ENERGY STATEMENT

Residential development

52 New Street, Ash, Canterbury, Kent

Prepared for:
Classicus Estates Ltd

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EXECUTIVE SUMMARY

This report has been compiled in order to provide an Energy Statement in support of an outline planning application for a new development of 52 residential Units on land at 52 New Street in Ash, Kent.

It has been compiled by Sol Environment Ltd on behalf of Classicus Estates Ltd (‘*the applicant*’). The statement has been formulated in accordance with the adopted Dover District Core Strategy, emerging Dover District Local Plan to 2040 and the adopted Ash Parish Council Neighbourhood Plan.

The statement includes an Energy Assessment, and the subsequent Energy Strategy has been prepared such that it is aligned with the Energy Hierarchy (see Section 2.1), with focus on sustainable building design (reduction of energy consumption at source) and provision of energy efficiency measures; and to also assess the viability of including building integrated LZC technologies.

To meet the planning policy requirements, the proposed high level energy strategy recommends utilising passive design measures, a well-insulated and airtight building fabric, high efficiency Air Source Heat Pump (ASHP) system, and/or a Solar PV array.

The conclusion of the energy statement is that the energy performance of the development has potential to meet the requirements of current Building Regulations Part L (2021), and performance standards set out in Ash Parish Council Neighbourhood Development Plan 2018-2037, the Dover District Council Local Plan (Adopted 2010) and the emerging Dover District Council Local Plan Draft (EDDCLP).

The energy strategy assesses the following measures (in order in accordance with the Energy Hierarchy):

- Passive solar design; building orientation, room layout, limiting solar gain etc.
- Energy efficient design; heat loss parameter (insulation) and air tightness of dwellings, energy efficient fittings and controls.
- Incorporation of LZC heating / cooling technologies.

The following measures are recommended to achieve the policy requirements:

- High performance insulated building fabric u-values:
  - External Walls – 0.18 W/m^{2}K
  - Floors – 0.11 W/m^{2}K
  - Roof – 0.13 W/m^{2}K
  - External Doors – 1.0 W/m^{2}K
  - Windows (G-Value) – 1.2 (0.8) W/m^{2}K
  - Party Walls – 0.0 W/m^{2}K
- Air Tightness – 5 m^3/ (h.m^2)
- Thermal Bridging y value – 0.05 W/m^{2}K (Accredited Construction Details assumed)

- Space and Water heating – Air Source Heat Pump (electricity fuelled, COP >2.5), with Heat Recovery unit (>89% efficiency with summer-bypass). Space heating will be delivered by underfloor heating and radiators and controlled via time and temperature zone control.
- LZC Technologies – it is recommended that a PV array is installed to south facing roofs where additional CO_2 emissions are required to be offset to meet the building regulations and planning policy requirements.
- *NOTE:* Although ASHPs are recommended a gas boiler could still meet the Future Homes/Part L 2021 requirements. If a gas boiler heating system is the client's preferred solution this is likely that the development will need to install significantly more PV to meet the minimum standards.

The above strategy is based on high level documentation only. It is recommended that a detailed energy strategy is prepared during the reserved matters application to confirm the energy performance of the development once the detailed documentation is prepared.

There are no existing or planned decentralised heat networks within the vicinity of the proposed site and the overall density of the proposed development is not suitable for the installation of a new network to cover the whole site.

1. INTRODUCTION

1.1 Background

Sol Environment Ltd ('Sol' hereafter) were engaged by Classicus Estates Ltd ('the applicant' hereafter) to undertake an energy demand assessment and produce an Energy Statement for the proposed development located at 52 New Street, Ash, Canterbury, Kent.

1.2 Proposed Development

The proposed development will consist of 52 residential Units, ranging from 1 to 4 bed homes, with disabled parking, cycle storage and resident amenity space. The proposed development has the following description:

"Outline planning permission with all matters reserved (except for access) for the demolition of existing buildings, including 51-53 Sandwich Road, and the erection of up to 52 new homes, including affordable, access from New Street and Sandwich Road, together with associated parking, open space, landscaping, drainage and associated infrastructure"

A site illustrative masterplan showing the proposed development is provided below. Note, only the area edged in red is relevant to this report.

Fig 1.1: Proposed Site Plan prepared by Taylor Roberts Ltd. NOTE: only the area edged in red is relevant to this report.

