Renewable & Low Carbon Energy Statement

Aldi Foodstore
Gazelle Close, Winnersh

Prepared for:
Aldi Stores ltd.

Date:
January 2024

Project Issue Number:
SOL_24_S010_AL-SW

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VERSION CONTROL RECORD			
Contract/Proposal Number:		SOL_24_S010_AL-SW	
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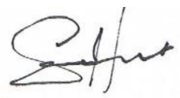
Signature:			
Issue	Description of Status	Date	Reviewer Initials
0	FOR COMMENT	16th January 2023	SVH

REPORT CONTENTS

EXECUTIVE SUMMARY

This document forms the Renewable and Low Carbon Energy Statement for the proposed new Aldi Foodstore development at Gazelle Close, Winnersh. This document has been prepared by Sol Environment Ltd on the behalf of the applicant, Aldi Stores Ltd. The information in this report has been prepared by Charlie Macknight, who is a registered CIBSE Low Carbon Consultant with >2 years' experience in undertaking energy assessments and designs of low and zero carbon solutions in the commercial buildings sector, and is employed by Sol Environment i.e., not professionally connected to a single low and zero carbon technology or manufacturer.

The Energy Statement has been formulated to provide a sustainable energy solution for the proposed site in accordance with the requirements of the Wokingham Borough Council Core Strategy (Adopted 2010), with specific reference to Policy CP 1: Sustainable Development; and Wokingham Borough Council Local Plan Chapter 2 with specific reference to Policy CC05: Renewable energy and decentralised energy networks.

The Proposed Development

The proposed retail development shall incorporate the construction of a new ALDI Foodstore with associated car parking, landscaping, access, and associated works. The development will comprise of the following elements (refer to Figure ES1):

- A new ALDI food store with a proposed Gross Internal Area of 1,806m^2.
- A 50kWp solar photovoltaic array has been incorporated on the roof of the building for renewable power generation.
- An Air Source Heat Pump supplemented by a refrigeration heat recovery scheme to provide energy savings through using energy recovered from the stores refrigerated cases for heating.
- Car parking for approximately 126 cars (including 5 disabled, 7 Parent & Child, 4 EV charging, and 6 Staff spaces).

The assessment and subsequent strategy have been prepared such that it is aligned with the Energy Hierarchy (see Section 2.1), with particular focus on sustainable building design (reduction of energy consumption at source), provision of energy efficiency measures and the installation of building-integrated low and zero carbon (LZC) technologies.

The conclusion of the energy strategy is that based on planning stage calculations, the development achieves a significant CO_2 emissions reduction when compared with a 2021 Building Regulations compliant development. The CO_2 emissions reductions are accounted for by the specification of a well-insulated and airtight building fabric, high efficiency M&E systems, an Air Source Heat Pump supplemented by a 'Freeheat' Refrigeration Heat Recovery System, and a roof-mounted 50kWp Solar PV array. Savings through the specification of renewable technologies alone achieve a 40% reduction in carbon emissions, therefore meeting the minimum 10% target of Policy CC05 of the Wokingham Borough Local Plan.

A summary of the energy and carbon emissions savings in accordance with the Energy Hierarchy is provided below.

ALDI Store: Energy Strategy Summary				
Scenario	Energy Demand (kWh / year)	Energy saving achieved (%)	Regulated CO_2 Emissions ($kgCO_2$ / year)	Saving achieved in CO_2 emissions (%)
2021 Part L Compliant Benchmark Building	80,385	-	10,890	-
Residual Scenario (improved building fabric and M&E services)	71,012	11.7	9,752	10.4
Renewable Scenario (Residual Scenario + RHR system & 80kWP PV array)	41,303	41.8	5,851	40
Total Savings in Energy and Emissions	**39,082**	**48.6**	**5,039**	**46.3**

A graphical representation of the cumulative reduction in CO_2 emissions through implementation of various stages of the Energy Hierarchy is provided below.

