Site Address

Newport Road, Hayes, UB4 8JX

Energy Assessment Report

Prepared By

Stroma Built Environment

For

Manjeet Singh

Date

May 2023

STROMA BUILT ENVIRONMENT

About Stroma Built Environment

Bespoke Builder Services is a construction consultancy specialising in sustainability, energy conservation and the application of renewable energy technologies. As a consultancy, we do not sell products, and so we are able to take an objective view of a development to assist developers in incorporating the most cost effective and practical solutions.

Our range of services includes specialist pre-planning reports, energy consumption calculations for Building Regulations purposes, and broader environmental and sustainability studies and reports as well as BRE EcoHomes, BREEAM and Code for Sustainable Homes assessments.

Our team of consultants includes registered SAP, SBEM and DSM Assessors, registered Code and BREEAM Assessors, Planning Specialists, Renewable Energy Specialists, Chartered Engineers and Chartered Surveyors.

A sister consultancy is a Corporate Approved Inspector, approved to provide Building Control services in both the residential and commercial sectors, and where necessary, able to draw on this additional expertise to ensure that all advice given in respect of energy conservation and sustainability will also meet all other constraints imposed by the Building Regulations.

Report Prepared By:

Date: 07.04.2020

Liam Seamer BSc

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Contents

1. Executive summary

The following Energy Assessment report demonstrates that the proposed development will fully satisfy all the planning policies relevant to energy and emissions under the London Plan 2016 and the London Borough of Hillingdon planning policy.

A fabric first approach to energy efficiency has been specified in order to minimise demand and create inherent efficiency. The energy efficiency measures alone can be shown to bring the proposals in line with the *Building Regulations Part L: Conservation of Fuel and Power*.

There are no available district heating schemes to connect to, nor is it likely that a district heating scheme shall become available in the future. The opportunities for connected heat and CHP have also been appraised and found to be technically, environmentally and economically unviable. Therefore, dwelling specific high-efficiency ultra-low NOx boilers have been specified as the preferred heating strategy for the development.

Unfortunately, due to conflicting demands for the roof area no renewables can be installed. The original submitted energy report included an area of photovoltaic (PV) panels. Due to planning requirements to provide amenity space for the residents, there is no available roof area to support the installation of a PV array.

The remaining emissions for the scheme are calculated as 28.18 tonnes/CO_2 per year. The London Borough of Hillingdon requires a payment in lieu via a S106 agreement, to offset the remaining emissions and be used to fund energy efficiency improvements elsewhere in the borough. This is currently calculated as £50,724[1]

The following tables and graph detail the site energy hierarchy results, formatted to the requirements of the London Plan.

[1] Note that as the detailed design progresses this figure may change. The final payment should be advised from the 'As Built' emissions calculations.

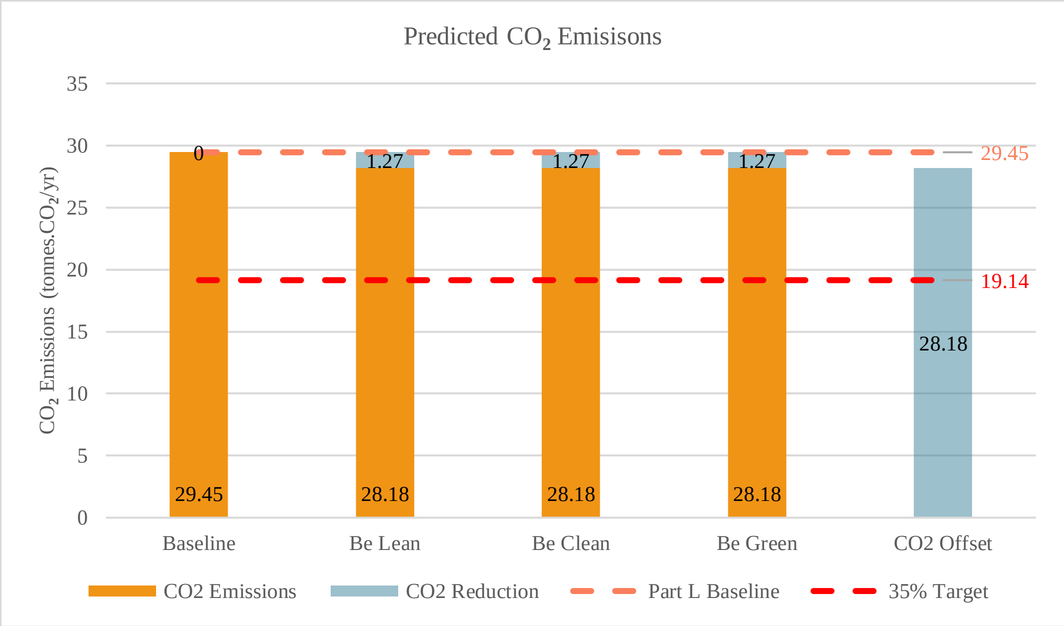


Table 1: CO_2 emissions at each stage of the energy hierarchy

Scenario - Residential Scheme	Regulated CO_2 emissions (Tonnes CO_2/annum)	Unregulated CO_2 emissions (Tonnes CO_2/annum)
Baseline	29.45	29.71
After demand reduction	28.18	29.71
After DEN / CHP	28.18	29.71
After renewable energy	28.18	29.71

