



**3 VIVEASH CLOSE
HAYES, LONDON**

ENERGY REPORT

FOR

GENERAL FOOD CO LTD



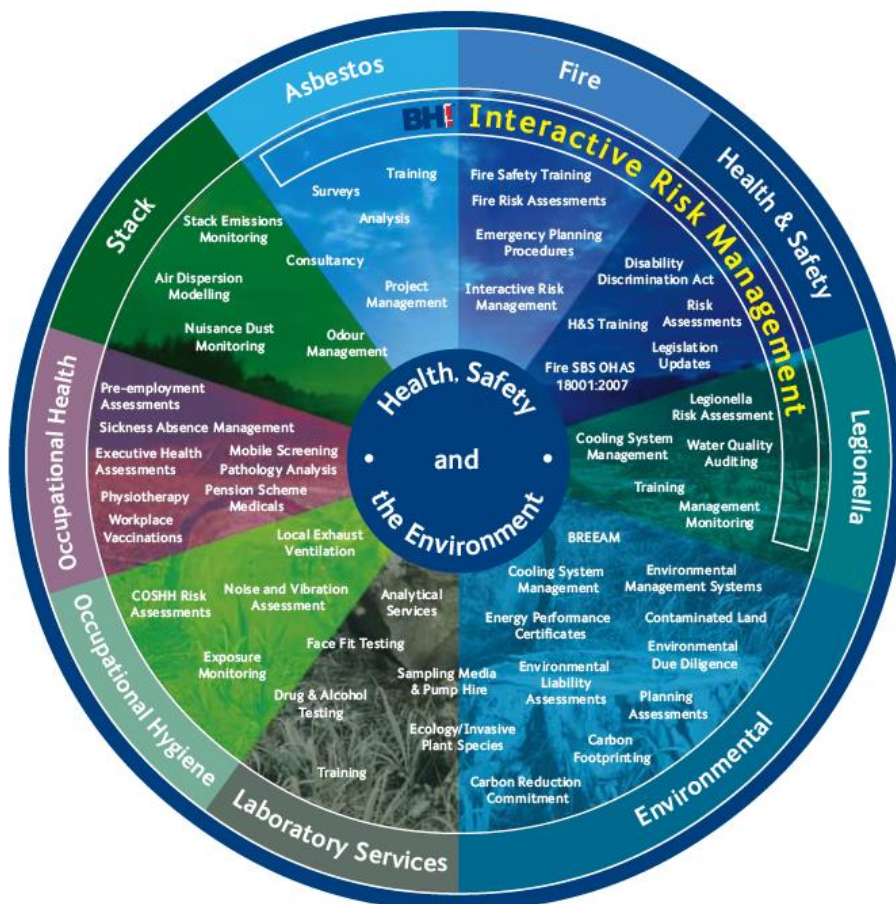
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EXECUTIVE SUMMARY

An Energy Strategy has been carried out for the proposed development at 3 Viveash Close, Hayes, London. The proposed development includes the construction of commercial space at ground and first floor and 68 residential units across two separate blocks. The building is divided into two blocks, Block A (39 residential units) and Block B (29 residential units).

This report establishes how the site will achieve compliance with Building and Local Authority requirements. This has been achieved by following best practice procedures of the London Plan's Energy Hierarchy: be lean (improved building performance); be clean (centralised heating and cooling systems); and be green (use of low or zero carbon technologies).

Reducing carbon emissions through lean measures

To maximise the energy efficiency of the development and thus reduce the energy demands, the following design principles and features have been incorporated:

- Building fabric elements and glazing specifications significantly improved to the Building Regulation requirements.
- Reduced air permeability compared to maximum required standards.
- Specification of efficient heating services and control systems.
- Energy efficient lighting through the development.

It was identified through the modelling undertaken, that a 9.3 t_nCO₂/year (7.97%) reduction in CO₂ emissions could be achieved over the baseline emissions via the implementation of the energy efficient design aspects.

Reducing carbon emissions through clean measures

The inclusion of a site wide heating system was investigated. Potential options at the site included either connection to an area wide low carbon heat distribution network, a site wide heat network or a Combined Heat and Power (CHP) system. It was considered that the installation of either of these options was not practical. Further information is provided in Section 3.

Reducing carbon emissions through green measures

A low or zero carbon (LZC) technology feasibility study was completed as part of this Energy Strategy which compared the feasibility of different technologies based on the energy demand of the development. Based on this, to comply with the energy requirements, it was identified that the most appropriate technologies to meet its sustainability and energy targets, are the installation of Photovoltaic Panels and Air Source Heat Pumps to provide heating for the domestic units and both

heating and cooling for the commercial unit. Overall, it is proposed to install 130.5m² of PV panels for a total peak of 26.2kWp. This is based on installing 80PV panels, with an output of 327W each.

Based on the robust approach to the energy hierarchy, the development has exceeded the required sustainability and energy targets. The proposed strategy achieves a site wide total reduction of the regulated carbon dioxide emissions of 37.79% over Building Regulations 2013 (37.16% over Part L1A and 39.81% over Part L2A). Moreover, the development achieves a total reduction of 29.82% of its regulated emissions through the use of renewables on site.

Domestic

Table 1 illustrates the reductions in CO₂ emissions for the proposed domestic building including both regulated and unregulated emissions. Regulated emissions alone are covered by Part L; and include emissions associated with fixed components of the building (i.e. fixed lighting, ventilation, space heating and water heating). Unregulated emissions are not covered by Part L and include emissions associated with plug-in appliances (i.e. cooking and appliances, catering and computing).

	Carbon dioxide emissions for domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	89.15	70.44
After energy demand reduction	86.15	70.44
After heat network / CHP	86.15	70.44
After renewable energy	56.02	70.44

Table 1: Carbon dioxide emissions after each stage of the Energy Hierarchy for domestic buildings

In Table 2 the carbon dioxide savings after each step of the energy hierarchy are presented. The savings in absolute values are calculated, for each tier, from the previous stage of the energy hierarchy. However, all savings in percentages (%) are reported against the baseline carbon emissions in order to evaluate the percentage saving against the baseline.

	Regulated domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Savings from energy demand reduction	3.00	3.36%
Savings from heat network / CHP	0.00	0.00%
Savings from renewable energy	30.14	33.80%
Cumulative onsite savings	33.13	37.16%
Annual Savings from off-set payment	56.02	62.84%
	(Tonnes CO ₂)	
Cumulative savings for off-set payment	1,680.53	

Table 2: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

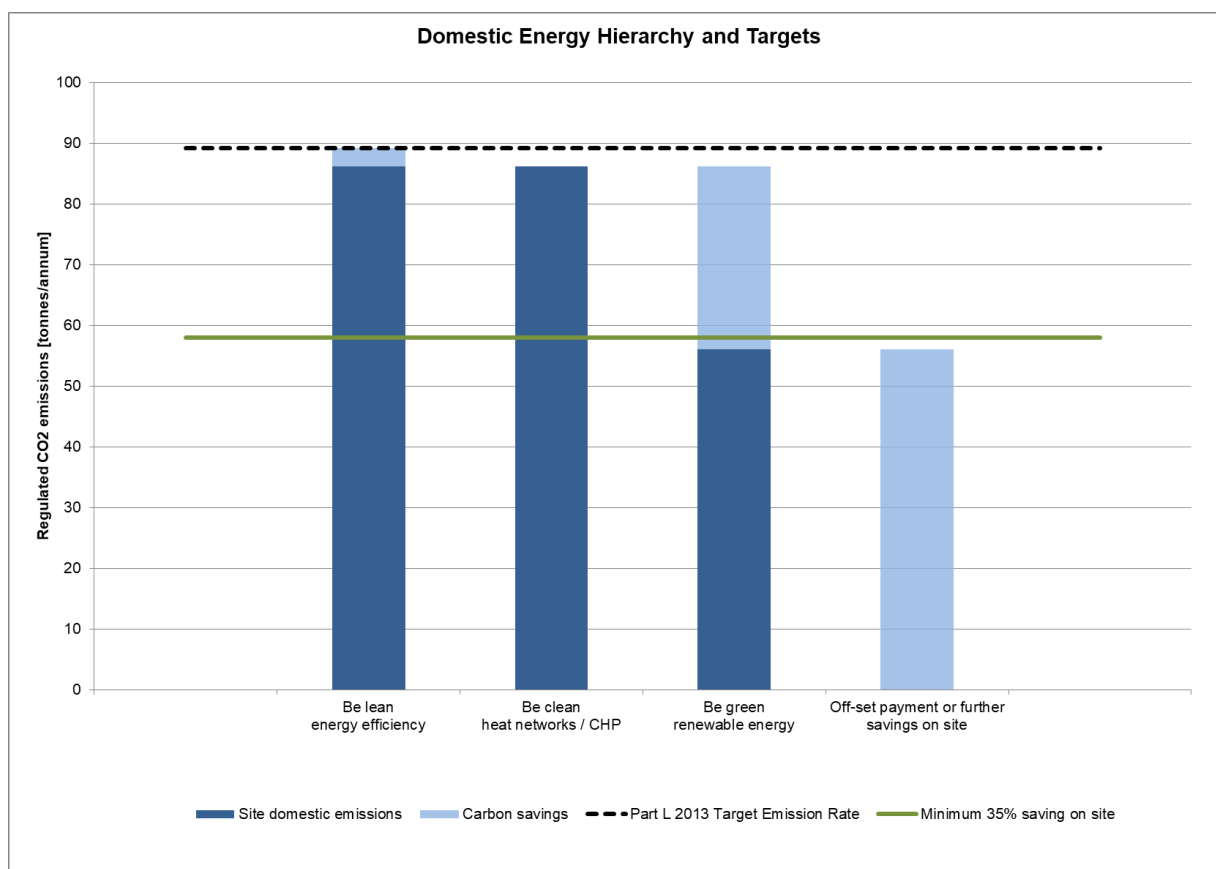


Figure 1: Step reduction in regulated CO₂ emissions for domestic buildings

As shown in Table 2 and Figure 1, a 100% carbon dioxide saving cannot be achieved on site for the domestic buildings. In order to meet 'Zero Carbon' onsite 56.02tnCO₂/yr must be offset, according to GLA Guidance. By multiplying the annual remaining carbon emissions with the assumed lifetime of the development's services (30 years) the cumulative shortfall has been calculated as

1,680.53tnCO₂/yr. Finally, the required cash-in-lieu contribution is £100,831 based on the carbon dioxide offset price of £60/tonne set by Hillingdon Council.

Non Domestic

Similarly, Table 3, Table 4 and Figure 2 present the carbon dioxide emissions and savings for each step of the Energy Hierarchy for the commercial unit.

