



ENERGIST

BEYOND BUILDING

Energy Strategy

Milton Place

On behalf of Gravesham Community Investment Partnership LLP

HI.MP.DA12

R02

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1. EXECUTIVE SUMMARY

This Energy Strategy has been produced by Energist UK on behalf of GCIP ('the Applicant'). It supports an application for the Milton Place site ('the Development'). This application is being submitted to Gravesham Borough Council. This report addresses the domestic development as described herewith in.

By adopting principles of sustainable design, and through the incorporation of efficient, Low and Zero-Carbon (LZC) technologies, the Applicant will successfully deliver the local planning policies as per the Gravesham Local Plan Core Strategy 2014, with reference to relevant aspects of Policy CS18: Climate Change. This Energy Strategy has been written in accordance with the principles of paragraphs 5.14.41 (Water demand management) and 5.14.42 (Carbon Reduction).

The Applicant is committed to a design approach aligned with the principles of the energy hierarchy. The development aims to achieve a significant reduction in regulated CO₂ emissions compared to the Target Emission Rate (TER) outlined in Approved Document Part L (AD-L) 2021, employing a comprehensive strategy encompassing 'Be Lean', 'Be Clean' and 'Be Green' measures.

Be Lean: Passive design measures will be integrated to reduce CO₂ emissions, including energy-efficient building fabric, high-quality insulation across floors, walls, and roofs, double-glazed windows, low-energy lighting, and efficient ventilation system. The report shows an 0.7% domestic improvement over the baseline.

Be Clean: Due to lack of a DHN for connection there are no 'Be Clean' measures to demonstrate.

Be Green: The Applicant aims to enhance the integration of LZC technologies, proposing a renewable energy strategy to supply heat and hot water to the dwellings via heat pump technology. The LZC technology will allow the development to achieve an additional 59.3% reduction in regulated CO₂ emissions via LZC measures.

Carbon Reduction Policy (Section 5.14.42) and Compliance Considerations:

The Carbon Reduction policy (Section 5.14.42) does not specify a percentage target for carbon reduction. Instead, it sets general requirements for:

- Decentralised energy projects that align with national and local policies.
- Low-carbon and renewable energy.

However, policies such as The London Plan (2021) set clear and ambitious expectations for major residential developments:

- A minimum 35% reduction in regulated CO₂ emissions on-site beyond Part L 2021.
- An aspirational target of 50% on-site carbon reduction for residential developments to further support London's net zero carbon goals.

The Milton Place site exceeds these benchmarks, achieving a 60.0% reduction in regulated CO₂ emissions on-site. This exceeds both the 35% minimum and the 50% aspirational target set by the London Plan (2021) by 10%, contributing significantly to carbon reduction objectives.

In accordance with the strategy outlined above, the ultimate estimated carbon emissions for the development are summarised in Table 1 and Figure 1 below.

Table 1: Regulated CO₂ savings from each stage of the Energy Hierarchy for the residential element of the site

	<i>CO₂ emissions</i>	
	<i>Tonnes of CO₂ per annum</i>	<i>% reduction</i>
Target Emission Rate (TER): Compliant with AD L 2021	62.40	-
Be Lean: After demand-reduction measures	61.95	0.7%
Be Clean: Viability of heat networks	61.95	0%
Be Green: Low-carbon and renewable energy	24.97	59.3%
Total cumulative savings	37.43	60.0%

The development has maximised every opportunity to reduce emissions where practicable on site through a combination of efficient fabric and design, and efficient low carbon heating systems to make significant reductions in CO₂ emissions against the baseline.