Table 2: Regulated CO_2 savings at each stage of the energy hierarchy

Scenario - Residential Scheme	Regulated CO_2 savings (Tonnes CO_2/annum)	CO_2 reduction (%)
Savings from demand reduction	1.27	4.29
Savings from DEN / CHP	N/A	N/A
Savings from renewable energy	N/A	N/A
Cumulative on-site savings	1.27	4.29
Remaining emissions to offset	28.18	95.17

2. Introduction

This Energy Assessment report has been prepared on behalf of the Applicant, Manjeet Singh, by Stroma Built Environment, a construction consultancy specialising in sustainability, energy conservation and the application of renewable energy technologies.

It has been prepared to accompany a detailed planning application for the proposed redevelopment of the Site at Newport Road, Hayes, UB4 8JX.

The site forms roughly a 0.16-hectare area, located on the eastern side of Newport Road, which forms a cul-de-sac. The site is located approximately halfway along the road and comprises single storey and two storey commercial buildings, with a two storey brick building fronting Newport Road and single storey industrial / warehouse buildings behind, which enclose a yard area. The surface of the site is covered in concrete hardstanding. To the south of the site is a 3-storey office building and to the east are commercial units. To the north of the site is a 4-storey apartment building 'Murray Grey House'.

The proposed works entail the demolition of the existing buildings on site, and construction of a stepped 4-storey residential apartment complex, with associated parking and cycle storage.

This statement shall set out the applicable policies on energy for proposed scheme, as well as the methodology for, and results from, an Energy Assessment.

It contains CO_2 emissions assessment in line with the guidance set out by the planning authority and shall detail the energy efficiency measures and low carbon technologies proposed within the design.

In presenting this information the Energy Statement demonstrates that the proposed development will fully satisfy the applicable planning policies relating to energy conservation, regulated building emissions and renewable energy.

3. Planning policy

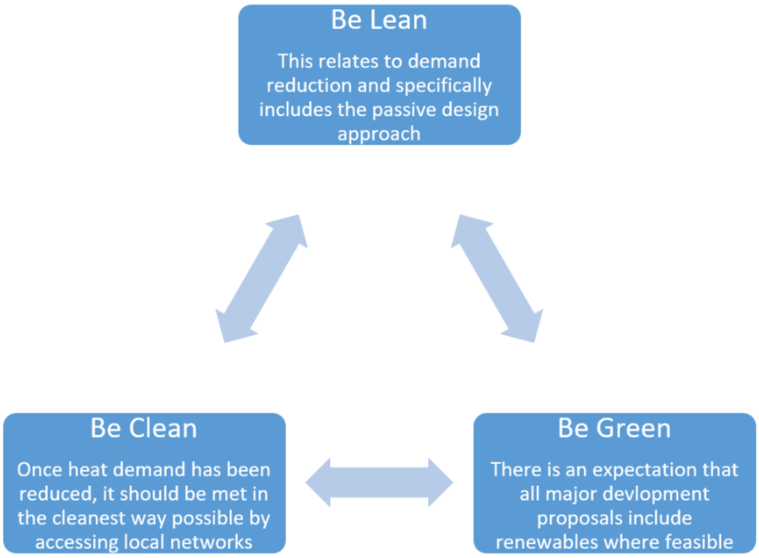
There are a wide range of energy-related planning policies that impact upon the design and construction of new developments. The National Planning Policy Framework (NPPF) 2018, indicates a presumption in favour of sustainable development. The regional policy '*The London Plan 2016'*, sets out a requirement to assess energy demand, adopt energy efficiency measures, and make use of decentralised energy and renewable technology where feasible. The London Borough of Hillingdon Core Policy and Development Management Policies broadly follow the requirements of the London Plan, and the wider Hillingdon Local Plan requires development to demonstrate how the principles of the London Plan have been followed. As the requirements of the London Plan are substantially more onerous than the Local Policies, these have been given precedence within the design process. Therefore, compliance with these policies shall automatically ensure that local policy requirements are exceeded.

London Plan Policy 5.2 Minimising CO_2 Emissions

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

The current residential target under the London Plan is for zero net regulated emissions or 'zero carbon'. To achieve this target, a minimum of a 40% reduction must be achieved on site where possible, with the remaining emissions offset via a 'payment in lieu', to fund energy efficiency improvement measures elsewhere in the Borough. It should be noted that a 40% reduction over 2010 building regulations equates to a 35% reduction over Part L 2013, which is the target referred to throughout this report.

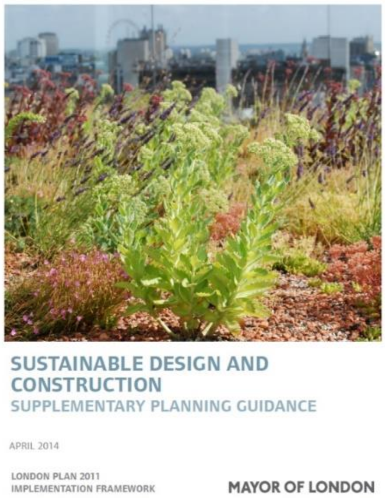
The London Plan details an ‘energy hierarchy’ to be followed. This is to ensure that poorly designed buildings cannot be offset by renewable energy alone.



