LIDL CROSS KEYS LANE, HOYLAND

ENERGY USAGE & SUSTAINABILITY STATEMENT

Client:

Lidl Great Britain Ltd

Architect:

SMR Architects

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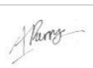
Signature				
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1.00 EXECUTIVE SUMMARY

DDA Consultant Engineers Ltd has been commissioned by Lidl Great Britain Ltd to prepare an energy statement in support of the planning application for the proposed development at Cross Keys Lane, Hoyland.

The development is required to demonstrate:

- How the incorporation of passive design and energy efficient measures can contribute towards mitigating and adapting to climate change and reducing the development's carbon emissions and energy consumption.
- How the incorporation of good building design with a holistic approach to sustainability can enhance the development's sustainable credentials.
- How the incorporation of good building design with a holistic approach to sustainability can reduce the energy demand, carbon emissions and running costs.
- How the incorporation of passive and active design strategies can reduce the development's regulated emissions to be in accordance with current Part L2 2021 Building Regulations and ensure the minimum standards of the Barnsley Council Local Plan are met.
- That carbon dioxide emissions associated with energy demand can be reduced in accordance with the energy hierarchy:

  a) Minimising energy requirements.
  b) Incorporating high efficiency systems and controls.
  c) Incorporating low or zero carbon energy sources.

This energy statement shows that:

- The store's incorporation of 'passive' design strategies will take advantage of:
  a) Natural daylighting thus, reducing dependency on electric lighting and the associated running costs and carbon emissions through natural contribution towards internal lighting requirements.
  b) Enhanced fabric efficiencies and thermal mass stabilise any temperature fluctuations within the building reducing heat gains and/or losses.

The incorporation of 'active' design strategies will take advantage of:

- Heat recovery ventilation to pre-heat incoming fresh air.

- Separate sub-metering to allow for all energy consumed to be monitored and any discrepancies to be easily identified and fixed thus minimising wasted energy.
- Low energy lighting with suitable controls provided.
- Building energy management system (BEMS) to manage all systems effectively, ensuring their efficiencies are achieved and maintained.

Combined Heat and Power (CHP) and De-centralised Energy Network (DEN) solutions have been reviewed and considered unviable for this store due to:

- Unsuitable energy consumption profiles for CHP (require high domestic hot water (DWS) consumption). CHP systems are well suited for buildings that have all year demand for heat. They require predictable and relatively constant base load for optimum performance, which can be found in applications with high domestic hot water loads. The store has a limited number of hot water outlets, therefore, connection to CHP plant would not be deemed viable, due to the lack of thermal demand.
- No suitable DEN within the vicinity of the proposed development.

Alternative Low or Zero Carbon (LZC) technologies have been reviewed with the following deemed to be both viable and advisable:

- Air Source Heat Pumps, or Aero-thermal Heat Pumps.
- Photovoltaic Panels

- Panel Array – 867.75m^2
- Panel Efficiency – 20.7%
- Panel Incline – 3.3°
- Orientation – 77° from North
- Annual Output – 148,173.27kWh/annum

The 'Baseline' building annual carbon emissions and energy consumption has been calculated as follows:

- Regulated Annual Carbon Dioxide Emissions: **8,059.24kgCO_2/annum.**
- Regulated Annual Energy Consumption: **57,864.59kWh/annum.**

The 'Be Lean', 'Be Clean', 'Be Green' actual building annual carbon emissions and energy consumption has been calculated as follows:

- Regulated Annual Carbon Dioxide Emissions: **-10,601.29kgCO_2/annum.**
- Regulated Annual Energy Consumption: **-91,551.46kWh/annum.**

The results show a **231.54%** carbon dioxide reduction and a **258.21%** energy reduction, when assessed to Part L2 2021 Building Regulations and accounting for the proposed passive, active and LZC strategies.

Furthermore, the introduction of roof mounted photovoltaic panels will provide an expected annual generation of 148,173.27kWh/annum. This represents >100% of the stores regulated energy consumption. It should be noted that the P.V. electrical generation may not correlate with the store's energy consumption profile, therefore, some of the on-site electrical energy generation may be exported back to the grid.

2.00 INTRODUCTION

DDA Consultant Engineers Ltd has been commissioned by Lidl Great Britain Ltd to prepare an energy statement in support of the planning application for the proposed development at Cross Keys Lane, Hoyland.

The energy statement will demonstrate how the store will provide heating and power and meet the energy / carbon emission target set by national and local policy. The energy statement will demonstrate Lidl's commitments to sustainable development and how they intend to reduce their annual carbon emissions and energy consumption through the utilisation of; good practice engineering, passive, and active strategies and Low or Zero Carbon (LZC) technologies.

The energy statement will demonstrate Lidl's commitment to go above and beyond the requirements of Part L (Volume 2) 2021 minimum standards to ensure a high carbon reduction/off-set is achieved, as well as supply LZC technologies to contribute towards the store's annual regulated energy consumption.

2.01 Energy Statement Requirements

The objective of this report is to define and outline how the incorporation of sustainable building design, coupled with the incorporation of LZC technologies at an early stage of the design process can ensure compliance with relevant local and national planning policies, achieve building regulation compliance to a high standard and reduce the energy consumption, associated carbon emissions and running costs of a new build. The core design principals to be outlined within this report will be to:

- Reduce energy demand through the implementation of the energy hierarchy.
- Meet end-use energy demands efficiently and effectively.
- Supply LZC technologies to further reduce the development's energy demand, associated carbon emissions and utility costs.
- Enable effective energy management to ensure installed systems work to their maximum efficiencies.

The report will compare the energy usage and CO_2 emissions from a Notional Building (Building Regulation Part L2 2021 compliant) to that of the proposed building including energy efficiency measures, decentralised energy, and renewable energy systems (where appropriate).

3.00 SITE CONTEXT

As shown in Fig 1, the store is orientated with a heavily glazed façade facing south. The emphasis on the southern orientation offers the advantage of natural daylighting contributions within the store, whilst ensure excessive solar gains are reduced by the incorporation of a 2.5m wide external canopy. This reduces the dependency on electric lighting through the natural contribution towards internal lighting levels, whilst ensuring mechanical cooling loads are minimised.

The site receives little over shading or overlooking offering privacy to the store and maintained privacy to residential houses and commercial units surrounding the site through careful landscaping.

Figure 1 - Site Context

4.00 PLANNING POLICIES & REFERENCE DOCUMENTS

The following documents offer a review of the necessary planning policies and requirements to be adhered to, to ensure sustainable design standards are met and the relevant targets set by local and national authorities understood.

4.01 National Planning Policy Framework (NPPF 2021)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these are expected to be applied. Taken together, these policies articulate the Government's vision of sustainable development, which should be interpreted and applied locally to meet local aspirations. The ministerial foreword of this NPPF highlights that 'the purpose of planning is to contribute to the achievement of sustainable development' and that at the heart of the framework is a presumption in favour of sustainable development.

Sustainable development is defined in the NPPF as comprising developments "meeting the needs of the present without compromising the ability of future generations to meet their own needs" in line with the definition of the Brundtland Commission ('Our Common Future', 1987). The NPPF also refers to the three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways – an economic objective, a social objective and an environmental objective.

4.02 Barnsley Local Plan – Adopted January 2019

4.02.1 Policy CC1: Climate Change

We will seek to reduce the causes of and adapt to the future impacts of climate change by:

- *Giving preference to development of previously developed land in sustainable locations;*
- *Promoting the reduction of greenhouse gas emissions through sustainable design and construction techniques; Locating and designing development to reduce the risk of flooding;*
- *Promoting the use of Sustainable Drainage Systems (SuDS);*
- *Promoting and supporting the delivery of renewable and low carbon energy; and*
- *Promoting investment in Green Infrastructure to promote and encourage biodiversity gain.*

4.02.2 Policy CC2: Sustainable Design and Construction

Development will be expected to minimise resource and energy consumption through the inclusion of sustainable design and construction features, where this is technically feasible and viable. All non-residential *development will be expected, to achieve a minimum standard of BREEAM 'Very Good' (or any future national equivalent). This should be supported by preliminary assessments at planning application stage.*

4.03 Building Regulations Approved Document Part L: 2021

Part L of the current Building Regulations (2021) considers the reduction of carbon emissions in new and existing buildings. As the proposal consist of the creation of new non-domestic space it falls under Part L Volume 2 of the Regulations.

