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Energy Strategy

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1 Issue Register

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1.0	For comment	23/08/10	J Simpson CEng MCIBSE
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2 Contents

3 Executive Summary

This document responds to planning policy in respect of energy consumption and carbon dioxide emissions. The methodology used herein is consistent with the London Renewables Toolkit (LRT) and Part L of the Building Regulations.

The Proposed Development features the following energy-saving measures:

- Improved U-values as detailed within Section 6;
- Efficient heating and hot water systems as detailed within Section 6; and
- Efficient lighting systems as detailed within Section 6.

The energy saving measures would be used to reduce the Proposed Development's energy requirements and to exceed the compliance requirements of Part L1A and L2A of the Building Regulations for residential and non-residential accommodation respectively. The carbon dioxide emissions of the Proposed Development are reduced by 7.6 % when compared to the compliance requirements of Part L 2006 due to the inclusion of energy saving measures.

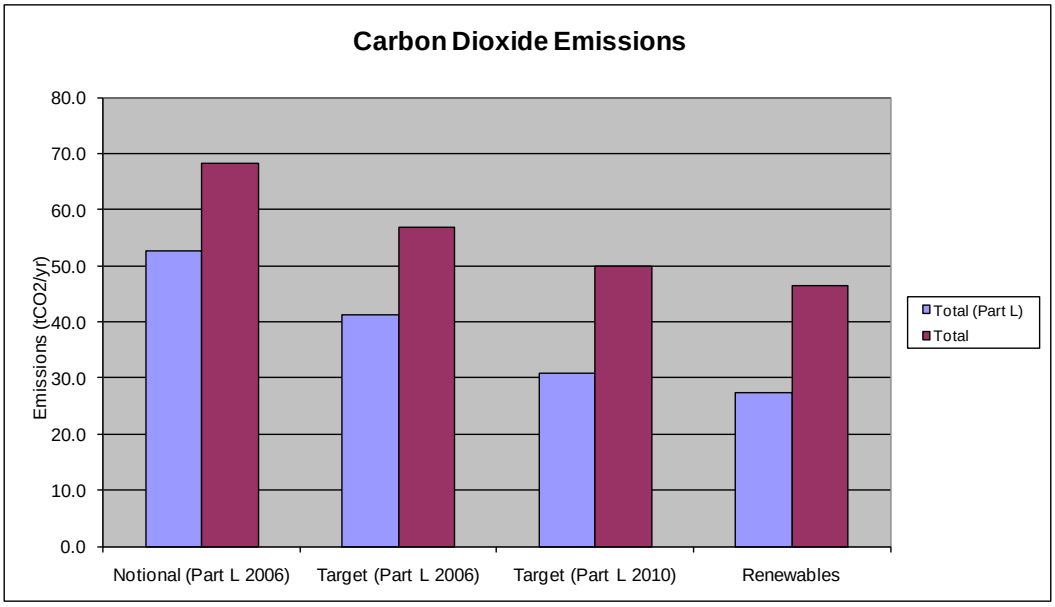
A feasibility study of the currently available low and zero carbon technologies has been undertaken, and the following systems would be incorporated within the Proposed Development:

- Air source heat pumps to generate space heating and hot water for the residential units; and
- Photovoltaic panels to generate electricity for the office building.

The combination of the heat pumps and photovoltaic panels would reduce the annual carbon dioxide emissions of the Proposed Development by 18.9 % when compared against the resultant carbon footprint after the energy efficiency measures are taken into account.

The incorporation of the energy efficiency measures and air source heat pumps equates to a reduction of 14.2 % against the TER 2010 for the residential units, which exceeds the mandatory energy requirements for Code 3 under the Code for Sustainable Homes Assessment.

