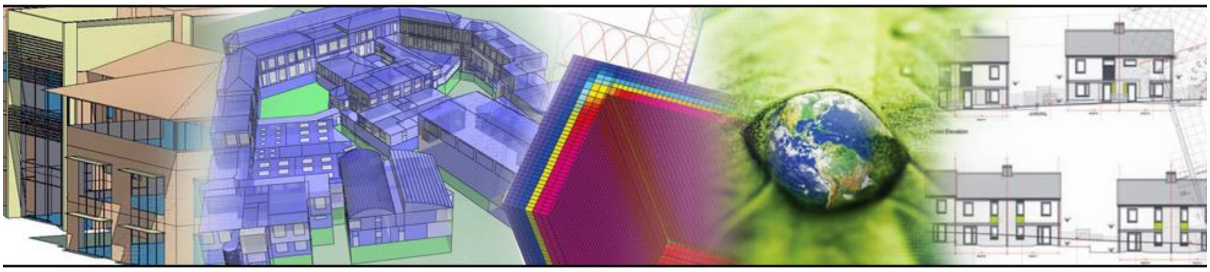

Energy Statement

Harefield Grove

Stroma Reference: 091486
Date: 01/09/2023
Prepared for: Comer Homes

1. Executive Summary

This Energy Statement has been produced by Stroma Built Environment to accompany the planning application for the development at Harefield Grove.

In accordance with requirements of the London Borough of Hillingdon, this development is required to achieve 35% CO_2 savings against a 2013 Part L1a compliant baseline. The remaining regulated carbon dioxide emissions to 100% is to be offset through a cash in lieu contribution.

This statement addresses the following requirements:

- Calculation of the baseline CO_2 emissions for the development
- Details of the performance of the building
- Details predicted annual CO_2 savings against the Mayor's Energy Hierarchy: Lean, Clean, Green
- Provides calculations of the Carbon Offset payment

This report outlines the proposed preliminary specification for the development and the resulting savings implemented at each stage of the energy hierarchy in accordance with the New London Plan 2021.

The opportunity for on-site heat networks has been evaluated and found to be not technically viable.

Additional energy and CO_2 savings will then be achieved through the use of a photovoltaic array which fills the available roof space of the new build blocks.

The measures implemented at the Be Green stage produce a CO_2 reduction of 65% against the baseline using the SAP10 carbon factors. This exceeds the minimum required 35%.
The remaining emissions shall be offset via a £32,497 contribution to The London Borough of Hillingdon carbon offset fund in order to contribute to sustainable improvements elsewhere in the Borough.

Calculations of the emissions savings achieved within the refurbishment of the main house have been included. Due to the scope of renovation and refurbishment proposed, and the listed nature of the building, the baseline emissions have been calculated using the notional specification for existing buildings from the GLA Energy Assessment Guidance June 2022.

The required tables and graphs can be seen on the next page and in the appended 'GLA Carbon Emissions Reporting Spreadsheet', where regulatory SAP10 carbon factors have been used for the purposed of this report throughout.

At post construction stage the in-use energy performance will be monitored, verified and reported through the Mayors post construction monitoring platform as required by the 'Be Seen' guidance

Results show that CO_2 targets can be achieved through a combination of high-performance building fabric, exhaust air Heat Pumps and the inclusion of a Solar Photovoltaic array.

1.1. Results Summary

Scenario	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline	32.6	11.76
Be Lean	221.0	11.76
Be Clean	221.0	11.76
Be Green	83.7	11.76

Table 1. Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings

Scenario	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from 'Be Lean'	1.4	4%
Savings from 'Be Clean'	0.0	0%
Savings from 'Be Green'	19.8	61%
Cumulative on-site savings	21.2	65%
Remaining emissions to offset	11.4	-
	Tonnes (Co_2)	
Cumulative savings for offset payment (for 30 years)	342	-
Cash in-lieu contribution*	£32,497	-

**Carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide*

Table 2. Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for domestic buildings

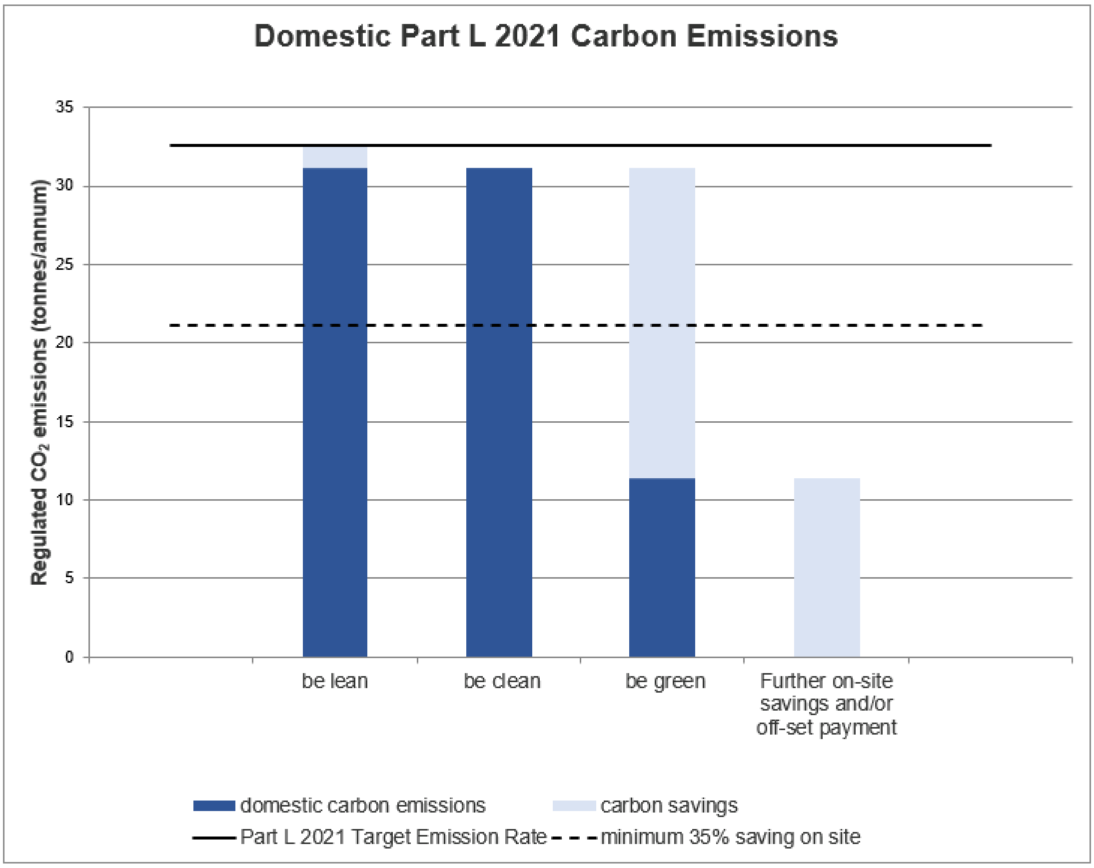

Figure 1. CO_2 savings through the Energy Hierarchy domestic buildings

Contents

2. Quality Management

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Principal Sustainability Consultant	Principal Sustainability Consultant
Date: 01/09/2023	**Date:** 01/09/2023
File reference: 091486 ES1	

Version	Status	Date	Change Summary
ES1	First Issue	18.08.23	-
ES2	Second Issue	01.09.23	-

3. Introduction

Stroma Built Environment have been commissioned by Comer Homes Group to prepare an energy statement to accompany the planning application (Ref 28301/APP/2022/2205 and 2206) for the proposed the development at Harefield Grove.

The proposed development is located within the London Borough of Hillingdon and will therefore need to meet the requirements of the Hillingdon Local Plan (Adopted November 2012 and January 2020) and London Plan (2021). The document outlines the sustainable design standards for this borough, including a requirement for all new residential developments to achieve reduction in carbon dioxide emissions in line with the London Plan targets through energy efficient design and efficient use of low and zero carbon technologies.

Policy BE1 Built environment of the Local Plan has been followed to show how this target can be achieved via the Mayor’s Energy Hierarchy (Figure 2). The tiered approach addresses fabric performance first, before connection to district heating network and then renewable energy technology.

Carbon dioxide emissions levels for each stage of the Mayor’s Energy Hierarchy have been calculated using June 2022 GLA Energy Assessment Guidance.

The energy strategy for the proposed development is as follows:

1. Minimal heat loss through fabric, thermal bridging and air infiltration.

2. Installation of energy efficient building services

3. Appropriate renewable energy technology to further reduce grid-energy demand and CO_2 emissions – Exhaust Air Heat Pumps, Air Source Heat Pumps and Solar Photovoltaic Panels

4. Development Site

The development site is located at Harefield Grove, Hillingdon.