The overall structure of compliance with the 2021 Building Regulations for new buildings includes the following main criteria to comply with:

- The Building Emission Rate (BER) should be better than the Target Emission Rate (TER) and the Building Primary Energy Rate (BPER) should be better than the Target Primary Energy Rate (TPER).
- Limit on design flexibility.
- Limiting effects of heat gain in summer.

The energy strategy for the scheme has been developed to ensure the scheme meets the relevant requirements of the Building Regulations.

5.00 ENERGY HIERACHY

The Energy Statement has been prepared using the "fabric first" approach of the 'Be Lean', 'Be Clean', 'Be Green' Governmental energy hierarchy:

- **Be Lean** – reduce the need for energy.
- **Be Clean** – supply and use energy in the most efficient manner.
- **Be Green** – supply energy from renewable sources.

Figure 2 - Energy Hierarchy

Adhering to the principles of the Energy Hierarchy has several benefits:

- By reducing the energy requirement of the building, the potential renewable requirement shrinks in proportion. This has obvious cost benefits and will help reduce the building's energy requirements and carbon emissions for the lifespan of the development.
- The sustainable credentials of each development are enhanced and are not validated by simply bolting on expensive renewable equipment. By focusing on fabric performance and the provision of efficient heating systems each building is intrinsically "green".
- Provides reassurance to the end user the building is performing to its highest potential and all systems are working to their maximum efficiencies with minimal energy waste, thus reducing dependencies on natural resources (gas & electric) as well as minimising running costs.
- The incorporation of energy efficiency measures and a holistic approach to building design will ensure that the carbon emission from the building will be kept to a minimum.

6.00 ASSESSMENT METHODOLOGY & DYNAMIC SIMULATION SOFTWARE

6.01 Calculation Process

To detail the benefits of adhering to the energy hierarchy, we must first create a baseline to compare against. This is done using a Dynamic Simulation Modelling software tool which follows a set methodology for calculating the buildings carbon emissions and associated energy use. Dynamic Simulation Modelling (DSM), as used for Part L Building Regulations compliance, has been carried out using the EDSL TAS software, Version 9.5.4, in accordance with CIBSE AM11.

The TAS software has been deemed appropriate for this project, as it allows a single model to be used for all required analysis relating to the building energy performance regarding passive and active strategies, energy efficient mechanical and electrical systems, and LZC technologies.

6.02 TAS Software

TAS is a governmentally approved software capable of analysing multiple environmental credentials of a building. By creating a virtual environment where, geometric form, thermal mass, interaction with local weather & climate, fabric performance, energy consumption and carbon emissions are analysed, different design strategy characteristics and benefits can be assessed and discounted (where necessary).

The TAS software analyses two buildings in parallel with each other, the first representing the notional building as defined by the National Calculation Method (NCM), and the second the building as proposed. The difference in CO_2 emissions and energy consumption between the models represents the CO_2 reduction achieved by the proposed low energy and low carbon design.

By modelling each area to be analysed, and inputting a series of parameters, the software can give projected annual loadings for heating and cooling requirements, carry out Part L2 compliance checks through the SBEM tool as well as multiple other dynamic simulations.

6.03 National Calculation Methodology

The National Calculation Method (NCM) is the methodology used for demonstrating compliance with Part L of the Building Regulations for buildings other than dwellings. Annual energy use and associated emissions for a proposed building are calculated and compared with the energy use and emissions of a comparable notional building. Both calculations make use of standard sets of data for different activity areas (internal conditions) and common databases are used to calculate emission factors, weather data, and set variables of construction and service elements.

The NCM allows the actual calculation to be carried out either by an approved simulation software or by a simplified tool. For this report, the building has been assessed using the Dynamic Simulation Software, TAS.

6.03.1 Weather Data

External weather conditions and variables must be considered within the Dynamic Simulation software.

The UK Meteorological Office (MO) collects and analyses weather data across the UK. They account for multiple climate variables such as wind speed and direction, air pressure, relative humidity, air temperature etc, across 14 locations. The weather data variables are broken into two types of weather files: Design Summer Year (DSY) and Test Reference Year (TRY).

Design Summer Year (DSY): This set of data represents a warmer than typical year and is used when calculating maximum resultant temperatures, cooling loads, TM52 calculations etc, as it will give a worst-case scenario with regards to UK temperatures.

Test Reference Year (TRY): This set of data represents a typical/average year and is used for calculating average energy uses within buildings for steady state calculations and for Part L compliance.

For the purposes of this report, the Test Reference Year (TRY) has been used to calculate the development's energy and carbon emissions and compliance with Part L2.

6.03.2 Internal Conditions

To determine the energy requirement of each zone, internal conditions are assigned to all relevant areas. An internal condition details the conditions to which each zone will be maintained and accounts for parameters such as occupancy gains, equipment gains, lighting, infiltration and ventilation, upper and lower temperatures. The NCM calculation methodology has pre-defined internal conditions which must be used to ensure consistent Part L2 calculations.