	Carbon dioxide emissions for non-domestic buildings (Tonnes CO ₂ per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	27.52	30.08
After energy demand reduction	21.22	30.08
After heat network / CHP	21.22	30.08
After renewable energy	16.56	30.08

Table 3: Carbon dioxide emissions after each stage of the Energy Hierarchy for non-domestic buildings

	Regulated non-domestic carbon dioxide savings	
	(Tonnes CO ₂ per annum)	(%)
Savings from energy demand reduction	6.30	22.90%
Savings from heat network / CHP	0.00	0.00%
Savings from renewable energy	4.65	16.91%
Total Cumulative Savings	10.95	39.81%

Table 4: Regulated carbon dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings

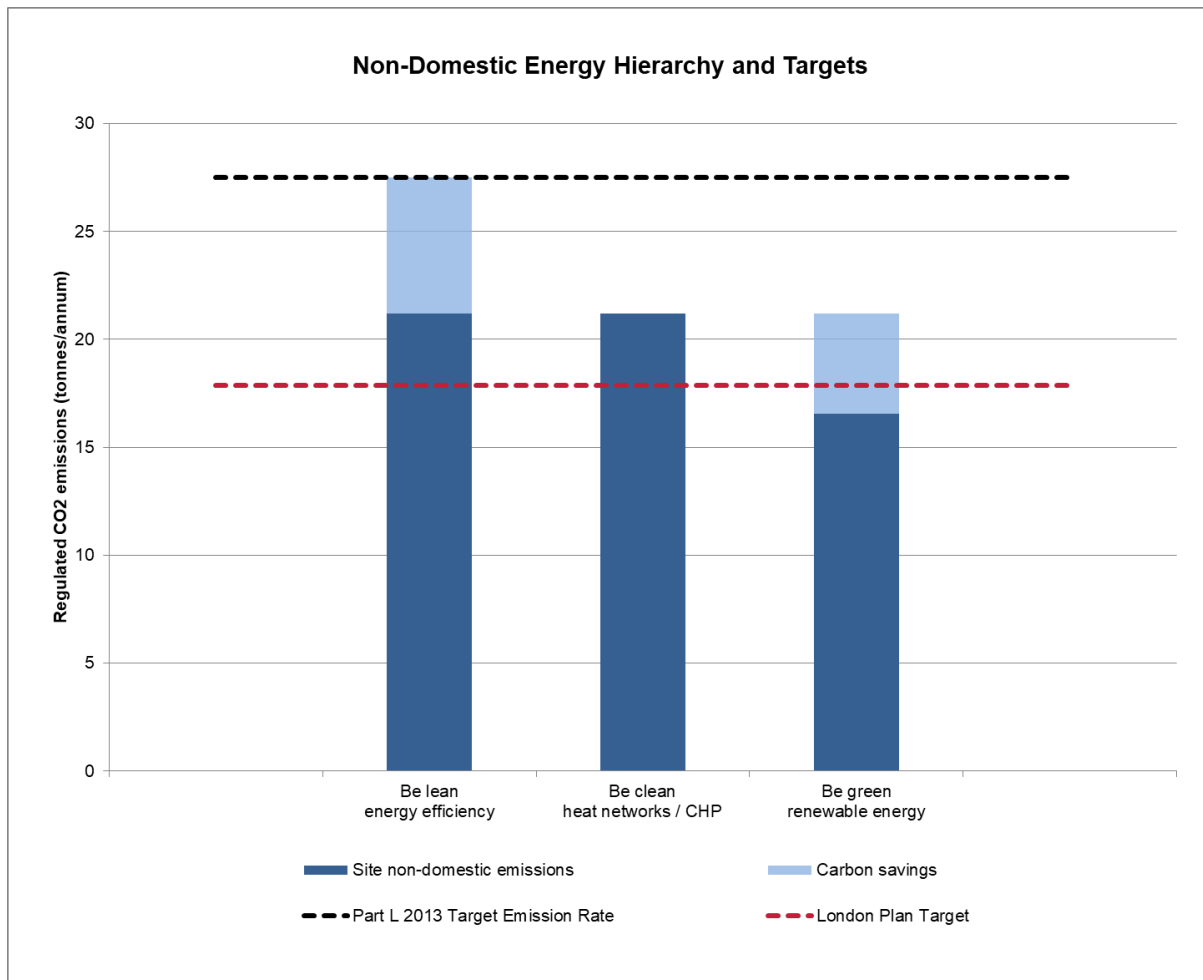


Figure 2: Step reduction in regulated CO₂ emissions for non-domestic buildings

Site Total

Table 5 below, presents the total estimated CO₂ emissions and savings for each step of the Energy Hierarchy for the entire development. In addition the required cash-in-lieu contribution for the carbon dioxide offset for the domestic emissions is also presented.

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	116.67		
Be lean	107.37	9.30	7.97%
Be clean	107.37	0.00	0.00%
Be green	72.58	34.79	29.82%
		CO ₂ savings off-set (Tonnes CO ₂)	
Off-set		1,680.53	

Table 5: Site wide regulated carbon dioxide emissions and savings

1 INTRODUCTION

RPS Consulting Services (RPS) was commissioned by *General Food Co Ltd* to undertake an Energy Strategy and produce a statement for a proposed development at 3 Viveash Close, Hayes, London. This report will form part of the planning submission to Hillingdon Council and relates to a full planning application.

This report outlines the scheme and current planning context and assesses likely energy demands of the development prior to consideration of low and zero carbon technology options. The report concludes with the proposed energy strategy.

This Energy Report comprises:

- (i) A scheme overview.
- (ii) A review of the planning context.
- (iii) A review of any applicable legislation or sustainability targets.
- (iv) An energy assessment of the project, following the energy hierarchy.
- (v) A presentation of results and recommendations.

1.1 Scheme Overview

The proposed development includes one building with commercial space at ground and first floor levels and 68 residential units. The building comprises of 2 separate blocks, of Block A (39 residential units) and Block B (29 residential units).

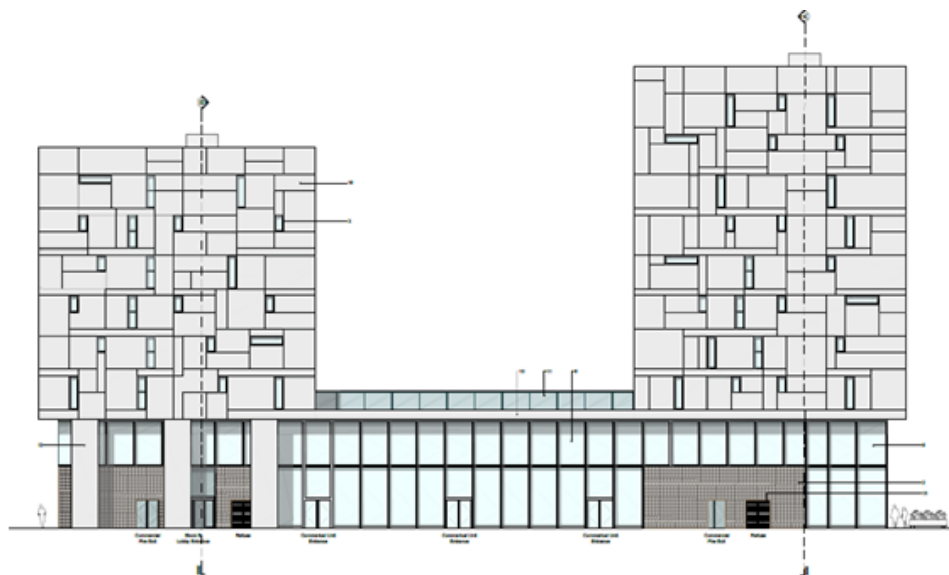


Figure 3: North elevation of the proposed development

1.2 Report Structure & Methodology

The report has been written in accordance with the planning requirements of an Energy Strategy. A summary of the planning requirements relevant to energy consumption within the development are provided in Section 2 of the report.

The method preferred by Hillingdon Council towards the site wide energy strategy is the adoption of a hierarchical approach which ensures that the energy requirements and associated emissions are reduced as far as possible before applying renewable energy options. Section 3 of this report details the steps taken to follow the energy hierarchy (be lean, be clean, be green). A summary of findings and a suggested approach for the development is presented in Section 5.

2 PLANNING CONTEXT

The relevant authority for this site is Hillingdon Council. The requirements of this Council and other relevant authorities have been taken into account within this feasibility study. The key planning framework applicable to the energy aspects of the development is outlined below:

2.1 National level policies

There are a number of national policies and regulations related to energy; those most relevant to the energy assessment of new developments are detailed below.

National Planning Policy Framework – NPPF (2012)

The National Planning Policy Framework (NPPF) was published in March 2012, and superseded the former planning policy statements (PPS) documents. The NPPF is designed to make the planning system less complex and more accessible; to protect the environment and promote sustainable growth. It provides a framework within which local people and their respective councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development. The three dimensions of sustainable development can be defined as the economic, social and environmental.

There are twelve core planning principles in the NPPF. Within these, there is a strong support for the transition to a low carbon future in a climate change context, taking full account of a number of different factors. There is also an aim to contribute to conserving and enhancing the natural environment and reducing pollution.

The NPPF aims to strengthen local decision making, with the use of decision-taking in a positive way, as a means of fostering the delivery of sustainable development.

However, the NPPF (paragraph 173) also highlights that pursuing sustainable development requires careful attention to the viability and costs in plan-making and decision-taking. Plans should be deliverable. Therefore, the sites and the scale of development identified in the plan should not be subject to such a scale of obligations and policy burdens, that their ability to be developed viably is threatened.

Climate Change Act 2008

The Government has introduced legislation and a number of policies during recent years focusing on the reduction of CO₂ emissions. The Climate Change Act (2008) sets a legally binding target for the reduction in UK carbon dioxide emissions. Upon ratification of the Kyoto Protocol, the UK committed to a reduction in its CO₂ emissions by 80% compared to 1990 levels (by 2050). In addition, under the Climate Change Act an interim target of a 34% reduction by 2020 was set.

In order to enforce these targets, the Government is using the Building Regulations: Part L 2010 – (Conservation of fuel and power) which set the standards to which all new and existing buildings must comply.

Building Regulations 2013 Part L

Building Regulations are statutory instruments that seek to ensure that the policies set out within any relevant UK legislation are carried out. Building regulations approval is required for the majority of building work carried out in the United Kingdom.

Part L of these regulations covers the requirements with respect to the conservation of fuel and power in all building types. It controls the insulation values of building fabric elements and openings, the air permeability of the structure, the heating efficiency of heating, ventilation and air conditioning systems together with hot water storage and lighting efficiency. It also sets out the requirements for calculating the carbon dioxide emissions and the Carbon Emission Targets for each building type.

Part L is split into four sections:

- L1A New Dwellings.
- L1B Existing Dwellings.
- L2A New Buildings other than Dwellings.
- L2B Existing Buildings other than Dwellings.

This development need to comply with Part L1A and Part L2A.

2.2 Regional level policies - The Greater London Authority

Planning policy for London is set out in the Mayor's London Plan March 2016; this sets out an integrated social, economic and environmental framework for future development of Greater London. The London Plan contains a number of policies relating to energy; those most relevant to the energy assessment of new developments are detailed below.

Policy 5.2 Minimising Carbon Dioxide Emissions

Development proposals should make the fullest contribution to minimising carbon dioxide emissions. All new development will have to achieve zero carbon for residential development and a 35% improvement over 2013 Part L Building Regulations for commercial developments.

Zero carbon homes are homes forming part of major development applications where the residential element of the application achieves at least a 35 per cent reduction in regulated carbon dioxide emissions (beyond Part L 2013) on-site. The remaining regulated carbon dioxide emissions, to 100 per cent, are to be off-set through a cash in lieu contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

All carbon dioxide emissions savings should be achieved in accordance with the following energy hierarchy:

- Be lean: use less energy.
- Be clean: supply energy efficiently.
- Be green: use renewable energy.

Major development proposals should include a detailed energy assessment to demonstrate how the targets for carbon dioxide emission reductions are to be met within the framework of the energy hierarchy. The calculation within the energy assessment should include the energy demand and carbon dioxide emissions covered by the Building Regulations; and, separately, the energy demand and carbon dioxide emissions from any other part of the development. This includes plant, equipment, cooking or appliances that are not covered by the Building Regulations at each stage of the energy hierarchy.

Policy 5.4 Retrofitting

All boroughs should develop policies and proposals regarding the sustainable retrofitting of existing buildings. In particular they should identify opportunities for reducing carbon dioxide emissions from the existing building stock by identifying potential synergies between new developments and existing buildings through the retrofitting of energy efficiency measures, decentralised energy and renewable energy opportunities

The Mayor supports an integrated, multi-agency approach, to promote the retrofitting of existing buildings, and where possible policies and programmes supporting zero carbon development and deployment of decentralised energy should also be applied to existing buildings. The Mayor will support measures through the Building Regulations and other regulatory and funding mechanisms to improve the performance of London's existing buildings, increase energy and water efficiency, and to make full use of technologies such as decentralised energy and renewable energy.

Policy 5.6 Decentralised Energy in Development Proposals

Development proposals should evaluate the feasibility of connection to a Decentralised Energy heating system and Combined Heat and Power (CHP) systems. In cases where a new CHP system is appropriate, development proposals should 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:

- Connection to existing heating or cooling networks.
- Site wide CHP network.
- Communal heating and cooling.

