sol environment

ENERGY STATEMENT

Mixed Use Development

Former Shredded Wheat Factory

WELWYN GARDEN CITY

Prepared for:
Plutus Estates (WGC) Limited

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Contents

EXECUTIVE SUMMARY

This report has been compiled in order to provide an Energy Demand & Carbon Dioxide (CO_2) Emissions Assessment for the planning application for the proposed mixed used development on the site of the former Shredded Wheat Factory in Welwyn Garden City.

This document has been compiled by Sol Environment Ltd on behalf of Plutus Estates (WGC) Limited ('*the applicant'*). The Energy Demand Assessment has been formulated to provide a sustainable solution for the proposed site in accordance with Welwyn Hatfield Borough Council Local Plan. This assessment will be specifically focused on **Policy SADM 13: Sustainability Requirements** and **Broadwater Road West Supplementary Planning Document Site Indicators**.

The **energy assessment** and subsequent 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), provision of energy efficiency measures and installation of building-integrated LZC technologies.

The strategy confirms how the development achieves compliance with current energy planning policy. Broadwater Road West Supplementary Planning Document **Section 7 Core National Indicator 2** requires all new developments in the Broadwater Road West development area, achieve a site target of at least 10% of their energy requirements from decentralised and renewable or low-carbon sources. **Policy SADM 13** requests that all major development proposals must demonstrate that they have sought to maximise opportunities for renewable and low carbon sources of energy supply where consistent with other Local Plan policies.

Due to the size of the site and the differing site uses, three separate energy strategies have been prepared to achieve compliance with the Local Planning requirements; therefore, for the sake of the energy strategy, the site is split into the following three areas – South Site (residential only), North Site (residential) and North Site (Non-Residential). All three proposed strategies utilise **passive design measures**, **high levels of insulation and air tight building fabric,** but the services proposed to provide the space and water heating differ for each strategy:

- For the South Site (residential), space and water heating are provided by **electric CPSU boilers** and renewable energy requirements will achieved through the installation of a **roof mounted PV array.**
- For the North Site (residential), space and water heating and the renewable energy requirements are provided by a **district heating network fuelled by a gas-powered CHP** located in an energy centre.

- For the North Site (non-residential), space heating and cooling are provided by **electrically powered high efficiency roof mounted VRF.** Water heating and the renewable energy requirements are provided by the **district heating network fuelled by a gas-powered CHP.**

To achieve a **>10% reduction in CO_2 emissions** and energy use through the installation of LZC/renewable technologies (as required by the Local Authority) the following measures are proposed:

South Site (Residential)	North Site (Residential)	North Site (Non-residential)
~500kWp roof mounts PV solar array (~3500m^2 PV panels)	Space and water heating provided by gas-powered CHP	Space heating & cooling provided by high efficiency VRF heat pumps; Water heating provided by gas-powered CHP

Specific detail relating to the predicted reductions in annual CO_2 emissions and predicted energy demand is detailed within the table below.

Former Shredded Wheat Factory, Welwyn Garden City: Energy Strategy Summary			
Scenario	Regulated Energy Use (kWh / year)	Regulated CO_2 Emissions (kgCO_2 / year)	Ave BER/DER (kgCO_2 / m^2 / year)
Baseline Scenario without On-Site LZC Technologies	17,833,230	2,650,592	31.70 (South) 17.27 (North) **36.57** (Non-Resi)
LZC Scenario with On-Site LZC Tech (PV and CHP)	15,558,824	2,114,938	26.97 (South) 11.03 (North) **34.9** (Non-Resi)
Total Saving achieved through the implementation of on-site LZC Technologies	**2,274,406**	**535,654**	-
Percentage reduction	**>10%**	**>10%**	**>10%**

Based on the above, the proposed development will endeavour to achieve a >10% reduction in both regulated energy use and CO_2 emissions through the installation solar PV arrays and a CHP district heating network in turn show compliance with Welwyn Hatfield Local Plan.

A graphical representation of energy savings provided by the various scenarios is detailed in Figure 2.2 below.

