RIDGE

HEMPLAND PRIMARY SCHOOL SUSTAINABILITY STATEMENT

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HEMPLAND SCHOOL
SUSTAINABILITY STATEMENT

Prepared for

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SUSTAINABILITY STATEMENT , HEMPLAND PRIMARY SCHOOL

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SUSTAINABILITY STATEMENT , HEMPLAND PRIMARY SCHOOL

1. INTRODUCTION

The following statement outlines the sustainability strategy adopted for the proposed construction of a new school at the site of the existing Hempland Primary School.

The sustainability strategy was developed in collaboration with the client and design team and aims to achieve a range of targets most of which can be considered innovative or pioneering in the construction industry.

The key sustainability aims for the new school are:

- To be a Net Zero Carbon in Operation, (NZCiOI) delivered via the UKGBC's Net Zero Framework
- To meet bespoke targets covering a range of wider sustainability issues, meeting the schools' specific aspirations and sustainable brief delivering a holistically sustainable development.
- Use less water
- Enhance existing Nature and Landscape of the site
- Responsible use of materials and minimise waste

2. DEVELOPMENT PROPOSALS

2.1. Project Description

The scheme is the demolition of existing school buildings and construction of a two-storey replacement school with associated landscaping, play space and parking.

2.2. Description of the site and proposed school

The site is situated in a residential area within the City of York on an existing school site. The existing primary entrance is to be retained from Whitby Avenue. A secondary pedestrian entrance is currently provided to the southwest of the site. .

The site is located opposite in a residential area with a playing field to the south, green spaces and a beck to the southwest of the site.

Figure 1 – Arial image of site

2.3. Project Description

The project consists of the construction of a two-storey primary school consisting of 16 classrooms, staff and administration rooms, circulation, large and small halls, learning resource areas, plant, storage and WC / changing Facilities.

In addition, the existing school will be demolished as part of a second phase of work to create a new car park and playing facilities for the new school.

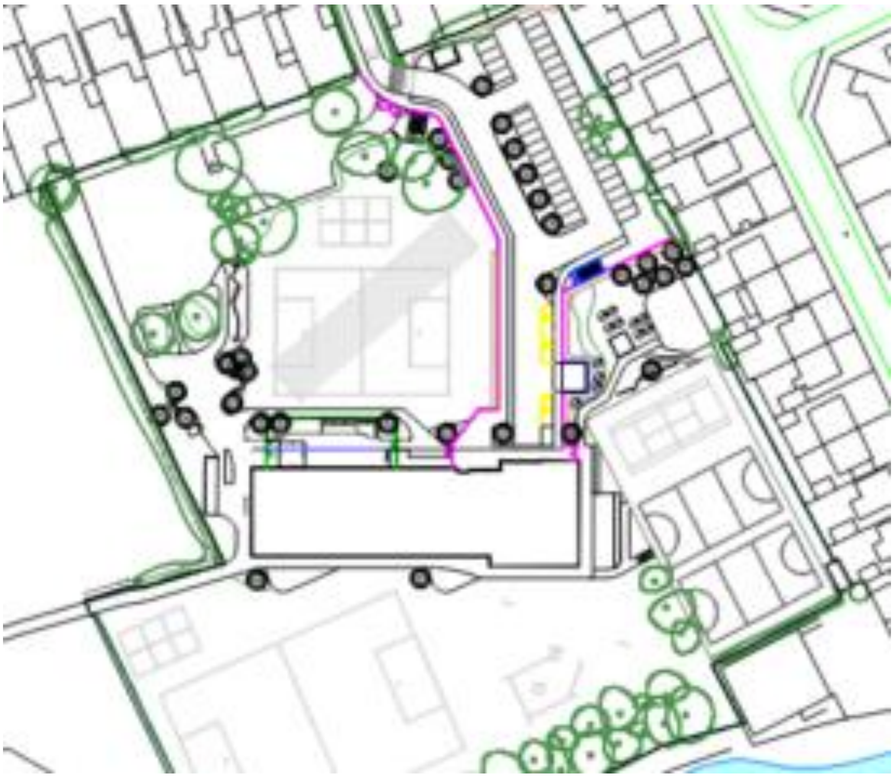


Figure 2 – Proposed site plan showing new school footprint

The school will be able to accommodate 420 pupils and around 50 staff members. The existing school will be operational until the new school is completed and then it will be demolished.

