23 RAVENSHAW STREET

LONDON NW16 1NP

ENERGY ASSESSMENT

For:

Mr Chris Taylor

July 2016

Project no. 3174

23 RAVENSHAW STREET, HAMSTEAD, CAMDEN, NW6 1NP

ENERGY ASSESSMENT

Mr Chris Taylor

REVISION	DATE	PREPARED BY	REVIEWED BY	COMMENTS
0	12/07/2016	M. Kurkowska		For Comment
1	24/01/2017	M. Kurkowska		For Comment
2	17/03/2017	M. Kurkowska		For Comment
3	04/04/2017	M. Kurkowska		For Comment

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1.0 Introduction

1.1 About C80 Solutions

C80 Solutions are independent Sustainability and Energy Consultants providing carbon reduction solutions to help the UK achieve its carbon emission reduction target of 80% by 2050 - as set out in the Government's Climate Change Act 2008.

Our comprehensive range of solutions for the construction industry are broken down into two sectors; i) Building Compliance and ii) Consultancy.

Building Compliance:
Our Building Compliance services include; Code for Sustainable Homes Assessments, SAP Calculations, On Construction Energy Performance Certificates, Water Efficiency Calculations, SBEM Calculations, Commercial EPCs, BREEAM assessments and Air Tightness Testing.

Consultancy:
Our experience and exposure to building compliance combined with previous experience and IEMA accredited training means we have built up a vast amount of knowledge which enables us to provide our clients with invaluable advice. Our Consultancy services include; Renewable Energy Feasibility Reports, Energy Statements for planning, Sustainability Statements and Building Compliance Advisory Reports.

1.2 Introduction to Development

C80 Solutions have been instructed by Mr Chris Taylor to prepare an Energy Assessment for the proposed residential development of 23 Ravenshaw Street, London, NW6 1NP. The location of the proposed development can be seen in Figure 1.

The proposed scheme is for a demoition of the exisitng building and erection of a three – storey, plus basement level, residential dwelling of eight new flats comprsing: 4*2- beds and 4*3-beds. The plan and elevations of the proposed development can be seen in Figure 2 and 3 respectively.