To demonstrate compliance with the policy it is necessary to assess the energy demand and emissions in detail, and to demonstrate how the “Be lean”; “Be clean” and “Be green” energy hierarchy is being followed and how the emissions targets will be met using efficiency measures, decentralised energy systems and renewable energy technologies as appropriate.

Standard 35 within the Housing Supplementary Planning Guide (SPG) for London outlines the timescales for the introduction of ‘Zero Carbon’. From 1st October 2016, major development or 10 units or more will be required to demonstrate compliance with this standard. Similar to former CO_2 requirements, an on-site saving of at least 35% against *Part L1a: 2013* should be achieved. 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.

London Plan Policy 5.3 Sustainable design and construction



This policy requires sustainable design and construction principles to be considered at an early stage and be integral to the proposal. Guiding principles are set out within the Mayor’s Sustainable Design and Construction SPD. These principles reflect several policies within the London Plan 2016, and include reducing CO_2 emissions, minimising pollution, waste and flood risk, avoiding overheating and increasing site biodiversity. Where feasible, securing sustainable procurement of materials and the use of local suppliers should be preferred.

London Plan Policy 5.6 Decentralised energy in development proposals

All major development is required to investigate the feasibility of decentralised energy, in accordance with the following hierarchy:

1. Connection to an existing or planned heating or cooling network
2. Implementation of a site wide CHP led energy network
3. Communal heating and cooling

London Plan 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 Planning decisions.

Where feasible, renewable energy systems should be incorporated on all development, subject to this not impacting on site biodiversity and avoiding any adverse impacts on air quality.

London Plan Policy 5.9 Overheating and cooling

The Mayor seeks to reduce the impact of the urban heat island effect in London and encourages the design of spaces to avoid overheating. Major development proposals must reduce potential overheating and reliance on air conditioning systems in accordance with the cooling hierarchy:

1. Minimise internal heat generation through energy efficient design
2. Reduce the amount of heat entering a building in summer

3. Manage the heat within the building through exposed thermal mass#
4. Passive ventilation
5. Mechanical ventilation
6. Active cooling systems

Local policy

The Hillingdon Core Strategy (adopted 2012) and Development Management Policy (adopted 2013) detail the sustainability target and aspirations for the borough. These targets follow the same approach of the current London Plan 2016.

Prior to closure of the assessment scheme, new residential developments were required to achieve a minimum of level 4 against the Code for Sustainable Homes Although official certification is no longer be required, the energy requirements of level 4 of the Code for Sustainable Homes is for a 25% reduction in CO_2 emissions, which shall be exceeded as a matter of course, to meet the zero-carbon policy of the London Plan 2016.

4. Calculation methodology

The Energy Assessment undertaken follows the detailed methodology set out within the Greater London Authority (GLA) guidance document *“Energy Planning – GLA guidance on preparing energy assessments (March 2016)”*.

As such, the scheme has had its regulated energy demand and emissions calculated using the Standard Assessment Procedure (SAP) 2012. This is the Government’s approved tool for assessing regulated carbon emissions from dwellings and is used to demonstrate compliance with the *Building Regulations Part L: Conservation of Fuel and Power*. The unregulated energy demand has been estimated using the latest version of Bredem-12, as developed for use in the now repealed *‘Code for Sustainable Homes’*.

The ‘Baseline’ case for emissions was determined by using the ‘Target Emission Rate’ (TER) from the compliance calculations. These figures provide an emission rate for the ‘notional’ target building, and hence a figure for acceptable total regulated emissions. The emissions saving from energy efficiency proposals (BE LEAN) was determined by comparing the total emissions from the TER figures, with the predicted dwelling emission rate (DER), based on the proposed specification. The potential emission savings from decentralised energy (BE CLEAN) and renewable energy (BE GREEN) proposals, were then appraised, in line with the GLA requirements.

It should 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 envisioned 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.

5. Establishing the baseline emissions

The SAP calculations have been undertaken to assess regulated energy use, accounting for energy demands from space heating and hot water, and electricity for pumps, fans and lighting. A separate calculation has been completed for unregulated energy demand.

The TER is the maximum permitted emissions for the dwellings and is expressed in $kgCO_2/m^2$. Thus, the total baseline emissions for the residential scheme are the product of the TER and the total floor area.

The unregulated emissions can be estimated using BREDEM-12. However, since the developer has no control over this aspect of energy use, no energy saving measures can be proposed. Therefore, no change to the unregulated emissions will occur.

Scenario	Annual CO_2 emissions (Tonnes CO_2/annum)	CO_2 reduction (%)	Cumulative CO_2 reduction (%)
Baseline Regulated	29.45	-	-
Baseline Unregulated	29.71	-	-

6. 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 notional baseline emissions.