Policy 5.7 Renewable Energy

The Mayor seeks to increase the proportion of energy generated from renewable sources, and expects that the projections for installed renewable energy capacity outlined in the Climate Change Mitigation and Energy Strategy and in supplementary planning guidance, will be achieved in London. Within the framework of the energy hierarchy (see Policy 5.2), 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. All renewable energy systems should be located and designed to minimise any potential adverse impacts on biodiversity, the natural environment and historical assets, and to avoid any adverse impacts on air quality.

Policy 5.9 Overheating and Cooling

Major development proposals should reduce potential overheating and reliance on air conditioning systems through consideration of principles of the following cooling hierarchy:

- Minimise internal heat generation through energy efficient design.
- Reduce the amount of heat entering a building during summer months through orientation, shading, albedo, fenestration, insulation and green roofs and walls.
- Manage the heat within the building through exposed internal thermal mass and high ceilings.
- Use passive ventilation.
- Use mechanical ventilation.
- Use active cooling systems (ensuring they are the lowest carbon options).

Major development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. New

development in London should also be designed to avoid the need for energy intensive air conditioning systems as much as possible.

In order to identify at an early stage whether there is likely to be an overheating risk, developers of domestic buildings should complete Section 1 of the Overheating Checklist and submit it with the preliminary energy information provided to GLA at pre-application stage. Section 1 and 2 of the Overheating Checklist should be reviewed as the design progresses and the full checklist should be completed and included within the energy assessment submitted at Stage 1 of the planning application.

2.3 Local level policies – Hillingdon Council

The Planning and Energy Act 2008 enables a local planning authority in England, through their development plan documents, to include policies imposing reasonable requirements for:

- A proportion of energy used in development in their area to be energy from renewable sources in the locality of the development.
- A proportion of energy used in development in their area to be low carbon energy from sources in the locality of the development.
- A development in their area to comply with energy efficiency standards that exceed the energy requirements of building regulations.

Local Plan: Part 1 – Strategic Policies (November 2012)

Hillingdon Council adopted the first stage of its Local Plan, namely its Part 1 – Strategic Policies, on November 2012. This is an important document because it contains the planning vision and strategy for the Borough. It identifies how the borough will guide future development, by also tackling the impact of climate change locally in the best way possible.

Policy BE1: Built Environment

The council will require all new development to improve and maintain the quality of the built environment in order to create successful and sustainable neighbourhoods, where people enjoy living and working and that serve long-term needs of all residents. All new development should:

1. Achieve a high quality of design in all new buildings.
2. Maximise the opportunities for all new homes to contribute to tackling and adapting to climate change and reducing emissions of local air quality pollutants. The council will require all new development to achieve reductions in carbon dioxide emission in line with the London Plan targets through energy efficient design and effective use of low and zero carbon technologies. Where the required reduction from on-site renewable energy is not feasible within major developments, contributions off-site will be sought.

Policy EM1: Climate Change Adaptation and Mitigation

The council will ensure that climate change mitigation is addressed at every stage of the development process by:

1. Promoting the use of decentralised energy within large scale development whilst improving local air quality levels.
2. Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan.

Monitoring of the Policy EM1 will be through the Annual Monitoring Report with specific links to E3 (Core) Indicator, that has a target of 20% of energy needs of the building to be generated from renewable sources, for all larger applications.

2.4 Policy summary

In conclusion, compliance with a number of national, regional and local policy standards is required for the proposed domestic and non-domestic units. These are presented in Table 6 below:

Policy Level	Standard	Buildings
National Policies	National Planning Policy Framework	Commercial and Residential
	Climate Change Act	Commercial and Residential
	Building Regulations Part L1A	Residential
	Building Regulations Part L2A	Commercial
Regional Policies	London Plan – GLA	Commercial and Residential
Local Policies	Local Plan: Part 1 – Strategic Policies	Commercial and Residential

Table 6: Summary of applicable policies

3 ENERGY MODELLING – NEW BUILDINGS

The National Calculation Method (NCM) for the Energy Performance of Buildings Directive (EPBD) is defined by the Department for Communities and Local Government (DCLG) and it is the procedure for demonstrating compliance with the Building Regulations for buildings other than dwellings. Depending on the complexity of the assessment, either the Simplified Building Energy Model (SBEM) or Dynamic Simulation Methodology (DSM) can be used. Both of these tools are Government approved. In order to identify the carbon dioxide emissions, a DSM assessment was carried out. The energy demand calculated using the NCM methodology is relative to the Regulated Emissions which include the energy consumed to power space heating, domestic hot water, cooling, ventilation and internal lighting systems. The unregulated emissions (i.e. catering and computing) are calculated using benchmark figures detailed in technical publications such as CIBSE guide A.

The Standard Assessment Procedure (SAP) is the Government's recommended system for the energy rating of residential dwellings. It is a tool which enables qualified energy assessors to calculate the energy demand and the CO₂ emissions of a dwelling. The energy demand calculated using the SAP methodology is relative to the Regulated Emissions which include the energy consumed to power space heating, domestic hot water, ventilation and internal lighting systems. The unregulated emissions (i.e. cooking and appliances) are calculated using BREDEM (BRE Domestic Energy Model).

The proposed development consists of 68 new build residential units. For the purpose of this report, 21 dwelling types have been identified for the whole development: 12 for Block A and 9 for Block B as can be seen on Table 7 below. The energy and CO₂ emissions reduction have been calculated for these dwelling types and the results have been multiplied by the cumulative floor area for the particular dwelling type in question to give the related CO₂ emissions.

Units	Dwelling type	Floor Area (m ²)	Bedrooms	Number of units
Plot A1	Flat	72.31	2B3P	1
Plot A2	Flat	88.29	3B5P	1
Plot A3	Flat	60.00	1B2P	1
Plot A4	Flat	86.20	3B5P	1
Plot A5	Flat	50.37	1B2P	6
Plot A6	Flat	85.94	3B5P	6
Plot A9	Flat	70.32	2B4P	6
Plot A35	Flat	52.00	1B2P	1
Plot A36	Flat	78.68	2B4P	1
Plot A37	Flat	50.00	1B2P	7
Plot A38	Flat	73.57	2B4P	7
Plot A39	Flat	73.84	2B4P	1
Plot B1	Flat	103.49	3B5P	1
Plot B2	Flat	105.40	3B5P	1
Plot B3	Flat	95.10	3B5P	1
Plot B4	Flat	59.83	1B2P	1
Plot B25	Flat	69.76	2B4P	5
Plot B26	Flat	86.36	3B5P	5
Plot B27	Flat	50.00	1B2P	5
Plot B28	Flat	89.62	3B5P	5
Plot B29	Flat	87.88	3B5P	5
TOTAL for the development				68

Table 7: Dwelling types for SAP calculations

The proposed development consists of these 68 residential units, along with a commercial unit. The energy and CO₂ emissions reduction have been calculated for both and their results have been used within this report.

The results of the indicative calculations should not be used for any other purpose other than those for which they are intended (namely as a basis for this energy statement). Formal assessments will be required at a later stage of the development process to satisfy Building Control requirements.

The proposed energy strategy approach is based on a recognised structure of reduction in carbon dioxide emissions through:

1. Reducing the building energy consumption (Be Lean) by optimising the design and construction of the building to ensure less energy is required.
2. Supplying the energy required in an efficient manner (Be Clean).
3. Supplying the energy from Low Zero Carbon and Renewable Energy Sources (Be Green).



Figure 4: The three stages of the Energy Hierarchy

On the whole, it becomes more expensive to implement both carbon reduction and sustainability measures the further along the design process, as the opportunities available diminish. This highlights the importance of early consideration of these measures within the design process.

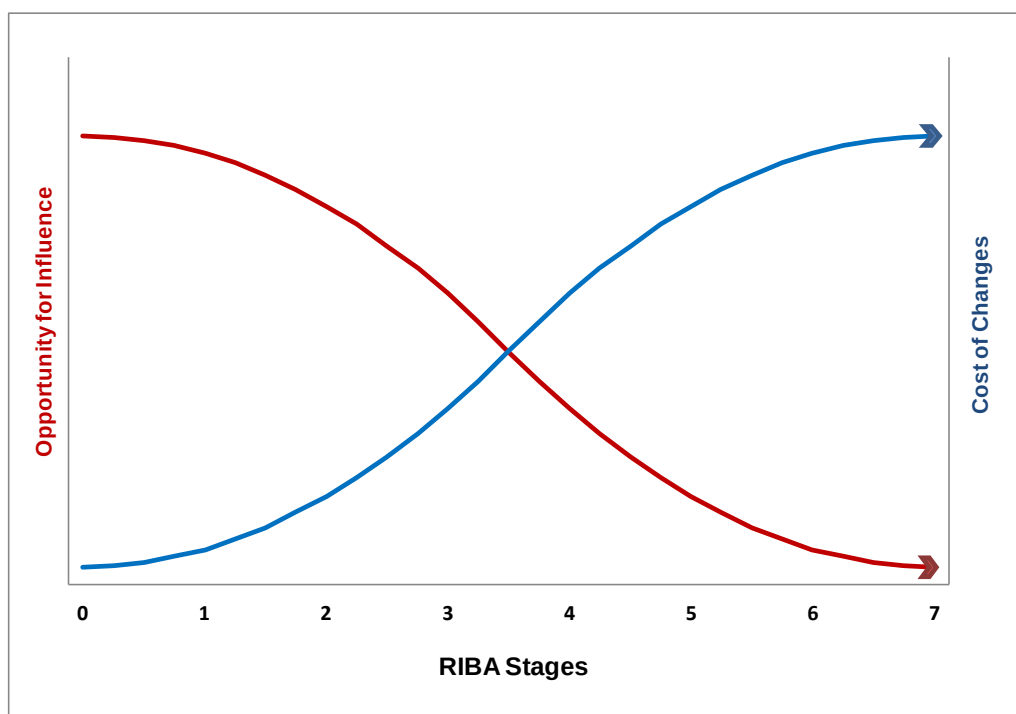


Figure 5: Opportunities to reduce CO₂ emissions and associated cost during the construction phases

A passive, well insulated envelope will last for the life of the building; with this being difficult to upgrade once building work is complete. The services installed within the building have a shorter life span and can be replaced or upgraded at a later date, when their lifetime will have expired and new more efficient services will be available. Once the most efficient building envelope and services are provided, the installation of Low and Zero Carbon technologies should be considered.

The design for this project will attain a final carbon emission rating that goes beyond the one required to comply with Part L1A and Part L2A 2013 of the Building Regulations, Domestic Building Services Compliance Guide 2013 and Non-domestic Building Services Compliance Guide 2013; in line with the requirements of the Energy Hierarchy which Hillingdon Council follows for all new developments.

4.1. Baseline scenario

In order to establish the baseline carbon dioxide emissions for the proposed development, the Government-approved software SAP2012 and IES 2017 was used to model the dwellings and the commercial unit.

The baseline scenario assumes the minimum values required to meet Building Regulation 2013 Part L1A and L2A. When determining this baseline, it is assumed that the heating would be provided by gas boilers and that any active cooling would be provided by electrically powered equipment.

The modelling undertaken identified the total CO₂ emissions across the site as 217.18 tCO₂/yr. This is broken down to 116.67tCO₂/yr from regulated emissions (covered by Building Regulations) and

100.52tnCO₂/yr from unregulated emissions (cooking and other plug-in appliances). The total baseline CO₂ emissions for the development are illustrated in Table 8 to Table 10.

