PRICE&MYERS

Consulting Engineers

30 Newman Street
London W1T 1LT
T 020 7631 5128
F 020 7462 1390
jjames@pricemyers.com
www.pricemyers.com

Englands Lane

Energy Strategy Report

CIBSE LOW CARBON ENERGY ASSESSORS

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Prepared by: Jessica Gray

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Executive Summary

This report details the proposed energy strategy for the Sandycombe Road scheme, which entails the demolition of a single storey office and being replaced by a new 4-storey development in the London Borough of Richmond upon Thames. The mixed-use development will comprise of a basement level flat, an office on the ground floor and a second flat occupying the first and second levels.

The proposed development addresses national planning policies on energy; in particular, mitigation of climate change and energy security through energy efficiency enhancements and use of alternative energy technologies. In order to reduce the carbon footprint of the building beyond the requirements of current regulatory and market standards, the development will benefit from the following integrated systems:

- Passive design features (Be Lean)
- Energy efficiency measures (Be Clean)
- Low and zero carbon technologies (Be Green)

The building fabric performance will meet or exceed the Part L 2013 requirements where applicable.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The proposed strategy has the potential to provide a 29.75% improvement over the Building Regulations 2013 minimum target; through passive design measures, energy efficient equipment and renewable technologies. Renewable technologies have been specified to achieve a 10% reduction in site wide CO_2 emissions.

Based on the proposed energy strategy, 3 credits can also be achieved in Ene 1 of the Code for Sustainable Homes assessment, with a further 3 credits in Ene 2, helping to achieve a Code Level 3 on the scheme. Further details can be found in the Price & Myers Code for Sustainable Homes Pre-assessment report.

1 Introduction

1.1 Site Analysis

The England's Lane development is located in the London Borough of Camden.

The development consists of refurbishment and reconfiguration to some parts of the building and demolition and rebuild of other parts. The proposed building works will provide 31 hostel units within the existing building fabric, 9 apartments within the existing building fabric and 39 hostel units within entirely new building fabric.

The site is located in a conservation area. The building is designed to match the existing as much as possible. It has a pitched roof with a dropped are for concealed plant, PV etc. The building occupies most of the site so there is only a small amount of space at ground level.

1.2 Objective

This report summarises the work undertaken to support the development of an energy strategy for the England's Lane development. This work has resulted in a strategy that requires design, technical and commercial decisions in order to continue the design development and ultimately select the final solution for ensuring a low carbon development.

This report outlines the energy strategy for the development, including passive design, energy and CO_2 footprint of the proposed scheme, and renewable energy options.

The final proposed strategy would allow the scheme to demonstrate compliance with the guidelines set out by the London Borough of Richmond upon Thames and the London Plan in demonstrating a positive commitment to sustainability through providing environmental improvements.

2 Policy

2.1 London Borough of Camden Policies on Energy

In line with Camden's Core Strategy 13 and Chapter 2 Camden's Planning Guidance 3, Sustainability developments involving 5 or more dwellings and/or 500sqm (gross internal) or more are required to submit an energy statement which demonstrates how carbon dioxide emissions will be reduced in line with the energy hierarchy.

Domestic developments should achieve Code Level 4 and 50% of the un-weighted credits in the Energy category under the Code for Sustainable Homes scheme. Residential developments that are classed as refurbishment or conversion will be expected to achieve an Excellent rating and 60% of the un-weighted credits in the Energy category of their BREEAM assessment.

2.2 The London Plan Policies on Energy

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning Decisions

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

1. Be Lean: use less energy
2. Be Clean: supply energy efficiently
3. Be Green: use Renewable energy

The mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emission reductions in buildings:

2013 - 2016: 35% improvement over Part L 2013

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emissions reduction outlined above are to be met within the framework of the energy hierarchy. This report contains a detailed energy assessment in line with the requirements of Policy 5.2.

Policy 5.6: Decentralised Energy in Development Proposals

Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

Major development proposals should select energy systems in accordance with the following hierarchy:

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

Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7: Renewable Energy

Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible.

There is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation wherever feasible. Development proposals should seek to utilise renewable energy technologies such as: biomass heating; cooling and electricity; renewable energy from waste; photovoltaics; solar water heating; wind and heat pumps. The Mayor encourages the use of a full range of renewable energy technologies, which should be incorporated wherever site conditions make them feasible and where they contribute to the highest overall and most cost effective carbon dioxide emissions savings for a development proposal.