1.3 Relevant Policy

This report has been prepared by Sol Environment Ltd in cooperation with the applicant and in accordance with National Planning Policy Framework, Building Regulations, Ash Parish Council Neighbourhood Plan 2018-2037 (Adopted September 2021) and Draft Dover District Council Local Plan to 2040 (Reg 19 version October 2021). Below is a summary of the legislation, guidance and policies relevant to this report:

The National Planning Policy Framework

The National Planning Policy Framework ('NPPF') was published in July 2021, replacing the previous NPPF that was adopted in February 2019. The revised NPPF sets out the Government's planning policies for England and how they are expected to be applied. It sets out a framework that aims to achieve sustainable development throughout the planning system with three overarching objectives – economic, social and environmental.

At the heart of the NPPF is a 'presumption in favour of sustainable development', which requires Local Authorities as part of any plan-making or decision-making, to provide clear guidance on how the presumption should be applied locally.

The NPPF sets out how to deliver sustainable development under 17 subheadings. Subheading 14 of the NPPF outlines how the planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

Building Regulations Part L 2021

The previous Building Regulations (2013) was adopted in June 2013 and was updated in July 2022 to the Building Regulations Part L (2021) version following the Future Buildings Standards consultation document published by the Government in January 2021. This document sets out the changes to regulations as a step towards the aim to deliver Zero Carbon ready homes by 2025.

The changes to Part L require all new residential developments to produce around 31% less carbon emissions than is acceptable by the previous Part L (2013) minimum standards.

Ash Parish Council Neighbourhood Plan

Policy ANP5 Climate Change

- Proposals for new development will be supported where it is evident that they seek to meet the following criteria:
    - a) are designed to minimise vulnerability to the range of impacts arising from climate change by maximising energy efficiency, utilising low carbon energy and reduce greenhouse emissions;
    - b) are resilient to climate change and demonstrate how the development will respond to climate change adaption measures;
    - c) incorporate one or more low carbon technologies;
    - d) do not increase, and where possible, reduce surface water run-off through increased permeability of surfaces and the use of Sustainable Drainage Systems;
    - e) incorporate, where appropriate, bio-diverse green roofs and green walls;
    - f) provide public or private open space that is accessible to shade and shelter and is multi-functional;
    - g) provide opportunities to encourage local food sources, recycling and composting;
    - h) adopt the Home Quality Mark and Passivhaus design standards;
    - i) provide electric vehicle car charging points; and
    - j) provide good quality pedestrian/cycle infrastructure.
- New developments should reduce greenhouse gas emissions by the use of renewable and low carbon energy and heat by reflecting the Government's policy for national technical standards.
- New developments should submit a positive strategy as part of the planning application, demonstrating how the development will achieve carbon sequestration. It should also demonstrate how low energy consumption will be achieved based upon low carbon technologies (e.g. air/ground source heat pumps, photovoltaic panels, solar water heating, rainwater harvesting etc.). If a positive strategy cannot be achieved, a statement outlining the reasons why it cannot be achieved will be required

<u>Emerging Dover District Council Local Plan Draft 2040 (Reg 19 version October 2021)</u>

Policy CC1: Reducing Carbon Emissions

In the event that the Future Homes Standard is required to be delivered through the planning system, all new residential dwellings must achieve, as a minimum, a reduction in carbon as required by this Standard.

This should be achieved using the measures set out below:

a. An increase in fabric standards to deliver a 'fabric first' approach to new development; and
b. The use of on-site renewable and low carbon energy technologies.

Until the introduction of the Future Building Standard, all new non-residential buildings must achieve BREEAM 'Very Good' standard overall, including Very Good for addressing maximum energy efficiencies under the energy credits.

Development proposals subject to this policy must submit an Energy Statement in the case of residential applications and a BREEAM pre-assessment for commercial developments as part of a planning application to demonstrate how the policy requirements above have been complied with. Policy requirements will be secured by condition.

