Energy Statement

CTL Foodstore Cribbs Triangle

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BOX TWENTY

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1 Executive Summary

The purpose of this report is to support the Reserved Matters planning application for the development of a Lidl Foodstore, Cribbs Triangle. This is one parcel of land in the overall Cribbs Triangle redevelopment site, which shall also include a community centre and residential units, plus the potential for other uses. The project requires the submission of an Energy Strategy which summarises the planned energy reductions, energy efficiency and sustainability measures that the Lidl Foodstore proposes. The requirements for energy use, including South Gloucestershire's Local Plan policy and Building Regulations have been outlined.

The project is the first stage of development as part of a wider mixed-use development for the site. The development proposed is a single storey building, plus car park space and roof space.

We have closely followed the South Gloucestershire Local Plan on energy in new development for this project. The report has been revised following comments from Lidl resulting in an updated store layout upon which these revised results are based.

We have taken two approaches to demonstrate Lean, Clean & Green Carbon reduction savings for this development as Lidl have very high lighting levels in the store & also high fan energy requirements, which the NCM Notional building do not take into account. Therefore firstly, we have created a "Lidl Baseline" scenario within the SBEM calculations where the Lidl lighting & ventilation/fan loads are used, with the fabric & system performance parameters matching or very similar to the Part L "Notional" building.

Secondly, we have undertaken a more conventional SBEM based on the BER / TER in line with Part L requirements.

For the "Lidl Baseline" scenario, we have incorporated stage 1 of the Energy Hierarchy, 'Minimising Energy Requirements'. This stage includes a fabric first approach with considerable improvements to minimum U-values and air permeability standards. These improvements have resulted in residual CO_2 emissions savings of 2.3%

Further to these fabric improvements, stage 2 of the Energy Hierarchy outlines our approach to incorporating "energy efficiency measures" such as high efficiency LED lighting with daylight dimming controls, VRF heat pump heating and cooling, low energy fans and MVHR's with CO_2 sensors and variable speed control. These improvements have resulted in residual CO_2 emissions savings of 17.8%.

Then, stage 3 of the Energy Hierarchy considers "Low and Zero Carbon (LZC) technologies" & an assessment of LZC technologies has been undertaken and it was found that the most appropriate low & zero carbon renewable technologies for the development are VRF heat pumps for heating and cooling and a significant photovoltaic (PV) electrical generation installation. These improvements have resulted in residual CO_2 emissions savings of 62.2%

For the BER / TER Part L compliance example, by taking the fabric improvement, energy efficiency measures and by incorporating a significant PV array on the roof with a peak output of 180kWp, a total CO_2 reduction of 39.9% will be achieved against the residual CO_2 emissions of the building.

In each of these two scenarios, with all measures combined, has resulted in CO_2 savings beyond Building Regulations compliance of 82.7% compared to the 'Lidl Baseline' and CO_2 savings of 39.9% compared to the BER / TER Part L.

The full results for each assessment scenario can be seen in Table 1 and **Error! Reference source not found.** below. This report provides further detail on the LZC feasibility study, a full list of assumptions and improvements made, and a detailed assessment of the results of Energy and CO_2 savings achieved against the targets for this development.

Table 1 – SBEM CO_2 Reduction Results compared to Lidl Foodstore Baseline

	Energy Demand (kWh/m²)	Energy Saving Achieved	Regulated CO_2 Emissions (kg/m²)	Saving Achieved on Residual CO_2 Emissions
Baseline	119.82	/	60.65	/
Lean	117.01	2.3%	59.22	2.3%
Clean	96.1	17.8%	48.63	17.8%
Green	37.75	60.7%	18.35	62.2%
Totals		80.8%		82.7%

Table 2 – SBEM CO_2 Reduction Results compared to TER

	Energy Demand (kWh/m²)	Energy Saving Achieved	Regulated CO_2 Emissions (kg/m²)	CO_2 Emissions Saving Achieved
TER	62.06	/	30.53	/
Green	37.75	39.17	18.35	39.9%

2 Introduction

The Lidl Foodstore development is located between Station Road and the A4018 at Cribbs Causeway Bristol (BS10 7LF). The site is known as Cribbs Triangle. The project is one parcel of land in the overall Cribbs Triangle redevelopment site, which shall include a community centre and residential units, plus the potential for other uses. The Triangle redevelopment is within an overall site masterplan which we understand has outline planning consent. The Triangle site is therefore part of a wider project at Cribbs Causeway, including neighbouring sites which are not under the ownership of our Client, Deeley Freed. Works on these sites are likely to be running in parallel with the Cribbs Triangle development. Infrastructure works for the Triangle site, including mains services and highways connections are currently underway. The Lidl Foodstore parcel is to be fully serviced with incoming utilities up to its boundaries.