Figure 1: OS Map 1:1250

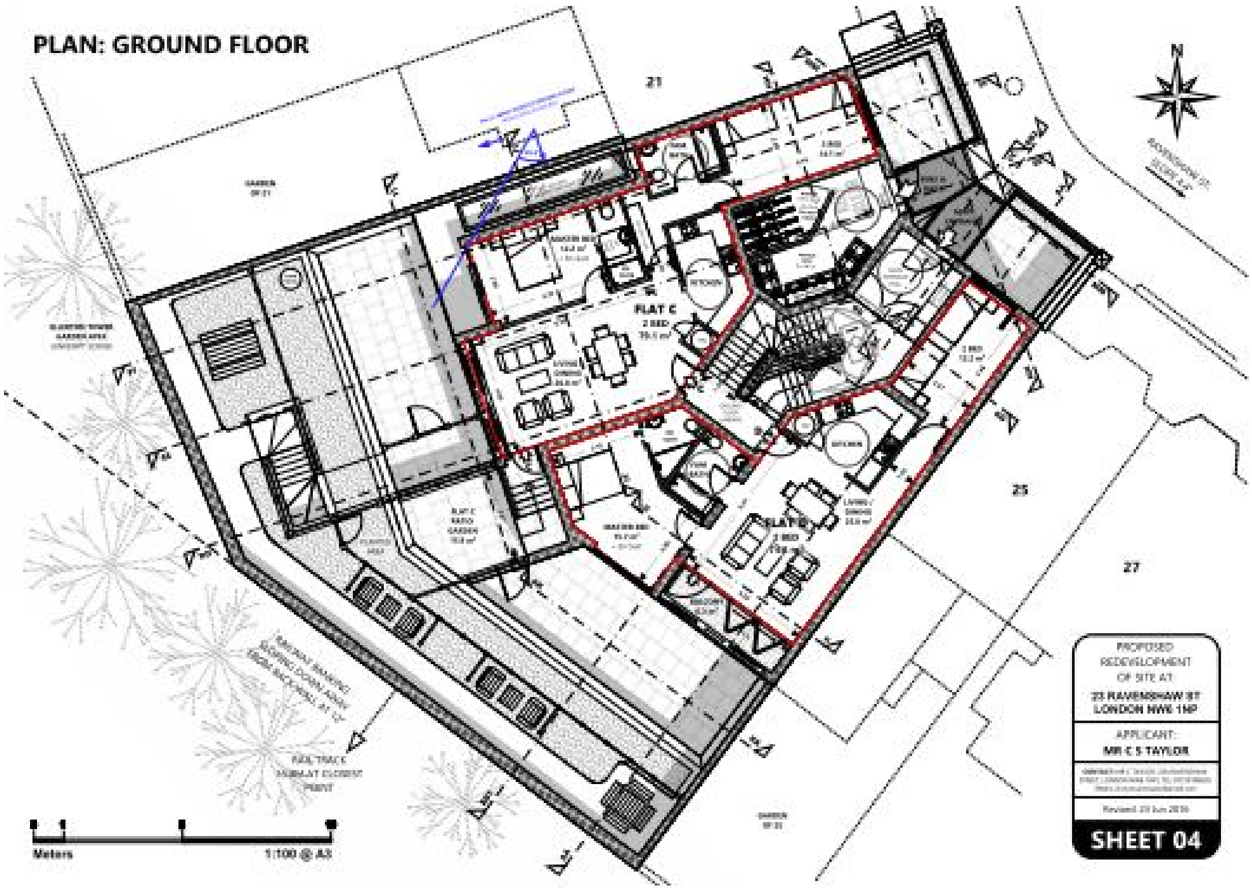

Figure 2: Plan of the Proposed Development - Ground Floor

Figure 3: Front Elevations of the Proposed Development

The statement will demonstrate how the predicted CO2 emissions of the development will be reduced by at least 20% compared with a typical 2013 Building Regulations Part L compliant building. The report will also demonstrate that 20% of achieved reduction in CO2 emissions will originate from on-site renewable technologies, as required by the London Borough of Camden Policy CS13: '*Tackling climate change through promoting higher environmental standards*.'

1.3 Planning Policy

The following Energy/CO2 related planning policies are applicable to this development:

Policy 5.2 of the London Plan - Minimising Carbon Dioxide Emissions

Planning decisions

A Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

1 Be lean: use less energy
2 Be clean: supply energy efficiently
3 Be green: use renewable energy

B The Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

Year	*Improvement on 2010 Building Regulations*
2010 – 2013	*25 per cent*
2014 – 2016	35 per cent
2016 – 2036	*Zero carbon*

C Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy.

D As a minimum, energy assessments should include the following details:

1. *Calculation of the energy demand and carbon dioxide emissions covered by Building Regulations and, separately, the energy demand and carbon dioxide emissions from any other part of the development, including plant or equipment,*

that are not covered by the Building Regulations at each stage of the energy hierarchy

2. *Proposals to reduce carbon dioxide emissions through the energy efficient design of the site, buildings and services*
3. *Proposals to further reduce carbon dioxide emissions through the use of decentralised energy where feasible, such as district heating and cooling and combined heat and power (CHP)*
4. *Proposals to further reduce carbon dioxide emissions through the use of on-site renewable energy technologies.*

E The carbon dioxide reduction targets should be met on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, any shortfall may be provided off-site or through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

London Borough of Camden Core Strategy Policy CS13: '*Tackling climate change through promoting higher environmental standards*'

Reducing the effects of and adapting to climate change

The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;
b) promoting the efficient use of land and buildings;
c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:
- ensuring developments use less energy,
- making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks;
- generating renewable energy on-site; and
d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

The Council will have regard to the cost of installing measures to tackle climate change as well as the cumulative future costs of delaying reductions in carbon dioxide emissions.

Local energy generation

The Council will promote local energy generation and networks by:

e) working with our partners and developers to implement local energy networks in the parts of Camden most likely to support them, i.e. in the vicinity of:
- housing estates with community heating or the potential for community heating and other uses with large heating loads;

- the growth areas of King's Cross, Euston; Tottenham Court Road; West Hampstead Interchange and Holborn;
- schools to be redeveloped as part of Building Schools for the Future programme;
- existing or approved combined heat and power/local energy networks (see Map 4); and other locations where land ownership would facilitate their implementation.
f) protecting existing local energy networks where possible (e.g. at Gower Street and Bloomsbury) and safeguarding potential network routes (e.g. Euston Road);

Camden's carbon reduction measures
The Council will take a lead in tackling climate change by:
j) taking measures to reduce its own carbon emissions;
k) trialling new energy efficient technologies, where feasible; and
l) raising awareness on mitigation and adaptation measures.

1.4 Methodology

The methodology that has been applied in this report is as follows:

1. Prepare baseline energy calculations for the site based on a Part L 2013 compliant construction specification designed for the development.

2. From the baseline energy calculations, the predicted energy demand for the development in kWh/year and the predicted CO2 emissions in kgCO2/year for the site can be established.

3. Multiplying the site wide predicted CO2 emissions figure by 20% will provide the CO2 reduction target required.

4. Apply energy efficient design principles (improved fabric spec) in order to reduce the energy demand and CO2 emissions of the site. Prepare energy calculations using the improved fabric specification.

5. From these improved calculations, the reduced energy demand for the development in kWh/year and the predicted CO2 emissions in kgCO2/year for the site can be established.