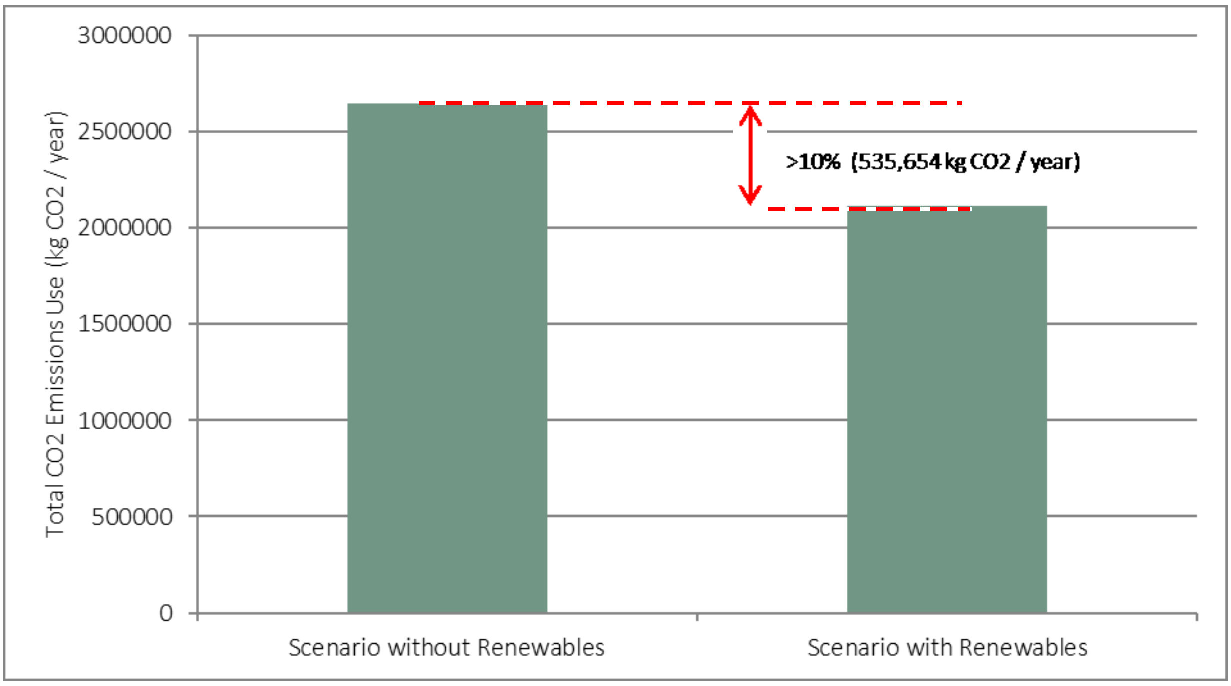

Figure E1: Implementation of the Energy Hierarchy at the Former Shredded Wheat Factory, Welwyn Garden City development.

1. INTRODUCTION

1.1 Background

Sol Environment Ltd ('Sol' hereafter) were engaged by Entran Ltd on behalf of Plutus Estates (WGC) Limited *('the applicant'* hereafter) to undertake an assessment of energy use and CO_2 emissions and produce an energy demand assessment for the proposed mixed used development on the site of the former Shredded Wheat Factory in Welwyn Garden City.

This report has been prepared by Sol Environment Ltd in cooperation with the applicant and in accordance with the following policies and guidance published by the Welwyn Hatfield Borough Council.

- Welwyn Hatfield Borough Council Draft Local Plan (Submission dated August 2016)
  - Policy SADM 13: Sustainability Requirements; and
  - Broadwater Road West Supplementary Planning Document Site Indicators

As stated in **Policy SADM 13**, requires that all major development proposals must demonstrate that they have sought to maximise opportunities for renewable and low carbon sources of energy supply where consistent with other Local Plan policies.

As stated in Broadwater Road West Supplementary Planning Document **Section 7 Core National Indicator 2** requires all new developments in the Broadwater Road West development area, achieve a site target of at least 10% of their energy requirements from decentralised and renewable or low-carbon sources.

This Energy Demand Assessment has been prepared in association with a new planning application for the development.

1.2 Proposed Development

A new planning application will be made for the proposed new mixed used development on the site of the former Shredded Wheat Factory in Welwyn Garden City. The overall site will include around 1,500 new dwellings and approx. 12,000m^2 of non-residential space (including commercial, gym, retail, arts centre, community centre, restaurant/bar and creche). All will be housed in two existing listed buildings from the original Shredded Wheat Factory and 11 new purpose built blocks.

A schedule of the overall site information use and associated gross internal areas is provided in Table 1.1 below.

