CHB Sustainability

Mixed Use Development

Sipson Road

London Borough of Hillingdon

Energy Statement

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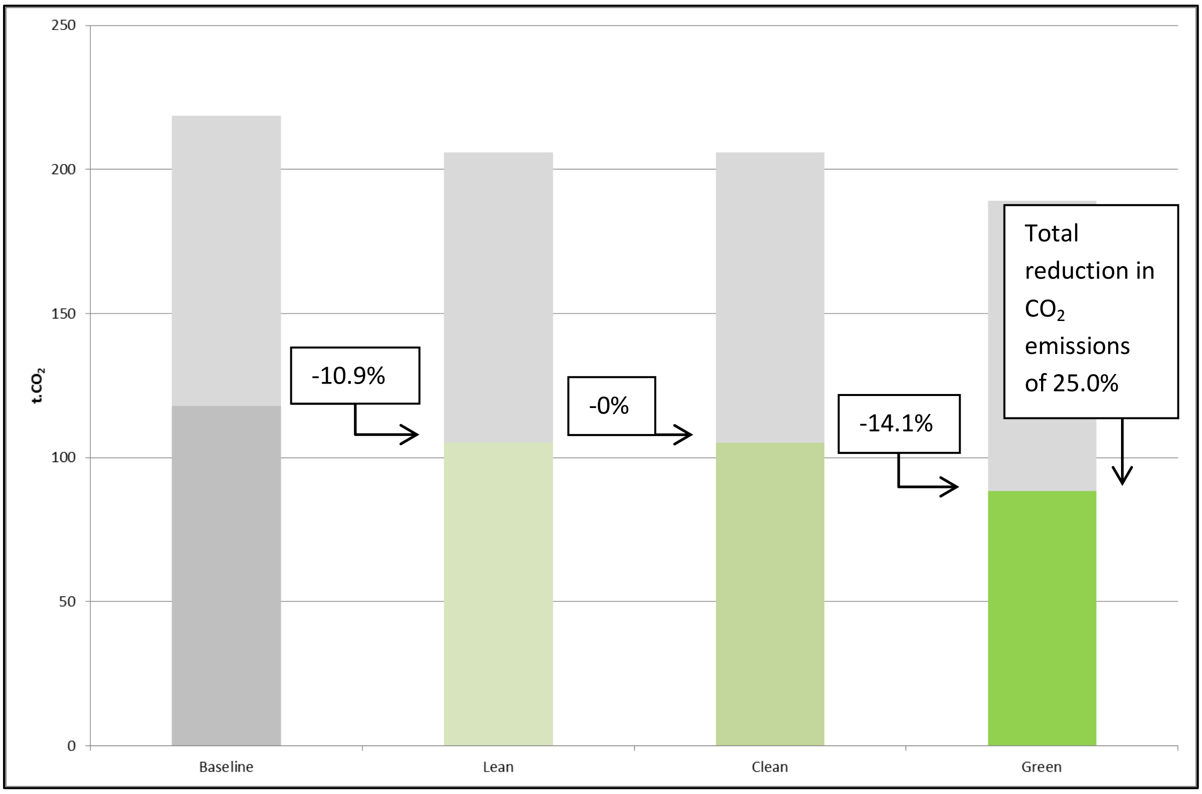
Executive Summary

The proposed mixed use development at Sipson Road has an Energy Strategy developed according to the requirements of the London Plan 2011 Policy 5.2 for Minimising Carbon Dioxide Emissions.

The Energy Strategy proposes to reduce the site-wide total regulated carbon dioxide emissions by a total of **25.0%,** meeting the London Plan 2011 target for developments between 2010 and 2013 of reducing carbon dioxide emissions by 25% compared to Part L 2010 Building Regulations.



	Tonnes CO_2 per annum		Percentage of baseline carbon dioxide emissions (%)	
	Part L Regulated Emissions	Total Emissions*	Part L Regulated Emissions	Total Emissions*
Baseline Emissions	117.89	218.61		
Savings from lean: using less energy)	12.80		10.9	5.9
Savings from clean: supplying energy efficiently	-		-	-
Savings from green: using renewable energy	16.67		14.1	7.6
Total Savings	29.47		25.0	13.5

**Including predicted carbon dioxide emissions due to energy end-uses not regulated by Building Regulations, such as equipment and external lighting.*

The Energy Strategy for the proposed development considers all aspects of the lean, clean and green Energy Hierarchy.

The proposed energy strategy puts a significant emphasis on the lean stage in order to reduce the energy demand for the building over its lifecycle.

The proposals for reducing carbon dioxide emissions at each stage of the Energy Hierarchy are summarised as follows:

1. **Be lean: use less energy**

The proposed development will achieve a significant reduction in carbon dioxide emissions through layout and orientation, building fabric and building services.

The potential for passive design of the site is maximised with a proposed layout that allows the majority of dwellings to benefit from a south eastern or southerly aspect, with remaining dwellings orientated east/west.

The detailed design shall ensure that the glazing areas are designed to optimise the relationship between passive solar gains, heat loss, daylight and overheating in order to reduce energy demands.

The site is sheltered by existing developments and through tree planting along the site boundaries.

It is proposed that the building fabric energy efficiency is significantly improved over the minimum requirements of the Building Regulations, both in terms of U-values, air tightness and thermal bridges.

A lean principle is also applied to the proposed building services, heating and hot water will be provided through high efficiency systems. The dwellings shall utilise energy efficient whole house mechanical ventilation with heat recovery. Energy efficient light fittings and advanced controls to non-domestic buildings are proposed, both to reduce energy demand and to reduce the heat gains to the proposed development.

2. **Be clean: supply energy efficiently**

In line with the clean energy hierarchy existing heat networks, combined heat and power and communal heating were assessed for their feasibility. It was found that none of these methods of clean energy supply were suitable for the proposed development.

3. **Be green: use renewable energy**

All renewable energy technologies were considered in order to assess the availability of renewable energy resources on the proposed development site and to assess the suitability of potential renewable energy technologies to the energy demands of the development.

It is proposed that to provide a site-wide solar photovoltaic capacity of 38.4 kW_p in order to generate renewable electricity on-site.

Contents

1. Introduction

This Energy Statement considers the proposed mixed use development at Sipson Road in the London Borough of Hillingdon.

The proposed mixed use development comprises of 53 new residential dwellings, 3 new light industrial units totalling 450 m^2, 2 new retail units totalling 300 m^2 and a 450 m^2 multi-purpose community facility.