The proposed development comprises 3 distinct areas. The refurbishment of an existing mansion house to provide 6 apartments. The erection of a new apartment 'stable block' to provide 29 apartments and 4 new detached homes through a mixture of new build and conversions.

The London Plan Energy Assessment guidance requires new build dwellings to be assessed against the energy hierarchy and thus this assessment addresses the CO_2 emissions associated with only these dwellings. The refurbishment of the mansion house has been assessed against a baseline assuming the notional specification for existing buildings as required by section 6.18 of the current Energy Assessment Guidance.

Figure 2. Arial snapshot of site location.

Figure 3.Proposed Site Plan

5. Planning Policy

There are a wide range of energy-related planning policies that impact upon the design and construction of new developments. The National Planning Policy Framework (NPPF) 2021, indicates a presumption in favour of sustainable development. The regional policy '*The London Plan 2021'*, sets out a requirement to assess energy demand, adopt energy efficiency measures, and make use of decentralised energy and renewable technology where feasible.

5.1. London Plan Policy SI.2 Minimising greenhouse gas emissions

This policy requires that all developments meet set targets for CO_2 emissions. These targets are set in the context of the Building Regulations UK Part L (BRUKL) 2010.

The target under the London Plan is for zero net regulated emissions or 'zero carbon'. To achieve this target, carbon reduction should be maximised on site where possible, with the remaining emissions offset via a 'payment in lieu', to fund energy efficiency improvement measures elsewhere in the Borough.

The London Plan details an 'energy hierarchy' to be followed. This is to ensure that poorly designed buildings cannot be offset by renewable energy alone.

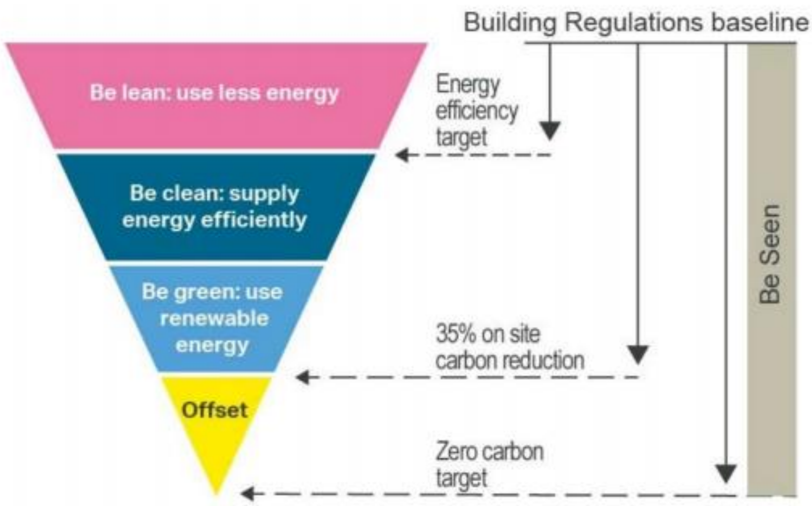

Figure 4.London Plan 2021 'energy hierarchy'

To demonstrate compliance with the policy it is necessary to assess the energy demand and emissions in detail, and to demonstrate how the energy hierarchy is being followed and how the emissions targets will be met using efficiency measures (Be Lean), decentralised energy systems (Be Clean), renewable energy technologies (Be Green) as appropriate. Finally, the in-use energy consumption needs to be monitors, verified and reported (Be Seen).

Zero Carbon status is then demonstrated through off-setting the balance of regulated CO_2 emissions via a financial contribution to the respective borough. This carbon off-set payment will contribute to a fund which is then invested into other projects where equivalent CO_2 savings can be realised.

5.2. London Plan Policy SI.3 Energy Infrastructure

Major developments with Heat Network Priority Areas (HNPA's) are required to investigate the feasibility of efficient heating infrastructure, in accordance with the following hierarchy:

1. Connection to an existing or planned heating or cooling network
2. Implementation of a communal heating system, using zero-carbon or local secondary heat sources (in conjunction with heat pump, if required), which is designed to allow a cost-connection to a future network if one becomes available.
3. Individual heating systems (low-density individual housing only)

5.3. Local Planning Policy and Conditions

The Hillingdon Development Management Policies document (adopted 16th January 2020) outlines the sustainable design standards for this borough. The energy strategy addresses the following policy:

Policy DMEI 2: Reducing Carbon Emissions

A) All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.

B) All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.

C) Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.

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

Policy EM1: Climate Change Adaptation and Mitigation

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

Ensuring development meets the highest possible design standards whilst still retaining competitiveness within the market.

Encouraging the installation of renewable energy for all new development in meeting the carbon reduction targets savings set out in the London Plan.

6. Assessment Methodology

6.1. Building Regulations – England Approved Document Volume 1 Domestic

Approved document L1A – Conservation of Fuel and Power sets the standard for carbon emissions for new dwellings and was last revised in June 2022 (Part L: 2021). The properties will need to comply with the criteria set out in the document, as follows:

New Build Dwellings

The predicted Dwelling Emission Rate of CO2 emissions from dwellings (DER) are not greater than the Target Emission Rate (TER).

The fabric energy efficiency rates for the building shall be no greater than the target fabric energy efficiency rate.

The primary energy rate for the building shall be no greater than the target primary energy rate.

That the performance of dwellings as-built comply with the DER values achieved, including site testing that the 'air permeability' rate achieved is as per that specified, or better.

The necessary provisions for energy efficient operation of dwellings are put in place, including operation and maintenance instructions aimed at achieving economy in the use of fuel and power in a way that householders can understand.

6.2. GLA Energy Assessment Guidance

The Energy Assessment undertaken follows the detailed methodology set out within the Greater London Authority (GLA) guidance document "Energy Assessment Guidance – GLA guidance on preparing energy assessments as part of a planning application (June 2022)".

As such, the schemes regulated energy demand and carbon emissions have been calculated using a Dynamic Simulation Model (DSM). This is a Government approved tool for assessing regulated carbon emissions from non-domestic properties and are used to demonstrate compliance with Building Regulations Part L: Conservation of Fuel and Power. The unregulated energy for non-domestic buildings is extracted from the SBEM results.

The 'Baseline' case for emissions was determined by using the 'Target Emission Rate' (TER) from the compliance calculations. The emissions saving from energy efficiency proposals (BE LEAN) was determined by comparing the total emissions from the 'baseline' figures, with the predicted 'Building Emission Rate' (BER), based on the proposed specification. The potential emission savings from the district heat network (BE CLEAN) and renewable energy (BE GREEN) proposals, were then appraised, in line with the GLA requirements.

Following the latest guidance from the GLA, the emissions from the scheme have been adjusted to reflect the latest carbon factors. As such, the adjusted SAP10 emissions have been utilised and referenced within this report.

It should also be noted that the compliance methodology was produced with the sole intention of demonstrating compliance with the Building Regulations Part L. As such, standardised assumptions are made regarding building occupancy, use, conditioning setpoints etc. It is therefore important to note that they are intended to be used on a comparable scale, rather than give accurate predictions of real energy use. The results herein are provided solely for the purposes of demonstrating compliance and are not intended as an accurate prediction of operational energy use.

The energy calculations have been undertaken by an accredited Energy Assessor, licensed to use all applicable assessment software's.

6.3. The thermal model

Figure 5.Energy Model New Build Stable Block

Figure 6.Energy Model Existing Mansion House

7. Establishing the Baseline Emissions

A SAP assessment has been undertaken to assess regulated energy use, accounting for energy demands from space heating and hot water, and electricity for pumps, fans and lighting. Unregulated energy use was also determined using the SAP and DSM assessment.

The energy assessment has first established the regulated CO_2 emissions assuming the development complied with Part L 2021 of the Building Regulations using the Building Regulations approved compliance software. When determining this baseline, it has been assumed that the heating would be provided by gas boilers and that any active cooling will be provided by electrically powered equipment.

The TER is the maximum permitted emissions for each new domestic building and is expressed in $kgCO_2/m^2$.

The unregulated emissions will also be reported separately as part of the 'Be Seen' policy and associated guidance.

The refurbishment of the Mansion house has followed the guidance within section 6 of the GLA Energy Assessment guidance and baseline CO2 emissions have been generated assuming the notional specification provided in the guidance. This will provide a consistent baseline across all refurbishments and clearly distinguish the improvements in CO_2 emissions that are over and above what would ordinarily be undertaken through meeting Building Regulation requirements.