6.04 Building Geometry

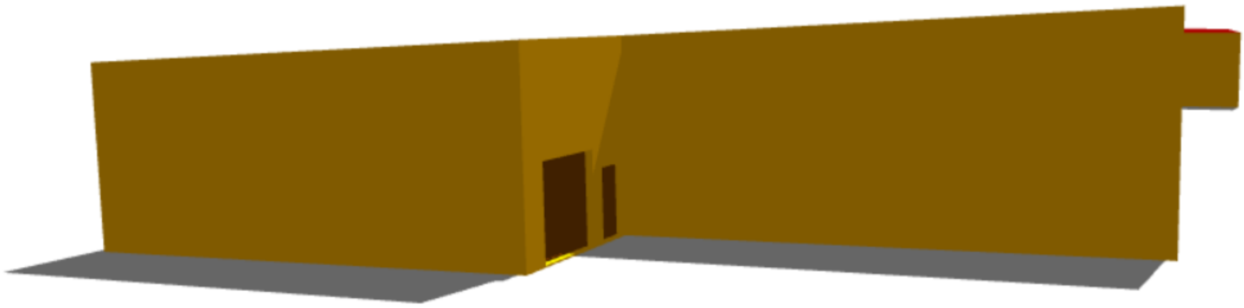


Figure 3 - North View

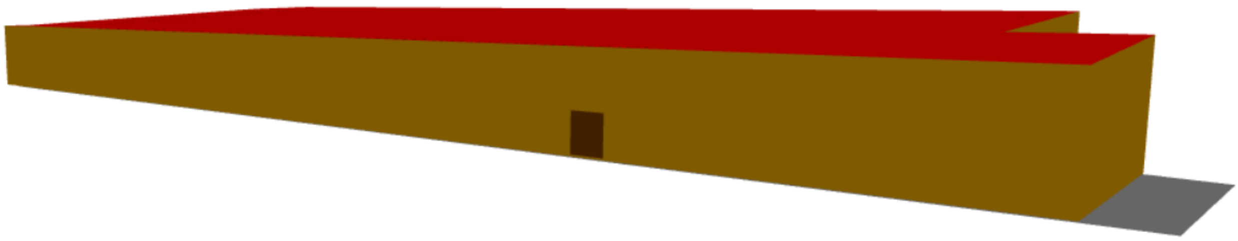


Figure 4 - East View

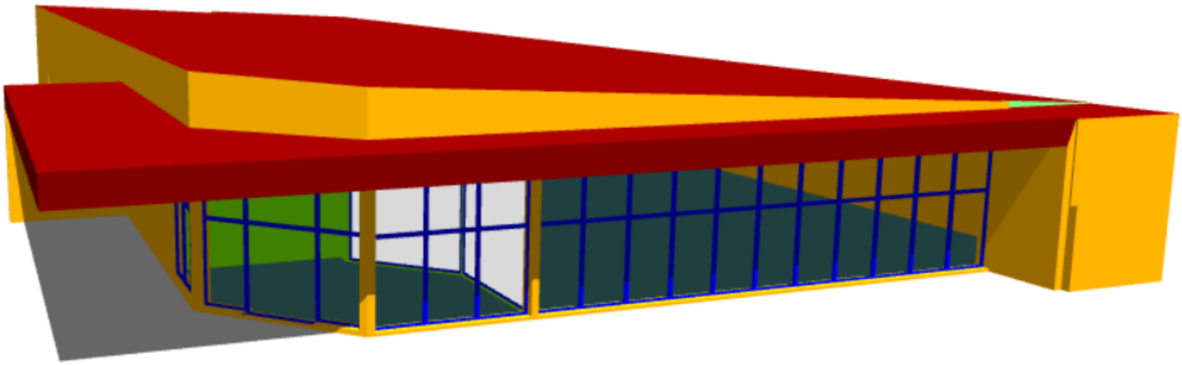


Figure 5 - South View

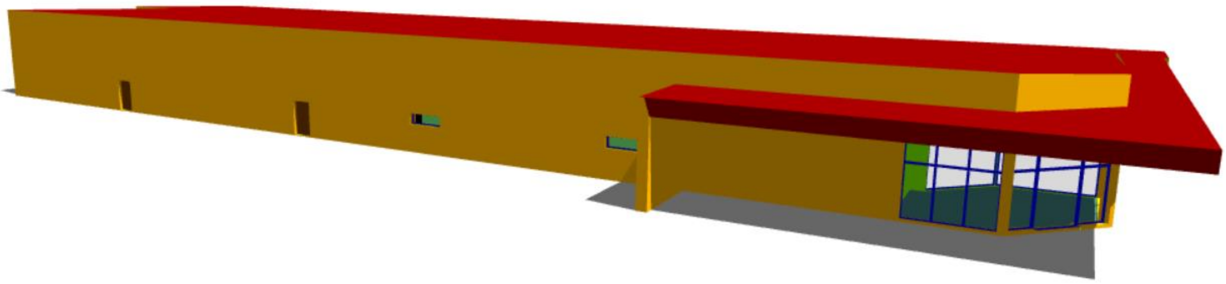


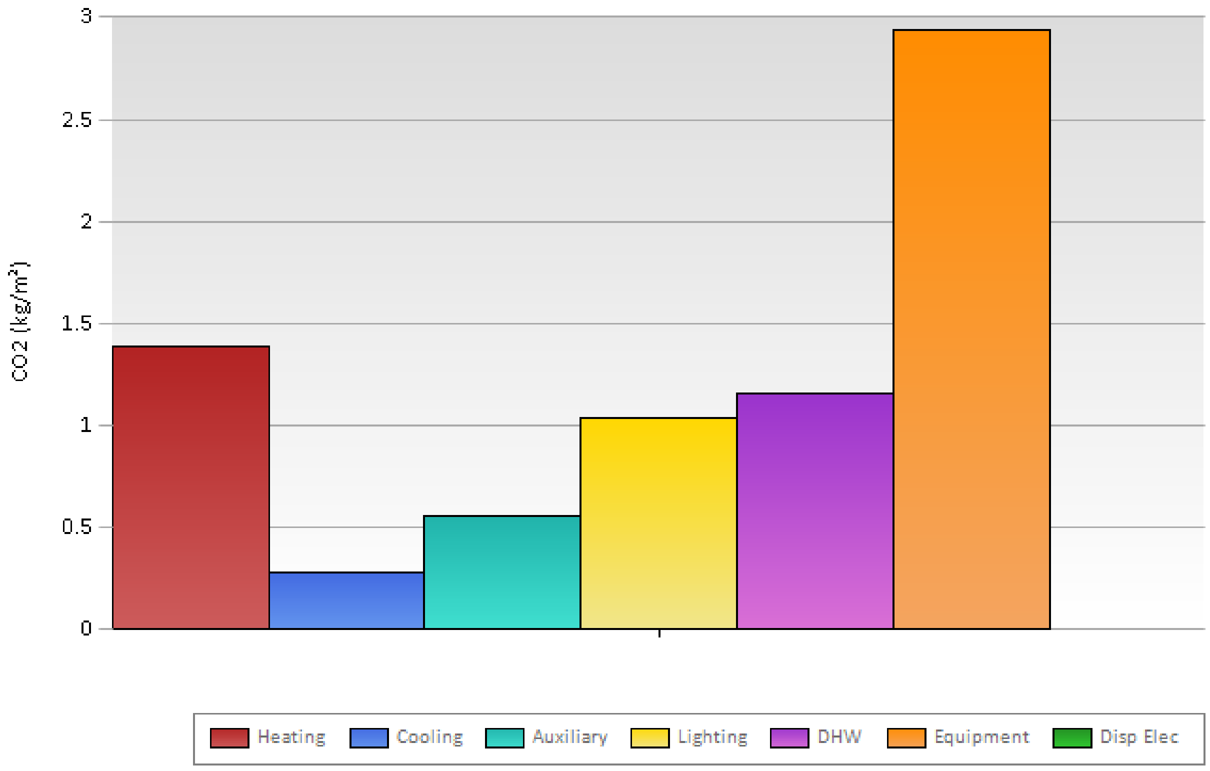
Figure 6 - West View

7.00 'PART L' – BASELINE PREDICTED ENERGY USAGE

The baseline against which each step of the energy hierarchy will be compared is the 'yard stick' determined by the Part L 2021 notional building.

The following section details the carbon emissions and annual energy consumption of the notional building. This offers a baseline for comparison which will be bettered by the actual design proposals put forward in this report.

7.01 Annual Carbon Dioxide Emissions of the Baseline Building

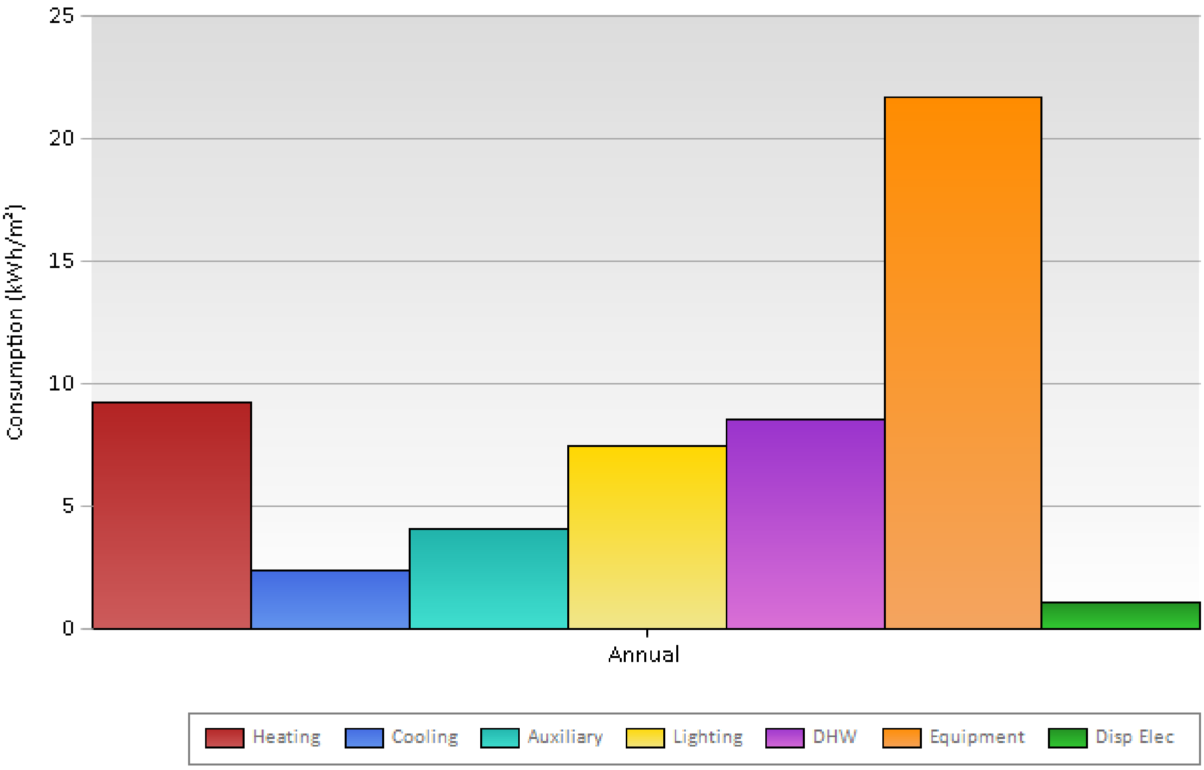


	Heating	*Cooling*	*Auxiliary*	*Lighting*	*DHW*	*Equipment*	*Displaced Electricity*
CO2 (kg/m²)	1.39	0.27	0.56	1.04	1.16	2.94	-0.14

Figure 7 - Annual Carbon Emissions - Baseline

Fig 7 above shows an annual baseline CO_2 emissions rate of 8,059.24kgCO_2/year of regulated emissions and 13,595.26kgCO_2/year inclusive of unregulated emissions.