The purpose of this Energy Statement is to demonstrate that climate change mitigation measures will be integrated into the scheme's design and that the proposed measures are appropriate to the site environment and energy demands of the development.

This document will describe the policy context to which the Energy Statement responds before presenting the baseline energy and carbon dioxide emissions and demonstrating how it is proposed to reduce these through a: lean, energy efficient design; clean energy supply; and green on-site renewable energy generation.

Due to the outline proposal stage indicative Standard Assessment Procedure (SAP) and Simplified Building Energy Model (SBEM) energy calculations have been performed based upon the available drawings and assumptions based on typical designs. Indicative energy modelling has been used in order to produce the most accurate estimate of the site energy demands that is available at this stage.

The report is based on information provided in the Planning Statement for the development of Sipson Road, Sipson by Chart Plan (2004) Ltd and Sipson Village Design and Access Statement by Robin Partington Achitects.

2. Policy Background

The London Plan 2011 is the core policy document to which this Energy Statement responds. The relevant London Plan 2011 policies considered within this statement are summarised as follows;

Policy 5.2 Minimising Carbon Dioxide Emissions is the key policy that this document responds to and it is split into 5 sections A – E.

Section A states that 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

Section B sets the overall targets for reducing carbon dioxide emissions expressed as an improvement over the Building Regulations 2010 Target Emission Rate (TER). The target for non-domestic buildings from 2010 – 2013 is a reduction of 25%.

From 2013 – 2016 a reduction in predicted carbon dioxide emissions of 40% is required. It is anticipated that this requirement shall be implemented in-line with the proposed uplift in Building Regulations Part L expected in October 2013. The expected changes to Part L in 2013 and the programme of implementation of these changes have not yet been confirmed by the relevant Authorities.

The June 2013 Greater London Authority Environment Programme budget 2013 – 2014 sets aside funds to provide guidance to the London Plan team and developers regarding the uplift in Part L of the Building Regulations expected in October 2013 and to recalibrate the standards in London Plan Policy 5.2. This provides a strong indication that the 2013 – 2016 targets will be implemented following the implementation of the uplift to Part L.

Section C states that major development should include: a detailed energy assessment to demonstrate how the Section B targets will be met; within the framework energy hierarchy of Section A.

Section D describes the minimum requirements for the energy assessment to: calculate the baseline energy demand and carbon emissions due to end-uses covered under Building Regulations; provide a separate calculation of non-regulated emissions; describe the proposals to reduce emissions in line with each stage of the energy hierarchy.

Section E states that carbon reduction targets should be met on-site. If this can be clearly demonstrated to be impossible for the site then shortfalls can be met off-site or through a 'cash in lieu' contribution.

Other relevant planning decision policies of the London Plan 2011 relating to this document are: Policy 5.3 Sustainable Design and Construction; Policy 5.6 Decentralised Energy in Development Proposals; Policy 5.7 Renewable Energy; and Policy 5.9 Overheating and Cooling.

Key energy and carbon dioxide emissions aspects of these policies that will be considered within this detailed energy assessment are as follows:

- Minimise carbon dioxide emissions across the site
- Evaluate the feasibility of CHP
- Select energy systems in accordance with following hierarchy
    1. Connection to existing heating or cooling networks.
    2. Site wide CHP network.
    3. Communal heating and cooling/
- Use London Heat Map to identify opportunities to connect to existing heat networks.
- Where feasible, renewable energy generation should form a part of carbon dioxide emissions reduction within the energy hierarchy.

- Major development should avoid the need for air conditioning through design, materials, construction and operation.

- Selecting cooling systems in accordance with the following hierarchy:
    1. Minimise internal heat generation through energy efficient design.
    2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.
    3. Manage the heat within the building through exposed internal thermal mass and high ceilings.
    4. Passive ventilation.
    5. Mechanical ventilation.
    6. Active cooling (ensuring they are the lowest carbon options).

4. Baseline Energy Demand and Carbon Dioxide Emissions

The baseline energy use and carbon dioxide emissions due to end-uses regulated by Building Regulations have been calculated using the National Calculation Methodology (NCM) Simplified Building Energy Model (SBEM) 2010 and Standard Assessment Procedure (SAP) 2009.

The baseline energy and carbon dioxide emissions are equivalent to the Target Emissions Rate (TER) calculated within the SBEM and SAP assessments of the proposed development.

Operational energy consumption due to appliances, including equipment and small power, is calculated within the SBEM method in a separate category entitled equipment, and within a separate calculation within SAP; although this usage is unregulated within Building Regulations, for the purposes of determining a more accurate account of the site energy demands these end-uses must be considered.

In addition to equipment that is unregulated by Building Regulations external lighting should also be considered for the proposed development.

From measurement of the site master plan it is estimated that approximately 10,000 m^2 of the site will be illuminated by external lighting. It is assumed that the external lighting power density will be approximately 1 W/m^2 and that on average the lighting shall operate for 3,300 hours/annum. Hence, the total annual external lighting energy is estimated to be 33 MWh.

Figure 1 shows the assumed fit-out baseline energy and carbon dioxide emissions through regulated end uses, based on the notional Target Emission Rate (TER) from approved modelling software, and unregulated emissions not assessed within Building Regulations.

Baseline Energy (MWh)						
Heating	Cooling	Auxiliary	Lighting	Hot Water	Equipment & External Lighting	Total including unregulated
286.50	6.34	6.15	55.53	125.12	194.82	674.45
Baseline CO_2 Emissions ($t.CO_2$)						
117.89					100.72	218.61

Figure 1: Predicted site-wide baseline energy consumption and carbon dioxide emissions.

5. Be lean: proposals for using less energy

In line with the requirements of the London plan 2011 Policies 5.2 and 5.3 the energy demand for the proposed development must be reduced compared to the 2010 Building Regulations baselines shown in Figure 1.

Energy demand reduction has been considered in three stages; layout and orientation; building fabric; and building services. The proposals to reduce energy at each of these stages are described within this section. Figure 2 shows the reduction in energy and carbon dioxide emissions due to the proposals to reduce energy demand.

Lean Energy (MWh)						
Heating	Cooling	Auxiliary	Lighting	Hot Water	Equipment & External Lighting	Total including unregulated
147.36	7.27	35.04	48.09	142.91	194.82	575.48
Lean Regulated CO2 Emissions (t.CO_2)						
105.09					100.72	205.81
Lean Emissions Reduction Over Baseline (%)						
10.86					0	5.85

Figure 2: Predicted site-wide lean energy consumption, carbon dioxide emissions and reduction over baseline.