The purpose of this report is to summarise the current strategy to reduce the energy consumption and carbon emissions of the Lidl Foodstore building following the Energy Hierarchy depicted below:

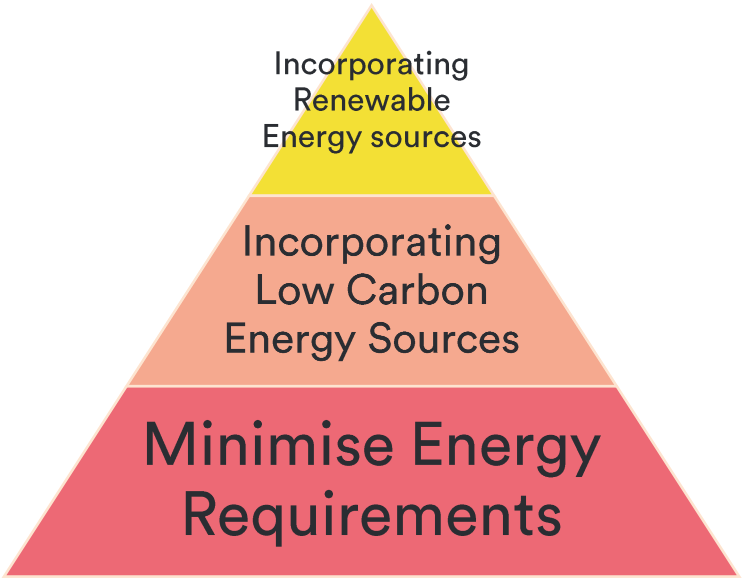

Figure 1 - Energy Hierarchy

This report also outlines how the development intends to comply with Building Regulations and seeks to improve the building fabric as far as practicable.

This report provides the information required by South Gloucestershire Council to accord with the following Core Strategy Policies:

- CS1 – High Quality Design.
- CS3 – Renewable and Low Carbon Energy Generation.
- CS4 – Renewable or Low Carbon District Heat Networks.

3 Regulation, Policy and Performance Targets

This development falls within South Gloucestershire Council's catchment and therefore the South Gloucestershire Local planning guidance applies, in addition to national planning guidance and Building Regulations. This section details the compliance requirements.

3.1 Building Regulations

Building Regulations Part L defines the energy efficiency standards required for buildings. This regulation controls the insulation values of thermal elements, areas of glazing, doors and other openings in the façade, efficiency, insulation, air permeability and controls of heating appliances and systems as well as lighting and hot water storage efficiencies. The Building Regulations also identify the requirements for SBEM (Simplified Building Energy Model) calculations to be undertaken and Carbon Emission Targets for non-dwellings to be calculated to demonstrate compliance.

The Simplified Building Energy Model (SBEM) is a software tool developed by the BRE in support of the National Calculation methodology (NCM) and the Energy Performance of Buildings Directive (EPBD). The NCM is used by the Government to assess and compare the energy and environmental performance of non-dwellings. Its purpose is to provide a fair and reliable assessment of a building's energy performance that is needed to underpin energy and environmental policy initiatives. SBEM calculations are a requirement of the Building Regulations and are required for all newly built non-dwellings in the UK.

Calculations have been undertaken in IES Apache 2019 Version 7.0.12, an advanced SBEM software tool that is certified for carrying out SBEM calculations.

3.2 National Policy

The National Planning Policy Framework sets out the government's planning policies for England. It provides guidance for local planning authorities and decision-makers, both in drawing up plans and making decisions about planning applications.

Chapter 14 is the relevant policy and relates to Meeting the Challenge of Climate Change, Flooding and Coastal change. The policy makes it a requirement for the built environment to reduce CO_2 emissions and energy demand, and to also promote renewable energy.

3.3 Local Policy

Planning policy has been followed closely in the development of the M&E design solution for the proposed project. The following details the specific planning policy that is applicable to the development and what the requirements are.

South Gloucestershire Local Plan Core Strategy 2006-2027 was adopted in December 2013 and sets out the following policies for a development of this scale:

CS1 – High Quality Design seeks to ensure that all new development minimises the amount of energy and natural resources used during construction and the operation of the development over its lifetime.

- The policy encourages higher energy efficiency standards to be achieved, for example BREEAM 'Very Good'.
- The policy normally expects developments to achieve at least a 10% improvement in energy conservation and would particularly welcome developments which seek to achieve the equivalent of Code for Sustainable Homes Level 4 (which equates to a 19% improvement on Building Regulations Part L).
- The policy suggests applicants carry out an assessment of overheating risk using a recognised methodology such as CIBSE TM52 or equivalent, using the latest climate projections for the lifetime of the development (normally considered to be at least 60 years).
- The policy requires a move away from the use of fossil-fuel based systems (i.e. gas boilers) towards alternative renewable sources of heat such as heat pumps. To be counted as renewable, heat pumps must have a minimum seasonal efficiency of 250%.

CS3 – Renewable and Low Carbon Energy Generation supports proposals which will generate energy from renewable or low carbon sources, subject to criteria which protects, for example, residential amenity and landscape designations.

For major greenfield development proposals, **PSP (Policies, Sites and Places plan) Policy 6** has an additional requirement for proposals to reduce CO2 emissions by at least 20% via the use of renewable and/or low carbon energy generation sources on or near the site.