3. POLICY AND LEGISLATION

There are several documents and policies that the new school development must address in its approach to energy use and sustainability.

- National Planning Policy Framework
- City of York Local Plan
- Building Regulations – Approved Document Part L2

In addition, the design of the new school follows the principles of the specific sustainability brief provided by the school.

3.1. National Policy Framework

A revised National Planning Policy Framework (NPPF) was updated and published in July 2021 which sets out the Government's planning policies for England and how they are expected to be applied. This framework states the purpose of Sustainable development that:

'The purpose of the planning system is to contribute to the achievement of sustainable development.'

This highlights sustainability as a critical issue that runs throughout all the planning policies. The National Planning Policy Framework (NPPF) defines sustainable development in agreement with the U.N. definition of "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The NPPF outlines how three overarching objectives need to be pursued in mutually supportive ways to achieve sustainable development. These objectives are outlined below.

The environmental objective of this framework is to:

- Contribute to protecting and enhancing our natural, built, and historic environment; including making effective use of land, helping to improve biodiversity, using natural resources prudently, minimising waste pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.

At the heart of the Framework is a 'presumption in favour of sustainable development.' Section 14 of the National Planning Policy Framework (NPPF) specifically addresses the challenge of climate change. It states that: 'New development should be planned for in ways that:

- Avoid increased vulnerability to the range of impacts arising from climate change. When new developments are brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the government's policy for national technical standard Local Plan and supplementary guidance.'

3.2. City of York Planning

The City of York planning requirements in relation to the construction of new non-residential development are outlined in the following document.

City of York Planning Policy CC1

This requires new developments to achieve a 28% reduction in carbon emissions compared to a Base Case building which is compliant with Building Regulations Part L 2013. The reduction is to be secured through on-site renewable energy and other low carbon technologies

Due to the update to Part L standards as of June 2022, it is believed that City of York's Policy CC1 will become redundant as new buildings will be required to outperform the policy. The new Part L figures represent a reduction in carbon emissions by 31% when compared to 2013 standards. Therefore, the 2021 Part L figures represent a reduction in carbon emissions compared to current planning requirements and thus supersede the requirements outlined in CYC CC1.

As a result, the school building has been assessed against the Approved Document L2:2021 Edition, which came into force on 15 June 2022.

Generally, the planning authority normally require new development to achieve a minimum of BREEAM excellent. However, as part of previous planning dialogue the DfE have advised that BREEAM will not be a specific requirement of the City of York due to the inherent sustainable features of new schools provided as part of the Governments Schools Rebuilding programme and the schools specific brief in relation to sustainable design.

3.3. School specific sustainable brief

As part of the overall brief for the new school a specific sustainable brief has been provided by the Department for Education and the school. The school specific Sustainable Estates Strategy identifies the key interventions to demonstrate a climate resilient school and be NZCiO.

- Fabric first approach with very low U-Values and air permeability
- Ventilation strategy – likely to be a mixed mode ventilation strategy with Mechanical
- Ventilation with Heat Recovery (MVHR) in winter and natural ventilation (non-attenuated
- Cross or side ventilation) in summer.
- Heating – to be ultra-low temperature hot water system via electric heat sources such as ground source or air source heat pumps
- Cooling – Passive means through ventilation strategy and potential for ground
- source heat pump to be put in reverse without activation of the compressors, enabling for 'passive' cooling through circulation of ground water. Ground source heat pumps provide the potential to adapt to the 4 degrees overheating risk.
- Domestic hot water – ASHP and direct point of use
- HVAC controls – Zoned systems, with smart controllers and easily interrogated and
- managed Building Energy Management System (BEMS)
- Electric systems – Very efficient systems, inclusive of LED lighting and smart

- controls
- Renewable technology – Solar PV offsetting demand through roof and canopy arrays
- Monitoring and metering – Ensuring transparent access to energy and water data
- for monitoring and behavioural change programmes

The strategy also identifies key opportunities to address wider climate issues:

- Climate change resilience – Adaptation for a 4°C global warning scenario by retro fitting equipment through the life cycle of the school.
- Flooding – Potential additional geo cellular attenuation or formation of safe and secure water bodies to minimise future flood risk.
- Biodiversity net gain- Additional provision beyond the current proposals by increased planning and other features to improve biodiversity across the estate.

