Renewable & Low Carbon Energy Statement

Aldi Stores Ltd.

Exhibition Way,

Exeter

Prepared for:
Aldi Stores ltd.

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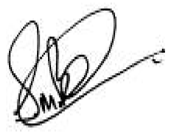
<tr><td colspan="2">Signature:</td><td colspan="2"></td></tr>
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EXECUTIVE SUMMARY

This document forms the Renewable and Low Carbon Energy Statement for the proposed Aldi foodstore, associated access and landscaping works on Exhibition Way, Exeter. This document has been compiled by Sol Environment Ltd on the behalf of the applicant, Aldi Stores Ltd.

The Energy Statement has been formulated in order to provide a sustainable energy solution for the proposed supermarket in accordance with the requirements of Ene 04 – Low or Zero Carbon Technology of the BREEAM UK New Construction 2018.

The Proposed Development

The proposed retail development shall incorporate an ALDI foodstore with associated car parking and landscaping. The development will comprise of the following elements:

- A new ALDI foodstore with a proposed net sales area of 1,205m^2 and a gross internal area of 1,644m^2;
- A refrigeration heat recovery scheme will be included to provide energy savings through using energy recovered from the stores refrigerated cases for heating;
- Car parking for approximately 103 cars (including 5 Parent & Child & 5 Disabled bays); and
- Associated landscaping.

The assessment and subsequent 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. Table E1 below provides an overview of the provisional energy strategy & sustainability statement, based on the objectives detailed throughout this report.

Table E1: Energy Strategy Overview			
Area	Objective Ref	Section	Description
Passive Solar Design	A (1)	2.2.2 (Box 2.1)	Minimising overshadowing
	B (1 – 4)	2.2.2 (Box 2.2)	Passive design principles
	C (1 – 4)	2.2.2 (Box 2.3)	Limiting excessive solar gain
Energy Management & Efficiency	D (1 – 5)	2.2.2 (Box 2.4)	Building energy efficiency measures
Renewable Technologies	E (1 – 2)	2.3.3 (Box 2.13)	Integration of LZC technologies

The conclusion of the energy strategy is that, based on planning stage calculations, the development achieves a significant reduction in CO_2 emission compared to 2013 Building Regulation compliant development, as well as 18% of the buildings predicted energy demand being offset through the incorporation of the principles of the Energy Hierarchy and the combination of passive measures, including building fabric design improvements and the utilisation of zero and low carbon technologies.

The extent of onsite renewable or low carbon technologies, including refrigeration heat recovery scheme utilising air source heat pumps (ASHP) providing heating to the sales area produces sufficient energy to ensure the reduction in CO_2 emissions significantly exceeds the mandated requirements stipulated by Local and Regional Planning Policy.

Specific detail relating to the predicted reductions in annual CO_2 emissions is detailed within the table 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 (%)
2013 Part L Compliant Benchmark Building	107,715	-	49,978	-
Residual Scenario (improved building fabric and M&E services)	94,316	12	45,703	9
Residual Scenario + Arctic Circle 'Freeheat'	87,855	7	44,388	6
Total Savings in Energy and Emissions	**19,860**	**18**	**5,590**	**11**

Based on the provisional figures detailed above, the installation of an 'Freeheat' refrigeration heat recovery system (see Section 2.3.4) will result in a significant reduction in the buildings energy demand and ***11% reduction in CO_2 emissions through on-site generation*** compared to Building Regulations Part L.

The above Table also details a potential ***18% reduction in regulation energy of the Energy Hierarchy*** when compared to the benchmark building scenario (comprising BRUKL 2013 'notional' building).

