



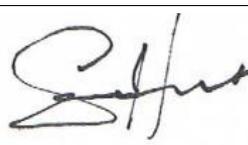
Energy Statement

ALDI Foodstore & Cafe Drive Thru Land North of Afan Way, Port Talbot

Prepared for:
Aldi Stores Ltd.

Date:
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EXECUTIVE SUMMARY

This document forms the Energy Statement for the proposed Aldi Foodstore & Cafe Drive Thru unit, with associated access and landscaping works on brownfield land at the former Burrows Yard site at land North of Afan Way in Port Talbot. This document has been compiled by Sol Environment Ltd on behalf of the applicant, Aldi Stores Ltd. The information in this document has been compiled by Charlie Macknight who is a CIBSE Low Carbon Consultant with relevant experience in undertaking assessments and designs of low and zero carbon solutions in the commercial buildings sector.

This Energy Statement has been formulated to provide a sustainable energy solution for the proposed site in support of a Planning Application in accordance with the requirements of the Neath Port Talbot County Borough Council Local Development Plan 2011 – 2016 (Adopted January 2016), with specific reference to Policy RE2: Renewable and Low Carbon Energy in New Development, which stipulates:

‘Schemes that connect to existing sources of renewable energy, district heating networks and incorporate on-site zero / low carbon technology (including microgeneration technologies) will be encouraged. The following proposals will be required to submit an Energy Assessment to determine the feasibility of incorporating such a scheme and where viable, would be required to implement the scheme:

(a) Residential development for 100 or more dwellings;

(b) Development with a total floorspace of 1,000 sqm or more.’

The Proposed Development

The proposed retail development shall incorporate the construction of a new ALDI Foodstore & Cafe Drive Thru Unit, with associated car parking and landscaping. The development will comprise of the following elements (refer to Figure 1):

- A new ALDI Foodstore with a gross internal area of 1842m², and a Café Drive Thru unit with a gross internal area of 171m².
- An Air Source Heat Pump in the Foodstore supplemented by a refrigeration heat recovery scheme to provide energy savings through using energy recovered from the stores refrigerated cases for heating.
- An 80kWp roof mounted Monocrystalline PV array on the Foodstore for supplementing energy usage.
- Sitewide car parking for approximately 145 cars, split as follows:
 - ALDI Foodstore – 117 car parking spaces including 6 disabled bays, 9 parental & child, and 12 active EV parking spaces.

- Coffee Drive Thru – 28 car parking spaces including 2 disabled bays and 6 active EV parking spaces.
- Associated landscaping and access works.

The assessment and subsequent energy strategy has 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 strategy has been derived in order to demonstrate broad compliance with current Local and Regional sustainable planning policy.

The conclusion of the energy strategy is that, based on planning stage calculations, the development achieves a significant reduction in CO₂ emission compared to a 2021 Building Regulations Part L compliant development, hence meeting the requirement of *Policy RE2 of the Port Talbot County Borough Council Local Development Plan 2011 – 2016* to reduce the amount of onsite carbon dioxide emissions.

Specific detail relating to the predicted reductions in annual CO₂ emissions for both the Aldi Foodstore and the Drive through coffee shop is detailed within the table below.

| ALDI Foodstore and Cafe Drive Thru: 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 | 88,653 | - | 12,296 | - |
| Residual Scenario (improved building fabric and M&E services inc. ASHP) | 79,509 | 10 | 11,157 | 9 |
| Renewable Scenario (Residual Scenario + PV + 'Freeheat') | 14,742 | 81 | 2,766 | 75 |
| Total Savings in Energy and Emissions | 73,911 | 83 | 9,530 | 78 |

The extent of onsite renewable and low carbon technologies includes an Air Source Heat Pump (ASHP) supplemented by a refrigeration heat recovery (RHR) scheme for the Foodstore, and an 80kWp roof-mounted Monocrystalline Solar PV array, to ensure the reduction in CO₂ emissions significantly exceeds the mandated requirements stipulated by Local and Regional Planning Policy.

Additionally, the use of CHP and district heat networks was reviewed but discounted in favour of the ASHP and Refrigeration Heat Recovery system (refer to the LZC Feasibility Study included in Section 2.3.3).

A graphical representation of the cumulative reduction in CO₂ emissions through implementation of various stages of the Energy Hierarchy is provided below.