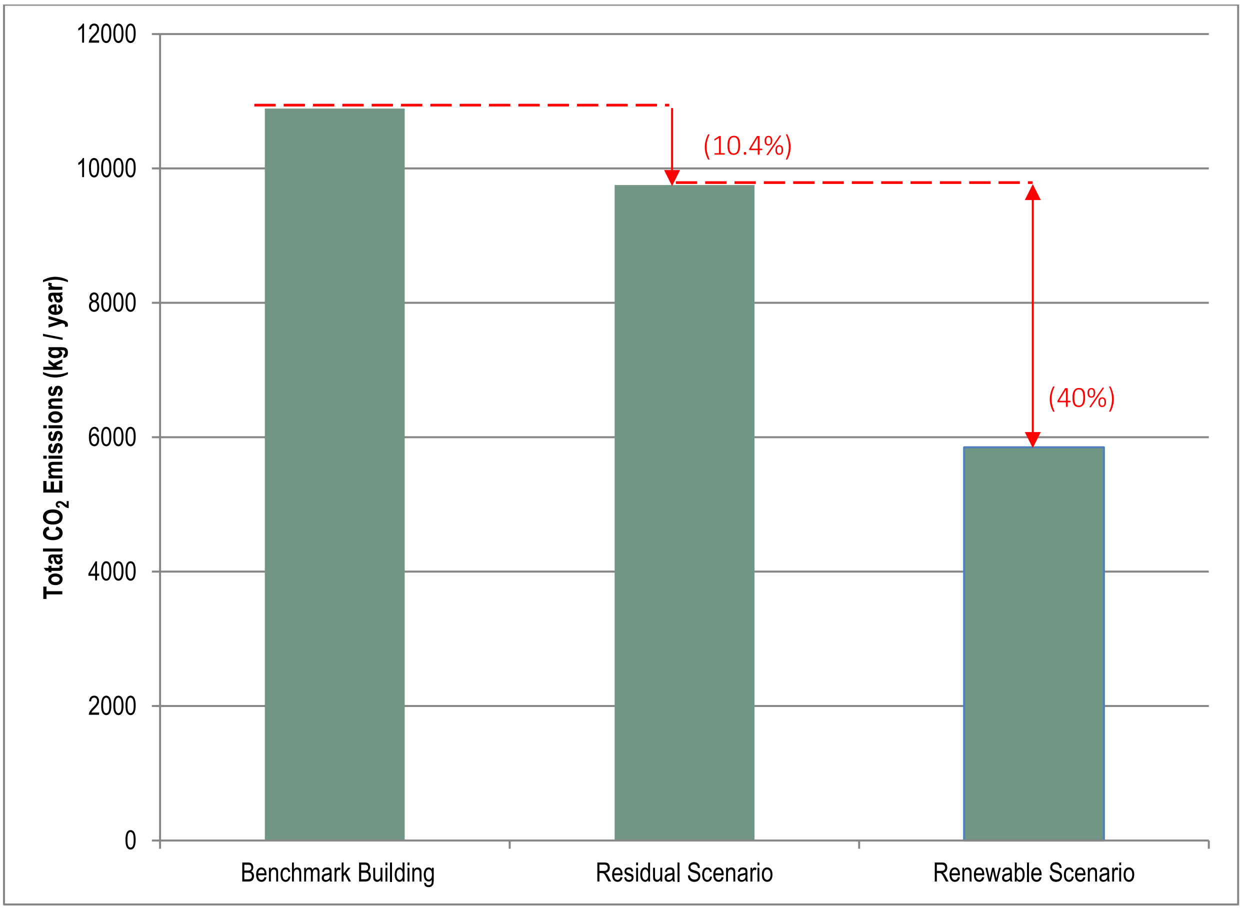


Figure E1: Implementation of the Energy Hierarchy for proposed development at Gazelle Close, Winnersh.

1. INTRODUCTION

1.1 Background

Sol Environment Ltd ('Sol' hereafter) was engaged by Aldi Stores Ltd. ('the applicant' hereafter) to undertake an assessment of energy use and production of an energy strategy for the proposed Aldi Stores Ltd. development at Gazelle Road, Winnersh.

1.2 Proposed Development

The proposed retail development shall incorporate the construction of a new ALDI Foodstore with associated car parking, landscaping, access, and associated works. The development will comprise of the following elements (refer to Figure ES1):

- A new ALDI food store with a proposed Gross Internal Area of 1,806m^2.
- An 50kWp solar photovoltaic array has been incorporated on the roof of the building for renewable power generation.
- An Air Source Heat Pump supplemented by a refrigeration heat recovery scheme to provide energy savings through using energy recovered from the stores refrigerated cases for heating.
- Car parking for approximately 126 cars (including 5 disabled, 7 Parent & Child, and 4 EV charging spaces and 6 Staff spaces).

This Energy Statement was informed by correspondence with the design team in addition to the Planning Issue drawings prepared by Kendall Kingscott.