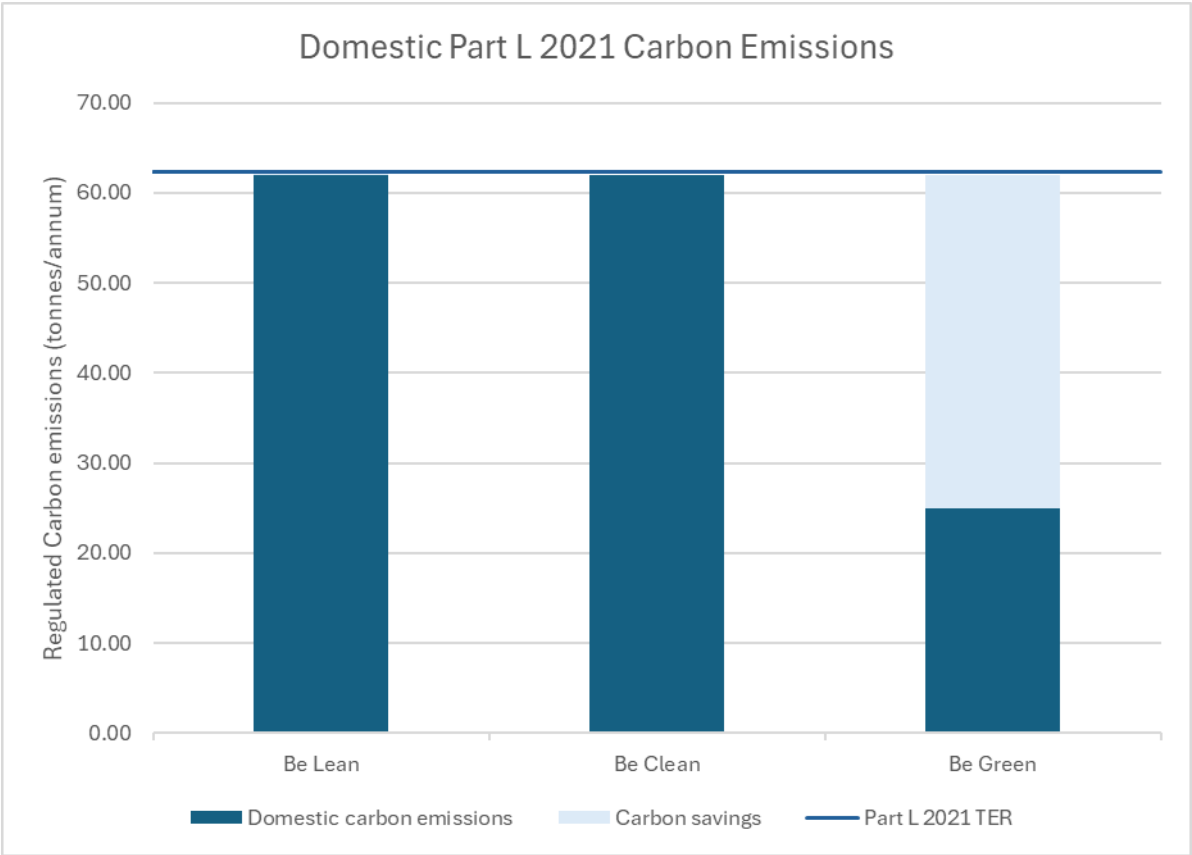


Figure 1: The estimated carbon emissions reductions for the site against the Part L 2021 target

1. INTRODUCTION

This Energy Strategy has been produced by Energist UK on behalf of GCIP ('the Applicant').

It supports an application for the Milton Place ('the Development'). This application will be submitted to Gravesham Borough Council.

This Energy Strategy describes demand-reduction measures, energy-efficiency measures, and LZC technologies in relation to how the Applicant meets the objectives of the energy hierarchy: 'Be Lean', 'Be Clean', and 'Be Green':

- i) National Planning Policy Framework (NPPF, 2023).
- ii) The Gravesham Borough Council Policy CS18 on climate change mitigation measures to:
 - Achieve significant carbon emissions reductions on site by implementing principles of the energy hierarchy.
 - Achieve a water usage standard of 105 litres/person/day.

Gravesham Borough Council Policy CS18 requires that 5% of homes on Key Sites serve as exemplars by achieving higher water efficiency standards, specifically 80 litres per person per day, in line with Code for Sustainable Homes Level 5/6.

Based on available information, Milton Place does not seem to be designated as a Key Site in the Gravesham Borough Council Local Plan Core Strategy. Therefore, the 80 litres per person per day requirement does not apply to this development.

2. DEVELOPMENT OVERVIEW

2.1 GENERAL INFORMATION

The Development is located at Milton Place, DA12 2PQ, which falls under the jurisdiction of Gravesham Borough Council.

The proposed redevelopment aims to deliver 76 residential units, consisting of 61 apartments and 15 houses.



Figure 2: The site layout of the Development
(Source: 02324-JTP-MP-RF-DR-A-10007 - Sitewide GA Plan - Roof Plan_D6)

3. METHODOLOGY

The purpose of the Energy Strategy is to demonstrate the Applicant's commitment to delivering the principles of the energy hierarchy.

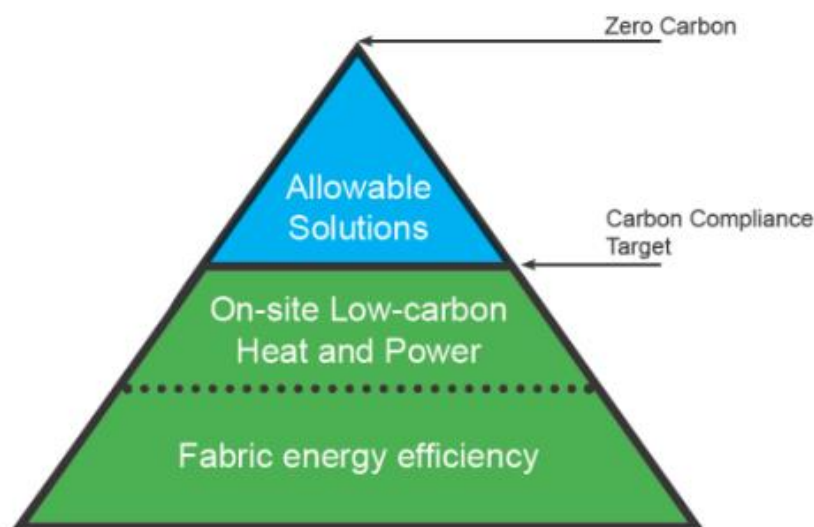


Figure 3: The Energy Hierarchy (source: *The Gravesham Local Plan Core Strategy 2014*)

The Strategy is assessed against, and presented, to align with the following steps:

The Baseline: The development's baseline energy demand and the Target Emission Rate will be calculated to establish the minimum on-site standard for compliance with AD L 2021.

Be Lean: The Development's Dwelling Emission Rate (DER) will be calculated to explain how the Applicant's design specification has led to a reduced energy demand and improved fabric-energy efficiency.

Be Clean: The potential to provide energy to the Development in an efficient way, by either connecting to a District Heat Network (DHN) or installing a site-wide, low-carbon energy system on site.

Be Green: The LZC technologies will be assessed for their suitability and viability in relation to the development. Solutions will be put forward for the Development and the resulting regulated CO₂ emission savings presented.

3.1 ASSESSMENT METHODS

At each stage of the energy hierarchy, the estimated energy performance of the Development has been calculated using the SAP 10.2 methodology to calculate representative residential dwellings. This sample size is considered appropriate for the purposes of extrapolation.