6. Carry out a renewable energy feasibility study to ascertain which LZC technologies would be suitable for the development.

7. Establish the sizing of suitable renewable technologies to ensure the 20% CO2 emission reduction target is met.

2.0 Predicted Annual Carbon Emissions

Baseline SAP 2012 calculations were prepared based on the construction specification shown in table 1 below.

Aspect		New Build
Fabric U-values W/m^2K	**Flat Roof**	0.14
	Other roofs	0.16
	Walls external	0.18
	Ground Floor	0.15
	Party walls	0.00
	Windows	1.20
	Doors and Rooflights	1.30
	Thermal Bridging	y= 0.15
Ventilation	**Airtightness m3/(hr.m^2)**	2
Heating	**Boiler**	Community Boilers (Mains Gas)
	Compensator	n/a
	Hot Water Cylinder	150L in each flat
	Controls	Programmer, Room thermostat and TRVs
	Secondary Heating	none
Low energy lighting		100%
Ventilation		Airflow Duplexvent DV72
Renewables / LZC		None

Table 1: Part L compliant construction specifications

The conducted SAP calculations have shown the proposed development will generate **10,650 kgCO2/year.** In order to satisfy the Local Authority's planning policies on CO2 reduction, the development needs to reduce predicted site wide CO2 emissions by 20%.

Therefore, since the development's predicted CO2 emissions is **10,650 kgCO2/yr**, this would equate to a reduction of **2,130 kgCO2/yr.** In other words, providing the total site emissions comes to equal to or less than **8,520 kgCO2/yr** (10,650 – 2,130) is achieved once improvements have been made to the calculations, this would prove that the 20% reduction target has been met.

3.0 Predicted Annual Energy Demand

Based on using the specification outlined in table 1 above, this would create a total predicted energy demand for the development of **36,601 kWh/year**. The breakdown of this predicted energy demand can be seen in table 2 below. The figures quoted have been derived from the Design Stage SAP 2012 Calculations for the development.

			Predicted Annual Energy Requirements:			Total Predicted Energy Requirement (kWh/yr)
			Space Heating	Water Heating	Lighting, Pumps, Fans	
Plot	No.	Units	Gas	Gas	Electric	
Flat A	1	kWh/yr	3,292	2,351	863	6,506
Flat B	1	kWh/yr	2,148	2,330	866	5,344
Flat C	1	kWh/yr	1,139	2,147	640	3,926
Flat D	1	kWh/yr	800	2,157	648	3,605
Flat E	1	kWh/yr	1,700	2,237	729	4,666
Flat F	1	kWh/yr	1,765	2,254	748	4,768
Flat G	1	kWh/yr	1,623	2,004	480	4,107
Flat G	1	kWh/yr	1,261	1,965	453	3,679
Total			**13,728**	**17,445**	**5,428**	**36,601**

Table 2: Baseline Predicated Annual Energy Demand

4.0 Reducing Carbon Emissions through Energy Reduction, Reuse and Recycling

The Energy Hierarchy sets out the most effective way to reduce a dwelling's CO_2 emissions. Firstly by reducing energy demand, then by using energy efficiently and lastly by incorporating LZC/Renewable technologies.

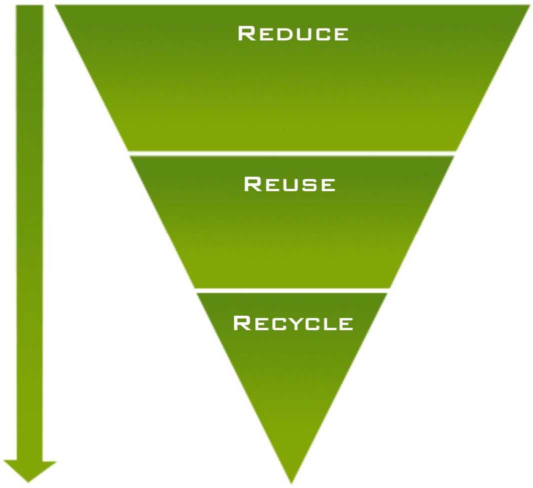

Figure 4: The Energy Hierarchy

Reducing the need for energy usage in the dwelling's design:

The first and most cost beneficial action is to reduce the amount of energy needed by the occupants of the dwelling whilst still maintaining or even improving the comfort conditions. A lot can be achieved through passive design, improving the dwelling's external fabric and following principles to reduce air infiltration.

Energy reduction strategies include:

- Adopting enhanced fabric specifications
- Incorporating energy-efficient lighting: 100% of all new lighting to be energy efficient (CFLs and LED)
- Adopting principles of airtight construction
- All new windows will be double -glazed with uPCV or timber frame
- Passive Solar Design – Solar gain, solar shading, thermal mass
- Natural / Passive Ventilation strategy

5.0 Cooling and Overheating

The proposed development has been designed to follow the cooling hierarchy of Policy 5.9 of the London Plan:

1. Minimising internal heat generation trough energy efficient design
2. Reducing the amount of heat entering the building in summer
3. Use of thermal mass and high ceilings to manage the heat within the building
4. Passive ventilation
5. Mechanical ventilation.