At an early stage, the design team have explored a range of energy efficiency measures including enhanced U-values, enhanced construction details to minimise thermal bridging, and the use of efficient mechanical ventilation systems. The London Plan target under the ‘Be Lean’ policy is to exceed the requirements of *Part L:2013* using energy efficiency measures alone.

6.1 Thermal envelope

Fundamental to achieving energy efficiency in any new 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 2013. It is shown that the proposed specification represents a significant betterment of the minimum standards.

Element	Proposed	Minimum	Improvement
External Walls	0.18 W/m²K	0.30 W/m²K	40%
Walls to unheated spaces	0.18 W/m²K	0.30 W/m²K	40%
Roofs	0.12 W/m²K	0.20 W/m²K	40%
Ground Floors	0.12 W/m²K	0.25 W/m²K	52%
Separating floors to unheated areas (refuse, cycle stores etc)	0.12 W/m²K	0.25 W/m²K	52%
Doors	1.5 W/m²K	2.2 W/m²K	32%
Air Permeability	4.0 m³/hm²	10 m³/hm²	60%

Glazing is proposed as a mild solar control glass throughout the development, in order to balance solar gain.

The proposed glazing specification can be seen below:

Element	U-Value	G-Value
All Glazing	1.4 W/m²K	50%

It is possible that alterations to the above glazing specification shall be made during detailed design, with higher G-value glass to the north façade where overheating is not generally an issue, and lower G-values to the southern and western façades where limiting solar gains is beneficial. However, this shall need to be investigated thoroughly during the detailed design to ensure the aesthetics of the proposals are not adversely impacted.

In addition to the primary envelope specification, non-repeating thermal bridging shall play a vital role in reducing energy demand, by ensuring that heat leakage at junctions is kept to a minimum. As a minimum, it is proposed that all junctions shall match or exceed Accredited Construction Details (ACD) standards where possible. The below table details the psi values targeted within the development.

Junction	Psi-Value	Reference
Lintels	0.23	Keystone (or equivalent)
Jambs	0.05	ACD
Ground Floor	0.16	ACD
Party Floor Between Dwellings	0.07	ACD
Flat Roof	0.04	ACD
Flat Roof with Parapet	0.28	ACD
Corner	0.09	ACD
Corner (inverted)	0.00	Default
Party Wall between dwellings	0.06	ACD
Party Roof (ceiling insulation)	0.24	Default
Party Floor (to ground)	0.16	Default

6.2 Building services

For the ‘Be Lean’ case, the GLA guidance states that the same heating specifications must be used as per the ‘baseline’ case. This is so that the improvements from energy efficiency measures alone can be understood.

The heating systems used within the assessment are independent gas fired Worcester Greenstar 32CDI[2] compact combination boilers, with a seasonal efficiency of 89.8%

Therefore, the applicable building services improvements relate to the controls, ventilation, lighting and auxiliary power equipment.

The below tables detail the proposed building services specification.

Residential Services	Specification
Heating System	Worcester Greenstar 32CDI compact (or similar) 89.8% SAP Seasonal efficiency
Heating System Controls	Time and temperature zone control with delayed start thermostat
Hot Water System	From combination boiler
Internal fixed lighting	100% ‘Low Energy’
Ventilation	Vent-Axia Sentinel Multivent continuous MEV system (or similar) SFP 0.25 W/l/s

6.3 Be Lean results

The below tables detail the CO_2 savings from the ‘Be Lean’ assessment

Scenario - Residential Scheme	Regulated CO_2 emissions (Tonnes CO_2/annum)	CO_2 reduction (%)	Cumulative CO_2 reduction (%)
Baseline	29.45	-	-
Be Lean	28.18	1.27	4.29

As detailed in the table above, the passive design proposals demonstrate a 4.29% reduction in CO_2 emissions over the regulatory requirement of the building regulations, exceeding the London Plan policy as required by the London borough of Hillingdon.

[2] The finalised boiler specification has not been agreed, and shall be investigated during detailed design. However, the performance standards noted shall be met

6.4 Summertime overheating

Effects of overheating have been well documented over recent years, often cited to result from climate change and modern materials and construction techniques.

Although guidance exists across the industry to forecast the risk of overheating, design considerations are often required at concept stage to provide adequate mitigation.

Requirements

For new-build construction projects, reducing the risk of overheating should be given consideration at the earliest possible opportunity. Although certain measures can be incorporated at later stages, the most robust and effective techniques are often inherent to a buildings design.

The ‘cooling hierarchy’, referred within Policy 5.9 of The London Plan indicates the preferred approach to reducing overheating risk and a reliance upon mechanical cooling. The hierarchal steps are;

1. Minimise heat generation through energy efficient design.

2. Reduce the amount of heat entering a building in summer.

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

4. Passive ventilation.

5. Mechanical ventilation

6. Mechanical cooling.

Glazing proportion and specification

The location, proportion and specification of glazing should aim to balance natural light and ‘beneficial’ solar gain whilst ensuring that levels of heat gain are not excessive. Glass manufacturers offer a broad variety of products including solar control coatings to enable the level of transmitted solar gain (denoted by the glass 'g-value') to be reduced with minimal impact upon visual performance. Certain glass specifications may be more appropriate for certain orientations, e.g. a lower g-value to a south/west façade than the north/east.