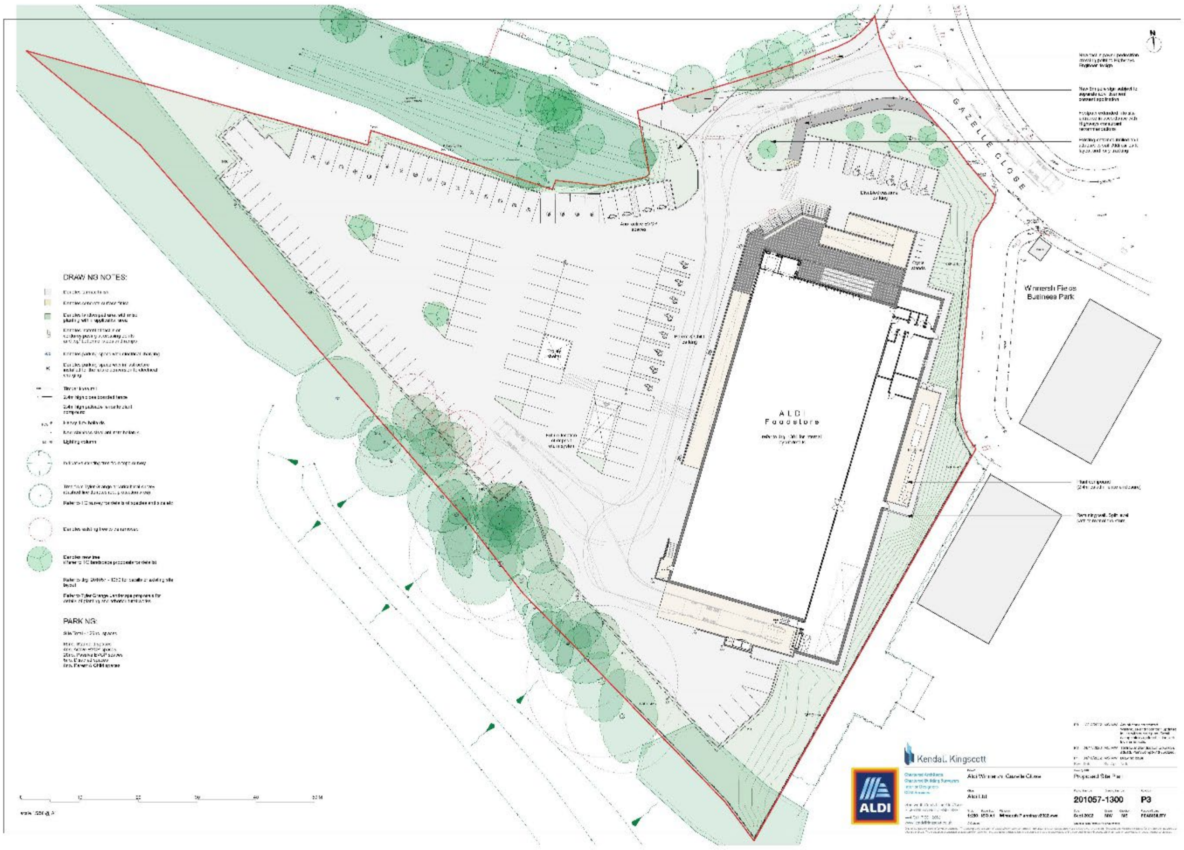


Figure 1.1: ALDI Proposed Site Layout at Gazelle Close, Winnersh.

1.3 Relevant Policy

This report has been prepared by Sol Environment Ltd in cooperation with the applicant and in accordance with the following national and local policies:

The National Planning Policy Framework

The National Planning Policy Framework ('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 Changes 2021-22

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

The changes to Part L require all new (non-residential) developments to produce around 27% less carbon emissions than was previously acceptable by Part L (2013) minimum standards. Additionally, a new metrics must now be achieved related to Primary Energy Rate (TPER), measured in kWh/m^2/year.

Wokingham Borough Council Core Strategy, adopted 2010

Policy CP 1: Sustainable Development

Planning permission will be granted for development proposals that:

1. Maintain or enhance the high quality of the environment;
2. Minimise the emission of pollutants into the wider environment;
3. Limit any adverse effects on water quality (including ground water);
4. Ensure the provision of adequate drainage;
5. Minimise the consumption and use of resources and provide for recycling;
6. Incorporate facilities for recycling of water and waste to help reduce per capita water consumption;
7. Avoid areas of best and most versatile agricultural land;
8. Avoid areas where pollution (including noise) may impact upon the amenity of future occupiers;
9. Avoid increasing (and where possible reduce) risks of or from all forms of flooding (including from groundwater);
10. Provide attractive, functional, accessible, safe, secure and adaptable schemes;
11. Demonstrate how they support opportunities for reducing the need to travel, particularly by private car in line with CP6; and
12. Contribute towards the goal of reaching zero-carbon developments as soon as possible by:
    a. Including appropriate on-site renewable energy features; and
    b. Minimising energy and water consumption by measures including the use of appropriate layout and orientation, building form, design and construction, and design to take account of microclimate so as to minimise carbon dioxide emissions through giving careful consideration to how all aspects of development form.

Wokingham Borough Council Local Plan Chapter 2, adopted 2010

Policy CC05: Renewable energy and decentralised energy networks

1. Local opportunities to contribute towards decentralised energy supply from renewable and low-carbon technologies will be encouraged
2. Planning permission will only be granted for proposals that deliver a minimum 10% reduction in carbon emissions through renewable energy or low carbon technology where the development is for:
    a. Schemes of more than 10 dwellings (gross), or
    b. Non-residential proposals of more than 1,000 sq m gross floorspace.
3. Proposals for renewable energy and decentralised energy works, including wind turbines, must demonstrate that:
    a. They are appropriate in scale, location and technology type;
    b. Are compatible with the surrounding area, including the impact of noise and odour;
    c. Do not have a damaging impact on the local topography and landscape;
    d. There is no significant impact upon heritage assets, including views important to their setting;
    e. In the case of wind turbines, take account of their cumulative effect and properly reflect their increasing impact on the landscape and on local amenity

1.4 Policy Review

The current local policy stipulates the development be constructed in accordance with best practice national guidance to ensure the operational performance is reduced through passive design measures, high performance building fabric, efficient M&E systems, and the use of on-site renewable and low carbon systems, with priority given to decentralised energy schemes where feasible.