CS4 – Renewable or Low Carbon District Heat Networks requires developments of over 10,000sqm (non-residential) or 100 dwellings to fully explore the feasibility of incorporating renewable or low carbon heating or Combined Heat and Power (CHP) infrastructure on site, or connect to or provide a heat distribution network.

4 LZC Feasibility Study

To assess the site wide energy strategy, it is important to analyse the possible low or zero carbon technologies (LZC) that could be implemented as part of this development. This list is not exhaustive, but merely aims to highlight some of the more viable solutions. The technologies are colour coded using a "traffic light" colour scheme where Red = Not feasible, Yellow = Possible, Green = Preferred.

Technology	Pros	Cons	Comments	
Air Source Heat Pump (ASHP)	▪ Can serve a significant proportion of heating and cooling for certain types of buildings, including offices, airports, sports facilities etc. ▪ Can generate heat and chilled water with a single system with integral controls. ▪ VRF heat pump systems are well understood in the commercial marketplace in terms of marketability, operation and maintenance. ▪ A VRF heat pump system can have a Seasonal Energy Efficiency Ratio of over 4.0 and a Seasonal Co-efficient of Performance of over 3.5 which can provide significant energy and carbon reductions.	▪ The efficiency reduces when producing heat above 45°C, therefore hot water usually has to be boosted using additional gas-fired boilers, indoor heat pump boosters or using electrical immersion heaters. ▪ Not effective at providing heat during periods of exceptionally cold weather (<-10°C) ▪ Will result in noise being generated in an external area	▪ Heat generated from VRF heat pump installation could be considered a low carbon technology. ▪ Cannot generate domestic hot water efficiently. ▪ Acoustics need to be considered carefully. ▪ The condensers ideally need to be located outside.	
Biomass Boiler	▪ Can provide very low carbon heating if in an appropriate location, within around 30-40 miles of biomass source and with suitable storage and delivery spaces. ▪ Eligible for Renewable Heat Incentive.	▪ Potentially high maintenance, particularly if woodchip is used. ▪ Requires considerably larger plant than gas fired heating plant to accommodate a significantly larger boiler and a fuel store. ▪ Delivery of biomass fuel can be problematic. ▪ Produces NOx and PM2.5/PM10 particulate matter that would increase pollution.	▪ Challenging site to source wood chip to a busy location on the outskirts of Bristol. ▪ Negative impact to air quality and may need to consider DEFRA clean air zone.	
Combined Heat & Power (CHP)	▪ Can be an efficient way of generating heating and power, provided the thermal energy can be fully-utilised. ▪ Works well in conjunction with gas-fired boilers as both deliver similar temperatures. ▪ Can make a significant contribution towards reducing carbon emissions. ▪ Can provide a good return on investment if the electricity is used on site.	▪ Anticipated changes to the Carbon factor associated with electricity will significantly reduce the carbon savings associated with this technology. ▪ The technology requires a significant year round base heating load to be commercially viable.	▪ South Gloucestershire identify this technology as high in the energy hierarchy, however due to SAP10 being introduced, CHP as a gas-fired system will not perform as favourably as electric systems in the near future due to a decarbonised electrical grid. ▪ Domestic Hot water base heating load will not be sufficient to justify a small CHP engine.	
Ground Source Heat Pump (GSHP)	▪ Can serve a significant proportion of heating and cooling for certain types of buildings, including offices, airports, sports facilities etc. ▪ Can generate heat and chilled water with an energy efficiency ratio of up to 5.00. ▪ Eligible for Renewable Heat Incentive.	▪ Renewable Heat Incentive will have ceased before the system could be installed. ▪ Expensive solution due to the costs associated with drilling the boreholes – horizontal loops could disrupt local infrastructure. ▪ The efficiency reduces when producing heat above 45°C, therefore hot water usually has to be boosted using additional gas-fired boilers, indoor heat pump boosters or using electrical immersion heaters.	▪ It is likely that boreholes for GSHP systems will be much more expensive to provide than an ASHP installation would be.	
Photovoltaics	▪ Fully renewable (energy generated is from sunlight). ▪ Can be installed on the roof of the building. ▪ Typical lifespan of panel is 25 years.	▪ A significant area of clear, unshaded roof space is typically required, with access for cleaning and maintenance.	▪ Roof area identified without any disturbance to development. ▪ Can be fed back into landlord supply or grid. ▪ Most cost-effective option to provide 20% carbon reduction.	
Solar Thermal Hot Water	▪ Can offset up to 50% of the building's hot water demand, and be installed on the roof of the building. ▪ Eligible for Renewable Heat Incentive.	▪ A significant area of clear, unshaded roof space is typically required with access for cleaning and maintenance. ▪ Not sensible to use on the same building as CHP as would reduce the potential hot water base-load and reduce CHP efficiency and potential utilisation. ▪ PV more effective as any spare electricity could be exported (sold) to the grid. ▪ Renewable Heat Incentive will have ceased before the system could be installed.	▪ Domestic hot water load is not considered to be large enough to justify Solar Thermal. PV's would provide a more effective use of roof space in terms of carbon reduction.	