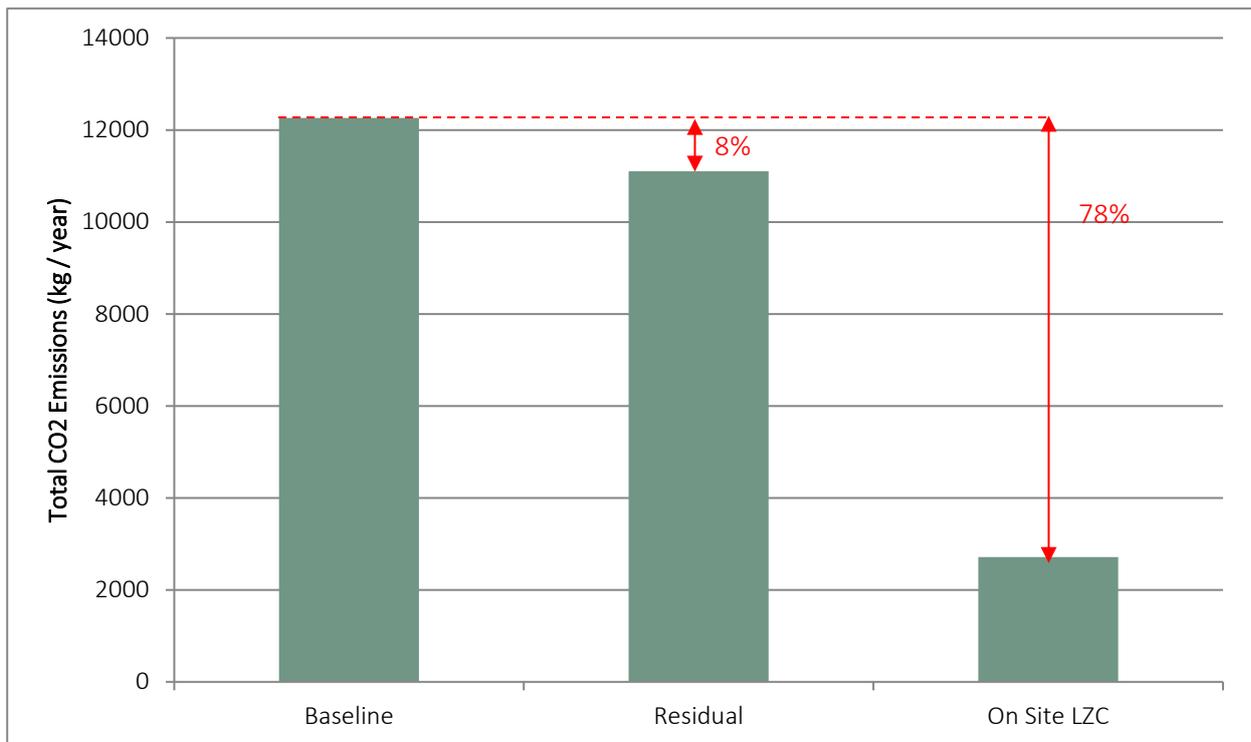


Figure ES1: Implementation of the Energy Hierarchy for proposed Aldi & Cafe development at land North of Afan Way, Port Talbot.

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 Statement for the proposed Aldi Foodstore and Cafe Drive Thru development at the former Burrows Yard site at land North of Afan Way in Port Talbot.

This Energy Statement has been formulated to provide a sustainable energy solution for the proposed site in support of a Planning Application in accordance with the requirements of the Neath Port Talbot County Borough Council Local Development Plan 2011 – 2016 (Adopted January 2016), with specific reference to Policy RE2: Renewable and Low Carbon Energy in New Development, which stipulates:

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1.2 Proposed Development

The proposed retail development shall incorporate the construction of a new ALDI Foodstore & Cafe Drive Thru Unit, with associated car parking and landscaping. The development will comprise of the following elements (refer to Figure 1):

- A new ALDI Foodstore with a gross internal area of 1842m², and a Café Drive Thru unit with a gross internal area of 171m².
- An Air Source Heat Pump in the Foodstore supplemented by a refrigeration heat recovery scheme to provide energy savings through using energy recovered from the stores refrigerated cases for heating.
- An 80kWp roof mounted Monocrystalline PV array on the Foodstore for supplementing energy usage.
- Sitewide car parking for approximately 145 cars, split as follows:
 - ALDI Foodstore – 117 car parking spaces including 6 disabled bays, 9 parental & child, and 12 active EV parking spaces.

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.

