79 CAMDEN ROAD
& 86-100 ST PANCRAS WAY

energy strategy overview
(incl. code for sustainable homes pre-assessment)

November 2013

by WHITECODE DESIGN ASSOCIATES

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79 Camden Road, London NW1 9EU
Energy Strategy Overview

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Executive Summary

The following report presents a list of energy strategies for the proposed development 79 Camden Road, London, referencing energy requirements for the site. The scheme is solely new-build and carbon has been calculated accordingly.

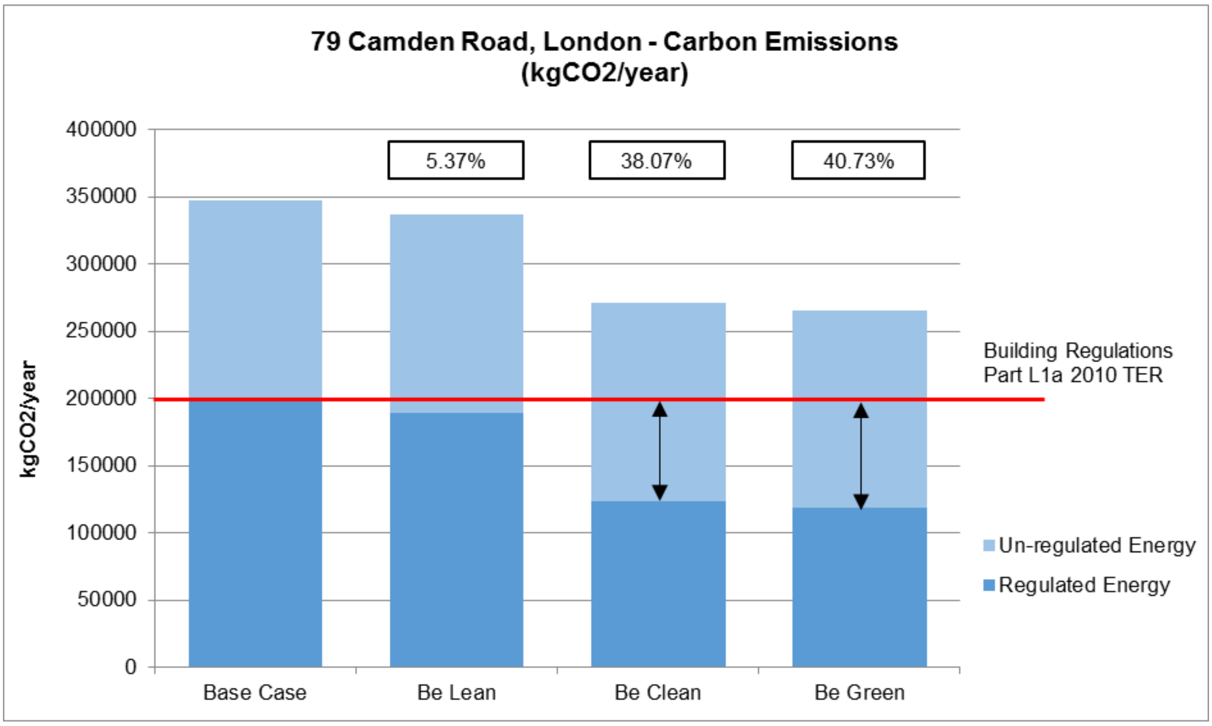
All residential elements have been analysed using the Standard Assessment Procedure (SAP) and averaged accordingly. Then, the Greater London Authority's '*Integrating renewable energy into new developments: Toolkit for planners, developers and consultants*' strategy was applied.

The London Mayor expects all new developments to fully contribute towards the reduction of carbon dioxide emissions. The targets are highlighted in Planning Policy 5.2 of The London Plan 2011. The target for this development is to achieve Code for Sustainable Homes Level 4 and improve carbon emissions reduction by at least 25% over the Target Emissions Rate (TER) outlined in the 2010 Building Regulations. Code for Sustainable Homes Level 4 is the minimum target for residential schemes between 2010 and 2013 as per Policy 5.2 of The London Plan 2011. This report concludes that the proposed scheme would achieve a **40.73%** carbon saving of fixed services above 2010 Building Regulations, thereby achieving Code for Sustainable Homes Level 4. The proposed option is as follows:

- Community heating scheme with an Ener-G 70kWe Combined Heat & Power (CHP) engine; and
- 13kWp of Photovoltaic (PV) array

As 79 Camden Road is to be assessed under current Building Regulations, particularly Part L1a:2010, the current SAP calculation 2009 and Code for Sustainable Homes Guidance November 2010 has been applied. All documents focus on low carbon buildings assisted by renewable technologies and do not focus on a fixed renewable percentage.

The above Code for Sustainable Homes compliance saves more carbon, isn't fixed on a particular renewable percentage, and focuses on carbon reduction from passive measures; hence the strategy above is preferred.



'79 Camden Road' Site-wide Carbon Emission for residential element – TER and DER

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Revision History

Rev	Date	Purpose / Status	Created by	Issued by
Draft	2013.09.09	Issued for discussion/comment	Emily Mansfield	Jason Tramontano
1	2013.10.16	Amended to show revised PV layout & accommodation schedule	Emily Mansfield	Jason Tramontano
2	2013.11.20	Amended accommodation schedule	Emily Mansfield	Jason Tramontano

1.0 Introduction

The purpose of this report is to show how Barratt West London can address the relevant energy conditions for the proposed development at 79 Camden Road located in London. These conditions are as follows, along with key issues in the design of the services strategy.

1.1 Planning Policy and Targets

1.1.1 National Policy

The development will be constructed to be compliant with Part L 2010 of the Building Regulations. The development consists of new build dwellings. This involves Part L1a of the Building Regulations. Part L1a of these regulations relates to conservation of fuel and power in new dwellings and mandates that the design of the building demonstrably causes lower carbon emissions than a notional equivalent of given specifications.

The National Planning Policy Framework (NPPF) was released in March 2012, which re-emphasises the Government's commitment to sustainable development and states the need for planning authorities to take an approach based on integrating the four aims of sustainable development. The document also refers to the Government's Energy policy and objectives and sets out key principles that regional planning bodies and local planning authorities should adhere to in their approach to planning for renewable energy.

1.1.2 Regional Policy

The proposed development lies in London Borough of Camden; the applicable Regional Spatial Strategy is the *London Plan (2011)*.

The London Plan draws energy into its major policies. In its strategic priorities, the London Plan addresses issues of environmental quality raised by the urban heat island effect and realises the unique potential for district energy networks. The London Plan requires all Boroughs to follow the London Plan's energy efficiency guides. In Policy 3.7 Large Residential Developments, it requires to look at the opportunities in large scale developments to provide for decentralised energy generation and provision. Tackling climate change will also require a move towards more sustainable energy sources and the London Plan seeks to support the development of decentralized energy systems, including the use of low carbon and renewable energy and the greater utilisation of energy generated from waste.

Overall, the most substantial emissions savings London can make will come from initiatives to decarbonise its energy supply and to reduce the emissions from the existing building stock. In addition, the Mayor expects that all new development will fully contribute towards the reduction in carbon dioxide emissions, and this will be principally achieved through the application of Policy 5.2 and the Mayor's energy hierarchy.

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

BE LEAN – minimise energy use by implementing passive design measures, e.g. improve fabric U-values and minimise air permeability.
BE CLEAN – all systems which use fossil fuels, i.e. gas, oil, coal or electricity, must utilise these fuels at optimum efficiency.
BE GREEN – any remaining energy demand should be produced with as much renewable technology as practically/financially possible.

As a minimum, all major development proposals should 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. For Residential Buildings, these targets are:

Year	Improvement on 2010 Building Regulations
2010-2013	25%
2013-2016	40%
2016-2019	As per Building Regulation Requirements
2016-2031	Zero Carbon

Further, the London Plan requires Major development proposals to include a detailed energy assessment to demonstrate how the minimum targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy and provides guidelines for the preparation of the same. These guidelines have been followed in preparation of this document.

1.1.3 Local Policy

The local policy for the proposed development is Camden's Local Development Framework (LDF), which is in conjunction with the national planning policy and the London Plan. Camden's Core Strategy, Section 3 – A sustainable and attractive Camden, focuses on delivering the key elements of their strategy relating to:

"Making Camden more sustainable and tackling climate change, in particular improving environmental performance of buildings, providing decentralised energy and heating networks, and reducing and managing our water use…"

Camden strongly support the use of decentralised heating systems served by Combined Heat & Power (CHP) engines to reduce carbon dioxide emissions.

Policy CS13 – Tackling climate change through promoting high environmental standards, states:

"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 visible during construction and occupation…"

This policy also follows the energy hierarchy set out in the London Plan, as follows:

1. Ensuring developments use less energy;
2. Making use of energy from efficient sources, such as the King's Cross, Gower Street, Bloomsbury and proposed Euston Road decentralised energy networks; and
3. Generating renewable energy on-site.

Item 13.11 – Generating renewable energy on-site, states:

"…the Council will expect developments to achieve a reduction in carbon dioxide emissions of 20% from on-site renewable energy generation (which can include sources of site-related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible."

1.1.4 Code for Sustainable Homes

The Code for Sustainable Homes (CSH) is a voluntary standard which demonstrates the environmental performance of new dwellings. Dwellings are awarded a rating from 1-6, based on their overall performance in a range of categories including:

- Energy and CO_2 emissions;
- Water;
- Materials;
- Surface Water Run-off;
- Waste;
- Pollution;
- Health and Wellbeing;
- Management; and
- Ecology.

The carbon emission reduction levels over baseline regulated energy required for meeting CSH Levels are summarised below. The current development has to comply with the 2010 version of the CSH.

Code Level	Carbon Reduction over 2010 Building Regulations
1	0
2	0
3	0
4	25%
5	100%
6	"Zero Carbon"

The proposed development will aim, as a minimum, to deliver CSH Level 4 across the site. In Energy credits, it is expected to achieve CSH Level 4 minimum requirements. This Energy Strategy sets out the approach to achieving a Part L1a 2010 compliant reduction in carbon emissions, in order to meet the energy requirement of achieving CSH Level 4.

1.2 The Development

The scheme consists of 166 apartments in six blocks labelled Blocks A to F. All apartments are self-contained. The accommodation is as follows:

- 50 x 1 Bedroom dwellings
- 99 x 2 Bedroom dwellings
- 14 x 3 Bedroom dwellings
- 3 x 4 Bedroom dwellings

A selection of 39 NHER SAP calculations for the dwellings have been carried out to produce an accurate representation of the site. Averages have been taken where applicable.

The baseline scheme will be based on an individual gas boiler heating scheme with radiators and u-values to 2010 Building Regulations.

2.0 Baseline Energy Demands

An assessment of the sites potential energy use was conducted in compliance with the minimum requirements of the current Part L of the Building Regulations. The Part L compliance results were calculated using the notional building from the NHER SAP software.

The SAP result sheets are summarised below:

'Base Case'		
Part L 2010 Notional Building (Target Emission Rate)		
Application	Annual Energy Consumption (kWh/year)	Annual Carbon Emissions ($kgCO_2$/year)
Space & Water Heating	862,206	173,913
Lighting	52,446	22,165
Fans & Pumps	17,535	7,400
Appliances (unregulated)	142,842	73,849
Cooking (unregulated)	82,258	42,527
Common Areas (unregulated)	63,696	32,931
Total	**1,220,983**	**352,785**

Table 2.1: Baseline SAP results – TER

The following pie chart indicates the breakdown of carbon emissions ($kgCO_2$/year) for the development.

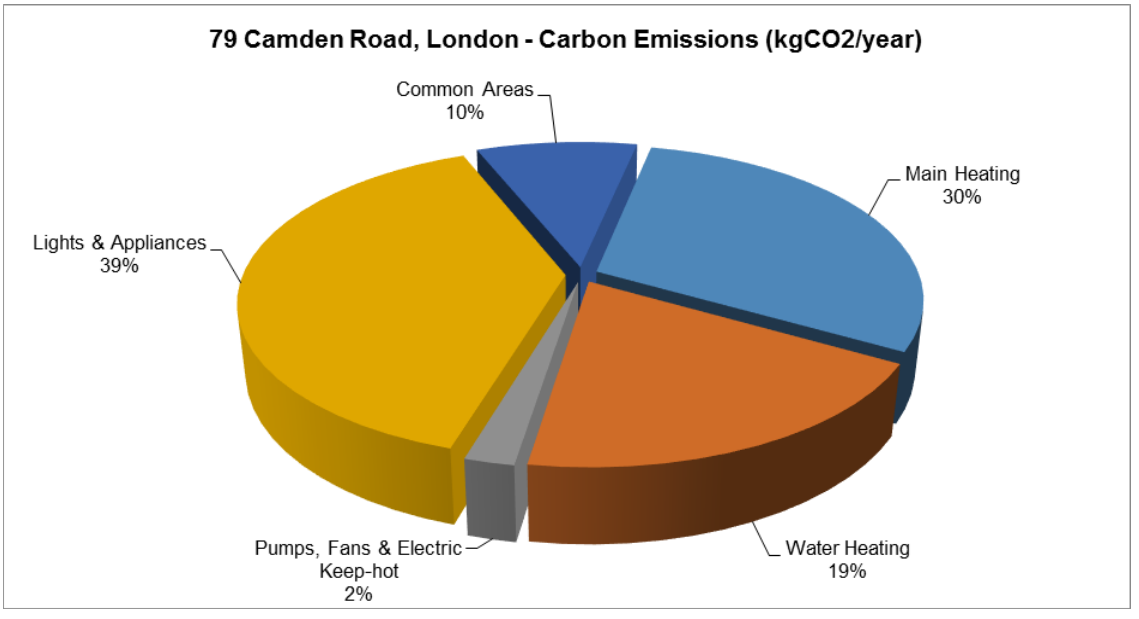


Table 2.2: Baseline Carbon Emissions Breakdown

3.0 Energy Efficient Design

Local planning guidelines require a reduction in the carbon emissions of the proposed scheme by energy-efficient measures. A number of energy-efficient measures are considered below:

3.1 Improved Fabric and Air Permeability

Approximately 50% of heat is lost through the fabric of a building. This includes walls, floors, windows, roofs and the thermal bridging connecting them. The remaining 50% is lost through uncontrolled ventilation through gaps around doors, windows and any service penetrations.

3.2 Thermal Bridging

Around 30% of the total heat loss through a building's fabric can be caused by thermal bridging. Indications are that better detailing and improved air tightness can reduce a dwelling's annual carbon dioxide (CO_2) emissions by up to 10%.

Simple design principles can improve the thermal performance of key details such as lintels, wall to floor junctions and ceiling to gable wall junctions by over 85%. Furthermore, improving fabric thermal performance with better detailing and improved air tightness can increase opportunities for design flexibility. Site construction activities are key to realising these designed improvements in thermal bridging performance and improved air tightness.

Barratt West London have decided to employ such details for the proposed development to reduce overall space heating demand. They feel that with a low loss building to begin with will reduce energy demands for years to come. It is a design philosophy which the government shares and should be encouraged. For further construction details, please refer to the website below:

http://www.energysavingtrust.org.uk/business/Business/Housing-professionals/Interactive-tools/Enhanced-Construction-Details

The thermal bridging y-value has been calculated for each dwellings using Accredited Construction Details for all appropriate junctions. Further calculations will need to be carried out at design stage of the SAP calculations to verify the actual thermal bridging value.

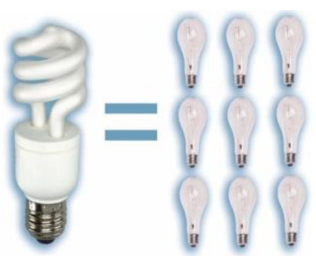
3.3 Appendix Q Ventilation – Part F 2010, System 4 Balanced Heat Recovery

The design difficulties associated with System 1 of the current ventilation regulations means that System 4 is an obvious option. Intermittent extract fans require a great deal more trickle vents under new regulations (Part F:2010). They are also required at the top and bottom of dwellings with single aspects, which is generally undesirable. The team have therefore chosen an Appendix Q registered heat recovery unit. The Nuaire MRXBOX95-WH1 unit removes stale air from wet areas creating a permanent air path through the property through the habitable rooms. The air drawn into the dwelling is routed through a high efficiency heat exchanger where warmth from the extracted air is transferred to the incoming fresh air before being supplied to habitable rooms. This therefore lowers the heating requirements of the dwelling.

3.4 Improved Heating Efficiency

The *baseline* heating system design model consists of a modern SEDBUK A gas boiler and typical indirect hot water cylinder. 40% of all energy used within dwellings is for heating, and so minor improvements of boiler efficiency, cylinder insulation and controls can have a huge impact on carbon savings and overall energy use.