Table 1.1: Proposed Areas		
Block	No. of Dwellings / Units	Total Area (m^2)
North Site (Residential)		
Block 2	143	7,191
Block 3	108	11,909
Block 6	273	15,915
Block 7	280	16,006
North Site Total (Residential)	804	51,021
South Site (Residential)		
Block 8	131	8,119
Block 9	105	6,675
Block 10	107	7,099
Block 11	101	6,721
Block 12	101	6,721
Block 13	98	6,228
North Site Total (Residential)	643	41,563
Total (Residential)	**1,447**	**92,584**
North Site (Non-residential)		
Retail		1,540
General non-residential		10,808
Total (Non-Residential)		**12,348**
GRAND TOTAL		**104,932**

A site plan showing the proposed development is provided below.

Fig 1.1: Proposed Site Plan prepared by Collado Collins Architects

2. ENERGY ASSESSMENT

This section comprises the Energy Assessment for the proposed development, in accordance with the Welwyn Hatfield Borough Council Draft Local Plan – Policies SADM 13 & Broadwater Road West Supplementary Planning Document Section 7 Core National Indicator 2.

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.

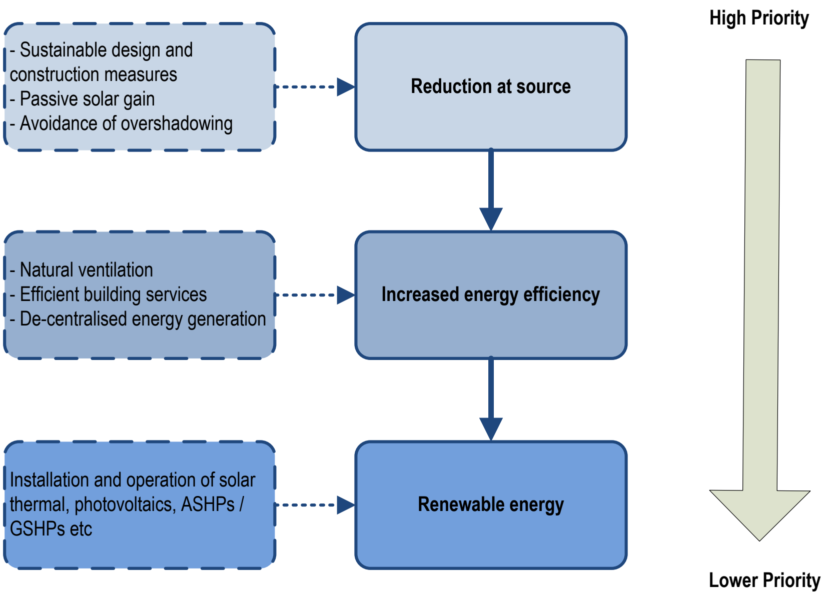

Figure 2.1: The Energy Hierarchy

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 2013 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/Building Emission Rate ('DER/BER') 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.

A benefit of the design of the buildings is the high levels of natural light and solar gain afforded by the large windows on all building aspects. In order to optimise this design feature, the design team have attempted to further optimise solar gain through the consideration of the solar orientation of internal facilities. Accordingly, a majority of the unoccupied building service areas and stairwells have been 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 3.1 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 – *Where no restrictions apply due to internal site layout, service and auxiliary areas (i.e. 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.*
2 – *Where possible dwellings have been orientated and internal layouts arranged to ensure the maximum amount of southern aspect (and passive solar heating) for the main living space.*

The internal aspects of all developments shall be designed (wherever possible) 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 to ensure thermal bridging is limited to achieve a **maximum Y-value of 0.05 W/m²K.***

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	*U Value (new build)*	*U Value (existing)*
External Walls	*0.14*	*0.35*
Roof	*0.11*	*0.35*
Floor	*0.11*	*0.16*
Doors	*1.3*	*2.82*
Windows	*1.3*	*1.98*

*5 – The new build building fabric shall not exceed a **maximum air permeability of 4m³ / (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.*

6 – The internal layout of the dwellings shall be constructed in consideration of building orientation and achieving maximum solar gain. Where no restrictions apply due to internal site layout (i.e. orientation of road infrastructure), the internal design of dwellings shall typically comprise the following:

- *The most heated and frequently used rooms (i.e. master bedrooms and living rooms) shall be placed on the south side of the dwelling (where appropriate).*
- *Rooms that benefit little from sunlight (i.e. hallways, utility rooms, bathrooms and storage areas) are placed on the north side of the dwelling.*
- *Wherever relevant and possible, the dining-room will be linked with the living-room in each proposed dwelling (in preference to the kitchen to maximise solar gain).*

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.