4. APPROACH TO LOW CARBON DESIGN

The following document outlines the low carbon design philosophy, for the proposed school to be developed.

The "Energy Hierarchy" methodology provides the design framework used to develop the proposed low carbon energy strategy. The approach described by this methodology provides a staged process: LEAN, CLEAN and GREEN (Illustrated below, Figure 3) to assess design measures.

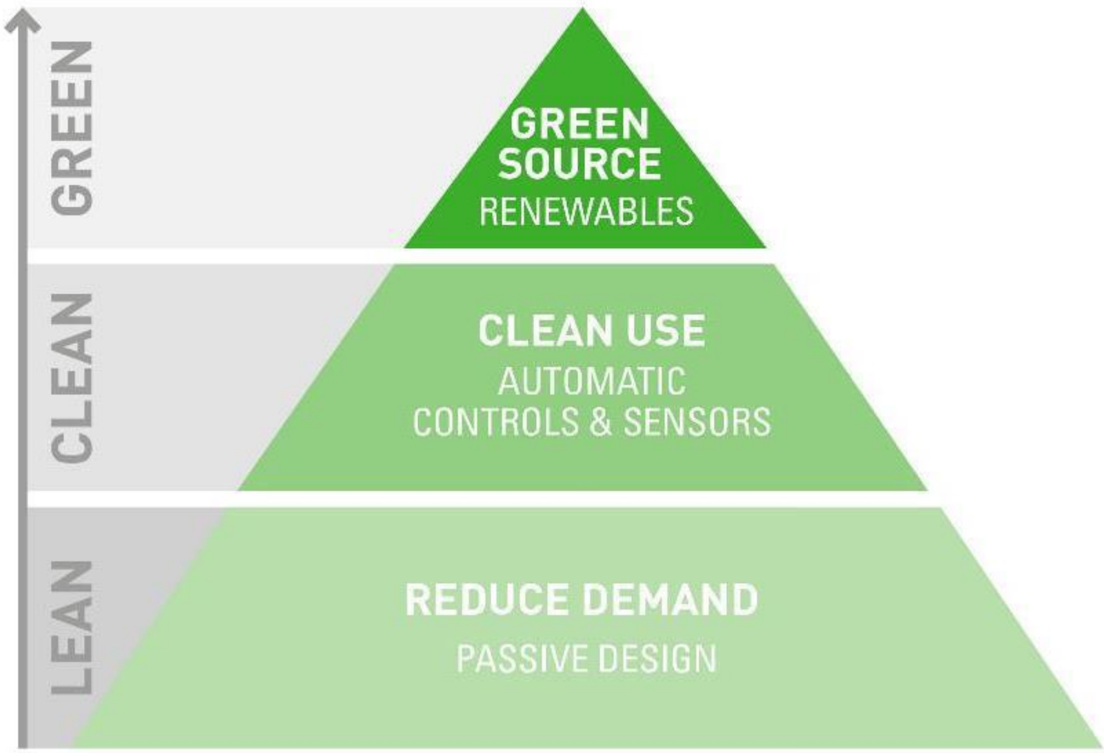


Figure 3 - Lean, Mean, Green Approach

Each stage would focus on the following:

- Lean – Main aim is to reduce the buildings energy demand through "passive measures".
- Clean – Meet the reduced energy demand in the most efficient way possible using "active measures"
- Green – Assess the technical feasibility of incorporating a low or zero carbon technology to further reduce the CO_2 emissions.