3.5 Energy Efficient Dwelling Lighting



It is proposed that 100% of all internal lighting is made up of low-energy lamps in order to reduce carbon and the overall energy used (typical tungsten bulbs can use up to 300% more energy). In SAP 2009, low energy lighting has an impact on Dwelling Emission Rates and therefore 100% of all internal light fittings will be low energy.

3.6 Water Strategy

In accordance with best practice and CSH Level 4 requirements, potable water consumption in residential units will be limited to less than 105 litres per person per day. The calculation methodology used to assess compliance with this credit assumes a standard usage pattern for each person, and the overall figure is determined based on the water consumption levels of the specified appliances and fittings in kitchens, bathrooms and toilets.

3.7 'Be Lean' Results

A number of SAP calculations have been carried out for the scheme, using an assumed 'be lean' specification (see Appendix A).

The SAP results sheets are summarised below:

'Be Lean'		
Please See Assumed Specification Table 1 (Appendix A)		
Application	Annual Energy Consumption (kWh/year)	Annual Carbon Emissions (kgCO2/year)
Space & Water Heating	709,333	140,448
Lighting	51,641	26,699
Fans & Pumps	49,123	25,397
Appliances (unregulated)	142,842	73,849
Cooking (unregulated)	82,258	42,527
Common Areas (unregulated)	63,696	32,931
Total	**1,098,893**	**341,851**

Figure 3.1: Be Lean SAP results

Through passive and active design, there has been a **3.10%** reduction in carbon emissions and a **10%** reduction in energy used (regulated and un-regulated energy). This is a significant saving when considering no additional technologies have been implemented into the design. Without passive and active design measures, a significantly higher amount of renewable energy would be required to achieve the carbon savings required. The SAP results show how we have exceeded requirements for Part L1a 2010 compliance through passive measures (see Appendix D).

When looking at the regulated energy only, there has been a **5.37%** reduction in carbon emissions and a **13.10%** reduction in energy used.

4.0 Efficient Services Design

Once the site has employed as much energy-efficient design as is practically possible, technologies such as district heating and CHP must be considered. This is to ensure the highly efficient use of any non-renewable fuels that the scheme is likely to expend.

4.1 District Heating

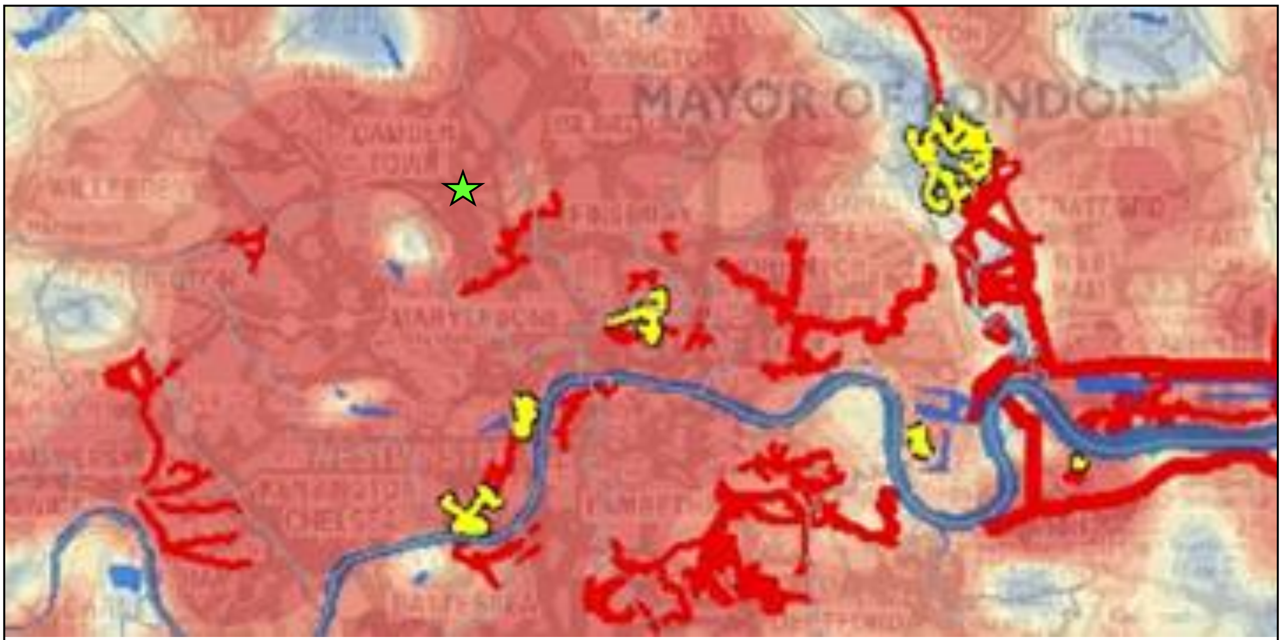
4.1.1 On-Site Central Plant

The main considerations with district heating are fuel running costs and management. Central boiler plant rooms, as their name suggests, allow servicing to be carried out in one location; therefore reducing maintenance costs. Also, there are small discounts to be had on the unit cost of fuel per kWh, as the gas supply serving the site is considered commercial. However, the initial installation cost for materials and labour is considerably more than the installation cost for serving each unit with its own boiler. Each dwelling is likely to cost approximately £4,000 more for the installation of a central boiler room. However, despite cost, one significant advantage of this technology is that the primary energy plant can be changed at a later date (according to technological advances) much more easily than if individual boilers are used. For example, fuel cells and advanced CHP technology could be installed in 15-20 years, once the old plant is decommissioned.

Maintenance is still required on a heat interface unit (HIU) within each dwelling and commercial unit; however, this is not mandatory like the annual gas checks. The HIU is simply the device which separates the main heating circuit from the dwelling LPHW circuit. It is typically a similar size to a boiler and houses a heat meter, plate heat exchanger and LPHW component valves.

4.1.2 Connection to an Existing Scheme

In line with the London Plan, the development is investigated to check it's suitability for centralised Combined Heat & Power (CHP) communal heating. As can be seen from the map below, there are currently no available district heating networks in the vicinity to connect to (current networks shown in yellow and potential networks are shown in red).



☆ *Approximate proposed development location* *Approximately 2km*

Table 4.1: London Heat Map

The above map indicates a potential district heating network approximately 1km from the proposed development. Provisions will be made within the risers and plant room for a possible future connection to this network.

4.2 Combined Heat & Power

Combined Heat & Power (CHP) requires a thermal load present throughout the year. This thermal load acts as a heat dump to cool the engine. To maximise efficiency of the engine it needs to run for at least 17 hours a day; therefore, the heat needs to be present for this period. In a residential scheme, summer time hot water is the only constant load present throughout the year and during daylight hours this load is very small, with peaks in the morning and evening. Thus, the engine supplies a proportion of the annual thermal demand.

The key benefit from running a CHP engine is that it produces electricity, which can displace grid-supplied electricity, which has significant carbon savings. It is for this reason that CHP is designed to run for as many hours of the year as possible.

The proposed development is primarily a residential scheme and therefore its base hot water load is in the summer months. The following feasibility study shows whether this demand is high enough to ensure little to no ‘down time’ for the CHP. Our calculations are based on a running time of 17 hours per day, which we feel is appropriate to maximise carbon savings and to include necessary maintenance. The calculations show that there is a significant base thermal load to warrant using CHP (Appendix E).

Below is the thermal load graph:

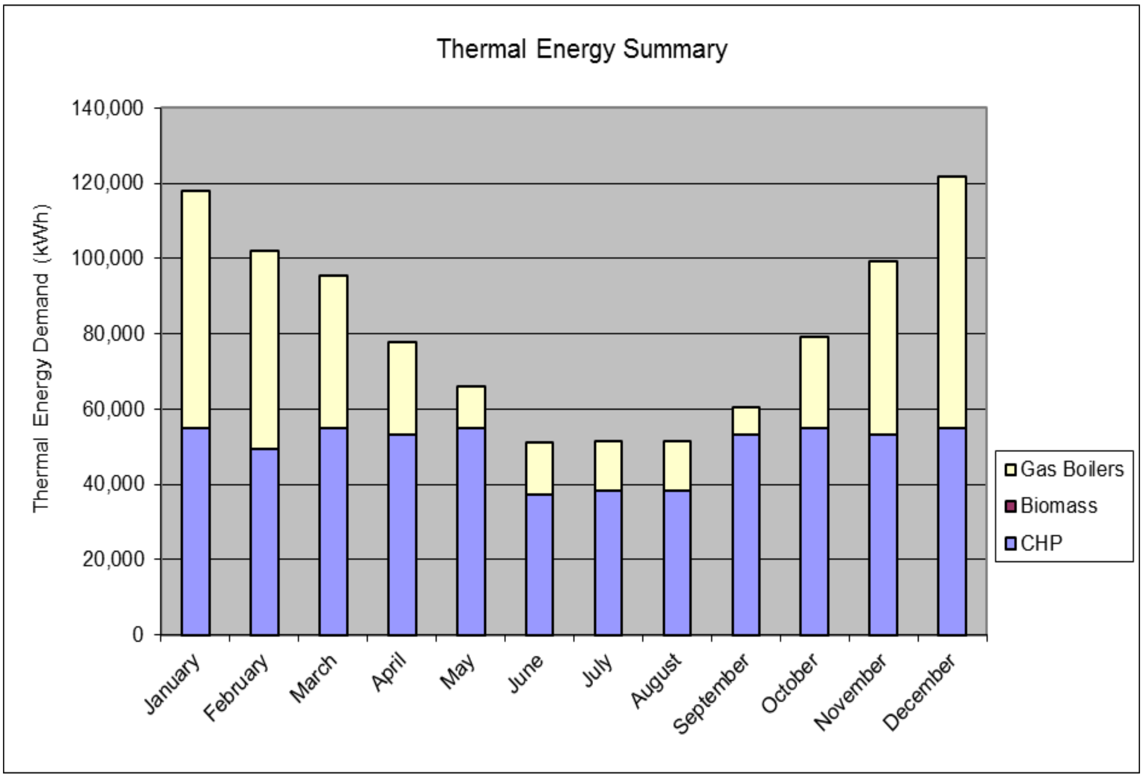


Table 4.2: Thermal Load Graph

The thermal demand calculations suggest that a **70kWe CHP** would be the most appropriate for the site. This would generate the most carbon savings without excessive heat dumping. Calculations also show that the scheme would be acceptable under CHPQA standards and be classified as ‘good quality’. This allows the operator to secure a capital grant and levy on current gas and electricity prices.

Although CHP is considered feasible for the scheme, it is not considered as a renewable energy source, therefore 20% of the sites energy demand must still be met with the use of renewable technologies. Should CHP not be able to work in conjunction with the renewable technology, the renewable technology will take preference and the use of CHP will be dismissed.

In accordance with the GLA's Draft Sustainable Design and Conclusion section 2.4.18, the electricity generated by the CHP engine was calculated in line with how the CHP engine is proposed to operate against the heat load. Below is a graph of projected electrical load for the common area lighting and small area compared with the electricity generated through CHP engine and photovoltaic (PV) array.

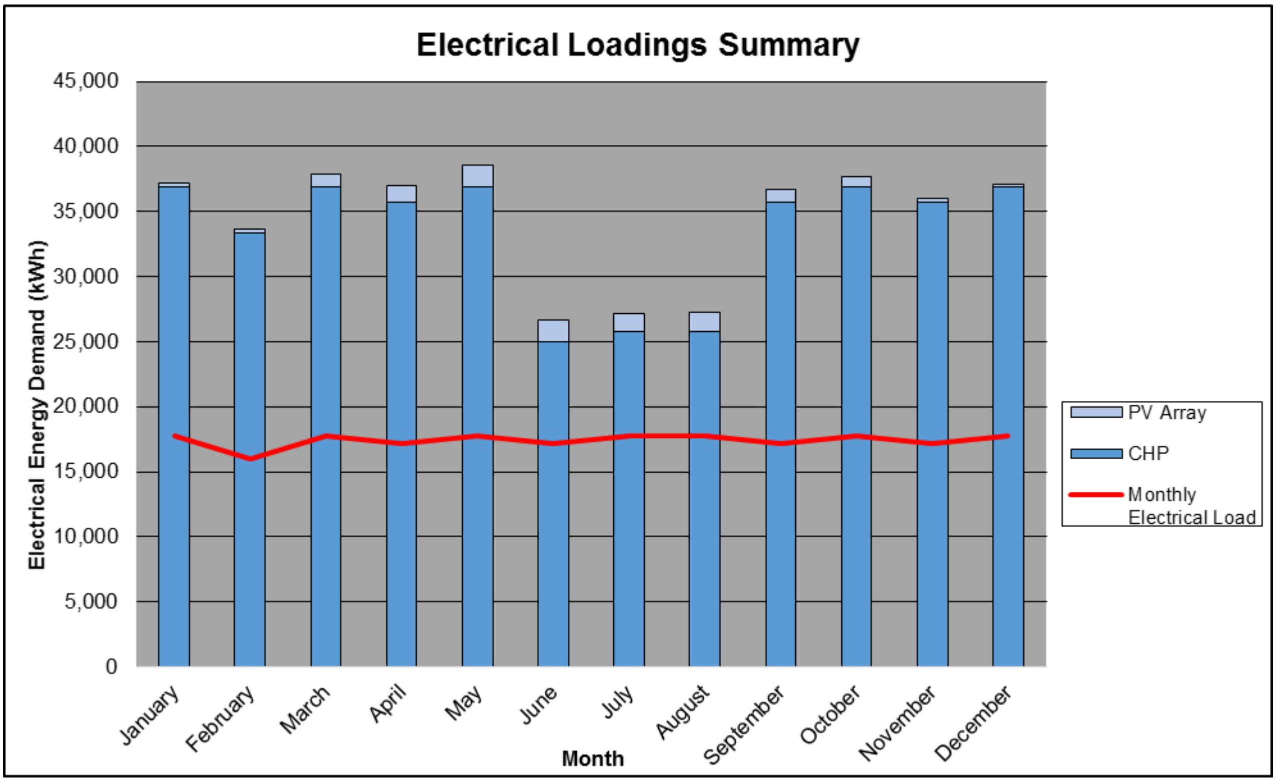


Table 4.3: Electrical Loadings Summary Graph

These results have been compiled from IES dynamic modelling software. The total estimated electricity load is 208,741kWh. The electricity by the CHP engine is 401,506kWh, and by PV is 5,703kWh.

Therefore, approximately 198,468kWh of electrical load per year will be exported to the grid.

Alternatively, the excess electrical load could be sold under a licence like arrangement.

4.3 'Be Clean' Results

A number of SAP calculations have been carried out for the scheme, using an assumed 'be clean' specification (see Appendix B).

The SAP results sheets are summarised below:

'Be Clean'		
Please See Assumed Specification Table 1 (Appendix B)		
Application	Annual Energy Consumption (kWh/year)	Annual Carbon Emissions (kgCO2/year)
Space & Water Heating	668,665	89,020
Lighting	51,641	26,699
Fans & Pumps	19,898	10,288
Appliances (unregulated)	142,842	73,849
Cooking (unregulated)	82,258	42,527
Common Areas (unregulated)	63,696	32,931
Total	**1,029,000**	**275,314**

Figure 4.4: Be Clean SAP results

The SAPs have been calculated using the u-values as per the assumed 'be lean' specification (see Appendix A). When a district heating system with CHP is implented into the design, there has been a **21.96%** reduction in carbon emissions and a **15.72%** reduction in energy used (regulated and un-regulated energy) against the 'base case' results.

When looking at the regulated energy only, there has been a **38.07%** reduction in carbon emissions and a **20.59%** reduction in energy used.

5.0 Consideration of renewable energy

After energy efficiency measures have been considered, the next step is to consider renewable technology. Item 13.11 – Generating renewable energy on-site, in the Core Strategy states a reduction in carbon dioxide emissions of 20% is to be achieved from on-site renewable energy generation. Although CHP is considered feasible on a scheme of this size, it is not considered a renewable source, so the following technologies will be assessed to ascertain whether they can achieve the required carbon savings.

5.1 Photovoltaic Array Systems

Photovoltaic (PV) array systems convert energy from the sun into electricity via semi-conductor cells. There are a wide range of different panels available on the market, from less expensive amorphous silicon with low efficiencies (1 kW installation requires approximately 20m^2 of roof area), to mono-crystalline silicon with much higher efficiencies (1 kW installation requires approximately 8m^2 of roof area). Ideally, PV panels need to be positioned within 30^o of south and at an angle of 30^o to achieve optimum performance. It is essential that PV arrays are un-shaded, as even a small amount of shading dramatically reduces the output of the panel. The preferred panel for this development is the Upsolar UP-M250M-B. This is a highly efficient panel with an output of approximately 850 kWh/year per 1 kW installation (approximately 11m^2 of roof space).