Layout and Orientation

The opportunities for beneficial solar gain are significant for this site. All of the proposed dwellings are orientated with their main elevation between east and west (through south) and are therefore well placed to take advantage of passive solar gains during winter months. The proposed dwellings are sufficiently spaced such that they will not significantly overshadow one another.

The non-domestic buildings on-site are located along the southernmost boundary of the site, therefore they have limited opportunity to utilise solar gains from south facing glazing. These building types, however, are at a greater risk of overheating which is mitigated by reducing south facing glazing.

The detailed design of the site will consider glazed areas and orientation in greater detail to ensure that the balance between beneficial solar gains, reducing heat losses, daylighting and avoiding overheating is optimised.

The site is provided with shelter through significant tree planting along the eastern boundary and through existing development to the north and south west of the site. The shelter will help to reduce direct winds onto the proposed buildings, reducing forced air infiltration and helping to conserve heat within.

Building Fabric

In order to reduce the demand for heat energy it is proposed to construct the development with a highly thermal efficient building envelope.

It is proposed to improve the building fabric U-values and air tightness significantly upon the minimum requirements of Building Regulations; the scale of the proposed improvements is demonstrated in figures 3 and 4.

Element	Proposed	Worst Allowable L1A 2010	Improvement Over L1A 2010
Floor U-value ($W/m^2.K$)	0.15	0.25	**40%**
Roof U-value ($W/m^2.K$)	0.13	0.20	**35%**
Wall U-value ($W/m^2.K$)	0.20	0.30	**33%**
Window Glazing ($W/m^2.K$)	1.40	2.00	**30%**
Thermal Bridging Y-value	0.04	0.15	**73%**
Air Permeability ($m^3/(m^2.hr)$ @50Pa)	3	10	**70%**

Figure 3: Proposed improvements in dwelling building fabric specification

Element	Proposed	Worst Allowable L2A 2010	Improvement Over L1A 2010
Floor U-value ($W/m^2.K$)	0.22	0.25	**12%**
Roof U-value ($W/m^2.K$)	0.18	0.25	**28%**
Wall U-value ($W/m^2.K$)	0.27	0.35	**23%**
Window Glazing ($W/m^2.K$)	1.60	2.20	**32%**
Air Permeability ($m^3/(m^2.hr)$ @50Pa)	5	10	**50%**

Figure 4: Proposed improvements in non-domestic building fabric specification

Domestic Building Services

It is assumed that space heating and domestic hot water will be provided by a 90% SEDBUK 2009 efficient gas boiler. It is assumed that advanced controls will be included in order to reduce energy consumption; these would include a delayed start thermostat and weather compensation control.

A domestic hot water cylinder of 150 litres and with 80 mm of factory fitted insulation is assumed.

It is assumed that a whole house mechanical ventilation with heat recovery system will ensure that occupants and building fabric are supplied with sufficient fresh air whilst recovering at least 85% of available heat from extracted air to pre-heat the fresh air supply.

It is assumed that all lights will be energy efficient and that an energy display device will be provided to help to make occupants aware of their energy consumption and hence implement successful behavioural change to reduce their bills.

Non-Domestic Building Services

Within the proposed light industrial units it is assumed that an accessible WC will be provided which is heated by a 90% efficient gas-fired combination boiler that also meets the domestic hot water demands. It is assumed that the warehouse area shall be heated by a 91% efficient gas-fired blown air heater.

It is assumed that a 90% efficient gas-fired combination boiler shall also provide for the space heating and domestic hot water demands of the community centre.

It is assumed that an A-rated energy efficient split/multi-split electric heat pump shall provide space heating and cooling to the proposed retail units.

It is assumed that the light industrial units shall be provided with 10% rooflights in order to maximise natural light availability. In order to take full advantage of the available natural light it is assumed that the workshop, retail and community centre artificial lights are controlled by photoelectric sensors to switch lights off when the natural light availability is sufficient.

It is proposed that the lighting installed within the light industrial workshop, retail and community centre is energy efficient and controlled in order to reduce energy consumption. The lighting will have an efficacy of no worse than 60 lumens per circuit Watt, a 9% improvement on the minimum requirements of Building Regulations.

The lighting within the proposed light industrial WC will be fitted with PIR (passive infra-red) sensors to provide auto on/off control to ensure that lighting is only used when spaces are occupied.

Areas of the development that cannot be sufficiently ventilated through natural ventilation only shall be served by mechanical ventilation with heat recovery. Such systems can significantly reduce the winter heat demand by pre-heating supply air with extract. The system shall be selected to have a low specific fan power and high heat recovery efficiency.

In order to reduce electrical energy demand power factor correction (>0.95) shall be installed to ensure that the electrical supply to the building is efficient and energy is not wasted due to distortions in the alternating supply current.

Advanced metering systems will be provided which includes alarms for out of range energy consumption such that the future occupants will be alerted to excessive energy consumption that may be occurring due to an equipment fault or the behaviour of the building user.

Comfort Cooling

A-rated energy efficient comfort cooling is assumed to be provided to the retail units; this option has been selected after the implementation of the following measures in accordance with the London plan 2011 cooling Hierarchy:

1. Minimise internal heat generation through energy efficient design.

   - Efficient lighting shall be specified to reduce internal heat gains.
   - Efficient equipment shall be specified.
   - Efficient fans and pumps shall be specified to reduce internal heat gains.

2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls.

   - Glazing is likely to be mainly north facing.
   - Fins could provide passive shading and reduce heat gains through windows.
   - Solar control glazing shall reduce solar gains through windows.

3. Manage the heat within the building through exposed internal thermal mass and high ceilings.

   - This shall be considered within the detail design.

4. Passive ventilation.

   - There is unlikely to be potential for cross-flow ventilation as retail units typically only have glazing on one façade.

5. Mechanical ventilation.

   - Mechanical ventilation shall only be required for deeper plan areas that cannot be sufficiently ventilated with passive ventilation.
   - Any mechanical ventilation heat recovery system shall have a summer by-pass to allow 'free-cooling'.

6. Active cooling (ensuring they are the lowest carbon options).

   - Comfort cooling shall be A-rated for energy efficiency in-line with the EU Energy Labelling requirements.

6. Be clean: proposals for supplying energy efficiently

In line with the requirements of the London plan 2011 Policies 5.2 and 5.6 the feasibility of efficient energy supply is considered.