In the residential buildings it is assumed mechanical ventilation will be provided in kitchens and wet rooms only to ensure sufficiently ventilated conditions.

Box 2.3: *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 operable (secure) 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.

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

Box 2.4: *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 ≥ 60 lumens per circuit Watt).*

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

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

2.3 Energy Modelling

2.3.1 Overview

In accordance with the Welwyn Hatfield Borough Council Local Plan, an assessment of the energy demand and carbon dioxide emissions is required for all major developments, this should demonstrate the expected energy and carbon dioxide emission savings from energy efficiency and renewable energy measures incorporated in the development. The development will be assessed in accordance with the energy hierarchy to show reduced energy use and how at least 10% of energy use will come through the installation of renewable or low carbon technologies in accordance with planning policy. The following appraisal reviews the carbon reduction opportunities with a particular focus on a comparison of appropriate LZC technologies.

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 energy consumption (and associated carbon dioxide emissions) for the site and select appropriate LZC technologies.

2.3.2 Baseline Energy Assessment

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

Proprietary energy demand calculations for the proposed development have been undertaken using SAP/SBEM modelling software. In accordance with Part L of the current Building Regulations (2013) a notional building will be used as the minimum benchmark for the dwellings and non-residential buildings. The total emissions combined, will form the baseline standard for the assessment for regulated emissions (heating, lighting and ventilation). Pursuant to this, initial energy demand calculations for the building have been undertaken to provide a '*baseline*' building from which further calculations based on energy measures, efficient supply and renewable energy systems can be progressed. SAP modelling was undertaken for each dwelling and SBEM modelling was undertaken for the non-residential portions of the site.

2.3.3 Scenarios Energy Assessment

Upon calculation of a baseline SAP/SBEM output, the dwellings were then remodelled in order to account for the various stages of the Energy Hierarchy and subsequently demonstrate the reduction in regulated CO_2 emissions.

Table 2.1 below provides a summary of the various modelled scenarios.

Table 2.1: Summary of SAP/SBEM Modelled Scenarios				
Parameter		**Part L limiting factors**	**Scenarios**	
			Baseline Scenario (without LZC Tech)	**LZC Scenario (with LZC Tech)**
DER ($kgCO_2/m^2/year$)		**-**	***Ave. 31.70 (South)*** ***Ave. 17.27 (North)***	***Ave. 26.97 (South)*** ***Ave. 11.03 (North)***
BER ($kgCO_2/m^2/year$)		**-**	***Ave. 36.57***	***Ave. 34.9***
U-Values ($W/m^2.K$)	Walls	0.30	0.14	0.14
	Roofs	0.20	0.11	0.11
	Floors	0.25	0.11	0.11
	Doors	2.0	1.3	1.3
	Windows	2.0	1.3	1.3
Y-Values		0.15	0.05 (ACD)	0.05 (ACD)
Air permeability ($m^3/(hr.m^2)$ @ 50 Pa)		10.0	4.0	4.0
Heating / Domestic Hot Water (DHW)	Type	Notional Gas Boiler	Electric CPSU Boilers (South) High efficiency gas boiler (North)	Electric CPSU Boilers (South); Gas CHP (North Residential); VRF (North Non-residential);
	Efficiency	85%	>99% (Elec) >91% (Gas)	>99% (Elec) >91% (Gas)
	Fuel	Gas	Electricity (South) Gas (North)	Electricity (South) Elec/Gas (North)
	Controls	Room thermostats; programmer	Room thermostats; programmer; TRVs	Room thermostats; programmer; TRVs; HIUs (North)
	DHW	From Main Heating System	From Main Heating System	From Main Heating System (Residential); CHP (Non-Residential)
Cooling		-	-	VRF (Non-Residential)
Internal Lighting		-	100% non-dedicated low energy	100% non-dedicated low energy
Electricity		-	Grid Supplied	Grid Supplied & PV (South)
Renewable Technologies		-	-	~500 kWp Solar PV array on flat rooves of south site (South)

Table 2.2 below provides a tabular summary of the energy performance of the different scenarios detailed in Table 2.1, detailing a significant reduction in energy consumption (and subsequent CO_2 emissions) through the installation of photovoltaic panels and CHP district heating network.