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

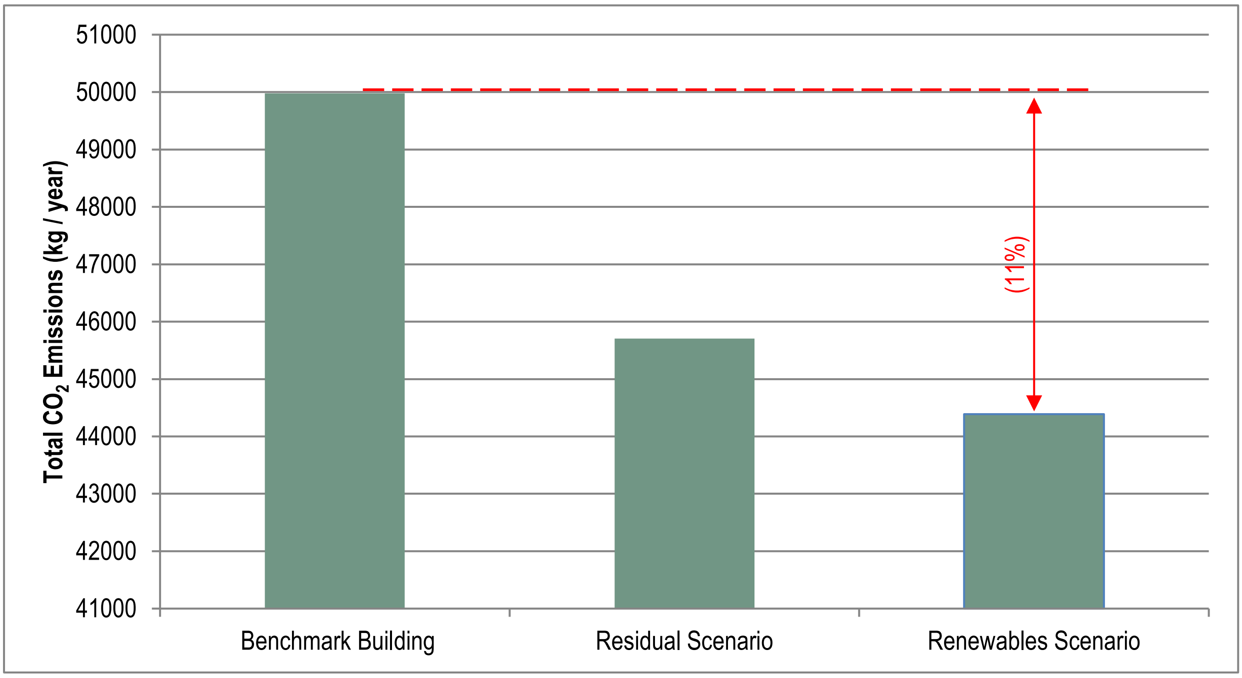

Figure E1: Implementation of the Energy Hierarchy for proposed Aldi development at Exhibition Way, Exeter

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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 Exhibition Way, Exeter.

This report has been prepared by Sol Environment Ltd in cooperation with the applicant and in accordance with the requirements of Ene 04 – Low or Zero Carbon Technology of the BREEAM UK New Construction 2018.

1.2 Proposed Development

The proposed retail development shall incorporate an ALDI foodstore with associated car parking and landscaping. The development will comprise of the following elements:

- A new ALDI foodstore with a proposed net sales area of 1,205m^2 and a gross internal area of 1,644m^2;
- A refrigeration heat recovery scheme will be included to provide energy savings through using energy recovered from the stores refrigerated cases for heating;
- Car parking for approximately 103 cars (including 5 Parent & Child & 5 Disabled bays); and
- Associated landscaping.

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

The development will endeavour to achieve a significant reduction in CO_2 emissions through the installation of renewable and low carbon technologies.