Based on the information provided in Table 1, it is assumed the proposed building is not in high risks of overheating.

Site features affecting vulnerability to overheating		Yes/No
Site location	Urban – within central London or in a high density conurbation	No
	Peri-urban – on the suburban fringes of London	Yes
Air quality and/or Noise sensitivity – are any of the following in the vicinity of buildings?	Busy roads / A roads	Yes - Mill Lane
	Railways / Overground / DLR	Yes
	Airport / Flight path	No
	Industrial uses / waste facility	No
Proposed building use	Will any buildings be occupied by vulnerable people (e.g. elderly, disabled, young children)?	Yes
	Are residents likely to be at home during the day (e.g. students)?	Yes
Dwelling aspect	Are there any single aspect units?	No
Glazing ratio	Is the glazing ratio (glazing: internal floor area) greater than 25%?	Yes
	If yes, is this to allow acceptable levels of daylighting?	Yes
Security - Are there any security issues that could limit opening of windows for ventilation?	Single storey ground floor units	No
	Vulnerable areas identified by the Police Architectural Liaison Officer	No
	Other	No

Table 7: Site features affecting vulnerability to overheating

To minimize the risk of overheating, the developer aims to implement a series of measures, such as:

- ***Green roof***

The developer will install extensive sedum gardens on available flat EPDM roof areas, as shown in Figure 5 below.

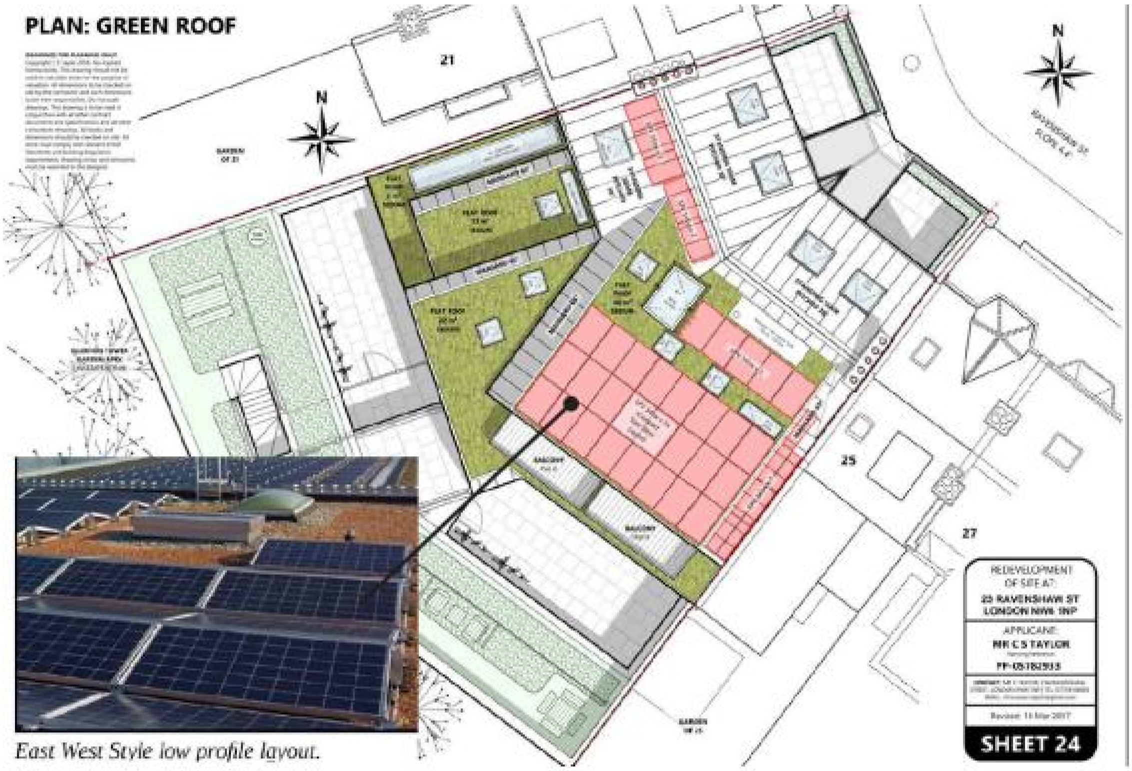

Figure 5: Location of Sedum Blankets on the Roof

Green wall - a green wall of approx. 97m2 will be planted along the back garden wall of the development, of native climbing species, such as: Honeysuckle (*Lonicera periclymenum*), Clematis (*Clematis vitalba*), Jasmin (*Jasmin* sp.), and Ivy (*Hedera helix*). The species will be planted into the ground and supported by a dedicated trellis structures. The location of the green wall is shown in Figure 6 below.

