16A LYNDHURST GARDENS GARDENS, NW3

REPORT: ENERGY STRATEGY

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16A Lyndhurst Gardens
Energy Strategy Report

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Contents

EXECUTIVE SUMMARY

The proposed 16A Lyndhurst Gardens development consists of one new luxury dwelling, which will replace the existing building. The building has been designed to blend into its green surroundings, and features a green roof.

The development consists of three floors, one on the ground floor, a lower ground floor and a basement. The surrounding land to the new dwelling on the site features new soft landscaping and the building will be sheltered by existing trees.

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;
- Energy efficiency measures
- Zero carbon energy systems;

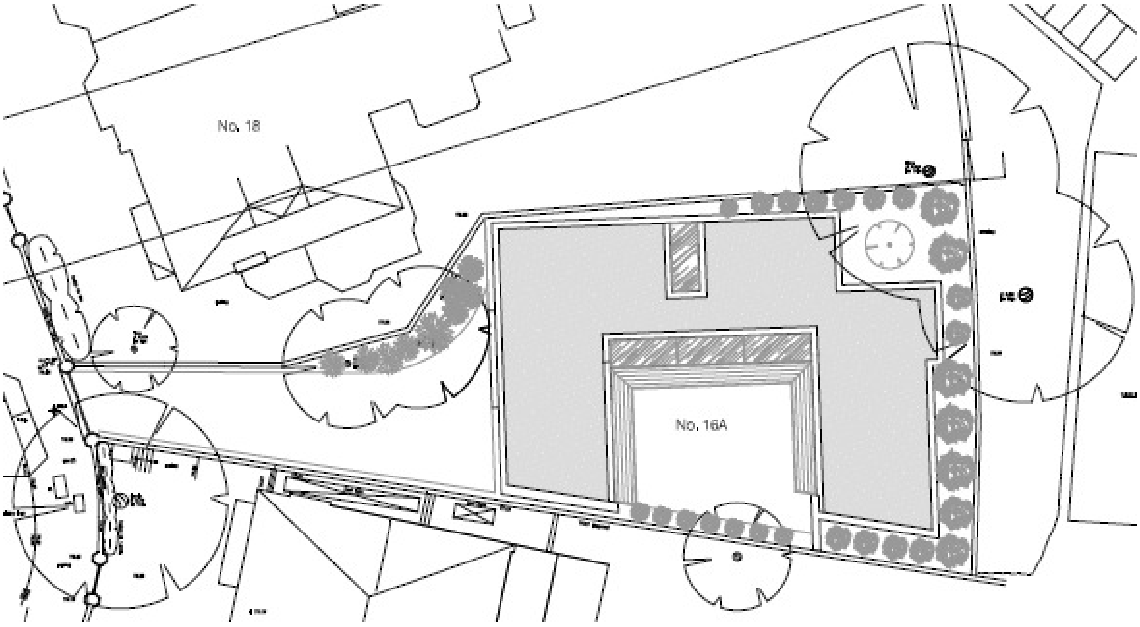
The building fabric U-values will meet or exceed the Part L 2010 requirements and robust detailing at joints and junctions will further reduce heat loss due to excessive infiltration. Energy efficient light fittings will minimise the electricity demand for lighting.

An energy assessment has been carried out based on design information to identify the most appropriate renewable strategy. The development is required to achieve a 20% reduction of the site's CO_2 emissions however the proposed strategy has the potential to save 32% through renewable technologies. The development is also required to achieve Code for Sustainable Homes Level 3, however the proposed strategy will allow the development to achieve the energy and CO_2 requirements of The Code for Sustainable Homes Level 4, with a saving over Part L of 54.78%, which is well in excess of the required 25% improvement.

1. INTRODUCTION

1.1. Site analysis

The 16A Lyndhurst Gardens development is located in Camden, London. The site is surrounded by existing trees and currently comprises an existing building. One new dwelling is proposed to replace the existing building.



The new design proposal aims to sit in harmony with the surrounding area and to maximise the natural feel of the site, whilst providing adequate amenity spaces for the dwelling. The dwelling will be one floor high, will feature a green roof and sit between the existing trees surrounding the site. The South facing courtyard with a W - E orientation will provide adequate sunlight to the rooms and reduce glare and overheating.

Access is from the West of the site from Lyndhurst Gardens as pictured above.