In order to comply with Policy CC05 a minimum 10% reduction in carbon emissions through renewable energy or low carbon technology must be achieved. This will be outlined in the report to prove this has been achieved to ensure continuation of the proposal is possible.

2. ENERGY ASSESSMENT

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 Local & County Councils, seeks to ensure that developments incorporate energy efficiency through the approach detailed in Figure 2.1.

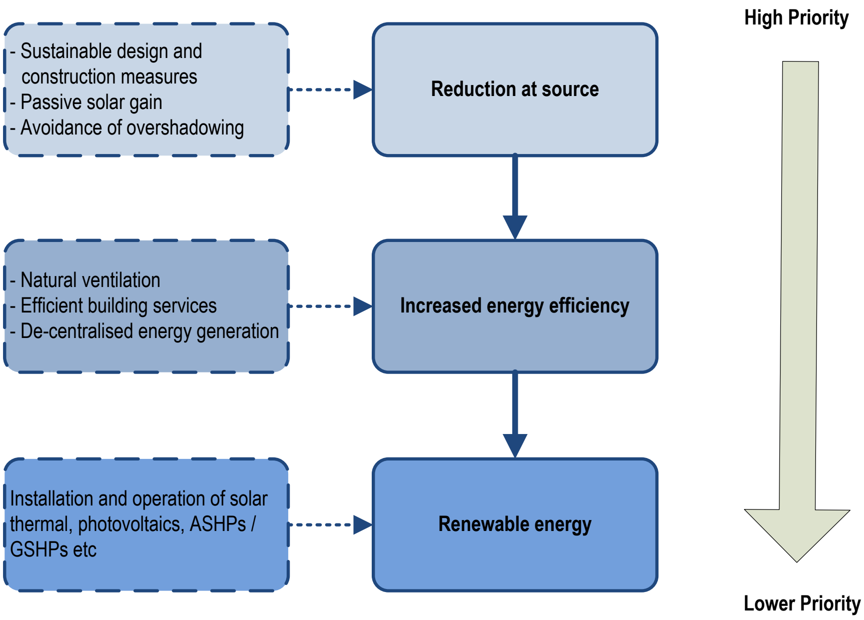


Figure 2.1: The Energy Hierarchy

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, as opposed to applying renewables as a first option at a significantly greater cost.

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 base energy demand is minimised.

At the time of writing, detailed design proposals relating to the scale, end user and occupier were not available, and assumptions have been made during the Energy Modelling process (listed in table 2.1) accordingly. Therefore, all quoted figures are only indicative of potential performance. Particular reference is made to the follow areas of the building's performance:

- Building size and orientation – any changes to building size and orientation may significantly affect energy performance;

- Air-tightness - this will require verification through an air permeability test;
- Auxiliary load - this may be significantly reduced when specification of items such as presence detecting (PIR) sensors are finalised; and,
- Building Services - performance may deteriorate over the operational lifetime, leading to changes in Regulated and Unregulated loads.

This report covers the proposed energy usage/carbon emissions only and is not intended to demonstrate compliance with Building Regulations.

2.2 Site Layout & 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 an improvement upon the Building Emission Rate ('BER') by typically 30% in new built projects, as a result of energy efficiency measures alone.

2.2.2 Site Location

The site is located on Gazelle Close, Winnersh. There are no features related to the site location which would inhibit passive design measures to be implemented.

2.2.3 Site Weather

To ensure accuracy of modelling, the weather location file for Swindon has been used in accordance with convention 2.04 SBEM Weather Locations of the 'Non-Domestic Conventions for England & Wales Issue 7.1. An 'extreme weather' scenario was used with a 2080 CIBSE DSY file as the weather data source.

2.2.4 Microclimate

There are no special considerations with regards to microclimate (such as significant overshading or large waterbodies).

2.2.5 Passive Solar Design

Passive design measures manage internal heating through solar gain and as such reduce the need for heating/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.

Although the large width and general geometry of the building is pre-determined due to the use, a benefit of the design is the high levels of natural light afforded by the large amount of glazing around the entry.

The predetermined orientation of the building has led to some minor benefits in relation to the solar orientation of internal facilities. The longer term occupied building areas are located on the north of the building with some glazing assisting solar gain. All areas of the site subject to refrigeration are inset, so as to avoid unwanted (and detrimental) solar heating.

It is therefore considered that where possible and taking into consideration the site and building use constraints, the internal layout has been optimised to ensure that additional energy consumption due to overshadowing has been minimised. The specific objectives related to this area are referenced in Box 2.1 below.

Box 2.1: *Objective A – Minimising Overshadowing*

1 *– Where no restrictions apply due to internal site layout, areas that do not require conditioning / mechanical heating shall be located to the east of the building. Therefore, maximising the utilisation of solar gain with minimal overshadowing and subsequently lower residual energy consumption.*

The development shall be designed (wherever possible) to further maximise the benefits provided by solar orientation. Subsequently, the building shall be constructed to specified design briefs and the principles detailed in Box 2.2, below.