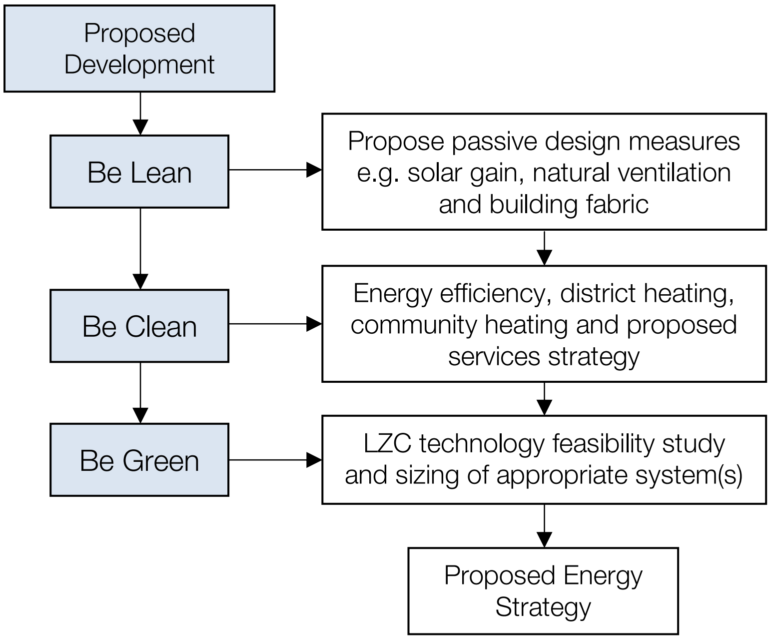
3 Approach

The approach to achieving the planning policy energy objectives has been to consider strategies and technologies to achieve a low energy and carbon footprint for the scheme.

The development will adopt the following energy hierarchy:

- Use less energy through passive design measures (Be Lean)
- Supply and consume energy efficiently (Be Clean)
- Utilise renewable energy sources to reduce carbon emissions (Be Green)

This energy strategy examines the energy performance of the proposed Englands Lane development based on the following methodology:



The performance of the development in terms of energy consumption and carbon emissions is calculated at each stage of the assessment, ensuring that both regulated and unregulated energy is considered when determining the performance of the proposed energy strategy.

3.1 Accredited Energy Assessor

This report has been written by Jessica Gray who is an On Construction Domestic Energy Assessor (OCDEA). The energy consumption and carbon emission figures within this report have been calculated using the approved Standard Assessment Procedure for the Energy Rating of Dwellings (SAP), current SAP 2012 version.

4 Passive Design

As part of the Be Lean approach, passive design measures have been considered throughout the pre-planning stage to reduce energy demand.

4.1 Solar Gain Control and Daylighting

Where possible, windows and natural daylight have been provided to ensure appropriate daylighting levels throughout the development and reduce the lighting demand. The size and orientation of external windows has been considered carefully to balance daylight with excessive solar gains. Windows are specified to incorporate low emissivity coatings to limit overheating while ensuring adequate daylight.

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and using a natural ventilation strategy the risk of solar overheating has been concluded to be not significant for the development.

4.2 Natural Ventilation

Other than mandatory ventilation to meet AD Part F, the development utilises natural ventilation in the form of openable windows.

The impact of solar gains has been incorporated into the SAP analysis for compliance with Part L and using a natural ventilation strategy the risk of solar overheating has been concluded to be not significant for the development.

4.3 Building Fabric Efficiency

To further improve the passive design of the development, the thermal fabric has been specified to meet or exceed current Building Regulations targets. Table 4.1 shows the proposed U-values that will be considered for the development and have been assumed for the energy strategy analysis at this stage.

Element	Measure	
	Existing building	New units
External Walls	0.28W/m^{2}K	0.15W/m^{2}K
Party Walls	Solid or fully insulated	
Roof	0.12W/m^{2}K	0.12W/m^{2}K
Ground Floor	Existing not upgraded	0.12W/m^{2}K
Windows	1.7W/m^2 (Sash windows to match existing)	1.7W/m^2 (Sash windows to match existing)
External Doors	1.0W/m^{2}K	1.0W/m^{2}K
Air Tightness	4m^3/m^2/h	4m^3/m^2/h

Table 4-1 Proposed Be Lean passive design measures

5 Energy Efficiency

As part of the Be Clean approach, the use of heat networks, community heating and cooling and energy efficient equipment has been considered for this development.

5.1 District Energy Systems

District energy systems produce steam, hot water or chilled water at a central energy centre. The steam or water is distributed in pre-insulated pipework to individual buildings for space heating, domestic hot water and air conditioning. As a result, individual buildings served by a district energy system don't required their own boilers or chillers.

According to the London Heat Map, there are no exiting or proposed networks within a reasonable distance of the site, as shown in Figure 5-1.