Baseline CO ₂ emissions for domestic buildings	
	Total CO ₂ (Tonnes CO ₂ /year)
Heating	41.73
Auxiliary	2.65
Lighting	11.08
Domestic Hot Water	33.69
Total (regulated)	89.15
Unregulated	70.44
Total (regulated & unregulated)	159.58

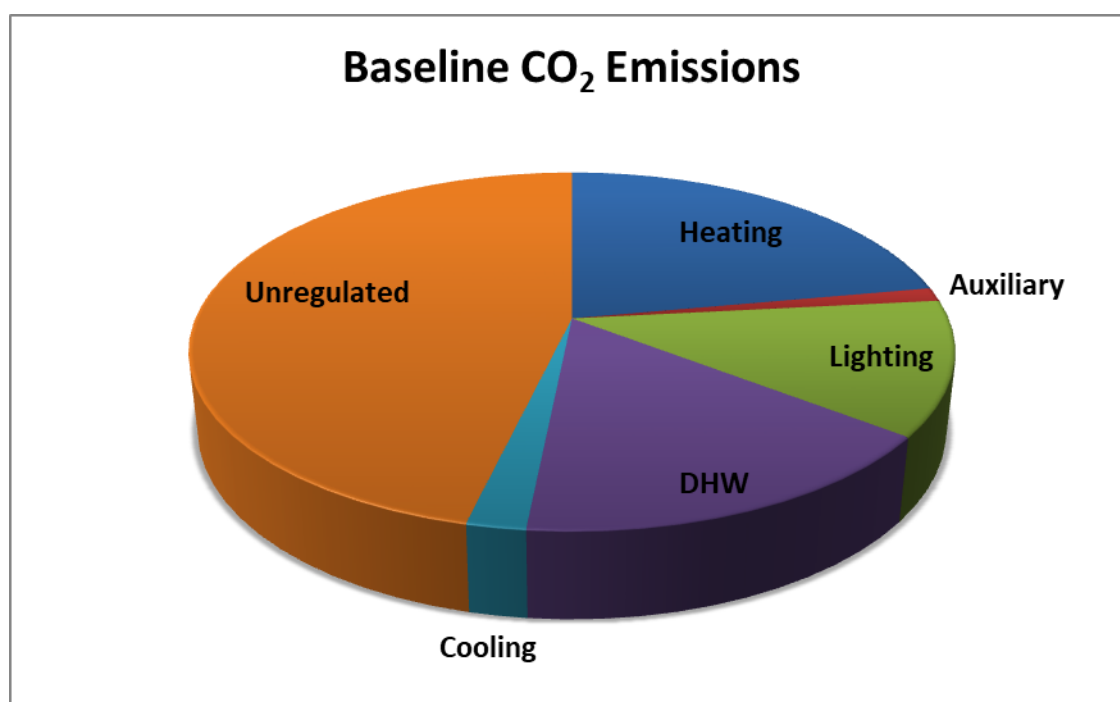
Table 8: Baseline CO₂ emissions per energy use for domestic buildings

Baseline CO ₂ emissions for non-domestic buildings	
	Total CO ₂ (Tonnes CO ₂ /year)
Heating	6.29
Lighting	15.20
Domestic Hot Water	1.40
Cooling	4.62
Total (regulated)	27.52
Unregulated	30.08
Total (regulated & unregulated)	57.60

Table 9: Baseline CO₂ emissions per energy use for non-domestic buildings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	116.67		

Table 10: Site wide regulated carbon dioxide emissions and savings

Figure 6: Baseline CO₂ emissions per energy use type

4.2. Energy Saving Measures (Lean)

Energy demand reduction within the building can be utilised to improve compliance with Part L1A and L2A 2013. This development has been reviewed to maximise both passive and active design measures to reduce the energy demand within the building.

4.2.1. Building Fabric

To reduce the CO₂ emissions of the development, it is important to minimise the heat losses through the building fabric. In order to achieve this, U-values for all building fabric elements and openings have been specified to exceed the levels required by Building Regulations. In addition, heat losses from infiltration have been minimised and a low air permeability target has been set. The details of these measures are summarised in the Table 11 below.

Element	Proposed values	Maximum values under Part L1A 2013	Maximum values under Part L2A 2013
Roof	0.12 W/m ² K	0.20 W/m ² K	0.25 W/m ² K
External wall	0.17 W/m ² K	0.30 W/m ² K	0.35 W/m ² K
Party walls (between dwellings and unheated areas)	0.17 W/m ² K	0.30 W/m ² K	N/A
Party walls (between dwellings)	0.00 W/m ² K	0.20 W/m ² K	N/A
Ground floor	0.12 W/m ² K	0.25 W/m ² K	0.25 W/m ² K
Windows	1.20 W/m ² K	2.00 W/m ² K	2.20 W/m ² K
Personnel doors	1.20 W/m ² K	2.00 W/m ² K	N/A
Thermal bridging	Default Ψ value apart from Lintels ($\Psi=0.05$ W/mK)	0.15 W/mK	N/A
Air permeability	3 m ³ /hm ² @50Pa	10 m ³ /hm ² @50Pa	10 m ³ /hm ² @50Pa

Table 11: Passive design energy saving measures

The glazing area of a building can have significant impact on heat losses, thermal comfort and daylight levels. For this project the estimated glazing percentage of the building is 35.45%. This is the total glazed area divided by the façade area.

4.2.2. Building Services

In addition to upgrading the insulation standards, it is important that the energy used within the building is efficient. Therefore the building systems have been designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance. Please note that all systems have efficiencies and controls which will meet or exceed the requirements of Part L1A, L2A 2013 and the Domestic and Non-Domestic Building Services Compliance Guides.

Space heating systems	Domestic	Non-domestic
Gas boiler - seasonal efficiency (%)	> 89.5%	> 91%
Comfort cooling systems	Domestic	Non-domestic
Split, multi-split and VRF – energy efficiency (EER)	-	> 2.6
Air distribution systems	Domestic	Non-domestic
Continuous extract and supply – SFP	< 1.5 W/l/s	< 1.9 W/l/s
Heat recovery efficiency	> 70%	> 50%
Internal lighting systems	Domestic	Non-domestic
Luminous efficacy – lumens per circuit watt	> 45 lm/W	> 60 lm/W

Table 12: Summary of minimum energy efficiency standards for building services in Part L1A and L2A 2013

Space heating within the building will be provided by an energy efficient (89.5%) communal gas boiler, with a very efficient heating control system (charging system linked to use of community programmer and at least two room thermostats) for all dwellings. Similarly an energy efficient (91%) gas boiler, with a very efficient heating control system has been assumed for commercial unit, in line with GLA Guidance for Energy Reports (2016).

Domestic hot water will also be provided from the communal gas boiler system. Each dwelling will be fitted with a cylinder varying from 125 litres for 1 bedroom dwellings to 170 litres for 2-3 bedrooms dwellings.

The air quality within a building and individual dwellings is significantly influenced by the ventilation system specified. To ensure high air quality within the building/dwelling(s), an efficient balanced ventilation system with heat recovery has been specified. The system will have a low specific fan power (0.44 W/l/s) and a heat recovery efficiency of 90% for the domestic units and 75% for the commercial unit.

Cooling within the commercial unit will be provided by an air source heat pump with a SEER of 5.0.

Electrical lighting also represents a significant energy use within a building. To maximise energy savings the installation of low energy lighting (T5, LED etc) across the development has been specified.

From the modelling undertaken, the total site wide carbon dioxide emissions, after the inclusion of improved building fabric and systems (i.e. lean measures) are estimated at 107.37tnCO₂/yr. This is

presented in Table 13, Table 13 and Table 15 below. Overall, a reduction of 9.3tnCO₂/yr is achieved compared to the baseline scenario, which equates to a saving of 7.97% over the regulated emissions.

CO ₂ emissions after energy demand reduction (Be Lean) for domestic buildings		
	Baseline Total CO ₂ (TonnesCO ₂ /year)	Be Lean Total CO ₂ (TonnesCO ₂ /year)
Heating	41.73	33.95
Auxiliary	2.65	5.76
Lighting	11.08	11.07
Domestic Hot Water	33.69	35.38
Total (regulated)	89.15	86.15
Unregulated	70.44	70.44
Total (regulated & unregulated)	159.58	156.59

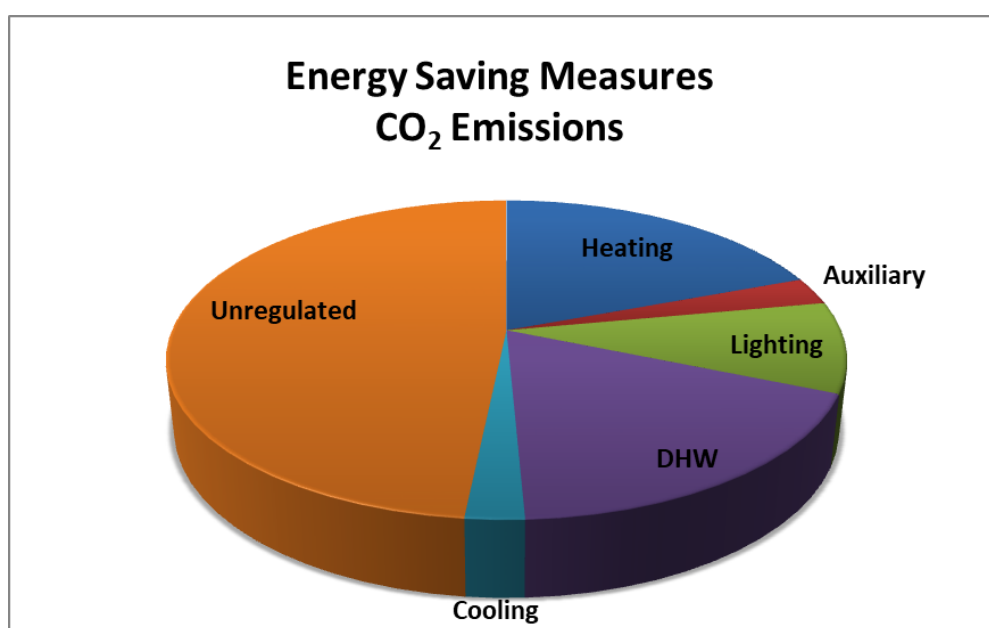
Table 13: CO₂ emissions after energy demand reduction for domestic buildings

CO ₂ emissions after energy demand reduction (Be Lean) for non-domestic buildings		
	Baseline Total CO ₂ (Tonnes CO ₂ /year)	Be Lean Total CO ₂ (Tonnes CO ₂ /year)
Heating	6.29	6.17
Lighting	15.20	8.09
Domestic Hot Water	1.40	2.02
Cooling	4.62	4.93
Total (regulated)	27.52	21.22
Unregulated	30.08	30.08
Total (regulated & unregulated)	57.60	51.29

Table 14: CO₂ emissions after heat energy demand reduction for non-domestic buildings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	116.67		
Be lean	107.37	9.30	7.97%

Table 15: Site wide regulated carbon dioxide emissions and savings

Figure 7: CO₂ emissions per energy use type after the application of the energy saving measures

4.3. Decentralised Energy – CHP (Clean)

Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The London Plan Policy 5.6: 'Decentralised Energy in Development Proposals' requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network using the London Heat Map tool. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system.

4.3.1. Heat Network

Consideration was given to the possible connection to an existing or proposed area wide decentralised energy network. The London Heat Map tool is an interactive tool, using an interactive GIS system, which allows users to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. This tool details the existing and

proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.

Following a review of the London Heat Map, it has been established that there are currently no existing district heating networks located in the vicinity that the development could link to. However, the London Heat Map does highlight that the site will be located close to a potential district heat network (Figure 8). The London Borough of Hillingdon was contacted to establish if there are any firm plans in place for the proposed district heat network. Even though no information regarding timescales, system details or operators' details were provided, any development in close proximity to the potential network should be easily adaptable to allow for connection to a wider district heat network in the future.

According to the District Heating Manual for London, the presence of a physical barrier such as the railway located on the north side of the proposed development must be considered. Therefore, this should be taking into account while assessing the viability and feasibility of a future connection at a later stage.