Policy CC2: Sustainable Design and Construction

In order to mitigate against and adapt to the effects of climate change all new buildings should:

a. Utilise layout, orientation, massing and landscaping to make the best use of solar energy, passive heating and cooling, natural light and natural ventilation;
b. Prioritise the use of low embodied carbon and energy efficient building materials and construction techniques;
c. Consider the lifecycle of the building and any associated public spaces, including how they can be easily modified to meet changing social and economic needs and how materials can be recycled at the end of their lifetime;
d. Provide measures to adapt to climate change, including the provision of water efficiency measures in accordance with Policy CC4, green infrastructure in accordance with Policies CC8, PM1 and PM3 and Strategic Policies SP2 and SP14, sustainable drainage systems (SuDS) in accordance with Policy CC6, suitable shading of gardens and other open spaces, rainwater harvesting, drought resistant landscaping; and in the case of major developments, the shading of pedestrian routes and the provision of opportunities for growing food.
e. Minimise waste and promote recycling, during both construction and occupation.

All applications for new buildings should be accompanied by a Sustainable Design and Construction Statement demonstrating how the requirements of this Policy have been met

Policy CC3: Renewable and Low Carbon Energy

Development to generate energy from renewable and low carbon sources will be supported where it is demonstrated that:

a. The environmental, social and economic benefits of their proposals are made clear;
b. It will not result in significant harm to the surrounding area, landscape character, natural or heritage assets, habitats, biodiversity, or wildlife (particularly protected species), having special regard to the natural beauty of the Kent Downs AONB;
c. There is no significant loss of amenity to local residents by virtue of visual impact, noise, disturbance or odour;
d. The proposals will conserve and enhance the natural environment through measures such as improvements to biodiversity;

e. There is no loss of the best and most versatile agricultural land, unless that it can be demonstrated that no alternative lower grade land is available;
f. It will not result in an unacceptable impact on the local transport network that cannot be satisfactorily mitigated;
g. Any fuel required is sustainably sourced.

All applications for renewable and low carbon energy developments should include a supporting statement

1.4 Policy Review

This Energy Statement has been prepared for the development to show how the proposed scheme could achieve compliance with the above current policy requirements. In addition to the adopted guidance, consideration has also been given to the relevant policy within the emerging Dover District Council Local Plan Draft (EDDCLP).

The EDDCLP is at a relatively advanced stage of preparation and Regulation 19 version was issued for consultation in October 2021. Therefore, the emerging provisions of the EDDCLP has been used to inform the design of new homes in the proposal and can be shown to achieve the emerging policy position. In particular, in accordance with Policy CC1: Reducing Carbon Emissions the design team are working towards a new future homes standard with the intention that all new residential dwellings will achieve, as a minimum, a reduction in carbon as required by this Standard. This also meets the recent changes to Building Regulations (2021 update).

The measures set out in this Energy Statement are based around the Energy Hierarchy and adopt a fabric first approach, in particular aiming to minimise energy consumption and focusing around energy efficiency in the development. More information on the approach to the Energy Hierarchy is contained in Section 2.

The proposed energy strategy is therefore satisfactory to meet all emerging and current adopted local and national policy.

2. ENERGY ASSESSMENT

This section comprises the Energy Assessment for the proposed development, in accordance with the Ash Parish Council Local Plan in addition to the Emerging Dover District Council Local Plan.

2.1 The Energy Hierarchy

The Energy Hierarchy adopts a set of principles to guide design development and decisions regarding energy, balanced with the need to optimise environmental and economic benefits. The Hierarchy, which is a widely accepted approach amongst many Councils, seeks to ensure that developments meet the Council's objectives of incorporating energy efficiency through the approach detailed in Figure 2.1.