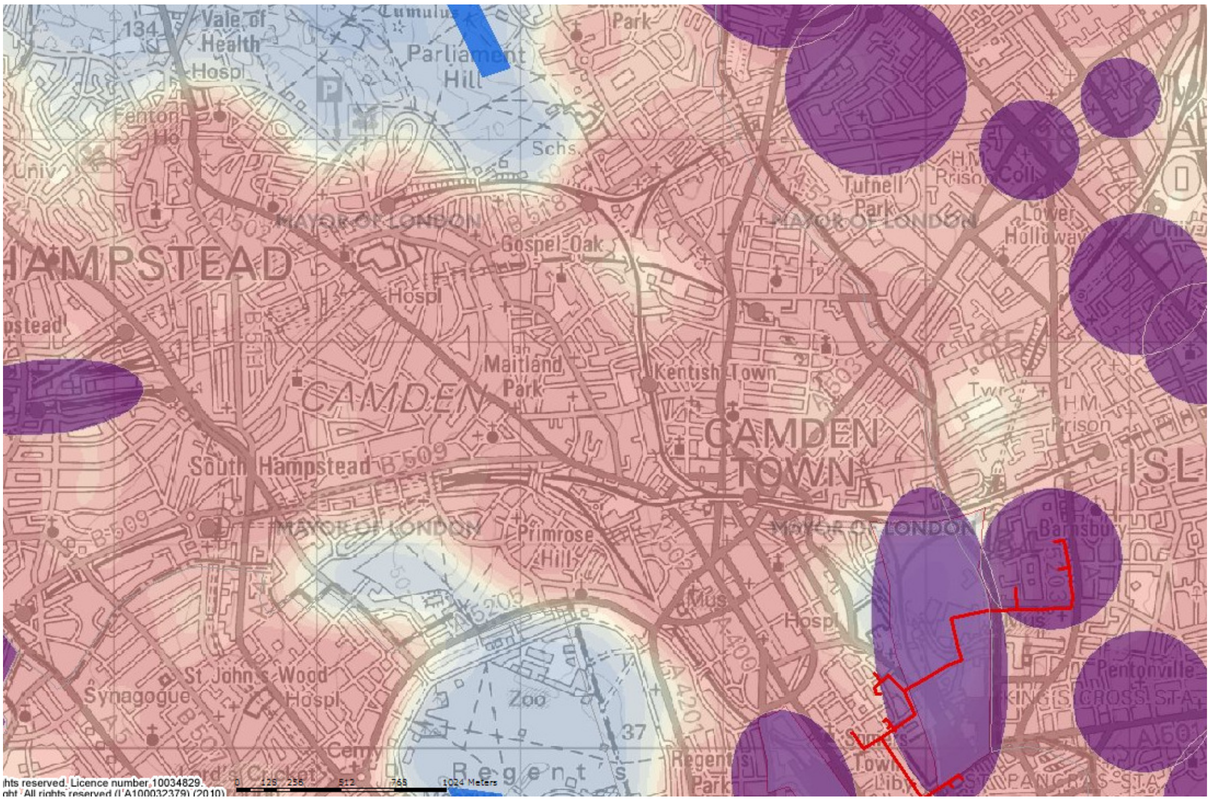


Figure 5-1: Heat Network map

In addition, this is not a particularly large scale development so it is unlikely to be financially viable to connect to a heat network.

5.2 Community Heating

Community heating involves distributing space and water heating services throughout the development served from a central plant, making use of higher efficiencies available from larger systems.

The existing hostel is served by a communal heating system. It is therefore practical to renew and extend this to provide heating to the new and refurbished hostel units.

5.3 Services Strategy

In addition to the passive design measures identified in Section 4, energy efficient equipment has been proposed where possible to support the services strategy. Table 5.1 shows the proposed services strategy and energy efficiency measures for the development.

Services	Measure
Space Heating & Hot water	Condensing Gas Boiler 90% Efficient (communal boiler for the hostel units, individual for appartments)
Heating Controls	Time and temperature zone control
Lighting	75% low energy lighting

Table 5-1 Proposed energy efficient design measures

5.4 Be Lean & Be Clean Performance

SAP calcualtions have been undertaken to show the performance onf the development when taking into account the passive design and energy efficient measures proposed in Sections 4 and 5.

Hostel Units & Apartments within Existing building

For the units within the existing building fabric, improvement is measured by comparing the existing scenario with the proposed.

Figure 5-2 below shows the improvement over the existing case.