. A summary of the reduction in emissions is shown in Figure 1 below:



4 Introduction

4.1 Planning Policy Context

4.1.1 National

The following description is taken from the LRT

"Increased development of renewable energy resources is vital to facilitating the delivery of the Government's commitments on both climate change and renewable energy. The Government's Energy Policy, including its policy on renewable energy, is set out in the Energy White Paper. This aims to put the UK on a path to cut its carbon dioxide emissions by some 60% by 2050, with real progress by 2020, and to maintain reliable and competitive energy supplies. As part of the strategy for achieving these reductions the White Paper sets out:

- The Government's target to generate 10% of UK electricity from renewable energy sources by 2010
- The Government's aspiration to double that figure to 20% by 2020 and suggests that still more renewable energy will be needed beyond that date.

"The Energy White Paper indicated that the Government would be looking to work with regional and local bodies to deliver its objectives, including establishing regional targets for renewable energy generation. Regional Planning Guidance should include the target for renewable energy generation for its respective region, derived from assessments of the region's renewable energy resource potential."

Planning Policy Statement 22 (PPS 22) sets out the Government's national policy for renewable energy, in terms of both dedicated renewable generation projects (e.g. wind farms) and 'embedded' generation. It states that "local planning authorities may include policies in local development documents that require a percentage of the energy to be used in new residential, commercial or industrial developments to come from on-site renewable energy developments. Such policies:

(i) Should ensure that requirement to generate on-site renewable energy is only applied to developments where the installation of renewable energy generation equipment is viable given the type of development proposed, its location, and design;

(ii) Should not be framed in such a way as to place an undue burden on developers, for example, by specifying that all energy to be used in a development should come from on-site renewable generation.

4.1.2 Regional

The London Plan (Consolidated with Alterations since 2004) was adopted in February 2008, and Policy 4A.7 Renewable Energy states that:

"The Mayor will, and boroughs should, in their DPDs adopt a presumption that developments will achieve a reduction in carbon dioxide emissions of 20% from on site renewable energy generation (which can include sources of decentralised renewable energy) unless it can be demonstrated that such provision is not feasible. This will support the Mayor's Climate Change Mitigation and Energy Strategy and its objectives of increasing the proportion of energy used generated from renewable sources by:

- Requiring the inclusion of renewable energy technology and design, including: biomass fuelled heating, cooling and electricity generating plant, biomass heating, renewable energy from waste (Policy 4A.21) photovoltaics, solar water heating, wind, hydrogen fuel cells, and ground coupled heating and cooling in new developments wherever feasible
- Facilitating and encouraging the use of all forms of renewable energy where appropriate, and giving consideration to the impact of new development on existing renewable energy schemes."

Paragraph 4.24 of the London Plan states that: 'The required renewable energy contribution should be established in line with Policies 4A.4 [production of Energy Assessment for Major Developments only] and 4A.7 [the 20% renewables target mentioned above].'

4.1.3 Local

The Core Strategy and accompanying documents, as part of the Local Development Framework (LDF), were submitted in January 2010 for examination by an independent planning inspector. The Inspectors report approved the Core Strategy and Development Policies on the 13th September 2010, and Pre-Adoption reports have been produced by Camden Council.

It states within Section 3 of the Core Strategy that 'the Council will expect developments to achieve a reduction in carbon dioxide emission of 20 % from on-site renewable energy generation (which can include sources of site-related decentralised renewable energy) unless it can be demonstrated that such provision is not feasible.'

4.2 Proposed Development

The Proposed Development consists of two new build 2-bedroom terrace houses and two 3-bedroom terrace houses over four floors, with a new build office building at the site entrance over four floors.

5 Methodology

This report draws on the information and approach set out in the LRT. The currency used for emissions is carbon dioxide, rather than the carbon equivalent, for consistency with Part L of the Building Regulations.

A Part L analysis is conducted to calculate carbon dioxide emissions for the following end uses: heating; hot water; cooling; fans, pumps and controls; and lighting. Various energy-saving measures are considered in terms of technical and economic feasibility and their effect on carbon dioxide emissions. A package of energy-saving measures is proposed that meets the Part L standard, without reliance on the contribution of CHP or renewables.