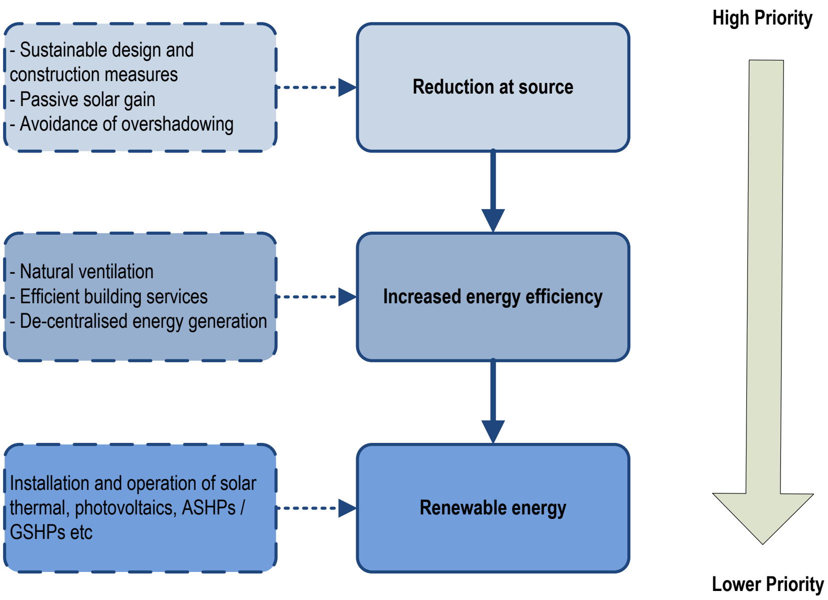

Figure 2.1: The Energy Hierarchy

It is considered that the above principles for carbon reduction form the most appropriate approach from both a practical and financial perspective. The industry is broadly in agreement that energy efficiency and low carbon technologies have the greatest impact in offsetting CO_2 emissions. Therefore, it is logical to encourage enhanced mitigation through energy efficiency and low carbon technologies in the first instance, with the application of renewable energy technologies as a secondary measure to reduce the primary energy requirements of a building.

Consequently, as a result of the above principles, the first stage in the energy strategy for the proposed development is the consideration of energy efficiency measures to ensure that the baseline energy demand is minimised.

2.2 Site Layout and Building Design

2.2.1 Overview

It is stated within the Part L of the 2021 Building Regulations that 'measures to make the building energy efficient must be incorporated within the scheme design.'

Typically, passive energy efficient design measures can bring about a significant improvement upon the Dwelling Emission Rate ('DER') in new built projects, as a result of energy efficiency measures alone.

2.2.2 Passive Solar Design

Passive design measures manage internal heating through solar gain and as such reduce the need for cooling. Buildings that are aligned in a north-south orientation are observed to maximise daylight and sunlight (i.e. solar gain), subsequently reducing energy consumption associated with excessive heating and lighting requirements.

It is recommended that glazing rates be specified to ensure that high levels of natural light and solar gain are afforded by the use of larger windows to be located on the east-, south- and westerly building aspects. The detail design team should further optimise solar gain through the consideration of the solar orientation of internal facilities. The majority of unoccupied building service areas and stairwells should be incorporated, wherever possible, into the areas which are not served by high levels of natural light.

The site has been designed in consideration of the parameters detailed within Table 2.1 and performance has been maximised in the absence of any constraints. Specific objectives related to overshadowing are referenced in Box 2.1 below.

Box 2.1: *Minimising Overshadowing*
1 *– The proposed accommodation rates (number of dwellings per hectare) allow for all dwellings on-site to have the opportunity to be designed and laid out such that potential overshadowing issues are alleviated, through low building heights and the separating distance between them.*
2 *– Where no restrictions apply due to the masterplan site layout, service and auxiliary areas (ie those that do not require heating) shall be located to the north of the building, therefore maximising the utilisation of solar gain for living spaces and subsequently lower residual energy consumption.*

The internal aspects of the development shall be designed (wherever possible) to further maximise the benefits provided by solar orientation. Subsequently, it is recommended that the dwellings shall be constructed to specified design briefs and the principles detailed in Box 2.2 below.

Box 2.2: ***Building Design Principles***

1 – Where orientation provides favourable conditions and no physical restrictions are provided by surrounding buildings, the glazing ratios within the development shall be designed such that potential for solar gain is maximised.

2 – Consideration will be given to the design of the internal envelopes of the proposed development, which will seek to utilise materials that not only provide high insulation values, but also have a high thermal mass.

3 – Accredited Construction Details will be used and to achieve a ***maximum Y-value of 0.05 W/m²K*** *limiting thermal bridging.*

4 – Consideration will be given to the selection of insulation materials for the building, ensuring the following heat loss parameters (U-Values) as a minimum:

Component	Limiting U Value	Notional U Value
External Walls	0.26	0.18
Roof	0.16	0.11
Floor	0.18	0.13
Doors	1.6	1.0
Windows	1.6	1.2 (0.8 G-Value)

5 – The dwellings shall not exceed a ***maximum air permeability of 5m³ / (hr.m²).*** *This shall be achieved through the following measures;*

- *Adequate sealing between openings / windows and panels;*
- *Adequate sealing of ceiling-to-wall joints;*
- *Provision of a continuous air barrier over ceiling areas and adequate sealing of service ducts (where appropriate);*
- *High specification openings (see Objective B4);*
- *Brick / block construction will be mitigated against through application of wet plastering / parging / dry lining.*

The general topography of the development site (gently sloped) provides limited opportunities regarding the maximisation of solar gain from a topographical perspective. Subsequently it is recommended that the developer implement the following measures (detailed in Box 2.3) in order to improve the amenity of the scheme with regards to landscape strategy.