Table 2.2: Energy Strategy Summary

Scenario	Regulated Energy Use (kWh / year)	Regulated CO_2 Emissions (kgCO_2 / year)	Ave BER/DER (kgCO_2 / m^2 / year)
Baseline Scenario without On-Site LZC Technologies	17,833,230	2,650,592	31.70 (South) 17.27 (North) 36.57 (Non-Resi)
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Total Saving achieved through the implementation of on-site LZC Technologies	**2,274,406**	**535,654**	-
Percentage reduction	**>10%**	**>10%**	**>10%**

Based on the above, the proposed development will endeavour to achieve a >10% reduction in both regulated energy use and CO_2 emissions through the installation solar PV arrays and a CHP district heating network in turn show compliance with Welwyn Hatfield Local Plan.

A graphical representation of energy savings provided by the various scenarios is detailed in Figure 2.2 below.

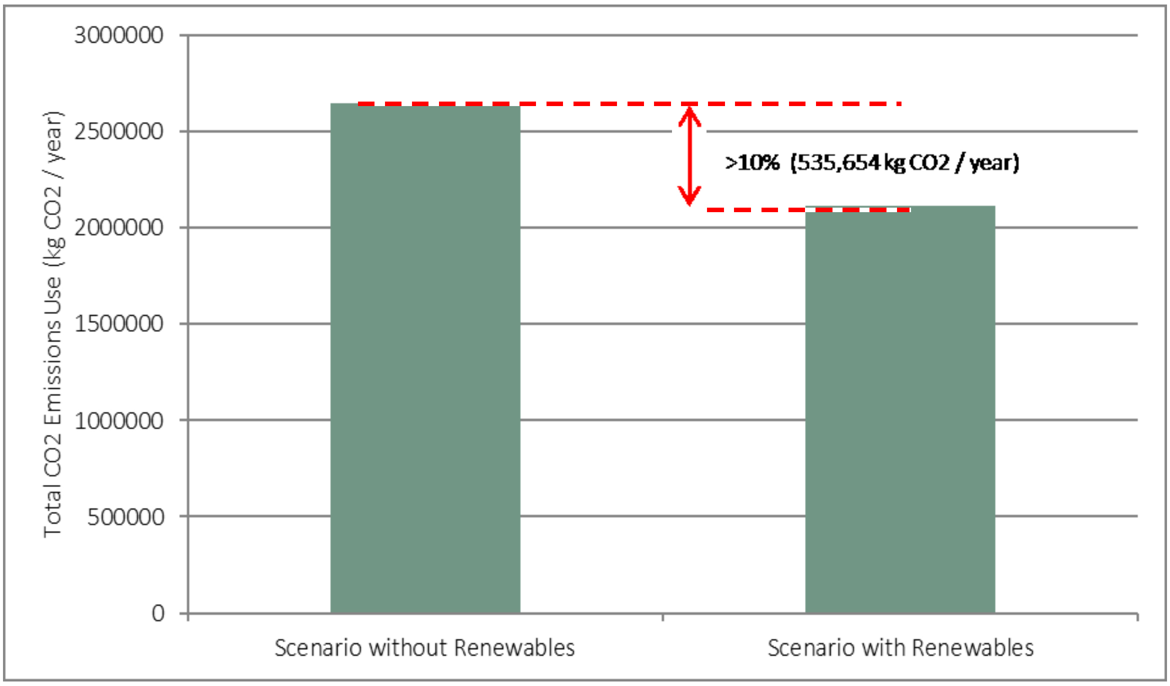

Figure 2.2: Implementation of the Energy Hierarchy at the Former Shredded Wheat Factory, Welwyn Garden City.

2.4 Low-Zero Carbon Technologies Feasibility Review

Combined Heat & Power

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.

The utilisation of Combined Heat and Power has been considered (in accordance with the heat hierarchy), and proposed as an option for the north site only.

Box 2.5: Feasibility Summary – CHP
A District Heat Network supported by an Energy Centre with a CHP plant was initial considered as the preferred option for the whole site (North and South). The Housing Trust that are to take over the management of the South Site preferred to utilise a wet electric system for heating and preferred not to share a heating system with the North Site; therefore, if was not considered viable for the District Heat Network to support the whole site. After the initial viability review it was considered that the final **preferred option** was for the **District Heat Network (incl. Energy Centre with CHP Plant)** to provide heating and power for the **North Site** only. The North Site is the most densely occupied part of the development and has the most varied heat profile, including non-residential and residential components, and therefore more suitable to CHP.

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 2.6: Feasibility Summary – Solar Thermal
Although roof mounted solar thermal panels were considered to have some benefit, it was considered more preferable to utilise the rooves within the proposed site for solar PV, as PVs are a more efficient way of achieving savings CO_2 emissions.