CHP is then considered in terms of technical and economic feasibility and its effect on carbon dioxide emissions. The strategic issues relating to each technology are also considered in the context of the Proposed Development, and two or three preferred options are short-listed. These are then considered in more detail in terms of technical and economic feasibility and its effect on carbon dioxide emissions.

Calculations are presented in summary form in subsequent sections, with detailed calculations in Appendix A.

Figure 2 below provides a summary of the methodology in the form of a flow diagram.

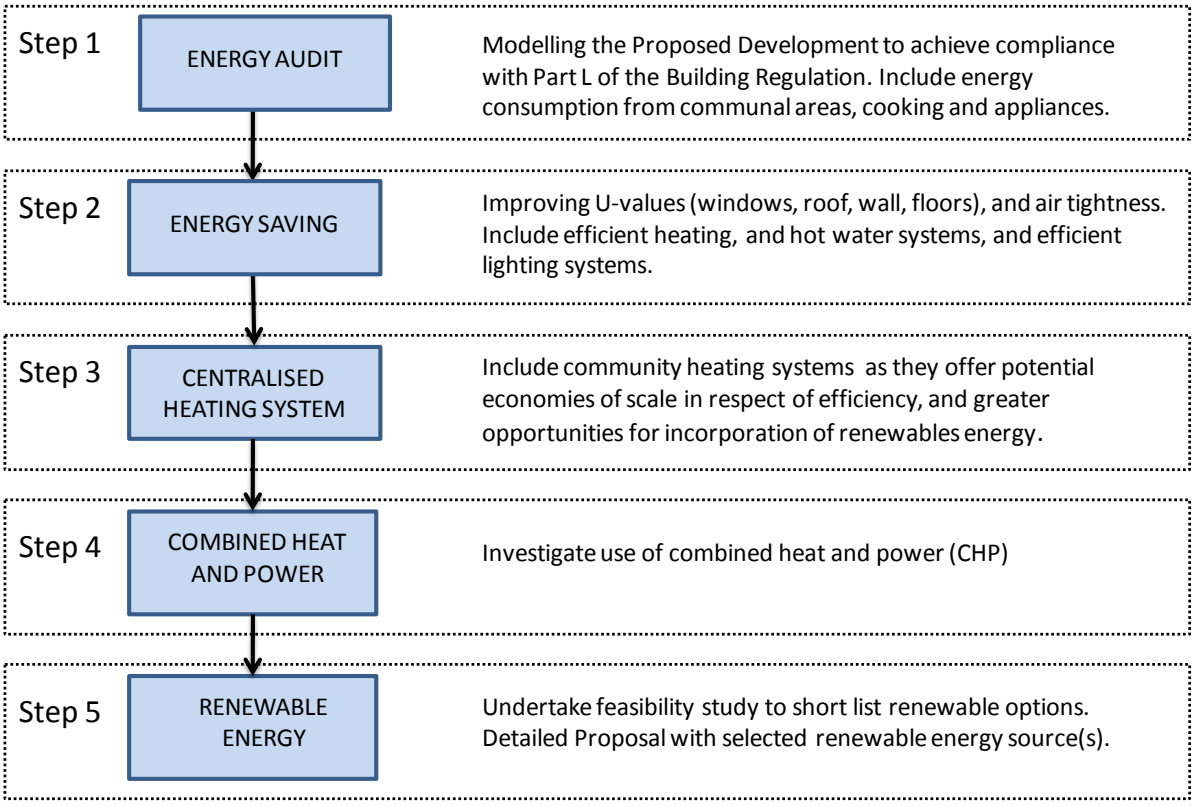


Figure 2 – Flow diagram of methodology

6 Energy Demand

The Proposed Development would feature energy saving measures such that compliance with Part L of the Building Regulations would be achieved without reliance on the contribution of CHP or renewables. As required under Part L, the residential apartments have been assessed under Part L1A, and the commercial office building has been assessed under Part L2A. Calculations have also been undertaken using the 2010 Part L calculation methodology, with the Target Emissions Rating (TER) for both 2006 and 2010 Regulations quoted in Table 1 below.