7.02 Annual Energy Consumption of the Baseline Building



	Heating	*Cooling*	*Auxiliary*	*Lighting*	*DHW*	*Equipment*	*Displaced Electricity*
Consumption (kWh/m²)	9.26	2.36	4.11	7.50	8.57	21.73	1.07

Figure 8 - Annual Energy Consumption - Baseline

Figure 8 above shows an annual baseline energy consumption rate of 57,864.59kWh/year of regulated energy and 98,782.18kWh/year inclusive of unregulated emissions.

8.00 'BE LEAN' – PASSIVE & ACTIVE DESIGN STRATEGIES

This section of the report describes the passive and active energy reduction features which have been considered and incorporated into the design. These constitute the 'Lean' measures.

8.01 Orientation and Site Location

The proposed Lidl store is located at Cross Keys Lane, Hoyland.

The store is orientated with a heavily glazed façade facing south. The emphasis on the southern orientation offers the advantage of natural daylighting contributions within the store, whilst ensure excessive solar gains are reduced by the incorporation of a 2.5m wide external canopy. This reduces the dependency on electric lighting through the natural contribution towards internal lighting levels, whilst ensuring mechanical cooling loads are minimised.

The site receives little over shading or overlooking offering privacy to the store and maintained privacy to the commercial units surrounding the site. The development has good local transport links and is near residential properties, ensuring transport associated carbon emissions can be reduced.

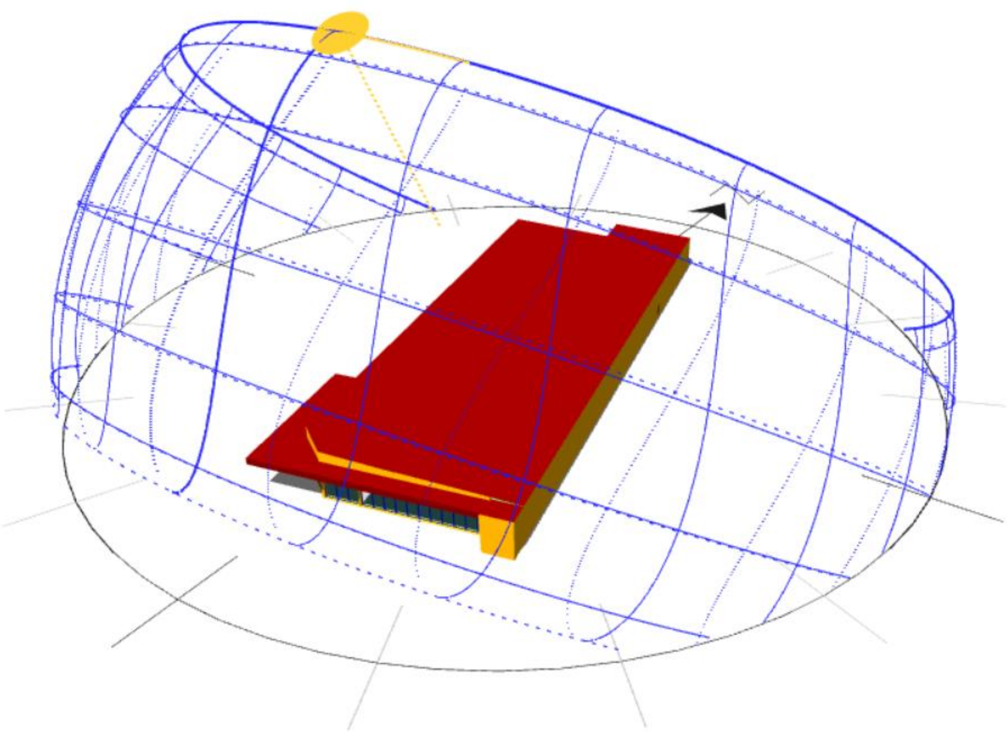


Figure 9 - Orientation & Sun Path Image

8.02 Fabric Performance and Thermal Mass

Focusing on the fabric thermal performance, ensures the building has reduced conductive heat loss during winter months and reduced conductive heat gains during summer months. This allows the internal environmental conditions to be better managed with reduced reliance on mechanical systems. This will in turn reduce energy demand, running cost and emissions whilst offering enhanced occupancy satisfaction.

With enhanced glazing properties, solar penetration is controlled reducing the potential for excess solar gains, as well as excessive levels of heat loss during winter months. Lidl have specified a high-performance glazing system which significantly betters the minimum standards of Part L2 to minimise the heat loss and enhance the insulation properties, whilst minimising solar gains to avoid overheating. Automatic internal sun blinds will also be installed, to mitigate against the solar penetration and potential glare risk within the checkout zone.

The following table details the anticipated fabric efficiency standards to be incorporated into the design. They have been set and compared against the minimum standards of Part L2 for reference purposes and to demonstrate Lidl's intent to exceed minimum standards.

Exposed element	New Part L2 2021 Minimum Standards	Lidl Store Proposed U-values	Improvement over Part L2A
Flat Roof	0.18 W/m^{2}K	0.16 W/m^{2}K	10.0%
Walls	0.26 W/m^{2}K	0.25 W/m^{2}K	3.8%
Ground Floor	0.18 W/m^{2}K	0.18 W/m^{2}K	0.0%
Curtain-walling	1.60 W/m^{2}K	1.31 W/m^{2}K (g-value = 0.395)	18.1%
Windows	1.60 W/m^{2}K	1.43 W/m^{2}K (g-value = 0.395)	10.6%
Vehicle access and similar large doors	1.30 W/m^{2}K	1.30 W/m^{2}K	0.0%
Pedestrian doors	1.6 W/m^{2}K	1.6 W/m^{2}K	0.0%
High usage entrance door	3.0 W/m^{2}K	1.7 W/m^{2}K	43.0%
Air Tightness Testing	8 m^3/(h.m^2)@50Pa	4 m^3/(h.m^2)@50Pa	50.0%

Figure 10 - U-value Comparison

As can be seen in the table above, the targeted ‘U’ values demonstrate an improvement over the minimum standards as detailed in the *Approved Document Part L2, Table 4.1, Limiting U-values for new or replacement elements in new and existing buildings and air permeability in new buildings*. This demonstrates Lidl’s commitment to going above and beyond to ensure a sustainable development.

8.03 Thermal Mass

The concrete floor slab of the proposed Lidl Store has been specified to give a relatively high thermal mass which will assist in reducing internal temperature fluctuations due to external temperature variations, to give a more easily controlled environment inside the building. The building would be considered to have low to medium thermal mass.

8.04 Natural Ventilation

Due to the deep floor plans, a natural ventilation strategy has not been adopted to the Sales Area. However, the mechanical ventilation strategy allows heat to be recovered from the stale air when it is extracted, thus tempering the fresh incoming air to reduce the heating coil loads. This is not something usually achievable with naturally ventilated strategies so advantages over passive strategies can be gained.

8.05 Mechanical Ventilation

The sales area will be heated, cooled, and ventilated through the incorporation of a centralised air handling unit with heat recovery, with an efficiency more than 80%. Energy efficient EC fans will be specified to reduce auxiliary loads and staged direct-expansion (DX) heating and cooling changeover coils, fed via Air Source Heat Pumps (an LZC technology) will provide the air distribution, heating, and cooling requirements.

All toilets shall be provided with extract ventilation. This will comprise of a mix between extract only, and mechanical ventilation with heat recovery (MVHR) units. Where extract only fans are provided, infra-red motion detectors will be installed ensuring they operate only when occupancy is detected. This reduces running time and ensures the fans are only used when necessary.

Where mechanical supply and extract is required, a MVHR unit will be installed. This ensures any fresh air entering the space is pre-treated by extracted air bringing it closer to the internal design temperature. This reduces the load on the heating/cooling system whilst still maintaining the necessary fresh air rates. This will also be controlled by PIR occupancy detectors.

8.05.1 Low Energy Fans

Low energy fans will be used with specific fan powers as good as or better than the limiting efficiencies detailed in *Approved Document Part L2, Table 6.9, Maximum specific fan power (SFP) in air distribution systems in new and existing buildings.*

8.05.2 Variable Speed Drives

Variable speed drives will be used to ensure fans operate no faster than required, thereby reducing energy consumption.

8.06 Sub-Metering

Separate sub-metering will be installed. This has obvious financial and sustainable benefits, allowing for financial verification with regards to consumption vs cost as well as allowing for consumption figures to be monitored and any out-of-range values easily identified, and energy wastage eliminated.