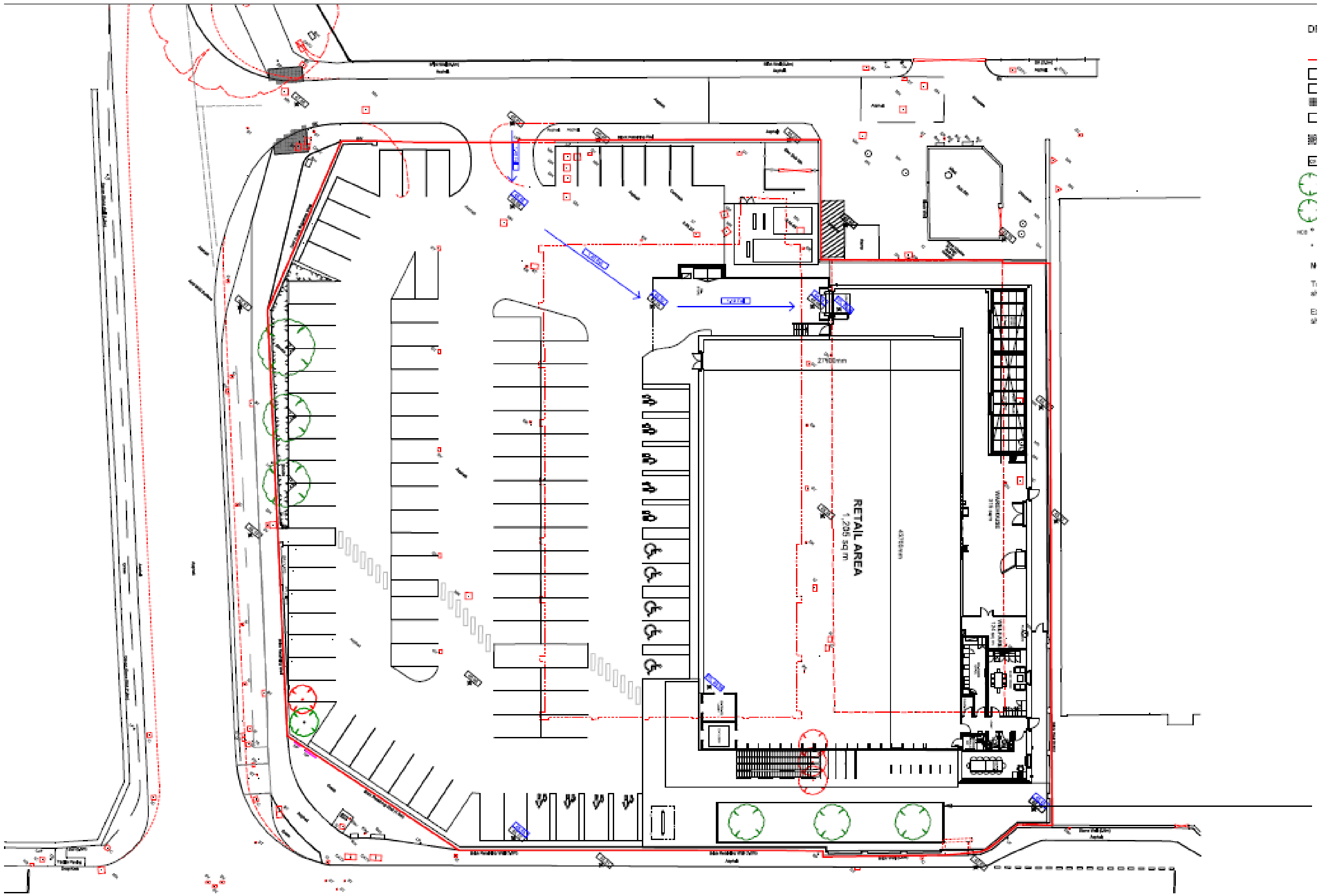

Figure ES1 Proposed Site Layout (prepared by Kendall Kingscott Architects Ltd.)

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.