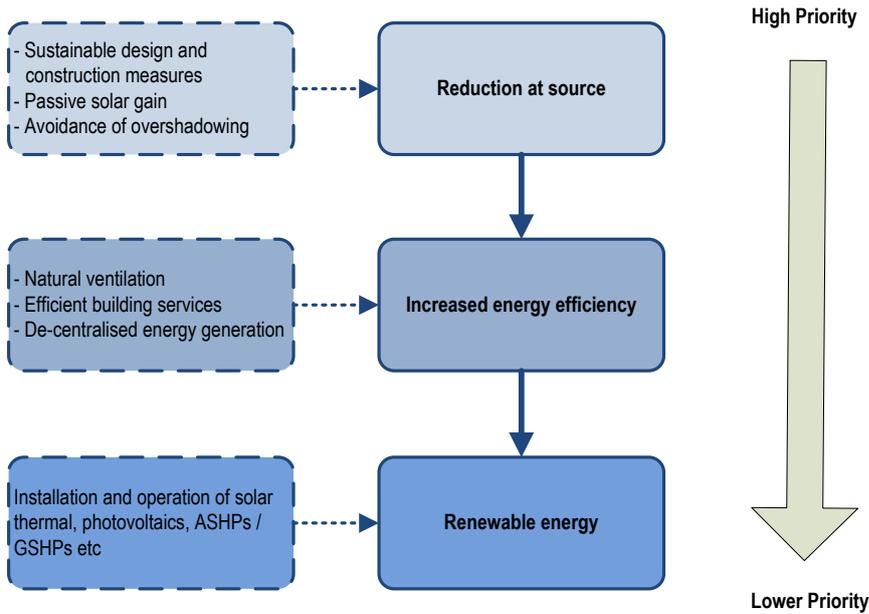


Figure 2.1: The Energy Hierarchy

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 CO₂ 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 buildings 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 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.

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

The site is located in the town of Port Talbot, and there are no features related to the site location which would inhibit passive design measures (as listed within this section) to be implemented. To ensure accuracy of modelling, the weather location file for Cardiff has been used in accordance with convention 2.04 SBEM weather locations of the 'Non-Domestic Conventions for England & Wales Issue 7.1'.

Although the general geometry of the buildings are pre-determined due to their use, a benefit of the designs of both units is the high levels of natural light afforded by the large amount of glazing around the respective building entrances.



The predetermined orientation of the buildings 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 southern side 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 layouts have 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 north 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

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 – 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 (W/m ² k) | |
|-----------|------------------------------|-------------------|
| | ALDI Store | Coffee Drive Thru |
| Walls | 0.26 | 0.16 |
| Roof | 0.18 | 0.13 |
| Floor | 0.18 | 0.10 |
| Doors | 1.6 | 1.6 |
| Windows | 1.6 | 1.00 |

| | | |
|----------------|-----|-----|
| Rooflights | - | 1.3 |
| High Use | 1.6 | 1.6 |
| Entrance Doors | | |
| Vehicle Access | 1.3 | - |
| Doors | | |

4 – The new elements of the building shall endeavour not to exceed a maximum **air permeability of 5m³ / (hr.m²)**. 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.

The Café Drive Thru will be serviced by an Air Source Heat Pump system throughout.

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 shopfront glazing is protected from excessive solar gain by a large, fixed canopy around the shop entry and solar shaded glazing. A canopy is provided to shade the glazing around the entrance of the Coffee Drive Thru.

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 CO₂ 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 110 lumens/circuit watt (with the exception of the sales area being at least 138 lumens/circuit watt) for the ALDI Foodstore, and at least 128 lumens/circuit watt for the Coffee Drive Thru. Display lighting shall be on a separate circuit which may be on automatic timing devices. Any display lighting must have an efficiency of at least 85 lamp lumens per circuit watt.

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) supplied to the Foodstore 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 inverter drive controls;

5 – The buildings have been designed with low building permeability and high levels of building fabric insulation to ensure high levels of building thermal performance;

2.3 Low-Zero Carbon Technologies Appraisal

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 ASHPs, with the Foodstore further supplemented by a 'Freeheat' refrigeration heat recovery scheme and an 80kWp roof-mounted PV array.

2.3.2 Baseline Energy Assessment

To determine the type and size of proposed LZC technology and reduction in CO₂ 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 air-tightness, 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 CO₂ emissions for the development.