Where PV panels are installed, an access hatch onto the roof will be provided. There are no significant shading devices in the area such as other buildings or trees; therefore, a shading factor of low/negligible has been used, i.e. less than 20%, and this has been accounted for in the SAP calculations.

In order to achieve a 20% reduction in carbon dioxide emissions through PV only, approximately 187kWp of PV would be required. Clearly, the technology alone cannot meet the targets set.

There is 130m^2 of roof space available for the installation of PV panels. This will accommodate 52no. of the Upsolar UP-M250M-B PV panel, providing 13kWp of PV. Along with the CHP this achieves the Code for Sustainable Homes Ene1 mandatory criteria for Level 4.

FEASIBLE WITH CHP

5.2 Solar Water Heating

Solar water heating is an excellent renewable energy source as it can cater for almost 80% of the hot water load of a dwelling. A south-facing 1m^2 highly efficient evacuated tube solar array will provide approximately 520kWh/year of hot water. The proposed panel is the Strebel vacuum tube.

However, for blocks of apartments there are a number of complications. If solar water systems are required to serve flats other than those on the top floor there is the requirement for long runs of pipework to serve the apartments. This results in access issues, adds to the long-term maintenance of the system and reduces efficiencies due to pipe losses. Also, if a communal system is to be implemented, then a buffer vessel, expansion vessels and commercial pumps will be required, all of which require a large amount of plant space and maintenance. Within the apartments themselves, a large solar hot water cylinder will be required, but due to spatial requirements, this may not be practical to implement.

In order to achieve a 20% reduction in carbon dioxide emissions through solar water heating, 306m^2 of panels would be required. Clearly, the technology alone cannot meet the targets set.

Solar water heating panels were incorporated into the SAP calculations, but they did not meet the mandatory requirements set within Code for Sustainable Homes Ene1 for all apartments. It also cannot be considered with the CHP, as this would remove the water heating demand during the summer months causing the CHP to run insufficiently. Therefore, this type of renewable technology has been considered as not feasible for this development.

NOT FEASIBLE

5.3 Wind Turbines

The installation of a large wind turbine is practically impossible, as there is nowhere to position or mount such a large piece of equipment in a dense urban area, such as where the proposed development is located. Opting for smaller roof-mounted turbines, such as those manufactured by Quiet Revolution (which are more aesthetically pleasing) could be an option. A typical 6kW turbine in a suburban environment could generate 6765kWh and hence save 3843kgCO_2. 2no. turbines are required to achieve the 20% reduction in carbon emissions through renewable technologies, and each turbine requires a minimum of 10m between each turbine and this would account for a significant alteration to the development. We would suggest that this technology is not suitable for this site as the space required to install the turbines is not available, plus the turbines can cause “flickering” within surrounding dwellings.

NOT FEASIBLE

5.4 Ground Source Heat Pumps

The use of horizontal ground source heat pumps is not possible due to the area required for the horizontal ground loop – 39,600kWh/year can be produced per 50x1.5m trench, saving 7,680kgCO_2/year. This would mean that 1 trench would be needed, which the site cannot cater for in terms of free surface area. Vertical GSHPs have therefore been investigated, but installation would be difficult on this site. One borehole needs to be 165m deep in order to produce 327,164kWh/year; therefore saving 63,470kgCO_2/year.

This technology is not preferred due to concerns over ability to reduce carbon dioxide emissions as carbon savings are reduced when heat pumps are required to meet domestic hot water demand for developments of this scale. Higher running costs are likely to be passed on to residents compared with other technologies. Finally, the EST Field Trial Report (September 2010) suggests that carbon savings from these systems may often be less than expected in reality. In addition, the lack of available open space and safe working area to install the boreholes excludes this technology, therefore it is not appropriate to include this technology within the scheme.

NOT FEASIBLE

5.5 Exhaust Air Heat Pumps

Exhaust air heat pumps extract warm, stale air from the dwelling and use it to heat hot water and heat fresh air entering the property. They do not require an externally-mounted condenser; however, they do have one of the lowest coefficients of performances for heat pumps and are therefore not applicable for an enhanced capital grant from the government. The units themselves can be very heavy and need to be craned into position. From completing SAP calculations, the reduction in carbon dioxide emissions from using this technology alone is not achieving the 20% target.

NOT FEASIBLE

5.6 Biomass

Whilst traditionally most suited to lower density situations (mainly due to the supply and storage of the fuel), more high-density developments are considering this technology. A biomass boiler is best incorporated within a district heating scheme. However, there are issues regarding fuel storage and air pollution. A separate area would be required for the fuel store. We would use woodchip as opposed to pellets due to the embedded energy involved in transporting pellets from the continent – there are doubts as to whether wood pellets are in fact a carbon-neutral fuel. Woodchips can be sourced locally and therefore are more readily available, as well as being more carbon-friendly. The store would need to be adjacent to the plant room where the biomass boiler is located.

Biomass heating faces storage, maintenance and fuel supply issues that are difficult to overcome given the scale of the development, as well as difficulties with servicing. Another storage compartment is also required in the plant room for the waste ash, which is discharged and collected at the boiler. The ash content can vary from wood chips to pellets but can be substantial and requires regular maintenance and careful disposal.

The use of solid fuel would also increase local emissions of Nitrogen Oxide and PM10s. Recent government reports regarding biomass emissions have sparked more stringent rules on air pollution in and around London. These reports concentrate on Nitrogen Oxide emissions, which have a serious effect on an individual's health.

Fuel cost is another issue to consider. Currently, gas-heated systems are still cheaper per kWh compared to most biofuel systems. The transportation of biomass can substantially increase the cost of the fuel, and therefore needs to be considered if used once the site is handed over. However, in the long term it is likely that biomass would become cheaper if the market drives down the cost. Therefore, a biomass boiler, or indeed a fuel cell boiler, may be more economical in the future. Cost modelling would be required from an energy service company to substantiate this claim.

As a centralised plant is being considered at this stage, employing the technology would be fairly easy to implement. However, due to the existing poor air quality in and around Camden the Council is resistant in promoting the use of biomass fuel due to the high level of associated NOx emissions. Another issue is that there is also not enough space on the proposed development to cater for the extra storage and fuel supply access requirements. Therefore, this technology has been considered as not feasible.

NOT FEASIBLE

5.7 'Be Green' Results

A number of SAP calculations have been carried out for the scheme, using an assumed 'be green' specification (see Appendix C).

The SAP results sheets are summarised below:

'Be Green'		
Please See Assumed Specification Table 1 (Appendix C)		
Application	Annual Energy Consumption (kWh/year)	Annual Carbon Emissions (kgCO2/year)
Total	**1,018,790**	**269,916**

Figure 5.1: Be Green SAP results

The SAPs have been calculated using the u-values as per the assumed 'be lean' specification (see Appendix A). When a district heating system with CHP is implented into the design with PV located on the roofs of the apartments, there has been a **23.49%** reduction in carbon emissions and a **16.56%** reduction in energy used (regulated and un-regulated energy) against the 'base case' results.

When looking at the regulated energy only, there has been a **40.73%** reduction in carbon emissions and a **21.69%** reduction in energy used.

6.0 Cooling due to potential overheating

As a result of increasing thermal efficiency and air tightness, the possibility of overheating and poor air quality within buildings has become an issue.

The possibility of summertime overheating is initially addressed by providing opening windows to provide natural ventilation and night time cooling, to comply with Part F of the Building Regulations. Low temperature air from external is allowed into the buildings during the night, and circulates throughout the building cooling the building fabric. This allows the building fabric to dissipate the cool air throughout the building at a later stage, for example during the next day, in order to offset heat gains. This night time cooling is achieved by occupants opening windows throughout the night where possible. This not only cools the building, but also improves the indoor air quality.

Solar gain through glazing is a main factor in the potential for overheating, unprotected glass is often the greatest source of unwanted heat gain within. Radiant heat from the sun passes through glass and is absorbed by building elements and furnishings which then re-radiates heat back into the internal space. Re-radiated heat has a different wavelength and cannot pass back out through the glass as easily. This therefore traps the radiant heat within the room causing heat gains within the room and elevated temperatures.

Overhangs and balconies provide shading, which reduces solar gain within apartments.

An initial study within the SAP calculations indicates there is no excessive summer overheating risk within the dwellings. This risk has been eliminated by providing a g-value of 0.4 for the East, South and West elevations and a g-value of 0.6 for the North elevations. Light coloured curtains/roller blinds have also been assumed as fully closed during daylight hours.

7.0 Conclusion

The use of CHP and photovoltaic (PV) array for the apartments have the greatest benefits to the residents and the scheme as a whole. The CHP utilises the base heat demand of the scheme.

We suggest that a 70kWe CHP engine and 13kWp of PV be given highest priority. The uplift in carbon savings required to achieve Code for Sustainable Homes Level 4 cannot be met by CHP alone. The PV array is ideal to achieve Code for Sustainable Homes Level 4 as it requires little maintenance and is likely to generate money from the scheme with an associated Feed In Tariff (FIT). The simplicity of both the CHP and PV array encourages a design that is simple, and easy to monitor and maintain.

Assessment	Gas kWh/year	Electricity kWh/year	Total Delivered kWh/year	Cumulative Savings of kWh/year	Cumulative Savings of kWh/year (%)
Base Case (2010)	862,206	69,981	932,187	-	-
Be Lean	709,333	100,764	810,097	122,090	13.1%
Be Clean	668,665	71,539	740,204	191,983	20.59%
Be Green	668,665	61,329	729,994	202,193	21.69%

Figure 7.1: Overall site-wide results summary for Energy Consumption (regulated energy only)

Assessment	$kgCO_2$/year	Cumulative Savings of $kgCO_2$/year	Cumulative Savings of $kgCO_2$/year (%)
Base Case (2010)	203,478	-	-
Be Lean	192,544	10,934	5.37%
Be Clean	126,007	77,471	38.07%
Be Green	120,609	82,869	40.73%

Figure 7.2: Overall site-wide results summary for Carbon Emissions (regulated energy only)

We can clearly see that the passive design measures ('be lean') make a significant impact on the carbon emissions. However, a large reduction can also be achieved from the employment of the CHP engine.

When analysing regulated energy use only, we can see that the improvement of building fabric through energy efficient designs and the use of CHP and PV reduces carbon emissions by **82,869kgCO2/year**, a reduction of **40.73%** compared to the 'base case' results.

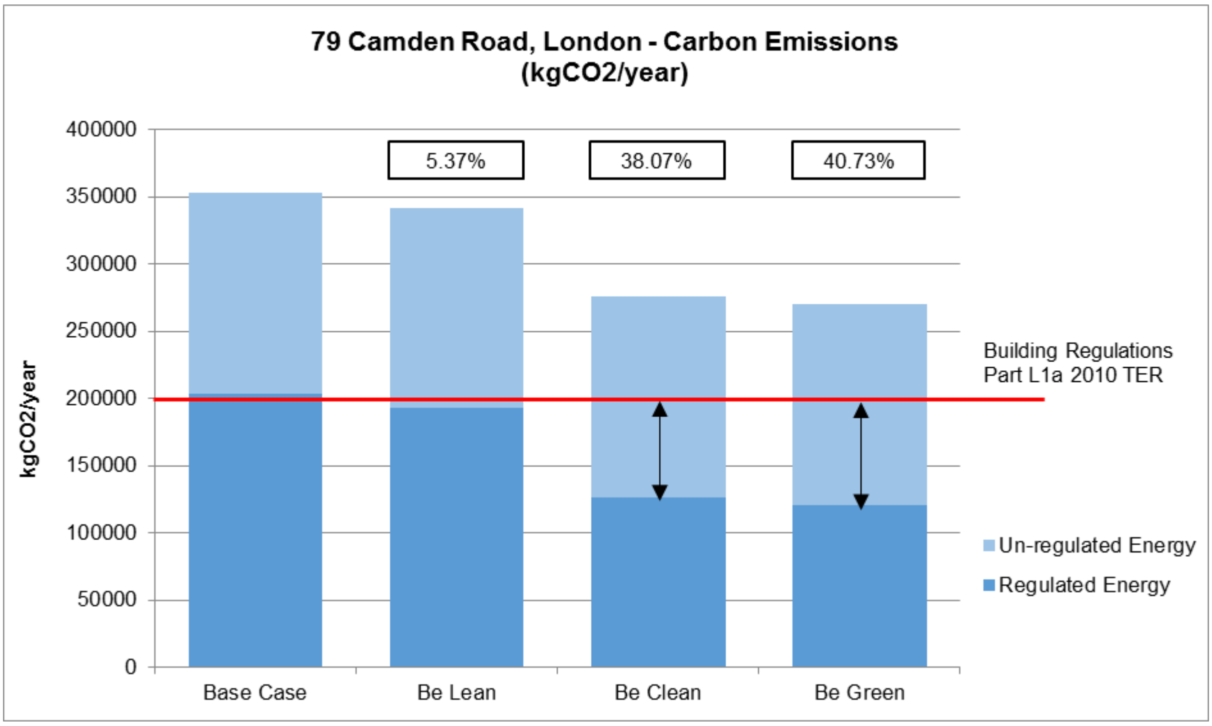


Figure 7.3: Summary of site-wide carbon emissions savings for residential element

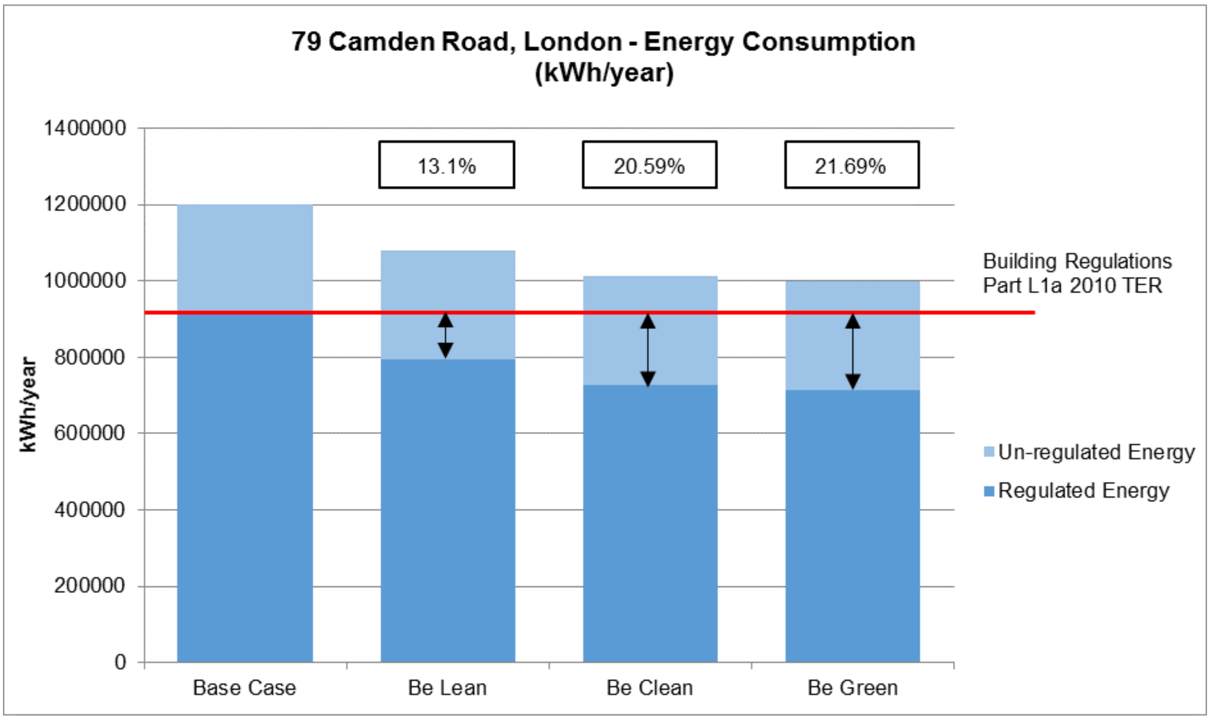


Figure 7.4: Summary of site-wide energy consumption savings for residential element

Appendices

APPENDIX A – BE LEAN ASSUMED SPECIFICATION

- Heat loss floor u-value – 0.18 W/m^{2}K
- External wall u-value – 0.18 W/m^{2}K
- Common area wall u-value – 0.20 W/m^{2}K
- Party wall u-value – 0 W/m^{2}K (assumed fully filled with effective sealing around the edges)
- Roof u-value – 0.13 W/m^{2}K
- Front door – Solid with u-value of 1.4 W/m^{2}K
- Windows – Double glazed with hard low-E coating; metal frame with 20mm thermal break and draught sealing; g-value of 0.6 used on North-East and North-West elevations and 0.4 South-East and South-West elevations; u-value of 1.4 W/m^{2}K
- Design air permeability – 4m^3/hm^2 (@50Pa) (not all dwellings being air pressure tested)
- Ventilation – Balanced heat recovery with Nuaire MRXBOX95-WH1 unit; SFP of 0.41 W/l/s and heat exchange efficiency of 91% for kitchen + 1 west area
- Space heating – Individual gas boilers; Keston Qudos 28h with an efficiency of 90.3%; time and temperature zone control; delayed start thermostat and weather compensator; heat emitted by underfloor heating
- Water heating – Cylinder located in dwellings as per Range Tribune cylinder sizing schedule; 1bath units to have 120 litre (declared loss factor of 1.05 kWh/day), 2 bath units to have 150 litre (declared loss factor of 1.31 kWh/day); $\leq$125 litres/person/day assumed
- Renewables – None
- Lighting – 100% low energy
- Thermal bridging y-value – Calculated using Accredited Construction Details for all junctions
- Summer overheating – Light coloured curtains/roller blind fully closed during daylight hours with windows fully open half the time