6.1 Residential Units

Part L1A calculations for the residential units have been undertaken for the Proposed Development using the accredited NHER software. The minimum requirements for compliance with Part L1A were established, and feasible improvements were included to further reduce the carbon dioxide emissions. The measures outlined below have been used in the Part L1A calculations, and exceed the requirements of Part L1A:

- Well-insulated building fabric with:
    - External walls at 0.22 W/m²K;
    - Roof at 0.14 W/m²K;
    - Ground floor at 0.20 W/m²K;
    - Glazing at 1.6 W/m²K;
    - Air permeability of 4 m³/hr. m² from air tests, but with value of 6 entered into calculations as required under the 2010 Part L1A methodology;
- Energy efficient lighting (100 %); and
- Efficient underfloor heating.

The calculations demonstrate that the proposed implementation of the above efficiency measures would reduce the residential carbon dioxide emissions by 6.8% against the 2006 Target Emissions Rate.

6.2 Commercial Unit

Part L2A calculations have been undertaken for the office building using the accredited DesignBuilder software. The minimum requirements for compliance with Part L2A were established, and feasible improvements were included to further reduce the carbon dioxide emissions. The measures outlined below have been used in the Part L2A calculations, and exceed the requirements of Part L2A:

- Well-insulated building fabric with:
    - External walls at 0.22 W/m²K;
    - Roof at 0.14 W/m²K;
    - Ground floor at 0.20 W/m²K;
    - Glazing at 1.6 W/m²K;
    - Air permeability of 4 m³/hr. m²;
- Energy efficient lighting at maximum of 2.2 W/m² per 100 lux; and
- Efficient heating production by high efficiency gas fired boilers, with local point-of-use electric water heaters.

The calculations demonstrate that the proposed implementation of the above efficiency measures would reduce the residential carbon dioxide emissions by 8.8% against the 2006 Target Emissions Rate.

6.3 Summary

Table 1 below provides details of the total energy demand within the Proposed Development, and provides a comparison against Part L compliance.

Model	Gas Demand (MWh)					Electricity Demand (MWh)								Carbon Dioxide Emissions (t)		
	Space heating	Hot water	Sub-total (Part L)	Other	Total	Space heating	Hot water	Cooling	Fans, pumps and controls	Lighting	Sub-total (Part L)	Other	Total	Elec. On-Site Generation	Total (Part L)	Total
Notional (Part L 2006)	-	-	-	-	-	-	-	-	-	-	-	37.1	-	0.0	52.6	68.2
Target (Part L 2006)														0.0	41.3	57.0
Target (Part L 2010)														0.0	30.7	49.9
Energy-saving	110.3	19.5	129.8	0.0	129.8	18.7	7.9	0.0	2.2	19.2	48.1	37.1	85.1	0.0	38.2	57.4

Table 1 - Total Energy Demand

7 Community Heating & CHP

The Mayor's Energy Strategy favours community heating systems because they offer:

- Potential economies of scale in respect of efficiency and therefore reduced carbon emissions; and
- Greater potential for future replacement with Low or Zero Carbon (LZC) technologies.

The Proposed Development is considered to be too small to successfully incorporate a community heating system. It is also considered that the small increase in heating plant efficiency due to the incorporation of a system would be cancelled out by the increase in energy consumption required to pump the heating water circuit.

Combined heat and power (CHP) has been assessed in terms of feasibility. There is no economic or sustainable justification for over-sizing the CHP plant, and therefore the CHP unit size needs to be carefully matched to the demands of the development. The smallest commercially available CHP unit is too large for the scheme due to the limited number of residential dwellings, and therefore CHP is not considered to be viable for the Proposed Development.