Scenario	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline New Build	32.6	11.8
Baseline Mansion House Refurbishment	24.6	11.8

Table 3. Carbon Dioxide Emissions at baseline stage of the Energy Hierarchy for domestic buildings

BE LEAN

Use Less Energy

8. Be Lean: Use Less Energy

This section outlines the energy efficiency proposals to minimise energy demand. Performance and savings are assessed against the previously calculated 'baseline' emissions.

At an early stage, the design team have explored a range of energy efficiency measures including enhanced U-values and the use of efficient mechanical ventilation systems. The London Plan target under the 'Be Lean' policy is to report an improvement on the baseline case with energy efficiency measures alone, as below:

1. Domestic developments should achieve at least a 10 per cent improvement on Building Regulations from energy efficiency
2. Non-domestic developments should achieve at least a 15 per cent improvement on Building Regulations from energy efficiency.

So that the improvements from energy efficiency alone can be properly understood, aspects of the proposals that relate to efficient supply of energy (energy centre proposals) or renewable energy generation, have not been included at this stage.

8.1. Thermal Envelope

8.1.1. New Build Specification

Fundamental to achieving energy efficiency in any building is a suitably designed and specified thermal envelope. Passive design features such as appropriate orientation, balancing solar gain and limiting heat loss are all proven techniques to reduce energy consumption. In addition, minimising thermal bridging and controlling air infiltration are important factors.

The following tables illustrate the proposed building fabric performance specification, with respect to the limiting values stipulated in Part L 2021. It is shown that the proposed specification represents a significant betterment of the minimum standards.

Element	Part L Average Minimim U-value (W/m²K)	Proposed U-value (W/m²K)	% Improvement
Ground / Exposed Floors	0.18	0.11	39%
External Walls	0.26	0.18	31%
Party Walls	0.20	0	100%
Roof	0.16	0.10	38%
Doors	1.6	1.0	38%
Windows	1.6	1.2 g value 0.5	25%

Table 4. Proposed New Build fabric specification.

Element	Part L Maximum Permeability $m^3/(h.m^2)$ @50 Pa	Proposed Permeability $m^3/(h.m^2)$ @50 Pa	% Improvement
Air permeability	8	3.00	62%

Table 5. Building airtightness specification

Element	Part L Average Minimim Ψ (W/mK)	Proposed Minimim Ψ (W/mK)	% Improvement
E1 Lintel	1.0	0.064	94%
E3 Sill	0.10	0.04	60%
E4 Jamb	0.10	0.05	50%
E5 Ground Floor	0.32	0.10	69%
E6 Intermediate Floor	0.14	0.07	50%
E7 Intermediate Party Floor	0.28	0.07	75%
E11 Eaves Insulation at Rafter	0.15	0.04	73%
E16 Corner	0.18	0.09	50%
E17 Inverted Corner	0	-0.09	0%
E18 Party Wall Corner	0.24	0.06	75%
E25 Staggered Party Wall Corner	0.24	0.12	50%
P4 Party Roof: insulation at Ceiling Level)	0.48	0.12	7%

Table 6. Building thermal bridging details

It should also be noted that all specification is subject to review, and as such U-Values, G-Values and thermal bridging details will be investigated further throughout the design stage, with the aim of limiting heat loss, and to reduce emissions as much as practically possible.

8.1.2. Refurbishment Specification

Element	GLA Baseline	Proposed U-value (W/m²K)	% Improvement
Ground / Exposed Floors	0.25	No change	-
External Walls	0.55	No change	-
Roof	0.16	0.10	38%
Doors	1.6	1.0	38%
Windows	1.4	1.2	25%
Thermal Bridging	Default	No Change	-
Element	**GLA Baseline**	**Proposed Permeability $m^3/(h.m^2)$ @50 Pa**	**% Improvement**
Air Permeability	15	No change	-
Element	**GLA Baseline**	**Proposed Specification**	**% Improvement**
Heating System	Part L baseline	Worcester Greenstar Combi Boiler	-
Domestic Hot Water	Part L baseline	Worcester Greenstar Combi Boiler	-

Table 7. Proposed Refurbished Building Specification.

8.2. Building Services

It is proposed that apartment space heating and domestic hot water will be provided by individual Exhaust Air Heat Pumps within each dwelling.

The houses will have individual air source heat pumps providing space heating and domestic hot water.

For the purpose of calculating carbon emissions associated with the Lean stage, in line with the GLA Guidance, a communal gas boiler with 91% efficiency has been used in SAP calculations.

The heating system will include time and temperature zone control which divides the dwellings into two distinct zones allowing differing temperature setpoints and timing to be applied to bedrooms and living areas. In most cases, heating all internal spaces to the same temperature at the same time consumes energy unnecessarily.

Low energy lighting will be specified throughout. In line with the Domestic Building Services Compliance Guide this means having a luminous efficacy of greater than 80 lumens per circuit watt.

The ventilation will be provided by zonal Mechanical Ventilation with Heat Recovery (MVHR) units which will also include a summer bypass.

Element	Specification
Heating	**New Build Stable Block** Exhaust Air Heat Pump Joule HMMC PP-012 **New Build Houses** ASHP (Mono Block) Assumed model: Mitsubishi Ecodan 11.2kW PUZ-WM112VAA **Refurbished Mansion House** Mains gas combi boiler, assumed model: Worcester Greenstar 4000 GR4700iW 30 C NG
Cooling	None
Hot Water	From main heating system. Showers: connected to main heating system, assessment assuming 1 bath per dwelling.
Lighting	Power of fittings: 35W, Efficacy: 80lm/W
Ventilation	**New Build Stable Block** Exhaust Air Heat Pump Joule Modul-AIR All-E HHH-AEHP-00001 **New Build Houses** System 1 ventilation: natural ventilation, openable windows with DMEV in all wet rooms. **Refurbished Mansion House** Natural ventilation, openable windows with DMEV in all wet rooms

Table 8. Building services specification New Build Stable Block

8.3. Results Summary – Be Lean

Scenario	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline	32.6	11.8
Be Lean	31.2	11.8

Table 9. Carbon Dioxide Emissions after Be Lean stage of the Energy Hierarchy for domestic buildings

Scenario	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from 'Be Lean'	1.4	4%

Table 10. Regulated Carbon Dioxide savings from Be Lean stage of the Energy Hierarchy for domestic buildings

8.4. Summertime overheating

A separate overheating assessment has been carried out following the cooling hierarchy been included in Appendix F. This has led the design of the systems proposed for the building.

In order to minimise the cooling required the following measures have been included in the design:

- Solar control glass with low g-values
- Exhaust air heat pump and Mechanical Ventilation Systems with Summer bypass modes

BE CLEAN

Supply Energy Efficiently

9. Be Clean: Supply Energy Efficiently

9.1. District Heating

Analysis of the London Heat Map was made to determine whether existing or proposed district heating networks are present in the vicinity of the development site. There are no proposed heat networks within the area and the heat density of the site is extremely low in this semi-rural location. It is unlikely a heat network will ever reach this development and thus no on-site heat network is proposed. The Borough Energy Officer was contacted by the applicant to confirm whether there are any existing or planned networks within the area. The Planning Case Manager at Hillingdon has confirmed that there are no networks within the Borough and evidence of this correspondence is provided in Appendix C. As this is a remote site, there are no other local heat network operators or nearby developers to consult with over any local heat network opportunities.

The applicant has elected to use individual exhaust air heat pumps to provide the space heating domestic hot water and ventilation to the new build apartments. These units will use significantly less energy during their operation and indeed their manufacture than a communal system with a central energy centre. It has therefore been determined that the benefits of the lower energy usage and carbon emissions associated with the exhaust air heat pump units outweigh those associated with providing an on-site heat network for this particular site.