The clean energy supply hierarchy is followed as such:

1. Connection to existing heating or cooling networks, using London Heat Map to identify opportunities to connect to existing heat networks.
2. Site wide CHP network.
3. Communal heating and cooling.

The analysis of the clean energy supply hierarchy found that there are no existing heat networks to connect to and that CHP could be a suitable technology for the proposed developments combined site-wide heat demands. However, communal heating is not a suitable technology for the proposed development due to a low heat demand density; hence CHP generated heat cannot be distributed to a sufficient amount of the site-wide heat demands for it to be viable.

Therefore, the provision of energy efficient supply of energy has been considered in accordance with the London Plan 2011 energy hierarchy and it has not been found possible to reduce the proposed development predicted carbon dioxide emissions by this means: the energy strategy will focus on reducing energy demand and renewable energy generation.

Connection to existing heating or cooling networks

The online resource www.londonheatmap.org.uk was considered to investigate whether an existing distribution network was in place close to the proposed site.

It was found from studying the London Heat Map that the proposed site is not within an Opportunity Area Planning Framework (OAPF) for district heating.

No existing major heat supply plants were identified surrounding the proposed development site, however, the hotel located to the north of the development site is served by a combined heat and power system.

As shown in figure 5 there are no existing or proposed distribution networks within the vicinity of the site hence this option is not feasible for further consideration.

The proposed site location is surrounded by similar commercial type developments, the density of development and predicted heat demands do not indicate that there would be potential to pursue the development of a new heat distribution network in the area.

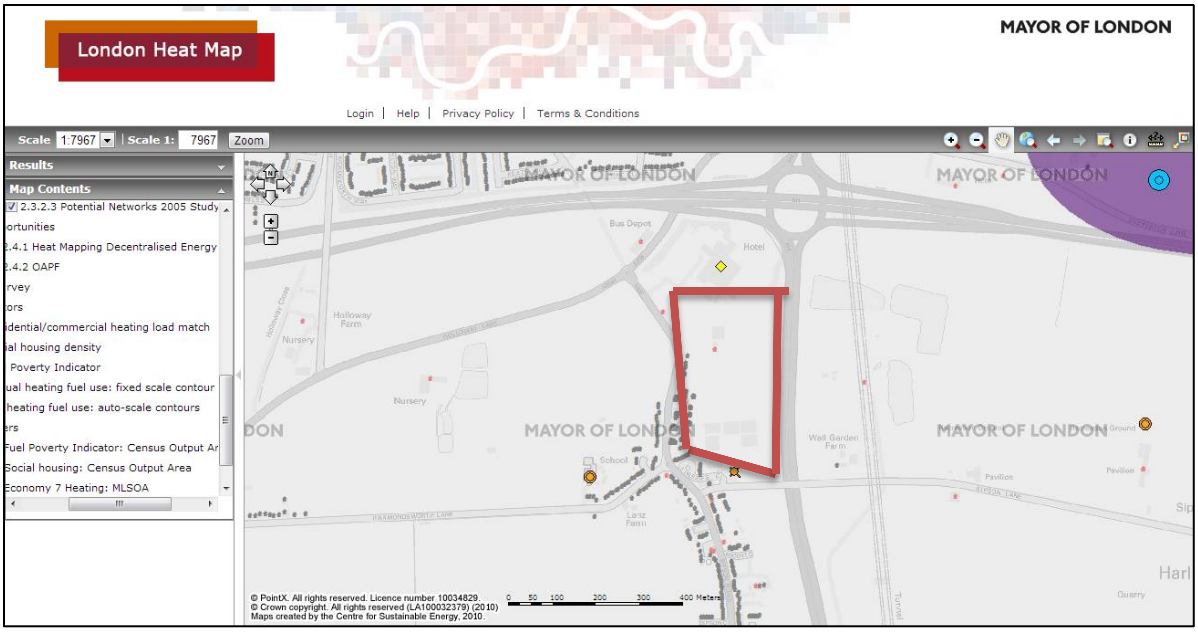


Figure 5: The London Heat Map showing the local area with the approximate development site boundary highlighted in red.

Site wide CHP network

In order for Combined Heat and Power (CHP) technology to be appropriate the site needs to have a suitable base-load heat demand. CHP works most effectively when it is operating consistently for long periods of the day throughout the year; therefore a consistent year round heat demand is required in order to avoid heat rejections during CHP operation.

Where a suitable heat base-load is unavailable, a cooling base-load can be sufficient for tri-generation of heat, coolth and power. The proposed development does not have a significant predicted demand for cooling; therefore tri-generation is not a feasible technology to consider.

Figure 6 shows the annual predicted heat and power demands for the proposed development based upon the SAP and SBEM calculations performed for this analysis.

From figure 6 it can be seen that there is a significant heat base-load compared to the peak demands for heat during the winter months.

The feasibility of a site-wide heat distribution network needs to be assessed in further detail as CHP will only be feasible if the whole, or a significant part, of the site can be served by heat generated from the CHP.

Figure 7 shows the site-wide heat demands broken down into three zones, a core zone which includes the majority of the proposed dwellings and around 70% of the site heat demands, and two peripheral zones of 10 no. 3 bed dwellings to the north and the non-domestic buildings to the south.

The core zone has a heat demand density of 22 kWh/m^2, all zones potentially served by a district heating scheme have a heat demand density of 7 kWh/m^2.

Research undertaken by DECC has estimated that areas with a heat density of less than 26 kWh/m^2/yr are unlikely to support a viable heat network[1]. Therefore it is considered that the proposed development is very unlikely to be able to support a site-wide heat distribution scheme due to its proposed low density of development. The costs for heat distribution networks are in the order of £1000 per meter therefore costs rise very quickly for heat distribution over moderate distances.

As it has been demonstrated that a site-wide scheme is not viable then it will not be possible for the development to take advantage of combined heat and power, as the site-wide demands are required to be combined such that there is a sufficient heat base load for CHP to be feasible.

Figure 6: Predicted site-wide heat and power energy demands.

[1] Poyry and Faber Maunsell, 2009. The Potential and Costs of District Heating Networks: A report to the Department of Energy and Climate Change.

Figure 7: Red circles proportional to area heat demand and black shows areas served by a potential site-wide heat distribution scheme.

Communal heating and cooling

As the heat density analysis described above demonstrates, the density of the proposed development is not sufficient for a site-wide heat distribution network to be viable.