In a similar vein to solar control glass coatings, external solar shading can be used to prevent the direct transmission of solar gain whilst enabling glazed areas to be maintained or, maximized. Horizontal overhangs are usually more appropriate for south facing windows due to higher sun angles. Conversely, vertical fins are more appropriate for east and west facing windows where sun angles are lower. Internal blinds can also play an important role in mitigating overheating. However, preventing the solar gain from reaching the window realises much greater performance.

Thermal Mass

Thermal mass is a physical property which defines the ability of an object or, construction to absorb heat energy; the greater the mass, the greater the heat absorption potential. Higher thermal mass construction enables heat to be absorbed during the day then released at night. This can reduce daytime temperatures and improve the thermal stability of a building. However, as greater energy is also then required to 'heat' the fabric, overall consumption can increase. Therefore, as with all approaches, a balance must be struck. Thermal mass can be increased by exposing dense fabric or increasing the physical connection between finishing materials, e.g. plaster, and the structural core, e.g. blockwork. Lighter-weight structures which do not offer high levels of energy-absorption potential are often at greater risk of suffering summertime overheating.

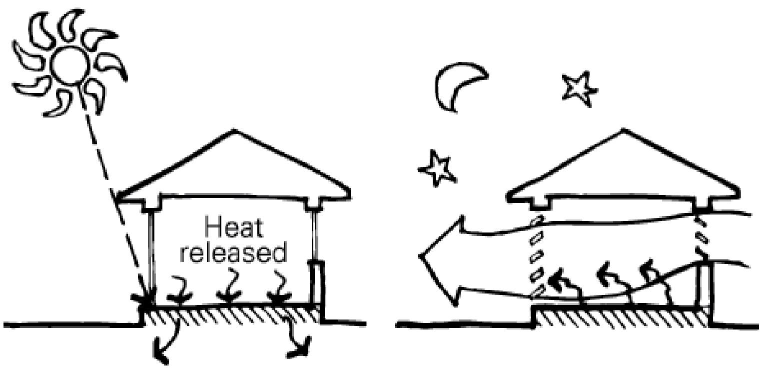


FIGURE 1: PRINCIPLES OF THERMAL MASS[3]

[3] http://www.yourhome.gov.au/passive-design/thermal-mass

Ventilation

The ventilation strategy is critical to overheating performance. Background ventilation levels are low compared to the airflow rates generally required to purge heat. Therefore, the ventilation strategy must enable the greatest volume of air possible to be moved should the requirement arise. The potential rate of ventilation is determined by several factors including;

- Opening type, size and duration.

- Building height and exposure.

- The number of storeys and opportunity for cross-ventilation.

Ventilation openings should enable the greatest possible opening for the greatest duration without compromising security and water ingress protection.

Proposed mitigation strategy

A dynamic thermal model has been constructed to support this Energy Statement, and an overheating risk analysis of the entire site undertaken.

The building shall benefit from a reasonably high level of thermal mass, owing to the preferred masonry construction style. A G-value of 0.5 has also been specified to reduce solar gain in the summer. Useful solar shading is proposed by way of overhanging balconies.

All habitable areas are to have openable windows for passive purge ventilation. Security measures shall also be put in place to allow partial operation of ground floor windows overnight, to purge built up heat.

Advice on managing overheating risk in hot weather shall also be included within the Home User Guide, to ensure that occupants understand how to operate the blinds and windows effectively.

The use of independent boilers per apartment shall not result in any internal heat gain from DHW circulation pipework, which in addition to an environmental ventilation strategy, shall mitigate any concerns of excessive temperatures within communal corridors.

The thermal comfort assessment indicates that the overheating risk can be reduced to an acceptable level. Due to the preliminary nature of the assessment, it is proposed that the mitigation strategy be reviewed during detailed design, in order to ensure that the most appropriate measures are adopted.

7. Be Clean: Supply energy efficiently

7.1 District heating

Where location and development permits; the opportunity of connecting to existing district heating networks or the creation of new district heating networks should be considered. District heating networks have the potential to offer significant energy, carbon and cost savings over localised alternatives. District heating networks often utilise low-carbon energy generation/harnessing technologies such as Anaerobic Digestion (AD), Combined Heat and Power (CHP) and Waste Heat Recovery (WHR). District networks also enable heat loads to be balanced between sites and therefore plant to operate more continuously and efficiently.

