supplier.

Example of pellet boiler and pellet storage room.
Source: Energy Crops Limited

Biomass Output Summary		
% of heating load supplied by biomass	90	%
Biomass system efficiency	90	%
Carbon intensity of biomass	0.039	$kgCO_2/kWh$
Backup System Efficiency	90	%
Carbon intensity of backup	0.216	$kgCO_2/kWh$
Heating demand met	20,190	kWh/yr
Total CO_2 savings	4.0	t/yr
Lean CO_2 emissions	13.1	t/yr
% regulated CO_2 reduction	30.3	%
% total CO_2 reduction	17.7	%

Ground Source Heat Pumps

There are limited options for the use of ground source heat pumps (GSHP) in this development as no space is available for horizontal ground source heat exchangers (buried in trenches) or vertical boreholes.

Any ground source loops will have to be installed within the building's footprint. Energy piles can offer this, as the loop heat exchangers are incorporated into the foundation piles. This is achieved by attaching the ground loop to the wire piling mesh before sinking it into the ground and filling with concrete. This innovative solution limits groundworks on site, whilst still supplying a free source of heat to the building.

Should piling be required for the development, the energy piles would be approximately 12m-16m each in length and spaced at 5m centres beneath the ground floor slab of the development. Thermal fluid would be circulated around the closed ground loops absorbing heat from the ground and relaying this heat via an electrically driven heat pump for use in the building.

GSHP Output Summary		
COP Heat	4.0	
Carbon Intensity of Electricity	0.519	$kgCO_2/kWh$
Proportion of Space Heating met by GSHP	90	%
Proportion of Cooling met by GSHP	100	%
Energy met by GSHP	13,880	kWh/yr
Energy used by GSHP	3,470	kWh/yr
Total CO_2 savings	1.5	t/yr
Lean CO_2 emissions	13.1	t/yr
% regulated CO_2 reduction	11.7	%
% total CO_2 reduction	6.8	%

The system would deliver space heating through a low-temperature efficient distribution network such as underfloor heating. Approximately 90% of the space heating demand can be supplied by the ground source heat pump if it is sized to approximately 50% of the peak heating load. A high efficiency gas boiler would provide top-up heat and domestic hot water.

While a feasible option, the installation of energy piles would have the following concerns:

- there is currently no clarification that foundation piles will be required during the development;
- no option to replace ground loops if malfunction should occur.

Viessman internal heat pump

Energy piles in place

Air Source Heat Pumps

Air source heat pumps employ the same technology as GSHPs. However, instead of using heat exchangers buried in the ground, heat is extracted from the external ambient air.

A benefit of ASHP is that they produce space heating and hot water through electricity, thereby negating the need for a gas connection to each unit.

ASHPs tend to have a lower COP than GSHPs due to variable air temperature throughout the year, when compared to ground temperature. This is because heat pumps are more efficient when the temperature difference between the heat source (the air in this instance) and the space demand is lower.

Another factor to consider is the location of ASHP evaporators. These need to be located outside of the building. Any noise associated with the units, could potentially be an issue, particularly at night. In addition, outdoor plant space would be required for this option.

Sizing an air source heat pump system to 90% of the space heating only provides an 4.8% CO_2 reduction. In addition to the outdoor space requirements and the noise issues mean ASHP was not considered further for Haverstock Hill.

ASHP Output Summary		
COP Heat	3.2	
Carbon Intensity of Electricity	0.519	$kgCO_2$/kWh
Proportion of Space Heating met by ASHP	90	%
Proportion of Cooling met by ASHP	100	%
Energy met by ASHP	13,880	kWh/yr
Energy used by ASHP	4,340	kWh/yr
Total CO_2 savings	1.1	t/yr
Lean CO_2 emissions	13.1	t/yr
% regulated CO_2 reduction	8.3	%
% total CO_2 reduction	4.8	%

Sanyo external unit and internal heat pump

Wind Energy

The development could be installed with wind turbines to achieve the 20% renewable energy target. Turbines in this case would be building-integrated due to lack of space on site.