7. Be green: assessing the renewable energy resource

In line with the requirements of the London plan 2011 Policies 5.2 and 5.7 the feasibility of renewable energy is considered.

A pre-feasibility analysis is performed which assesses the potential renewable energy resources on the proposed development site.

It is found that there are potential solar energy and ambient heat energy resources on site that could be exploited by renewable energy technologies.

Figure 12 shows a pre-feasibility matrix which assesses the potential for renewable energy generation and summarises the findings of the assessment of the feasibility of renewable energy generation.

Solar Energy Resource

The two main methods to exploit solar energy are Solar Thermal and Photovoltaics; these methods generate solar heated water and electricity respectively. A further method is the Solar Air Collector; this method harnesses heat from the solar energy on a surface and draws air either through or across the collector to absorb this heat and distribute it into the building.

For the successful exploitation of solar energy on the site a suitable location for a solar array must be available, such a suitable location would have a clear shade free view due east to west through south in order to take advantage of the highest amount of available direct sunlight throughout the year.

Solar arrays can be mounted vertically on the building façade; however, their annual energy yield is reduced as there is less available solar radiation as shown in Figure 8. Figure 8 shows that a vertical array will receive around 30% less annual solar radiation than a solar array optimised at 30° tilt angle due south, resulting in a vertical solar array achieving worse financial payback, lifecycle carbon reduction costs and internal rate of return (IRR) than an optimally aligned and orientated array.

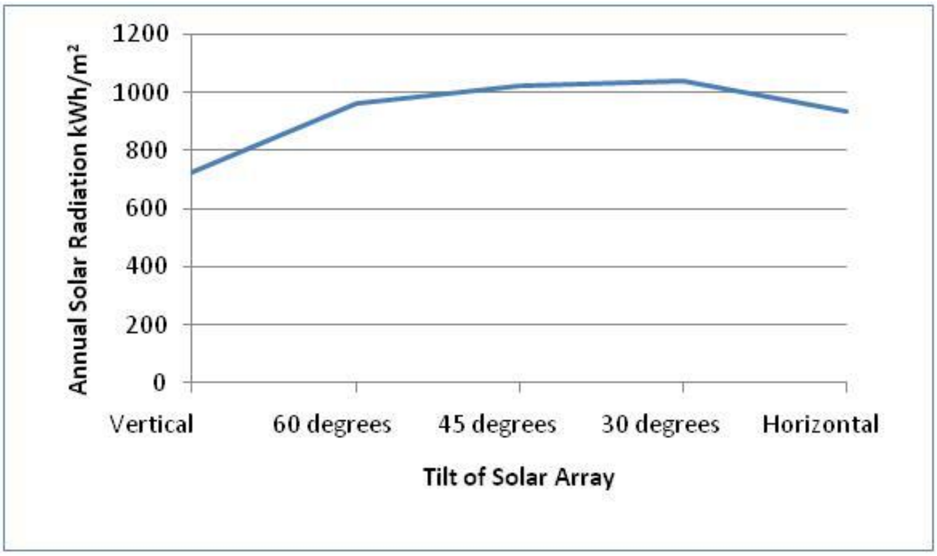


Figure 8: Annual Solar Radiation due South for a range of angles of tilt (Data source: SAP2005 Version 9.81 Table H2)

The most suitable location for a solar array would be on the roof of the proposed buildings where there is available space with no significant overshading. Figure 9 demonstrates which buildings within the proposed development have the most appropriate roof orientations to benefit from solar energy generation. The roof areas clouded orange have the best potential as they are located due south east to south west. The yellow clouded roof areas are orientated closer to east west and will have approximately 15% less available solar radiation that an optimally orientated solar panel.

Figure 9: Annotated site plan showing very good locations for solar energy generation (orange) and acceptable locations (Yellow).

Solar air collectors require a vertical surface as they are optimised to benefit from low winter sun. Solar air collectors can be used to pre-heat air for either ventilation or space heating systems. This technology is most appropriate for light industrial buildings where it can be integrated into the wall cladding. However, the light industrial units (three units in inverted 'L' in south east corner) do not have a significant south facing façade.

Both resources availability and energy demand must be considered. Dwellings have a significant hot water demand, therefore there is potential to achieve significant environmental and financial benefits through solar hot water generation. The light industrial, retail and community buildings are not expected to have a significant domestic hot water demand, therefore a solar hot water system serving these areas would be likely to have a negligible effect on the overall environmental impact and energy cost of the proposed development.

The peak domestic electricity demand is generally in mornings and evenings, however, there can still be a significant daytime demand dependent on the lifestyle of the occupants.

The light industrial and retail units will have peak electricity demand throughout office or opening hours during the daytime. The usage of the community centre is likely to be variable, although some daytime usage would be expected. Hence, there is likely to be sufficient daytime electricity demand for solar photovoltaics to be beneficial.

Biomass Energy Resource

There are three main types of biomass fuel, solid biomass, biogas and liquid biomass. Solid biomass includes wood chips, pellets or logs. Due to the scale of the proposed development logs are likely to be highly impractical due to fuel handling issues, so wood chip and pellets will be the solid biomass fuels considered in this section.

Biogas is generally produced from landfill sites or bio-digesters. Both processes involve collecting the gas generated when organic matter breaks down in anaerobic conditions.

Liquid biomass includes first, second and third generation biofuels. First generation biofuels are made from sugar, starch and vegetable oil. Common first generation biofuels are vegetable oil, biodiesel and bio alcohols. First generation biofuels use a feedstock in competition with food crops and could result in increased carbon emissions due to land change of use, therefore are not considered a sustainable option. Second generation biofuels have been developed to avoid use of feedstock's that are in competition with food crops, or they use parts of food crops which would normally go to waste.

Second generation biofuels are produced using advanced technical processes where first generation biofuels use conventional technology. Third generation biofuels are currently in development and are mainly produced using algae.

The only biofuels with a well-established supply network nationally are logs, wood chip and wood pellets, the application of which requires significant space for fuel storage.

The Borough of Hillingdon has been declared an Air Quality Management Area, the 2011 Hillingdon Air Quality Report states that the worst areas of air quality are located close to Heathrow Airport and close to major roads. The proposed development site is located both close to Heathrow Airport and close to Major Roads.

The 2011 Hillingdon Air Quality Report states that biomass will be discouraged and that any proposed biomass installation shall provide an air quality assessment to demonstrate that the proposals will not contribute to reducing the local air quality.