8 Renewables – Feasibility Study

The LRT provides benchmark sizing and cost data for "renewable energy technologies suitable for London". It therefore provides information to assess the various technologies at an early design stage, with initial measurements of the impact of using each technology on the building's carbon dioxide emissions. Table 2 (below) outlines these technologies and the variations proposed in the LRT used in this assessment.

Table 2

Technology	End Use Demand Met
Wind	Electricity
PV Cells - rooftop	Electricity
PV Cells - cladding	Electricity
Solar Water Heating	Annual DHW (50 %)
Biomass heating (a)	Annual Space Heating +Domestic Hot Water (33%)
Biomass heating (b)	Annual Space Heating +Domestic Hot Water (50%)
Biomass heating (c)	Annual Space Heating +Domestic Hot Water (100%)
Biomass CHP (a)	Annual Space Heating +Domestic Hot Water (33%)
Biomass CHP (b)	Annual Space Heating +Domestic Hot Water (50%)
Ground sourced heat pumps (a)	Annual Space Heating +Domestic Hot Water (50%)
Ground sourced heat pumps (b)	Annual Space Heating +Domestic Hot Water (100%)
Ground sourced heat pumps (c)	Peak Space Heating (50 %) Annual Space Heating + Domestic Hot Water (85 %)
Ground cooling (a)	Annual Cooling (50%)
Ground cooling (b)	Annual Cooling (100%)

The following other "acceptable renewable energy technologies" are considered to be not typically appropriate in London:

- Fuel cells using hydrogen from renewable sources;
- Gas from anaerobic digestion;
- Geothermal;
- Ground cooling air systems;
- Micro hydro; and
- Solar air collectors.

On the basis of this preliminary analysis, and a review of the general advantages and disadvantages of the different technologies relative to the Proposed Development, the following technologies were not considered to be appropriate to the Proposed Development:

- Wind turbines: on the basis of visual appearance, noise issues and concerns over outputs in urban areas. Wind turbines are not considered appropriate for the urban context. There are

still concerns over noise with the horizontal axis turbines, and therefore they are not considered appropriate for the development;

- Biomass: on the basis of concerns over air quality issues from flue discharge; concerns over transport issues relating to regular deliveries of biomass; security and cost of fuel supply; concerns over disposal of ash; and relatively high maintenance. Biomass is not considered to be a suitable fuel for use within an urban development, and therefore this technology is not considered appropriate for the development;
- Biomass CHP: on the basis of embodied impacts; high maintenance; concerns over air quality issues from flue discharge; concerns over transport issues relating to regular deliveries of biomass; lack of micro-scale units on the market to suit this scale of development; and it being an immature technology. Biomass is not considered to be a suitable fuel for use within an urban development, and therefore this technology is not considered appropriate for the development; and
- Ground source: due to the provision of basements within the scheme, there is limited area available for horizontal loops, and therefore costs for the ground works involved would be significantly increased. Ground source is therefore not considered to be a viable option.

9 Detailed Proposal

On the basis of this preliminary analysis, and a review of the general advantages and disadvantages of the different technologies relative to the Proposed Development, the following technologies were considered to be appropriate to the Proposed Development:

- Air source heat pumps:- these use the energy efficient refrigeration cycle to generate heat for space heating and hot water within dwellings; and
- Photovoltaic panels:- these extract the energy of the sun to generate electricity. It is proposed that photovoltaic panels be installed on the roofs above the residential atria, to generate electricity for the development. It is also proposed that photovoltaic panels be installed on the sedum roof of the office building. These electrical generation systems would be connected to the National Grid so that any surplus electricity can be exported to the Grid, and would be eligible for the feed-in tariffs proposed by the Government.

9.1 Air Source Heat Pumps

It is proposed that individual air source heat pumps are installed within each residential dwelling. It is proposed that exhaust air heat pumps, such as those manufactured by Thermacell and Nibe, are used to avoid the need for external condensers. These units have integral hot water cylinders, and are perfectly suited for underfloor heating systems with lower water temperatures, as proposed within the scheme.