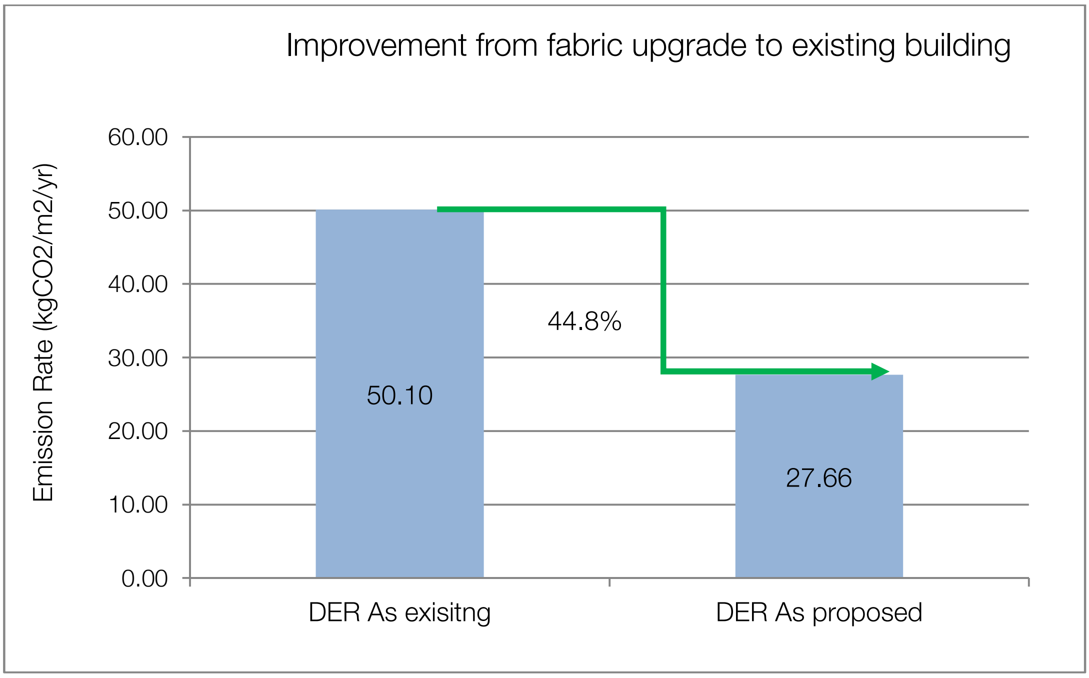


Figure 5-2 Improvement for refurbished units over the existing case

<u>New Hostel Units</u>

For the new hostel units, SAP calculations have been carried out to show the improvement over Part L 2013, as shown in figure 5-3.

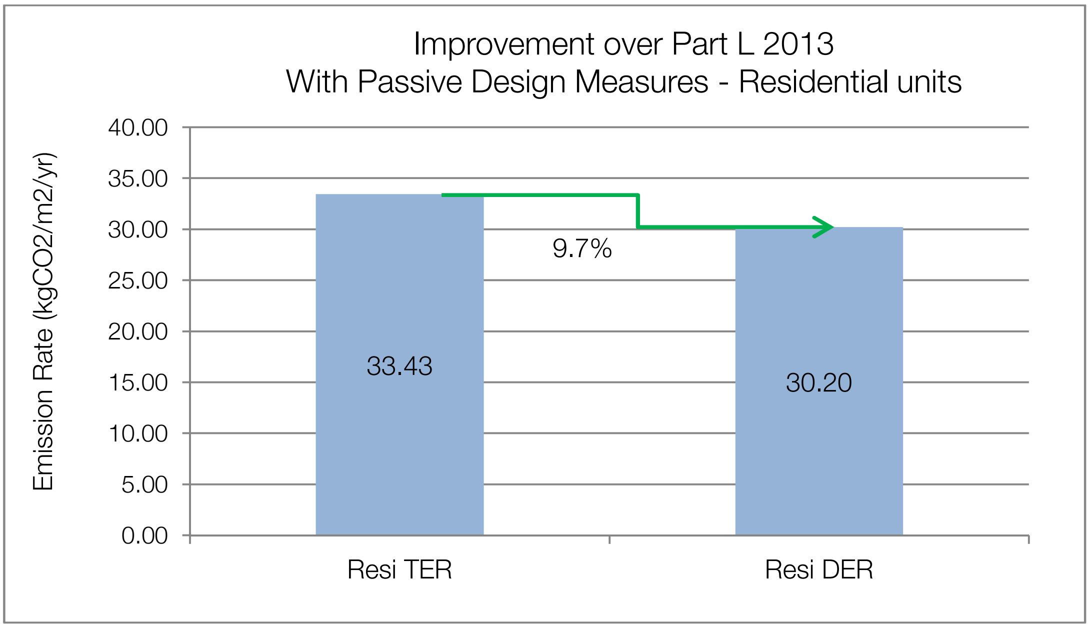


Figure 5-3 Improvement over Building Regulations Part L 2013 before LZCs for Commercial A4

6 Estimated Energy Use And Carbon Footprint

Calculations have been carried out to determine the estimated energy demand and carbon footprint of the proposed development, taking into account the passive design and energy efficiency measures identified in Sections 4 and 5. This will form a base case for the development using gas as the baseline fuel.