8.07 Low Energy Lighting and Controls

A high proportion of glazing will significantly reduce the dependences and output requirements on electric lighting offering reduced energy demand and carbon emissions and enhanced occupancy comfort.

LED lamps will be provided throughout, both for internal spaces and the external car park. LED lamps have a very low energy consumption and have a life expectancy exceeding that of conventional light bulbs. This reduces both energy use and waste.

The sales area lighting shall be controlled based on the following controls strategy:

- Once the store is opened and the intruder alarm unset, the 1/3 lighting will turn ON.
- 15-minutes before store opening, the store lighting will switch to 100% i.e. 1/3 and 2/3 lighting. For Sunday “Browsing Time” 2/3 lighting should be activated 30-minutes before store opening.
- The lighting will remain at 100% for the duration of store opening.
- 30-minutes after the store is closed, lighting will switch back to 1/3.
- Once the store is closed and the intruder alarm is set, all the lights will switch off after a delay of 10-seconds, except for one single light in the main entrance.
- Upon activation of the confirmed intruder alarm signal, the lighting will turn on to 100%.
- Once the activation has been cleared, the lighting will turn off.

When 2/3 lighting is active in the following zones the lighting will be dynamically dimmed, using daylight sensors in each zone:

- Checkouts: dim down to minimum of 50% (adjustable) while maintaining min. 750lux (adjustable).
- Checkout Aisle: dim down to minimum of 50% (adjustable) while maintaining min. 400lux (adjustable)
- Main Entrance lobby: dim down to minimum of 50% (adjustable) while maintaining min. 400lux (adjustable)
- Sales entrance: dim down to minimum of 60% (adjustable) while maintaining min. 400-500lux (adjustable).

When 2/3 lighting is active in the sales area the rest of the LED lighting will be statically dimmed down to a fixed output of 55%.

Infra-red motion sensor will be provided throughout the warehouse and all side rooms, so that lights are only turned on when the rooms are occupied.

8.08 Building Energy Management System

A full building management system will be incorporated to ensure plant is controlled and operated efficiently.

8.09 Building Energy Performance

All the above systems will be designed in accordance with the 'Non-Domestic Building Services Compliance Guide', CIBSE recommendations and relevant British Standards. The incorporation of 'Good Practice' engineering design coupled with the provision of renewable systems (described below) will ensure that an energy efficient store is achieved, minimising the energy consumption and associated CO2 emissions through its life cycle.

8.10 Water Efficiency

Water is becoming an increasingly scarce resource, with new development generating a growing demand. To meet increased demand new water sources and associated infrastructure need to be in place.

Main cold-water consumption for the store will be reduced through water efficiency.

This will be achieved through the provision of efficient water fittings throughout the store, including services valves complete with flow restrictors, (also helping to reduce hot water demand), dual flush toilets, and low water consumption appliances where provided, as outlined below:

Fittings	Flow rate
Wash Hand Basin	0.048 litres/second
Sink (Kitchenette)	0.08 litres/second
Sink (Bakery, Sluice, Cleaners)	0.12 litres/second
Urinal	2 litres/bowl/hour
WC	4 litres
Dishwasher	12 litres/cycle

The store will incorporate water efficient fittings in line with equivalent BREEAM standards to reduce water consumption.

The incoming mains cold water supply will be separately metered, using a smart meter to allow Lidl and the local water authority to easily monitor water consumption. There will also be a water sub-meter in the utility room, which will be connected to the store building management system and will record and monitor store consumption. The water consumption will be monitored by Lidl on a regular basis, via their central control system, known as GLT.

9.00 'BE CLEAN' – DECENTRALISED LOW CARBON TECHNOLOGIES

A low or zero carbon technology is defined as something which either; produces energy through an endless, renewable source with low or zero carbon emission throughout its operation, or one in which uses a specific energy source i.e., electricity and provides a significantly higher output to input ratio. Refer to the Directive 2009/28/EC of the European Parliament for a more comprehensive summary of the definition of and what constitutes as a low or zero carbon technology.

Detailed below are the types of low or zero carbon technologies considered for implementation on this development. A series of centralised and decentralised systems have been analysed and viability stated to offer justification for use or omission.

9.01 Combined Heat and Power (CHP)

Combined Heat and Power (CHP) is the on-site generation of electricity and the recovery of the normally wasted heat produced during this process.

- The operation of CHP plant can offer significant CO_2 emission rate reductions when compared to conventional methods of energy generation and use.
- Most large conventional power stations currently generate electricity at 30-50% efficiency (due to waste heat and transmission/distribution loss).
- 'Good quality' CHP schemes achieve overall efficiencies of 70-85% by making use of waste heat and eliminating transmission losses.

The efficient use of CHP typically depends on finding a use for the heat generated by the process. Issues to consider include:

- If heat is not used, then the system is effectively just an electricity generator and electricity will be greener and cheaper if sourced from the national grid.
- If excess electricity is generated on site this can be exported (sold) back to the grid whereas excess heat needs to be rejected (wasted). Exported electricity can count towards reducing the site's CO_2 emissions.
- Exported electricity will typically not be financially attractive as exports tend to coincide with low demand periods on the national grid. The cost of producing the electricity on site can be less than the prices received for the exported electricity.

9.01.1 Viability

The introduction of a CHP unit will reduce running costs and carbon dioxide emissions associated with the operation of the building when compared to employing a conventional generator and/or boiler. However, the CHP plant should always operate as the lead heat source to maximise savings.

CHP systems require steady, constant loads all year round for best performance, with high running hours. This type of running schedule will usually be found in applications with high domestic hot water loads such as hotels, hospitals, care homes etc. Food retail stores have an inherently low hot water demand and therefore a CHP plant would not be deemed viable due to the lengthy amount of the year where the CHP engine would be sitting idle due to lack of thermal demand.

It can therefore be concluded that the possibility of introducing a combined heat and power system is both un-sustainable and un-economically viable on this project.

9.02 Decentralised Energy Networks (DEN)

9.02.1 Heat Density

Based on the heat density map below from The Department for Business, Energy and Industrial Strategy, the surrounding area has a moderate heat density surrounding the site and associated with the surrounding area. Much of the associated heat density is residential, small scale industrial or commercial heat load. The low heat density associated with commercial or industrial units renders the possibilities of introducing a district heating network to the area low due to the high cost and low return potential.

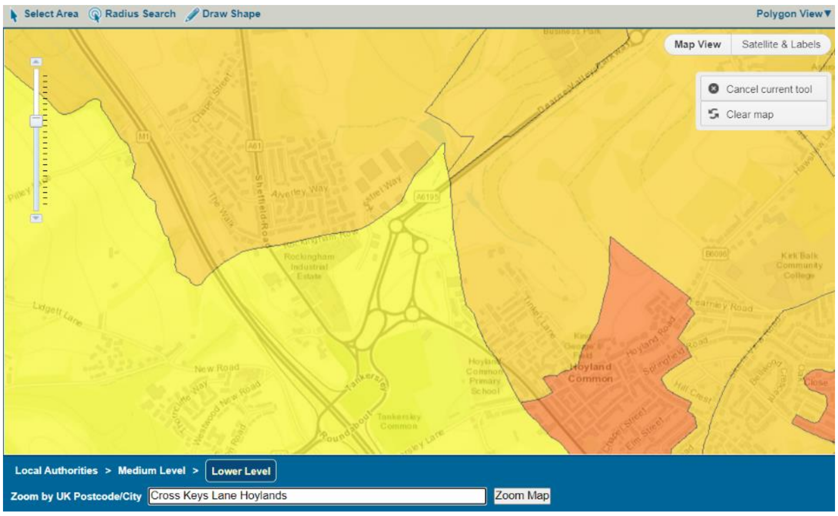


Figure 11 -The Department for Business, Energy & Industrial Strategy Heat Density Map

9.02.2 Existing Networks

The below map from The Department for Business, Energy and Industrial Strategy shows there are no current district heating schemes within the area.