The provision of individual air source heat pumps would reduce the residential carbon emissions by 8,972 $kgCO_2$ per annum, which equates to a reduction of 27.3%.

9.2 Photovoltaic Panels

It is also proposed that photovoltaic panels are installed on the flat sedum roof of the office building. These would be orientated towards the south-west at an angle of 30 °, and would reduce the annual carbon dioxide emissions of the commercial element of the scheme by 1,886 $kgCO_2$, which equates to a reduction of 7.7%.

9.3 Summary

The combination of the heat pumps and photovoltaic panels proposed would reduce the annual carbon dioxide emissions of the whole scheme by 10,859 $kgCO_2$, which equates to a reduction of 18.9% against the energy baseline.

10 Conclusion

This document responds to planning policy in respect of energy consumption and carbon dioxide emissions. The methodology used herein is consistent with the London Renewables Toolkit (LRT) and Part L of the Building Regulations.

The Proposed Development features the following energy-saving measures:

- Improved U-values as detailed within Section 6;
- Efficient heating and hot water systems as detailed within Section 6; and
- Efficient lighting systems as detailed within Section 6.

The energy saving measures would be used to reduce the Proposed Development's energy requirements and to exceed the compliance requirements of Part L1A and L2A of the Building Regulations for residential and non-residential accommodation respectively. The carbon dioxide emissions of the Proposed Development are reduced by 7.6 % when compared to the compliance requirements of Part L 2006 due to the inclusion of energy saving measures.

A feasibility study of the currently available low and zero carbon technologies has been undertaken, and the following systems would be incorporated within the Proposed Development:

- Air source heat pumps to generate space heating and hot water for the residential units; and
- Photovoltaic panels to generate electricity for the office building.

The combination of the heat pumps and photovoltaic panels would reduce the annual carbon dioxide emissions of the Proposed Development by 18.9 % when compared against the resultant carbon footprint after the energy efficiency measures are taken into account.

The incorporation of the energy efficiency measures and air source heat pumps equates to a reduction of 14.2 % against the TER 2010 for the residential units, which exceeds the mandatory energy requirements for Code 3 under the Code for Sustainable Homes Assessment.

11 Appendix A – Detailed Calculations

See attached calculations.

Building Details

Building/Demise	Gross Internal Floor Area (m²)	Net Internal Floor Area (m²)	Sales Floor Area or Treated Floor Area (m²)	Relevant Floor Area for emissions (m²)	Relevant Floor Area for renewables (m²)	Relevant Floor Area for build cost (m²)	Benchmarked Build Cost (£)	Benchmarked Carbon Dioxide Emissions (kg)
Residential	1,084	1,084	1,084	1,084	1,084	1,084	-	-

LRT Type (renewable energy benchmarks)	Infill medium density housing
LRT Type (delivered energy benchmarks)	Housing: Infill medium density housing

Carbon Dioxide Emissions

Key

Unknown
Calculated (SBEM)
Benchmark
Calculated (DesignBuilder)
Calculated (SAP 2005/NHER)
Calculated (other)

Model	Gas Demand (MWh)					Electricity Demand (MWh)								Carbon Dioxide Emissions (t)		
	Space heating	Hot water	Sub-total (Part L)	Other	Total	Space heating	Hot water	Cooling	Fans, pumps and controls	Lighting	Sub-total (Part L)	Other	Total	Elec. On-Site Generation	Total (Part L)	Total
Notional (Part L 2006)	89.2	39.7	128.9	0.0	128.9	7.7	0.0	0.0	1.0	8.2	16.9	17.1	34.1	0.0	32.2	39.4
Target (Part L 2006)														0.0	25.8	33.0
Notional (Part L 2010)	107.8	24.3	132.1	0.0	132.1	0.0	0.0	0.0	1.1	4.8	5.8	17.1	23.0	0.0	29.2	38.0
Target (Part L 2010)														0.0	17.5	26.4
Energy-saving	91.6	19.5	111.1	0.0	111.1	0.0	0.0	0.0	1.1	2.8	3.9	17.1	21.0	0.0	24.0	32.9
Renewables - Heat Pump	0.0	0.0	0.0	0.0	0.0	18.7	5.7	0.0	0.5	2.8	27.7	17.1	44.9	0.0	14.3	23.2
Proposed Development	0.0	0.0	0.0	0.0	0.0	18.7	5.7	0.0	0.5	2.8	27.7	17.1	44.9	0.0	14.3	23.2