1.2. Objective

This report summarises the work undertaken to support the development of an energy strategy for the 16A Lyndhurst Gardens scheme. This work has resulted in a strategy, which 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 will allow the scheme to achieve the minimum CO_2 reduction for CSH Level 4 and save 32% of total site CO_2 with renewable technologies.

2. POLICY

2.1. Camden Policies on Energy

Policy DP22 – Promoting sustainable design and construction

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) Demonstrate how sustainable development principles, including the relevant measures set out in (Camden Development Policies – Section 3, paragraph 22.5), have been incorporated into the design and proposed implementation; and

b) Incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c) Expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;

d) Expecting developments (except new build) of 500 sq m of residential floor space or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;

e) Expecting non-domestic developments of 500 sqm of floor space or above to achieve "very good" in BREEAM assessments and "excellent" from 2016 and encouraging zero carbon from 2019.

The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) Summer shading and planting;

g) Limiting run-off;

h) Reducing water consumption;

i) Reducing air pollution; and

j) Not locating vulnerable uses in basements in flood-prone areas.

Policy CS13 Reducing the effects of and adapting to climate change

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

a) Ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

b) Promoting the efficient use of land and buildings;

c) Minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all of the elements of the following energy hierarchy:

    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;

3. generating renewable energy on-site; and

d) Ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

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

2.2. The London Plan Policies on Energy

Although it is not a major development, there is an aspiration to achieve a high level of environmental performance. The London Plan policies have therefore been adhered to.

Policy 5.2: Minimising Carbon Dioxide Emissions

Planning decisions
A Development proposal 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 emissions reduction in buildings:

Residential buildings:
2010 – 2013: 25% improvement over Part L 2010 (Code for Sustainable Homes level 4)

Non-domestic buildings:
2010 – 2013: 25% improvement over Part L 2010

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.

As a residential development the energy strategy for the scheme follows the energy hierarchy:

- Using less energy by passive design
- Supplying energy efficiently
- Using renewable energy sources to reduce CO_2

This energy strategy examines the energy performance of the proposed 16A Lyndhurst Gardens development as follows:

- Section 4 contains the passive design and energy efficiency measures that will be considered in the scheme. This section describes targets and recommended/ proposed actions to achieve these targets.
- Section 5 contains the estimated carbon footprint for this site including passive design and energy efficiency measures identified in section 4.
- Section 6 analyses Low and Zero Carbon Energy Systems to offset emissions
- Section 7 summarises the overall carbon reductions that could be achieved by the scheme

4. PASSIVE DESIGN

Passive design measures have been considered throughout the pre-planning stage to reduce energy demand. Risk of solar overheating has been considered in the Standard Assessment Procedure (SAP) analysis for compliance with Part L1A.

Opportunities for day lighting, efficient ventilation and passive solar heating have been identified.

4.1. Solar Gain Control & Daylighting

The U-Values of all glazed elements will exceed Building Regulations standards, and incorporate low emissivity coating, resulting in an efficient balance between passive solar gain and the thermal losses from each room.

Daylight levels are good and are supplemented with low energy light fittings. The orientation of the buildings reduces peak solar gain while ensuring good levels of daylight both morning and evening.

4.2. Energy Efficiency

Studies have been carried out to determine the energy and carbon emissions benefits of various enhancements to the thermal performance of the new proposed building envelope by using lower U-Values for new elements and improving overall air tightness, resulting in a significant improvement over Building Regulations standards. The houses are designed to be naturally ventilated, reducing additional energy loads for the building.

Table 4-1 shows a summary of the proposed U-values, air tightness, heating and ventilation strategy for 16A Lyndhurst Gardens scheme. These measures will be considered for the development, and have been assumed for the analysis at this stage.