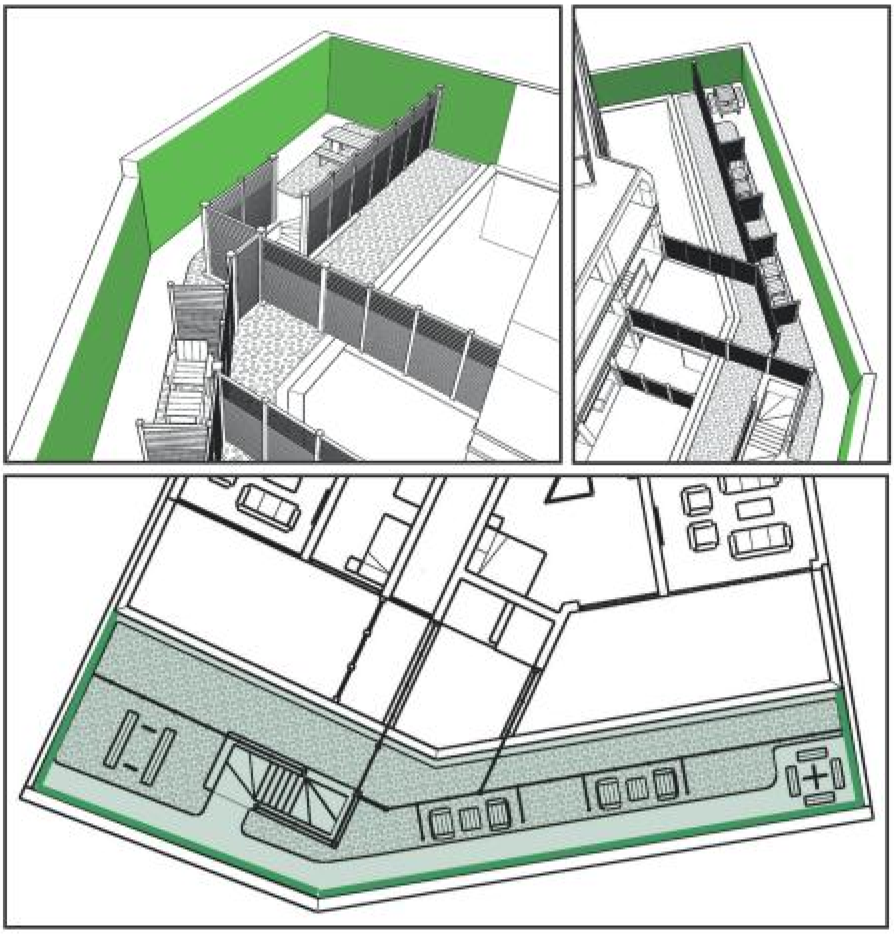

Figure 6: 97m2 of Planted Green Wall Along the Back Garden Wall of the Development

- ***Native Planting Scheme*** **-** 99.07m2 of fully permeable garden area.
- ***Mechanical Ventilation with Heath Recovery*** – the heat recovery system reclaims and redistribute the heat into the property which would have been wasted if a traditional system had been used instead. Unlike these traditional systems, such as trickle vents or extractor fans, little or no thermal bridging occurs from using a MVHR system.
- ***External Shutters*** – the balconies will be equipped with sliding plantation/storm shutters to provide sun screening and help to control overheating in summer.

No mechanical cooling is proposed for the site.

Design features implemented to mitigate overheating risk		Yes/No
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	No
	Will green roofs be provided?	Yes
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	Yes
Materials	Have high albedo (light colour) materials been specified?	No
Dwelling aspect Glazing Totals: Total= 146.80 m2 Openable = 121.58 m2 / 82.82% Fixed = 25.21 m2 / 17.17% S/SE/SW = 105.72 m2 / 72.01% N/NE/NW = 29.15 m2 / 19.86% Roof Lights= 11.93 m2 / 8.13%	% of total units that are single aspect	0
	% single aspect with N / NE / NW orientation	19.86%
	% single aspect with E orientation	0
	% single aspect with S / SE / SW orientation	72.01%
	% single aspect with W orientation	0
Daylighting	What is the average daylight factor range?	1.5%(dining and study rooms), 2% kitchens)
Window opening	Are windows openable?	No
Window opening	What is the average percentage of openable area for the windows?	82.82%
Window opening - What is the extent of the opening?	Fully openable	Yes 82.82%
	Limited (e.g. for security, safety, wind loading reasons)	No
Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	Yes
Shading	Is there any external shading?	Yes (shutters)
	Is there any internal shading?	No
Glazing specification	Is there any solar control glazing?	No
Ventilation – What is the ventilation strategy?	Natural – background	No
	Natural – purge	No
	Mechanical – background (e.g. MVHR)	Yes
	Mechanical – purge	No
Heating system	Is communal heating present?	Yes (community boilers)
	Have horizontal pipe runs been minimised?	Yes

	Do the specifications include insulation levels in line with the London Heat Network Manual	Yes

Table 8: - Design Features Implemented to Mitigate Overheating Risk

Detailed overheating assessment carried out using SAP 2012 software revealed the likelihood of high internal temperature to be medium in the summer months July and August. The SAP calculation reports are attached separately to this report.