SAP

SAP calculates the regulated energy demands associated with hot water, space heating and fixed electrical items. Part L1 is used for the purposes of the new build energy assessment. The cumulative floor areas for a representative 12 sample dwellings have been used to estimate the TER and DER for new dwellings within the proposed development.

4. THE DEVELOPMENT BASELINE

In order to measure the effectiveness of 'Be Lean' demand-reduction measures, it is first necessary to calculate the baseline energy demand for the development and this has been done using the SAP 10.2 methodology. This is also referred to as the Target Emission Rate (TER).

The resulting AD L 2021 TER for the development has been calculated using Part L model designs which have been applied to the Applicant's development details. The TER, or baseline energy demand represents the maximum regulated CO₂ emissions that are permitted for the development in order to comply with AD L 2021.

The resulting TER under AD L 2021 has been calculated as 62.40 tCO₂/year for the domestic areas. Please refer to Appendix 3 for energy assessment summary spreadsheet, and Appendix 4 for sample TER and DER worksheets.

5. BE LEAN: REDUCED ENERGY DEMAND

The development achieves a high-quality sustainable design by integrating the following passive and active design measures to reduce energy demand:

- Energy-efficient building fabric with insulation across all heat loss floors, walls, and roofs.
- Strategic management of solar gains, optimizing in winter and minimizing in summer.
- A commitment to quality construction, verified through achieving excellent air-tightness results.
- Implementation of low-energy lighting throughout the Development.

Designing an efficient thermal envelope will greatly reduce the need for space heating as heat transmittance through the thermal elements is reduced, whilst low air permeability rates will also reduce heating demand by reducing the volume of air that can enter the building, minimising heat losses in the winter and heat gains in the summer.

As part of a fabric first approach, the building fabric has been carefully considered and specified to meet or exceed AD L 2021 minimum requirements. The proposed 'Be Lean' design specification is presented in the table below.

Table 2: The 'Be Lean' design specification

Element	'Be Lean' Design Specification
Exposed floor (<i>U-value</i>)	0.10 W/m ² .K
External walls (<i>U-value</i>)	0.15-0.22 W/m ² .K
Heatloss roof (<i>U-value</i>)	0.10 W/m ² .K
External Doors (<i>U-value</i>)	1.20 W/m ² .K
External windows (<i>U-value</i>)	Double Glazing, U-value of 1.20 W/m ² .K, G-value of 0.45 for houses G-value of 0.40 for apartments <i>(options will be reassessed during the detailed design phase; if these glazing specifications prove unviable, the design team will ensure that the design remains achievable)</i>
Air permeability	3.00 m ³ /h.m ² @ 50Pa
Thermal bridging approach	Recognised Construction Details Psi values targeted
Ventilation system	Centralised MEV
Main heating system	Mains gas boiler
Cooling system	None

5.1 BE LEAN CARBON EMISSIONS REDUCTION

The Applicant's design specification and proposed demand-reduction measures for the Development have been modelled using SAP 10.2 methodology for domestic areas. This allows the effectiveness of 'Be Lean' measures to be assessed as a percentage reduction in CO₂ emissions over the baseline for both domestic and commercial elements of the Development separately. Refer to Appendix 4 for sample TER and DER worksheets.

The Applicant made every effort to achieve a high performing fabric and Part L 2021 compliance. By incorporating sustainable design, the Applicant will reduce regulated CO₂ emissions over AD L 2021 across the development.

This commitment to sustainability is demonstrated in Table 3 below, which indicates a 0.7% improvement in domestic energy performance compared to the baseline.

Table 3: Domestic CO₂ savings from adopting an energy efficient specification

	<i>Total regulated emissions (Tonnes.CO₂/yr)</i>	<i>Regulated CO₂ emissions savings (Tonnes.CO₂/yr)</i>	<i>Percentage saving (%)</i>
Target Emission Rate: Compliant with AD L 2021	62.40	-	-
Be Lean: After demand-reduction measures	61.95	0.45	0.7%

6. BE CLEAN: HEATING INFRASTRUCTURE

To ensure compliance with the energy hierarchy, the potential to supply energy efficiently to the development and further reduce regulated CO₂ emissions through 'Be Clean' measures, has been evaluated. This has been done with attention to the following hierarchy for selecting an energy system:

- 1) Connection to an area wide heat network.
- 2) Communal heating system:
 - Site-wide heat network.
 - Building-level heating system.
- 3) Individual heating system.

There is so no evidence that there are any district heating opportunities in the surrounding areas, and due to the relative low density of the development the Applicant has proposed individual heating systems to all dwellings on site.

6.1 BE CLEAN CARBON EMISSIONS REDUCTION

For this development there are no 'Be Clean' emissions to report as the heating and hot water needs are to be met via heat pump technology. Carbon emission reductions achieved via heat pumps are encapsulated at the 'Be Green' stage.

7. BE GREEN: LOW-CARBON AND RENEWABLE ENERGY

In line with local planning policy, the Applicant seeks to maximise opportunities for incorporating LDC technologies as part of their energy strategy for the development.

LDC technologies have been assessed for their viability as a component of a complementary heating strategy for the Development. A detailed review of the LDC technologies is provided in Appendix 5, including wind, solar thermal, biomass, and other heat pump technologies. The Applicant's adopted strategy for LDC technologies is compatible with the 'Be Lean' design specification.

7.1 PROPOSED LOW AND ZERO CARBON TECHNOLOGIES

The Applicant has followed opportunities for incorporating LDC technologies as part of their energy strategy for the Development.