Element	Measure
Walls	0.15W/m^{2}K
Roof	0.15 W/m^{2}K
Ground Floor	0.15 W/m^{2}K
Windows	1.2 W/m^{2}K
Air tightness	4 m^3/m^2/h

Table 4-1: Passive design measures

4.3. Energy Conservation Measures

Additional energy conservation measures which will help to reduce energy consumption in use have been identified, as follows:

- All new white goods selected for this development are rated A or A+ in the EU energy labelling scheme for domestic appliances,
- Water efficient fittings throughout, helping to reduce hot water demand
- Movement and daylight sensors fitted to lighting for external area

5. ESTIMATED ENERGY AND CARBON DIOXIDE FOOTPRINT

Table 5-1 below outlines the estimated total energy demand and associated carbon emissions for the 16A Lyndhurst Gardens development, taking into account the passive measures identified in the previous section. The consumption is estimated based on the use of typical systems utilising gas central heating, in order to estimate the baseline CO_2 emissions for the site. Alternative fuel sources are investigated in the following sections. Any CO_2 savings from the use of renewable technologies are compared with the 'typical' gas case, as this is the lowest carbon solution for dwellings not benefitting from renewables. The calculations have been based on SAP results with an inclusion for appliance use, not covered by SAP (based on BRE methodology). Full details of assumptions are included in Appendix A.

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 (kgCO_2/yr)		
23,430	2,940	26,370	5,120	175	935	3,793	4,900	2,068	31,270	7,184

Table 5-1: Estimated energy demand and CO_2 emissions of the site by energy source

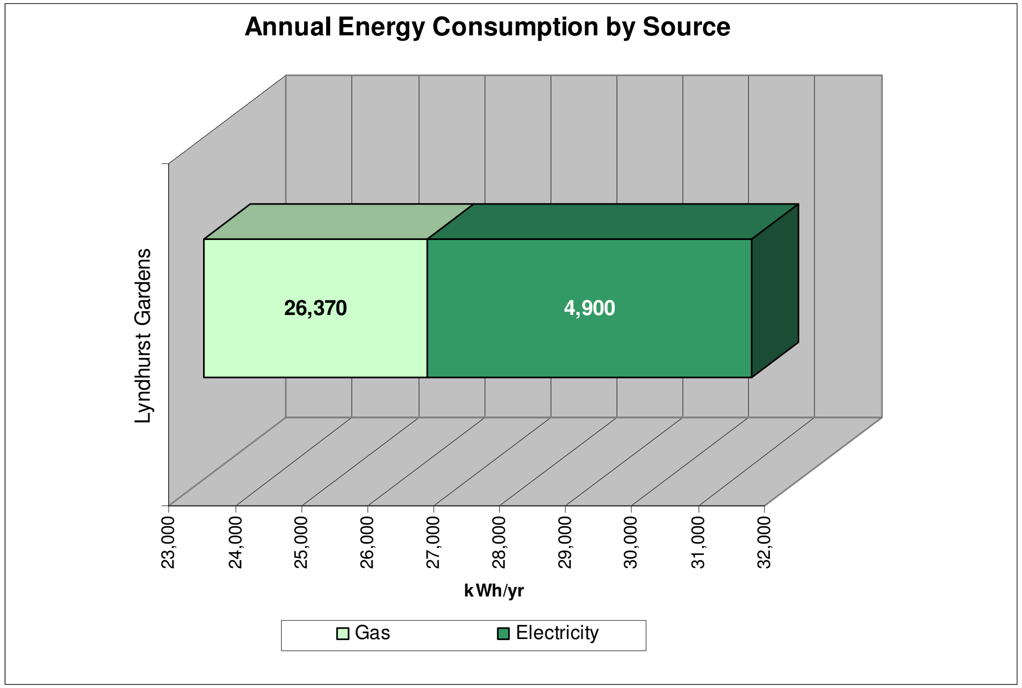


Figure 5-1 Lyndhurst Gardens Energy Consumption

6. LOW AND ZERO CARBON ENERGY SYSTEMS

The following table outlines the low and zero carbon technologies that have been considered for the site. The technical feasibility for each has been discussed based on the energy demand and site constraints.

Technologies	Description	Advantages	Disadvantages	Feasibility	
Solar thermal collectors	Solar collectors can be used to provide hot water. They can provide up to around 50% of the 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 Low capital cost	The hot water cylinder will need to be larger than a traditional cylinder. Consideration will need to be given to the space required. Needs unobstructed space on roof.	The building roof has areas of flat roofs although it is to be covered by a green roof, and it is one storey high and is shaded by surrounding large trees shade making it unfeasible to locate solar technologies. In addition it is not thought this would fit into building aesthetics	×
Photovoltaic Panels (PV)	Photovoltaics provide noiseless, low-maintenance, carbon free electricity.	Can have significant impact on carbon by offsetting 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.	High capital investment required Needs unobstructed space on roof	The building roof has areas of flat roofs although it is to be covered by a green roof, and it is one storey high and is shaded by surrounding large trees shade making it unfeasible to locate solar technologies. In addition it is not thought this would fit into building aesthetics	×