Technology	Pros	Cons	Comments	
Wind Power	▪ Can be a particularly visual component of a renewable or low carbon energy strategy and generate significant energy and carbon savings in an appropriate setting. ▪ If efficiently operated (good location and exposure to wind), equipment can pay back in 2-3 years.	▪ Can be noisy – care must be taken to site turbines with an appropriate separation distance from residential areas. ▪ A large-scale turbine would not be suitable for this site. ▪ Small to mid-scale wind turbines are often inefficient in built-up locations due to the reduction of wind speeds by obstructions. Aesthetics are also a concern.	▪ Site is not suitable due to urban setting.	
District Heating	▪ Where a district heating network has a low carbon factor such as in Bristol it can provide a good carbon reduction. ▪	▪ A district heating network is not available in the vicinity of the building. ▪ Requires a reasonably significant heating demand to be commercially and practically viable. ▪ It is not compatible with VRF heat pump systems which are proposed due to the buildings cooling requirement.	▪ As the building is a sealed foodstore with mechanical ventilation, the main energy demand will be driven by cooling rather than heating. ▪ The most appropriate and preferred cooling solution for the building is VRF which is not compatible with district heating.	

<u>Conclusion</u>

Given the site opportunities and constraints, the most appropriate technologies are VRF Air source heat pumps and Photovoltaics.

5 SBEM Modelling

5.1 Building Regulations Criteria

To meet regulatory standards, the development must be assessed using the Part L compliance procedure, known as SBEM, which incorporates the use of standardised templates and a 'notional building' to provide a consistent means of comparing similar buildings.

The assessments must be carried out in accordance with the version of the UK Building Regulations which is in force at the time of the initial construction works.

During the design stage, criteria 1 to 3 must be assessed:

5.1.1 Criterion 1: 'Achieving the TER rate'

It must be demonstrated via the use of accredited modelling software (CIBSE AM11) that the Building CO_2 Emission Rate (BER) is lower than or equal to the Target Emission Rate (TER). The modelling should be carried out at or before RIBA Stage 4 to ensure that the proposed building envelope and services designs meet the minimum regulatory standard before construction begins.

5.1.2 Criterion 2: 'Limits on Design Flexibility'

Minimum standards apply to the building envelope (U-values, air permeability) and the building services (for example heat generation plant efficiency, fan power).

5.1.3 Criterion 3: 'Limiting the Effects of Solar Gains in Summer'

Modelling in accredited software must demonstrate that the total summer solar gains in each occupied or air-conditioned space is less than a target as defined within the Approved Document. Criterion 3 addresses energy consumption and should not be confused with thermal comfort or overheating risk which should be assessed separately. For further information, refer to UK Building Regulations Approved Document Part L2A – 2010 with 2013 and 2016 amendments.

During and after construction, two further criteria must be assessed:

5.1.4 Criterion 4: 'Building Performance'

The performance of the building, as built, should be consistent with the building emission rate (BER) and therefore lower than or equal to the target emission rate (TER).

5.1.5 Criterion 5: 'Energy Efficient Operation'

This relates to providing information for the occupants to allow energy efficient operation of the building to be put in place.

5.2 Methodology

South Gloucestershire Council promotes a fabric first approach to new developments, encouraging energy efficiency to be achieved through improved U-values before looking to offset any residual emissions with renewables. Therefore, several iterations have been run for the development to ascertain the maximum fabric efficiencies that could be achieved, and the effect that different mechanical systems and renewable technologies could make to the overall results.

5.2.1 'Baseline' - Baseline building

The TER cannot be used for direct comparison here because it does not use Lidl Foodstore's lighting spec which is particularly onerous (1000lux within store) and a single-duct VAV system. Therefore, 'Baseline' refers to a building with Lidl Foodstore's required lighting lux levels and system types, but with all performance parameters matching or similar to the minimum regulatory standards.

5.2.2 'Lean' - Fabric improvements

'Lean' as per 'Baseline' but with proposed fabric, shade canopy, and airtightness values improved.

5.2.3 'Clean' - HVAC improvements

'Clean' as per 'Lean' but with proposed high-efficiency fixed building services performance. This includes lighting efficacies, heating and cooling plant performance and ventilation specific fan power improvements.

5.2.4 'Green' - Renewables

'Green' as per 'Clean' but with PV generation incorporated.

We have created a baseline model for the Lidl Foodstore and various improvements have been incorporated into the building fabric and equipment efficiency assumptions. The resulting reduction in regulated carbon emissions has been calculated for each area in line with policy CS3.

5.3 Inputs

5.3.1 Building Fabric Performance

The build elements for the Lidl Foodstore will be assessed under Approved Document Part L2A: Conservation of Fuel & Power (New buildings other than dwellings). The proposed improvement to the minimum standards and the notional standards used for the baseline model are shown in Table 3.