Wind turbine outputs are based on the mounting height, turbine wind curve and wind data for the site from the BERR website. This was used in the Carbon Trust Wind Yield Estimation Tool.

The average annual wind speed at a mounting height of 20m above the surrounding building canopy is estimated to be 3.8 m/s. It is not generally recommended that wind turbines should be installed in any area where average wind speeds fall beneath 5m/s.

Two Proven wind turbines were considered for installation. Two 2.5kW wind turbines would achieve a 12.8 % reduction in CO_2 emissions for Haverstock Hill while alternatively two 6kW turbines could be installed for a 32.2% saving.

In order to meet the 20% CO_2 saving, too many wind turbines are required to fit within the Haverstock Hill development. Due to the space restrictions on site and the low predicted wind speeds, this technology is not considered to be suitable for Haverstock Hill.

A building-mounted 6kW Proven wind turbine

2.5kW Wind Turbine Output Summary		
Average wind speed at site	3.5	m/s
Electricity offset	1,760	kWh/yr
Carbon intensity of offset electricity	0.529	$kgCO_2/kWh$
Total CO_2 savings	1.68	t/yr
Lean CO_2 emissions	13.1	t/yr
Percentage regulated CO_2 reduction by 2.5kW wind turbine	12.8	%
Percentage total CO_2 reduction by 2.5kW wind turbine	7.5	%
Number required for 20% saving	4	

6kW Wind Turbine Output Summary		
Average wind speed at site	3.5	m/s
Electricity offset	4,430	kWh/yr
Carbon intensity of offset electricity	0.529	$kgCO_2/kWh$
Total CO_2 savings		t/yr
Lean CO_2 emissions		t/yr
Percentage regulated CO_2 reduction by 6kW wind turbine	32.2	%
Percentage total CO_2 reduction by 2.5kW wind turbine	18.9	%
Number required for 20% saving	2	

Photovoltaics

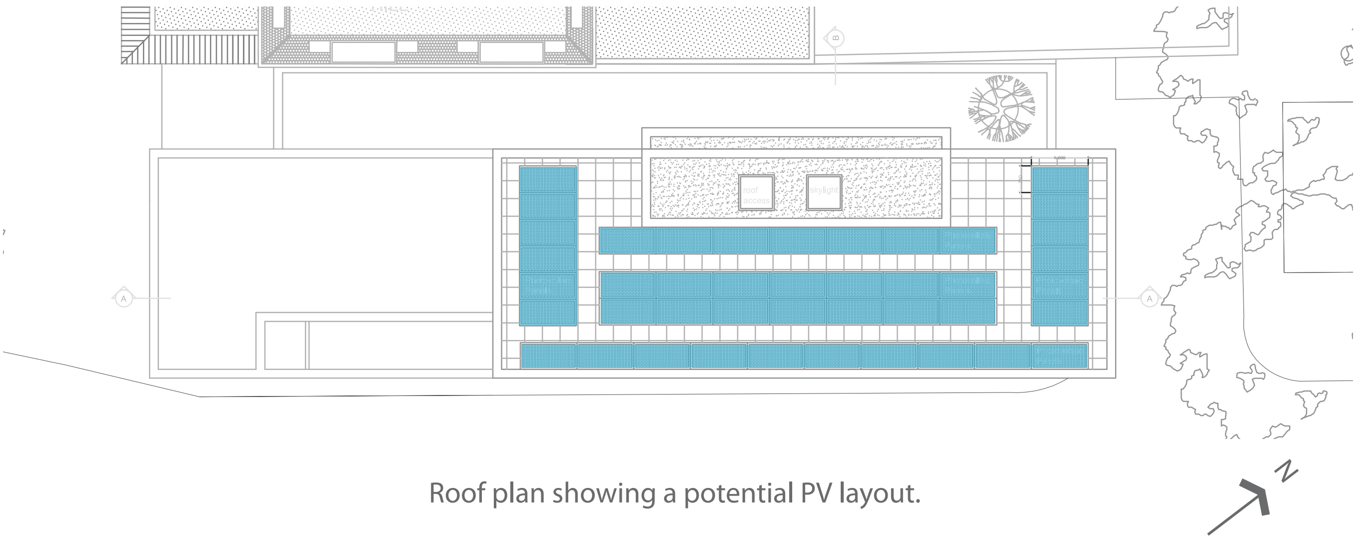
Currently, there are four types of solar cells available: mono-crystalline, poly-crystalline, thin film and hybrid. Mono-crystalline and hybrid cells are the most expensive to produce but are the most efficient (12-20%), poly-crystalline cells are cheaper but their efficiency is lower (9-15%) and thin film cells are only 5-8% efficient but can be produced as thin flexible sheets.