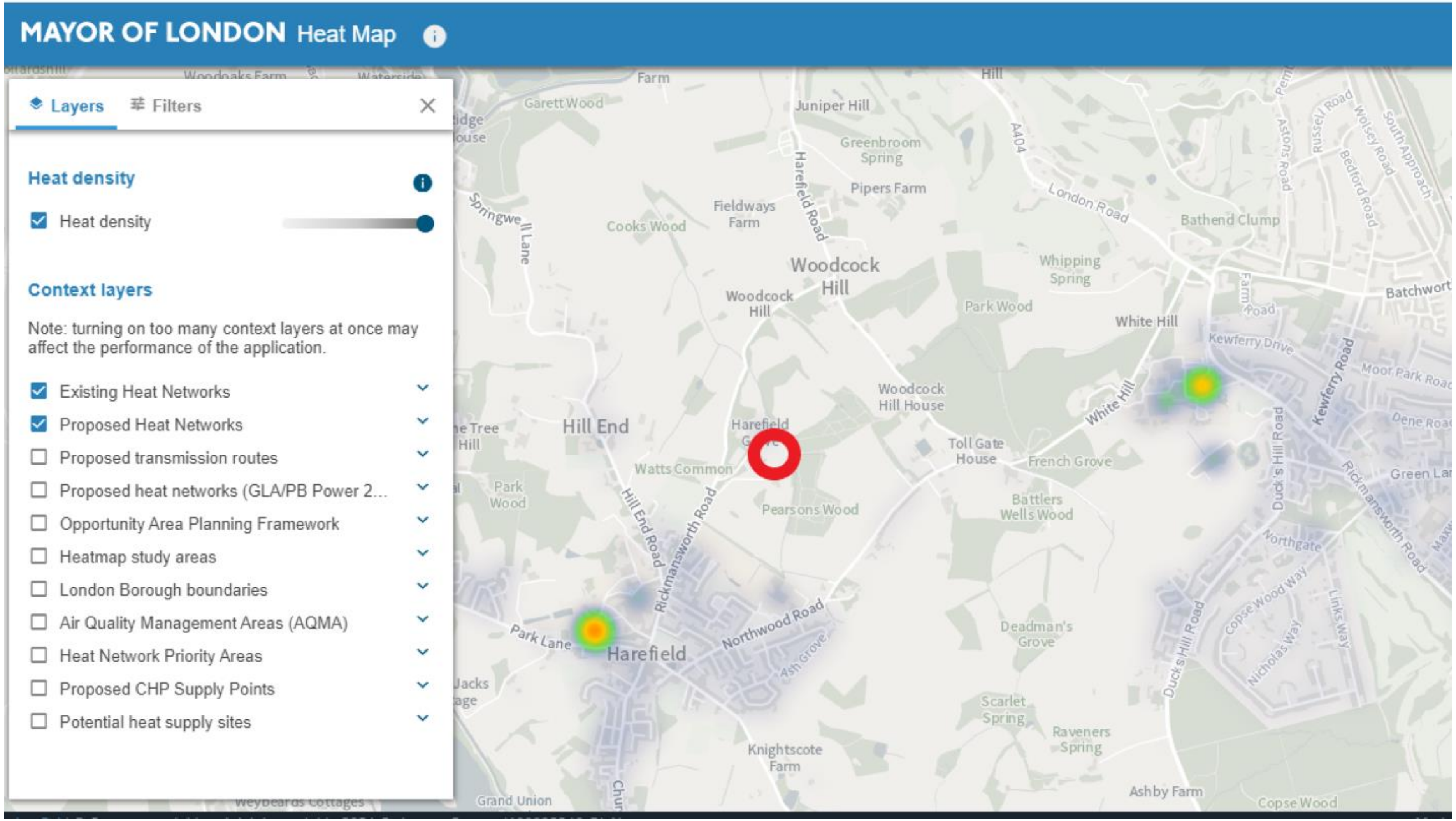

Figure 7.London Heat Map for the site region[1]

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[1] https://www.london.gov.uk/what-we-do/environment/energy/london-heat-map/view-london-heat-map

9.1. Site wide heat network

The heating hierarchy requires developments to assess the feasibility of using zero-emission or local secondary heat sources.

The are no sewage plants, enclosed tube networks or data centres close to the development. As such there is not considered to be any feasible secondary heat sources available.

The proposals are therefore to utilise Exhaust air heat pump and air source heat pump technology as much as practical to generate heat for the development. Heat pumps are introduced into the energy hierarchy at the 'Be Green' stage, so are detailed in the Be Green section of this report.

9.2. Results Summary – Be Clean

Scenario	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline	32.6	11.8
Be Lean	31.2	11.8
Be Clean	31.2	11.8

Table 1. Carbon Dioxide Emissions after Be Lean stage of the Energy Hierarchy for domestic buildings.

Scenario	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from 'Be Clean	0	0

Table 2. Regulated Carbon Dioxide savings from Be Lean stage of the Energy Hierarchy for domestic buildings.

BE Green

Use Renewable Energy

10. Be Green: Use Renewable Energy

10.1. Overview

Renewable energy is defined as energy derived from energy flows that occur naturally and repeatedly in the environment. It may be contrasted with energy sources that can be depleted such as fossil fuels or uranium-238-based nuclear power. It therefore follows that the commonly used phrase "equipment to generate renewable energy" is an oxymoron since renewable energy cannot be "generated" – the true function of the technology is to harness a natural energy flow.

Renewable energy technologies, with a couple of exceptions, all utilise energy from the sun – either directly or indirectly, the exceptions being true geothermal, which uses heat from the earth's core, and tidal / marine current electricity generation which uses the gravitational forces between the earth and the moon, (although some marine currents are also greatly affected by solar energy). Insofar as this report is only concerned with practical options for on-site renewable energy, these options are not considered further. The remaining range of "solar" technologies are however vast, and some would not even appear to be solar on superficial inspection. They can be summarised as follows:

- Solar thermal – direct heating of water for space heating or domestic hot water
- Photovoltaic – direct generation of electricity from sunlight
- Hydroelectricity – use of solar (water cycle) driven water flows to generate electricity
- Wind turbines – use of solar driven air movement to generate electricity
- Heat pumps – extraction of solar heat from the earth, atmosphere or water bodies
- Bio-fuels – combustion of solid or liquid bio-fuels to produce heat or electricity

The technologies, and their potential application to this site are discussed in more detail in the following sections. However, one further pertinent point must be made. The reason for adopting renewable energy technologies is to reduce greenhouse gas emissions – mainly carbon dioxide, and none of the technologies are wholly "zero carbon". This is because when the whole life cycle is considered, some energy must be put into every system to manufacture and maintain the equipment (which has a finite life) or to operate the equipment, and generally at present this energy is derived from non-renewable sources. Examples include the energy needed to refine and process the silicon used to manufacture photovoltaic panels, the diesel fuel used to transport wood pellets to the development and to power the wood processing machinery, and where applicable to bio-fuels, the energy used to manufacture the fertilizers needed to maintain soil fertility.

Finally, due to the dynamic and innovative nature of the renewable energy technology industry even apparently similar products can differ in vital practical details which means that detailed design of installations must be undertaken by experts, often working closely with the product manufacturers, as virtually no two products are identical or interchangeable.

The following section contains an overview of the technologies selected for this development. For more detailed analyses of all listed technologies, and the reasons for their exclusion, please see Appendix A.

10.2. Heat Pumps

Heat pumps collect low temperature heat and "concentrate" it to a usable temperature. A typical heat pump serving a heat network will typically deliver 2-3 kWh of useful energy for every 1 kWh of input energy. A heat pump operating in this way can therefore be deemed to have delivered 1-2 kWh of low carbon energy.

There are two common types of heat pump – ground source and air source. Water source heat pumps are also available, but rarely applicable, as they require a local large body of water. Ground source heat pumps require drilling boreholes to collect heat. These are typically up to 240m deep and should be spaced at least 6m apart to avoid over-cooling the ground. A typical borehole can deliver a maximum output of 4kW of heat, therefore, a significantly large area is required in order to be considered feasible.

Air source heat pumps collect heat from the ambient air using air-heat-exchanger units.

Whilst heat pumps can provide good levels of performance, they have practical limitations. Firstly, to be effective, the units must be located externally, which can impact acoustically as well as on visual amenity and space.

The introduction of SAP10 carbon emission factors has, in most cases, resulted in heat pumps being the only viable option to reduce carbon emissions in line with London Plan target requirements.

The performance and output of the system will be monitored in line with the be seen policy and relevant guidance document.

Element	Specification
Heating	**New Build Stable Block** Exhaust Air Heat Pump Joule HMMC PP-012 SCOP 230.75% **New Build Houses** ASHP (Mono Block) Assumed model: Mitsubishi Ecodan 11.2kW PUZ-WM112VAA 396.05% **Refurbished Mansion House** Mains gas combi boiler, assumed model: Worcester Greenstar 4000 GR4700iW SEDBUK efficiency 88.7% winter, 87.6% summer
Hot Water	**New Build Stable Block** Exhaust Air Heat Pump Joule HMMC PP-012 SCOP 129.86% **New Build Houses** ASHP (Mono Block) Assumed model: Mitsubishi Ecodan 11.2kW PUZ-WM112VAA 175.31% **Refurbished Mansion House** Mains gas combi boiler, assumed model: Worcester Greenstar 4000 GR4700iW SEDBUK efficiency 88.7% winter, 87.6% summer

Table 3. Heat pump Efficiency figures

10.3. Exhaust Air Heat Pumps

The applicant proposed to use the Joule Module-Air EAHP. The Modul-AIR ALL-E Exhaust Air Heat Pump (EAHP) and optional Green Comfort provides mechanical ventilation with heat recovery (MVHR), domestic hot water (DHW) & heating via radiators or underfloor (UFH).