The energy consumption includes regulated energy (space and water heating, lighting, pumps and fans) derived from outputs of the SAP calculations for the site and unregulated energy (household appliances and equipment) based on the BRE methodology. Full details of assumptions are included in Appendix A and Table 6.1 details the energy demand for the site taking into account the regulated and unregulated energy.

Energy & CO_2										
Gas Demand				Electricity Demand					Total Energy (kWh/yr)	Total CO_2 (kg/yr)
Space Heating (kWh/yr)	Hot Water (kWh/yr)	Total (kWh/yr)	Gas CO_2 (kg/yr)	Pumps & Fans (kWh/yr)	Lighting (kWh/yr)	Appliances (kWh/yr)	Total (kWh/yr)	Electricity CO_2 (kgCO2/yr)		
101,998	139,378	241,376	52,137	3,266	12,436	115,657	131,359	68,175	372,735	120,313

Table 6.1: Estimated regulated and unregulated energy demand and carbon emissions per energy source

7 Low and Zero Carbon (LZC) Technologies Feasibility Study

The final level of the energy hierarchy is to Be Green, therefore the following table discusses the options for on-site low and zero carbon technologies and their feasibility on this development to contribute to meeting the relevant London Plan and Borough's sustainability targets.

LZC Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar Thermal Collectors	Solar thermal collectors can be used to provide hot water using the irradiation from the sun They can generally provide approx. 50% of the hot water demand	No noise issues associated with Solar thermal collectors No additional land use from the installation of solar thermal collectors Low maintenance and easy to manage Favourable payback periods	The hot water cylinder will need to be larger than a traditional cylinder Needs unobstructed space on roof Low efficiencies Often not compatible with other LZC technologies Saves less carbon when offsetting gas systems	There is a recessed area of the roof where solar thermal panels can be installed. However, solar PV is favoured due to greater potential carbon savings.	✗
Solar Photovoltaic Panels (PV)	Solar PV panels provide noiseless, low-maintenance, carbon free electricity	Can have significant impact on carbon emissions by offsetting grid electricity (which has a high carbon footprint) Low maintenance No noise issues No additional land use from the installation of PV panels Bolt on technology that does not need significant amounts of auxiliary equipment Favourable payback periods	Needs unobstructed space on roof Low efficiencies per unit area of PV Often used to supplement landlord's electricity so savings not always transferred to individual properties	There is a recessed area of the roof where Solar PV panels could be installed to contribute to the electricity demand of the building	✓

CHP (Combined Heat & Power)	CHP systems use an engine driven alternator to generate electricity while using the waste heat from the engine, jacket and exhaust to provide heating and hot water Economic viability relies on at least 4,000 hours running time per annum	Mature technology High CO_2 savings	Cost of the system is relatively high for small schemes Only appropriate for large development with high heat loads	Communal CHP is not viable at this scale of development as the base load would not be high enough.	×
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating	Potential to reduce large component of the total CO_2 A biomass boiler would supplement a standard gas heating system so some of the cost may be offset through money saved on using smaller traditional boilers	Regular maintenance is required Reliability of fuel access/supply can be a problem The noise generated by a biomass boiler is similar to that of a gas boiler. It is advisable not to locate next to particularly sensitive areas such as bedrooms A plant room and fuel store will be required which may take additional land from the proposed development or surroundings Biomass is often not a favoured technology in new development due to the potential local impacts of NO_x emissions and delivery vehicles for the fuel	This is a small tight site in an urban area and so there is insufficient space for a biomass boiler system Biomass is not considered feasible for this development due to issues with fuel storage, access for delivery vehicles and local NO_x emissions	×

Wind Turbines	Vertical and horizontal axis wind turbines enable electricity to be generated using the power within the wind	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment	Not suitable for urban environments due to low wind conditions and obstructions High visual impact Noise impact (45-65dB at 3m) High capital cost and only achieve good paybacks in locations with strong wind profiles Requires foundations or vibration supports for building installations (generally not recommended)	This development is in an urban environment and so a wind turbine will not generate much energy	✘
Ground Source Heat Pumps (GSHP)	Utilising horizontal loops or vertical boreholes, GSHP make use of the grounds almost constant temperature to provide heating and/or cooling using a heat exchanger connected to a space/water heating delivery system	Low maintenance and easy to manage High COP (ratio of energy output per energy input) Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The heat pump has a noise level around 35-60dB so some attenuation may be required and it should be sensibly located Relatively high capital cost Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	GSHP are not a feasible technology for the site since there is insufficient external space available for installation of boreholes	✘