In this development, the upper roof is considered the most suitable for photovoltaics. The lower roof spaces will be heavily shaded by the higher floor, meaning any panels installed here would suffer from a drop in output. These roof areas are best left as green roofs.

In order to make maximum use of the roof space available, the panels are to be installed horizontally allowing more panels to be installed without self-shading issues.

There is sufficient space on these upper roofs to meet the Camden Council aspiration of 20% CO_2 reduction from renewables. The photovoltaic area which meets this target and is suitable for 192 Haverstock Hill is 51.6m^2 of photovoltaic panels, rated at about 8.26kWp.

Photovoltaic Panels Output Summary		
Module Efficiency	16	%
Orientation	Horizontal	
Predicted site solar energy	950	kWh/m^2/yr
System losses	20	%
System peak power	8.26	kWp
Array area	51.6	m^2
Primary electricity offset by PV array	6,280	kWh/yr
Total CO_2 savings	3.3	t/yr
Lean CO_2 emissions	13.1	t/yr
Percentage regulated CO_2 reduction	24.9	%
Percentage total CO_2 reduction	14.6	%



Roof plan showing a potential PV layout.

Solar Thermal

Solar thermal modules would be installed in a similar way to PV arrays, i.e. there orientation and inclination would be dependent on the roofs that they are able to be installed onto.

Evacuated tube and flat plate collectors are both commercially available. Although more expensive than flat plate collectors, their higher efficiencies and higher temperatures make evacuated tube collectors a better choice for the UK climate.

The proposed system would be used for domestic hot water only, not space heating since this is not required during the season when solar thermal is the most effective.

A suitable solar thermal system would supply approximately 50% of the annual hot water consumption (the maximum feasible due to seasonal variations), and would be topped up with high efficiency gas boilers.

Calculations show that even by having a solar fraction of 100% solar thermal does not meet the 20% CO_2 renewables target. 10m^2 of solar thermal would reduce CO_2 emissions by 6.4%.

Solar thermal can provide limited CO_2 savings. Higher CO_2 savings can be achieved by the installation of photovoltaics.

Solar Thermal Output Summary		
Collector Type	Evacuated Tube	
System Efficiency	40	%
Orientation	SE-facing, 30 deg	
Predicted site solar energy	1,027	kWh/m^2/yr
Total collector area	10	m^2
Primary gas energy offset by Solar Thermal system	3,800	kWh/yr
Total CO_2 savings	0.8	tCO_2/yr
Lean CO_2 emissions	13.1	t/yr
Percentage regulated CO_2 reduction	6.4	%
Percentage total CO_2 reduction	3.7	%

Evacuated Shell and Tube Solar Thermal Panel

Renewable Energy Summary

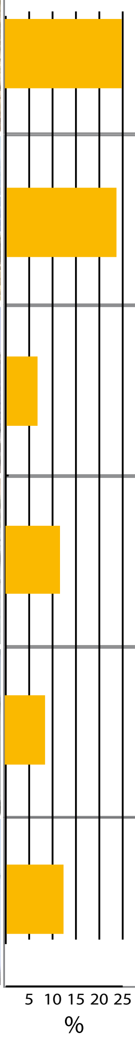
The table below summarises the factors taken into account in determining the appropriate renewable technology for this project. This includes estimated capital cost, simple payback, lifetime, level of maintenance and level of impact on external appearance.