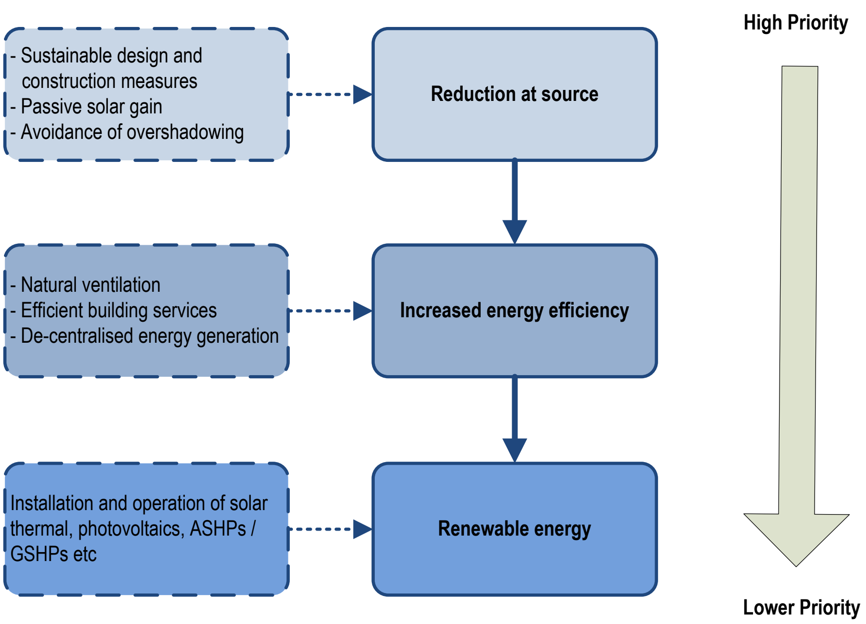

Figure 2.1: The Energy Hierarchy

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

2.3 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, such as the staff room, 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 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*
A1 *– 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 for the staff, office and working spaces, 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-value*
Walls	*0.35*
Roof	*0.21*
Floor	*0.25*
Doors	*1.8*
Windows	*1.8*
High Use Entrance Doors	*1.5*
Vehicle Access Doors	*1.5*

B4 *– The new elements of the 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.*

The provision of a large awning over the main entry glazing and the orientation of the building (i.e. entry facing north) minimises the impact of solar gain and subsequent building overheating thus reducing the reliance on mechanical cooling systems in the summer months.

The retail space is being serviced by a refrigeration heat recovery (RHR) system known as the 'Freeheat' system. The proposed 'Freeheat' RHR system feeds a ducted air supply and extract system serving the retail space. The retail space does not require cooling, with air change rates dictated by the estimated footfall within the development. Refer to section 2.3.3 for further detail.

The office, WCs and other staff facilities to be supported by mechanical extract ventilation system with Part L2A 2013 compliant efficiencies, flow rates and fan powers. Active cooling has been specified for the Manager's office only. The offices house the stores Safe and is therefore fully enclosed for security reasons.

Box 2.3: *Objective C – Limiting Excessive Solar Gain*
C1 – Where mechanical ventilation and extract is required, Part L2A 2013 compliant efficiencies, flow rates and fan powers shall be installed.
C2 – When cooling is required the proposed 'Freeheat' RHR system feeds a ducted air supply and extract system serving the retail space with cooling provided though absorption chillers.
C3 – The shopfront glazing is protected from excessive solar gain by a large fixed canopy around the shop entry.

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 35% 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*
D1 – Lighting shall achieve an initial efficiency averaging over the whole building of not less than 70 lumens/circuit watt. 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 22 lamp lumens per circuit watt.
D2 – The building management system shall be fitted and integrated with AMR energy display devices for the provision of half hourly energy consumption data.
D3 – Majority of the heat (all heating to the sales area) will be supplied from the waste heat available from refrigeration heat recovery system.
D4 – All electric fans, motors and pumps will be specified with high efficiency motors and invertor drive controls;

D5 – The buildings have been designed with low building permeability and high levels of building fabric insulation to ensure high levels of building thermal performance.

2.4 Low-Zero Carbon Technologies Appraisal

2.5 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 CO_2 emissions), and the site locations and ground conditions.

The proposed scheme is to include the Arctic Circle 'Freeheat' refrigeration heat recovery scheme.

2.6 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 (2013) 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 CO_2 emissions for the development.