Box 2.2: *Objective B – Building Design Principles*

B1 *– 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.*

B2 *– 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.*

B3 *– 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-values*
Walls	*0.26*
Roof	*0.16*
Floor	*0.16*
Doors	*1.4*
Windows	*1.4*
High Use Entrance Doors	*1.3*
Vehicle Access Doors	*1.3*

*B4 – The elements of the new building shall endeavour not to exceed a maximum **air permeability of 5m^3 / (hr.m^2)**. This can 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 B3);*
- *Brick / block construction will be mitigated against through application of wet plastering / parging / dry lining.*

With the exception of the Warehouse and Plant Room, the Foodstore is being serviced by an Air Source Heat Pump supplemented by a refrigeration heat recovery (RHR) system known as the 'Freeheat' system which feeds an underfloor heating system. The same building areas are cooled via an underfloor cooling system supplied by the ASHP.

The office, WCs and other staff facilities to be supported by mechanical extract ventilation system with Part L 2021 compliant efficiencies, flow rates and fan powers.

Box 2.3: *Objective C – Limiting Excessive Solar Gain*

1 – Where mechanical ventilation and extract is required, Part L 2021 compliant efficiencies, flow rates and fan powers shall be installed.

2 – The Foodstore's shopfront entry glazing is protected from excessive solar gain by a large-fixed canopy, and the west-facing shopfront glazing is protected using solar control glazing 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 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: *Objective D – Energy Efficiency Measures*

1 – Lighting shall achieve an initial efficiency averaging over the whole building of not less than 121 lumens/circuit watt, with the exception of the sales area achieving 138 lumens/circuit watt. Display lighting shall be on a separate circuit which may be on automatic timing devices.

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

3 *– Majority of the heat (all heating to the sales and welfare area) will be supplied from the waste heat available from refrigeration heat recovery system.*

4 *– All electric fans, motors and pumps will be specified with high efficiency motors and invertor drive controls;*

2.3 Energy Modelling

2.3.1 Overview

This report forms a high-level feasibility study to ascertain the viability of appropriate renewable technologies based on the proposed developments energy demand (and associated CO2 emissions), and the site locations and ground conditions.

The proposed scheme is to include an Air Source Heat Pump supplemented by the 'Freeheat' refrigeration heat recovery scheme, and a roof mounted 50kWp Monocrystalline PV array. Savings through the specification of renewable technologies alone achieve a 40% reduction in carbon emissions, therefore meeting the minimum 10% target of Policy CC05 of the Wokingham Borough Local Plan.

2.3.2 Baseline Energy Assessment

To determine the type and size of proposed LZC technology and reduction in CO_2 emissions, a detailed baseline modelling and assessment exercise was undertaken.

Proprietary energy demand calculations for the proposed development have been undertaken using SBEM modelling software. Subsequently, Part L of the current Building Regulations (2021) will be used as the minimum benchmark and will form the benchmark 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 *'benchmark'* building from which further calculations based on energy measures, efficient supply and renewable energy systems can be progressed.

As the calculations are based on assumptions, figures are indicative only, and changes may occur during detailed design, including the buildings airtightness, which will require verification through an air permeability test, the auxiliary load which may be significantly reduced when specification of items such as presence detecting (PIR) sensors are finalised, and building services efficiencies and specifications.

Upon calculation of a baseline SBEM outputs, the building was then remodelled to account for the various stages of the Energy Hierarchy and subsequently demonstrate the reduction in CO_2 emissions for the development.

Table 2.1 (overleaf) provides a summary of the results for each scenario.

Table 2.1: Summary of Modelled Scenarios (Aldi Food Store)				
Parameter		Scenario		
		Baseline	Residual	After LZC Energy
Building Emission Rate ($kgCO_2/m^2/year$)		***6.03***	***5.4***	***3.24***
U-Values ($W/m^2.K$)	Walls	0.26	0.26	0.26
	Roofs	0.18	0.16	0.16
	Floors	0.18	0.16	0.16
	Doors	1.6	1.4	1.4
	Windows	1.6	1.4	1.4
	Vehicle Access Doors	1.5	1.5	1.5
Y-Values		0.15	0.05	0.05
Air permeability ($m^3/(hr.m^2)$ @ 50 Pa)		8.0	5.0	5.0
Heating / Domestic Hot Water (DHW)	Type	Notional Gas Boiler	ASHP UFH System	ASHP UFH System with 'Freeheat' RHR
	Efficiency	82%	421%	421%
	Fuel	Gas	Grid Supplied Electricity	Partially Grid Supplied Electricity & ASHP with 11% Waste Heat Supplement
	Controls	Zoned and fitted with independent time and temperature controls	Zoned and fitted with independent time and temperature controls	Zoned and fitted with independent time and temperature controls
	DHW	Electric Instantaneous Hot Water	Electric Instantaneous Hot Water	Electric Instantaneous Hot Water
Cooling		100%	460% (ASHP UFC system)	460% (ASHP UFC system)
Internal Lighting		50% non-dedicated low energy	100% LED Lighting	100% LED Lighting
Renewable Technology		-	-	50kWp PV array & RHR 'Freeheat'

Based on the provisional figures detailed above, the development achieves a significant CO_2 emissions reduction when compared with a 2021 Building Regulations compliant development. The CO_2 emissions reductions are accounted for by the specification of a well-insulated and airtight building fabric, high efficiency M&E systems, an Air Source Heat Pump supplemented by a 'Freeheat' Refrigeration Heat Recovery System, and a roof-mounted 50kWp Solar PV array. Savings through the specification of renewable technologies alone achieve a 40% reduction in carbon emissions, therefore meeting the minimum 10% target of Policy CC05 of the Wokingham Borough Local Plan.