APPENDIX B – BE CLEAN ASSUMED SPECIFICATION

- Heat loss floor u-value – 0.18 W/m^{2}K
- External wall u-value – 0.18 W/m^{2}K
- Common area wall u-value – 0.20 W/m^{2}K
- Party wall u-value – 0 W/m^{2}K (assumed fully filled with effective sealing around the edges)
- Roof u-value – 0.13 W/m^{2}K
- Front door – Solid with u-value of 1.4 W/m^{2}K
- Windows – Double glazed with hard low-E coating; metal frame with 20mm thermal break and draught sealing; g-value of 0.6 used on North-East and North-West elevations and 0.4 South-East and South-West elevations; u-value of 1.4 W/m^{2}K
- Design air permeability – 4m^3/hm^2 (@50Pa) (not all dwellings being air pressure tested)
- Ventilation – Balanced heat recovery with Nuaire MRXBOX95-WH1 unit; SFP of 0.41 W/l/s and heat exchange efficiency of 91% for kitchen + 1 west area
- Space heating – Community heating with CHP and boilers; gas Ener-G 70kWe CHP providing 61% of heat demand, with overall efficiency of 77.1% and heat to power ratio of 1.49; gas boilers providing 39% of heat demand with overall efficiency of 95.5%; controlled by charging system linked to use, programmer and TRVs; heat emitted by radiators
- Water heating – Cylinder located in dwellings as per Range Tribune cylinder sizing schedule; 1bath units to have 120 litre (declared loss factor of 1.05 kWh/day), 2 bath units to have 150 litre (declared loss factor of 1.31 kWh/day); $\leq$125 litres/person/day assumed
- Renewables – None
- Lighting – 100% low energy
- Thermal bridging y-value – Calculated using Accredited Construction Details for all junctions
- Summer overheating – Light coloured curtains/roller blind fully closed during daylight hours with windows fully open half the time

APPENDIX C – BE GREEN ASSUMED SPECIFICATION

- Heat loss floor u-value – 0.18 W/m^2K
- External wall u-value – 0.18 W/m^2K
- Common area wall u-value – 0.20 W/m^2K
- Party wall u-value – 0 W/m^2K (assumed fully filled with effective sealing around the edges)
- Roof u-value – 0.13 W/m^2K
- Front door – Solid with u-value of 1.4 W/m^2K
- Windows – Double glazed with hard low-E coating; metal frame with 20mm thermal break and draught sealing; g-value of 0.6 used on North-East and North-West elevations and 0.4 South-East and South-West elevations; u-value of 1.4 W/m^2K
- Design air permeability – $4m^3/hm^2$ (@50Pa) (not all dwellings being air pressure tested)
- Ventilation – Balanced heat recovery with Nuaire MRXBOX95-WH1 unit; SFP of 0.41 W/l/s and heat exchange efficiency of 91% for kitchen + 1 west area
- Space heating – Community heating with CHP and boilers; gas Ener-G 70kWe CHP providing 61% of heat demand, with overall efficiency of 77.1% and heat to power ratio of 1.49; gas boilers providing 39% of heat demand with overall efficiency of 95.5%; controlled by charging system linked to use, programmer and TRVs; heat emitted by radiators
- Water heating – Cylinder located in dwellings as per Range Tribune cylinder sizing schedule; 1bath units to have 120 litre (declared loss factor of 1.05 kWh/day), 2 bath units to have 150 litre (declared loss factor of 1.31 kWh/day); $\leq$125 litres/person/day assumed
- Renewables – 13kWp of PV installed at 15° tilt on roof as indicated on roof plan; Upsolar UP-M250M-B PV panel used with output of 0.25kWp per panel; none to very little overshading
- Lighting – 100% low energy
- Thermal bridging y-value – Calculated using Accredited Construction Details for all junctions
- Summer overheating – Light coloured curtains/roller blind fully closed during daylight hours with windows fully open half the time

APPENDIX D – SAP EVALUATION

79 Camden Road, London NW1 9EU

SAP Evaluation

Job No.: 9871

Date: 07-Oct-13

WHITECODE DESIGN ASSOCIATES

BUILDING SERVICES DESIGN CONSULTANTS

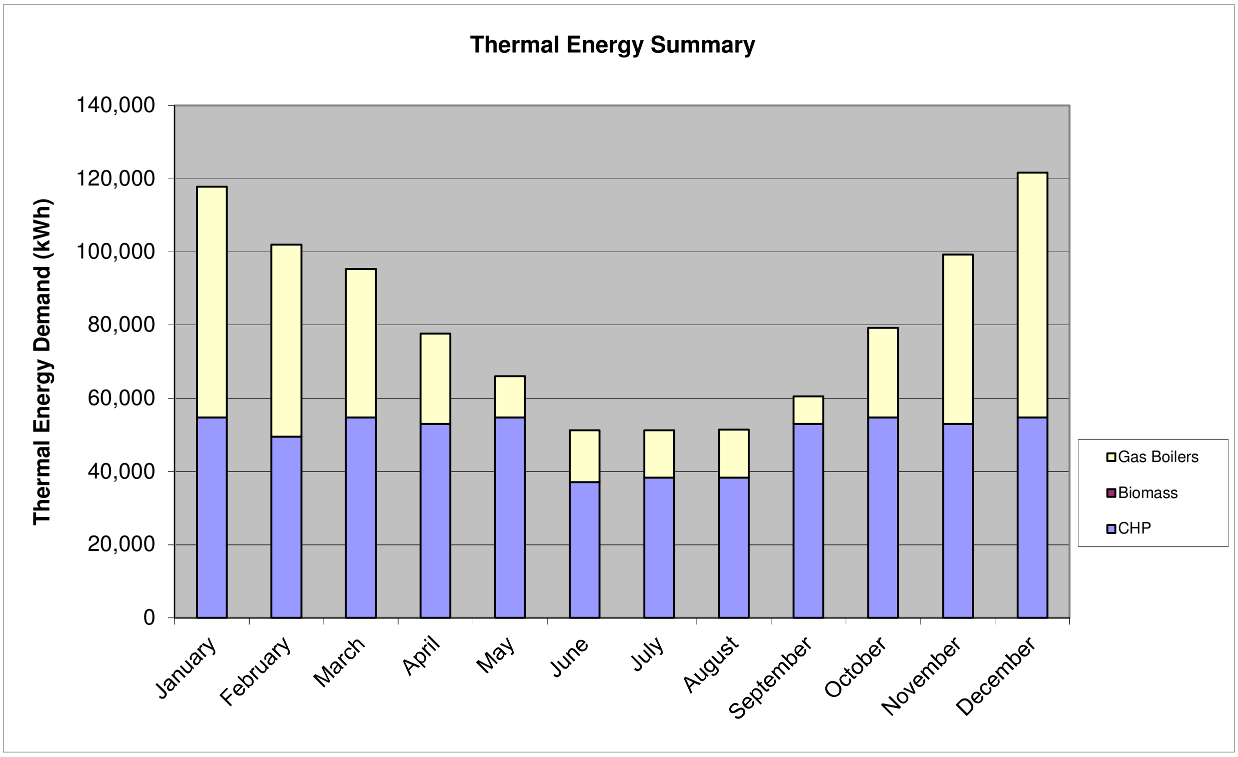
					Base Case			Be Lean			Be Clean			Be Green		
					The following results are for the notional dwelling of the dwelling being calculated.			Floor u-value - 0.18 W/m²K External wall u-value - 0.18 W/m²K Common area wall u-value - 0.20 W/m²K Party wall u-value - 0 W/m²K (fully filled cavity with effective sealing around the edges) Roof u-value - 0.13 W/m²K Front door u-value - 1.4 W/m²K Windows - Metal frame with thermal break of 20mm; double glazing with hard low-E coating and argon gap of 16mm ore more; g-value of 0.6 on North-East and North-West elevations and 0.4 on South-East and South-West elevations; u-value of 1.4 W/m²K Design air permeability of 4m³/hm² (@50Pa) (not all dwellings being air pressure tested) Mechanical ventilation - Balanced heat recovery with Nuaire MRXBOX95-WH1 unit; SFP of 0.41 W/l/s and heat exchange efficiency of 91% for kitchen + 1 wet area Space heating - Individual gas boilers; Keston Qudos 28h with an efficiency of 90.3%; time and temperature zone control; delayed start thermostat and weather compensator; heat emitted by underfloor heating Water heating - Cylinder located in dwellings as per Range Tribune cylinder sizing schedule; 1bath units to have 120 litre cylinder with declared heat loss of 1.05 kWh/day, 2bath units to have 150 litre cylinder with declared heat loss of 1.31 kWh/day Renewables - None Lighting - 100% low energy lighting Thermal bridging y-value - Calculated using Accredited Construction Details for all junctions Summer overheating - Light coloured curtains/roller blinds fully closed during daylight hours with windows fully open half the time			Floor u-value - 0.18 W/m²K External wall u-value - 0.18 W/m²K Common area wall u-value - 0.20 W/m²K Party wall u-value - 0 W/m²K (fully filled cavity with effective sealing around the edges) Roof u-value - 0.13 W/m²K Front door u-value - 1.4 W/m²K Windows - Metal frame with thermal break of 20mm; double glazing with hard low-E coating and argon gap of 16mm ore more; g-value of 0.6 on North-East and North-West elevations and 0.4 on South-East and South-West elevations; u-value of 1.4 W/m²K Design air permeability of 4m³/hm² (@50Pa) (not all dwellings being air pressure tested) Mechanical ventilation - Balanced heat recovery with Nuaire MRXBOX95-WH1 unit; SFP of 0.41 W/l/s and heat exchange efficiency of 91% for kitchen + 1 wet area Space heating - Community heating with CHP and boilers; Gas Ener-G 70kWe CHP providing 61% of heat demand, with overall efficiency of 77.1% and heat to power ratio of 1.49; Gas boilers providing 39% of heat demand with overall efficiency of 95.5%; controlled by charging system linked to use, programmer and TRVs; heat emitted by underfloor heating Water heating - Cylinder located in dwellings as per Range Tribune cylinder sizing schedule; 1bath units to have 120 litre cylinder with declared heat loss of 1.05 kWh/day, 2bath units to have 150 litre cylinder with declared heat loss of 1.31 kWh/day Renewables - None Lighting - 100% low energy lighting Thermal bridging y-value - Calculated using Accredited Construction Details for all junctions Summer overheating - Light coloured curtains/roller blinds fully closed during daylight hours with windows fully open half the time			Floor u-value - 0.18 W/m²K External wall u-value - 0.18 W/m²K Common area wall u-value - 0.20 W/m²K Party wall u-value - 0 W/m²K (fully filled cavity with effective sealing around the edges) Roof u-value - 0.13 W/m²K Front door u-value - 1.4 W/m²K Windows - Metal frame with thermal break of 20mm; double glazing with hard low-E coating and argon gap of 16mm ore more; g-value of 0.6 on North-East and North-West elevations and 0.4 on South-East and South-West elevations; u-value of 1.4 W/m²K Design air permeability of 4m³/hm² (@50Pa) (not all dwellings being air pressure tested) Mechanical ventilation - Balanced heat recovery with Nuaire MRXBOX95-WH1 unit; SFP of 0.41 W/l/s and heat exchange efficiency of 91% for kitchen + 1 wet area Space heating - Community heating with CHP and boilers; Gas Ener-G 70kWe CHP providing 61% of heat demand, with overall efficiency 77.1% and heat to power ratio of 1.49; Gas boilers providing 39% of heat demand with overall efficiency of 95.5%; controlled by charging system linked to use, programmer and TRVs; heat emitted by underfloor heating Water heating - Cylinder located in dwellings as per Range Tribune cylinder sizing schedule; 1bath units to have 120 litre cylinder with declared heat loss of 1.05 kWh/day, 2bath units to have 150 litre cylinder with declared heat loss of 1.31 kWh/day Renewables - 13 kWp of PV installed at 15 degrees on roof as indicated on roof plan; Upsolar UP-M250M-B PV panel used with output of 0.25kWp per panel; none to very little overshading Lighting - 100% low energy lighting Thermal bridging y-value - Calculated using Accredited Construction Details for all junctions Summer overheating - Light coloured curtains/roller blinds fully closed during daylight hours with windows fully open half the time		
Plot No.:	**Area (m2):**	**No. of Occupants:**	**Type:**	**Floor:**	**DER**	**TER**	**Improvement on TER:**	**DER**	**TER**	**Improvement on TER:**	**DER**	**TER**	**Improvement on TER:**	**DER**	**TER**	**Improvement on TER:**
A-SR02	61.46	4	2Bed	Ground	20.24	20.24	0.00%	20.25	20.24	-0.05%	13.19	20.24	34.83%	12.74	20.24	37.06%
A-SR04	121.74	8	4Bed	Ground	15.99	15.99	0.00%	15.43	15.99	3.50%	10.52	15.99	34.21%	10.06	15.99	37.09%
A-SR05	61.46	4	2Bed	Mid	17.33	17.33	0.00%	18.03	17.33	-4.04%	11.68	17.33	32.60%	11.23	17.33	35.20%
A-SR06	75.29	4	2Bed	Mid	18.80	18.80	0.00%	19.29	18.80	-2.61%	12.77	18.80	32.07%	12.32	18.80	34.47%
A-SR07	51.05	2	1Bed	Mid	17.82	17.82	0.00%	18.05	17.82	-1.29%	11.43	17.82	35.86%	10.98	17.82	38.38%
A-SR09	50.66	2	1Bed	Mid	18.99	18.99	0.00%	18.34	18.99	3.42%	11.61	18.99	38.86%	11.15	18.99	41.28%
A-SR10	61.46	4	2Bed	Mid	16.49	16.49	0.00%	17.21	16.49	-4.37%	11.11	16.49	32.63%	10.66	16.49	35.35%
A-SR11	75.29	4	2Bed	Mid	16.69	16.69	0.00%	17.68	16.69	-5.93%	11.67	16.69	30.08%	11.22	16.69	32.77%
A-SR12	51.05	2	1Bed	Mid	17.41	17.41	0.00%	17.58	17.41	-0.98%	11.10	17.41	36.24%	10.65	17.41	38.83%
A-SR14	50.66	2	1Bed	Mid	18.99	18.99	0.00%	18.34	18.99	3.42%	11.61	18.99	38.86%	11.15	18.99	41.28%
A-SR20	51.7	2	1Bed	Top	20.50	20.50	0.00%	20.77	20.50	-1.32%	13.34	20.50	34.93%	12.89	20.50	37.12%
A-SR21	51.54	2	1Bed	Top	23.82	23.82	0.00%	23.34	23.82	2.02%	15.09	23.82	36.65%	14.63	23.82	38.58%
A-SR22	52.17	2	1Bed	Top	20.78	20.78	0.00%	20.56	20.78	1.06%	13.21	20.78	36.43%	12.76	20.78	38.59%
A-SR23	72.47	4	2Bed	Top	19.82	19.82	0.00%	18.76	19.82	5.35%	12.41	19.82	37.39%	11.96	19.82	39.66%
B-SO25	49.86	4	2Bed	Top	22.18	22.18	0.00%	20.46	22.18	7.75%	13.06	22.18	41.12%	12.61	22.18	43.15%
B-SR01	110.25	6	3Bed	Ground	18.25	18.25	0.00%	17.45	18.25	4.38%	11.89	18.25	34.85%	11.44	18.25	37.32%
B-SR02	110.95	6	3Bed	Ground	15.36	15.36	0.00%	15.79	15.36	-2.80%	10.76	15.36	29.95%	10.32	15.36	32.81%
B-SR07	101.41	6	3Bed	Ground	18.09	18.09	0.00%	16.94	18.09	6.36%	11.47	18.09	36.59%	11.02	18.09	39.08%
B-SR09	72.76	4	2Bed	Mid	15.95	15.95	0.00%	15.74	15.95	1.32%	10.32	15.95	35.30%	9.87	15.95	38.12%
B-SR13	72.76	4	2Bed	Mid	15.88	15.88	0.00%	15.56	15.88	2.02%	10.20	15.88	35.77%	9.74	15.88	38.66%
C-SO08	49.95	2	1Bed	Mid	16.47	16.47	0.00%	16.46	16.47	0.06%	10.32	16.47	37.34%	9.86	16.47	40.13%
C-SO11	50.26	2	1Bed	Mid	18.60	18.60	0.00%	18.52	18.60	0.43%	11.72	18.60	36.99%	11.27	18.60	39.41%
C-SO14	49.95	2	1Bed	Mid	16.47	16.47	0.00%	16.46	16.47	0.06%	10.32	16.47	37.34%	9.86	16.47	40.13%
C-SO17	50.26	2	1Bed	Mid	17.23	17.23	0.00%	17.28	17.23	-0.29%	10.85	17.23	37.03%	10.40	17.23	39.64%
D-PD04	70.35	4	2Bed	Mid	17.02	17.02	0.00%	17.66	17.02	-3.76%	11.59	17.02	31.90%	11.14	17.02	34.55%
D-PD05	49.98	2	1Bed	Mid	18.31	18.31	0.00%	18.62	18.31	-1.69%	11.79	18.31	35.61%	11.33	18.31	38.12%
D-PD08	70.35	4	2Bed	Mid	16.37	16.37	0.00%	16.84	16.37	-2.87%	11.03	16.37	32.62%	10.57	16.37	35.43%
D-PD09	49.98	2	1Bed	Mid	16.80	16.80	0.00%	17.21	16.80	-2.44%	10.80	16.80	35.71%	10.35	16.80	38.39%
D-PD17	72.9	4	2Bed	Top	17.79	17.79	0.00%	17.65	17.79	0.79%	11.61	17.79	34.74%	11.16	17.79	37.27%
D-SO01	61.27	4	2Bed	Ground	21.91	21.91	0.00%	21.03	21.91	4.02%	13.74	21.91	37.29%	13.28	21.91	39.39%
E-PD08	72.83	4	2Bed	Mid	17.66	17.66	0.00%	17.76	17.66	-0.57%	11.69	17.66	33.81%	11.24	17.66	36.35%
E-PD13	72.83	4	2Bed	Mid	15.93	15.93	0.00%	16.35	15.93	-2.64%	10.72	15.93	32.71%	10.26	15.93	35.59%
E-PD28	73.34	4	2Bed	Top	19.64	19.64	0.00%	18.61	19.64	5.24%	12.24	19.64	37.68%	11.80	19.64	39.92%
E-PD29	109.35	6	3Bed	Top	15.72	15.72	0.00%	15.34	15.72	2.42%	10.35	15.72	34.16%	9.90	15.72	37.02%
F-PD01	98.41	4	2Bed	Ground	15.82	15.82	0.00%	16.25	15.82	-2.72%	10.99	15.82	30.53%	10.52	15.82	33.50%
F-PD02	98.41	4	2Bed	Ground	17.69	17.69	0.00%	17.71	17.69	-0.11%	11.98	17.69	32.28%	11.53	17.69	34.82%
F-PD10	74.14	4	2Bed	Mid	17.77	17.77	0.00%	17.38	17.77	2.19%	11.45	17.77	35.57%	10.99	17.77	38.15%
F-PD15	74.14	4	2Bed	Mid	16.67	16.67	0.00%	16.25	16.67	2.52%	10.67	16.67	35.99%	10.21	16.67	38.75%
F-PD30	149.08	6	3Bed	Top	16.54	16.54	0.00%	15.35	16.54	7.19%	10.50	16.54	36.52%	10.13	16.54	38.75%
					17.94	**17.94**	**0.00%**	**17.80**	**17.94**	**0.64%**	**11.61**	**17.94**	**35.15%**	**11.16**	**17.94**	**37.70%**