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 4000 hours running time per annum.	Mature technology High CO_2 savings	Cost of the system is relatively high for small schemes such as this. Only appropriate for large development with high heat loads.	Communal CHP is not viable for a single dwelling. Micro CHP would be technically feasible but is unlikely to save enough carbon to meet the targets.	✗
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 replace a standard gas heating system so some of the cost may be offset through money saved on a traditional boiler.	Regular maintenance will be required Reliability of fuel may become a problem, therefore limited cost saving for residents 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 The fuel will need to be delivered, which can cause issues with access etc. Biomass is often not a favoured technology in new development due to the potential local impacts of NO_x emissions and delivery vehicles.	This is a small tight site in an urban area. Biomass is not considered feasible for such a development due to issues of fuel storages, access for delivery vehicles and local NO_x emissions.	✗

Wind turbines [Vertical axis]	Most small (1-25kW) wind turbines can be mounted on buildings, but larger machines require foundations at ground level in a suitable site.	Low noise Bolt on technology that does not need significant amounts of auxiliary equipment.	Low energy output particularly in urban environments, therefore not suitable here High visual impact Noise impact High capital cost	The development is not appropriate for this technology as wind speeds and profiles are inadequate in this urban area.	✗
Ground Source Heat Pumps (GSHP) – heating & cooling	A ground loop heat exchanger offer efficient heating of a space in winter, as the temperature of the ground (below approx 2m) remains almost constant all year round. The same loop of pipe and compressor allows heat from the building to be rejected (via a highly efficient compressor) into the soil, dissipating heat from the space.	Low maintenance and easy to manage Optimum efficiency with under-floor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through money saved on a traditional boiler.	The heat pump has a noise level around 45-60dB 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 most cases For communal systems plant room required which may take additional land from the proposed development/surroundings	GSHP is a technically feasible option for the site. There is insufficient space to install a horizontal system but a vertical borehole system could be used. It is anticipated that a single borehole would suffice (depth dependant). There is a good technology for the site as a large house such as this has a significant heat demand. Final suitability will depend on a ground survey.	✓

Air Source Heat Pump (ASHP) - heating	Air Source Heat Pumps extract latent energy from the air in a manner similar to ground source heat pumps.	ASHP systems are generally cheaper than ground source as there is no requirement for long lengths of buried piping. Low maintenance and easy to manage Optimum efficiency with under-floor heating systems As heat pumps would replace standard heating systems, some of the cost may offset through money saved on a traditional boiler.	The heat pump 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 most cases For communal systems plant room required which may take additional land from the proposed development/surroundings Potential noise issues	The use of ASHP would be technically feasible. However, this technology does not have the potential to save enough CO_2 to meet the CSH Level 4 target.	×

Table 6-1: Feasibility of LZC technologies for the site

7. SUMMARY OF ESTIMATED CARBON DIOXIDE EMISSIONS REDUCTIONS

The energy demand and potential impact on CO_2 of the inclusion of renewable technologies has been considered for the development.

The carbon reduction target for the site is to ensure that the CO_2 emissions meet the requirements of the Building Regulations Part L 2010, and a total CO_2 saving of at least 20% of the site's overall CO_2 emissions through the use of renewable technologies. The passive design measures identified in section 4 have been incorporated into energy demand calculations to give a baseline for the development of 7,184 $kgCO_2$/yr. The feasibility of renewable energy systems to further reduce this has been analysed above.

For those renewable technologies that are considered feasible, calculations have been undertaken to estimate the energy each would generate and the associated CO_2 savings. These calculations are based on the energy demands and CO_2 emissions for the site calculated in section 5. The energy produced by the various technologies and the associated CO_2 emissions have been calculated based on the emission factors and efficiencies detailed in Appendix B.

Table 7-1 and Figure 7-1 show the overall impacts in terms of carbon of combining passive design with the incorporation of PV panels.