This solution is best suited for new build flat developments. It uses the waste heat from the extract ventilation through a heat pump cycle to provide the heating and hot water for the dwelling. When fitted with the optional Green Comfort the supply air to the habitable space is pre-heated to increase the occupants comfort level and thus reducing the load on the radiators or underfloor heating in the dwelling. The EAHP supplier has provided further technical information including the system components, user controls and operation in Appendix G.

The system operates using Opentherm control logic. OpenTherm is a digital language that puts the heat pump and thermostat in constant communication. It gives the heat pump more information about the current and target temperature of the room, which it can use to run more efficiently. Its self-learning functionality fine tunes the logic to align with both the dwellings load and occupier control preferences. In combination with the GreenComfort unit it will ensure optimum comfort levels during the heating season, by maintaining a constant supply temperature (determined by the thermostat set point) to the habitable rooms regardless of external temperature. In the summer months the system will utilise its "Nighttime Cooling" by automating a purge function should, 1. The set point be below the current temperature by >-2°C & 2. the external temperature is below the current temperature -2°C. (This can be explained in greater detail if required)

In no circumstance will the unit over-ventilate. It is commissioned in line with Part F of the Building Regs. The maximum flow temperature of the unit is 65°C. DHW cylinder temperature of 60°C can be achieved by heat pump only. In peak heat load condition back-up electric may be required. This is controlled by the Opentherm logic and has been captured in the energy usage files.

A summary is given in the figure below demonstrating the thermal zoning capability when connected to the underfloor heating system. In use energy data has been submitted within the appendix G to provide evidence of this innovative approach.

modulair green comfort

Modul-AIR All-E & GreenComfort with 2 Zone Underfloor Heating

	Description
A	Modul-AIR Hot Water Tank
B	Modul-AIR Heat Pump
C	Green Comfort Module
D	Tundish
E	Potable Expansion Vessel
F	Robokit
G	Modul-AIR Digital Room Stat
H	Filling Loop
I	Inlet Control Group
J	Hot Outlet
K	Balanced Cold Outlet
L	Mains/Boosted Cold Inlet
M	2 Zone Underfloor Heating
N	DIRTMAGPLUS ® (AAV, Filter, Strainer, Fill&Flush)
O	Modul-AIR 24V Basestation

MVHR Ventilation

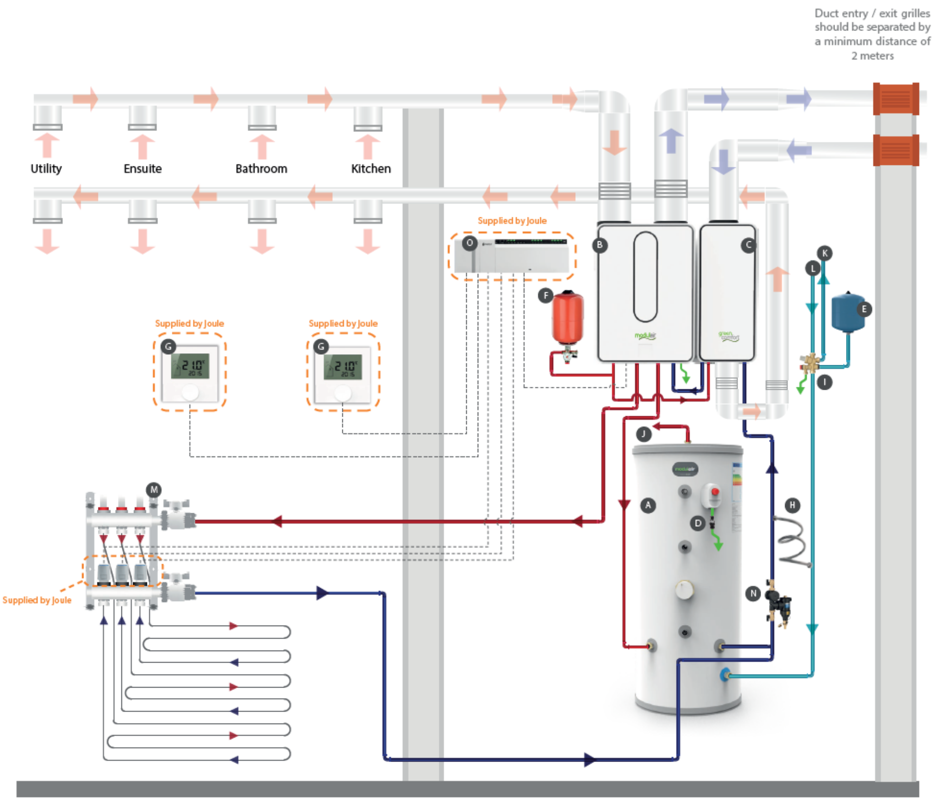
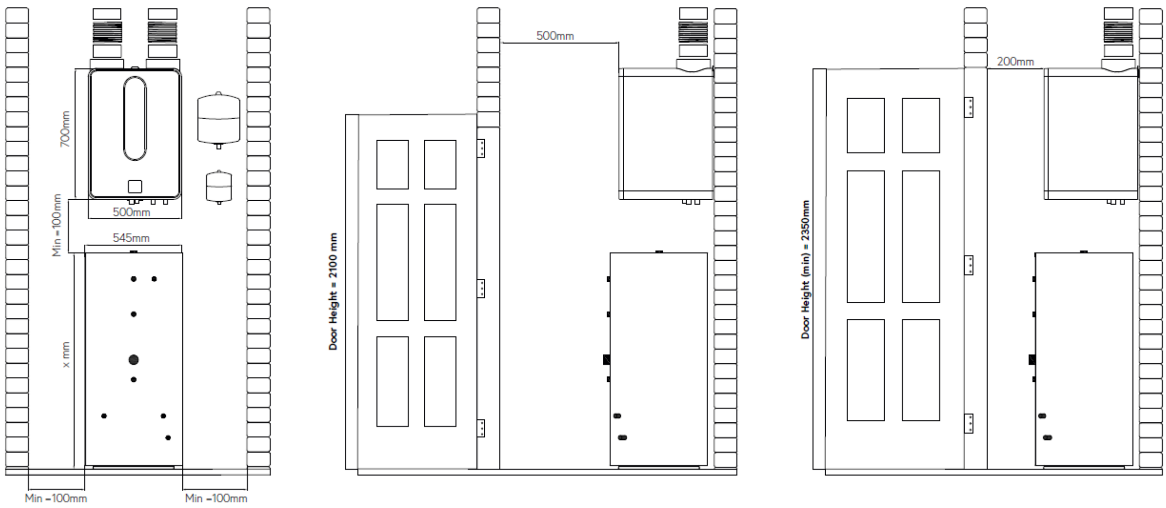


Figure 8.Joule EAHP Components



JOULE HEATING SOLUTIONS
MODULAIR ALL-E + CYLINDER
FOOTPRINT DRAWING
joule

Modul-AIR Cylinders variants:		
X	TUMA-00150-LFC	H = 1102mm
	TUMA-00180-LFC	H = 1293mm
	TUMA-00210-LFC	H = 1478mm

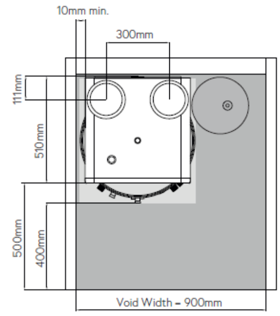


Figure 9.Joule EHAP Footprint Drawings

10.4. Solar Photovoltaics (PV)

Photovoltaic panels are conceptually straightforward. The panels produce "zero carbon" electricity that is used in place of grid electricity, and the carbon dioxide emissions saved are the emissions that would have occurred had the electricity been produced by a power station feeding the grid.

Photovoltaic panels have certain siting constraints. To produce the maximum output, they should face due south, although south-east to south-west is certainly acceptable, and even east or west will be acceptable if the angle of inclination is no more than 20º. When not in direct sunlight, but shaded by obstacles such as adjacent buildings or trees, the output of the affected panel is significantly reduced. As groups of panels are connected electrically in "series" a reduced output from one panel will reduce the output from all the panels in the group. This means that it is particularly important to avoid shading. However, photovoltaic panels have many advantages. They are clean, silent, reliable, low maintenance, and are easy to install. They also have a very long life – up to 40 years – which is at least double that typically quoted for other technologies.