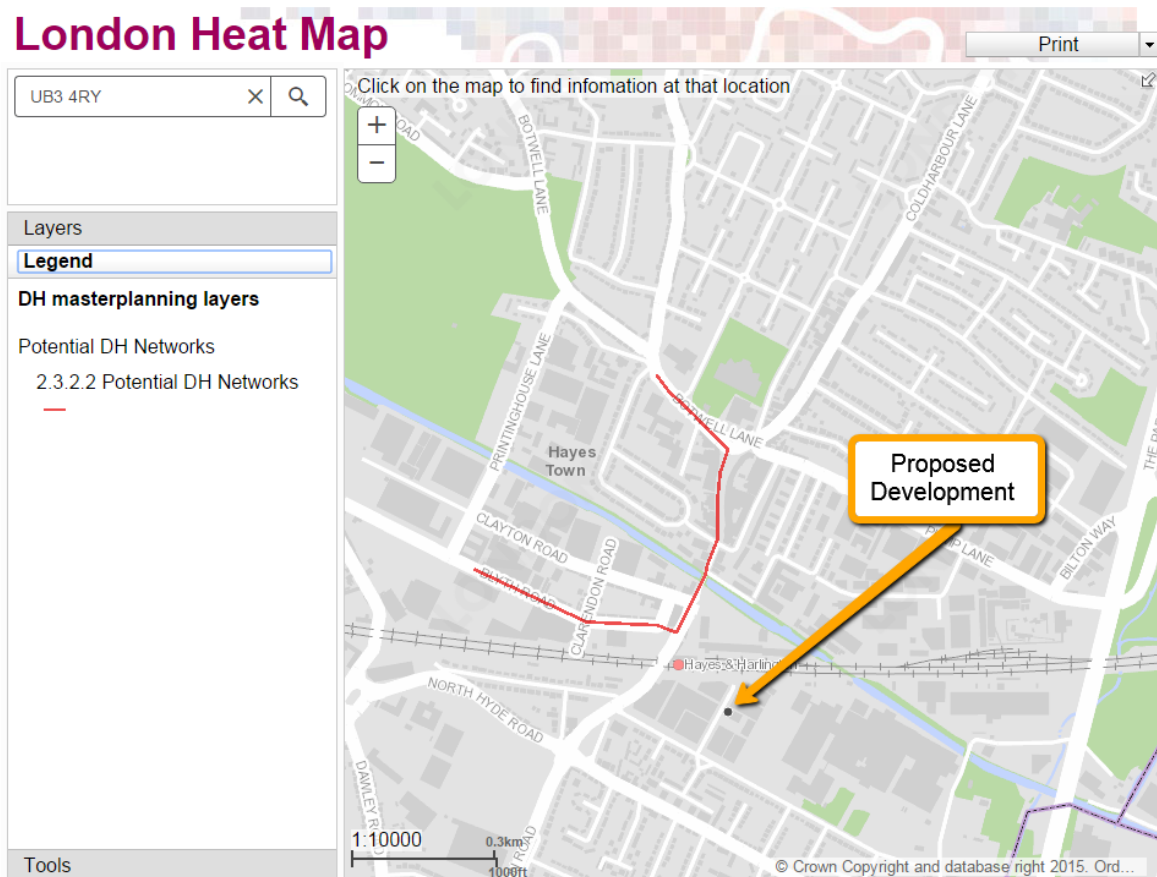


Figure 8: London Heat Map for the area

Given the current absence of any suitable systems, connection to an area wide district heating system has not been considered further as part of this energy report. However, an allowance will be made within the building services design to allow for a future connection. By ensuring the necessary

infrastructure is in place and providing a single point of connection, a site wide heat network served by a single energy centre, will help to facilitate later connection of the development to an area wide district heating network. As the development is located in an area that could be served by a district heating network in the future, a communal heating system will be adopted.

The communal plant room will be located on the ground floor of the building, on the Block B side, as shown in Figure 9 (hatched in orange). Depending on the fuel of the future potential district heating network, there might be a conflict of compatibility between the existing and future distribution systems. Further investigations will be required to study the compatibility between the future incoming district heating pipes and the currently proposed development infrastructure.

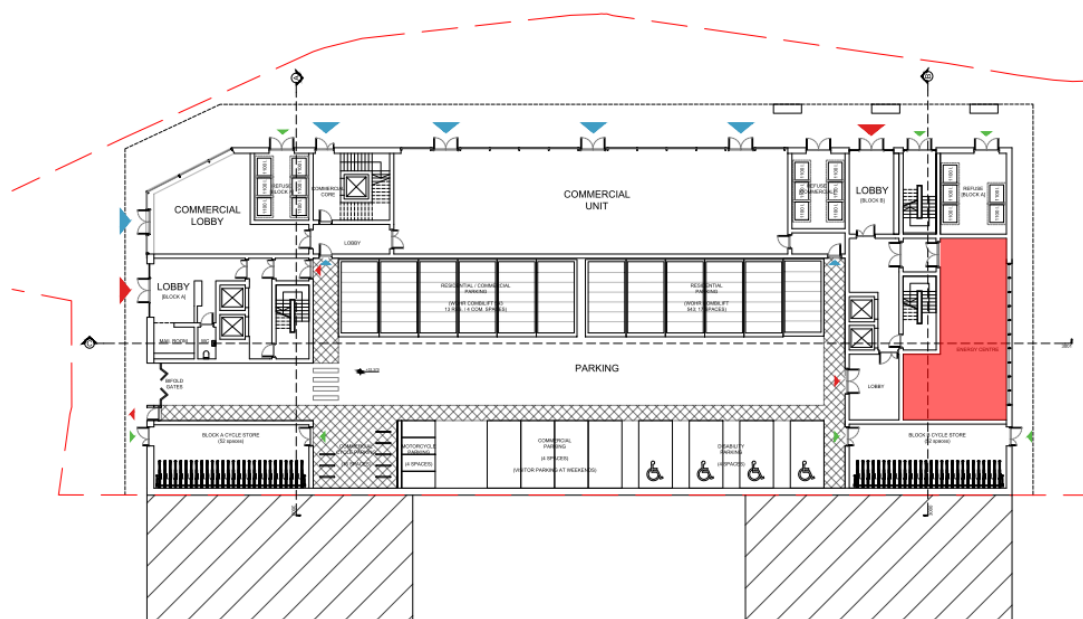


Figure 9: Marked up site plan of communal boiler system

4.3.2. Combined Heat and Power (CHP)

The installation of a Combined Heat and Power (CHP) unit for the development has also been considered. CHP units can achieve considerable savings in CO₂ emissions when installed and utilised correctly. To maximise the performance of a CHP, long operating hours are required and the heating demand of the development needs to match the power generation. According to 'GLA guidance on preparing energy assessments' residential developments with fewer than 500 dwellings and non-residential developments with simultaneous demand for heat and power of less than 5000kWh/yr are not expected to install on-site CHP. At this scale it is generally not economic to install CHP in residential led, mixed use developments (and where CHP is installed it tends to have lower electrical efficiencies). Due to the small landlord electricity demand, CHP installed to meet the base heat load would require the export of electricity to the grid. However, the administrative burden of managing CHP electricity sales at this small scale where energy service companies (ESCOs) are generally not active, and the low unit price available for small volumes of exported CHP electricity, means it is

generally uneconomic for developers to pursue. This can lead to CHP being installed but not operated.

In view of the absence of the likely energy demand required to match CHP production, the installation of a CHP system will not be considered any further for this development.

4.4. Low and Zero Carbon Technologies (Green)

This section discusses the feasibility of using low and zero carbon (LZC) technologies for the proposed scheme. The London Plan, which the London Borough of Hillingdon comes under, aspires that all major developments reduce their carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation, where feasible.

In order to address the London Plan requirement for the integration of LZC technologies on site, the installation of solar thermal panels, photovoltaics, wind turbines, biomass and heat pumps was investigated.

These technologies meet all requirements as defined by Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. In addition, their use is recommended by the London Plan and they are also listed in the Code for Sustainable Homes Technical Guide as 'Low or Zero Carbon Technologies'. Full details for these technologies can be found in Appendix A.

LZC Technology	CO ₂ savings	Capital cost	Considerations
Photovoltaic panels	Medium	Medium	Suitable roof space available, present a viable option for consideration for further analysis.
Solar thermal panels	Low	Medium	Not compatible with the communal heating system and in turn would conflict if connection is made with the potential future district heat network. Not considered for further analysis
Air source heat pumps	Medium	Medium	High efficient heating system compatible with the well-insulated and draught-proof proposed development. Future proof technology as the carbon emission factor of electricity is likely to reduce in the coming years. Further investigations will be required to analyse the compatibility with the potential future district heat network.
Ground source heat pumps	Medium	High	Not enough land available for the pipes. Not considered for further analysis.
Wind turbines	Low	High	Not appropriate in highly dense urban environment. Not considered for further analysis.
Biomass	High	High	Within London a significant majority of biomass systems do not comply with air quality legislation. Not considered for further analysis.

Table 16: Summary of LZC technologies

After taking into consideration a number of different factors, including local authority requirements, land use, potential noise impacts and available space within the development, it was concluded that the best strategy for this development is the installation of 26.2kWp (in total) of photovoltaic panels.

Photovoltaics (PV) panels are an established form of renewable technology which converts solar energy into electricity. The electricity is fed into an inverter which converts it from a direct current supply to an alternating current supply, which can then be used to supply the demands within the development.

PV panels need to be located on the roof of each Block, at 30°, facing south. The commercial unit will be fed by a 2.94kWp system while the residential units will benefit from the installation of 23.3kWp photovoltaic panels. A PV system of this power would require 130.5m² of panel area and in turn, to allow for access, prevention of self-shading and spacing requirements, would require a designated roof area of 209m². As can be seen in Figure 10, the PV area has been hatched in magenta on both blocks.

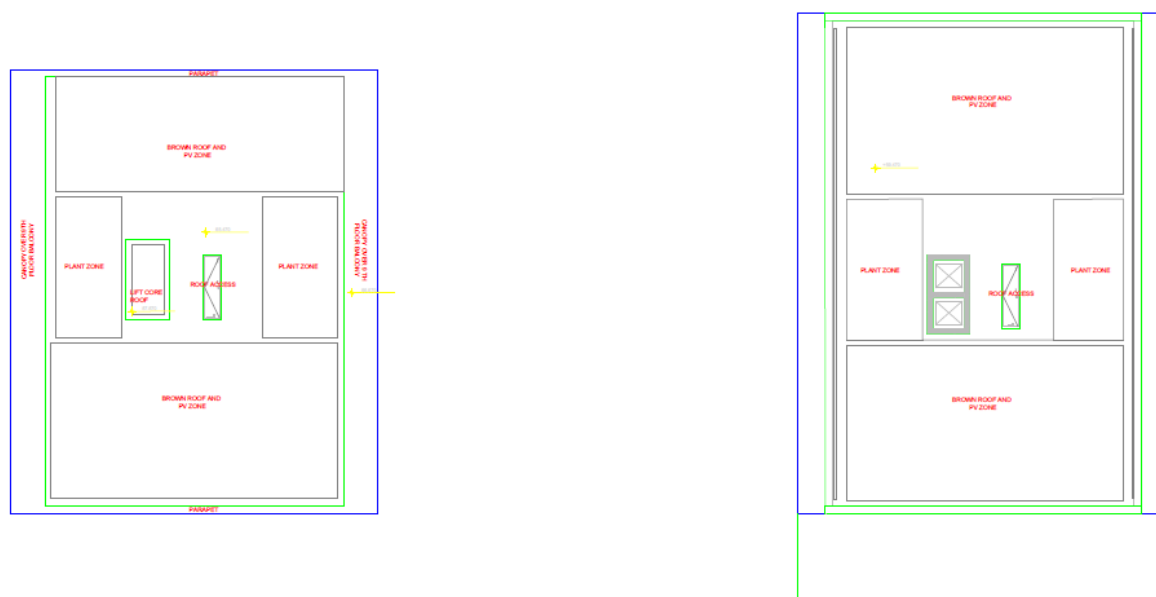


Figure 10: Proposed roof plan showing allocated space for the PV system (left: Block A, right: Block B)

The 26.2kWp PV system will generate electricity in the region of 22,267.78kWh/yr. This is based upon the SAP and IES outputs when the PV panels are mounted south facing at 30° with minimal shading. This output could be achieved by installing 80PV panels, with an output of 327W each and an efficiency of 20.1%. Generating this amount of electricity through the PV system will displace the grid electricity that would have otherwise been used. It is anticipated that the use of this technology would result in a CO₂ saving of 11.55tn/yr.