Tables 2.1 (overleaf) provide a summary of the results for each scenario.

| Table 2.1: ALDI Foodstore - Summary of Modelled Scenarios | | | | |
|---|---------------------------------|--|---|---|
| Parameter | Scenario | | | |
| | Baseline | Residual | Renewable | |
| Building Emission Rate (kgCO₂/m²/year) | 4.96 | 4.40 | -0.26 | |
| U-Values (W/m ² .K) | Walls | 0.26 | 0.26 | 0.26 |
| | Roofs | 0.18 | 0.18 | 0.18 |
| | Floors | 0.18 | 0.18 | 0.18 |
| | Doors | 1.6 | 1.6 | 1.6 |
| | Windows | 1.6 | 1.6 | 1.6 |
| | Vehicle Access Doors | 1.3 | 1.3 | 1.3 |
| Y-Values | 0.15 | 0.15 | 0.15 | |
| Air permeability (m ³ /(hr.m ²) @ 50 Pa) | 8.0 | 5.0 | 5.0 | |
| Heating / Domestic Hot | Type | Notional Gas Boiler | Electricity UFH Heating System | Electricity UFH Heating System |
| | Efficiency | 82% | 421% | 421% |
| | Fuel | Gas | Partially Grid Supplied Electricity; ASHP with 11% Waste Heat Supplement (RHR). | Partially Grid Supplied Electricity; ASHP with 11% Waste Heat Supplement (RHR). |
| Water (DHW) | 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% | >460% | |
| Internal Lighting | 50% non-dedicated low energy | 100% LED Lighting | 100% LED Lighting | |
| Renewable Technology | None | None | 80kWp PV Array. | |

| Table 2.2: Coffee Drive Thru - Summary of Modelled Scenarios | | | | |
|---|------------|--|--|--|
| Parameter | | Scenario | | |
| | | Baseline | Residual | Renewable |
| Building Emission Rate (kgCO₂/m²/year) | | 20.63 | 19.83 | 19.83 |
| U-Values (W/m ² .K) | Walls | 0.26 | 0.16 | 0.16 |
| | Roofs | 0.18 | 0.13 | 0.13 |
| | Floors | 0.18 | 0.10 | 0.10 |
| | Doors | 1.6 | 1.6 | 1.6 |
| | Windows | 1.6 | 1.0 | 1.0 |
| | Rooflights | 1.6 | 1.3 | 1.3 |
| Y-Values | | 0.15 | 0.15 | 0.15 |
| Air permeability (m ³ /(hr.m ²) @ 50 Pa) | | 8.0 | 5.0 | 5.0 |
| Heating / Domestic Hot Water (DHW) | Type | Notional Gas Boiler | Electricity Heating System | Electricity Heating System |
| | Efficiency | 82% | >300% | >300% |
| | Fuel | Gas | Grid Supplied Electricity | Grid Supplied Electricity |
| | 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% | >500% | >500% |
| Internal Lighting | | 50% non-dedicated low energy | 100% LED Lighting | 100% LED Lighting |
| Renewable Technology | | None | None | None |

Based on the provisional figures detailed above the development shall achieve a significant predicted overall energy demand & carbon emissions reduction over the 2021 Part L Notional building through improved building fabric, the installation of ASHPs, with the Foodstore further supplemented by the 'Freeheat' refrigeration heat recovery system and an 80kWp roof-mounted Monocrystalline Solar PV array, in accordance with the requirements of the Neath Port Talbot County Borough Council Local Development Plan.

Additionally, all space heating requirements within both units will be provided by ASHPs, with the Foodstore supplemented by the waste heat recovered from the 'Freeheat' refrigeration heat recovery system, therefore the use of CHP and/or district heat networks has been discounted (refer to the LZC Feasibility Study included in Section 2.3.3).

Table 2.3 below details the 'baseline case' scenarios for the development regarding CO₂ emissions.

| Table 2.3: Port Talbot ALDI Foodstore and Coffee Unit - 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 | 88,653 | - | 12,296 | - |
| Residual Scenario (improved building fabric and M&E services inc. ASHP) | 79,509 | 10 | 11,157 | 9 |
| Renewable Scenario (Residual Scenario + PV + 'Freeheat') | 14,742 | 81 | 2,766 | 75 |
| Total Savings in Energy and Emissions | 73,911 | 83 | 9,530 | 78 |

Table 2.3 demonstrates a total 78% reduction in CO₂ emissions through the specification of improved building fabric, M&E services, and the installation of LZC technologies in accordance with the Energy Hierarchy (as detailed in section 2.1).

A graphical representation of the cumulative reduction in CO₂ emissions through implementation of various scenarios is provided in Figure 2.2 overleaf.