The Applicant will adopt a renewable energy strategy most compatible with the use of current emission factors and incorporates the capability to supply heat and hot water to the dwellings via heat pump technology. Due to the rapidly decarbonising national electricity grid heat pumps are able to benefit from both a low carbon fuel source and high operating efficiencies.

It is currently proposed that the houses will benefit from individual Air Source Heat Pumps for both heating and hot water.

The apartments will have air-to-water domestic hot water heat pumps to provide hot water via LDC energy. Space heating will be met via panel heaters.

7.2 BE GREEN CARBON EMISSIONS REDUCTION

The Applicant has maximised opportunities to incorporate low and zero carbon (LZC) technologies as part of their energy strategy for the Development. It has been calculated that the use of heat pumps will provide a further improvement over AD L 2021 of 59.3%.

Table 4: Domestic predicted CO₂ savings from adopting proposed low and zero-carbon technologies

	CO ₂ emissions	
	Tonnes of CO ₂ per annum	% reduction
Target Emission Rate (TER): Compliant with AD L 2021	62.40	-
Be Lean: <i>After demand-reduction measures</i>	61.95	0.7%
Be Clean: <i>Viability of heat networks</i>	61.95	0%
Be Green: <i>Low-carbon and renewable energy</i>	24.97	59.3%

The Carbon Reduction policy (Section 5.14.42) does not specify a percentage target for carbon reduction. Instead, it sets general requirements for new developments to implement principles of the energy hierarchy. The Milton Place development significantly exceeds the requirements of AD L 2021 TER and goes beyond local policy expectations, achieving a total 60.0% reduction in regulated CO₂ emissions on-site.

8. WATER DEMAND REDUCTION

The water consumption of a property has a significant impact on not only direct operational running costs (i.e., water consumption charges), but also indirectly through additional energy usage and the heating of water for domestic use. This is, in part, reflected in SAP 10.2 methodology.

In line with the Gravesham Local Plan Core Strategy 2014, specifically Policy CS18: Climate Change paragraphs 5.14.41 (Water demand management), the development incorporates water saving measures and equipment to achieve the following water demand standard:

- A water usage standard of a maximum of 105 litres/person/day.

A Part G calculation demonstrating how each standard can be achieved is shown in Appendix 3.

Gravesham Borough Council Policy CS18 requires that 5% of homes on Key Sites serve as exemplars by achieving higher water efficiency standards, specifically 80 litres per person per day, in line with Code for Sustainable Homes Level 5/6.

Based on available information, Milton Place is not designated as a Key Site in the Gravesham Borough Council Local Plan Core Strategy. Therefore, the 80 litres per person per day requirement does not apply to this development.

9. SITE WIDE RESULTS

In accordance with the outlined Energy Hierarchy stages, the final carbon emissions for the development are summarized in Table 5 below.

Table 5: Regulated CO₂ savings from each stage of the Energy Hierarchy

	CO ₂ emissions	
	Tonnes of CO ₂ per annum	% reduction
Target Emission Rate (TER): Compliant with AD L 2021	62.40	-
Be Lean: <i>After demand-reduction measures</i>	61.95	0.7%
Be Clean: <i>Viability of heat networks</i>	61.95	0%
Be Green: <i>Low-carbon and renewable energy</i>	24.97	59.3%
Total cumulative savings	37.43	60.0%

In summary, the proposed Development incorporates the following design measures, aligning with the Energy Hierarchy, to minimize carbon emissions:

- Energy-efficient building fabric with insulation across all heat loss floors, walls, and roofs.
- Strategic management of solar gains, optimizing in winter and minimizing in summer.
- A commitment to quality construction, verified through achieving excellent air-tightness results.
- Implementation of low-energy lighting throughout the Development.
- Provision of renewable energy via heat pumps.

10. CONCLUSION AND RECOMMENDATIONS

The Applicant is dedicated to climate change mitigation for the proposed development, employing a design approach aligned with the energy hierarchy principles. The Development aims to achieve a substantial reduction in regulated CO₂ emissions, implementing measures categorized as 'Be Lean', 'Be Clean', and 'Be Green'.

Be Lean:

- Passive design measures will be integrated, leading to a reduction in regulated CO₂ emissions, surpassing the AD L 2021 TER.
- Energy-efficient building fabric, insulation to all heat loss floors, walls, and roofs, double-glazed windows, low-energy lighting, and an efficient ventilation system contribute to a **0.7%** domestic CO₂ regulated emissions improvement.

Be Clean:

- For this development there are no 'Be Clean' emissions to report as the heating and hot water needs are to be met via heat pump technology. Carbon emission reductions achieved via heat pumps are encapsulated at the 'Be Green' stage.

Be Green:

- The Applicant aims to enhance LZC technology integration, implementing heat pump technology for heating and hot water.
- This initiative targets a further **59.3%** reduction, achieving a cumulative 60% reduction in regulated CO₂ emissions. This significantly exceeds the requirements of AD L 2021 TER and goes beyond local policy expectations.

The figure below presents the ultimate estimated carbon emissions for the Development.