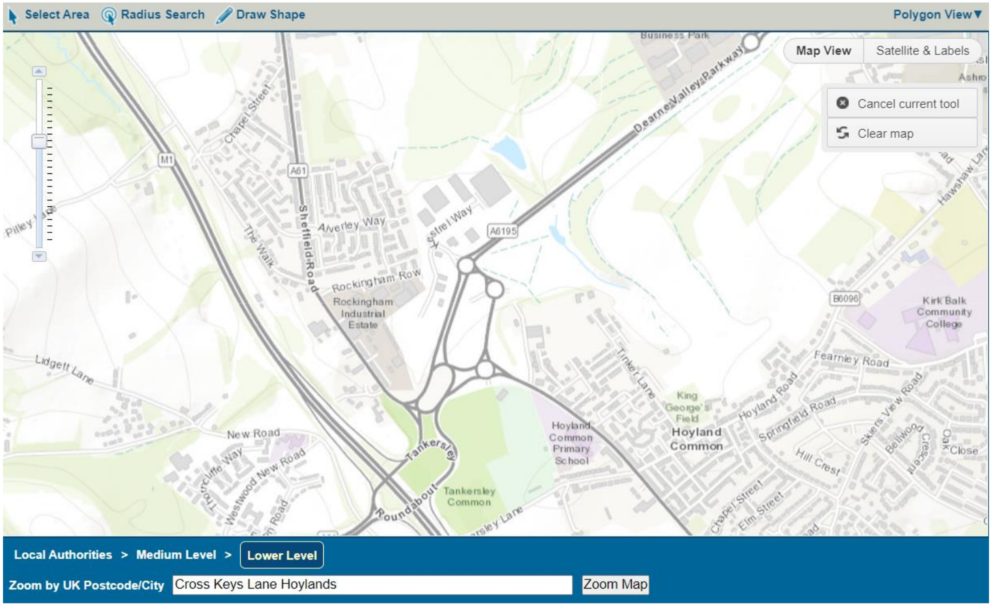


Figure 12 - The Department for Business, Energy & Industrial Strategy Current District Heating Schemes

9.02.3 Viability

As detailed in the above Heat Map, there are no current district heating networks, so the building services design strategy cannot be focused on the connection to a decentralised system.

10.00 'BE GREEN' – LOW OR ZERO CARBON TECHNOLOGIES

A low or zero carbon technology is defined as something which either; produces energy through an endless, renewable source with low or zero carbon emission throughout its operation, or one which uses a specific energy source i.e., electricity and provides a significantly higher output to input ratio. Refer to the Directive (EU) 2018/844 of the European Parliament for a more comprehensive summary of the definition of and what constitutes as a low or zero carbon technology.

Due to the unviable incorporation of Combined Heat and Power (CHP), and current lack of existing district heating networks, the development will be required to incorporate "Individual building renewable systems" to ensure compliance with local and national planning requirements.

10.01 Biomass Boiler

Biomass in the form of logs, wood chips and wood pellets are classified as a low carbon source of energy because the carbon dioxide emitted when the biomass is burned has been taken out of the atmosphere by the growing plants, even allowing for emissions of carbon dioxide in planting, harvesting, processing, and transporting the fuel. Replacing fossil fuel with biomass fuel will typically reduce net CO_2 emissions by over 90%.

Wood fuel efficiencies vary enormously due to several factors including the moisture content of the fuel. Fuels with high moisture content requires more energy to be combusted as it must first dry out before it can be converted to energy. This emphasises the need for good quality onsite storage facilities and a good quality fuel supply.

Wood fuels also have varying calorific value. A high calorific value refers to the amount of energy the wood contains compared to waste products such as bark, which can form ash as a by-product.

Biomass boilers are unsuitable for applications that have large fluctuations in thermal loads, unless a large heat sink or buffer vessel is used.

Unlike most other renewable energy sources, biomass can be stored and used on demand to give controllable energy. It is therefore free from the problem of intermittency, which affects both solar and wind technologies. However, unlike wind and solar, biomass energy is not "free" and so a reliable, sustainably managed, and cost-effective source of biomass needs to be secured.

10.01.1 Fuel delivery & fuel storage:

Fuel storage and regular supply is key for efficient running of Biomass boilers. Biomass fuel will absorb moisture if exposed to it and can biodegrade if not kept dry, therefore, the store must be well maintained to prevent contact between moisture and pellets. The storage facility must also allow for easy access to ensure deliveries can be made efficiently. A larger storage facility will allow for less frequent deliveries and more reserve in case of delays. The National Biofuel Supply Database shows there are several suppliers within a reasonable radius of the site.

10.01.2 Viability

This technology can provide the development with significant savings for a relatively low cost however, an overriding reason against using a biomass system is the space restrictions on this site and the lack of available space for the storage and delivery of the fuel. In addition to this, the high NO_x emissions, and particle content of the exhaust gases from typical small-scale biomass units may raise objections from the Environmental Agency and planning department.

Considering this, biomass boilers are considered not to be a viable option for the proposed development.

10.02 Solar Thermal

Solar thermal collectors utilise solar radiation to heat water for use in water heating of a building. The radiation is converted using a solar collector, of which there are two main types available: Flat Plate and Evacuated Tube collectors. Evacuated tube systems occupy a smaller area and are more efficient, but also generally more expensive. Flat plate systems are cheaper to install but generally less efficient.

The solar coverage indicates the percentage of the annual domestic hot water energy requirement that can be covered by a solar water heating system. The higher the solar coverage, the more conventional energy usage can be offset, but this can cause excess heat generation in the peak summer months and generally lower the average collector efficiency. Therefore, solar coverages of 40-70% are recommended for domestic applications and up to 40% in non-domestic buildings.

Solar thermal systems in the UK normally operate with a backup fuel source, such as gas or electricity. The solar system pre-heats the water up to a maximum hot water temperature. If there is not enough solar power available to fully meet the required hot water load, then the backup fuel system fires up to meet this short fall.

The optimum orientation for a solar collector in the UK is a south facing surface, tilted at an angle of 30º from the horizontal.

For the solar water heating system to run safely and efficiently, a series of temperature sensors are connected to a digital solar controller to switch the system on or off according to the solar energy available.

10.02.1 Viability

Solar thermal panels are suited to buildings with a high and consistent hot water demand. Lidl Stores inherently have a low hot water demand and therefore, a solar thermal array would not be deemed viable or cost effective.

10.03 Air Source Heat Pump (ASHP)

Air source heat pumps exchange heat between the outside air and a building to provide space heating in winter and cooling in the summer months. The efficiency of these systems is inherently linked to the ambient air temperatures. Air source heat pumps operate best in environments with long, mild, mid-season periods, as the heating efficiency drops at lower ambient temperature in winter.

Unlike some other sources of renewable energy, heat pumps do require electricity to pump and compress refrigerants through the system. However, heat pumps supply more energy than they consume, by extracting heat from their surroundings. Heat pump systems can supply as much as 4kW of thermal energy for just 1kW of electrical energy input, which is why they are recognised as a renewable technology under the Renewable Energy Directive 2009/28/EU.

10.03.1 Viability

ASHP's have been deemed a suitable way of offering space heating to the Sales Area, Warehouse and Side Rooms.

The Sales Area will be conditioned using an internal centralised intelligent AHU, with staged direct expansion heating and cooling changeover coils, fed via a two pipe VRF system.

For the Warehouse and Side Rooms, a three pipe VRF system with heat recovery capabilities will be utilised, which will work with ceiling mounted cassettes, or wall mounted units.

- Seasonal Coefficient of Performance: ≥3.5

- Seasonal Energy Efficiency Ratio: ≥4.5

The efficiencies detailed above exceed minimum national standards, ensuring the heating and cooling provided is of the highest standards available on the market for the selected type of Air Source Heat Pump.

10.04 Photovoltaics (PV)

Photovoltaic solar cells convert solar energy directly into electricity. The cells consist of two layers of silicon with a chemical layer between. The incoming solar energy charges the electrons held within the chemical. The energised electrons move through the cell into a wire creating an electrical current.

A range of Photovoltaic products and colours are available, varying in efficiency and cost. These include Monocrystalline, Polycrystalline, Thin Film and Hybrid Panels. Hybrid Panels are the most energy efficient and Thin Film the least.

All the above technologies can be installed in roof and wall mounted arrays or as integrated building members, giving the additional benefit of offsetting the cost of other construction materials, such as weatherproof roof membranes or integrated into glazed wall constructions.