All Foodstore space heating requirements will be provided by the ASHP supplemented by waste heat recovered from the 'Freeheat' refrigeration heat recovery system and all cooling will be provided by the ASHP, the feasibility of using decentralised heat or energy networks has therefore been discounted.

Table 2.2 below details the 'baseline case' scenarios for the development regarding CO_2 emissions.

Table 2.2: ALDI Store Energy Strategy Summary

Scenario	Energy Demand (kWh / year)	Energy saving achieved (%)	Regulated CO_2 Emissions ($kgCO_2$ / year)	Saving achieved in CO_2 emissions (%)
2021 Part L Compliant Benchmark Building	80,385	-	10,890	-
Residual Scenario (improved building fabric and M&E services)	71,012	11.7	9,752	10.4
Renewable Scenario (Residual Scenario + RHR system & 80kWP PV array)	41,303	41.8	5,851	40
Total Savings in Energy and Emissions	**39,082**	**48.6**	**5,039**	**46.3**

A graphical representation of the cumulative reduction in CO_2 emissions through implementation of various scenarios is provided in Figure 2.2 overleaf.

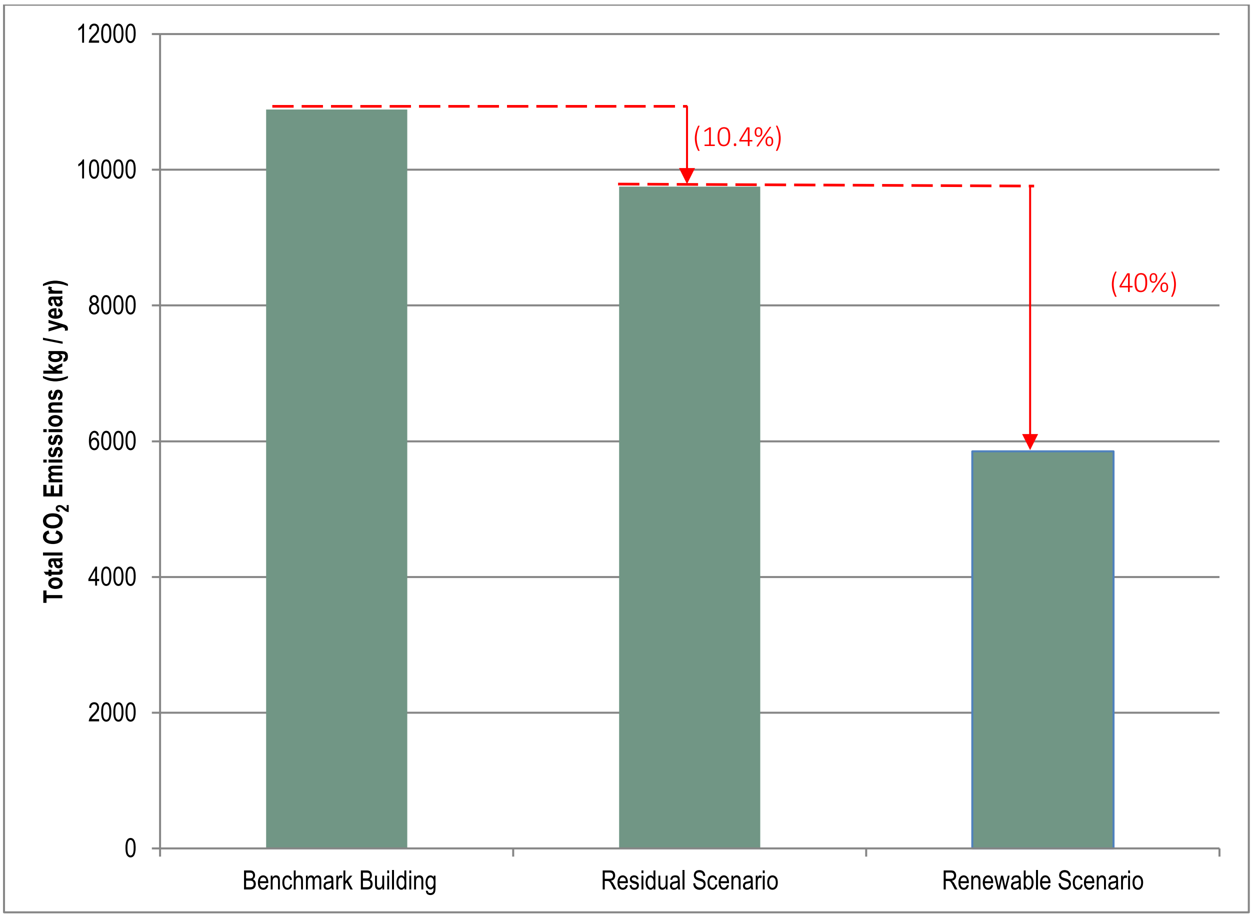


Figure 2.2: Implementation of the Energy Hierarchy for proposed development at Gazelle Close, Winnersh.