APPENDIX E – THERMAL LOADINGS FOR CHP

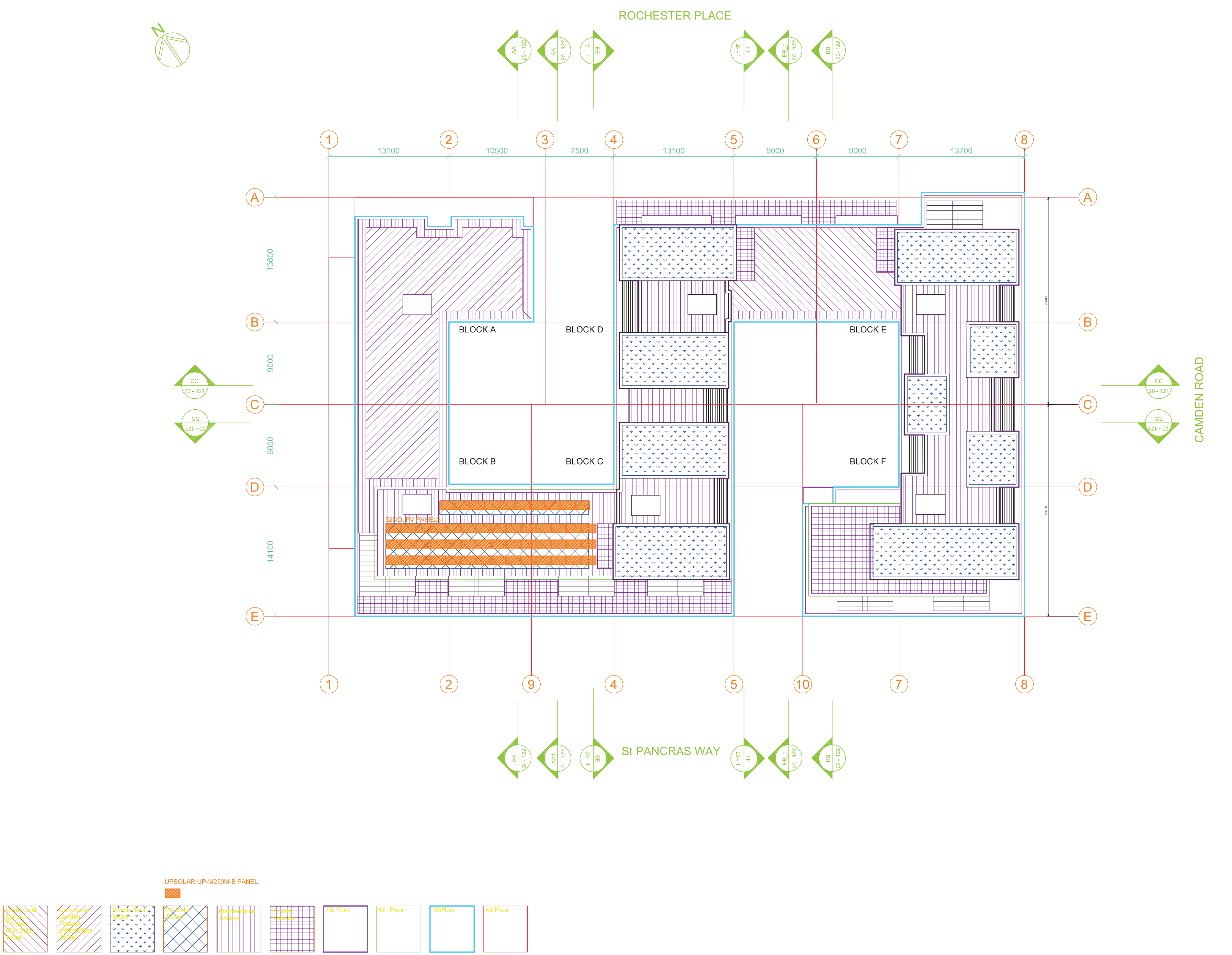
Thermal Loadings Summary
79 Camden Road, London

WDA Job Number: 9871
Prepared by: JT
Date: 23-Aug-13

WHITECODE DESIGN ASSOCIATES
BUILDING SERVICES DESIGN CONSULTANTS



APPENDIX F – PROPOSED PV LAYOUT



DO NOT SCALE FROM THIS DRAWING
The contractor shall check and verify all dimensions on site and repo
discrepancies in writing to Sheppard Robson before proceeding work.

FOR ELECTRONIC DATA ISSUE
Electronic data / drawings are issued as "read only" and should not
interrogated for measurement. All dimensions and levels should read,
only from those values stated in text, on the drawing.

AREA MEASUREMENT
The areas are approximate and can only be verified by a detailed din
survey of the completed building. Any decisions to be made on the b
these predictions, whether as to project viability, pre-letting, lease a
or the like, should include due allowance for the increases and decre
inherent in the design development and building processes. Figures re
the likely areas of the building at the current state of the design an
Gross External Area (GEA) / Gross Internal Area (GIA) / Nett Interna
(NIA) method of measurement from the Code of Measuring Practice,
6th Edition (RICS Code of Practice). All areas are subject to Town Pl
and Conservation Area Consent, and detailed Rights to Light analysis.

NOTES

REV.	DATE	AMENDMENT
A	13.09.2013	General Amendments
B	17.09.2013	General Amendments
C	27.09.2013	Design Freeze

KEYPLAN

CLIENT

..\..\sr_data\SR_8cm_black.jpg

77 Parkway Camden Town London NW1 7PU
T: +44 (0)20 7504 1700 E: london@sheppardrobson.com

PROJECT
79 CAMDEN ROAD

SCALE@A1	DATE	ORIGINATOR	CHECKED	AUTHORISED
1 200	18.08.2013	PJ	TK	DB

TITLE
PROPOSED ROOF PLAN

STATUS
DESIGN FREEZE

DRAWING NO.
4998-20-108

REV.
C

APPENDIX G – COMBINED HEAT & POWER (CHP) ENGINE OVERVIEW

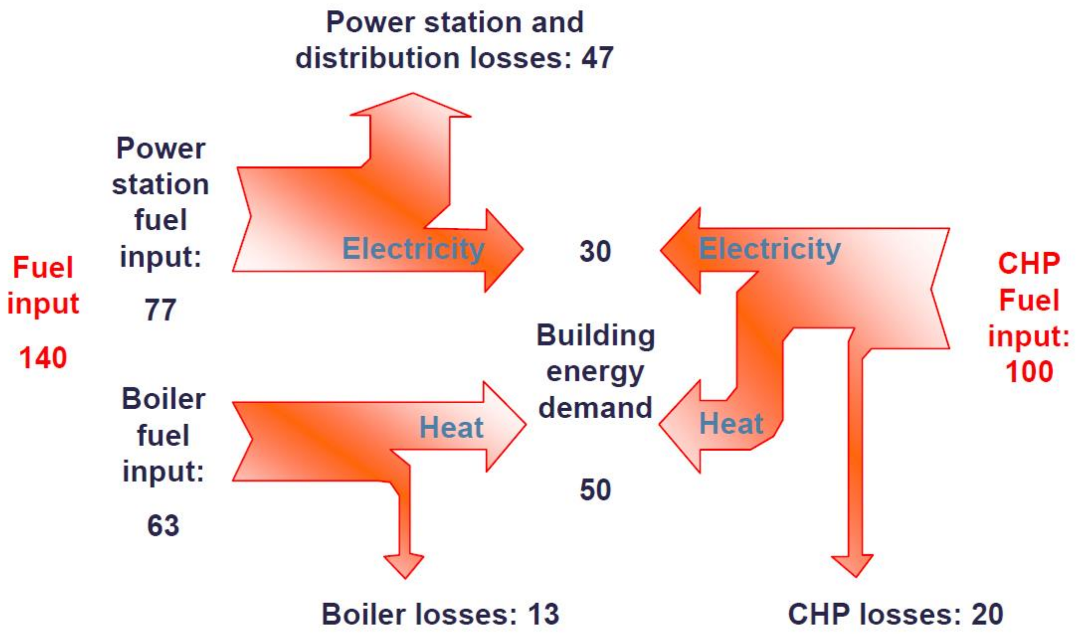
G.1 Combined Heat and Power Engines (CHP)

G.1.1 Overview

A CHP engine generates both heat and power, using gas (or biomass/biofuel) to drive a turbine that produces electricity and from which the heat is captured to produce hot water. Financial and environmental benefits are derived from the electricity production, but the use of a CHP is limited by the heat demand. A CHP requires a thermal load present throughout the year. To maximise efficiency of the engine it needs to run at least 17 hours a day; therefore, the heat needs to be present for this period. There are different scales of CHP from around 1kWe (micro-CHP) to 2MW+ giving a wider opportunity. The larger engines are ideal for use on buildings with high heat demands and are being increasingly used for District Energy Networks.

The key benefit from running a CHP engine is that it produces electricity, which can displace grid-supplied electricity, which has significant carbon savings. It is for this reason that CHP is designed to run for as many hours of the year as possible. The SAP calculation assumes 40% of the electricity generated is used directly within the dwelling and 60% is exported to the grid.

G.1.2 Example Layout



G.1.3 General Rules of Thumb

Energy Generated	Depends on size and use
Cost	Capital costs £1,000-500/kWe depending on size; £2,000-5,000 per unit to switch from individual to communal heating systems
CO_2 Savings	Approximately 430g of CO_2/kWh
Life Span	15-20 years
Payback	Approximately 10-20 years depending on engine size and development

G.1.4 Technical Considerations

- Limited modulation compared to gas boilers so needs to be sized to meet constant heat demand, i.e. hot water
- Need to aim for 4,500+ hours of operation each year
- Ideal for wet leisure centres, hotels, halls of residence, hospital, block of flats etc.
- Micro-CHP can be used for houses with a large heat demand
- Thermal store improves system performance can also consider part-loads, multiple units, heat dumping
- Absorption cooing also improves usage; however, need to consider relatively low CoP of absorption chillers
- Energy Centre (size, location, design) and Heat Network
- Flue height and air quality implications
- System set up for phasing

G.1.5 Pros & Cons

Pros

- Planning compliance
- High CO_2 savings from local electricity generation
- Potential to provide reduced operational costs
- Potential to reduce building electrical supply
- District energy networks

Cons

- Significant operational and maintenance implications
- High capital costs especially for district heating network infrastructure

APPENDIX H – RENEWABLE TECHNOLOGIES OVERVIEW

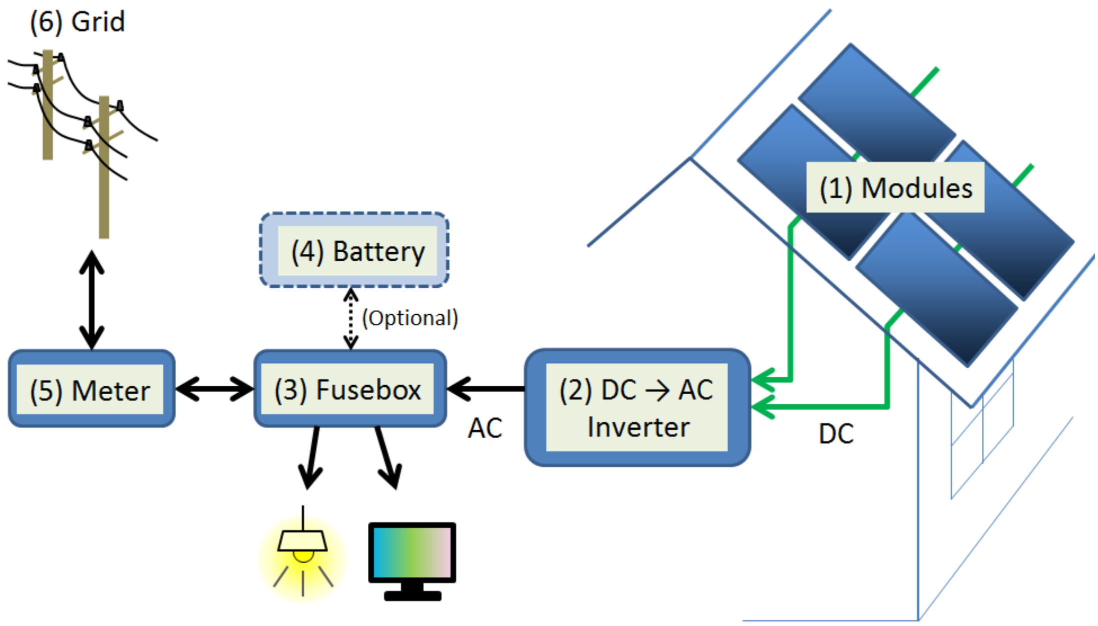
H.1 Photovoltaics

H.1.1 Overview

Photovoltaic (PV) systems convert energy from the sun into electricity via semi-conductor cells. There are a wide range of different panels available on the market, from less expensive amorphous silicon with low efficiencies (1 kW installation requires approximately 20m^2 of roof area), to mono-crystalline silicon with much higher efficiencies (1 kW installation requires approximately 7-8m^2 of roof area). Ideally, PV panels need to be positioned within 30^o of south and at an angle of 30^o to achieve optimum performance. It is essential that PV arrays are un-shaded, as even a small amount of shading dramatically reduces the output of the panel.