Table 3 - Building Fabric Performance Requirements in Part L2A 2010 (HM Government, 2010)

Building Element Properties		Part L2A Minimum	Part L2A Notional	Proposed
Wall	W/m².K	0.35	0.35	0.25
Floor	W/m².K	0.25	0.25	0.25
Roof	W/m².K	0.25	0.25	0.19
Glazing	W/m².K	2.2	2.22	1.7
Personnel doors	W/m².K	2.2	1.5	1.5
Air Tightness	m³/hr/m² @ 50Pa	10	5	4

As can be seen the proposed fabric standards are an improvement on baseline compliance, however, have a relatively small effect on reducing CO_2 emissions, since the energy and carbon emissions are predominantly driven by the lighting and auxiliary power requirements of the building, and therefore the proposed fabric performance improvements do not greatly improve upon the 'Lean'.

5.3.2 Mechanical Services

It is proposed that an external heat rejection plant area is created on the ground to accommodate Variable Refrigerant Flow condensers (VRF) for highly efficient heating and cooling services. Mechanical ventilation will be provided using high efficiency Air Handling Units (AHU) with Heat Recovery units & variable speed fans. A dedicated split AC unit will be provided for dedicated cooling in the IT room.

Table 4 details the mechanical services performance assumptions used in the Part L compliant baseline notional building model for Lidl Foodstore.

Table 4 – Proposed Mechanical Services Performance compared to Baseline Model

Mechanical services	Baseline model	Proposed model
VRF – No vent	Heating efficiency: 2.5 Cooling efficiency: 2.6	Heating efficiency: 3.5 Cooling efficiency: 4.5
VRF – MVHR	Heating efficiency: 2.5 Cooling efficiency: 2.6 HR efficiency: 0.5	Heating efficiency: 3.5 Cooling efficiency: 4.5 HR efficiency: 0.8
DX Split – No vent	Heating efficiency: 2.5 Cooling efficiency: 2.6	Heating efficiency: 2 Cooling efficiency: 2.5
Sales VAV	Heating efficiency: 2.5 Cooling efficiency: 3.2 SFP [W/(l/s)]: 1.6 HR efficiency: 0.65	Heating efficiency: 3.5 Cooling efficiency: 4.5 SFP [W/(l/s)]: 1.6 HR efficiency: 0.8
Hot Water System	Local point of use	
Hot Water Heating Efficiency	100%	
Ventilation and Fan Strategy	SFP [W/(l/s)]: 1.9	SFP [W/(l/s)]: 1.2

It can be seen that the proposed performance standards are considerably better than the Part L compliant baseline model with significant improvements to the VRF heating and cooling efficiencies as well as to the fresh air ventilation systems serving the majority of the building. A significant performance improvement is shown at 'Clean'.

5.3.3 Electrical Services

The proposed building design will include high efficiency LED lighting with daylight sensing and dimming control.

Table 5 details the electrical design assumptions used in the notional baseline model compared to the proposed improvements.

Table 5 – Proposed Electrical Services Performance compared to Baseline Model

Electrical services	Baseline model	Proposed model
Building electric power factor	>0.95	
Luminaire luminous efficacy (lm/W)	65	80
Lamp luminous efficacy (lm/W)	65	80
Display lamp (lm/W)	65	80

5.4 Model Geometry

The model geometry can be seen in Figure 2.