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

Table 2.1: Summary of Modelled Scenarios				
Parameter		Scenario		
		Baseline	Residual	After LZC Energy
Building Emission Rate ($kgCO_2/m^2/year$)		*30.4*	*27.8*	*27*
U-Values ($W/m^2.K$)	Walls	0.35	0.35	0.35
	Roofs	0.25	0.25	0.25
	Floors	0.25	0.25	0.25
	Doors	2.2	1.8	1.8
	Windows	2.2	1.8	1.8
	Vehicle Access Doors	1.5	1.5	1.5
Y-Values		0.15	0.15	0.15
Air permeability ($m^3/(hr.m^2)$ @ 50 Pa)		10.0	5.0	5.0
Heating / Domestic Hot Water (DHW)	Type	Notional Gas Boiler	Gas Boiler	'Freeheat' - ASHP
	Efficiency	82%	91%	>500%
	Fuel	Gas	Natural Gas	Recovered Heat
	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 (Manager's office only)		100%	>300%	>300%
Internal Lighting		50% non-dedicated low energy	100% LED Lighting –	100% LED Lighting

Based on the provisional figures detailed above the development shall achieve a predicted overall ***energy reduction demand of 18% over the 2013 Part L Notional building trough the implementation of the energy Hierarchy*** and ***11% reduction in CO_2 emissions through on-site renewable technologies.***

All space heating requirements within the sales area will be provided by the waste heat recovered by the 'Freeheat' refrigeration heat recovery system.

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

Table 2.2: Energy Strategy Summary				
Scenario	Energy Demand (kWh / year)	Energy saving achieved (%)	Regulated CO_2 Emissions ($kgCO_2$ / year)	Saving achieved in CO_2 emissions (%)
2013 Part L Compliant Benchmark Building	107,715	-	49,978	-
Residual Scenario (improved building fabric and M&E services)	94,316	12	45,703	9
Residual Scenario + Arctic Circle 'Freeheat'	87,855	7	44,388	6
Total Savings in Energy and Emissions	**19,860**	**18**	**5,590**	**11**

Table 2.2 demonstrates a total of 11% reduction in CO_2 emissions through the specification of improved building fabric 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 CO_2 emissions through implementation of various scenarios is provided in Figure 2.2 below.