	Energy & CO_2				Life cycle carbon and cost analysis	
Renewable Systems	Energy provided by technology (kWh/yr)	CO_2 saved by technology ($kgCO_2$/yr)	% Site CO_2 saving (inc appliance)	Improvement in DER over TER	25 year CO_2 saving	Payback time (including capital & installation costs, maintenance etc.)
GSHP (to provide 100% of the dwellings space heating)	21,317	2,296	32%	54.78%	57,400	~25 years
Total CO_2 savings from renewables		**2,296**	**32%**	**54.78%**	**57,400**	

Table 7-1: CO_2 saving from Renewable Technologies

The provision for GSHP system will be combined with the provision of a gas boiler for hot water.

Table 7-1 shows the CO_2 savings from a GSHP that can be installed on the site. The system will offset 32% of the site's CO_2 emissions. This is illustrated in Fig 7-1 below.

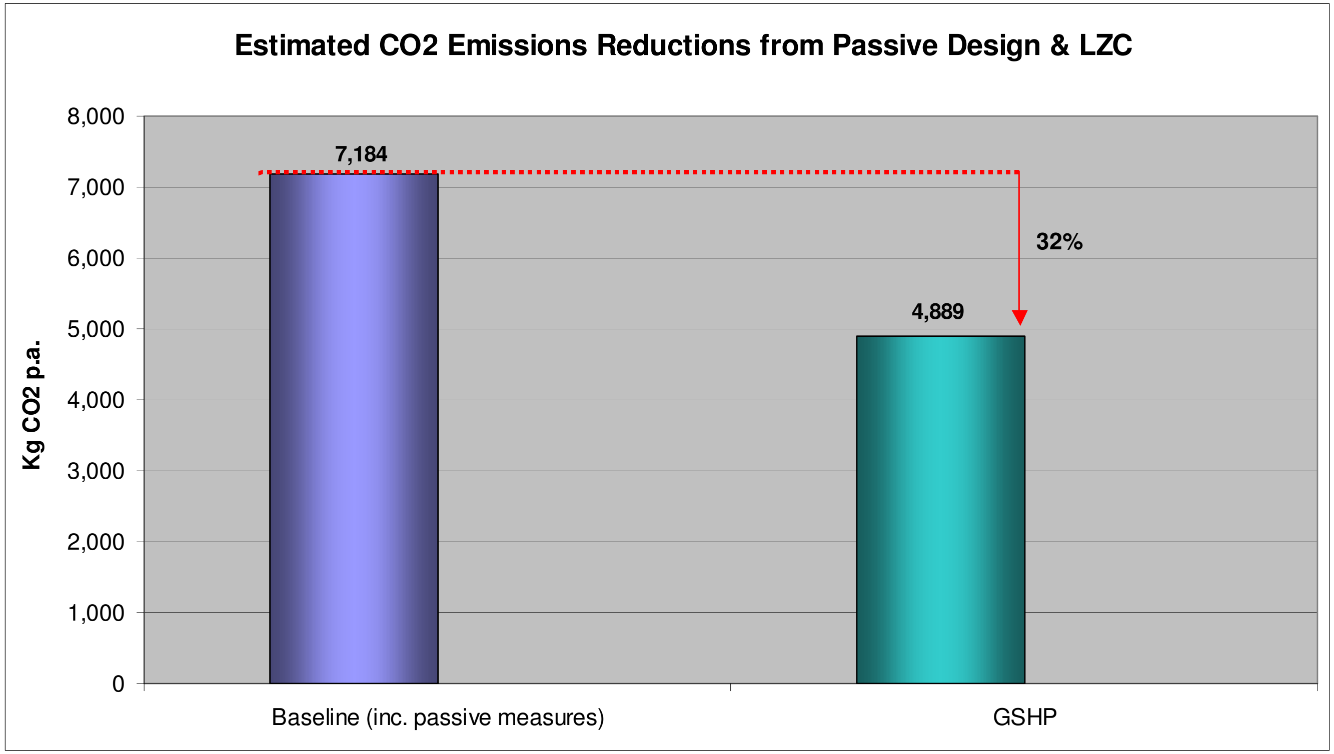


Figure 7-1 Estimated Reduction in CO_2 Emissions by using Passive Design and Renewable Technologies.

8. CONCLUSION

For the 16A Lyndhurst Gardens development, passive design measures have been identified to help to reduce the energy load. After reducing demand, options for further reducing the CO_2 emissions through renewables have been identified.