Air Source Heat Pumps (ASHP)	Air Source Heat Pumps extract latent energy from the external air in a manner similar to ground source heat pumps	ASHP systems are generally cheaper than GSHP as there is no requirement for long lengths of buried piping or boreholes Low maintenance and easy to manage Optimum efficiency with underfloor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through savings on a traditional boiler	The ASHP unit has a noise level around 50-60dB so some attenuation may be required and it should be sensibly located The potential noise from the external unit may mean there is local opposition to their installation Requires electricity to run the pump, therefore limited carbon savings in some cases For communal systems a plant room is required which may take additional land from the proposed development/surroundings	The use of ASHP is technically feasible for the development but is discounted due to noise issues and locating the unsightly units and low carbon savings.	✗

Table 7-1 Feasibility of LZC technologies for the development

Having reviewed potential LZC technologies for the development it has been identified that the most appropriate system would be solar PV panels, which would most suitably be installed on the roof space. The chosen system should be accurately sized during the detailed design stages and MCS (Microgeneration Certification Scheme) approved equipment and installers used.

8 Summary of CO2 Emission Savings

The most appropriate LZC technology for the development has been identified as solar PV panels and to meet the London Plan and Borough's target for on-site renewables.

Table 8.1 shows the proposed system size and the estimated energy and carbon emissions savings and financial feasibility for this development.

	Energy & CO2				Life Cycle Carbon and Cost Analysis		
Proposed LZC Technologies	Energy Generated (kWh/yr)	% site energy demand met	CO2 saved by system (kgCO2/yr)	% reduction in site CO2 emissions	25 year CO2 saving (kgCO2)	Estimated capital cost	Payback period
Solar PV – 6.75 kWp 30 deg, SW facing Approx 27 panels Approx gross array area = 39 m2 (Areas and efficiency may vary on specification at tender stage)	5,546	1.49%	2,878	2.4%	71,957	£20-30K	10-15 years

Table 8-1 Energy, carbon and financial performance of the proposed LZC technologies

The PV system size is the largest that the recessed roof can accommodate. The pitched roof that faces the street cannot be used due to the conservation area location. This system would be to provide electricity to the new hostel units in order to ensure the target reduction of 19% over Part L 2013 required to achieve CSH Level 4.

The graphs below show the site wide saving from renewable technologies, as well as the improvement over Part L 2013 for the new hostel units.

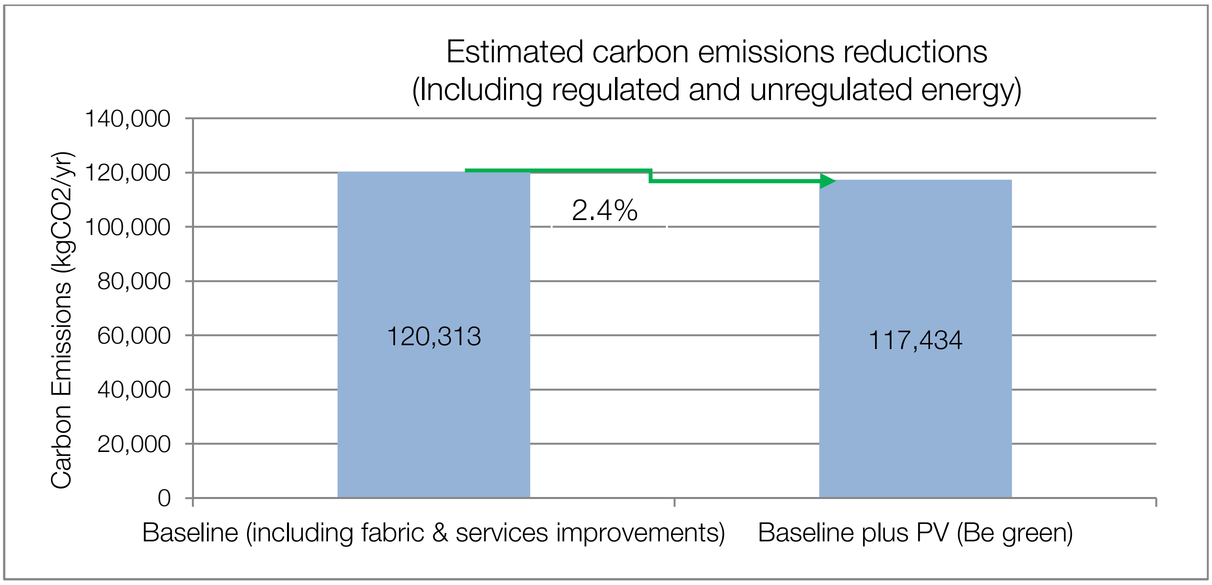


Figure 9.1: Estimated carbon emissions reductions for the site

Based on the feasibility study of LZC technologies in Sections 7 and 8 above, Figure 8-1 demonstrates the percentage improvements over Part L 2013 after incorporating appropriate technologies for each space.