10.04.1 Viability

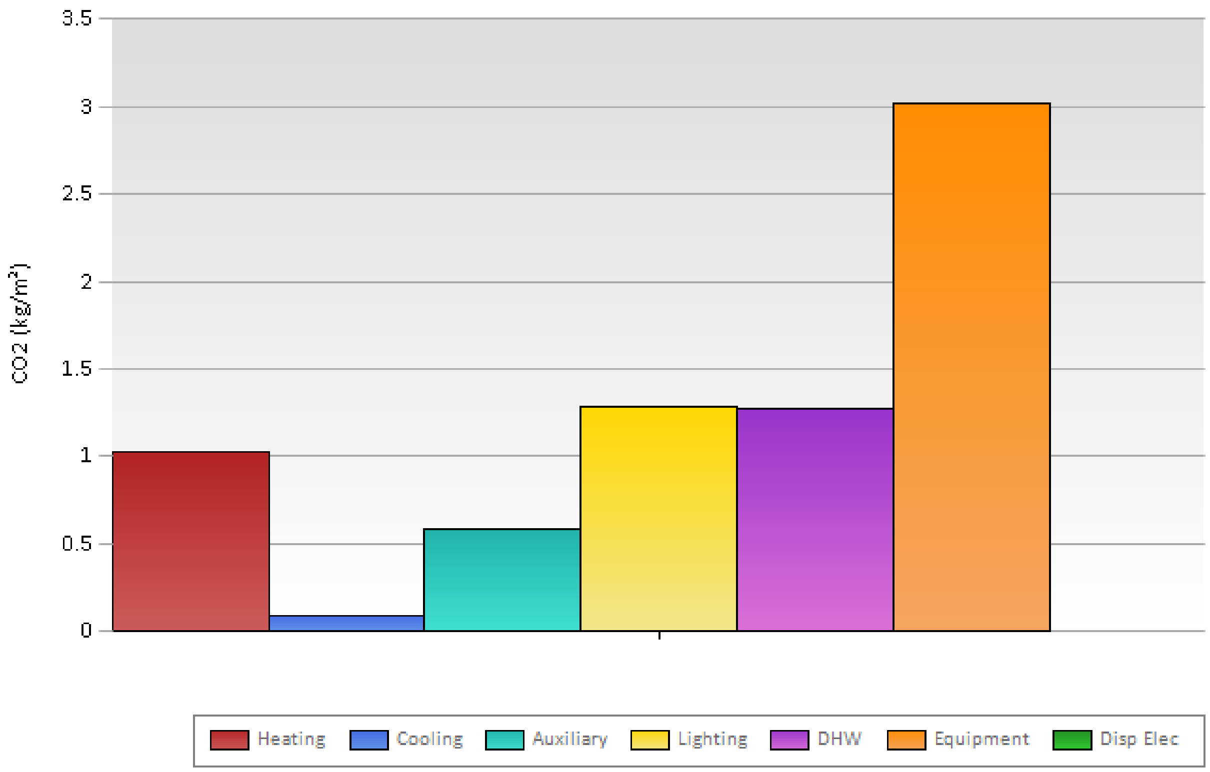
Photovoltaic panels have been deemed a suitable way of offering significant on-site energy generation to reduce the requirement for imported electrical energy. P.V. panels will be incorporated into the building services strategy:

- Panel Array – 867.75m^2
- Panel Efficiency – 20.7%
- Panel Incline – 3.3°
- Orientation – 77° from North
- Annual Output – 148,173.27kWh/annum

11.00 'BE LEAN', 'BE CLEAN' AND 'BE GREEN' – PREDICTED ENERGY USAGE

The following section details the predicted annual carbon emissions and energy consumption based on the TAS model of the building once all passive and active design strategies detailed in section 8.00, 9.00 and 10.00 have been allowed for.

11.01 Predicted Annual Carbon Emissions of the Actual Building

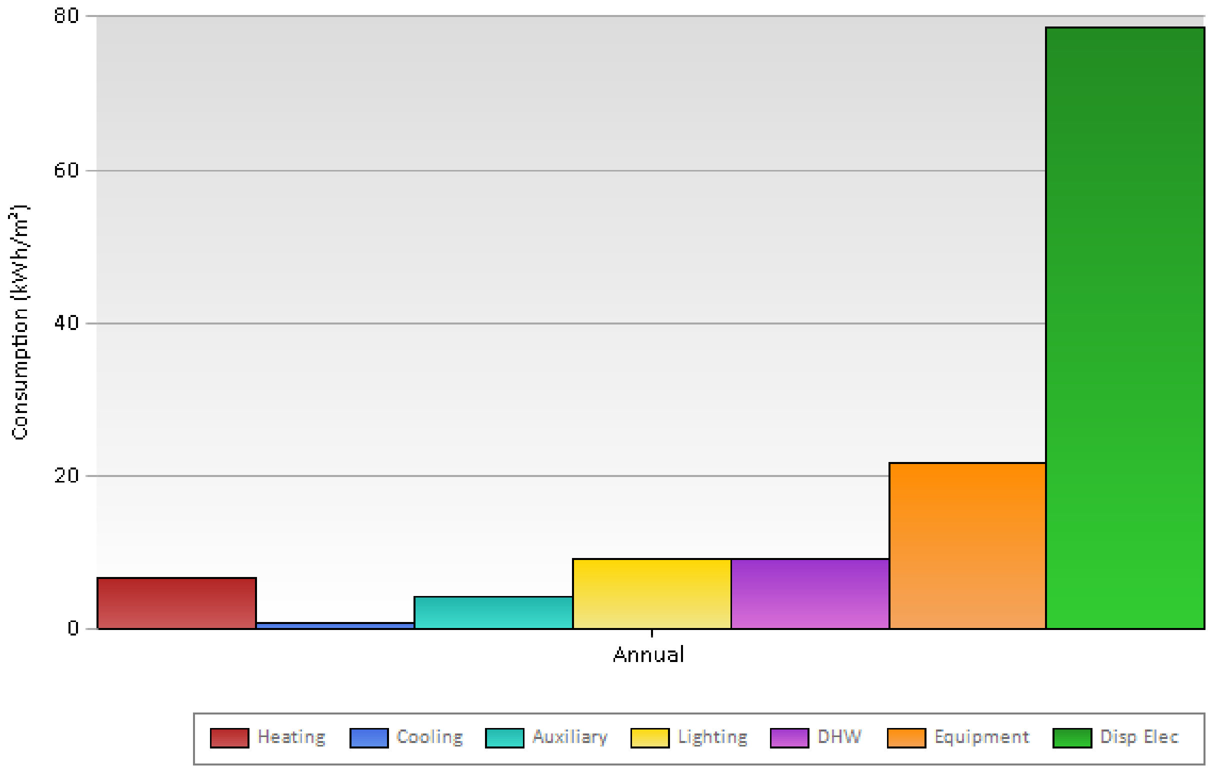


	Heating	*Cooling*	*Auxiliary*	*Lighting*	*DHW*	*Equipment*	*Displaced Electricity*
CO2 (kg/m²)	1.03	0.09	0.58	1.28	1.28	3.01	-9.89

Figure 13 - Annual Carbon Dioxide Emissions - Be Green

Figure 13 shows an annual CO_2 emissions rate of -10,601.29kgCO_2/year of regulated emissions and -4,933.46kgCO_2/year inclusive of unregulated emissions. This represents a **231.54%** and **136.28%** carbon dioxide reduction respectively over the 2021 baseline detailed within section 7.0.

11.02 Predicted Annual Energy Consumption of the Actual Building



	Heating	*Cooling*	*Auxiliary*	*Lighting*	*DHW*	*Equipment*	*Displaced Electricity*
Consumption (kWh/m²)	6.71	0.76	4.18	9.22	9.20	21.73	78.69

Figure 14 - Annual Energy Consumption - Be Green

Figure 14 above shows an annual energy consumption requirement of -91,551.46kWh/year of regulated energy and -50,633.87kWh/year inclusive of unregulated energy. This shows an annual energy consumption reduction of **258.21%** and **151.25%** respectively over the 2021 baseline detailed within section 7.0.

The renewable technology energy generation contribution is expected to be, 148,173.27kWh/annum. This represents more than 100% of the stores anticipated annual energy consumption. It should be noted, the stores energy consumption profile may not correlate with the on-site energy generation, therefore, some of the electrical energy generated by the P.V. panels may be sent back to the grid, not used on site.

12.00 CONCLUSION

The report has demonstrated the proposed Lidl store located at Cross Keys Lane, Hoyland will:

Incorporate passive design strategies to take advantage of:

- Natural daylighting through careful building and glazing orientation. This will offer a reduced dependency on electric lighting through the contribution of natural lighting to achieve the required Lux levels.
- Enhanced fabric efficiencies and thermal mass have been allowed for to help stabilise any temperature fluctuations within the building reducing heat gains and/or losses.