Building Details

Building/Demise	Gross Internal Floor Area (m²)	Net Internal Floor Area (m²)	Sales Floor Area or Treated Floor Area (m²)	Relevant Floor Area for emissions (m²)	Relevant Floor Area for renewables (m²)	Relevant Floor Area for build cost (m²)	Benchmarked Build Cost (£)	Benchmarked Carbon Dioxide Emissions (kg)
Commercial Unit	470	470	470	470	470	470	-	-

LRT Type (renewable energy benchmarks)	Suburban standard office
LRT Type (delivered energy benchmarks)	Standard offices: Type 2

Carbon Dioxide Emissions

Key

Unknown	Benchmark	Calculated (SAP 2005/NHER)
Calculated (SBEM)	Calculated (DesignBuilder)	Calculated (other)

Model	Gas Demand (MWh)					Electricity Demand (MWh)								Carbon Dioxide Emissions (t)		
	Space heating	Hot water	Sub-total (Part L)	Other	Total	Space heating	Hot water	Cooling	Fans, pumps and controls	Lighting	Sub-total (Part L)	Other	Total	Elec. On-Site Generation	Total (Part L)	Total
Notional (Part L 2006)	-	-	-	-	-	-	-	-	-	-	-	19.9	-	0.0	20.4	28.8
Target (Part L 2006)														0.0	15.6	24.0
Target (Part L 2010)														0.0	13.2	23.5
Energy-saving	18.7	0.0	18.7	0.0	18.7	0.0	2.3	0.0	1.6	16.4	20.3	19.9	40.3	0.0	14.2	24.5
Renewables (PV)	18.7	0.0	18.7	0.0	18.7	0.0	2.3	0.0	1.6	16.4	20.3	19.9	40.3	1.9	12.3	22.6
Proposed Development	18.7	0.0	18.7	0.0	18.7	0.0	2.3	0.0	1.6	16.4	20.3	19.9	40.3	1.9	12.3	22.6

Building Details

Building/Demise	Gross Internal Floor Area (m²)	Net Internal Floor Area (m²)	Sales Floor Area or Treated Floor Area (m²)	Relevant Floor Area for emissions (m²)	Relevant Floor Area for renewables (m²)	Relevant Floor Area for build cost (m²)	Benchmarked Build Cost (£)	Benchmarked Carbon Dioxide Emissions (kg)
Site Total	1,555	1,555	1,555	1,555	1,555	1,555	-	-

LRT Type (renewable energy benchmarks)	
LRT Type (delivered energy benchmarks)	

Carbon Dioxide Emissions

Key

Unknown
Calculated (SBEM)
Benchmark
Calculated (DesignBuilder)
Calculated (SAP 2005/NHER)
Calculated (other)

Model	Gas Demand (MWh)					Electricity Demand (MWh)								Carbon Dioxide Emissions (t)		
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Notional (Part L 2006)	-	-	-	-	-	-	-	-	-	-	-	37.1	-	0.0	52.6	68.2
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Renewables	18.7	0.0	18.7	0.0	18.7	18.7	7.9	0.0	2.2	19.2	48.1	37.1	85.1	1.9	26.7	45.8
Proposed Development	18.7	0.0	18.7	0.0	18.7	18.7	7.9	0.0	2.2	19.2	48.1	37.1	85.1	1.9	26.7	45.8