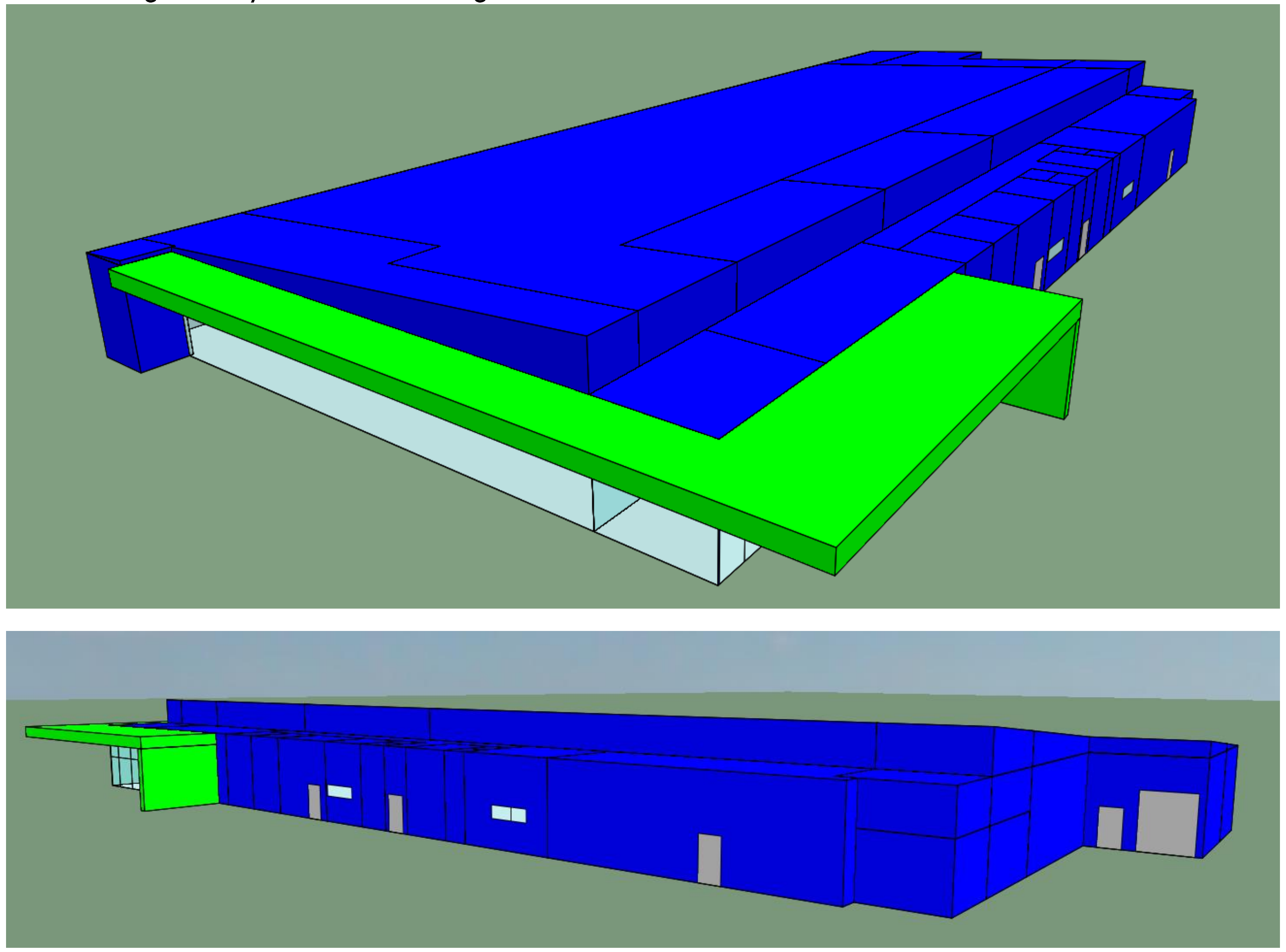

Figure 2 - SBEM Model Geometry

5.5 Results

We have taken two approaches to demonstrate Lean, Clean & Green Carbon reduction savings for this development as Lidl have very high lighting levels in the store & also high fan energy requirements, which the NCM Notional building do not take into account. Therefore firstly, we have created a "Lidl Baseline" scenario within the SBEM calculations where the Lidl lighting & ventilation/fan loads are used, with the fabric & system performance parameters matching or very similar to the Part L "Notional" building.

Secondly, we have undertaken a more conventional SBEM based on the BER / TER in line with Part L requirements.

For the "Lidl Baseline" scenario, we have incorporated stage 1 of the Energy Hierarchy, 'Minimising Energy Requirements'. This stage includes a fabric first approach with considerable improvements to minimum U-values and air permeability standards. These improvements have resulted in residual CO_2 emissions savings of 2.3%.

Further to these fabric improvements, stage 2 of the Energy Hierarchy outlines our approach to incorporating "energy efficiency measures" such as high efficiency LED lighting with daylight dimming controls, VRF heat pump heating and cooling, low energy fans and MVHR's with CO_2 sensors and variable speed control. These improvements have resulted in residual CO_2 emissions savings of 17.8%.

Then, stage 3 of the Energy Hierarchy considers "Low and Zero Carbon (LZC) technologies" & an assessment of LZC technologies has been undertaken and it was found that the most appropriate low & zero carbon renewable technologies for the development are VRF heat pumps for heating and cooling and a significant photovoltaic (PV) electrical generation installation. These improvements have resulted in residual CO_2 emissions savings of 62.2%. A graph of the results can be seen in Figure 3 below:

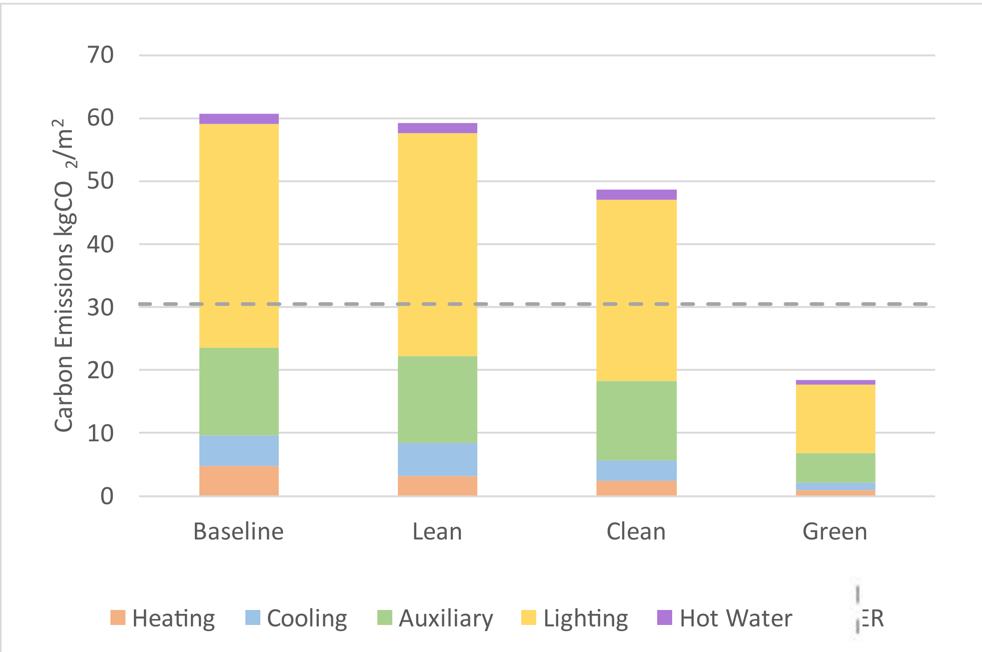

Figure 3 –Lidl Baseline Carbon Emissions reductions

For the BER / TER Part L compliance example, by taking the fabric improvement, energy efficiency measures and by incorporating a significant PV array on the roof with a peak output of 180kWp, a total CO_2 reduction of 39.9% will be achieved against the residual CO_2 emissions of the building. A graph of the results can be seen in Figure 4 below:

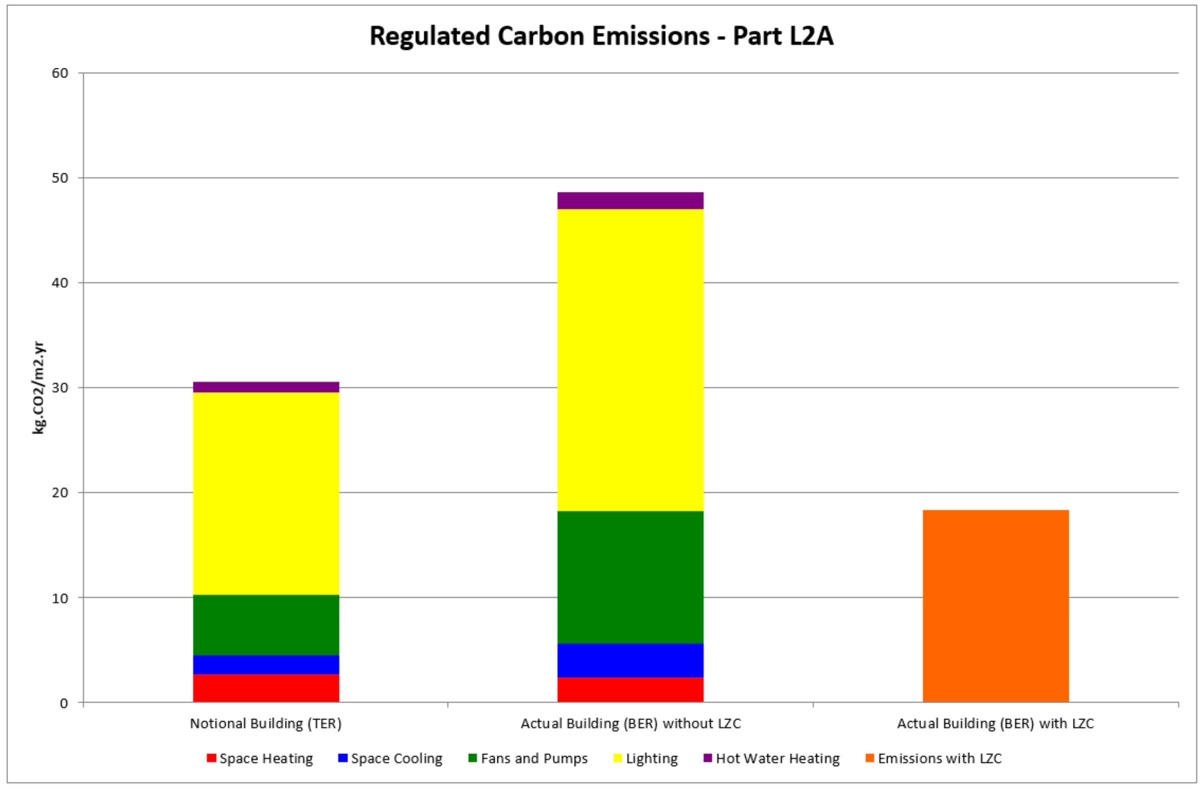

Figure 2 – BER / TER Carbon Emissions reductions

In each of these two scenarios, with all measures combined, has resulted in CO_2 savings beyond Building Regulations compliance of 82.7% compared to the 'Lidl Baseline' and CO_2 savings of 39.9% compared to the BER / TER Part L.

The full results for each assessment scenario can be seen in Table 16 and **Error! Reference source not found.**7 below.

Table 6 – SBEM CO_2 Reduction Results compared to Lidl Foodstore Baseline

	Energy Demand (kWh/m²)	Energy Saving Achieved	Regulated CO_2 Emissions (kg/m²)	Saving Achieved on Residual CO_2 Emissions
Baseline	119.82	/	60.65	/
Lean	117.01	2.3%	59.22	2.3%
Clean	96.1	17.8%	48.63	17.8%
Green	37.75	60.7%	18.35	62.2%
Totals		80.8%		82.7%

Table 7 – SBEM CO_2 Reduction Results compared to TER

	Energy Demand (kWh/m²)	Energy Saving Achieved	Regulated CO_2 Emissions (kg/m²)	CO_2 Emissions Saving Achieved
TER	62.06	/	30.53	/

Green	37.75	39.17	18.35	39.9%

5.6 Renewable Energy

As described above it is proposed that renewable energy is incorporated in order to achieve a 39.9% reduction in the residual carbon emissions of the development.