In addition, and unlike most solar thermal panels, and most other renewable energy technologies, photovoltaic panels are "zero carbon" in use. They simply produce electricity when exposed to sunlight. However, the situation is rather different when the carbon dioxide emissions are determined using a "whole life cycle analysis" approach that includes the energy and other greenhouse gas emissions associated with panel.

This development proposal is well suited to photovoltaic panel technology and there is available roof space.

The potential for CO2 savings from solar PV have been assessed using the Governments approved SAP: 2012 (Standard Assessment Procedure) methodology. This SAP methodology considers UK solar irradiance data, collector pitch, orientation and over-shading to determine the expected annual energy yield. In order to represent a semi-optimal installation, it is taken that solar PV could be installed on East/West/South roof areas to the stable block apartments. On this basis, calculations show that a total installed PV capacity of 55 kWp (kilo-Watt peak) would be expected to generate 40,632 kWh of primary energy per annum.

It is advised that a PV specialist is appointed at the earliest opportunity to confirm the exact area required and ensure there is obtainable roof area to support this solution. An indicative layout for the Solar PV array is shown in the drawing extract below:

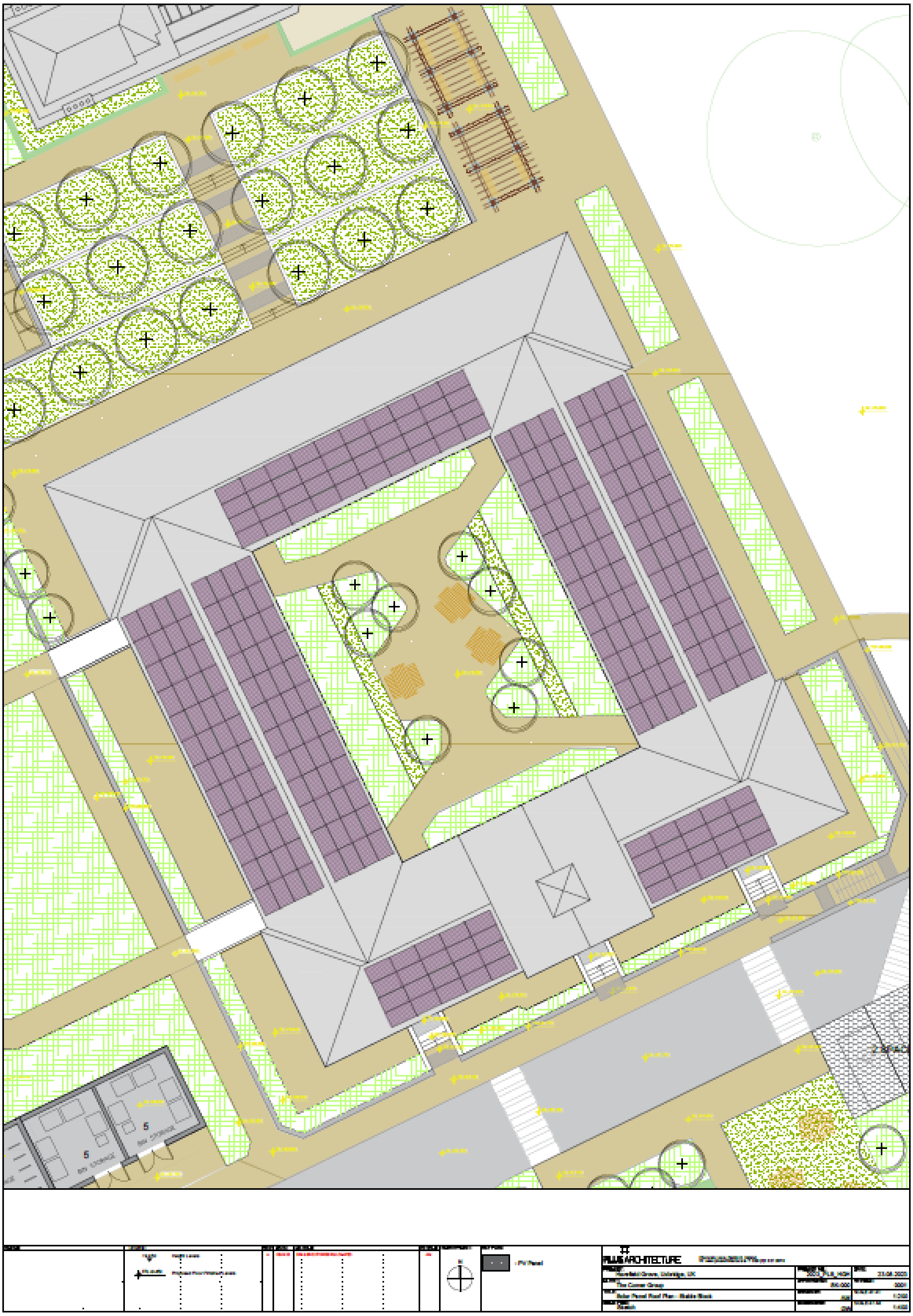


Figure 10.Solar PV Layout Drawing.

10.5. Results Summary – Be Green

Scenario	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline	32.6	11.8
Be Lean	31.2	11.8
Be Clean	31.2	11.8
Be Green	11.4	11.8

Table 4. Carbon Dioxide Emissions after Be Green stage of the Energy Hierarchy for domestic buildings.

Scenario	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from 'Be Lean'	1.4	4%
Savings from 'Be Clean'	0	0%
Savings from 'Be Green'	19.8	61%
Cumulative on-site savings	**21.2**	**65%**
Remaining emissions to offset	11.4	-

Table 5. Regulated Carbon Dioxide savings from Be Green stage of the Energy Hierarchy for domestic buildings.

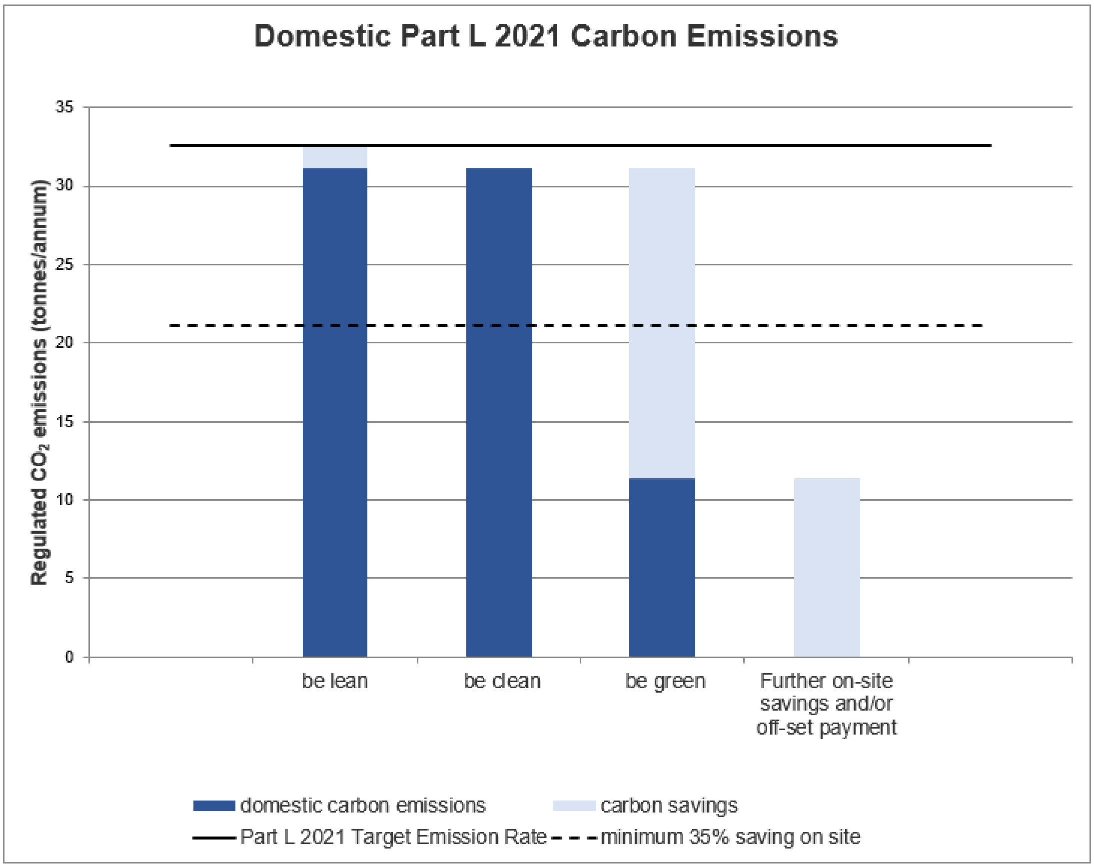


Figure 11. CO_2 savings through the Energy Hierarchy

Scenario	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline	24.64	11.8
Proposed	23.92	11.8

Table 1. Carbon Dioxide Emissions after Be Green stage of the Energy Hierarchy for domestic buildings refurbishment

Scenario	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from 'Be Lean'	0.72	2.91%

11. Carbon Offset

As of the March 2021 it is a requirement of the London Plan policy SI2 that all major residential development must achieve the Zero Carbon Standard. This is done by meeting a minimum onsite CO2 reduction of 35% against a Building Regulations L1a (2013) baseline, and then offsetting the remaining emissions via a cash in lieu contribution to the relevant borough. The calculations in table 4 indicated an offset payment of £32,497 is due.