In addition, it was concluded that the flats and the commercial unit will also be provided with air source heat pumps to provide space heating and domestic hot water for the flats only. Flats will be fed by a community scheme while the commercial unit will have an individual system. A heat pump is a machine that moves heat from one location (at a lower temperature) to another location (at a higher temperature), using mechanical work or high-temperature heat source. The main advantage of a heat pump over a conventional heating system is that very high efficiencies can be achieved; typically up to around 4 times higher than a modern gas boiler. In addition, heat pumps can also meet cooling demand of buildings and in this case, will provide cooling to the commercial unit.

Upon consideration of the LZC technologies, the modelling identified that a further reduction of 34.79 tnCO₂/yr has been achieved for the regulated emissions. The total CO₂ emissions for the development after the incorporation of the LZC technologies are illustrated in Table 17. This equates to a 29.82% reduction in CO₂ over regulated emissions compared to the clean measures (be clean) scenario (Table 19). The overall carbon dioxide savings compared to the baseline emissions are also presented in Table 19.

CO ₂ emissions after LZC Technologies (Be Green) for domestic buildings				
	Baseline Total CO ₂ (TonnesCO ₂ /year)	Be Lean Total CO ₂ (TonnesCO ₂ /year)	Be Clean Total CO ₂ (TonnesCO ₂ /year)	Be Green Total CO ₂ (TonnesCO ₂ /year)
Heating	41.73	33.95	33.95	24.36
Auxiliary	2.65	5.76	5.76	5.76
Lighting	11.08	11.07	11.07	11.07
Domestic Hot Water	33.69	35.38	35.38	25.27
Renewable Energy	0.00	0.00	0.00	-10.44
Total (regulated)	89.15	86.15	86.15	56.02
Unregulated	70.44	70.44	70.44	70.44
Total (regulated & unregulated)	159.58	156.59	156.59	126.45

Table 17: CO₂ emissions after LZC for domestic buildings

CO ₂ emissions after LZC Technologies (Be Green) for non-domestic buildings				
	Baseline Total CO ₂ (TonnesCO ₂ /year)	Be Lean Total CO ₂ (TonnesCO ₂ /year)	Be Clean Total CO ₂ (TonnesCO ₂ /year)	Be Green Total CO ₂ (TonnesCO ₂ /year)
Heating	6.29	6.17	6.17	2.63
	0.00	0.00	0.00	0.00
Lighting	15.20	8.09	8.09	8.09
Domestic Hot Water	1.40	2.02	2.02	2.02
Cooling	4.62	4.93	4.93	4.93
Renewable Energy	0.00	0.00	0.00	-1.11
Total (regulated)	27.52	21.22	21.22	16.56
Unregulated	30.08	30.08	30.08	30.08
Total (regulated & unregulated)	57.60	51.29	51.29	46.64

Table 18: CO₂ emissions after LZC for non-domestic buildings

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	116.67		
Be lean	107.37	9.30	7.97%
Be clean	107.37	0.00	0.00%
Be green	72.58	34.79	29.82%
Overall Savings		44.09	37.79%

Table 19: Site wide regulated carbon dioxide emissions and savings

4 COOLING AND OVERHEATING

The section below details how the different measures implemented have followed the London Plan cooling hierarchy developed in Policy 5.9: 'Overheating and Cooling' and the requirements detailed in the London Legacy Development Corporation Local Plan Policy S.7: 'Overheating and Greening'.

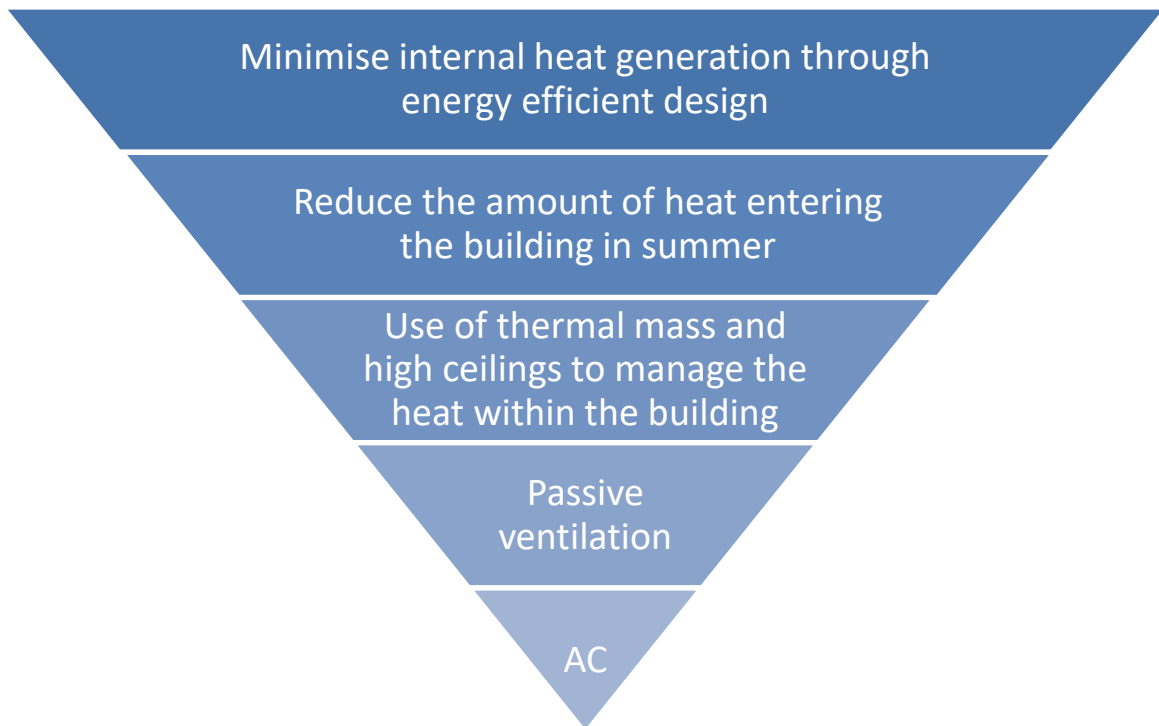


Figure 11: Cooling hierarchy

New development proposals should demonstrate how the design, materials, construction and operation of the development would minimise overheating and also meet its cooling needs. Therefore, all new developments should also be designed to avoid the need for energy intensive air conditioning systems as much as possible. Taking this into account the following measures have been implemented into design:

Passive Design.

- Use materials with high surface reflectivity to the sun's radiation.
- No windows present on the south elevation.
- Use carefully designed shading measures, including balconies and shading panels
- Heat transfer and infiltration is controlled by maximising insulation levels with low U-values to prevent the penetration of heat as much as practically possible.
- Use low windows with low solar energy transmittance (g-value), to reduce the amount of solar energy passing through the glazing area.

- Minimise internal heat gains by using low energy equipment, including energy efficient lighting.
- Use well insulated space and hot water systems and pipework.
- Encourage the occupants to use energy efficient appliances.

Passive ventilation

- Design the building and its internal layout to enable passive ventilation, including openable windows, a shallow floor plan, high floor to ceiling heights, and a double façade where possible.

Mechanical ventilation

- High efficiency Mechanical Ventilation with Heat Recovery (MVHR) will be provided for the whole of the building.
- Extract fans in the kitchen areas and toilets.

Active cooling systems (ensuring they are the lowest carbon options)

- High efficiency cooling system used (SEER: 5) for the commercial unit.

In order to identify at an early stage whether there is likely to be an overheating risk, a desktop analysis was carried for the proposed development. The results are presented in the Overheating Checklist in Appendix B of this report.

Overheating is not fully assessed by carbon dioxide emission models; therefore it is encouraged to undertake dynamic thermal modelling to ensure that a development does not overheat. Where dynamic modelling is carried out, it should be undertaken in accordance with the guidance and data sets in CIBSE Guide TM59 'Design Methodology for the Assessment of Overheating Risk in Homes' and Guide TM49 'Design Summer Years for London'. In addition, CIBSE Guide TM52 'The Limits of Thermal Comfort: Avoiding Overheating in European Buildings', is the recognised standard on predicting overheating in buildings.

A detailed overheating assessment was carried out by RPS and it is part of this planning application. The results are presented in HLEU59723-002R_Viveash Close_Overheating Report.

5.1. Active Cooling

Due to the nature of the proposed development in order to guarantee the occupant's comfort, air conditioning for the commercial unit has been specified. The cooling requirements of the different elements of the development have been identified. In accordance with the 'GLA guidance for preparing energy assessments', the aim is to reduce the actual cooling demand below that of the

notional for each of the non-domestic spaces in the development where an active cooling load exists. The cooling load of both the actual and notional commercial unit is presented in Table 20.

	Area weighted average building cooling demand (MJ/m ²)
Actual	94.6
Notional	89.9

Table 20: Area weighted average building cooling demand for the commercial unit

It needs to be noted that these results are based on an open, shell and core unit. It is expected when partitioning and full fit-out is carried out the cooling requirements of the actual building to be reduced below the notional level.

5 ENERGY REDUCTION ANALYSIS

The Hillingdon Council follows the principles of the London Plan for the sustainable design and construction of all major developments within its boundary.

The following specifications for this development have been assumed:

Feature	Description	Technical Values
External walls		0.17 W/m ² K
Party walls (flats and unheated areas)		0.17 W/m ² K
Party walls (between dwellings)	Fully filled cavity with sealed edges	0.00 W/m ² K
Ground and upper floors		0.12 W/m ² K
Roofs		0.12 W/m ² K
Windows		1.20 W/m ² K
Doors		1.20 W/m ² K
Air permeability		3 m ³ /m ² h @50Pa
Thermal bridging	Default Ψ value everywhere apart from lintels ($\Psi=0.05$ W/mK)	
Ventilation	MVHR	Heat exchanger efficiency $\eta=75\%$ (commercial)/90% (domestic)
Heating System	Communal ASHP (Residential) ASHP (Commercial)	SCOP= 3.0 (Residential) SCOP=5.0 (Commercial)
Hot Water System	From the main heating system	Water cylinder in all flats
Cooling	Air Source Heat Pump (Commercial)	SEER = 5.0
Lighting	100% low energy lights	
LZC Technologies	Monocrystalline PV panels	26.2kWp on about 130.5m ²

Table 21: Performance specifications for building fabric and services

Policy 5.2 and 5.7 of the London Plan require zero carbon residential developments and a 35% improvement over 2013 Part L Building Regulations for commercial developments, following the

energy hierarchy (be lean, be clean, be green) and there is a presumption that all major development proposals will seek to reduce carbon dioxide emissions by at least 20% through on-site renewable energy generation, where feasible.