Incorporate active design strategies to reduce energy consumption by:

- Introduce heat recovery ventilation to pre-heat incoming fresh air. This will reduce the energy loads associated with fresh air heat loss/gains.
- Introduce separate sub-metering to allow for all energy consumed to be monitored and any discrepancies easily identified and fixed thus minimising wasted energy.
- Low energy lighting will be installed with suitable controls to ensure lights are not left on unnecessarily. Suitable controls will eliminate human error.
- Building energy management system (BEMS) will be designed and installed to manage all systems effectively, ensuring their efficiencies are maintained and achieved.

The Part L 2021 baseline annual carbon emissions and energy consumption has been calculated as follows:

- Regulated Annual Carbon Dioxide Emissions: **8,059.24kgCO_2/annum.**
- Regulated Annual Energy Consumption: **57,864.59kWh/annum.**

Combined Heat and Power and De-centralised Energy Network (DEN) solutions have been reviewed and discounted to be unviable for this store due to:

- Unsuitable energy consumption profiles for CHP (require high DWS consumption).
- No suitable De-centralised Energy Networks (DEN) in the vicinity of the development.

Alternative Low or Zero Carbon (LZC) technologies have been analysed with the following deemed to be both viable and advisable:

- Air Source Heat Pumps, or Aero-thermal Heat Pumps.

- Photovoltaic Panels
- Panel Array – 867.75m²
- Panel Efficiency – 20.7%
- Panel Incline – 3.3°
- Orientation – 77° from North
- Annual Output – 148,173.27kWh/annum

Air source heat pumps are defined as a renewable energy source under the Energy Performance of Buildings Directive, 2010/31/EU, Article 2:

'Energy from renewable sources' means energy from renewable no-fossil sources, namely wind, solar, aero-thermal, geothermal, hydrothermal and ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases'

They are also defined as a renewable source under the Renewable Energy Directive 2009/28/EU, Article 5:

'provided that the final energy output significantly exceeds the primary energy input required to drive the heat pumps'

The 'Be Green' actual building annual carbon emissions and energy consumption has been calculated as follows:

- Regulated Annual Carbon Dioxide Emissions: **-10,601.29kgCO_2/annum.**
- Regulated Annual Energy Consumption: **-91,551.46kWh/annum.**

These show a **231.54%** carbon dioxide reduction and a **258.21%** energy reduction, when assessed to Part L2 2021 Building Regulations and accounting for the proposed passive, active and LZC strategies.

The expected annual energy generation through low and / or zero carbon technologies will be 148,173.27kWh/annum. This represents >100% of the stores anticipated annual energy consumption. It should be noted that the P.V. electrical generation may not correlate with the store's energy consumption profile, therefore, some of the on-site electrical energy generation may be exported back to the grid.

APPENDIX A – 'BE GREEN' BRUKL OUTPUT DOCUMENT

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

Lidl Hoyland (Be Green)

As designed

Date: Thu Jan 19 12:15:41 2023

Administrative information

Building Details

Address:

Certifier details

Name: Stephen Ogden

Telephone number: 01924 265 757

Address: RCM Business Centres, Dewsbury Road, Ossett, Wakefield, WF5 9ND

Certification tool

Calculation engine: TAS

Calculation engine version: "v9.5.4"

Interface to calculation engine: TAS

Interface to calculation engine version: v9.5.4

BRUKL compliance check version: v6.1.b.0

Foundation area [m²]: 1882.58

The CO_2 emission and primary energy rates of the building must not exceed the targets

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	4.28	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	-5.63	
Target primary energy rate (TPER), $kWh/m^2.annum$	45.75	
Building primary energy rate (BPER), $kWh/m^2.annum$	-69.18	
Do the building's emission and primary energy rates exceed the targets?	BER =< TER	BPER =< TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.25	0.25	External Wall
Floors	0.18	0.18	0.18	Ground Floor
Pitched roofs	0.16	-	-	No pitched roofs in project
Flat roofs	0.18	0.16	0.16	Roof
Windows** and roof windows	1.6	1.4	1.7	Internal Window
Rooflights***	2.2	-	-	No rooflights in project
Personnel doors^	1.6	1.6	1.6	1900 Door
Vehicle access & similar large doors	1.3	1.3	1.3	Delivery Door
High usage entrance doors	3	1.7	1.7	ME Door

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]
U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	4

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	<0.9

1- Extract Only (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- AC Only (3 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.3	-	-	-	-
Standard value	2.5*	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

3- MVHR Only (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	1.15	0.81
Standard value	N/A	N/A	N/A	1.9^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

4- AC + MVHR (4 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.3	-	-	1.15	0.81
Standard value	2.5*	N/A	N/A	1.9^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

5- Central Vent System (2 Zones)

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	4.3	-	-	1.91	0.81
Standard value	2.5*	N/A	N/A	1.5^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

6- Natural Vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	-	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

1- Instantaneous Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0
Standard value	1	N/A

2- Bakery Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.03
Standard value	1	N/A

3- Staff Room Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	1	0.03
Standard value	1	N/A

4- Sluice Water Heater

	Water heating efficiency	Storage loss factor [kWh/litre per day]
This building	Hot water provided by HVAC system	0
Standard value	N/A	N/A

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
Customer Toilet	-	-	-	-	-	0.5	-	-	-	-	N/A
Bakery	-	-	-	-	-	0.5	-	-	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
Main Entrance	-	-	-
Sales Area	-	100	-
Customer Toilet	-	-	-
DRS Room	140	-	-
Meeting Room	140	-	-
Cash Room	140	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
Cloakroom	-	-	-
Staff WC A	-	-	-
Staff WC B	-	-	-
Staff Area	-	95	-
IT Room	140	-	-
Utility Room	140	-	-
Storage Warehouse	160	-	-
Delivery Warehouse	160	-	-
Bakery	-	-	-
Daylite Zone	-	100	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Sales Area	NO (-99%)	NO
DRS Room	N/A	N/A
Meeting Room	NO (-68%)	NO
Cash Room	N/A	N/A
Staff Area	NO (-80%)	NO
IT Room	N/A	N/A
Storage Warehouse	N/A	N/A
Delivery Warehouse	N/A	N/A
Daylite Zone	NO (-53%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	YES
Is evidence of such assessment available as a separate submission?	YES
Are any such measures included in the proposed design?	YES

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m^2]	1883	1883
External area [m^2]	4991	4991
Weather	LEE	LEE
Infiltration [m^3/hm^2@ 50Pa]	4	4
Average conductance [W/K]	1084	1417
Average U-value [W/m^2K]	0.22	0.28
Alpha value* [%]	22.49	7.49

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
99	**Retail/Financial and Professional Services**
	Restaurants and Cafes/Drinking Establishments/Takeaways
	Offices and Workshop Businesses
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
1	**Others: Miscellaneous 24hr Activities**
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	6.71	9.26
Cooling	0.76	2.36
Auxiliary	4.18	4.11
Lighting	9.22	7.5
Hot water	9.2	8.57
Equipment*	21.73	21.73
TOTAL**	**30.07**	**31.79**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	78.69	1.07
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*78.69*	*1.07*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	106.02	126.9
Primary energy [kWh/m^2]	-69.18	45.75
Total emissions [kg/m^2]	-5.63	4.28

HVAC Systems Performance

System Type		Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] No Heating or Cooling										
	Actual	34	0	9.5	0	11.5	1	0	1	0
	Notional	29.6	0	6.1	0	9.2	1.34	0	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	247.7	25.2	16	1	0	4.3	6.7	4.3	6.7
	Notional	116.9	29.3	12.3	1.9	0	2.64	4.4	----	----
[ST] No Heating or Cooling										
	Actual	145.6	0	40.5	0	5.3	1	0	1	0
	Notional	102.3	0	21.2	0	10.3	1.34	0	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	102.1	7	6.6	0.3	6.4	4.3	6.7	4.3	6.7
	Notional	81.5	22.5	8.6	1.4	6.8	2.64	4.4	----	----
[ST] Variable refrigerant flow, [HS] ASHP, [HFT] Electricity, [CFT] Electricity										
	Actual	32	21.4	2.1	0.9	5.3	4.3	7	4.3	7
	Notional	49.4	48.1	5.2	3	5	2.64	4.4	----	----
[ST] Other local room heater - unfanned, [HS] LTHW boiler, [HFT] Electricity, [CFT] Electricity										
	Actual	157.6	0	43.8	0	0	1	0	1	0
	Notional	120.2	0	24.9	0	0	1.34	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type