Contributions to the Carbon Offset Fund are to be spent within the vicinity of the named development and used for retrofitting existing buildings, decentralized energy networks, renewable energy or any other programmed that achieves a calculable reduction in carbon emissions.

Scenario	Total Regulated Emissions (tonnes CO_2/annum)	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from 'Be Lean'	1.4	4%	4
Savings from 'Be Clean'	0	0%	0
Savings from 'Be Green'	19.8	61%	61
Cumulative on-site savings	21.2	**65%**	**65**
Remaining emissions to offset	11.4		
	Tonnes CO_2		
Cumulative savings for offset payment (for 30 years)	342		
Cash in-lieu contribution*	£32,497		

**Carbon price is based on GLA recommended price of £95 per tonne of carbon dioxide*

Figure 12.Regulated Carbon Dioxide savings from each stage of the Energy Hierarchy for non-domestic buildings showing the carbon offset payment.

It should be noted however that the exact amount will change dependent on detailed design, and specific products specified for construction, as such it is the case that this payment be recalculated post-construction, and true figures calculated from the 'As Built' emissions.

12. Energy Costs

The estimated energy costs to the occupants have been confirmed in the GLA carbon emission reporting tool from the predicted energy usage section. The predicted energy usage of the development per m2 is calculated as 68.13 kWh/m2. The developer is committed to protecting the consumers from high prices through the use of individual exhaust air heat pumps providing the space and domestic hot water to each dwelling. This allows the occupants to control their own energy usage costs rather than be reliant on a communal system where the cost of energy per kWh is set by a district heat network operator. The occupants will be free to select any energy supplier in the marketplace and thus have the greatest choice of tariffs available.

13. Conclusions

This Energy Statement has outlined the proposed specification for the development and the resulting savings against each stage of the energy hierarchy. A fabric-first approach realises considerable savings against the current Building Regulations baseline.

Additional energy and CO2 savings will be achieved through the application of renewable energy technology.

13.1. Be Lean - Energy Efficiency

A high-performance building envelope has been specified comprising of low U-values, thermally efficient construction details and low air permeability. Performance values demonstrate improvement against that of the Part L1a 2013 Notional building used for comparison in compliance assessment.

13.2. 11.2. Be Clean – Decentralised Energy

Analysis of the London Heat Map was made to determine whether existing or proposed district heating networks are present in the vicinity of the development site. There are no existing district heat networks, however the development site is situated in near proximity to proposed networks.

13.3. 11.3. Be Green – Low and Zero Carbon Technology

Additional energy and CO2 savings will then be achieved through the use of individual Exhaust Air Heat Pumps to new build apartments, Air Source Heat Pumps to individual houses and a solar Photovoltaic array installed to the new build Stable Block.

BE Seen

Monitor Energy

14. Be Seen: Monitor Energy

14.1. Introduction

Policy SI 2 of the New London Plan contains a requirement for post construction monitoring and reporting of energy use, known as 'Be Seen'.

The process for meeting this starts at the planning stage and continues for at least 5 years after occupation of a development.

At the planning stage three actions are required

- Provide data on the development regarding its nature and predicted energy use figures via the 'Be Seen' assessment spreadsheet tool
- Indicate the predicted dates for the completion of the subsequent stages of the 'Be Seen' process. In particular the predicted date of completion and of 1 year post occupancy.
- Provide confirmation that metering plans are in place that will enable the in use energy performance reporting

14.2. Performance Indicators

The performance indicators fall into five groups which are described in the following table. The specific indicators that should be reported at each stage of the monitoring process (i.e. from planning to as-built to in-use) are described in the subsequent sections and tailored according to whether the development is residential or non-residential.

Performance Indicator Group	Description
Contextual data	Applicants will be expected to provide contextual data relating to the development's reportable units (RUs). This includes non-energy information such as data on location and typology of buildings.
Building Energy Use	Applicants will be expected to report on the energy and fuel imports into each RU of a development. This includes data from national energy grids (e.g. electricity, gas etc.) and district heating connections. This information will enable the building owner to report on the amount of energy being consumed on-site for distinct building uses.
Renewable Energy	Applicants will be expected to report on the renewable energy generation within the development to identify how much energy is being generated on-site and where this is used.
Energy Storage Equipment	Applicants will be expected to report on building energy storage equipment data.
Plant Parameters	Applicants will be expected to report on parameters that relate to the performance of heat or cooling generation plant within energy centres that form part of a development. This will include energy inputs and outputs of energy centres, energy use and contribution of heating and cooling technologies, and network efficiency data to monitor losses in district and communal energy networks.
Carbon Emissions	Applicants will be expected to report on the development's estimated carbon emissions at planning stage based on the appropriate carbon emission factors, as set out in the GLA's Energy Assessment Guidance. When on-site carbon reductions have been maximised, but a carbon shortfall still exists, applicants will be expected to report on and confirm the carbon offsetting contribution to the relevant local authority's fund in line with the net zero carbon target.

Table 2. Performance indicators

14.3. Reporting Units

In terms of reporting after the 'As Built' stage the development will be divided into 'Reportable Units' (RUs) with each RU reported separately. However, at the planning stage all information is provided at a development overview level.

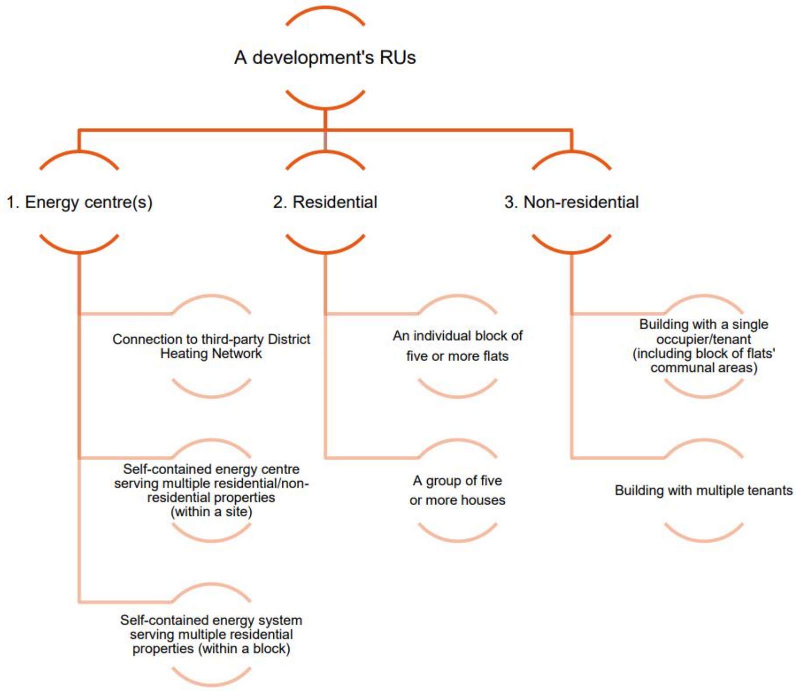


Figure 13. Visual representation of reportable Units from the Be Seen Guidance

14.4. Energy Use Prediction Methods

The method for predicting energy use at the planning stage differs for residential and non-residential units. In addition, two different methods are used for non-residential units as explained below:

Aspect	Methodology
Residential	The methodology for reporting energy consumption (kWh/m^2) and carbon emissions (tonnes CO_2/m^2) estimates should follow a Building Regulations Part L compliant methodology using the Standard Assessment Procedure (SAP) tool. This is as per current planning calculation and reporting methodologies
Non-residential First Method	Submit the Building Regulations Part L compliant figures, in line with London's existing planning approach. These should be the same as the data included in the GLA's Energy Assessment Guidance.
Non-residential Second Method	CIBSE TM54 analysis, which recommends using a tailored Part L model for the estimates of regulated and unregulated loads, should be undertaken and its findings should be reported in the 'be seen' spreadsheet. A TM54 analysis gives more accurate predictions of a building's energy use.