Box 2.3: *Landscaping*
1 *– Where possible proposed landscaping to the south-west boundary of the site will be maximised to provide protection for the dwellings from the prevailing south-westerly winds.*
2 *– It is recommended that the majority of planted trees on-site (particularly those south of proposed buildings) will be of a deciduous variety, such that solar obstruction is minimised, and penetration of low-level winter sun is allowed.*

Consideration has also been given to minimising excessive solar gain and subsequent building overheating, thus avoiding excessive use of mechanical cooling systems in the summer months. Mechanical (forced draught) ventilation systems can account for a significant percentage of building energy use due mainly to the forced draught and fan plant required to maintain sufficient through-flow of internal air.

Mechanical ventilation will only be provided in the areas of the buildings where it is required to meet building regulations requirements.

Box 2.4: *Limiting Excessive Solar Gain*
1 *– In order to limit the requirement for excessive mechanical cooling, cross or stack-ventilation shall be provided where possible and practicable, in the form of secure openable windows and trickle vents, such that night cooling can be encouraged without compromising building security.*
2 *– Natural ventilation shall be utilised within all buildings on-site (unless specific conditions require the use of mechanical ventilation such as wet rooms / trickle vents etc).*
3 *– Where the external envelope has large glazed areas, the windows shall be inset from the main external building facade (wherever possible) or fitted with low emissivity coatings such that potential overheating is minimised.*

2.2.3 Energy Efficiency Measures

In addition to regulated emissions (heating, cooling and ventilation), energy consumed by ancillary activities (primarily electricity consumption derived from the use of lighting and electrical appliances) is anticipated to account for approximately 30-40% of the overall CO_2 emissions from the development.

It is recommended that the following energy efficiency measures shall be installed such that unnecessary energy consumption is reduced at source (in accordance with the Energy Hierarchy).

Box 2.5: *Energy Efficiency Measures*

1 *– All fixed lighting will comprise dedicated low energy fittings (i.e. those which are only capable of accepting low energy lamps with a luminous efficacy of ≥75 lumens-per-circuit Watt).*

2 *– The building shall be fitted with AMR energy display devices for the provision of half hourly energy consumption data.*

3 *– All occupants shall be provided with a 'Home User Guide', which shall provide information on energy systems within the building and details on best practice and energy saving techniques.*

4 *– All dwellings with off street parking will be supplied with electric vehicle charging points.*

2.3 Energy Modelling

2.3.1 Overview

To meet the requirements of the Dover District Councils Core strategy, and Ash Parish Councils Local Plan aims, an assessment of the carbon dioxide emissions has been prepared for the development, this will demonstrate the expected carbon dioxide emission savings from low carbon and any renewable energy measures incorporated in the development.

The following appraisal reviews the carbon reduction opportunities with a particular focus on meeting the prevailing energy efficiency standards and will then assess the feasibility of which on-site LZC technologies will be most suitable if required to meet Building Regulations minimum standards.

In order to assess opportunities and show required percentage reduction in CO_2 emissions, the applicant has commissioned a high-level feasibility study to ascertain the predicted carbon dioxide emissions for the site and select appropriate LZC technologies.

2.3.2 Energy Assessment

In order to determine the type and size of LZC technology suitable for the site, a high-level baseline modelling and assessment exercise was undertaken.

Proprietary energy demand calculations for the proposed development have been undertaken using SAP modelling software.

In accordance with Part L of the current Building Regulations (2021), the performance of the building fabric and services must not exceed the 'limiting factors'. To achieve the required Part L compliance dwellings fabric u-vales and services efficiencies are significantly better than the Part L limiting factors (as can be seen in Columns 2 and 3 in Table 2.1), and the passive design and energy efficiency measures nominated in Section 2.2 of this report have been implemented.

Implementing the above specification details into the energy model, initial energy demand calculations for the buildings have been undertaken; these provide a '*baseline*' scenario from which further calculations can be progressed to establish the proposed renewable energy systems.