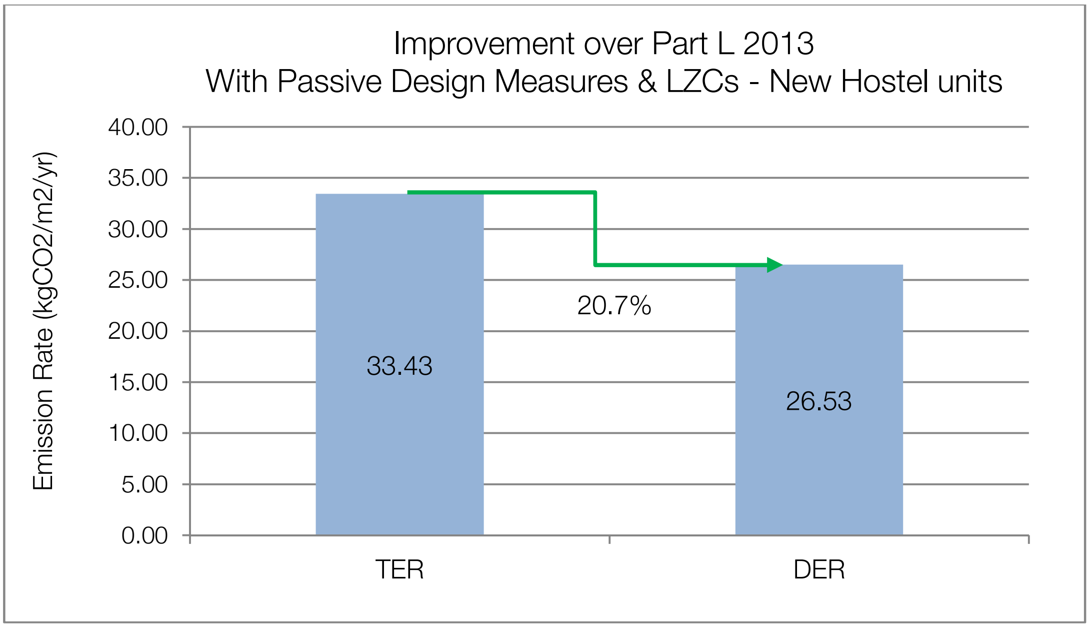


Figure 8-1 Improvement over Building Regulations Part L 2010 after LZCs for the new hostel units

8.1 Code for Sustainable Homes & BREEAM

Code for Sustainable Homes (CSH) has set out Energy and CO2 criteria for the residential units and the numbers of credits are available under Ene1: Dwelling Emission Rate and Ene2: Fabric Energy Efficiency. The new hostel units can achieve 3 credits under Ene1, and 3 credits under Ene2 of the CSH. The units within the existing building fabric (hostel units and apartments) achieve 1 credit under Ene 1, 3 credits under Ene 2 and 6.5 credits under Ene 3 of the BREEAM Domestic Refurbishment criteria.

9 Conclusion

Following the Be Lean, Be Clean and Be Green energy hierarchy, passive design measures, energy efficient equipment and LZC technologies have been shown to provide a 20.7% improvement over the Building Regulations Part L 2013 Target Emissions Rate (TER) for the new hostel units.

Improvments to the existing building fabric result in a 44.8% improvement in carbon emissions.

There is an overall 2.4% saving in carbon emissions from renewables.

Fabric improvements have been prioritised for the development, which will have a longer lasting impact on energy use than renewable technologies with a finite lifetime. The fabric U-Values are extremely low and triple glazing has been specified. Efficiencies for building services are all particularly high and represent the best that is available on the market. The PV system specified occupies the entire available roof space. The strategy therefore represents the best possible savings that could be achieved for this development.

Based on the results of the SAP assessment, the development can achieve a total of 6 credits under the Code for Sustainable homes assessment Ene 01 and Ene 02 and 10.5 credits under Ene 01-03 of BREEAM. The minimum performance in the energy section required by Camden is met.

The figures within this report are based on preliminary analysis only and further detailed studies will be required at the detailed design stage before specifying any of the proposed systems.

Appendix A

The following table shows the energy assumptions used for the energy and CO_2 calculations within this report. Calculations for residential areas are based on Standard Assessment Procedure (SAP) results with an inclusion for unregulated energy appliance use not covered by SAP (based on BRE methodology).

The appliances figure is based on the BRE calculation formula for appliances and cooking, taken from the Code for Sustainable Homes in Ene 7 table 1.4, as below.