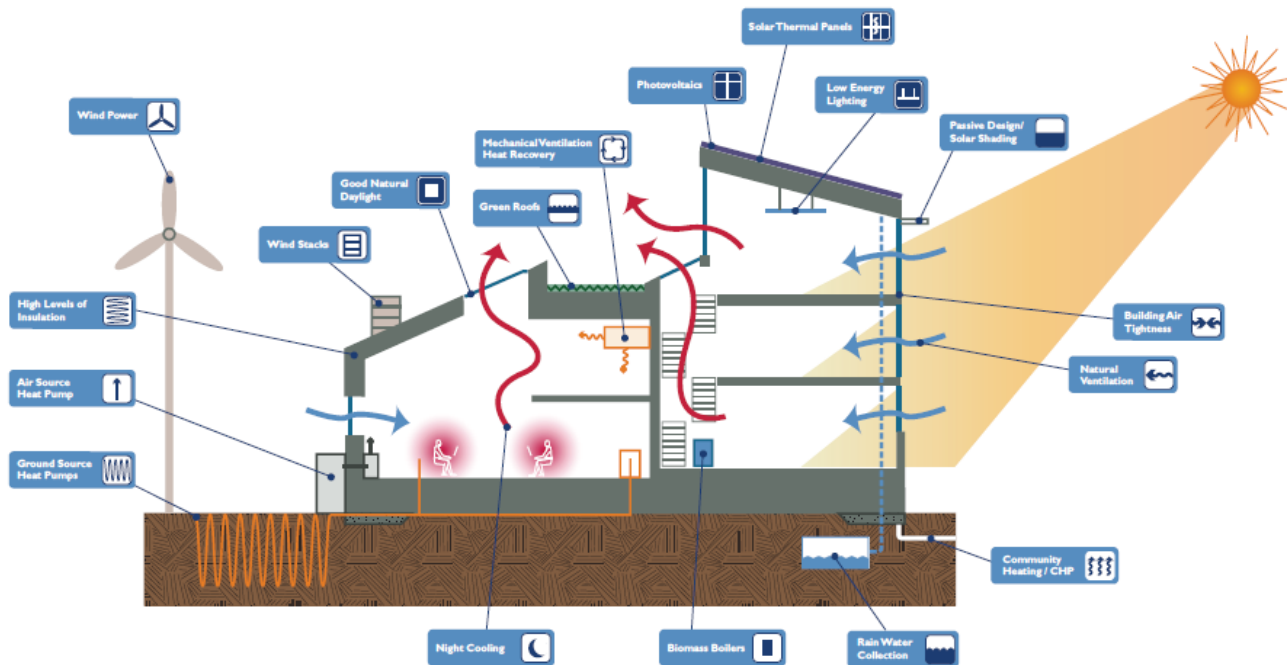


Figure 12: Energy saving measures and technologies

This energy strategy has been produced in line with the energy hierarchy. Carbon dioxide emission savings have been achieved through the following step process. The specified 'Be Lean' measures include improved building fabric and high specification systems. Moreover, 'Be Clean' measures on site include the installation of a CHP on site or connection to a decentralised energy system. As explained in Section 3.3, the use of decentralised energy or CHP was deemed not to be appropriate for this project. The remaining carbon dioxide savings have been achieved through the inclusion of renewable energy technologies 'Be Green'.

In order to achieve compliance with Part L1A 2013, the actual Dwelling Emissions Rating (DER) for every dwelling, must be less than the Target Emissions Rating (TER). Finally according to London Plan, the percentage of improvement of DER over TER must be at least 35%, across the entire development. All these are presented in Table 22 below.

Dwelling	Part L Target emissions (kgCO ₂ /m ² yr)	GLA 35% Target emissions (kgCO ₂ /m ² yr)	Dwelling emissions (kgCO ₂ /m ² yr)
Plot A1	17.54	11.40	11.02
Plot A2	15.99	10.39	10.61
Plot A3	16.37	10.64	9.78
Plot A4	16.28	10.58	10.43
Plot A5	18.83	12.24	11.33
Plot A6	15.6	10.14	9.95
Plot A9	17.17	11.16	10.56
Plot A35	22.79	14.81	14.59
Plot A36	20.22	13.14	13.73
Plot A37	20.14	13.09	12.46
Plot A38	18.16	11.80	11.70
Plot A39	20.66	13.43	13.50
Plot B1	16.44	10.69	10.28
Plot B2	14.59	9.48	9.04
Plot B3	13.59	8.83	8.12
Plot B4	17.97	11.68	9.68
Plot B25	19.83	12.89	12.38
Plot B26	20.33	13.21	13.49
Plot B27	19.92	12.95	11.39
Plot B28	17.07	11.10	10.79
Plot B29	19.28	12.53	12.22

Table 22 : SAP results

The reduction in total carbon dioxide emissions and savings at each stage of the Energy Hierarchy process is provided in Table 23. The table presents the site wide regulated CO₂ emissions.

Site Total

	Total regulated emissions (Tonnes CO ₂ /year)	CO ₂ Savings (Tonnes CO ₂ /year)	Percentage saving (%)
Part L 2013 baseline	116.67		
Be lean	107.37	9.30	7.97%
Be clean	107.37	0.00	0.00%
Be green	72.58	34.79	29.82%
		CO ₂ savings off-set (Tonnes CO ₂)	
Off-set		1,680.53	

Table 23: Site wide regulated carbon dioxide emissions and savings

As shown in Table 23, a 100% carbon dioxide saving cannot be achieved on site for the domestic buildings. In order to meet 'Zero Carbon' onsite 56.02tnCO₂/yr must be offset, according to GLA Guidance. By multiplying the annual remaining carbon emissions with the assumed lifetime of the development's services (30 years) the cumulative shortfall has been calculated as 1,680.53tnCO₂/yr. Finally, the required cash-in-lieu contribution is £100,831 based on the carbon dioxide offset price of £60/tonne set by Hillingdon Council.

6 CONCLUSIONS

In conclusion, based on the measures outlined in the report, the development achieves both its sustainability and energy targets. The proposed strategy includes high insulation standards, very efficient building services, communal air source heat pumps for the flats, air source heat pumps (heating and cooling, to the commercial unit) and a total 130.5m² of photovoltaics spread across the roof of the two Blocks. It has been confirmed that a **37.79%** improvement on 2013 Building Regulations will be achieved and **29.82%** of the total CO₂ emissions reduction of this development will be achieved by the incorporation of a low or zero carbon technology onsite.

The modelling undertaken shows that Building Regulations 2013, London Plan 2015 and local authority planning requirements have been met with respect to energy and CO₂ reduction. This can be seen in Figure 13 and Figure 14.

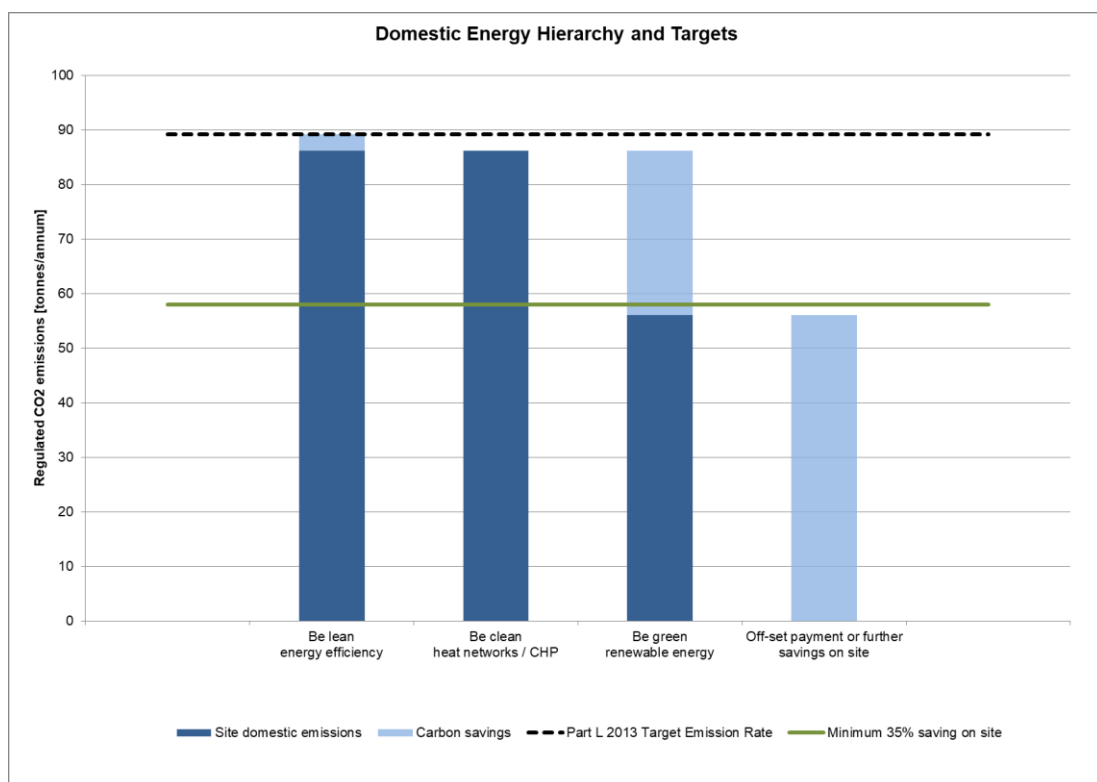


Figure 13: Step reduction in regulated CO₂ emissions for domestic buildings

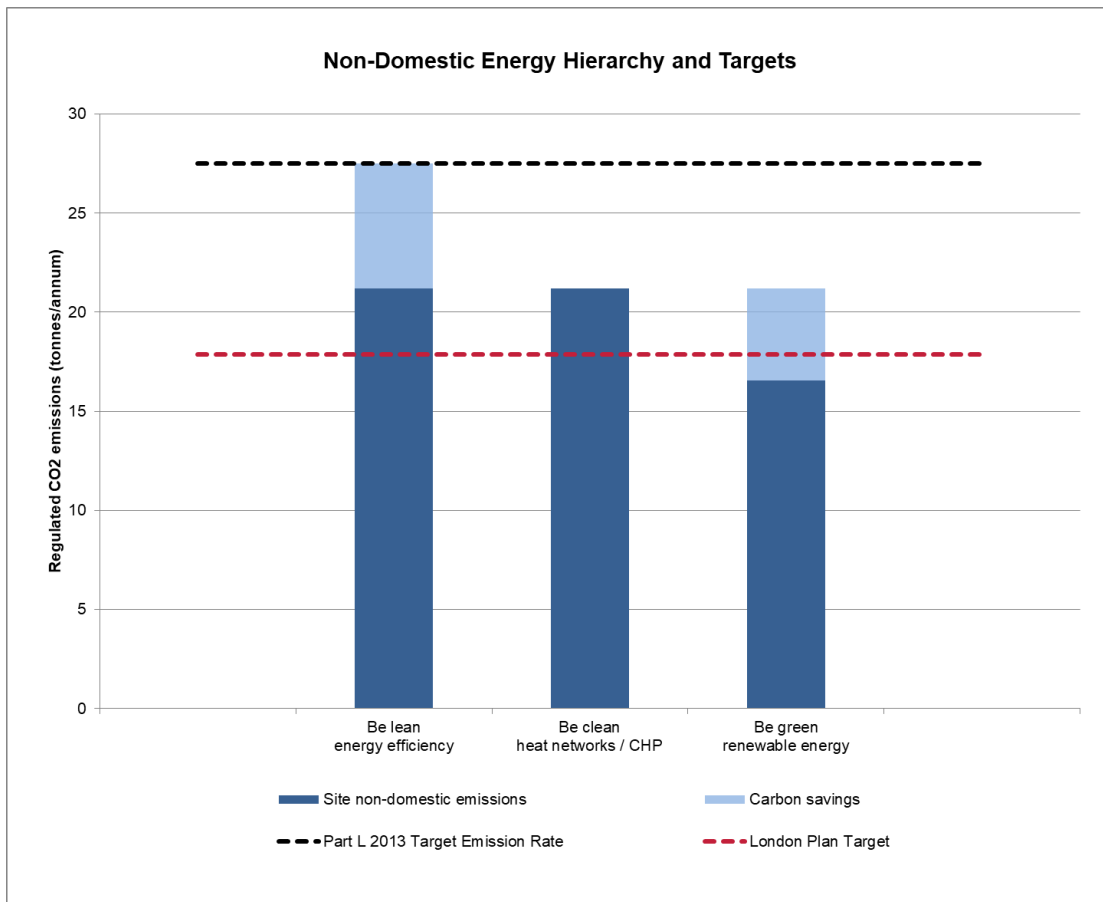


Figure 14: Step reduction in regulated CO₂ emissions for non-domestic buildings

APPENDIX A

Analysis of Low and Zero Carbon Technologies

Solar Thermal

Solar thermal generates energy for the provision of domestic hot water; this system typically works in tandem with a conventional boiler in the event that the hot water demand cannot be solely met by the renewable technology. The two types of solar thermal technology suitable for inclusion are flat plate collectors and evacuated tubes; with the latter typically being more efficient. The panels are most efficient when they face south at 30°.