Appendices

Appendix A - Renewable Technology Considerations

Solar Thermal Systems

Solar thermal panels use the sun's energy to contribute to the heat energy needed to provide space heating and/or domestic hot water. They are perhaps the oldest, and certainly the most obvious and easily understood type of renewable energy technology.

The panels consist of a roof-mounted solar heat collector which can be either a flat plat or tube system containing water, or a more complex evacuated tube system, which in some cases utilises "heat pipes". The systems also include provision to ensure that the water in the panel does not freeze in winter, and pumps to drive the "solar circuit". The principle disadvantage with solar thermal systems is that the heat cannot be stored for long periods, and unlike electricity cannot be exported when surplus is available.

In large schemes such as this, an array of panels would be connected to a storage vessel in the plant room. The amount of fossil fuel that can be saved is limited to the amount that would have been used if the solar heated water was not available. If surplus hot water is produced it will be wasted, so cannot be counted when determining the amount of renewable energy being delivered. Solar thermal systems also use electricity to power the pumps needed to circulate the heat exchange fluid through the solar panels, and the resulting carbon emissions from this electricity must be offset against the emissions saving from the heat collected.

It is considered unlikely that solar thermal technology will provide adequate heat to serve a development of this size. As such, other technology will need to be proposed alongside. This would need to be heat pump technology to ensure the carbon emissions are maximised. It was therefore considered more appropriate to use ASHP to provide all heat, and then the remaining roof space can be allocated to PV panel instead of solar thermal, which would generate electricity instead of heat, where excess energy can be exported in not utilised on site.

It is therefore established that a Solar Photovoltaic array would be a more viable use of this roof space, making solar thermal infeasible.

Micro-Hydroelectricity

The utilisation of "water power", together with "wind " is generally recognised as having facilitated the early stages of the Industrial Revolution in Europe. Water wheels were simple to manufacture and produced high torque without gears and simple gears could be used to increase speed. Water power was, unlike wind power, controllable, and subject to a sufficient water level in the "mill pond", was available on demand.

Water power was of course used to grind wheat to produce flour, but also powered many types of machinery including fans for blast furnaces, and hammer mills used to produce wrought iron. Today, large hydroelectric schemes are still very important energy sources in many countries, although in the UK only 0.8% of the electricity demand is produced in this way, mainly because there are very few suitable sites. The Government estimates that if all the rivers and streams in the UK could be harnessed the output would still only be 3% of the total demand, so while local schemes can be important, strategically, this is one of the less important technologies.

Micro-hydro is the term used for very small schemes, although it is applied to any scheme producing less than 1 MW. On-site micro-hydro is clearly totally dependent on the availability of a suitable river or stream that could be utilised in an environmentally acceptable way, and produce a worthwhile output, and such availability is so limited in typical urban sites as to make this a technology that is generally of no relevance.

The extraction of energy from flowing water will by definition reduce its velocity and change water levels and introducing such changes even to a canalised urban river can have both upstream and downstream impacts. And where the site has a natural ecology the local impacts can be far greater and the necessary mitigation difficult to achieve. So, in conclusion, the most likely instance where a micro-hydro installation might be possible is one where an existing or historical site can be utilised, but these are very rare.

Micro-Hydro is not suitable for this development.

Wind Turbines

The general principles of operation of small scale wind turbines are straightforward, and windmills are probably one of earliest ways that mankind harnessed natural energy flows and put them to practical use. However, while conceptually simple, wind turbines present complex challenges both on technical and planning terms and cannot be considered a simple option.

Considering in the first instance only the technical issues, it will first be necessary to establish whether a site has an adequate wind resource. Preliminary checks can be made using the DTI wind speed database and a site with a theoretical average wind speed of at least 5 m/s at 25m above ground level can be suitable. Other relevant issues are the amount of local wind shadowing and turbulence likely to be produced by nearby buildings and trees and whether the site is open in the direction of the prevailing wind. In practice, even on a promising site these issues mean that to have any confidence that a worthwhile amount of electricity could be generated and thereby validate an investment decision it is necessary to carry out extended wind speed measurements, typically over a full year.

In the normal absence of valid wind data at the beginning of a project some guidance is becoming available on the reduction in output typically seen on a sheltered urban site compared to manufacturer's wind-tunnel data. This can be illustrated by reference to the data for a 2.5kWe unit with a rotor diameter of 3.5m. In a rural environment with an average wind speed of 8 m/s, such a unit would produce 10,164 kWh/yr. and reduce carbon dioxide emissions by 5,773 kg. On an urban site where the wind speed is just 4.8 m/s it would produce only 392 kWh/yr. and reduce emissions by just 223 kg. A single turbine of this type would therefore reduce the emissions from the development by a negligible amount so would make no practical contribution to the emissions reduction target.

While this technical review indicates that wind turbines are very unlikely to be feasible, in addition, other issues must be considered. Clearly the overriding issue is the impact on the visual amenity of the site and surroundings and opinions are generally divided on the aesthetics of wind turbines.

So, while large wind turbines installed in "wind farms" in exposed locations and increasingly off shore, can and are providing a substantial amount of the UK's current renewable electricity, the use of micro wind turbines on small residential or commercial developments is of questionable value, and is frequently no more than a token gesture.

Bio Fuels

In the UK there are essentially two types of bio-fuels available at present. Biomass generally refers to either wood chips or wood pellets. Bio-diesel (or plant oil) is a liquid bio-fuel (chemically modified vegetable oil) that can be used in place of heating oil or to run diesel engines. In the built environment, bio-diesel is not a viable proposition at present due to fuel availability and cost, and it is questionable whether this should ever be the case since it is a valuable energy source which can be readily used for transport that cannot at present easily be powered by other bio-fuels. There are also real issues of the true carbon emissions associated with its production. There are a range of energy inputs associated with growing and processing the fuel, and while it is generally regarded as having a bio-fuel output to fossil fuel input ratio of around 4 : 1, some studies suggest it can be 2 : 1 or lower.

In contrast, biomass is readily available, requires minimal processing, and a proportion is sourced from the waste stream that would ultimately go to landfill where decomposition releases methane, a greenhouse gas 22 times more potent than CO_2. However, the delivery, storage and utilisation of biomass is far less convenient than gas or even oil. In terms of types of system, there are essentially two – a simple biomass boiler burning either wood chips, which are cheaper but more difficult to handle, or wood pellets.

Biomass heating systems generally need a lot of room to store the fuel, and suitable arrangements to enable it to be delivered to the plant rooms. They are also an extremely high-maintenance system when compared to alternative solutions. Furthermore, the burning of Biofuels has a negative impact on the surrounding air quality which is against the current drive to clean up the air in the city. In this instance, it is not considered a viable option.

Appendix B - CO_2 Emission Factors

CO_2 emission factors are variable and relate to the carbon intensity of the fuel that is supplied to the building. In the case of natural gas, this is fairly stable, and varies only marginally with regard to processing and delivery of the gas to site. In the case of electricity, this varies substantially, and can range by a factor of 10 over the course of a single day. This is due to peaks and troughs in demand, and the associated electricity production methods that are used in order to provide power to the national grid.

The below table details the CO_2 emission factors, only fuels used within the site proposals have been listed here:

Fuel	Regulatory CO_2 emission factor ($kgCO_2$/kWh)	London Plan (GLA) CO_2 emission factor ($kgCO_2$/kWh)
Natural gas	**0.210**	**0.210**
Grid electricity	**0.136**	**0.136**

Appendix C – District Heating Correspondence

Appendix D Air Quality

Appendix E - Future Proof to Achieve Carbon Zero

Emissions from heating and hot water have been reduced as far as practically possible. This would then leave the electrical demand for the site. As the grid becomes 'de-carbonised' the carbon factor associated with the electricity will reduce. This has been demonstrated by the introduction of SAP10 carbon emissions where the grid electricity carbon factor has been reduced from 0.519 to 0.136, a dramatic reduction. If we see similar reductions in the future, the carbon emissions associated with electricity will reduce in line. Further to this, the installed PV array will continue to deliver a proportion of the electricity, and when it needs replacing it is likely that the technology will have improved, so the same amount of panel area will be able to provide a larger amount of electricity. The timeline to achieve carbon zero will therefore be dependent on any future DH Networks, the future carbon factor of grid electricity, and the development of PV efficiency

Appendix F Overheating Report

Appendix G – Manufacturers Data

Appendix H – SAP Calculations

Appendix I GLA Carbon Calculations Spreadsheet

Appendix J – Planning Drawings

Appendix K Be Seen GLA Spreadsheet