SAP 2012 Overheating Assessment

Calculated by Stroma FSAP 2012 program, produced and printed on 04 April 2017

Property Details: Flat 8

Dwelling type:	Flat
Located in:	England
Region:	Thames valley
Cross ventilation possible:	Yes
Number of storeys:	1
Front of dwelling faces:	North East
Overshading:	Average or unknown
Overhangs:	None
Thermal mass parameter:	Indicative Value Low
Night ventilation:	False
Blinds, curtains, shutters:	
Ventilation rate during hot weather (ach):	6 (Windows fully open)

Overheating Details:

Summer ventilation heat loss coefficient:	504.9	**(P1)**
Transmission heat loss coefficient:	87.1	
Summer heat loss coefficient:	592	**(P2)**

Overhangs:

Orientation:	**Ratio:**	**Z_overhangs:**
South West (SW)	0	1
North East (NE)	0	1
South (S)	0	1
West (W)	0	1

Solar shading:

Orientation:	**Z blinds:**	**Solar access:**	**Overhangs:**	**Z summer:**	
South West (SW)	1	0.9	1	0.9	**(P8)**
North East (NE)	1	0.9	1	0.9	**(P8)**
South (S)	1	0.9	1	0.9	**(P8)**
West (W)	1	0.9	1	0.9	**(P8)**

Solar gains:

Orientation		**Area**	**Flux**	**g_**	**FF**	**Shading**	**Gains**	
South West (SW)	0.9 x	18.12	119.92	0.76	0.8	0.9	1070.16	
North East (NE)	0.9 x	10.25	98.85	0.76	0.8	0.9	498.96	
South (S)	0.9 x	2.88	112.21	0.76	0.8	0.9	158.87	
West (W)	0.9 x	0.65	117.51	0.76	0.8	0.9	37.62	
						Total	1765.6	**(P3/P4)**

Internal gains:

	June	**July**	**August**	
Internal gains	544.64	524.11	533.03	
Total summer gains	2411.31	2289.71	2129.4	**(P5)**
Summer gain/loss ratio	4.07	3.87	3.6	**(P6)**
Mean summer external temperature (Thames valley)	16	17.9	17.8	
Thermal mass temperature increment	1.3	1.3	1.3	
Threshold temperature	21.37	23.07	22.7	**(P7)**
Likelihood of high internal temperature	**Slight**	**Medium**	**Medium**	

Figure 7: SAP 2012 Overheating Assessment

6.0 Feasibility Study of Renewable Technologies

This section will assess the technical viability of the following renewable energy technologies for the site in order to rule out unfeasible options:

- Mast mounted wind turbines
- Roof mounted wind turbines
- Solar PV (Photovoltaic) Panels
- Solar Thermal Panels
- ASHP (Air Source Heat Pump)
- GSHP (Ground Source Heat Pump)
- Biomass
- CHP

The following observations have been made with regard to the technical feasibility of integrating renewable energy technologies into this development.

Renewable Technology	Feasible	Reasons
Mast Mounted Wind Turbine	No	There is no open land for a mast mounted wind turbine to be installed on site.
		Currently the BWEA suggests a large wind turbine to be viable where wind speed is 7m/s or above. According to the NOABL database the average wind speeds for the site is: 4.9 m/s at 10m, 5.7 m/s at 25m and 6.2 m/s at 45m height for the property postcode (NW6 1NP). Therefore the wind speeds are not sufficient for a mast wind turbine to be viable.
Roof Mounted Wind Turbine	No	Currently the BWEA suggests a large wind turbine to be viable where wind speed is 7m/s or above. Therefore the wind speeds are not sufficient for a roof mounted wind turbine to be viable.
		Roof mounted wind turbines are not yet a proven technology and a number of technical problems have been identified by manufacturers which are being investigated to rectify these issues. Vibration that can be transmitted to the building structure. Noise from a turbine may cause irritation to occupants of the dwelling and adjacent buildings. Noise may also adversely affect ventilation strategy.
Solar PV (Photovoltaic) Panels/Tiles	Yes	The proposed development has sufficient flat and south-east and south west facing roof areas for solar panels accommodation.
		The roof should be free from overshadowing for most of the day from other buildings, structures or trees. There is sufficient unshaded roof area.
		The site is located in the region with high level of global horizontal irradiation (1,000-1050 kWh/m2/year)
Solar Thermal Collectors	No	The proposed development has flat sufficient roof area that could accommodate solar thermal panels.