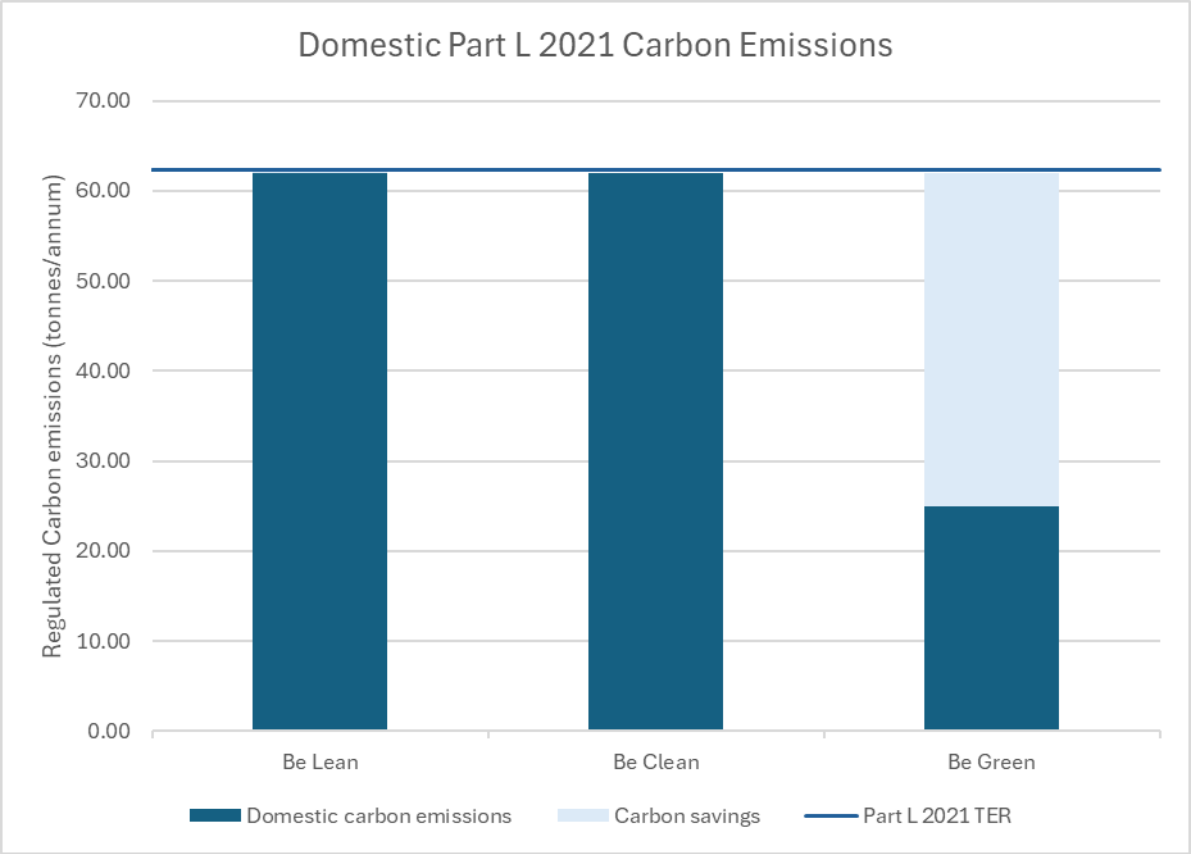


Figure 4: The estimated carbon emissions reductions for the development

Overall, the development is considered to exceed the requirements of Gravesham Borough Council and national planning policies, representing a sustainable development. Notably, the site is expected to exceed some of the most ambitious carbon reduction targets, such as those set by the London Plan (2021), which is often used as a benchmark for sustainability.

APPENDICES

APPENDIX 1: LIST OF ABBREVIATIONS

AD-L 2021	<i>Approved Document Part L of Buildings Regulations 2021</i>
ASHP	<i>Air Source Heat Pump</i>
BER	<i>Building Emission Rate</i>
BRE	<i>Building Research Establishment</i>
CHP	<i>Combined Heat and Power</i>
CIBSE	<i>Chartered Institution of Building Services Engineers</i>
COP	<i>Coefficient of Performance</i>
DER	<i>Dwelling Emission Rate</i>
DHN	<i>District Heat Network</i>
DHW	<i>Domestic Hot Water</i>
DSY	<i>Design Summer Year</i>
EAHP	<i>Exhaust Air Heat Pump</i>
EVC	<i>Electric Vehicle Charging</i>
FEES	<i>Fabric Energy Efficiency Standard</i>
GLA	<i>Greater London Authority</i>
LZC	<i>Low and Zero-Carbon technologies</i>
NCM	<i>National Calculation Methodology</i>
PV	<i>Photovoltaics</i>
SAP	<i>Standard Assessment Procedure</i>
TER	<i>Target Emission Rate</i>
TFEE	<i>Target Fabric Energy Efficiency</i>
VRF	<i>Variable Refrigerant Flow</i>

APPENDIX 2: PLANNING POLICY AND DESIGN GUIDANCE

The Climate Change Act (2008)

Passed in November 2008, the Climate Change Act mandated that the UK would reduce emissions of six key greenhouse gases, including Carbon Dioxide, by 80% by 2050.

As a consequence, the reduction of carbon dioxide emissions is at the forefront of National, Regional and Local Planning Policy, along with continuing step changes in performance introduced by the Building Regulations Approved Document L (2013).

Approved Document L (2021)

This development is subject to the requirements of Approved Document L (2021).

ADL 2013 represented an approximate reduction of 6% in the Target Emission Rate (kg/CO₂/sqm per annum) over the requirements of Approved Document L (2010) for residential development and an aggregate 9% reduction for non-residential development. ADL 2021 has seen a further 31% improvement over these targets.

It also sees the introduction of a Primary Energy Target, a measure of heating demand (kWh/m² per annum) to ensure new-build dwellings with low-carbon heating systems still meet satisfactory energy-efficiency standards.

National Planning Policy Framework (2024)

The National Planning Policy Framework (NPPF) encourages Local Planning Authorities to 'support the transition to a low carbon future in a changing climate, taking full account of flood risk and costal change' (NPPF paragraph 161), 'whilst taking a proactive approach to mitigating and adapting to climate change, taking into account the long-term implication for flood risk, costal change, water supply, biodiversity and landscapes, and the risk of over shading from rising temperatures'. (NPPF Paragraph 162).