2.4 Low-Zero Carbon Technologies Review

Community 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, it is 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.

A comparative flow diagram of CHP and a typical gas-fired power station is shown in Figure 2.3 below:

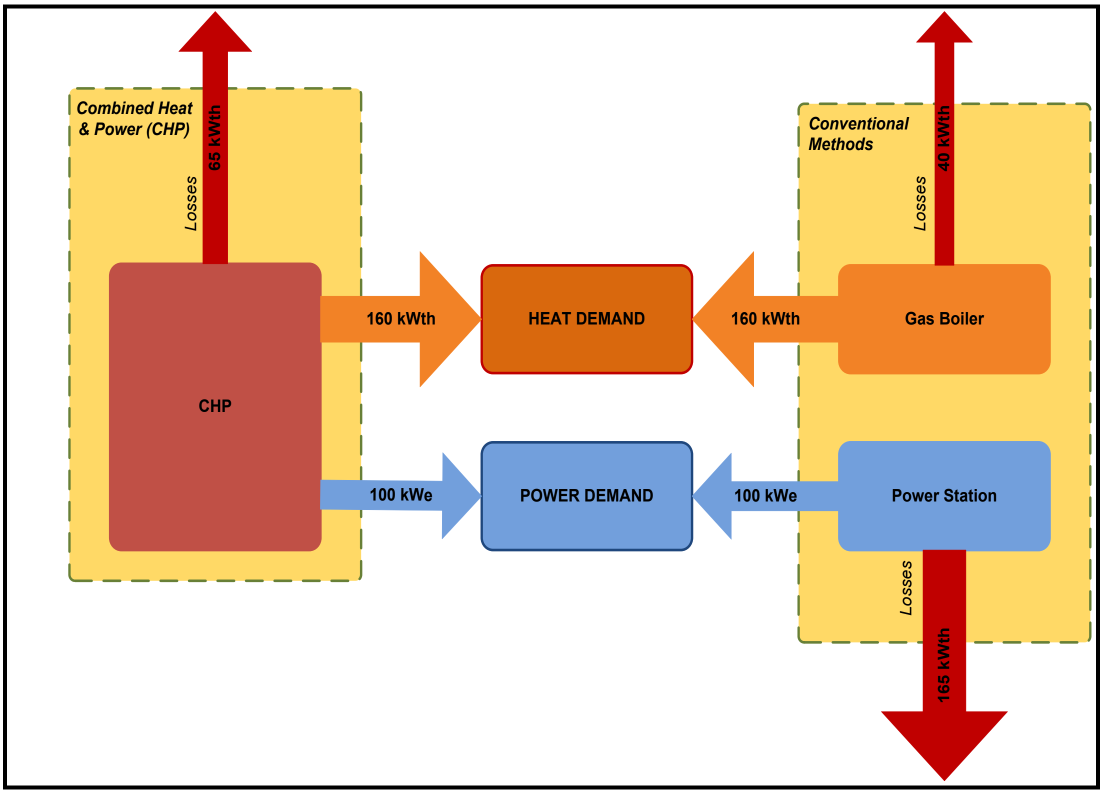


Figure 2.3: Flow Diagram of Gas fired CHP versus Grid Electricity and Gas Fired Heating

Major mixed use and residential developments often install dedicated *'energy centres'* as part of the development. These effectively comprise a localised, small scale power station (typically 1 – 3 MW) which provides the development with both electricity and heat (usually with zero to minimal supplementation from the grid).

Given the size and nature of the energy profile of the development, using a CHP plant for the entire development was not considered appropriate.

Box 2.5: Feasibility Summary – CHP

The specification of CHP would lead to increased reliance on non-renewable fuel sources as the site limited footprint does not allow suitable storage of biofuels. Furthermore, the benefit of connecting to a CHP system (local or network) would be discounted with the use of an ASHP and 'Freeheat' system as specified.

As such, CHP has been discounted from the assessment.

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 gas / oil supply.

Typically, solar collectors would produce approximately 5-600 kWh/m² of hot water. Evacuated tube systems are about 30% more efficient but 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

The provision of the supplementary DHW heating via installation of solar thermal is neither considered suitable nor necessary due to the very limited requirement for domestic hot water.

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 – 20Wth 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
Installation of GSHPs as a supplementary heating system for the building is not considered to be feasible due the significant space, cost, and ground work required in order to lay the pipework. All space heating requirements are considered to be able to be met through the utilisation of ASHPs supplemented by recovered heat from the 'Freeheat' system and therefore additional GSHP is not 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. ASHPs work on a similar principle to a fridge, which extracts heat from its inside. 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. This methodology is also used with GSHPs, although the use of air as a heat source instead of the earth results in ASHPs having a lower CoP than GSHPs, with subsequently less carbon savings for a similar sized heat pump. ASHPs have a relatively low heat yield when compared traditional boilers, therefore buildings must be well insulated and draught-proofed to ensure that the heating system is effective.