		The roof should be free from overshadowing for most of the day from other buildings, structures or trees: there is sufficient unshaded roof area.
		The site is located in the region with high level of global horizontal irradiation (1,000-1050 kWh/m2/year)
		Solar thermal collectors would be compatible with the planned heating system.
		There will be a year round hot water demand.
		In practical domestic solar hot water systems, the solar hot water system is usually run in conjunction with, rather than instead of, a backup conventional boiler and as a result the carbon intensity of the combined system is high relative to other renewables, at some 100-200 gCO2/kWhth. Moreover the high efficiency of modern condensing gas boilers, which can convert over 90% of the calorific value of the fuel into useful heat, means that the carbon intensity of these heat sources is relatively low at 200-300 gCO2/kWhth. As a result domestic solar water heating systems are a relatively expensive way of mitigating carbon emissions when they replace heat from efficient modern boilers. For this reason they are not recommended.
ASHP (Air Source Heat Pump)	No	The proposed developments have not been designed to accommodate the space for a hot water cylinder.
		Condenser units can be noisy and also blow out colder air to the immediate environment causing nuisance to the residents.
		An external ASHP will have to be installed close to the bedrooms, causing noise issues.
		There are reported performance issues with this technology. During the heating season the outside air temperature is often less than the ground temperature. This lower temperature has the effect of reducing the COP. For an air-to-water heat pump the standard specifies test conditions of 7oC outdoor air temperature (source temperature). At external air temperatures lower than this, the COP will fall, as will the heating output of the heat pump. Depending on the application this reduction may be significant, such as during a cold winter morning when building pre-heat is needed.
GSHP (Ground Source Heat Pump)	No	There is no space on the site for drilling vertical or horizontal boreholes for GSHP.
		There is not sufficient space inside all the proposed dwellings for the heat pump equipment.
Biomass Boiler	No	There is an established fuel supply chain for the area.
		There isn’t sufficient space for a delivery vehicle (vehicular access to fuel storage, turning circle etc.)
		There isn't sufficient space in the proposed buildings for a wood-fuel boiler and associated auxiliary equipment.
		There isn't sufficient space for fuel storage

		to allow a reasonable number of deliveries.
		Biomass systems are management intensive (fuel sourcing, transport, storage) and require adequate expertise from users.
CHP	No	Given the proposed building use there won't be a high demand for heat for most of the year, therefore CHP won't be suitable.
		A CHP unit only generates economic and environmental savings when it is running at least 4,500 hours per year. This equates to an average heat demand of about 17 hours a day for five days a week throughout the year. The proposed development energy and heat demand profile does not match this requirement.
		CHP is typically utilized on buildings with high electricity and heating demand for most of the year such as local authority buildings, leisure centres, universities, hotels, and district heating schemes where CHP is used to provide electricity, space and water heating.
		CHP should be considered wherever there is demand for electricity and an appropriate demand for heat in the near vicinity.

Table 3: Feasibility Study of Renewable Technologies

Based on the feasibility study in table 3 above, solar PV (photovoltaic) panels have been identified as the most suited technology for reduction of the development's CO2 emissions.