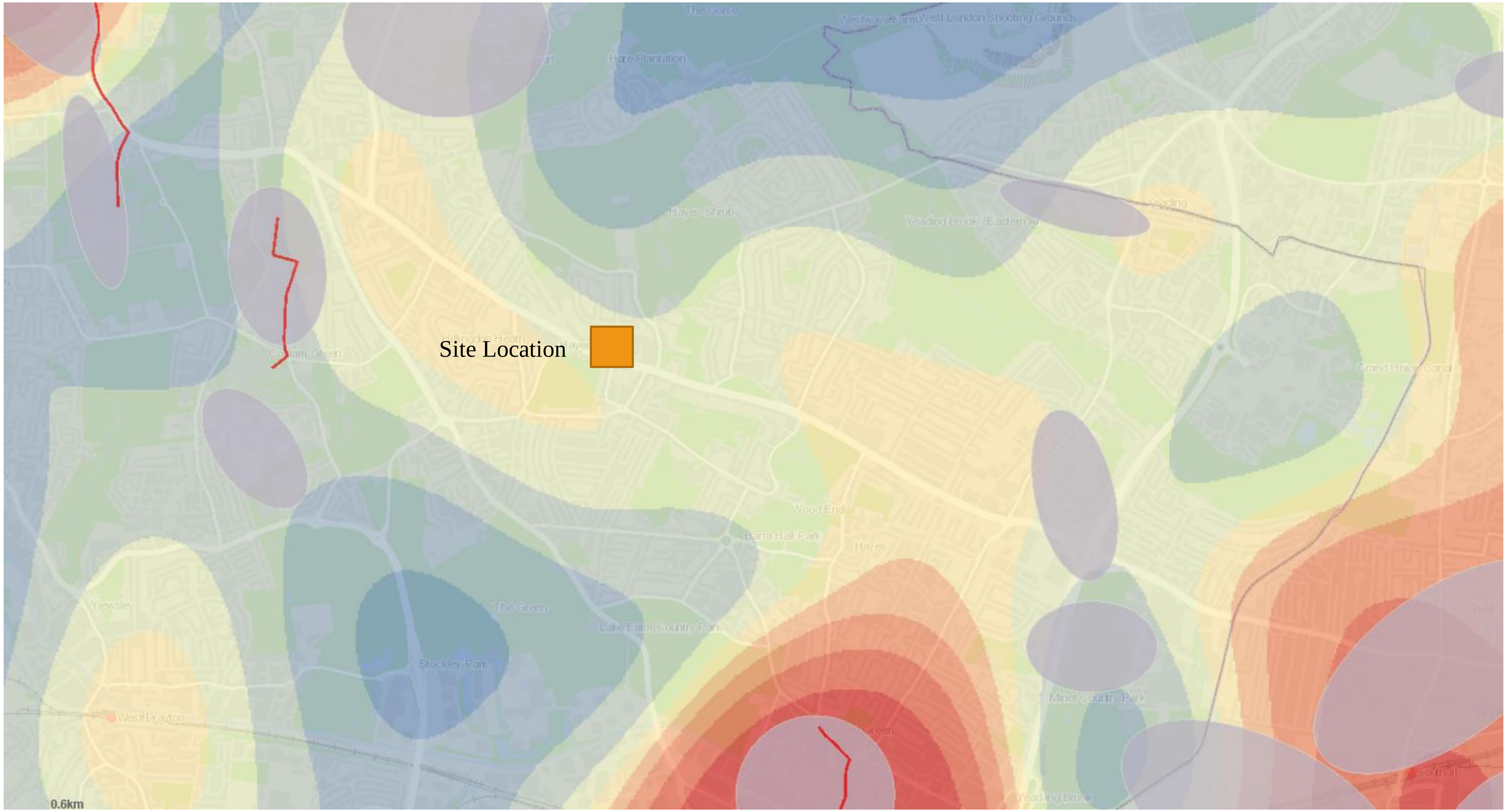
District energy networks are only generally feasible where there is a high density of heat demand. Capital costs and distribution losses must be relatively insignificant to support their viability. Where an opportunity exists, the network operator should be contacted to assess the viability and costs of current or, future connection.

In London, there is a desire to generate at least 25% of heat and power through localised decentralised energy systems by 2025. As such, the London Boroughs were commissioned to identify the energy loads and energy densities within their region. This information has been used to develop The London Heat Map which shows the potential, proposed and existing district heat networks.

The London Heat Map has been investigated for the development site. This shows there to be no existing or, proposed district heating networks within the vicinity of the development.

The proposed development comprises of 24 no. residential apartments. In addition to a high-performance specification, the predominant annual heating load is likely to be from Domestic Hot Water (DHW) and limited to one or two peak periods during the day. In addition to capital costs, the thermal losses and circulation energy are likely to make a district or, community network technically and economically unviable.

From the review of the surrounding area, using the London Heat Map, it has been found that the immediate vicinity of the development is an area of very low energy density, with most of the residential accommodation consisting of low-rise housing. For this reason, and the technical limitations above, it is considered extremely unlikely that a district heating scheme shall be implemented in this area in the future.



Red = Potential DH Network Yellow = Existing DH network Grey = Area of Decentralised Energy Potential

7.2 Combined Heat and Power (CHP)

CHP systems are recognised as a desirable way of reducing energy wastage and resulting carbon dioxide emissions. While generally operating on fossil fuel, mainly natural gas, and using reciprocating engines or gas turbines to drive electrical generators, their advantage is that the waste heat produced by the engine or turbine (the reason for the familiar “cooling towers” at power stations) is collected and put to good use providing space heating and hot water. This means that the overall fuel efficiency can be increased significantly. The efficiency of the systems is such that the carbon dioxide emissions produced by the engine are typically similar to the “marginal” generating plant feeding the National Grid, so the result is that the “waste” heat is effectively generated at a near-zero emissions rate.