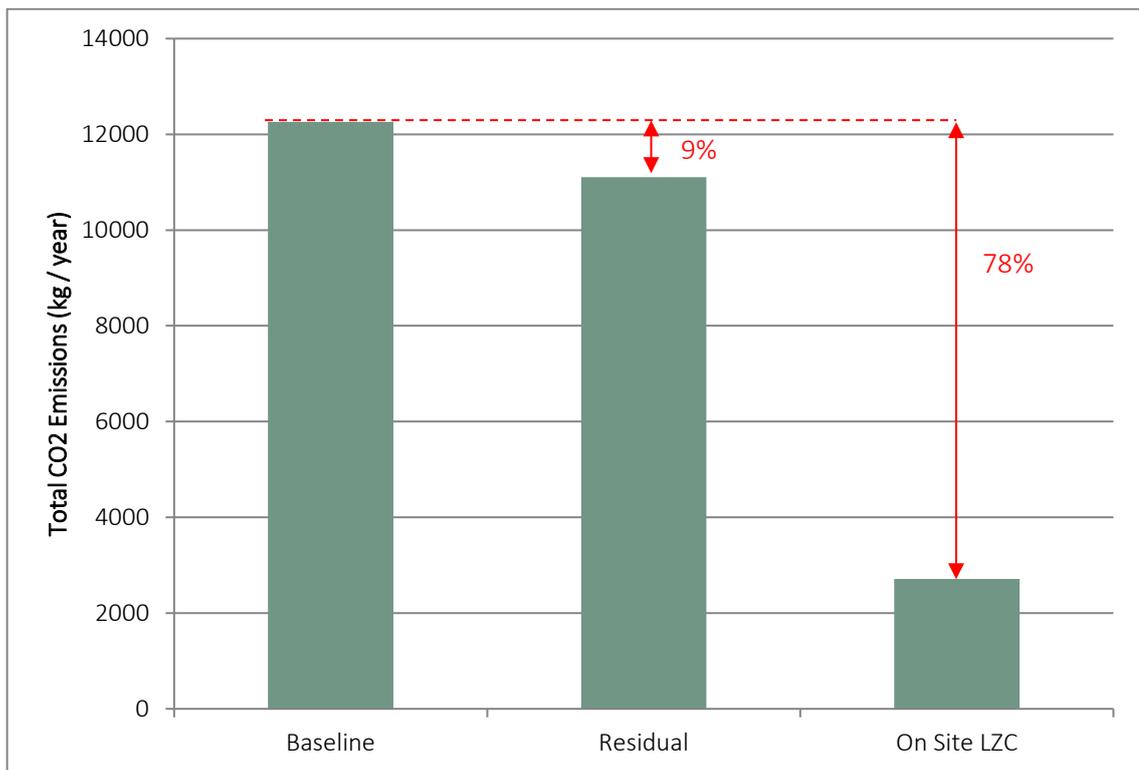


Figure ES1: Implementation of the Energy Hierarchy for proposed Aldi & Cafe development at land North of Afan Way, Port Talbot.

2.3.3 High-Level 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, 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.

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.

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 m² will normally save approximately 230kg of CO₂ 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 to the significant amount of electrical energy that would be required from the pumps in order to satisfy the proposed building heating and cooling load.

All space heating requirements are considered to be able to be met through the utilisation of ASHPs (with the Foodstore receiving additional supplement 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 ASHPs, 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 is considered the most feasible and appropriate option for LZC technology in both units within the development.

All space heating requirements are considered to be able to be met through the utilisation of ASHPs (with the Foodstore system 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.

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 in the Foodstore.

All selling floor space heating requirements of the Foodstore 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.

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

It has been seen suitable, with the orientation of the site roof space available and no shadowing from surrounding buildings, that an **80kWp Monocrystalline PV Array, with a preferable South orientation**, is deemed a viable way for supplementing energy production of the Foodstore.

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.

2.3.4 Proposed LZC Strategy

The proposed development 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 ASHPs supplemented by a 'Freeheat' refrigeration heat recovery scheme to meet all space heating and cooling needs of the development, while the Cafe Drive Thru unit will be provided with an ASHP system only. Additionally, an 80kWp roof-mounted monocrystalline PV array will be specified on the Foodstore.

Through the implementation of the Energy Hierarchy, the development will provide a realistic total carbon equivalent emission saving of approximately 9.5 tonnes per annum.

The use of CHP was reviewed but discounted in favour of ASHP and RHR (refer to the LZC Feasibility Study included in Section 2.3.3).

A summary of the proposed technologies is provided in Box 2.13.

Box 2.13: Objective E – ALDI and Cafe Site-integrated renewable technologies

1 – The Foodstore will be serviced ASHPs supplemented by the recovered heat available from the ‘Freeheat’ refrigeration heat recovery scheme, while the Cafe Drive Thru will be serviced by an ASHP system only.

Additional energy savings will be achieved through the installation of an 80kWp roof-mounted monocrystalline PV array on the Foodstore.

The development has been estimated to provide a realistic total carbon equivalent emission saving of 9.5 tonnes per annum when compared with Building Regulations minimum standards, through the implementation of the Energy Hierarchy, with 8.3 tonnes attributable to LZC technologies alone.