Due to the outline nature of the proposals, only indicative high-level SAP modelling has been undertaken. It is recommended that detailed energy modelling for each dwelling type is conducted for the reserved matters application once detailed information is available.
Table 2.1 below provides a summary of the various recommended scenarios.

Table 2.1: Summary of SAP Modelled Scenarios to Building Regulations 2021			
Parameter		Scenarios	
		Baseline Part L compliant TER (with limiting factors)	Proposed Scenario (with notional factors)
Dwelling Emission Rate ($kgCO_2/m^2/year$)		*Est. – 12.23*	*Est. – 5.45*
U-Values ($W/m^2.K$)	Walls	0.26	0.18
	Roofs	0.16	0.11
	Floors	0.18	0.13
	Doors	1.6	1.0
	Windows	1.6	1.2 (0.75 G-Value)
Y-Values		0.15	0.05
Air permeability ($m^3/(hr.m^2)$ @ 50 Pa)		8.0	3.0
Heating / Domestic Hot Water (DHW)	Type	Notional Gas Boiler	ASHP / Heat Recovery
	Efficiency	85%	COP 2.5 / 89%
	Fuel	Gas	Electricity
	Controls	Room thermostats; programmer	Room thermostats; programmer; TRVs
	DHW	From Main Heating System	From Main Heating System
Cooling		-	No cooling
Internal Lighting		-	100% non-dedicated low energy, >75 Lumens/circuit Watt
Renewable		-	1.9kWp Solar PV Array (where required)

2.3.3 Energy Strategy Summary

To meet the planning policy requirements, the proposed high level energy strategy recommends utilising passive design measures, a well-insulated and air tight building fabric, high efficiency Air Source Heat Pump (ASHP) system, and a Solar PV array.

A fabric first approach has been agreed and a good specification for building fabric, driven by achieving necessary values of Dwelling Fabric Energy Efficiency (DFEE), the development aims to achieve, as a minimum, a reduction in carbon as required by the Future Homes Standard (as required by the emerging Local Plan) which will also meet current Part L 2021 requirements.

It is recommended that space and hot water heating could be provided by high efficiency Air Source Heat Pumps.

Where further energy savings are required to meet planning policy and Part L requirements it is recommended that an array of roof mounted solar PV is installed.

NOTE: Although ASHPs are recommended a gas boiler could still meet the Future Homes/Part L 2021 requirements. If a gas boiler heating system is the client's preferred solution this is likely that the development will need to install significantly more PV to meet the minimum standards.

2.4 Low-Zero Carbon Technologies Feasibility Review

Combined Heat & Power and District Heating

CHP comprises combination of the generation of electricity for general consumption, with the recovery of exhausted heat energy (otherwise emitted from power stations / generators as waste heat) which can be used to provide heating for domestic and industrial processes.

Although not considered a renewable source (excepting biofuel-fired plants), CHP plants (typically 75% - 80% efficient) are significantly more efficient than a typical oil / gas fired power station (35% - 45% efficient), even when it is used in combination with fossil fuels such as gas and diesel. Therefore, they are viewed as being more efficient than obtaining energy from the National Grid ('the grid').

In addition, transmission losses (typically 5% when consuming electricity from the grid) are minimised by on-site generation and, as such, a gas-fired CHP can be seen as a relatively carbon efficient means of energy supply.

Box 2.6: Feasibility Summary – CHP
The installation of a CHP system was considered but has been discounted on the basis that the inconsistent load requirements of the residential development are not suited to a CHP plant. District heating was also considered, but due to the relatively low density of the development, rural location and the lack of an existing district heat network in the vicinity it was discounted as a viable option. There are no existing or planned decentralised heat networks within the vicinity of the proposed site.

Solar Thermal Heating / Hot Water

Solar thermal panels are typically used in order to provide supplementary heat for the purposes of space heating or domestic hot water (DHW).

These systems consist of solar collectors, a pump, a control unit, connecting pipes, hot water tank and a conventional heat source (gas / oil fired boiler). The collectors are usually mounted on the roof and provide heat to a fluid circulated between the collectors and a water tank. The efficiency of solar collector panels depends on a number of factors, including the type of collector, correct installation, location and orientation.