However, CHP, although highly desirable, does have practical limitations. The principle requirement is that to be effective, all of the energy produced must be utilised. This means that all the electricity must be used in a financially sound manner and all the waste heat must be put to good use – preferably to meet a heat demand. This is generally not an issue when CHP is used in a district heating scheme as these schemes, with a substantial number of users, tend to have a good balance of loads through the year, but can it pose significant challenges when CHP is proposed for a single user or building. As such, and in order to be economically and technically feasible, a base heating load should exist to support regular and constant operation. The current rule of thumb calls for a minimum running-hours of 5000 per annum.

CHP engines are most ideally suited to developments which require significant and regular heat, e.g. swimming pools, care homes and hotels. They are not generally suited to developments where the heat load is sporadic or, infrequent, e.g. residential, offices and schools.

It is considered, that where residential developments are large, i.e. circa 500+ units, CHP may be an economic solution[4]. Viability may also exist in smaller mixed-use developments (circa. 350 units) where additional heat loads are present. In smaller residential developments, heat loads are too low and infrequent to support CHP without small engines and large buffer vessels. In addition to higher relative distribution losses, a smaller CHP system is also likely to offer a lower electrical efficiency and higher resulting

[4] ENERGY PLANNING, Greater London Authority guidance on preparing energy assessments, The London Mayor, March 2016.

NOx emissions. For these reasons, CHP is deemed not applicable to the development, and would likely result in an increase in real-world emissions, rather than a reduction.

7.3 Be Clean summary

There are currently no existing or proposed district heating networks within the vicinity of the development site. Furthermore, the London Heat Map confirms the heat density within the region to be low. Therefore, connection to an existing network is not an option at the moment nor does the energy profile support development of a new network.

Integration of CHP or a local heat network to this development would not be technically or economically viable due to a low and infrequent heat demand and high relative distribution losses.

In instances of development of less than 350 units, where CHP is not deemed applicable and no future heat networks are planned, a site heat network should not be expected of developers[5], as there is no prospect of connecting to an area heat network. Because of this, the relatively high distribution losses from such a site network could realise greater long-term emissions than dwelling specific solutions.

Therefore, individual gas boilers have been specified as the preferred conditioning strategy for the apartments. Due to the limitations of the site and impracticalities identified above, this is considered an acceptable approach under the current GLA guidance.

It is understood that the 35% site reduction target shall still apply to the scheme, which shall be accomplished using renewable energy technology.

The below table details the CO_2 emissions after the 'Be Clean' assessment, detailing no improvement at this stage.

Scenario - Residential Scheme	Regulated CO_2 emissions (Tonnes CO_2/annum)	CO_2 reduction (%)	Cumulative CO_2 reduction (%)
Baseline	29.45	-	-
Be Lean	28.18	4.29	4.29
Be Clean	28.18	-	4.29

[5] ENERGY PLANNING, Greater London Authority guidance on preparing energy assessments, The London Mayor, March 2016.

8. Be Green

8.1 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.

8.2 Solar photovoltaics

Photovoltaic technology – the direct generation of electricity in semi-conductor panels when these are exposed to sunlight, is not new. The first PV cells were demonstrated in the late 1950s although the physics had been known since the beginning of the 20th century. There are three types of modern silicon semiconductor panels; monocrystalline; polycrystalline; and thin film; plus, a new technology that involves screen printing non-silicon nano-technology inks on to a flexible substrate. In many ways, these products are similar, with outputs ranging from 50 to 150 kWh/m2. However, the main thrust of development now is towards reducing cost, with potential cost reductions of up to a factor of 10 being claimed for the nano-technology systems once they are in volume production.

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. As photovoltaic panels produce electricity, they substitute for the energy type that has the highest emissions of carbon dioxide per kWh of delivered energy of any common fuel type. This means that although the energy output can be quite modest, the carbon dioxide emissions saved can be very worthwhile.

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 over-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. So, while being relatively expensive in terms of capital cost per kWh, they perform much better when measured in terms of cost per kgCO2 saved, and in “whole life” cost terms, larger installations can perform the best of all technologies, even at current prices.

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 manufacture (panel manufacture uses large amounts of electricity and greenhouse gases such as SF6 which has a Global Warming Potential 24,000 time greater than CO2). Studies have shown that when analysed in this way the effective whole life emissions rate of a typical photovoltaic panel is approximately 0.050 kgCO2/kWh compared to the much lower rates of 0.008 kgCO2/kWh for wind turbines and 0.025 kgCO2/kWh for biomass systems. So, although in the UK, the compliance methodologies do not consider “embodied” emissions, they are real, and for photovoltaic panels, substantially larger than for most other technologies. Of course, once the panels are manufactured in plants powered by renewable energy, this problem will be substantially reduced, and the new nano-technology systems are far less energy intensive.

This development proposal is well suited to photovoltaic panel technology, the flat roof to the building should allow for minimal over-shading, and has easy access for maintenance.