If the electricity generated is greater than the demand, any additional electricity can be exported to the grid. The SAP calculation assumes 50% of the electricity generated is used directly within the dwelling and 50% is exported to the grid.

F.1.2 Example Layout



H.1.3 General Rules of Thumb

Energy Generated	SAP assumes 850kWh per kWp (South @ 30^o) but will vary depending on various features
Cost	Around £4,500-5,000/kWp depending on size and type of panel
CO_2 Savings	0.45 tonnes CO_2/kWp
Space Needed	Panel area – 7-8m^2 per kWp. Roof area larger especially for flat roofs
Lifespan	30+ years (inverter 10-20 years)
Energy Payback	Depends on system type

H.1.4 Technical Considerations

- Orientation – optimum South & Inclination – optimum 30^o
- Avoid shading
- Weight of modules on the roof
- Safe access to roof space
- Installation and subsequent access to import/export meters
- Where the electricity will be used, i.e. who will benefit
- Planning constraints
- Over-shading from existing or planned buildings
- Annual and daily electricity demands of the building
- Cleaning access and schedule
- Quality of product

H.1.5 Pros & Cons

Pros

- Simple to install
- No limitations on generation
- Potentially good investment opportunity

Cons

- Still relatively expensive
- Require large amounts of roof space

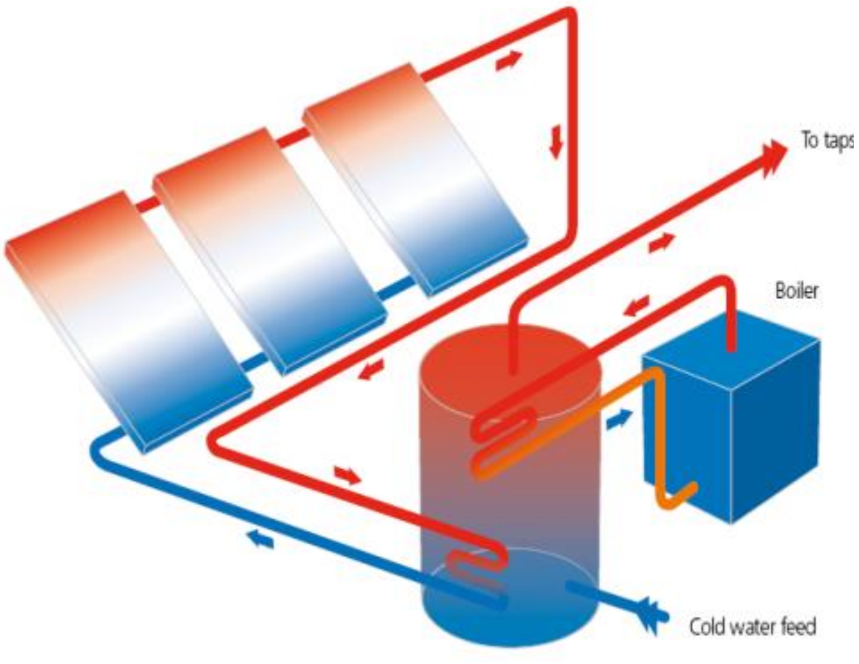
H.2 Solar Thermal

H.2.1 Overview

Solar water heating is an excellent renewable energy source as it can cater for almost 80% of the hot water load of a dwelling by absorbing solar gains from the sun. There are two different module types available on the market, flat plate and evacuated tubes. A south-facing 1m^2 highly efficient flat plate solar array will provide approximately 396kWh/m^2 of hot water and a highly efficient evacuated tube will provide approximately 520kWh/m^2 of hot water. The array needs to be sized to the meet the demand of the dwelling.

Solar water heating is suitable for houses; however, for blocks of apartments there are a number of complications. If solar water systems are required to serve flats other than those on the top floor there is the requirement for long runs of pipework to serve the apartments. This results in access issues, adds to the long-term maintenance of the system and reduces efficiencies due to pipe losses. Also, if a communal system is to be implemented, then a buffer vessel, expansion vessels and commercial pumps will be required, all of which require a large amount of plant space and maintenance. Within the apartments themselves, a large solar hot water cylinder will be required, but due to spatial requirements, this may not be practical to implement.

H.2.2 Example Layout



H.2.3 General Rules of Thumb

Energy Generated	396kWh/m^2 (Flat Plate (FP)) 520kWh/m^2 (Evacuated Tube (ET))
Cost	£700/m^2 (FP) – 1,000/m^2 (ET)
CO_2 Savings	78kg/m^2 (FP) 103kg/m^2 (ET) Usually around 5-10% of building CO_2 emissions depending on building type and system
Life Span	Approximately 30 years
Energy Payback	Reduced bills plus 8.5p/kWh Renewable Heat Incentive (RHI) for non-domestic (domestic scheme due in 2012)

H.2.4 Technical Considerations

- Avoid shading
- Weight of systems on the roof
- Orientation and inclination
- Drain-back systems
- Needs to be sized to match building demand but can be difficult to quantify at design stage
- Larger duel coil hot ware cylinders for domestic properties (or could be used as pre-feed)
- Pipe run lengths
- Vandalism if collectors exposed
- Safe access for maintenance and cleaning

H.2.5 Pros & Cons

Pros

- Simple to install
- Proven technologies
- Targets a specific component of energy consumption

Cons

- Limited cost savings
- Limited carbon savings

H.3 Wind Turbines

H.3.1 Overview

This is the most economic from the renewable energy in the UK for areas where high wind speeds are prevailing. Wind turbines converts kinetic energy from the wind into mechanical energy, a process known as wind power. There are two different types of turbine, vertical and horizontal axis. Scales of energy generated ranges from 1.5kW to 7MW+.

The distance to the nearest dwelling is determined by the design of the wind turbine and the ambient noise levels in the area. In general, it is recommended that the turbine noise level is kept to within 5dB (A) of the average existing evening or night-time background noise level. Typically this means that a large to medium scale wind turbine has to be located a distance of at least 350m-400m from any dwellings in order to maintain noise at the required levels (35-45dB) and avoid any problems with shadow flicker. Therefore, the installation of a large wind turbine is practically impossible on developments in the middle of the city.

Opting for smaller roof-mounted turbines (0.1-50kW), such as those manufactured by Quiet Revolution (which are more aesthetically pleasing) could be an option. These smaller wind turbines have been developed for remote power and are more suitable for use in urban environments. These are generally horizontal axis rotors but vertical axis machines are available. When consider the installation of roof mounted wind turbines the following issues should also be considered:

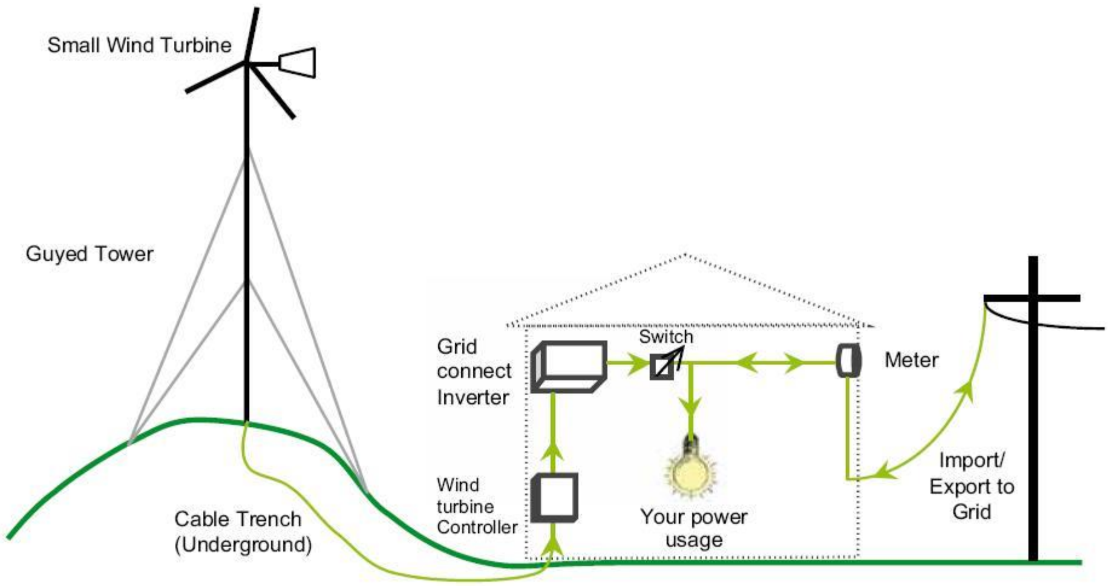
- Potential noise disturbance, particularly when close to residential properties.
- Shadow flicker – the shadow of rotating blades, again particularly when residential properties are nearby.
- Structural connection to the buildings, together with potential vibration and vibration generated noise.

Building-integrated wind turbines are still considered innovative, despite the already widespread use of larger scale wind turbines in wind farms. There is also a significant amount of risk when dealing with wind speed estimates I na turbulent environment. In general, the performance of the turbine will vary greatly with local conditions depending on the height, form and layout of surrounding buildings or features.

A typical 15kW turbine in a suburban environment could generate 5,626kWh/month and hence save 3,196kgCO_2. A 15kW turbine can cost approximately £39,000-46,000. A minimum space of 10m is required between each turbine, which could have a visual impact on the surrounding area. Generally, the available roof space on a scheme is not sufficient for the installation of a large number of the smaller roof-mounted wind turbines. In addition to spacing requirements, the use of turbines in urban areas severely reduces outputs and combined with the low wind speeds can render them ineffective. Recent studies have questioned viability and output from small systems, particularly in urban environments, leading to a number of suppliers of the small-scale turbines leaving the market.

If the electricity generated is greater than the demand, any additional electricity can be exported to the grid. The SAP calculation assumes 30% of the electricity generated is used directly within the dwelling and 70% is exported to the grid.

H.3.2 Example Layout



H.3.3 General Rules of Thumb

Energy Generated	Produces 5626.2 kWh/month
Cost	Based on 15kW turbine – grid connected - £39,000, battery charging - £46,000
CO_2 Savings	Infinite
Life Span	20-30 years
Payback	The payback for a 15kW wind turbine will be approximately 10 years

H.3.4 Technical Considerations

- If building mounted – physical fixing and vibration
- At least one year of wind speed measurement
- Site location for turbine (obstructions)
- Impact on surrounding area: shadow flicker, toppling distance, radar, noise, bird and bat migration, visual impacts
- Site electricity needs and local grid connectivity
- Loss of space (parking, green, visual)
- Planning restrictions
- Access on site for installation vehicles and equipment
- Space on site for turbine to be lain before installation (hoisted into place)

H.3.5 Pros & Cons

Pros

- Where big turbines work they can deliver the best CO_2 savings for the initial investment

Cons

- Questionable viability for smaller scale systems
- Urban environments severely reduce output
- Lots of initial work to demonstrate viability
- Planning issues

H.4 Heat Pumps

H.4.1 Overview

Heat pumps can deliver heating and cooling by moving heat from one place to another using electricity to drive compression and expansion. There are three types of source heat pumps can use, ground, air and water. The efficiency of heat pumps is referred to as the Coefficient of Performance (CoP), which is the unit of heat delivered for each unit of electricity used. The efficiency for heating drops as the output temperature increases, so heating systems need to be specifically designed for low temperature hot water such as underfloor heating. Systems sometimes include an immersion for hot water.

H.4.1.1 Ground Source Heat Pumps (GSHPs)

The Coefficient of Performance (CoP) of a GSHP for heating is around 3, and for cooling around 5. There are different system set-ups, such as horizontal and vertical and open loop and closed loop. GSHPs are dependent on site ground conditions and available space. A horizontal GSHP will generate 39,600kWh/ear per 50m x 1.5m trench, saving 7,680kg/CO_2/year. The open loop system requires licenses from the EA.

H.4.1.2 Air Source Heat Pumps (ASHPs)

Exhaust air heat pumps extract warm, stale air from the dwelling and use it to heat hot water and heat fresh air entering the property. They do not require an externally-mounted condenser; however, they do have one of the lowest CoP for heat pumps of around 2.5 and are therefore not applicable for an enhanced capital grant from the government. The units themselves can be very heavy and need to be craned into position. They are also expensive, at £6,000-10,000 per unit.

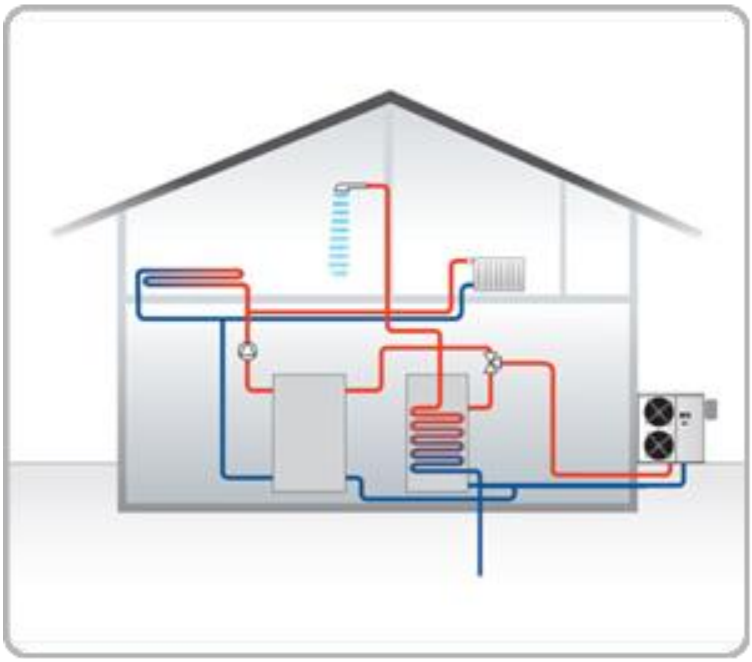
H.4.1.3 Water Source Heat Pumps (WSHPs)

WSHPs work in a similar way to GSHP systems, with the exception that they use 'open loop' collectors, where underground water is circulated through the pipes. A system of flexible pipework containing fluid is submerged in a river, stream or lake. The fluid is pumped around the system and absorbs heat from the surrounding water as it passes through the pipes. The fluid is then passed through a compressor which raises it to a higher temperature to be used for warm water, underfloor heating systems, or stored in a conventional hot water cylinder or thermal store.

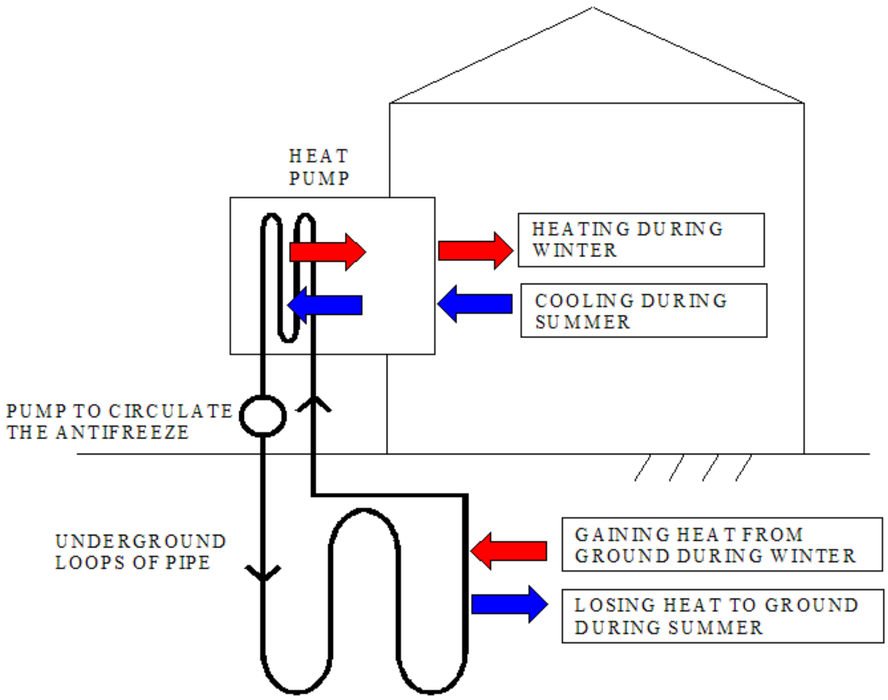
WSHPs are virtually silent and have no visible external units and for properties near a suitable water source offer an attractive alternative to a GSHPs.

A fully installed WSHP system costs approximately £7,000-10,000 (assuming individual systems not a community system).