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 2.7: Feasibility Summary – Ground Source Heat Pumps
Ground source heat pumps have been considered and discounted as part of this feasibility study. Given the dense nature of the site, it is considered that there is not sufficient area required for horizontal pipework for ground source heat pumps. Vertical pipework could be considered an option although further bespoke viability investigation of the ground conditions and cost analysis would be required.

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 2.8: Feasibility Summary – Air Source Heat Pumps
ASHPs were considered as an option for heating the residential blocks of the North Site, but the size and noise levels of the required roof mount plant were considered inappropriate for the 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 2.9: Feasibility Summary – Biomass Boilers
The use of a Biomass Boiler was considered as an option to support the proposed district heat network, but given the urban nature of the site and therefore, likely stringent restrictions on emissions, the use of an energy centre with a biomass boiler was not considered a viable option.

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 2.10: Feasibility Summary – Photovoltaic Cells
For the **South Site** of the development roof mounted PV panels were considered the most preferable option to deliver the >10% reduction in CO_2 emissions and energy use. This can be achieved through a total **solar PV array of approximately 500kWp (~3500m2)** spread across all rooves.

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 2.11: Feasibility Summary – Micro Wind Turbines
Owing to site-constraints micro-wind turbines have been considered and discounted as part of this feasibility study. Constraints also include low wind speeds in this area, averaging < 4.9 ms^{-1}. 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. Wind turbines are also not feasible for urban locations.

2.5 Summary

To achieve a >10% reduction in CO_2 emissions through the installation of LZC/renewable technologies (as required by the Local Authority) the following energy strategy has been developed.

Due to the size of the site and the differing site uses, three separate energy strategies have been prepared to achieve compliance with the Local Planning requirements; therefore, for the sake of the energy strategy, the site is split into the following three areas – South Site (residential only), North Site (residential) and North Site (Non-Residential). All three proposed strategies utilise **passive design measures**, **high levels of insulation and air tight building fabric,** but the services proposed to provide the space and water heating differ for each strategy:

- For the South Site (residential), space and water heating are provided by **electric CPSU boilers** and renewable energy requirements will achieved through the installation of a **roof mounted PV array.**
- For the North Site (residential), space and water heating and the renewable energy requirements are provided by a **district heating network fuelled by a gas-powered CHP** located in an energy centre.
- For the North Site (non-residential), space heating and cooling are provided by **electrically powered high efficiency roof mounted VRF.** Water heating and the renewable energy requirements are provided by the **district heating network fuelled by a gas-powered CHP.**

A summary of the proposed energy efficiency measures and site-integrated renewable technologies, in accordance with the Welwyn Hatfield Local Plan, are provided in Box 2.12 below.

Box 2.12: *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	0.14
Roofs	0.11
Floors	0.11
Doors	1.3
Windows	1.3
Air Tightness and Thermal Bridging	

Y-Values	0.05 (achieved through Accredited Construction Details)
Air permeability ($m^3/(hr.m^2)$ @ 50 Pa)	4.0
Space & Water Heating (South Site)	*Efficiency*
Electric CPSU boilers	>99% (elec)
Space & Water Heating (North Site Residential)	*Delivery*
Combined Heat and Power (CHP) plant	Via an Energy Centre & District Heat Network
Space Heating & Cooling (North Site Non-residential)	*Efficiency*
High efficiency VRF	EER 3.49 SEER 6.25

<u>Site Integrated Low or Zero Carbon Technologies</u>

North Site

The space and water heating for each of the dwellings within the North Site will be provided by a district heat network powered by a CHP plant located in the Energy Centre. The water heating for the non-residential elements on the North Site will also be provided by the CHP plant located in the Energy Centre. ***The CHP system shall be installed to the following guideline specification or similar;***

Parameter	*Value*
System	*Combined Heat and Power Plant*
Fuel	*Electric/gas*
Efficiency (Thermal)	*~60%*
Efficiency (Power)	*~30%*
Delivery	*District Heat Network*

South Site

The developer will install a roof-mounted Photovoltaic array on all of the unshaded flat rooves in the South Site of the development. The Photovoltaic system shall be installed to the following guideline specification or similar;

Parameter	***Value***
Capacity	***~500kWp (c. 3500m2 of roof-mounted panels)***
Orientation	***South***
Pitch	***Horizontal***
ECA List	***Yes***