The final column indicates the feasibility of the technology in relation to the site conditions (10 being the most feasible and 0 being unfeasible).

It is important to note that the information provided is indicative and costs are based upon initial estimates. Payback calculations do not take into consideration any grants or inflation. Current feed-in-tariffs have been included.

From the feasibility study it is clear to see that PV is the most feasible option for the site.

192 Haverstock Hill



	% CO_2 Reduced	Capital Cost	Simple Payback	Tonnes CO_2 per year	Lifetime	Mainten-ance	Impact on External Appearance	Site Feasibility
Biomass		£30-40k	10-15	4.0	20yrs	High	Low	2
PV		£30-40k	15-20	3.3	25yrs	Low	Med	9
Solar Thermal		£12-15k	10-15	0.8	25yrs	Low	Med	7
GSHP		£25-35k	15-20	1.5	20yrs	Med	Low	3
ASHP		£20-25k	10-15	1.1	20yrs	Med	Med	5
Wind		£70-90k	no payback	1.7	25yrs	Med	High	0

Conclusion

The regulated CO_2 emissions for this development have been reduced by 28.2%, once energy efficiency measures and renewables are taken into account.

The table at the bottom of the page shows the savings made at each stage of the energy hierarchy. The reductions made through each step have been outlined below:

1. Be Lean - use less energy

In accordance with this strategy, this development will incorporate a range of energy efficiency measures including efficient lighting, levels of insulation beyond building regulation requirements and the installation of high performance glazing. The implementation of these measures would potentially reduce regulated CO_2 emissions by 4.4%, when compared to a notional building built to current Part L Building Regulations (2013).

2. Be Clean - supply energy efficiently

The feasibility study of CHP and communal heating systems showed that they were not suitable for the development due to the space limitations on site and low heat demand. There are also no district heat networks close enough to the site to be considered for connection to. However, the developer is committed to installing high efficiency condensing gas boilers into each dwelling.

3. Be Green - use renewable energy

The renewables feasibility study analysed a number of renewable technologies for their suitability for the site. The analysis concluded the following technologies were unsuitable for the development:

- Biomass - local air pollution and difficulties surrounding fuel deliveries
- Wind turbines - low predicted annual energy and lack of space on-site
- GSHP - lack of space on site meant energy piles were to only option, with which there would be concerns over the groundworks involved
- ASHP - as GSHP, with additional noise implications and lower operating CoP
- Solar thermal - low CO_2 saving in comparison to photovoltaics

The analysis demonstrated that photovoltaics were the most suitable renewable technology for this development. The installation of 51.6m^2 of photovoltaic array at 8.26kWp would potentially reduce regulated CO_2 emissions by a further 24.9%. This exceeds Camden Council's aspiration of 20% reduction by renewables.

Overall, the proposed development at 192 Haverstock Hill achieves a 28.2% reduction in regulated CO_2 emissions in comparison to a Baseline Building constructed to Part L 2013 standards. This meets Camden Council Policy targets and enable the development to achieve Code for Sustainable Homes Level 4.

Regulated Carbon Dioxide Savings From Each Stage of the Energy Hierarchy

	Regulated Carbon Dioxide Savings	
	Tonnes CO_2 per annum	%
Savings from energy demand reduction	0.6	4.4%
Savings from CHP	0.0	0.0%
Savings from renewable energy	3.3	24.9%
Total Cumulative Savings	3.9	28.2%