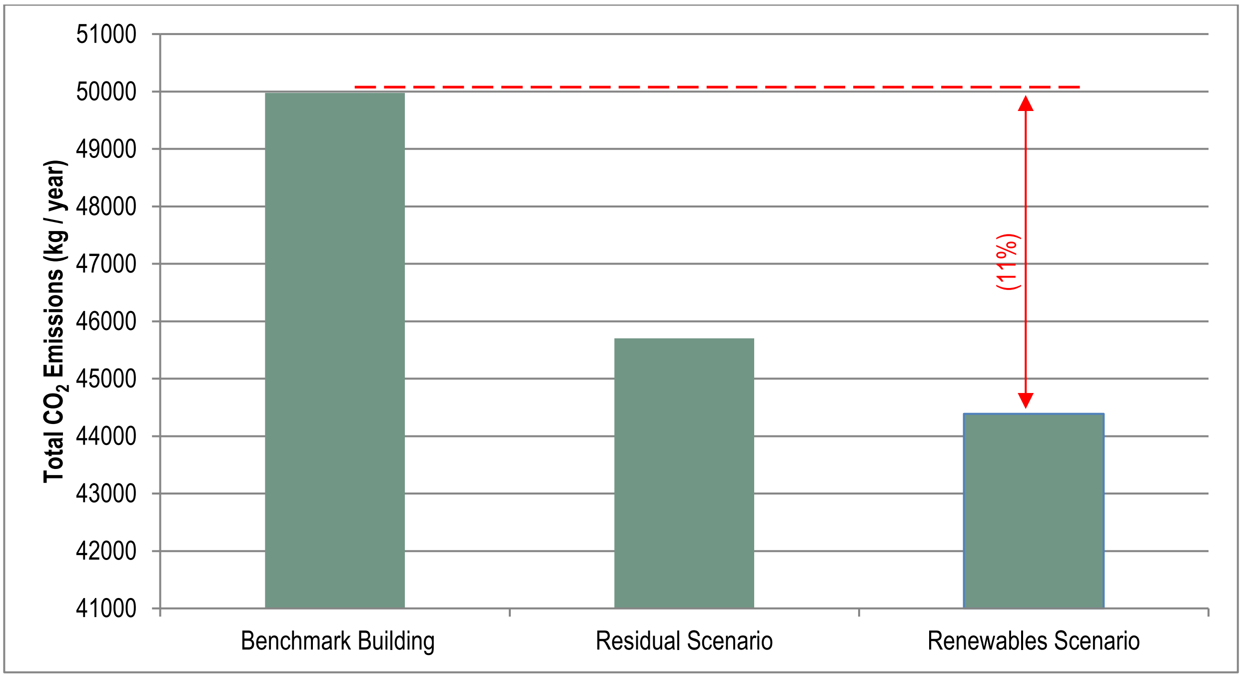

Figure 2.2: Implementation of the Energy Hierarchy for proposed Aldi development at Exhibition Way, Exeter

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2.7 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.

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

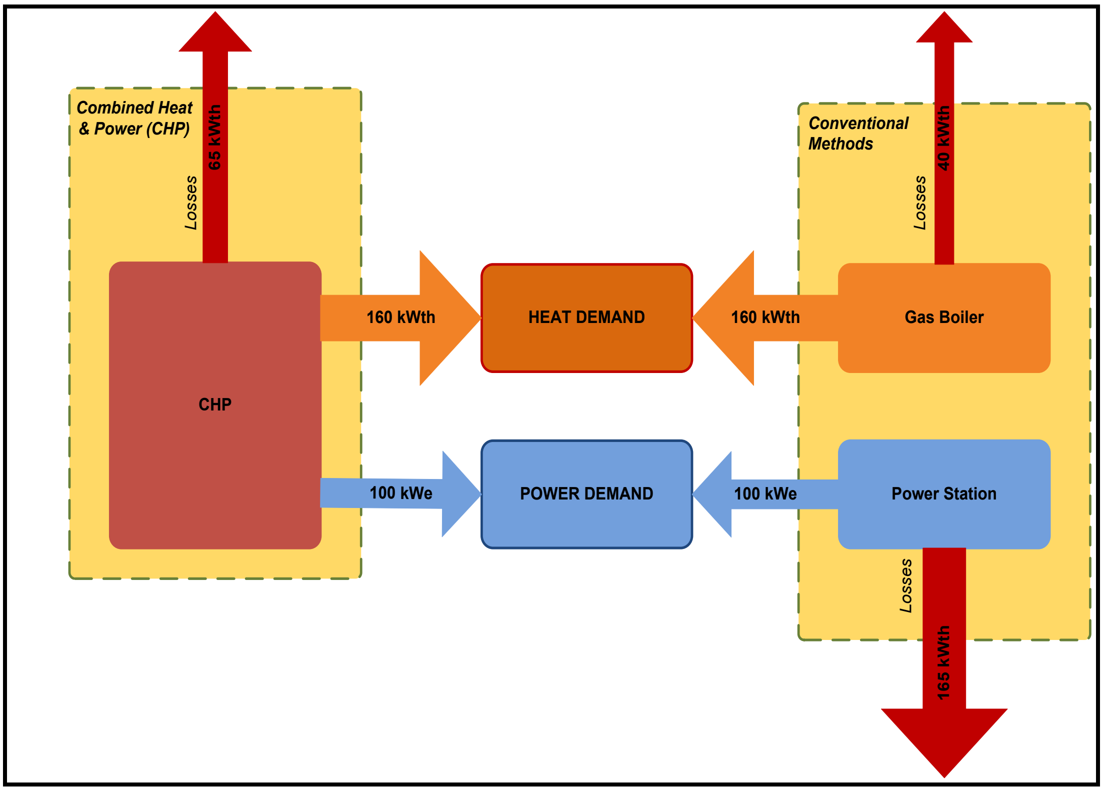

Figure 2.3; Flow Diagram of Gas fired CHP versus Grid Electricity and Gas Fired Heating