The proposed strategy combines GSHP for space heating with a gas boiler for hot water. The energy strategy for the site achieves a 54.78% improvement in the DER over the TER, which is well in excess of the target for CSH Level 4, as well as incorporating renewable technologies to reduce the CO_2 emissions by over 32% over the baseline building, when taking both regulated and unregulated emissions into account, a saving much higher as that required by London Plan Policy 5.7.

The advised option will be considered at the detailed design and construction stages and adequate provisions made to ensure that the various carbon reduction targets are met.

The figures in this report are based on preliminary analysis only, and further detailed studies will be required before specifying any of the potential systems. Further investigation into fuel suppliers will be required.

APPENDIX A

8.1. The following tables show the energy assumptions used for the energy and CO_2 calculations.

The calculations have been based on SAP results with an inclusion for appliance use not covered by SAP (based on BRE methodology) for the residential units.

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

8.2. [3] Kg CO_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 and N = Number of Occupants

For TFA < 43 m^2; N = 1.46

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

8.2.1. Residential		
Energy Demands		*Source*
Use Type	*Demand/m²*	
Heating	71.98	SAP Calculations
DHW	9.04	
Fans/Pumps/Controls	0.54	
Lighting	2.87	
Appliances	11.7	BRE Methodology

APPENDIX B

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

CO2 Intensity Values	
Gas Intensity	0.194 $kgCO_2/kWh$
Electricity Intensity	0.422 $kgCO_2/kWh$
Grid displaced electricity intensity	0.568 $kgCO_2/kWh$
Biodiesel carbon intensity	0.028 $kgCO_2/kWh$

Renewable Technology Efficiencies	
PV energy produced per kWp	858 kWh/kWp
PV kWp per m^2 panel	0.25 kWp/m^2
Efficiency of solar thermal collectors	600 kWh/m^2
COP of GSHP	4
Boiler efficiency	91%

Fuel Prices	
Gas	£0.04/kWh
Electricity	£0.11/kWh

APPENDIX C

Grants available

The following table summarises grants that may be available for funding renewable technologies for this project.

Grant	Run By	Who Can Apply	What microgeneration technologies are covered?	Grant Availability
Feed in Tariff	Ofgem (paid by energy companies)	Open to all (max system sizes apply)	• Anerobic Digestion • Hydro • Micro CHP (pilot) • PV • Wind	Applies to all MCS (Microgeneration Certification Scheme - www.microgenerationcertification.org) installations post 15th July 2009.
Renewables Heat Incentive	Ofgem	Open to all (max system sizes apply)	• Biomass • Bioliquids • Biogas • GSHP • ASHP • Solar Thermal	Applies to all MCS (Microgeneration Certification Scheme - www.microgenerationcertification.org) installations post 15th July 2009.
Community Sustainable Energy Programme (CSEP)	BRE	Not-for-profit community based organisations	• Solar photovoltaics • Solar thermal hot water • Wind turbines • Heat pumps • Automated wood pellet stoves • Wood fuelled boiler systems • Micro-hydro turbines	Both capital and project development grants are available under this scheme. Capital grants are available. Money is allocated in rounds. Please visit www.communitysustainable.org.uk for more information.

Carbon Emission reduction target (CERT)	Energy	Housing sector (new & existing)	• Energy efficiency measures in existing homes. Renewable technologies installed to offset carbon emissions over and above planning requirements.	CERT money comes direct from energy companies and can usually be accessed through renewable technology suppliers who have set up deals with these companies. E.g. EON provide funding for GSHP & ASHP through Calorex. Find out from suppliers if they have access to this funding when getting costs.
Bioenergy Capital Grant	Department of Energy & Climate Change	Industrial, commercial sector (This includes, but is not restricted to, public and private limited companies (Ltd and plc), sole traders, farmers etc) Community sector (This includes, but is not restricted to, schools, colleges, universities, hospitals, local authorities, housing associations, charities etc.)	• Biomass heat boilers and biomass combined heat and power (CHP) equipment, including anaerobic digesters for heat-only or CHP.	Up to 40% of the capital cost & Installation of the difference in cost of installing the biomass boiler or CHP plant compared to installing the fossil fuel alternative. Max £500,000. Funding is available in rounds. Check http://www.bioenergycapitalgrants.org.uk/ to see if a round is open now or will be available in time for your development.