H.4.2 Example Layout



Air Source Heat Pumps



Ground Source Heat Pumps

(This is similar to the Water Source Heat Pump system)

H.4.3 General Rules of Thumb

Energy Generated	Generally 100 kWh of heat generated with just 20-40 kWh of electricity
Cost	£6,000-£10,000
CO_2 Savings	Heat pump performing at 300% can save approximately 800 kgCO_2/year against an existing gas system and 5,270 kgCO_2/year against an existing electric system
Life Span	15-20 years
Payback	Approximately 10 years

H.4.4 Technical Considerations

- Need an appropriate heating system
- ASHP specific issues
    - Noise
    - Space
- GSHP specific issues
    - EA Licence
    - Ground survey
    - Distance between piles
    - Ground recharging

H.4.5 Pros & Cons

Pros

- Works well off grid when displacing electric heating/oil/lpg
- Heating and cooling systems provide greater CO_2 savings and allow recharging of the ground
- Possible future standard option

Cons

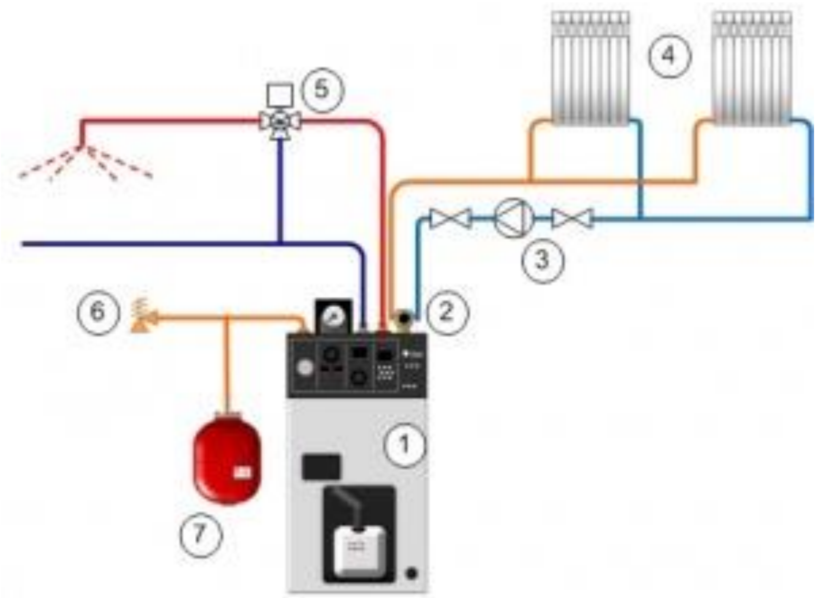
- Limited cost savings/potentially higher running costs
- Limited CO_2 savings
- Lack of certainty of energy returns
- High capital costs.

H.5 Biomass Boilers

H.5.1 Overview

Whilst traditionally most suited to lower density situations (mainly due to the supply and storage of the fuel), more high-density developments are considering this technology. A biomass boiler is best incorporated within a district heating scheme. However, there are issues regarding fuel storage and air pollution. A separate area would be required for the fuel store. We would use woodchip as opposed to pellets due to the embedded energy involved in transporting pellets from the continent – there are doubts as to whether wood pellets are in fact a carbon-neutral fuel. Woodchips can be sourced locally and therefore are more readily available, as well as being more carbon-friendly. The store would need to be adjacent to the plant room where the biomass boiler is located. In comparison to employing wind turbines or photovoltaic panels, this technology is much less demanding of space. Another storage compartment is required in the plant room for the waste ash, which is discharged and collected at the boiler. The ash content can vary from wood chips to pellets but can be substantial and requires regular maintenance and careful disposal.

H.5.2 Example Layout



H.5.3 General Rules of Thumb

Energy Generated	A boiler sized to meet around 50% peak could provide 80% of demand
Cost	Reduces with size: 100kW approximately £300/kW, 500kW approximately £200/kW
CO_2 Savings	0.189kg/CO_2 per kWh for chips 0.174kg/CO_2 per kWh for pellets
Life Span	20-30 years
Energy Payback	RHI payment

H.5.4 Technical Considerations

- Fuel type
- Fuel storage
- Local suppliers
- Fuel quality and security
- Access
- Flue design
- Air quality impacts

H.5.5 Pros & Cons

Pros

- Delivers high CO_2 savings (under current calculation methodology)
- Relatively good value for CO_2 savings realised compared to alternatives

Cons

- Significant operational and maintenance issues
- Fuel supply and cost risks (possible increased future demands)
- Planning issues relating to the flue and air quality implications

APPENDIX I – CODE FOR SUSTAINABLE HOMES PRE-ASSESSMENT

Prepared by Whitecode Design Associates
On behalf of Barratt Homes
79 Camden Road

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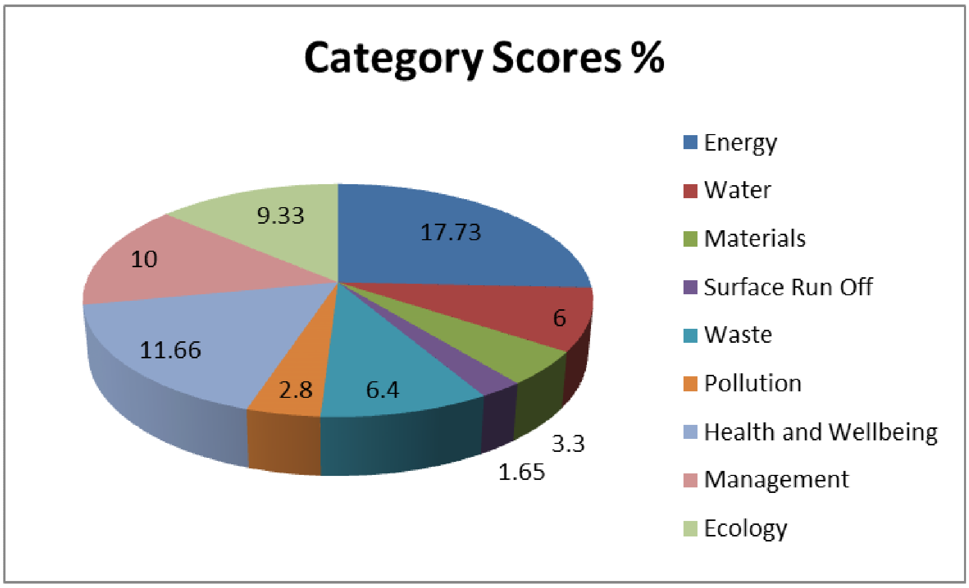
Executive Summary

The Code for Sustainable Homes covers nine categories of sustainable design. These categories are split into the following:

- Energy and CO_2 Emissions
- Water
- Materials
- Surface Water Run-off
- Waste
- Pollution
- Health and Well-being
- Management
- Ecology

The predicted scores for each of these categories are shown in the chart below:



The predicted overall score is 68.87 which equates to Code for Sustainable Homes (CSH) Level 4.

Certain aspects of the design specification, in particular attitudes toward reducing internal and external water use and improving ecological enhancement have resulted in the CSH Level 4 being achieved. Other notable contributing factors include:

- CHP and PV provides at least 15% reduction in CO^2 emissions
- External lighting designed to be 100% low energy
- Designing to incorporate all Lifetime Homes features
- Ensuring good levels of sound insulation between apartments
- Commitment to seek Secured by Design Section 2 Physical Security certification
- Provision for ample cycle storage

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1.0 Introduction

This Code for Sustainable Homes (CSH) report has been produced at the request of Barratt Homes by Whitecode Design Associates Ltd who is licensed by BRE to carry out CSH Assessments. The report aims to provide a detailed investigation, aided by available architect's drawings and technical reports, into how the required CSH level can be obtained. Full evidence must be supplied throughout the design stage assessment in order for the credits to be awarded and the predicted rating achieved. The design team should be aware that as the project progresses, if any credits are lost they will need to be made up elsewhere in the assessment. For this development, it is our understanding is that the Code performance objective (and planning requirement) for this development is Code Level 4. To achieve this rating, it will be vital for Code issues to be addressed throughout the design and construction phases with regular reviews of the assessment in progress.

The proposed development located at 79 Camden Road, London will comprise 166 flats. The accommodation is as follows:

- 50 x 1 Bedroom apartments
- 101 x 2 Bedroom apartments
- 13 x 3 Bedroom apartments
- 2 x 4 Bedroom apartments

This development is being assessed under the November 2010 version of CSH.

2.0 Conclusion

Within each of the nine CSH categories are a total of 34 sub categories. The predicted score for each sub category is detailed below:

Ene 1	Dwelling Emission Rate	4.1	4.797
Ene 2	Fabric Energy Efficiency	0	0
Ene 3	Energy Display Devices	2	2.34
Ene 4	Drying Space	1	1.17
Ene 5	Energy Labelled White Goods	1	1.17
Ene 6	External Lighting	2	2.34
Ene 7	Low and Zero Carbon Technologies	2	2.34
Ene 8	Cycle Storage	2	2.34
Ene 9	Home Office	1	1.17
Wat 1	Indoor Water Use	3	4.5
Wat 2	External Water Use	1	1.5
Mat 1	Environmental Impact of Materials	7	2.1
Mat 2	Responsible Sourcing - Basic Elements	3	0.9
Mat 3	Responsible Sourcing - Finishing Elements	1	0.3
Sur 1	Management of Surface Water Run Off	1	0.55
Sur 2	Flood Risk	2	1.1
Was 1	Storage of Non recyclable and Recyclable Waste	4	3.2
Was 2	Construction Site Waste Management	3	2.4
Was 3	Composting	1	0.8
Pol 1	GWP of Insulants	1	0.7
Pol 2	Nox Emissions	3	2.1
Hea 1	Daylighting	2	2.34
Hea 2	Sound Insulation	3	3.51
Hea 3	Private Space	1	1.17
Hea 4	Lifetime Homes	4	4.68
Man 1	Home User Guide	3	3.33
Man 2	Considerate Constructors Scheme	2	2.22
Man 3	Construction Site Impacts	2	2.22
Man 4	Security	2	2.22
Eco 1	Ecological Value of Site	1	1.33
Eco 2	Ecological Enhancement	1	1.33
Eco 3	Protection of Ecological Features	1	1.33
Eco 4	Change of Ecological Value of Site	2	2.66
Eco 5	Building Footprint	2	2.66

The total predicted score for this development is 68.87% thus achieving CSH Level 4 which requires a score of 68.

3.0 Detailed Review

3.1 Methodology

This section of the pre assessment examines each sub category in detail to identify where credits are possible. It includes a description of the relevant aspects of the development, the results of any calculations or investigations completed and the reasoning behind the score predicted.
It is vital that individual design team members consult the detailed credit and evidence requirements in the CSH November 2010 Technical Guidance Manual to ensure compliance; evidence which is not provided in accordance with these requirements will not pass the BRE's strict quality assurance process. The information in this report is provided for guidance only and does not constitute a comprehensive set of requirements.

It is worth noting that many of the sub categories consider the site as a whole and award each individual dwelling with the same credits – such as Sur 2 Flood Risk, however this is not the case in some sub categories where the performance of a single dwelling or group of dwellings may result in differing credits – such as Hea 1 Daylighting. To assess 167 individual dwellings at pre assessment stage would be a complex task due to the lack of accurate information available therefore the overall predicted score in this report is based on the worst performing dwelling. Where credits are likely to be achieved by other dwellings, this is noted in the text. Where applicable, suggestions for possible improvements have been included in each section.

3.2 Energy

3.2.1 Ene 1 – Dwelling Emission Rate

This section compares the Dwelling Emission Rate (DER) against the Target Emission Rate (TER) and awards credits on the basis of percentage improvement. 0 credits are achieved for just meeting the TER; however, up to 10 credits are awarded for 100% improvement. There is no mandatory requirement in this section for CSH Level 3.

All dwellings will be powered by a community heating scheme consisting 70kWe CHP and 13kWp PV. The results from current SAP calculations show that the average reduction in the DER compared to the TER is 37.3%. This is sufficient to award 4.1 credits.

Possible Improvements

Credits under November 2010 are much harder to achieve in this section as simply meeting CSH Level 3 standards is no longer sufficient to award any credits. The first whole credit is only awarded where there is an 8% improvement DER/TER. Dwellings with the most external elements (ground and top floor typically) perform the worst due to the fabric heatloss and increased space heating required. By improving the insulation and air tightness of these dwellings, it may be possible to achieve greater improvement and thus more credits.

3.2.2 Ene 2 – Fabric Energy Efficiency (FEE)

This section awards credits based on the thermal performance (energy demand for space heating and cooling) of each dwelling as calculated using SAP 2009 software. Up to 9 credits are awarded on a sliding scale dependant on the building type. Flats and mid terrace houses are rewarded for having a FEE of between $\leq$48 kWh/m^2/year and $\leq$32 kWh/m^2/year. Houses and end of terraces for having a FEE of between $\leq$60 kWh/m^2/year and $\leq$38 kWh/m^2/year.

The results from the Current SAP calculations indicate that the average FEE of 51.6 is being achieved. This does not achieve any credits in this section.

Possible Improvements

As mentioned in Ene 1, improving the insulation in the ground and top floor apartments will result in better Building Fabric performance.

3.2.3 Ene 3 – Energy Display Devices

The aim of this section is to promote the specification of equipment to display energy consumption data, thus empowering dwelling occupants to reduce energy use. One credit can be achieved for installing a device which displays electricity or primary fuel consumption data. Two credits can be awarded for providing a device which displays both electricity and primary fuel consumption data. The device must be dedicated to each dwelling.

All units will be fitted with compliant Energy Display Devices. This will display both the current electricity and gas consumption data. 2 credits can be awarded in this section.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.2.4 Ene 4 – Drying Space

A credit can be gained in this section for discouraging the use of a tumble dryer by providing internal or external drying lines to each dwelling. The drying line must be fixed in its location and at least 4 meters in length for 1 and 2 bedroom dwellings and 6 meters for dwellings with more than 3 bedrooms.

The apartments will be fitted with internal drying lines of at least 4m in length for 1 and 2 bedroom apartments and at least 6m in length in 3 and 4 bedroom apartments. This will be fixed above the bath.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.2.5 Ene 5 – Energy Labelled White Goods

A single credit is awarded where A+ rated fridge/freezers are provided to a dwelling along with a copy of the EU Energy Efficiency Labelling Scheme leaflet. A second credit can be achieved by providing an A rated dishwasher and washing machine or B rated washer/dryer or tumble dryer. Where no white goods are being provided a credit can still be achieved where a copy of the EU Energy Efficiency Labelling Scheme leaflet is supplied to the dwelling.

No white goods are being provided to the Housing Association units. The occupants of these apartments will receive a copy of the EU Energy Efficiency Labelling Scheme Leaflet in order to promote the purchase of energy efficient white goods, thus reducing the CO_2 emissions from appliance use in the dwelling. 1 credits can be achieved for the HA apartments.

Private units will be supplied with appliances that are 'best in class' for energy consumption as determined by the EU Energy Labelling Scheme. Fridge freezers will be 'A+' rated, washing machines and dishwashers will be 'A' rated and where supplied tumble dryers or washer/dryers will be 'B' rated. 2 credits can be gained.

Possible Improvements

The provision of compliant white goods to the HA apartments would result is 1 additional credit in this section for those units. No further improvement is possible for the private units.

3.2.6 Ene 6 – External Lighting

One credit is available for the specification of 100% dedicated low energy lighting to all indoor and outdoor communal areas including bin stores and cycle stores. A second credit can be achieved where security lighting is designed for energy efficiency with a maximum wattage of 150W and is adequately controlled through the use of PIR and daylight cut-off sensors.

All internal and external common area lighting, including lighting to the bin stores and cycle stores will be low energy and be controlled by PIR or daylight cut-off devices. Any security lighting will be designed such that the fittings are rated 150W maximum and be controlled by PIR sensors with daylight cut-off devices. 2 credits can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.2.7 Ene 7 – Low and Zero Carbon Technologies

To limit CO2 emissions and running costs arising from the operation of a dwelling and its services by encouraging the specification of low and zero carbon energy sources to supply a significant proportion of energy demand. Once credit can be gained where energy supplied by low or zero carbon technologies provide a 10% result in CO_2 emissions when compared with a 'Standard Case' dwelling with no renewables. Two credits can be achieved where the reduction in CO_2 emissions is 15%.

All dwellings will be powered by a community heating scheme consisting 70kWe CHP and 13kWp PV. The results from current SAP calculations indicate that this achieves at least a 20% reduction in CO2 emissions. The full 2 credits can be achieved in this section.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.2.8 Ene 8 – Cycle Storage

Credits are awarded in this section where weatherproof, secure cycle storage is provided for each dwelling. One credit can be gained where studios or 1 bedroom dwellings have storage for 1 cycle for every two dwellings; 2 and 3 bedroom dwellings have storage for 1 cycle per dwelling; and 4 bedrooms and above have storage for 2 cycles per dwelling is. Two credits can be gained where studios or 1 bedroom dwellings have storage for 1 cycle per dwelling; 2 and 3 bedroom dwellings have storage for 2 cycles per dwelling; and 4 bedrooms and above have storage for 4 cycles per dwelling is provided.