Figure A1: Flat plate and Evacuated tubes Solar Panels

Solar thermal is mostly suited to houses. Providing solar panels and associated pipework to each flat within the main block would not be a practical approach. For non-residential buildings, they should only be considered for buildings with high hot water demand, like hotels and gyms.

Photovoltaic panels

The word photovoltaic is a marriage of the words 'photo', which means light in Greek, and 'voltaic', which refers to the production of electricity. Photovoltaic technology is similar to Solar Water Heating (SWH) but it generates electricity and not heat from light.

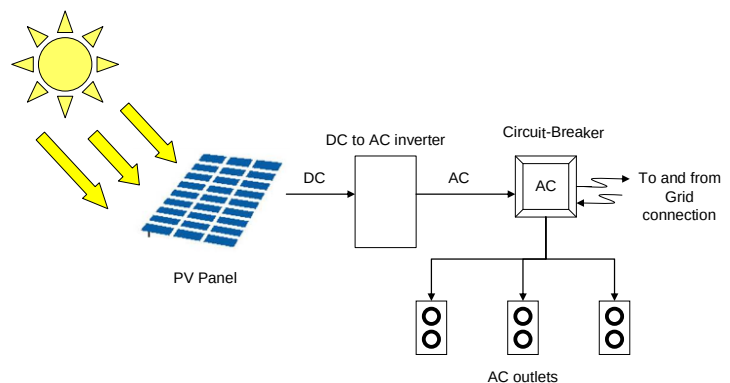


Figure A2: Photovoltaic panels

The photovoltaic panel converts free solar energy directly into electricity. The electricity produced is on direct current (DC). Therefore inverters are used to convert the output into alternating current (AC) for connection to the building's supply board. The electricity generated can either be used to supply communal (landlord) areas or for individual dwellings, the latter configuration tending to be more complex and costly owing to the need for multiple meters.

The panels are most efficient when they face south at 30°. Photovoltaic panels should not be considered in cases with significant overshadow (i.e. next to taller buildings)

Biomass

Biomass is a term used to describe all plant and animal material. A range of biomass material can be burnt to generate energy including wood, straw, poultry litter and energy crops such as willow or poplar. Biomass material is considered carbon neutral if the fuel comes from a sustainably managed source.



Figure A3: Biomass boiler

The primary disadvantage for any biomass installation is that it requires large amounts of fuel storage (which will need to be fed by deliveries of biomass fuel). Developments that use biomass need to secure constant delivery of wood chips or wood pellets, from a local supplier. Finally biomass requires a suitable flue design to address air quality issues.

Wind Turbines

Wind technology is now a well established technology for the generation of electricity in large scale projects. Small scale wind projects within built up areas however is less common.



Figure A4: Wind turbine

The lower uptake of wind turbines in urban settings is due to the reduced efficiency of smaller scale turbines as a result of the high surface roughness reducing wind speeds. According to the Department of Energy and Climate Change Windspeed Database, the average wind speed at 10 m agl (above ground level) is 5.1 m/s in the vicinity of the site. At 25 m agl the average speed is 5.8 m/s. These speeds are towards the lower end of what would be considered economical for a turbine. Furthermore, it is likely that the surrounding buildings will create turbulence and locally reduce near surface wind speeds thus further reducing the potential of good wind speeds. In addition wind turbines integrated on buildings might cause other problems, like vibrations. Wind turbines are therefore not considered a viable renewable technology for the development given the setting within a built up area and lack of consistent adequate winds.

Heat Pumps

A heat pump is a machine that moves heat from one location (the 'source') at a lower temperature to another location (the 'sink' or 'heat sink') at a higher temperature using mechanical work or a high-temperature heat source. There are two main categories of heat pumps, the Ground Source Heat Pump (GSHP) and the Air Source Heat Pump (ASHP). They operate very similarly; the difference is on the source of the heat.

Several options are possible for a GSHP, depending on local geology and hydrology. Various types of ground source heat pump arrangements are available including: vertical boreholes, horizontal coils and slinky coils, e.g. around perimeter of building.

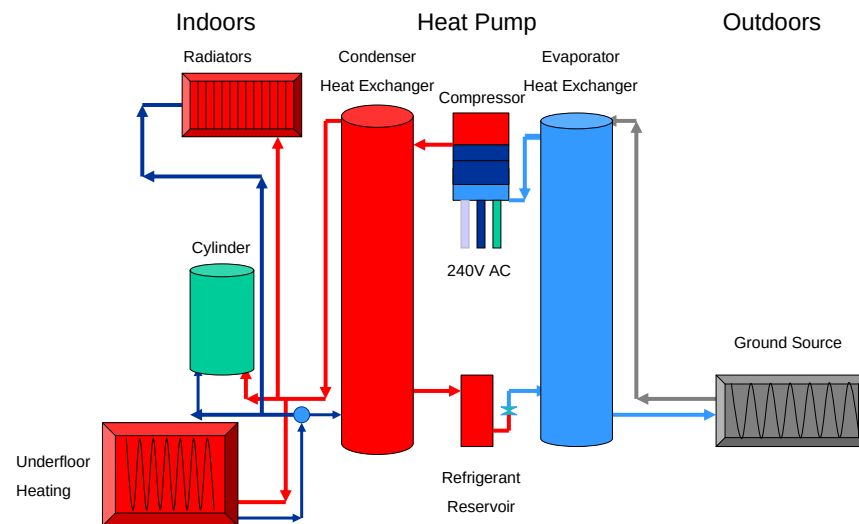


Figure A6: Typical GSHP diagram

The ASHP is an alternative system of the GSHP but they operate with the same physics. Their only difference is that the ASHP uses the ambient outdoor air to provide the low grade source heat instead of the ground. Owing to the greater seasonal variation in air temperatures, air-source heat pumps are unable to provide year-round heating requirements alone; hence they operate less efficiently, the running costs are higher and CO₂ savings lower than for a ground source heat pump.

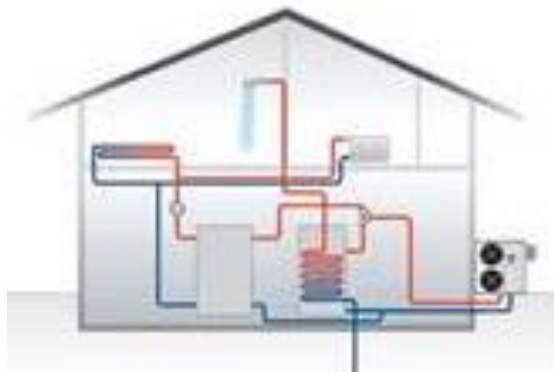


Figure A7: ASHP

The main advantage of a heat pump over a conventional heating system is that very high efficiencies can be achieved; typically up to around 350% compared to 90% for a modern gas boiler. However, they use electricity as a fuel and the CO₂ emissions that are emitted for each kWh burnt for electricity, are more than double for the same kWh produced by gas.

	LZC Technologies					
	SWH Panels	PV Panels	Wind	Biomass	GSHP	ASHP
Lifespan	20	25	20	20	25	20
CO₂ savings	Low	Medium	Low	High	Medium	Medium
Grants	RHI	FiT	FiT	RHI	RHI	RHI
Cost	Medium	Medium	High	High	High	Medium
Export	Y	Y	Y	NA	NA	NA
Space	Y	Y	N	Y	N	Y
Noise	NA	NA	Low-medium	Medium (deliveries)	Low	Low
Air Quality	NA	NA	NA	High NOx emissions	NA	NA
Appropriate	N	Y	N	N	N	Y

Table A1: LZC Technologies Matrix

APPENDIX B

Overheating Checklist

Design features implemented to mitigate overheating risk		Response
Landscaping	Will deciduous trees be provided for summer shading (to windows and pedestrian routes)?	Yes, all trees proposed will be deciduous
	Will green roofs be provided?	Brown roofs will be provided in on the Roof PV Area Raised planters to podium & playspace including various groundcover, shrub and tree species Areas of lawn to podium
	Will other green or blue infrastructure be provided around buildings for evaporative cooling?	No
Materials	Have high albedo (light colour) materials been specified?	Light coloured materials are being used for the external walls and balcony finishes
Dwelling aspect	% of total units that are single aspect	82%
	% single aspect with N / NE / NW orientation	0%
	% single aspect with E orientation	40.9%
	% single aspect with S / SE / SW orientation	0.0%
	% single aspect with W orientation	40.9%
Glazing ratio - What is the glazing ratio (glazing; internal floor area) on each facade?	N / NE / NW	1.84%
	E	19.08%
	S / SE / SW	0%
	W	19.65%
Daylighting	What is the average daylight factor range?	-
Window opening	Are windows openable?	Yes. north façade only bedroom windows are operable
Window opening	What is the average percentage of openable area for the windows?	50.00%
Window opening - What is the extent of the opening?	Fully openable	Yes. East and west
	Limited (e.g. for security, safety, wind loading reasons)	North bedroom windows only

Security	Where there are security issues (e.g. ground floor flats) has an alternative night time natural ventilation method been provided (e.g. ventilation grates)?	-
Shading	Is there any external shading?	Full width balconies provide external shading for the units
	Is there any internal shading?	No
Glazing specification	Is there any solar control glazing?	No
Ventilation - What is the ventilation strategy?	Natural – background	
	Natural – purged	Yes, provided by openable windows to all habitable rooms
	Mechanical – background (e.g. MVHR)	Yes
	Mechanical – purge	
	What is the average design air change rate	
Heating system	Is communal heating present?	Yes
	What is the flow/return temperature?	
	Have horizontal pipe runs been minimised?	Yes
	Do the specifications include insulation levels in line with the London Heat Network Manual	

APPENDIX C

General Notes

RPS CONSULTING SERVICES

Sustainability and Energy Assessments

General Notes

General

1. The report is based on information available at the time of the writing and discussions with the client during project meetings. Where any data supplied by the client or from other sources have been used it has been assumed that the information is correct. No responsibility can be accepted by RPS for inaccuracies in the data supplied by any other party.
2. The review of local and regional policy does not constitute a detailed review. It is simply used as a guide to provide the context for the development and to determine the likely requirements of the Local Authority.
3. No site visits have been carried out as any part thereof, unless otherwise specified.
4. This report is prepared and written in the context of an agreed scope of work and should not be used in a different context. Furthermore, new information, improved practices and changes in guidance may necessitate a re-interpretation of the report in whole or in part after its original submission.
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7. These terms apply in addition to the RPS Group "Standard Terms of Business" (or in addition to another written contract which may be in place instead thereof) unless specifically agreed in writing. (In the event of a conflict between these terms and the said Standard Terms of Business the said Standard Terms of Business shall prevail.) In the absence of such a written contract the Standard Terms of Business will apply.

Energy Feasibility Studies

8. Energy Feasibility Studies are intended as a guide as to potential technologies considered feasible for the proposed scheme. The Studies should not be used in place of other energy assessments typically required during the design process (e.g. SAP / SBEM, Part L compliance, M&E Design etc).
9. Energy Feasibility Studies are typically undertaken at an early stage of the design process and therefore make a number of assumptions about the ultimate design. All assumptions are agreed with the client prior to their inclusion. Should any of the assumptions ultimately prove false, the client should be aware that this may have implications with regards to the inclusion of the technology.
10. Consideration is given to a range of zero and low carbon technology solutions. Whilst due care has been taken to ensure that the information is accurate, it should be noted that there may be some discrepancy between actual performance and predicted performance on the basis that environmental factors play a significant role in affecting performance.
11. Energy demand is calculated on the basis of best available information at the time of writing the report.
12. System sizes are indicative and based upon manufacturer information and appropriate guidance values. CO₂ emissions are based upon published benchmarks and guidance documents.