PV specification

Unfortunately, due to conflicting demands for the roof area no renewables can be installed. The original submitted energy report included an area of photovoltaic (PV) panels. Due to planning requirements to provide amenity space for the residents, there is no available roof area to support the installation of a PV array.

8.3 Be Green results

The below tables detail the CO_2 savings from the 'Be Green' assessment

Scenario - Residential Scheme	Regulated CO_2 emissions (Tonnes CO_2/annum)	CO_2 reduction (%)	Cumulative CO_2 reduction (%)
Baseline	29.45	-	-
Be Lean	28.18	4.29	4.29
Be Clean	28.18	-	4.29
Be Green	28.18	-	4.29

9. Carbon offsetting

As of the 1st October 2016 it is a requirement of the London Plan Policy 5.2 that all major residential development must achieve the Zero Carbon Standard. This is done by meeting a minimum onsite CO_2 reduction of 35% against the *Building Regulations Part L (2013)* baseline, and then offsetting the remaining emissions via a financial contribution to the relevant Borough's carbon offset fund.

Contributions to the carbon offset fund are to be spent within the vicinity of the named development and used for retrofitting existing buildings, decentralised energy networks, renewable energy or any other programme that achieves a calculable reduction in carbon emissions.

The emissions from the proposed scheme have been shown to have been reduced by 4.29% over the *Part L* baseline, which equates to a reduction in regulated CO_2 emissions of 1.27 tonnes of CO_2 per year.

The total remaining emissions are calculated as 28.18 tonnes/CO_2/year. In accordance with the London Borough of Hillingdon planning policy, the offset fee is calculated as £60/tonne for a period of 30 years (equivalent to £1,800 per tonne). The offset fee required can therefore be calculated as per the below:

Carbon Emissions (tonnes/CO_2 year)	Offset Payment (£1,800/tonne)
28.12	**£50,724**

10. Conclusions

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

The opportunity for connected heat and CHP has been evaluated and found to be technically and economically unviable. It has also been determined that a district scheme is highly unlikely to be introduced to the area in the future, due to the relatively low heat density of the surrounding residential area. Therefore, high efficiency ultra-low NOx boilers have been specified per individual dwelling, reducing the air pollution, distribution losses and life cycle carbon emissions associated with the development.

The option of installing renewables has been assessed and proposed within the original energy report. There is limited roof area and following a debate with the London Borough of Hillingdon planning department it was concluded that the most beneficial usage is for residential amenity space. Therefore the scheme will not have a PV array installed.

Finally, the remaining emissions shall be offset via a financial contribution to the London Borough of Hillingdon's carbon offset fund. In order to contribute to sustainable improvements elsewhere in the Borough.

Therefore, the foregoing results show that the development proposals shall meet the applicable planning policies of the London Plan: Policy 5.2: Minimising Carbon Dioxide Emissions; Policy 5.3 Sustainable Design and Construction; Policy 5.6: Decentralised Energy in Development Proposals; and Policy 5.7: Renewable Energy, in addition to the local policies of the London Borough of Hillingdon.

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 commercial 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.

In this case, we have established that the hot water demand for the Development will be met by a CHP, which is considered incompatible with solar thermal technology. For these reasons, solar hot water is not considered feasible on this development.

Micro-Hydroelectricity

The utilisation of "water power", together with "wind power" 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 clearly 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 only 0.1%, 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.

Heat Pumps

Heat pumps collect low temperature heat from renewable sources and "concentrate" it to a usable temperature. Fossil fuel based (grid) electricity is generally required to operate the pumps and the renewable component of the output is therefore by convention taken as the difference between the output energy and the input energy. A typical heat pump will deliver 4-5 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 3-4 kWh of renewable energy.

There are two common types of heat pump – ground source and air source. In urban locations ground source heat pumps are rarely viable, due to the complexity of drilling boreholes to collect heat. These are typically up to 100m 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. Air source heat pumps collect heat from the ambient air using air-heat-exchanger units.

The installation of air source heat pumps for each dwelling was investigated, however would require the situation of 24 external evaporator units, whilst theoretically possible, this would have had serious acoustic implications for neighbouring property, as well as significantly altering the aesthetics of the proposals. For these reasons, heat pumps were discounted and demed unfeasible for this development.

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 CO2. 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. In this instance, it is not considered a viable option.

Appendix B – CO_2 emission factors

These factors are taken from SAP2012 version 9.92, Table 12 and are used in Part L: 2013 of the Building Regulations. They have superseded the factors used in Part L: 2009, and due to significant differences, can result in different level of emissions reduction, particularly with CHP systems and PV panels where grid displaced electricity is considered.

It should be noted that these emission factors must be used to ensure a comparative approach between development, irrespective of the accuracy of the BRE data.

Fuel	CO2 emission factor kgCO2/kWh
Natural gas	**0.216**
LPG	**0.241**
Heating oil	**0.298**
House coal / Anthracite	**0.394**
Smokeless fuel (inc. coke)	**0.347**
Dual fuel appliances (mineral + wood)	**0.226**
Wood logs	**0.019**
Wood chips	**0.016**
Wood pellets	**0.039**
Grid supplied electricity	**0.519**
Grid displaced electricity	**0.519**
Waste heat from power stations	**0.058**