Paragraph 165, upholds the requirement for Local Plans to: 'To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- a) provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);
- b) consider identifying suitable areas of renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and
- c) identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for collocating potential heat customers and suppliers.'

In paragraph 166, NPPF stipulates that local planning authorities should take account of the benefits of decentralised energy and passive design measures as a means of energy efficiency in new development: 'In determining planning applications, local planning authorities should expect new development to:

- a) comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and
- b) take account of landform, layout, building orientation, massing and landscaping to minimise energy consumption.'

Gravesham Local Plan Core Strategy 2014 (2014)

Policy CS18

Water Demand Management

5.14.41 The Council will seek to manage the supply of water in the Borough and reduce the impact of new development on the supply of potable water as much as possible.

In particular, the Council will:

- Require all new homes to be built to at least level 3/4 of the Code for Sustainable Homes in terms of water use (105 litres per person per day consumption). Where it can be demonstrated that a development is unable to meet these standards, or the additional standards set out below, permission will only be granted if provision is made for compensatory water savings elsewhere in the Borough;
- Seek 5% of homes on Key Sites to act as exemplars by meeting level 5/6 of the Code for Sustainable Homes in terms of water use (80 litres per person per day consumption);
- Require all non-residential developments of 1,000 sq m and above to meet the BREEAM "excellent" standards of water efficiency and include provision for the collection of rainwater; and
- Support proposals to retrofit existing residential properties in ways which reduce water consumption.

Carbon Reduction

5.14.42 The Council will seek to reduce the overall carbon footprint of the Borough. In particular, the Council will:

- In the context of national policy on the transition to zero carbon development via amendments to Part L of the Building Regulations, require proposals for development of the Key Sites throughout the Borough and other major development elsewhere in the Gravesend Town Centre Opportunity Area to consider the potential and include proposals for low carbon and renewable energy generation, including combined heat and power. Where choosing not to do so, applicants must submit evidence which demonstrates that compliance is not technically or financially feasible or that improved fabric energy efficiency or an allowable solution results in improved carbon saving benefits;
- Support stand-alone decentralised, renewable or low carbon energy development where it is compatible with national policies for protecting the Green Belt and where it accords with policies in this plan, in particular those relating to Development and Design Principles, Transport, Green Infrastructure, and Heritage and the Historic Environment; and
- Support other proposals which lead to a reduction in carbon footprint including the retrofitting of existing homes and businesses, including local initiatives based on carbon off-setting via allowable solution

APPENDIX 3: PART G CALCULATIONS

Table A1: The water efficiency calculator

Installation type	Unit of measure	Capacity / Flow rate	Use factor	Fixed use litres/person/ day	Litres per person per day
WC (single flush)	Flush volume (litres)	0.0	4.42	0	0.00
WC (dual flush)	Full flush volume (litres)	4.0	1.46	0	5.84
	Part flush volume (litres)	2.6	2.96	0	7.70
WCs (multiple fittings)	Average effective flushing volume (litres)	0.0	4.42	0	0.00
Taps (excluding kitchen / utility room taps)	Flow rate (litres per minute)	6.1	1.58	1.58	11.29
Bath (where shower also present)	Capacity to overflow (litres)	155.0	0.11	0	17.05
Shower (where bath also present)	Flow rate (litres per minute)	8.0	4.37	0	34.96
Bath only	Capacity to overflow (litres)	0.0	0.50	0	0.00
Shower only	Flow rate (litres per minute)	0.0	5.60	0	0.00
Kitchen / utility room sink taps	Flow rate (litres per minute)	8.0	0.44	10.36	13.88
Washing machine	Litres/kg of dry load	8.2	2.10	0	17.16
Dishwasher	Litres/place setting	1.3	3.60	0	4.50
Waste disposal unit	Litres/use	0.0	3.08	0	0.00
Water softener	Litres/person/day	0.0	1.00	0	0.00
Total calculated use					112.37
Contribution from greywater (litres/person/day) from Table 4.6					0.00
Contribution from rainwater (litres/person/day) from Table 5.5					0.00
Normalisation factor					0.91
Total water consumption					102.26
External water use					0.00
Total water consumption (litres/person/day)					102.26

APPENDIX 4: SAMPLE SAP REPORTS

Be Lean & Be Green sample TER and DER Worksheets for domestic areas to be provided separately.

APPENDIX 5: LZCT ASSESSMENT

Wind	<i>The ability to generate electricity via a turbine or similar device which harnesses natural wind energy. This could be considered as an onsite solution to reducing carbon emissions (turbines included within the development), or offsite (investing financially into a nearby wind farm).</i>
Installation considerations	- Wind turbines come in a variety of sizes and shapes. Turbines of 1 Kw can be installed to single house and large-scale turbines of 1-2 MW can be installed on a development to generate electricity to multiple dwellings and other buildings. In both instances the electricity generated can be used on site or exported to the grid. Vertical- or horizontal-axis turbines are available. - A roof-mounted 1 kW micro wind system costs up to £3,000. A 2.5 kW pole-mounted system costs between £9,900 and £19,000. A 6 kW pole-mounted system costs between £21,000 and £30,000 (taken from the Energy Saving Trust, TBC by supplier) - Local average wind speed is a determining factor. A minimum average wind speed of 6 m/s is required. - Noise considerations can be an issue dependent on density and build-up of the surrounding area. - Buildings in the immediate area can disrupt wind speed and reduce performance of the system. - Planning permission will be required along with suitable space to site the turbine, whether ground installed, or roof mounted.
Advantages	- Generation of clean electricity which can be exported to the grid or used onsite. - Can benefit from the Feed in Tariff, reducing payback costs.