$kgCO_2$/year from appliances and cooking. See Ene 1:

$$99.9 \times (TFA \times N)^{0.4714} - (3.267 \times TFA) + (32.23 \times N) + 72.6$$

Where:

TFA = Total Floor Area

N = Number of Occupants

For TFA < $43m^2$; N = 1.46

For TFA ≥ $43m^2$; N = $2.844 \times (1 - \exp(-0.000391 \times TFA^2))$

Residential		
Energy Demands		Source
Use Type	Demand (kWh/m^2)	
Space Heating	44.38	SAP Calculations
DHW	60.64	
Fans/Pumps/Controls	1.42	
Lighting	5.41	
Appliances	50.32	BRE Methodology

10 Appendix B

The following tables show figures used in the energy and CO_2 calculations to estimate energy produced and CO_2 savings from LZC technologies. These figures can be used to validate the results.

CO_2 Intensity Values	
Gas Intensity	0.198 $kgCO_2/kWh$
Electricity Intensity	0.517 $kgCO_2/kWh$
Oil Intensity	0.266 $kgCO_2/kWh$
Grid Displaced Electricity Intensity	0.529 $kgCO_2/kWh$
Biodiesel Intensity	0.025 $kgCO_2/kWh$

Energy & Renewable Technology Outputs	
PV energy produced per kWp	858.4 kWh/kWp
PV kWp per m^2 panel	0.167 kWp/m^2
Efficiency of solar thermal collectors	600 kWh/m^2
COP of ASHP	2.5
COP of GSHP	3.5
Electricity efficiency	100%
Gas boiler efficiency	90%

Fuel Prices (as of Feb 2012)	
Natural Gas	4.37 p/kWh
Electricity (Grid)	13.7 p/kWh

11 Appendix C

The following grants may be available with the use of renewable technologies on this development.

<table>
<tr><th colspan="2">Grant</th></tr>
<tr><td>Feed-in Tariff</td><td>By generating your own renewable electricity your energy supplier may pay you money, called a 'Feed-in Tariff' (FIT).

Using an MCS certified installer, the system could entitle you to a rate for each unit (kilowatt hour or kWh) of electricity you generate.

As well as the FIT, you can sell any excess electricity back to your electricity supplier through an 'Export Tariff'.

To qualify, the installation must be less than 5 MW, with the following technologies covered:
• Solar photovoltaic (PV) panels
• Wind turbines
• Water (Hydro) turbines
• Anaerobic digestion (biogas energy)
• Micro combined heat and power (micro-CHP)

https://www.gov.uk/feed-in-tariffs</td></tr>
<tr><td>Renewable Heat Incentive (RHI)</td><td>The RHI is a scheme for the non-domestic sector that provides payments to industry, business and public sector organisations that use renewable energy to heat their buildings. Payments are made to the owner of the heat installation over a 20-year period, for the following technologies:
• Biomass boilers (including CHP biomass boilers)
• Ground source heat pumps (GSHP)
• Water source heat pumps
• Deep geothermal heat pumps
• All solar thermal collectors
• Biomethane and biogas

There are plans to extend support to the following in 2013:
• Air source heat pumps (ASHP)
• Biomass direct air heating
• Biomass combustion over 200kW

There are also plans to launch a domestic RHI scheme in summer 2013.

http://www.ofgem.gov.uk/e-serve/RHI/Pages/RHI.aspx</td></tr>
<tr><td>Green Deal</td><td>The Green Deal is a Government backed initiative to promote the installation of energy efficiency measures in households in order to reduce energy consumption and bills.

There will be no upfront costs, instead consumers will pay through their household energy bills. Consumers can see the Green Deal charge alongside the reductions in energy use which generate savings on their bill. It also means that if they move out (and cease to be the bill payer) the financial obligation remains at the property for the next bill payer: the charge is only paid where/whilst the benefits are enjoyed.

https://www.gov.uk/green-deal-energy-saving-measures/how-the-green-deal-works</td></tr>
</table>

ECO (Energy Company Obligation)	ECO is a requirement for all large gas and electricity suppliers to fund energy efficiency improvements to dwellings in the UK. Energy suppliers have specific carbon reduction targets to achieve, and therefore must buy ECO 'credits' of CO_2 on a free market, either from installers (and home owners) or from other energy suppliers. Therefore the price of ECO 'credits' is not fixed. The installer (home owner or private renter with owner's permission) can claim back the money for the installation of the improvement measures from the energy suppliers (full payback or partial refund depending on type of improvement(s) and value of ECO 'credits'). The scheme can be used to fund a number of domestic energy efficiency improvements. If householders are applying for the Green Deal and are eligible for ECO, they will receive a lower quote from their Green Deal Provider and will benefit from lower repayments. The scheme runs until 31st March 2015, however there are certain Eligibility requirements. See https://www.gov.uk/energy-company-obligation for more information. Energy Companies Obligation - Guidance for suppliers

Table C: A selection of available grants as of 1st March 2012

12 Appendix D

SAP Calculations