Installing solar thermal heating panels could reduce energy consumption and carbon impacts through significant reductions in electric water heating and typically produce approximately 5-600 kWh/m² of hot water.

Although evacuated tube systems are about 30% more efficient, they have a corresponding increased capital outlay. A collector area of 4–5 m^2 will normally save approximately 230kg of CO_2 emissions per year. A well-designed system should satisfy 70-80% of the hot water demand in the summer and 20-30% in the winter.

Box 2.7: Feasibility Summary – Solar Thermal
Based on the orientation of the dwellings and the available roof space DHW heating via installation of solar thermal was considered a viable option, but the design team preferred to utilise the available roof space for a solution that involved Solar PV panels instead. Therefore, a roof mounted solar thermal panels are NOT considered a preferred option.

Ground Source Heat Pumps

Ground Source Heat Pumps (GSHPs) operate by the removal of residual heat from the ground by using various 'loops' containing a water and glycol fluid mix, heat from the ground is absorbed into this fluid and is pumped through a heat exchanger in the heat pump. Low grade heat passes through a compressor and is concentrated into a higher temperature gas capable of heating water for DHW and central heating systems.

There are a number of configurations for GSHP systems. A vertical collector system is considered to be the most appropriate in the context of the proposed development given the large scale of the system and limited area available for horizontal collectors. Vertical collectors can be between 15-180m deep and minimum spacing between adjacent boreholes should be maintained at 5-15m to prevent thermal interference.

The heat yielded from GSHPs is relatively small (collecting approximately 14-20W_{th} per metre of collector loop), therefore the adequacy of the accompanying heat exchanger is vital in ensuring greater heat transfer (although more efficient exchangers have a significantly larger capital cost).

The performance of a GSHP system is entirely dependent on the appropriateness of the ground conditions (i.e. depth of soil cover, the type of soil or rock, ground temperature and thermal conductivity), which would be established subject to a ground survey.

'Reversible' heat pumps systems are also available that give the potential for provision of space cooling, if required. Groundwater can also be used to cool buildings where a suitable source exists, abstraction and discharge permissions can be obtained from the Environment Agency and test bores are favourable.

Box 2.8: Feasibility Summary – Ground Source Heat Pumps
Installation of GSHPs for the provision of primary space / DHW heating for the building is not considered feasible due to financial reasons and the large amount of ground works required to install a GSHP system.

Air Source Heat Pumps

Air source heat pumps (ASHPs) absorb heat from ambient air in order to provide heat for the purposes of space heating and domestic hot water. An evaporator coil mounted outside absorbs the heat; a compressor unit then drives refrigerant through the heat pump and compresses it to the right level to suit the heat distribution system.

Finally, a heat exchanger transfers the heat from the refrigerant for use, depending on which of the two main types of systems (identified below) is installed;

- Air to air system - produces warm air which is circulated by fans to heat a home; and
- Air to water system - uses heat to warm water. Heat pumps heat water to a lower temperature than a standard boiler system; therefore, these systems are more suitable for underfloor heating systems than radiator systems, requiring less space to incorporate, compared with an air to air system.

The efficiency of ASHPs is measured by a coefficient of performance (CoP) i.e. the amount of heat produced compared to the amount of electricity needed for them to operate.

ASHPs are often a more popular (and technically / financially viable) alternative to GSHPs due to lack of requirement for extensive excavation, requiring far less space and easier installation.

Box 2.9: Feasibility Summary – Air Source Heat Pumps
Installation of ASHPs for the provision of primary space / DHW heating for the building is considered the most viable and efficient option due to, among other reasons, the efficiency the units can provide. Furthermore, there is not likely to be any gas supply to the site, therefore it is recommended that the ASHPs are specified for this development, supplemented by heat recovery systems. **ASHPs are considered the preferred option for low carbon technologies for this site.**

Biomass Heating

Biomass boilers replace conventionally powered boilers with an almost carbon neutral fuel (such as wood pellets). In addition, the installation and operation of a biomass boiler in new-build developments could yield significant revenue from the forthcoming Renewable Heat Incentive, a government funded clean energy cashback scheme.

Although many biomass burners will meet Clean Air Act requirements, combustion of woody biomass releases higher quantities of NOx compared to a comparable system fuelled by natural gas. As a consequence, many Local Authorities, particularly in urban areas have concerns about the potential impact on air quality that the widespread uptake of biomass boilers would have.