Disadvantages	- Planning restrictions and local climate often limit installation opportunities. - Annual maintenance required. - High initial capital cost. It is usual for an investor to consider a series of turbines to make the investment financially sound.
Development feasibility x	- Installing a large turbine in an area such as this is not considered to be appropriate due to its appearance and physical impact on the built-up environment. Residents' and neighbours' concerns may include the look of the turbine, the hum of the generator and the possibility of stroboscopic shadowing from the blades on homes. - Wind speed has been checked for the development scheme using the NOABL wind map: http://www.rensmart.com/Weather/BERR. The wind speed at ten metres for the development scheme is 4.8 metres per second (m/s) which is below the minimum of 5 m/s and threshold for technical viability. - Typical payback times for a single turbine are expected to be greater than 15 years which means that the cost of installing and maintaining a single wind turbine is not considered a commercially-viable option.
Solar PV Solar Thermal	<i>The ability to generate energy (either electricity, hot water or a combination of the two) through harnessing natural solar energy. This could include the use of solar thermal panels, photovoltaic (PV) panels, or a combined solution. PV panels, similarly, to turbines, can be considered both on and offsite.</i> Solar Photovoltaics convert solar radiation into electricity which can be used on site or exported to the national grid. Solar Thermal generates domestic hot water from the sun's radiation. Glycol circulates within either flat plate or

	evacuated tube panels, absorbing heat from the sun, and transferring this energy to a water cylinder. A well-designed solar thermal system will account for 50-60% of a dwelling's annual hot water demand. Sizing the system to meet a higher demand will lead to excess heat generation in the summer months and overheating of the system.
Installation considerations	▪ Operate most efficiently on a south-facing sloping roof (between 30- and 45-degree pitch.) ▪ Shading must be minimal (one shaded panel can impact the output of the rest of the array.) ▪ Panels must not be laid horizontally on a flat roof as they will not self-clean. Panels will therefore need to be installed at an angle and with appropriate space between them, to avoid over-shading. ▪ Large arrays may require upgrades to substations if exporting electricity to the grid. ▪ Local planning requirements may restrict installation of panels on certain elevations. ▪ Installation must take into account pitch and fall of the roof, along with any additional plant on the roof to ensure there is sufficient room. ▪ The average domestic solar PV system is 4kWp and costs £5,000 - £8,000 (including VAT at 5 per cent) - (taken from the Energy Saving Trust).
Advantages	▪ Relatively straightforward installation, connection to landlord's supply and metering. ▪ Linear improvement in performance as more panels are installed. ▪ Installation costs are continually reducing. ▪ Can benefit from the Feed in Tariff to improve financial payback.

Disadvantages	▪ Less appropriate for high-rise developments, due to lack of roof space in relation to total floor area. ▪ With Solar Thermal, performance is limited by the hot water demand of the building – system oversizing will lead to overheating.
Development feasibility ✓	▪ The suitability of Solar panels has been considered for this Development and are concluded as a technically-viable option. ▪ There are potential areas of roof space suitable for the positioning of unshaded Solar PV arrays. ▪ The Development is not on land, which is protected or listed, so it is considered that Solar panels would not have a negative impact on the local historical environment or the aesthetics of the area.
Aerothermal	<i>The transfer of latent heat in the atmosphere to a compressed refrigerant gas to warm the water in a heating system. This includes air to water heat pumps and air conditioning systems.</i> Air Source Heat Pumps (ASHPs) extract heat from the external air and condense this energy to heat a smaller space within a dwelling or non-domestic building. A pump circulates a refrigerant through a coil to absorb energy from the air. This refrigerant is then compressed to raise its temperature which can then be used for space heating and domestic hot water. They can feed either low-temperature radiators or underfloor heating and often have electric immersion heater back-up for the winter months.
Installation	▪ ASHPs operate effectively in buildings with a low energy demand, as they emit low levels of energy suitable for

considerations	maintaining rather than dramatically increasing internal temperatures. It is therefore vital that the dwelling has a low heating demand to ensure the system can provide appropriate space-heating capability. ▪ Underfloor heating will give the best performance, but oversized radiators can also be used. ▪ Immersion heater back-up required to ensure appropriate Domestic Hot Water (DHW) temperature in winter months. ▪ Noise from the external unit can limit areas for installation. ▪ £7,000-£11,000 per dwelling (taken from the Energy Saving Trust).
Advantages	▪ Air source systems are a good alternative solution to providing heating and hot water to well-insulated, low heat loss dwellings. ▪ They require additional space when compared to a gas boiler. Space for an external unit is needed, as is space for the hot water cylinder and internal pump. ▪ Heat pumps are generally quiet to run, however if a collection of pumps were used, this could generate a noticeable hum while in operation. ▪ Running costs between heat pumps and modern gas boilers are comparable.
Disadvantages	▪ Residents need to be made aware of the most efficient way of using a heat pump as the low flow rates used by such a system means that room temperature cannot be changed as reactively as a conventional gas or oil boiler system. ▪ Will not perform well in homes that are left unoccupied and unheated for a long period of time. ▪ Back-up immersion heating can drastically increase running costs.

	Noise and aesthetic considerations limit installation opportunities.
Development feasibility ✓	- ASHPs are considered a viable option for this development scheme and shall be utilised as part of an individual heat pump strategy for dwellings. This works well with the reduced energy demand, as achieved through passive design principles. - This presents a zero carbon ready energy strategy for the development, as the national grid continues to decarbonise.