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 2.4: Feasibility Summary – CHP
The specification of CHP would lead to increased reliance on non-renewable fuel sources as the sites limited footprint does not allow suitable storage of biofuels (such as biomass pellets). Further to this, all waste heat from the refrigeration units would be released to atmosphere. 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 amount of electrical energy that would be required from the pumps in order to satisfy the proposed building heating and cooling load. All selling floor space heating requirements are considered to be able to be met through the utilisation of 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 is 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
Air Source Heat Pumps shall be utilised within the development to distribute heat recovered from the store's refrigeration cases. Further details on the 'Freeheat' system can be found in Box 2.9 overleaf.

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 worked 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 'Freeheat' RHR system feeds a ducted warm air supply and extract system serving the retail space. It is a dual source heat pump with high efficiency utilising the heat normally rejected from the refrigeration system, together with a heat pump function which boosts the heat available to heat the store to design temperature.

During periods of low refrigeration load which would typically result in a reduction in heating – the system will operate as an air source heat pump, by utilising the outdoor condenser as a heat source. This enables the system to meet the stores heating requirement.

Box 2.9: Feasibility Summary – Refrigeration Heat Recovery
'Freeheat' refrigeration heat recovery scheme 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 recovered heat and distributed through a network of Air Source Heat Pumps.

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
Local policy requirements can be exceeded through the specification of ASHP's utilising waste head. Further to this, Increased capital costs and retraction of financial incentives have

led to a significant increase in the predicted payback time of photovoltaic panels. As such, at this time PV panels have been discounted by the developer.

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
Owing to site-constraints, micro-wind turbines have not been considered as part of this feasibility study. Constraints also include relatively low wind speeds in this area, averaging <4.65 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.

2.8 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 system will be designed to utilise 'Freeheat' refrigeration heat recovery scheme to meet all space heating needs for the selling floor area of the development. Furthermore, given the opportunity to utilise the south facing aspects of the roof space on site, a significant photovoltaic array (with surplus electricity generated being exported to the National Grid) has been provided across all suitable buildings. The extent of photovoltaic arrays within the development is considered sufficient to offset 20% of regulated emissions requirements.

The development will provide a realistic total carbon equivalent emission saving of approximately the 5.5 tonnes per annum.

2.8.1 Life Cycle Cost

Carbon Trust guidance states that low grade refrigeration heat recovery systems have a 'medium' payback period of approximately 5 years based on 3,000 operating hours per annum.

2.8.2 Local Planning Criteria

There are no specific local land use requirements relating to LZC technologies that would impact the implementation of the proposed system. Heat recovery plant will be sited to the rear of the building, using standard sized condensers, and PV panels will be located on the roof. The impact on the buildings footprint and profile will therefore be negligible.

Any external plant associated with Refrigeration Heat Recovery system functions in a similar manner to traditional refrigeration plant with the additional of a heat exchanger. It is anticipated that there will be minimal additional noise in comparison to a typical retail development.

2.8.3 Export Feasibility

Heat generated the by Refrigeration Heat Recovery system is low grade and therefore not suitable for export. Any excess electricity generated by the PV panels will be exported to the grid and is eligible for FiT's.

3.3.4.4 Grants

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

Any excess electricity generated by the PV panels will be exported to the grid and is eligible for FiT's.

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

Box 2.13: *Objective E – Site-integrated renewable technologies*

E1 *– The retail floor space heating will be supplied from the recovered heat available from the 'Freeheat' refrigeration heat recovery scheme.*

Parameter	*Value*
Type	'Freeheat' RHR system – ASHP
Efficiency	>500%
Fuel	Recovered Heat/Grid Supplied Electricity
Controls	Zoned and fitted with independent time and temperature controls

The development has been estimated to provide a realistic total carbon equivalent emission saving of 5.5 tonnes per annum.