Due to the required electrical load of AHSPs, consideration must be given to the source of grid electricity when considering the potential carbon savings of ASHPs. Therefore, the purchase of *'cleaner'* grid electricity (i.e. renewable or CHP tariffs) result in increased carbon savings from ASHPs.

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.

The use of ASHP technology at the proposed development are considered feasible on a number of grounds:

- The systems are reversible and can provide both heating and cooling duty; and
- The pump units can be located on the available roof space, within a louvered enclosure such that visual impact is minimised.

Box 2.8: Feasibility Summary – Air Source Heat Pumps
An air source heat pump heating system supplemented by the refrigeration heat recovery system is considered the most feasible and appropriate option for LZC technology. All selling floor space heating requirements are considered to be able to be met through the utilisation of ASHPs supplemented by recovered heat from the 'Freeheat' system.

Refrigeration Heat Recovery

Due to the large number of refrigeration units in a typical supermarket there is a significant opportunity to recover and reuse heat that would typically be wasted. A refrigeration heat recovery (RHR) scheme works in a similar way to air source heat pumps by capturing heat normally rejected from the refrigeration system in order to provide heat for the purposes of space heating.

The efficiency of an RHR scheme 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.

The Proposed RHR system feeds into the heating Flow and Return pipework which serves the underfloor or FCU heating systems to the sales floor. The RHR system will be utilised to supplement the heating system. Due to the reduction in plant size the use of the Air Source Heat pump system has become the primary source for the heating system.

During periods of high heating loads – the system will operate with both the ASHP and RHR system to enable the systems to meet the stores heating requirement.

Carbon Trust guidance states that low grade refrigeration heat recovery systems have a 'medium' payback period of approximately 5 years based on 8,000 operating hours per annum.

Heat generated by the Refrigeration Heat Recovery system is low grade and therefore not suitable for export.

There are currently no grants available for waste heat from refrigeration systems.

Box 2.9: Feasibility Summary – Refrigeration Heat Recovery
An air source heat pump heating system supplemented by the refrigeration heat recovery system is considered the most feasible and appropriate option for LZC technology. All space heating requirements are considered to be able to be met through the utilisation of ASHPs supplemented by recovered heat from the 'Freeheat' system.

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 biomass heating is not considered feasible due to both air quality issues and the significant storage and handling areas given the sites limited footprint. All selling floor space heating requirements are considered to be able to be met through the utilisation of recovered heat from the 'Freeheat' system.

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
Increased capital costs and retraction of financial incentives have led to a significant increase in the predicted payback time of photovoltaic panels, however, It has been seen suitable, with the orientation of the site roof space available and no shadowing from surrounding buildings, **that an 50kWp PV Array, with** a preferable South orientation**, is deemed a viable way for supplementing energy production of the store.**

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 consisting of three blades.

Box 2.12: Feasibility Summary – Micro Wind Turbines
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.

On-Site Battery Storage

Although not technically a form of renewable energy, housing banks of industrial-scale batteries in existing or purpose-built new industrial buildings on site could provide a significant financial saving on the energy bill as well as reducing the peak energy demand. The batteries, producing around 10MW of power per site, will charge when the National Grid has surplus power and deliver the stored power back to the National Grid at times of peak demand.

In addition to grid balancing, battery storage can also be coupled with renewable energy generation such as wind or solar PV to store the energy generated when the sun is shining, or wind is blowing and allow the energy to be available for use when it is needs 24hrs a day all year round.

Box 2.13: Feasibility Summary – On Site Battery Storage
Energy generated by the PV array will be used entirely by the development, and therefore would not warrant battery storage that would subsequently require a large amount of space within the site. All heat generated by the 'freeheat' system will be used directly by the store to provide heating to the sales area, therefore there is no opportunity for energy storage from the RHR..

2.4.1 Proposed LZC Strategy

The ALDI Store has been formally assessed and considered against all potential options regarding the use and incorporation of integrated low carbon technologies.

The store will be designed to utilise an ASHP supplemented by a 'Freeheat' refrigeration heat recovery scheme to meet all space heating and cooling needs for the selling floor and welfare area of the development, and an 50kWp PV array will generate renewable energy to further offset emissions. Through the implementation of the Energy Hierarchy, the development will provide a realistic total carbon equivalent emission saving of approximately >5 tonnes per annum.

A summary of the proposed technologies is provided in Box 2.14.

Box 2.14: *Objective E – Site-integrated renewable technologies*
1 *– The retail and welfare floor space heating and cooling will be supplied from the ASHP supplemented by recovered heat available from the 'Freeheat' refrigeration heat recovery scheme.* *Additional renewable energy generation will be provided by an 50kWp, roof-mounted monocrystalline PV array.* *The installation of both the 'Freeheat' refrigeration heat recovery scheme and PV array has generated a 40% reduction in CO2 emissions; this has ensured compliance with policy CC05.* *The development has been estimated to provide a realistic total carbon equivalent emission saving of 5 tonnes per annum, with 3.9 tonnes attributable solely to renewable and LZC technologies.*