Ambient Heat Resource

Ambient heat resources in air, ground and water can be exploited using heat pump technology. Heat pumps consume electricity in order to extract low grade ambient heat from a source and provide a higher grade heat in a reverse refrigeration cycle.

Heat pumps are designed to work with either air or Low Pressure Hot Water (LPHW) heat distribution networks, it should be noted that the temperature of distribution in LPHW is lower than a conventional gas-fired boiler therefore to achieve optimum performance either under floor heating or oversized radiators should be specified.

The efficiency of a heat pump is measured by its Coefficient of Performance (CoP); generally ranging between 2 and 4 averaged throughout the year. This means that for every unit of electricity used to power the system, 2-4 units of heat are produced.

The efficiency of the system fluctuates with ambient temperatures with the worst performance where ambient heat resources are low in the winter months. Occasionally systems need to run defrost cycles in order to stop the compressor of the outdoor unit from freezing up, resulting in increased energy consumption.

Ground ambient heat sources allow higher Coefficients of Performance (COPs) than air ambient heat sources because there is a higher average temperature within the ground than in the air throughout the year, hence more available ambient heat energy.

Ground source resources are limited by area; approximately 25 W/m^2 of heat is available in the ground to a horizontal collector and 100 – 200 W/m^2 of heat would be expected to be available using more expensive vertical boreholes. It is not recommended to locate boreholes beneath buildings.

Ground ambient heat sources are often confused with geothermal energy. The difference is in the grade of heat available, geothermal energy exploits high grade heat directly from much deeper locations where heat from the Earth's core radioactive decay can be tapped.

Geothermal

Figure 10 shows the temperatures expected at 1000 m below ground level. It can be seen that the London area on the whole does not have sufficient ground temperatures to exploit for geothermal energy at this depth. Local temperatures may vary; however, the cost of exploratory drilling is very high and only viable for large developments where there is a high chance of a viable geothermal resource.

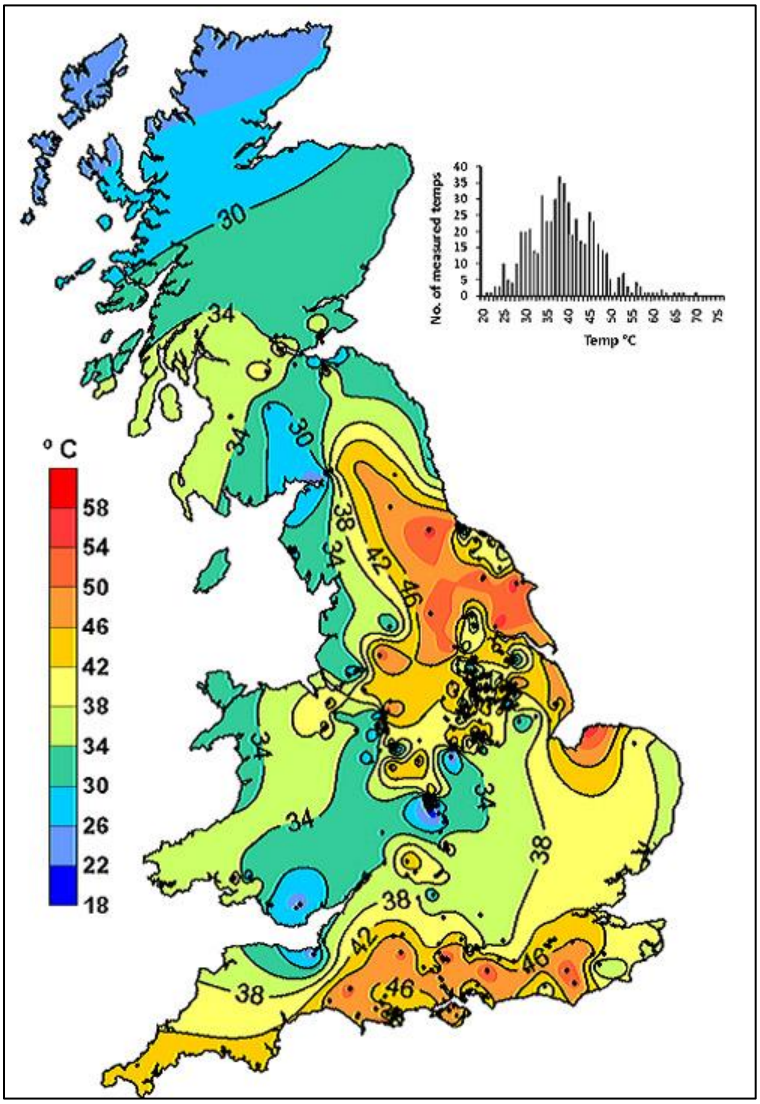


Figure 10: Temperature depth slice at 1,000m below ground level (British Geological Society www.bgs.ac.uk).

Wind Energy Resource

The location of the proposed development is surrounded by dwellings to the west and south of the site, a hotel to the north and a quarry to the east. There are also mature trees and hedgerows present on site.

'Location, Location, Location' the Energy Saving Trust Domestic small-scale wind field trial report (July 2009) found that the BERR database is known to overestimate the wind resource in built-up areas. Therefore the MCS 3003 standard is used to correct the BERR database values.

An obstruction height of 10 m was assumed, the results of the predicted windspeed varying with height in a shear graph are shown in figure 11.

The Energy Saving Trust report recommends a minimum average windspeed for further investigation to be viable as 5 m/s.

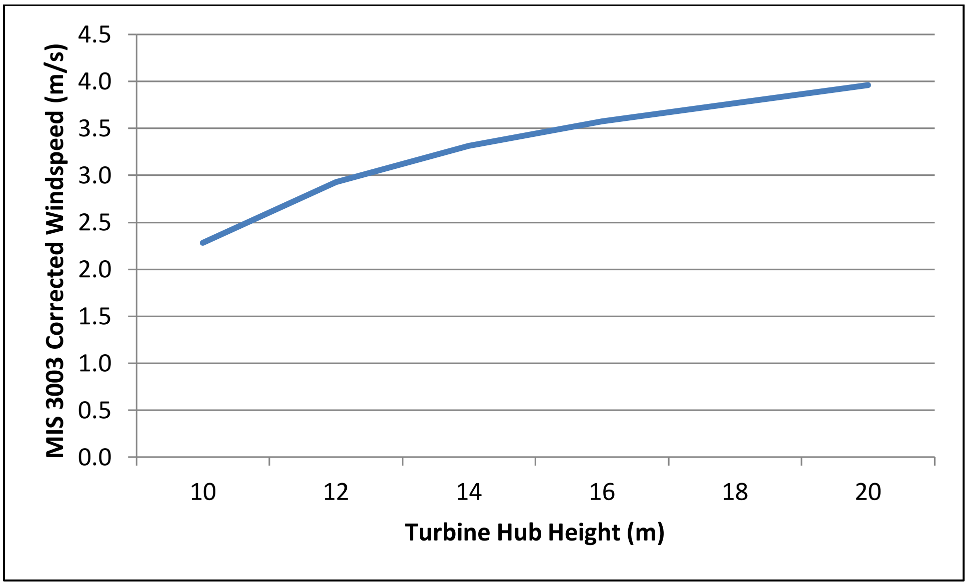


Figure 11: Windspeed varying with height at postcode UB7 0HR, canopy at 10 m (Data Source: BERR Database and MIS 3003 Standard).