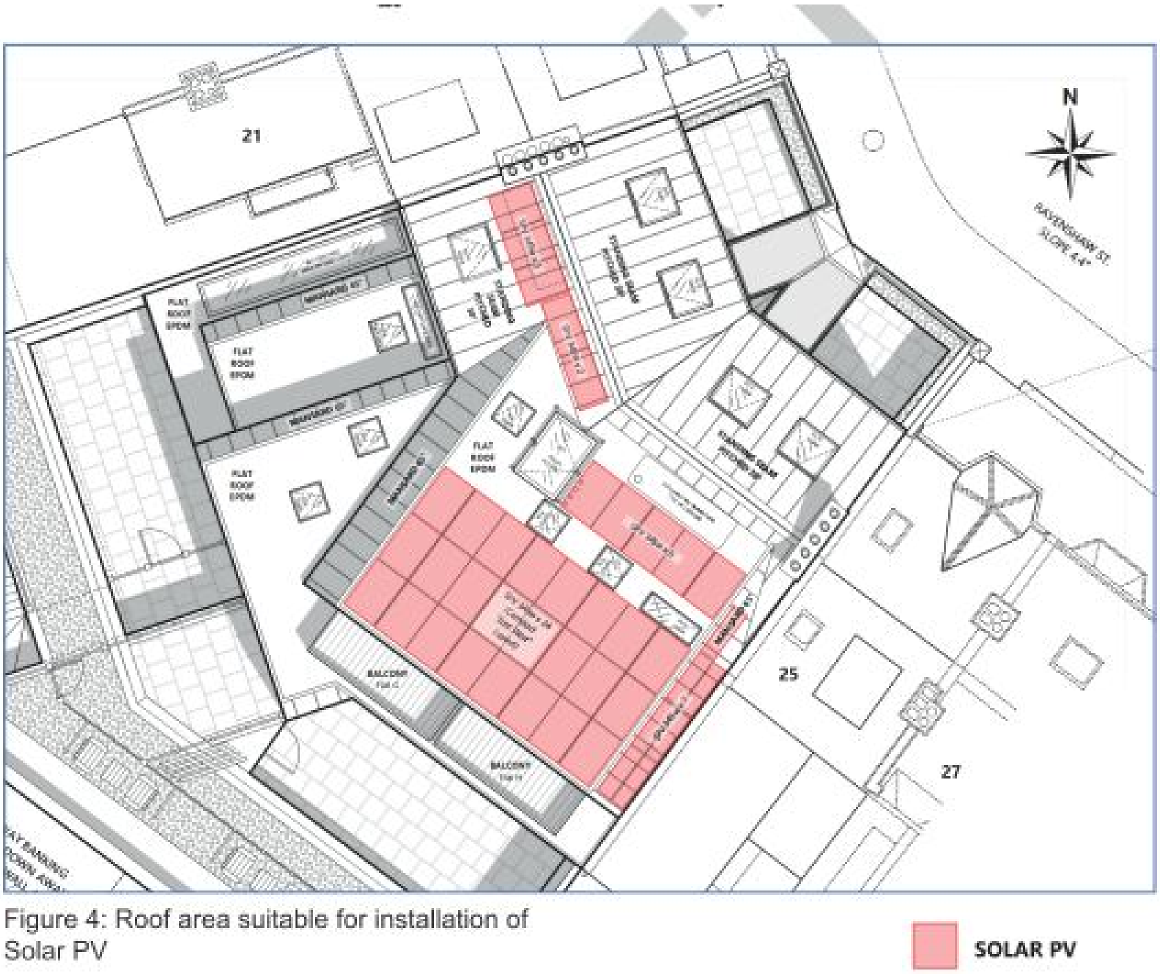

Figure 8: Roof Areas Suitable for Installation of Solar PV

7.0 System Size to Provide In Excess of 20% CO2 Emissions Reduction

London Borough of Camden Council requires new developments to achieve a 20% reduction in on-site carbon dioxide emissions through on site renewable technologies. To meet this requirement, the developer aims to install 14.15 kWp of solar panels on the roof of the building; this is an equivalent of no. 41 345W solar panels.

Plot	Total Floor Area [m2]	PV [kWp]
Flat A	109.24	2.42
Flat B	102	2.26
Flat C	71.89	1.60
Flat D	72.92	1.62
Flat E	83.18	1.85
Flat F	85.76	1.90
Flat G	58.05	1.29
Flat H	54.6	1.21
Total	**637.64**	**14.15**

Table 4: PV pro rata per flat

As the projected CO2 emissions from the proposed building total 10,650 kgCO2/year, solar panels will have to reduce the emissions by at least 2,130 kgCO2/year.

According to SAP results, installation of 14.15 kWP of PV will generate **10,797** KWh/year and reduce the total CO2 emissions by **5,712** kgCO2/year (10,797 KWh/year*0.529 kg CO2/kWh[1]), with represents an equivalent of **54%** of the total projected CO2 emissions of the dwelling.

	Associated Total CO_2 ($kgCO_2/yr$)
Baseline (no PV) (2)	10,650
With PV	4,938
Reduction in CO2 (1)	5,712
% Reduction (1) / (2) x 100	**54%**

Table 5: Percentage Reduction in Carbon Emissions from 14.15 kWp Solar PV

[1] Carbon Factors Used from SAP 2012: Electric = 0.529 kg CO2/kWh

Table 5 above shows the percentage reduction in CO2 emissions following the energy efficiency improvements and the introduction of the solar PV panels. Therefore the installation of 14.15 kWp of solar PV will allow the development to achieve a required 20% reduction in the total CO2 emissions from on-site renewable technology, and therefore meets the planning requirements of the London Borough of Camden and the London Plan.

	Associated Total CO_2 ($kgCO_2/yr$)	**CO2 Reduction ($kgCO_2/yr$)**	**% CO2 Reduction**
Baseline: Part L 2013 of the Building Regulations Compliant Development	10,650	0	0%
After energy demand reduction	10,650	0	0%
After heat network / CHP	10,650	0	0%
After PVs added	4,938	5,712	54%
Total	4,938	5,712	54%

Table 6: Carbon Dioxide Emissions after Each Stage of the Energy Hierarchy