The development proposal includes 294 cycle parking spaces, all of which are located at lower ground floor level. Secure weatherproof cycle storage for 288 cycles is required to achieve 2 credits therefore full credits can be awarded in this section.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.2.9 Ene 9 – Home Office

One credit can be achieved in this section for providing 1.8m wall space in a room with an Average Daylight Factor of 1.5% and providing sufficient services to that room to enable the occupant to set up a Home Office at home. This includes 2 double power sockets and 2 telephone points (or 1 telephone point where cable or broadband is available).

Each dwelling will have a room with a window that achieves an ADF of at least 1.5%, that is equipped with basic facilities required for setting up a 'home office' i.e additional power sockets and a phone point. This will be in a living room in 1 and 2 bed units and in bedroom 2 or 3 in 3 bed units. 2 credits can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.2.10 Energy Summary of Credits

		Maximum	Predicted
Ene 1	Dwelling Emission Rate	10	4.1
Ene 2	Fabric Energy Efficiency	9	0
Ene 3	Energy Display Devices	2	2
Ene 4	Drying Space	1	1
Ene 5	Energy Labelled White Goods	2	1
Ene 6	External Lighting	2	2
Ene 7	Low and Zero Carbon Technologies	2	2
Ene 8	Cycle Storage	2	2
Ene 9	Home Office	1	1
	Predicted scores in this section		15.1
	% contribution to overall score		17.73

3.3 Water

3.3.1 Wat 1 – Internal Water Use

Up to 5 credits are available in this section for specifying water saving sanitary ware and fittings, grey water recycling systems or rainwater harvesting systems. CSH Level 3 and 4 have a mandatory requirement not to exceed 105 litres/person/day.

In this case the client is proposing to limit the water usage to105 litres/person/day. This can be achieved by specifying sanitary and brassware with the following flow rates:

WC flush volumes:	6/3 litres dual flush
WHB taps:	4 litres/min regulator
Kitchen sink taps:	7 litres/min regulator
Showers:	8 litres/min regulator
Bath capacity:	180 litres to overflow
Washing machines:	8.16 litres/kg dry load
Dishwashers:	1.25 litre/place setting

3 credits can be gained.

Possible Improvements

By installing rainwater harvesting or grey water recycling, water usage could be further reduced to 90 or 80 litres/person/day and therefore achieve the full 5 credits in this section.

3.3.2 Wat 2 – External Water Use

One credit is available in this section for installing rainwater harvesting systems to promote the recycling of rainwater and reduce the amount of mains potable water used for external water uses.

The client proposes to install a rainwater harvesting system to collect water for external use. This would use a pump to deliver water to conveniently located irrigation points provided for landscaping. This would gain 1 credit.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.3.3 Water Summary of Credits

		Maximum	Predicted
Wat 1	Indoor Water Use	5	3
Wat 2	External Water Use	1	1
	Predicted scores in this section		4
	% contribution to overall score		6

3.4 Materials

3.4.1 Mat 1 – Environmental Impact of Materials

Up to 15 credits are awarded in this section where specified materials for the main building elements (roof, external walls, internal walls, ground and upper floors and windows) have a lower environmental impact over their life cycle. The BRE's 'Green Guide to Specification' is referred to in order to establish a rating for each element of between A+ and E. It is a mandatory requirement for all CSH levels that at least 3 of the 5 elements achieve a rating between A+ and D. Credits are awarded accordingly.

The client proposes to specify materials with a high Green Guide Rating. Detailed material specification is not available at this time however is likely that the construction will gain at least 7 credits in this section.

Possible Improvements

When detailed specification is available extra credits may be achieved.

3.4.2 Mat 2 – Responsible Sourcing of Materials – Basic Building Elements

Up to 6 credits can be awarded where the suppliers of the materials specified in the basic building elements (frame, floors, roof, walls, foundations and staircases) can provide documentation confirming responsible sourcing. A minimum of 5 elements must be assessed and 80% of the materials within that element must be responsibly sourced.

3 credits could be gained by using suppliers who can produce EMS certification for the construction materials.

Possible Improvements

When detailed specification is available extra credits may be achieved.

3.4.3 Mat 3 – Responsible Sourcing of Materials – Finishing Elements

Up to 3 credits can be awarded where the suppliers of the materials specified in the finishing elements (staircase, windows, doors, skirting, panelling, furniture, fascia) can provide documentation confirming the responsible sourcing of that material. 80% of the materials within that element must be responsibly sourced.

1 credit could be gained by using suppliers who can produce EMS certification for the finishing materials.

Possible Improvements

When detailed specification is available extra credits may be achieved.

3.4.4 Materials Summary of Credits

		Maximum	Predicted
Mat 1	Environmental Impact of Materials	15	7
Mat 2	Responsible Sourcing - Basic Elements	6	3
Mat 3	Responsible Sourcing - Finishing Elements	3	1
	Predicted scores in this section		11
	% contribution to overall score		3.3

3.5 Surface Water Run Off

3.5.1 Sur 1 – Management of Surface Water Run Off from Developments

This section is mandatory for all CSH levels and requires that the post development peak run off rates and volume of run off does not exceed the pre developments rates. Once these criteria have been satisfied, 2 credits are available for incorporating SUDs into the drainage design. The first credit is awarded where SUDs are used to ensure that the first 5mm of rainfall run off from all hard surfaces is prevented from entering the watercourse. The second credit is awarded where SUDs ensure that the run off from all hard surfaces receive treatment to reduce the risk of pollution in accordance with best practices.

It is likely that with the incorporation of landscaped areas and brown roofs, the impermeable area will have decreased compared with the pre developed site which consists mainly of hardstanding and buildings. This will mean that the mandatory criteria will be met by default.

The incorporation of brown roofs and permeable paving will result in the 5mm criteria being achieved. 1 Credit can be gained in this section.

Possible Improvements

Should mitigation measures be incorporated into the design, in line with best practice operational guidelines, that will deal with run-off water from potential sources of pollution, and improve the quality of the water discharged into the watercourse, 1 additional credit could be gained in this section.

3.5.2 Sur 2 – Flood Risk

Two credits can be awarded in this section where a Flood Risk Assessment (FRA) confirms that the site is located in Flood Zone 1 (low annual probability of flooding) and that there is a low risk of flooding from all sources considered in PPS25 *Development and Risk*. Where the FRA identifies the site to be located in flood Zones 2 or 3a (medium and high annual probability of flooding) a single credit can still be gained where the finished floor level of all habitable parts of the dwelling and access routes to the ground level and the site, are at least 600mm above the *design flood level* of the flood zone.

The site has been confirmed as being situated within Flood Zone 1 – Low risk of flooding. 2 credits can be achieved subject to confirmation that there is a low risk of flooding from all sources.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.5.3 Surface Run Off Summary of Credits

		Maximum	Predicted
Sur 1	Management of Surface Water Run Off	2	1
Sur 2	Flood Risk	2	2
	Predicted scores in this section		3
	% contribution to overall score		1.65

3.6 Waste

3.6.1 Was 1 – Storage of Non-recyclable Waste & Recyclable Household Waste

This is a mandatory element which applies to all CSH levels and requires that sufficient external space is provided for the storage of recyclable and non-recyclable waste. The minimum volume recommended by British Standard 5906 (British Standards Institution, 2005) based on a maximum collection frequency of once per week is 100 litres for a single bedroom dwelling, with a further 70 litres for each additional bedroom. Up to 4 credits are awarded where there is dedicated internal storage for recyclable waste within the dwelling and a Local Authority Recycling Collection Scheme.

The proposals include a dedicated residential refuse and recycling store on the ground floor of the building to store 31,500 litres of waste. This will comprise mixed dry recyclables, organic food waste as well as non recyclable waste. In addition, separate storage for recyclable materials will be provided within the kitchen of each dwelling to encourage residents to participate in the recycling collection scheme. A total of 4 credits can be achieved in this section.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.6.2 Was 2 – Site Waste Management Plan

One credit is awarded where a Site Waste Management Plan (SWMP) is produced that contains targets, procedures and commitments to minimise construction waste in accordance with the CSH criteria. In addition to this credit a second and third can be gained where the SWMP contains commitments and procedures to divert 50% and 85% of waste, by weight or volume, from landfill.

A Site Waste Management Plan will be implemented which will include target, procedures and commitments to minimise waste production and to sort and divert at least 85% of waste from landfill. This is sufficient to gain 3 credits.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.6.3 Was 3 – Composting

One credit is available for the provision of home composting facilities or where the Local Authority operates a kitchen waste collection scheme.

The Waste and Recycling Strategy produced by URS states that London Borough of Camden will make a twice weekly collection of organic food waste. Bins will be stored in the dedicated bin stores on the ground floor of the building. Residents will have a small food waste bin provided within their apartment. 1 credit can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.6.4 Waste Summary of Credits

		Maximum	Predicted
Was 1	Storage of Non recyclable and Recyclable Waste	4	4
Was 2	Construction Site Waste Management	3	3
Was 3	Composting	1	1
	Predicted scores in this section		8
	% contribution to overall score		6.4

3.7 Pollution

3.7.1 Pol 1 – Global Warming Potential (GWP) of Insulants

A single credit can be awarded in this section where the insulating materials specified in the construction have a GWP no greater than 5.

The construction will avoid the use of any insulating materials that have a GWP of 5 or greater. 1 credit can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.7.2 Pol 2 – NOx Emissions

This section aims to promote the reduction of nitrogen oxide emissions in the atmosphere by awarding credits for the specification of heating systems which produce low NOx emissions.

The apartments will be supplied with heat from a communal plant room, located in the basement of the building. The Energy Centre contains a 70kWe CHP unit and 2No 500 kW gas boilers. The gas boilers will have low NOx emissions at approximately 60mg/kWh. The CHP unit will supply 61% of the annual heat load and be fitted with a catalytic converter so will have emissions less than 500mg/kWh. In the calculations these are offset against the average grid electricity emissions, so will count as zero. The final average heat related NOx emissions will therefore be approximately 24mg/kWh. 3 credits can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.7.3 Pollution Summary of Credits

			Maximum	Predicted
Pol 1	GWP of Insulants		1	1
Pol 2	Nox Emissions		3	3
		2.8	4	
	Predicted scores in this section			4
	% contribution to overall score			2.8

3.8 Health & Wellbeing

3.8.1 Hea 1 – Daylighting

Two credits are available in this section for achieving an average daylight factor of 2% in kitchens and 1.5% in living rooms, dining rooms and home offices. A further 1 credit can be gained where the room has a view of sky over 80% of the floor area.

All dwellings benefit from large windows and it is likely that good daylight levels can be achieved which meet the Code criteria. 2 credits can be gained.

Possible Improvements

There are no improvements possible here.

3.8.2 Hea 2 – Sound Insulation

Credits are available where through sound testing or by the use of Robust Details, there is up to 8 dB improvement over the requirements set out in Approved Document E of the Building Regulations.

The client is proposing to design the separating walls and floors to achieve a performance that is at least 5dB better than the building regulations. This will gain 3 credits in this section

Possible Improvements

Further sound proofing the walls and floors to achieve a performance of 8dB improvement would award the full 4 credits in this section.

3.8.3 Hea 3 – Private Space

Through the provision of either private amenity space or shared amenity space, 1 credit can be gained. The space must be of sufficient size as defined by CSH, be accessible only to the residents of the designated dwellings, be secure and wheelchair accessible.

Fully accessible roof terraces on the fifth floor provide sufficient amenity space for all residence in addition to private balconies and terraces. 1 credit can be achieved

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Possible Improvements

No further credits possible as full credits have already been assumed.

3.8.4 Hea 4 – Lifetime Homes

Four credits can be gained in this section where all applicable criteria on the Lifetime Homes checklist have been met.

The scheme will comply with all 16 sections of the Lifetime Homes standards. Compliance with these standards will result in the full 4 credits being awarded in this section.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.8.5 Health & Wellbeing Summary of Credits

		Maximum	Predicted
Hea 1	Daylighting	3	2
Hea 2	Sound Insulation	4	3
Hea 3	Private Space	1	1
Hea 4	Lifetime Homes	4	4
	Predicted scores in this section		10
	% contribution to overall score		11.66

3.9 Management

3.9.1 Man 1 – Home User Guide

Up to 3 credits are available in this section for the provision of a guidance manual which enables the occupant to understand and operate their home efficiently and make the best use of local facilities.

Each dwelling will be provided with a guide on the operation and environmental performance of the dwelling. It will include information on the overall environmental strategy, energy saving measures and renewables. It will also cover water saving, recycling and waste tips, information on sustainable DIY and links to further information. The guide will also cover details of local amenities, A&E facilities and minor injury clinics. This will award 3 credits.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.9.2 Man 2 – Consider Constructors Scheme

The aim of this section is to promote the environmentally and socially considerate and accountable management of construction sites. One credit is available in this section for registering with a scheme such as Considerate Constructors Scheme and there is a commitment to achieve *best practice* certification. Where there is a commitment to go *significantly beyond best practice* 2 credits can be gained.

The client has confirmed that they will be registering the site with the Considerate Constructors Scheme and have every expectation of achieving beyond best practice with a score in excess of 35 with no less than 7 points in each section. 2 credits can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.9.3 Man 3 – Construction Site Impacts

The aim of this section is to increase awareness of the impact on the environment from site activities by awarding up to 2 credits for setting targets, monitoring and reporting water consumption and CO_2 emissions arising from site activities and commercial transport. Adopting best practice procedures to reduce the risk of dust and water pollution on site and by using recycled or certified timber for site purposes such as formwork and hoardings also contributes towards achieving both credits.

The client has confirmed that they routinely adopt best practice policies relating to air (dust) and water (ground and surface) pollution arising from site activities. The monitoring of site energy and water consumption and transport to and from the site is also recorded. 2 credits can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.9.4 Man 4 – Secured by Design

Two credits are available in this section where an Architectural Liaison Officer or Crime Prevention Design Advisor from the local police force is consulted at design stage and their recommendations are incorporated into the design of the dwellings so that the development achieves the standard of *Section 2 – Physical Security* from *Secured by Design – New Homes.*

A Secured by Design Officer will be consulted and their recommendations will be incorporated into the design of the development, 2 credits could be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.9.5 Management Summary of Credits

		Maximum	Predicted
Man 1	Home User Guide	3	3
Man 2	Considerate Constructors Scheme	2	2
Man 3	Construction Site Impacts	2	2
Man 4	Security	2	2
	Predicted scores in this section		9
	% contribution to overall score		10

3.10 Ecology

3.10.1 Eco 1 – Ecological Value of Site

A single credit can be awarded where the pre developed site contains no features of ecological value as confirmed by either a Suitably Qualified Ecologist or by using the BRE Ecology checklist.

The current site is made up of buildings and hardstanding therefore it is likely that the land will be deemed to have low ecological value. 1 credit has been assumed. This credit is subject to confirmation from a Suitably Qualified Ecologist.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.10.2 Eco 2 – Ecological Enhancement

Where a Suitably Qualified Ecologist is appointed to give key and additional recommendations for enhancing the ecological value of the site, and those recommendations are incorporated into the design, 1 credit can be awarded.

An ecologist will be appointed to give advice on improving the ecological value of the site and the recommendations will be incorporated into the design. 1 credit can be awarded.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.10.3 Eco 3 – Protection of Ecological Features

The aim of this section is to promote the protection of existing ecological features from substantial damage during the clearing of the site and the completion of construction works. One credit can be gained by default where the site has been confirmed as containing no features of ecological value or by following protection measures recommended by a Suitable Qualified Ecologist.

It is assumed that the site will be confirmed as being of low ecological value therefore this credit can be awarded by default. 1 credit can be gained.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.10.4 Eco 4 – Change in Ecological Value

Up to 4 credits can be awarded where the ecological value of the site post construction has been calculated and compared with that of the pre developed site and the improvement is between -9 and +9 species per hectare.

Once an ecologist has been appointed the pre and post species per hectare can be compared. At this stage a safe assumption would be that the improvement is neutral – a Change of between -3 and +3 species/ hectare. 2 credits can be awarded.

Possible Improvements

It is likely that due to the nature of the existing site, the change in ecological value could be classified by an ecologist as major, a change of +9. This would award up to 2 additional credits.

3.10.5 Eco 5 – Building Footprint

The aim of this section is to promote the most efficient use of a building's footprint by ensuring that land and material use is optimised across the development.

The development comprises of 167 apartments over 5 to 7 storeys. The full 2 credits are awarded for a building footprint ratio of 4:1.

Possible Improvements

No further credits possible as full credits have already been assumed.

3.10.6 Ecology Summary of Credits

		Maximum	Predicted
Eco 1	Ecological Value of Site	1	1
Eco 2	Ecological Enhancement	1	1
Eco 3	Protection of Ecological Features	1	1
Eco 4	Change of Ecological Value of Site	4	2
Eco 5	Building Footprint	2	2
	Predicted scores in this section		7
	% contribution to overall score		9.33