Geothermal	<i>The transfer of latent heat from the ground to a compressed refrigerant gas to warm the water in a heating system. This includes ground source heat pumps. Heat can be collected through the use of either horizontally laid or vertically installed coils.</i> Ground Source Heat Pumps (GSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the ground) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the ground, either through coils or in bore holes and piles, circulating a mix of water and antifreeze to extract energy from the ground, where the year-round temperature is relatively consistent (approx. 10 °C at 4 metres depth). This leads to a reliable source of heat for the building. Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for GSHPs tend to be higher than those of ASHPs.
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Installation considerations	- Require appropriate ground conditions to sink piles/bore holes or excavate for coils (which also require a large area of land.) - Decision between coils or piles can lead to significant extra cost. - Need to consider whether low temperature output is fed through underfloor heating (most efficient) or oversized radiators. - Similar to ASHPs, perform best in well-insulated buildings with a low heating demand. - Electric immersion heater required for winter use. £11,000-£15,000 per dwelling dependent on the size of the system (taken from the Energy Saving Trust).
Advantages	- Perform well in well-insulated buildings, with limited heating demand. - More efficient than ASHPs.
Disadvantages	- The coils can be damaged by natural earthworks and by intensive gardening practices – occupants would need to be aware of the location of the coils for this system, and how to operate the system efficiently. Coils may also be damaged within the dwelling where the circuit is connected to the internal unit. - Will not perform well in buildings that are left unoccupied and unheated for a long period of time. - Back up immersion heating can drastically increase running costs. - Large area of ground needed for coil installation.
Development feasibility x	GSHPs are not considered a viable option for this development scheme as they conflict with the preferred option of ASHP electric heating which works well with the reduced energy demand, as achieved through passive design principles.

Water Source Heat Pumps	<i>The transfer of latent heat from a local water source to a compressed refrigerant gas to warm the water in a heating system. This includes water source heat pumps. Heat can be collected through the use of either horizontally laid or vertically installed coils.</i> Water Source Heat Pumps (WSHPs) operate on the same principle as an Air Source Heat Pump (ASHP) in that they extract heat from a source (in this instance the water) and compress this energy to increase temperature for space heating and hot water. Pipework is installed into the water source, circulating a mix of water and antifreeze to extract energy from the water, where the year-round temperature is relatively consistent (approx. 10 °C below surface). This leads to a reliable source of heat for the building. Again, an electrically powered pump circulates the liquid and powers the compressor, however annual efficiencies for WSHPs tend to be higher than those of ASHPs.
Installation considerations	▪ Require a reliable water source near to the site. ▪ Need to consider affect on the water course. ▪ Need to consider whether low temperature output is fed through underfloor heating (most efficient) or oversized radiators. ▪ Similar to ASHPs, perform best in well-insulated buildings with a low heating demand. ▪ Electric immersion heater required for winter use. ▪ £11,000-£15,000 per dwelling dependent on the size of the system (taken from the Energy Saving Trust).
Advantages	▪ Perform well in well-insulated buildings, with limited heating demand. ▪ More efficient than ASHPs.

Disadvantages	▪ The coils can be damaged by high water flow or low water levels– occupants would need to be aware of the location of the coils for this system, and how to operate the system efficiently. Coils may also be damaged within the dwelling where the circuit is connected to the internal unit. ▪ Will not perform well in buildings that are left unoccupied and unheated for a long period of time. ▪ Back up immersion heating can drastically increase running costs. ▪ Large area of water needed for coil installation.
Development feasibility x	▪ WSHPs are not considered a viable option for this development scheme as they conflict with the preferred option of ASHP electric heating which works well with the reduced energy demand, as achieved through passive design principles.
Biomass	<i>Providing a heating system fuelled by plant based materials such as wood, crops, or food waste.</i> Biomass boilers generate heat for space heating and domestic hot water through the combustion of biofuels, such as woodchip, wood pellets or potentially biofuel or bio diesel. Biomass is considered to be virtually zero carbon. They can be used on an individual scale or for multiple dwellings as part of a district-heating network. A back-up heat source should be provided as consistent delivery of fuel is necessary for continued operation.
Installation considerations	▪ Biomass boilers are larger than conventional gas-fired boilers and also require what can be significant storage space for the fuel source. This needs to be considered at planning stage to ensure an appropriate plant room can be provided.

	▪ Flue required to expel exhaust gases – design needs to be in line with the requirements of the Building Regulations. ▪ Need to consider whether fuel deliveries will be reliable and consistent to the location of the site (especially relevant in rural areas) and whether the plant room can be easily accessed by the delivery vehicle. ▪ £9,000-£21,000 per dwelling dependent on size (taken from Energy Saving Trust).
Advantages	▪ Considerable reduction in CO₂ emissions.
Disadvantages	▪ Limited reduction in running costs compared to A-rated gas boilers, but at a substantially higher up-front cost. ▪ Plant room space required for boiler and storage. ▪ Dependent on consistent delivery of fuel. ▪ Ongoing maintenance costs (need to be cleaned regularly to remove ash.)
Development feasibility x	▪ Biomass is not considered a technically-viable option for the development scheme. The primary reason for this is down to the development's location within the context of London and the negative environmental impact of high levels of NO_x gases that are emitted from biomass boilers and the subsequent impact on local air quality. This is contrary to planning policies for air quality in London. ▪ There are also concerns regarding a sustainable supply of biomass to the site. ▪ The capital installation cost would be high which leads us to the conclusion that biomass would not be a commercially viable option for this development scheme.

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