For this development it is proposed that solar photovoltaics (PV) are installed on the roof of the Lidl Foodstore. PV panels cannot occupy the full area due to panel arrangement and maintenance access. We have spoken to a specialist PV contractor and they have carried out an assessment of the size of installation that may be needed to meet the required annual yield. The proposed design consists of approx. 600no. panels, each with a peak electricity generating capacity of 300W, equating to a total installed peak output of 180kWpeak. When installed at a horizontal angle of 3° (in line with the roof) and an azimuth (degrees from North) of 70°, this system is estimated to generate around 135,372kWh per annum. Figure 5 shows an indicative sketch of where the extent of PV is proposed to be installed, with an estimated area of 985m^2, highlighted in green. The below is indicative and there is an option to spread the panel system across the roof to achieve a more uniform appearance which can be explored at the next stage of design.

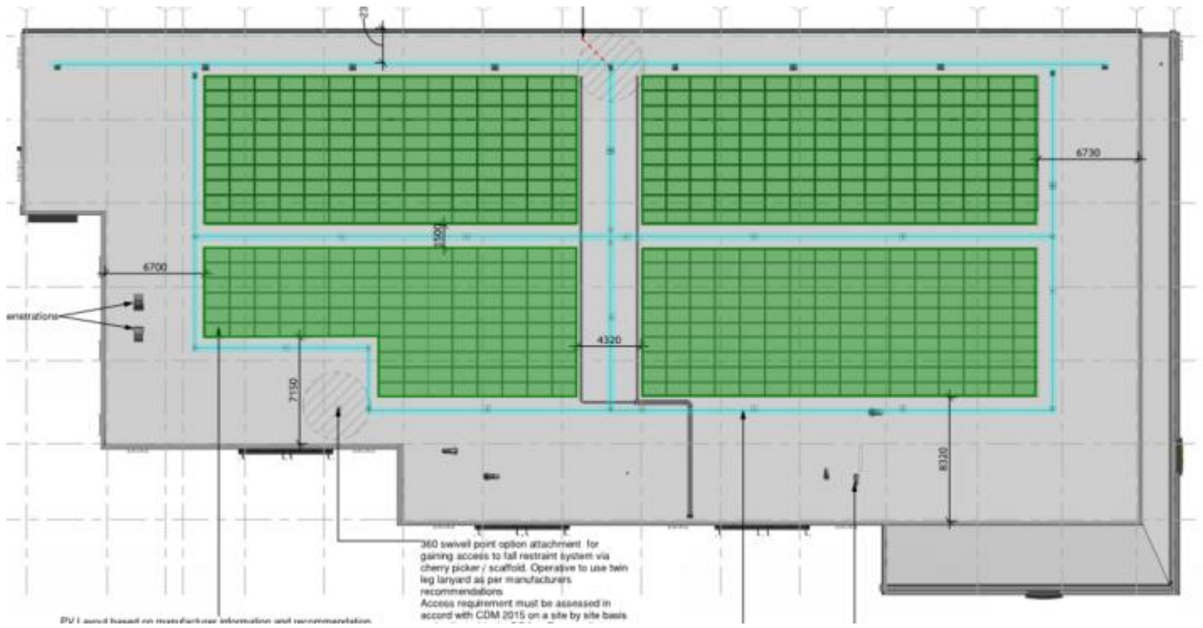

Figure 3 - Indicative Solar PV Area

6 BREEAM

We understand that there is no requirement for a BREEAM assessment to be undertaken as part of the Reserved Matters planning application.

7 Water Consumption

7.1 Policies and Drivers

The following water consumption and management policies and drivers have been considered as part of this proposed scheme: CS9 – Managing the Environment and Heritage, which requires the development to utilise water in an efficient and sustainable way.

7.2 Water Efficiency Measures

Water is a valuable resource and water conservation is key to environmental and sustainable design. It is proposed that low water usage fittings will be utilised throughout the development to minimise water consumption, these will include; flow restrictors on wash hand basin taps and dual flush WCs.

Close monitoring of landlord's water consumption through water metering and leak detection systems shall be incorporated and an alarm will be activated when inefficiencies in the water distribution systems are detected.

New incoming water mains shall be provided with bulk potable water storage on site to limit the load of the local water infrastructure and distribution network.

8 Thermal Comfort / Overheating

In line with South Gloucestershire's requirements, developments should contribute to both mitigating and adapting to climate change, and to meeting targets to reduce carbon dioxide emissions.

This development has considered high levels of thermal insulation, building orientation, low air permeability, highly efficient building services and suitable heat recovery & MVHR ventilation measures in order to mitigate overheating & provide sufficient ventilation with cooling to some areas in a controlled and energy efficient manner.

Glazing g-values & roof overhangs have also been reviewed in order to further reduce solar gain.

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