Therefore, a large number of Councils generally approve of the specification of biomass when linked to a large-scale biomass CHP as opposed to being used for individual boilers.

Box 2.10: Feasibility Summary – Biomass Boilers
The use of an energy centre with a biomass boiler was considered a feasible option but due to the relatively small size of the overall development, the potential air quality issues associated with the combustion of woodchips and limited space for such aspects as the fuel storage hoppers etc. it was discounted as a viable option. In addition to these considerations, biomass boilers are considered more feasible for larger scale developments with a district heat network.

Photovoltaic Cells

Solar Photovoltaics (PVs) are solar panels which generate electricity through photon-to-electron energy transfer, which takes place in the dielectric materials that make up the cells. The cells comprise layers of semi-conducting silicon material which, when illuminated by the sun, produces an electrical field which generates an electrical current.

PVs can generate electricity even on overcast days, requiring daylight, rather than direct sunlight. This makes them viable even in the UK, although peak output is obtained at midday on a sunny summer's day. PVs offer a simple, proven solution to generating renewable electricity.

Box 2.11: Feasibility Summary – Photovoltaic Cells
Given the variety of south sloping roofs within the proposed site and the low-rise nature of the development site, a roof mounted solar PV array across the whole development would be considered a preferred technology for the incorporation of LZC technologies on the site. To meet building regulations and planning policy targets some of the dwellings will require PV to be installed. In these cases it is recommended that a ~1.9m2 PV array is installed to the south facing roofs. **A PV array is considered the preferred option for low carbon technologies for this site.**

Micro Wind Turbines

Large wind turbines are an established means of capturing wind energy and converting it into usable electricity. Wind turbines come in various sizes depending on the location and electrical load of a particular site. A wind turbine usually consists of a nacelle containing a generator connected, sometimes via a gearbox, to a rotor generally consisting of three blades.

Box 2.12: Feasibility Summary – Micro Wind Turbines
Owing to site-constraints, micro-wind turbines have not been considered as part of this feasibility study. Although there is a reasonable wind speeds in this area, averaging < 5.1 ms^{-1} the residential location is not considered suitable for the installation of a wind turbine. Wind turbines are also likely to have a significant visual impact on local environment, as well as health and safety implications for occupiers or users on-site and on adjacent areas as a result of noise and light flicker associated with the wind turbines. Due to the residential location, large-scale wind turbines are also not feasible.

2.5 Energy Strategy Summary

Through implementation of the above strategy the proposed development will endeavour to achieve the emerging planning policy requirement of a reduction in carbon as required by the Future Homes Standard (as required by the emerging Local Plan) which will also meet current Part L 2021 requirements.

The recommended energy strategy is based on utilising **passive design measures**, **well insulated and airtight building fabric** and **high efficiency Air Sourced Heat Pump (ASHP) heating system.** Where required this would be supplemented by a **PV array** to generate renewable energy and offset further emissions.

Although ASHPs are recommended a gas boiler could still meet the Future Homes/Part L 2021 requirements. If a gas boiler heating system is the client's preferred solution this is likely that the development will need to install significantly more PV to meet the minimum standards.

This strategy is based on high level documentation only. It is recommended that a detailed energy strategy is prepared during the reserved matters application to confirm the energy performance of the development once the detailed documentation is prepared.

A summary of the proposed energy efficiency measures and site-integrated renewable technologies, in accordance with the appeal decision, and planning application are provided in Box 2.13 below.

Box 2.13: *Energy efficiency measures and site-integrated renewable technologies*

Energy Efficiency Measures

The developer will install the following energy efficiency measures are installed

Element	*U-Value*
Walls	0.18
Roofs	0.11
Floors	0.13
Doors	1.0
Windows	1.2 (0.8 G-Value)
Air Tightness and Thermal Bridging	
Y-Values	0.05 (achieved through Accredited Construction Details)
Air permeability ($m^3/(hr.m^2)$ @ 50 Pa)	5.0
Space Heating	*Efficiency*

Air Source Heat Pump (plus Heat Recovery)	COP 2.5 (>89% HR)
Water Heating	*Efficiency*
Air Source Heat Pump (plus Heat Recovery)	COP 2.5 (>89% HR)
On-Site Renewable Energy	*Spec*
Roof Mounted Solar PV Array	est. 1.9kWp/Dwelling