The proposed site is within close proximity to Heathrow Airport (within 15 km) therefore restrictions are likely to be in place with regard to wind turbines due to safety reasons.

Waste Heat

Due to the speculative nature of the light industrial units proposed on-site it is unknown whether there will be industrial processes that generate waste heat that could be used within the development to contribute towards space heating or domestic hot water demands.

Desktop searches have not found any significant potential sources of high grade heat available within the vicinity of the proposed development site.

Technology	Pre-feasibility
Solar Hot Water	There is sufficient solar resource available for this technology and the proposed dwellings will have a significant demand for domestic hot water.
Biomass	Air Quality Management Area (AQMA) for NO_x and PM10 in Hillingdon therefore biomass discouraged due to potential adverse effect on local air quality.
Water Source Heat Pump	No potential bodies of water to locate water source collector.
Ground Source Heat Pump	There is significant ground area available within the proposed development therefore this technology is considered feasible.
Air Source Heat Pump	There are no technical feasibility restraints to this technology.
Geothermal	Unlikely to be potential geothermal resource available.
Waste Heat	No off-site potential high grade heat sources & unknown whether available waste heat from light industrial units proposed on-site.
Transpired Solar Air Collectors	Limited light industrial south facing façade available.
Solar Photovoltaic	Suitable shade free south facing roof space available and significant daytime electricity demand.
Hydro, Wave & Tidal	No potential resource of flowing or tidal water on-site.
Wind Turbine	Potential average is less than 5m/s minimum required for further investigation and restrictions due to proximity to Heathrow Airport.

Figure 12: Renewable energy pre-feasibility matrix.

8. Be green: proposals for renewable energy generation

The previous section of this report presented a pre-feasibility analysis for each renewable energy technology as well as a more detailed analysis of the potential renewable energy resources on site. It was found that the potentially feasible technologies for the proposed development are air source heat pumps (ASHP), solar photovoltaics (PV), ground source heat pumps (GSHP) and solar hot water (thermal).

Figure 13 shows the predicted capital investment cost per kg of carbon dioxide for each of the potential renewable energy technologies highlighted in figure 12 when implemented on the dwellings within the proposed mixed-use development. It is clearly demonstrated that solar photovoltaics are the cheapest capital cost per kg of carbon dioxide emissions mitigated.

It is proposed that a photovoltaic (PV) array with a peak output of 38.4 kW_p, is installed on appropriate roof areas of the proposed development.

Figure 14 shows the predicted renewable energy generation through the PV array, and demonstrates the predicted reduction in carbon dioxide emissions.

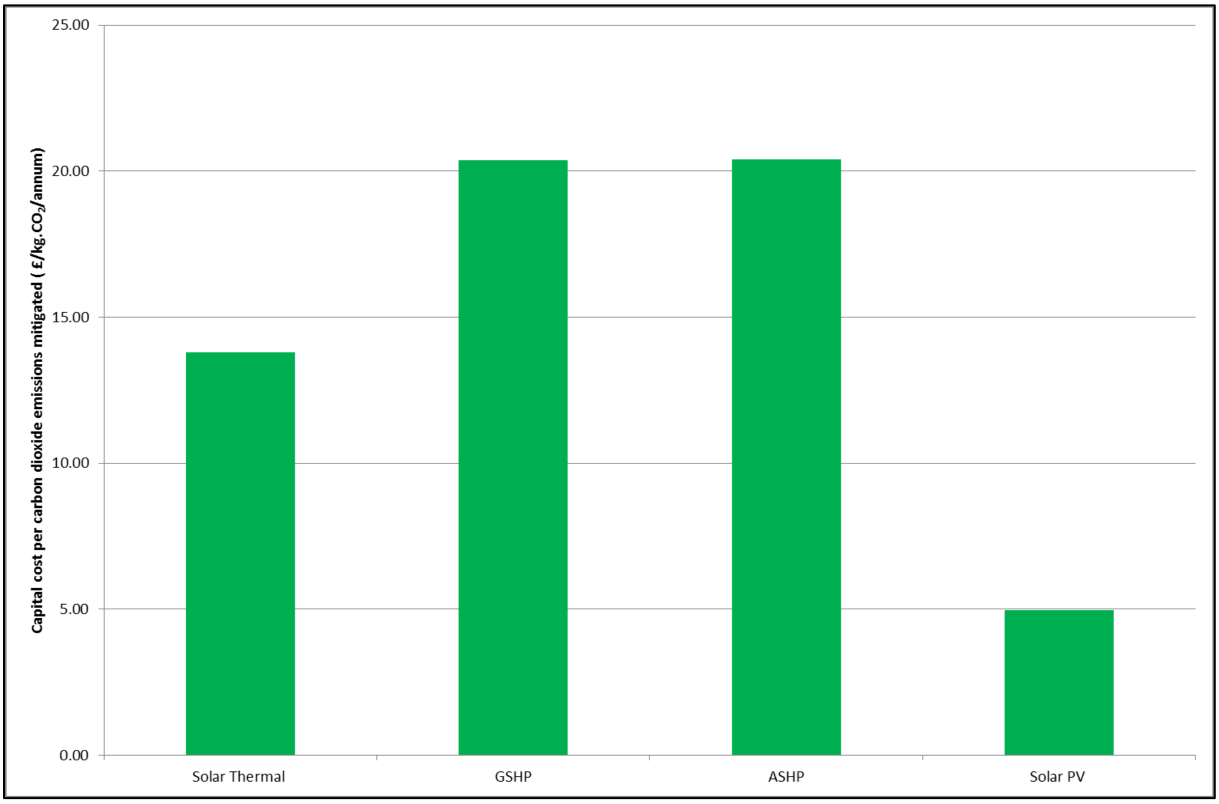


Figure 13: Capital cost per carbon dioxide emissions mitigated for range of appropriate renewable energy technologies serving proposed dwellings.

Green Energy (MWh)						
Heating	Cooling	Auxiliary	Lighting	Hot Water	Equipment & External Lighting	Total including unregulated
147.36	7.27	35.04	48.09	142.91	194.82	575.48
Renewable Electricity Output (MWh)						
Annual output (kWh) from 38.4 kW_p PV*						31.52
Green Regulated CO2 Emissions ($t.CO_2$)						
88.42					100.72	189.14
Green Emissions Reduction Over Baseline (%)						
14.14					0	7.63

**PV array assumed to be 30˚ pitch and assumed to be orientated south east.*

Figure 14: Predicted Fit-out Green Energy Generation and Carbon Dioxide Emissions and reduction over baseline.

9. Concluding Summary

This Energy Statement has been created following the guidance of London Plan 2011 Policy 5.2; it demonstrates proposed reductions in carbon dioxide emissions of 25.0% through implementation of the lean, clean and green energy hierarchy.

This Energy Statement demonstrates that an emphasis has been placed on energy efficient design, with a reduction in predicted carbon dioxide emissions of 10.9% through energy demand reduction alone. The Energy Statement details the proposals to reduce energy demand through a layout and orientation to maximise available daylight and beneficial solar gains and includes passive shading to reduce the cooling load.

The Energy Statement details the proposal for the building fabric to be improved upon the minimum Building Regulations requirements in order to reduce the heat loss through conduction and air infiltration through the building fabric, and that building services will be specified with a strong consideration for energy efficiency.

The Energy Statement has described how energy efficient provision of energy through an existing heat network, site-wide CHP or communal heating systems was considered and found not to be feasible for the proposed development.

The Energy Statement demonstrates that the site emissions are proposed to be reduced by a further 14.1% through the specification of photovoltaic solar panels with a total site-wide capacity of 38.4 kW_p in order to generate renewable electricity.

Figures 15 and 16 summarise visually and numerically the reductions in the site baseline emissions achieved through implementation of the London Plan 2011 as described within this Energy Statement.

It is demonstrated that the Mayor's carbon reduction targets for new developments between 2010 and 2013 of a 25% reduction in regulated emissions over 2010 Building Regulations is exceeded.

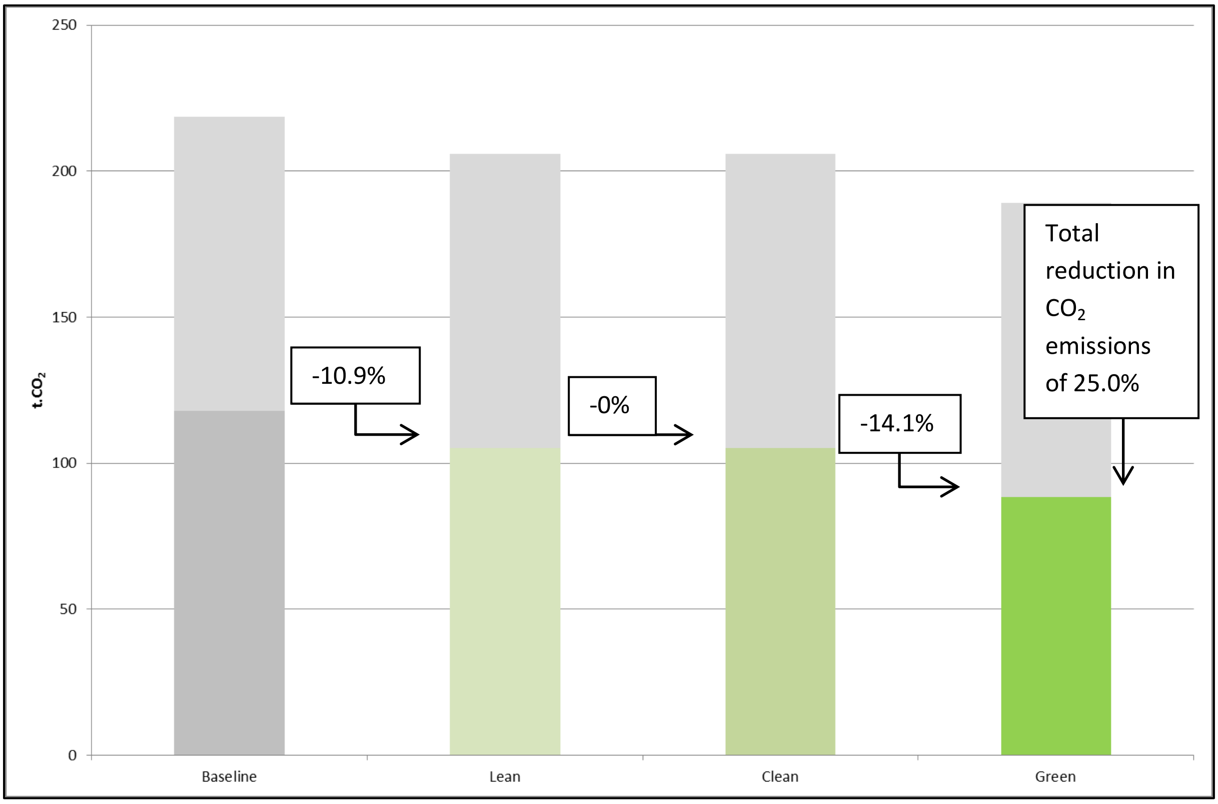


Figure 15: Summary graph of predicted CO_2 emissions and reduction achieved through application of the energy hierarchy.

	Tonnes CO_2 per annum		Percentage of baseline carbon dioxide emissions (%)	
	Part L Regulated Emissions	Total Emissions*	Part L Regulated Emissions	Total Emissions*
Baseline Emissions	117.89	218.61		
Savings from lean: using less energy)	12.80		10.9	5.9
Savings from clean: supplying energy efficiently	-		-	-
Savings from green: using renewable energy	16.67		14.1	7.6
Total Savings	29.47		25.0	13.5

**Including predicted carbon dioxide emissions due to energy end-uses not regulated by Building Regulations, such as equipment and external lighting.*

Figure 16: Table of predicted CO_2 emissions and reduction achieved through application of the energy hierarchy.