The following sections demonstrate the approach undertaken to develop a robust and deliverable energy strategy to demonstrate compliance with both National, regional and School specific targets in relation to energy consumption and carbon reduction.

5. ENERGY HIERARCHY

In line with the draft definition of zero carbon an energy hierarchy has been created (see figure 5 below). The new school will initially be expected to secure high levels of energy efficiency and low energy demand. This is followed by the incorporation of on-site measures where these exist, such as low or zero carbon energy technologies and directly connected heat (not necessarily on-site).

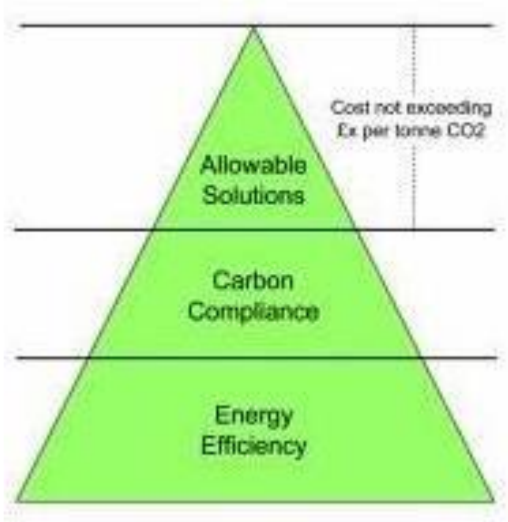


Fig 4 – Energy Hierarchy

However, to achieve the highest level of carbon reductions, it is intended that developers will be able to contribute to or co-ordinate investment in near or off-site infrastructure. This could include, for example, the connection of buildings to district heating networks and investment in low or zero carbon technologies on buildings owned by the city or by public and community institutions.

5.1. Decarbonisation of the Electricity Grid

The National Grid in the UK is decarbonising rapidly. This permits the electrification of heat and heralds the end to combustion of fossil fuels as the main source of heating. The attractive alternative to combustion is heat transfer using heat pumps linked to ground source or air source energy.

The carbon factor of grid electricity was 495 grams of CO_2 for each kWh of electricity generated in 2014 according to Defra. This fell by 6.5% to 462 grams in 2015, and by a further 10.8% to 412 in 2016.

The Department for Business, Energy and Industrial Strategy (BEIS) published its Energy and Emissions Projection (EEP) in October 2020 showing the projected Grid Carbon Factor falling dramatically from 156 grams in 2019 to just 67 grams in 2040.

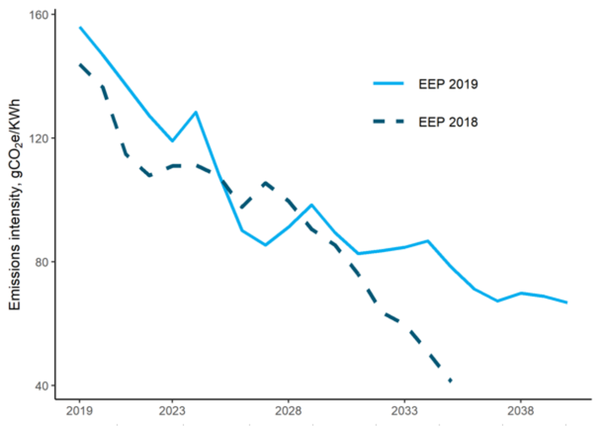


Figure 5 – Grid Decarbonisation predictions.

Furthermore, the UK Government has passed laws that require the country to reduce all greenhouse gas emissions to net zero by 2050 and the phasing out of natural gas as a source of heating with gas heating to be banned from 2025.

6. REGULATORY FRAMEWORK

6.1. Building Regulations

Part L 2021 came into effect in June 2022 with a transitional period of 12 months and will act as an uplift to help the construction industry adapt to changing regulations and low carbon heating. Figure 7 shows the timeline for the new Part L regulations and displays that the new regulations will require a 31% and 27% reduction in CO_2 emissions compared to the previous 2013 regulations for domestic buildings and non-domestic buildings respectively.

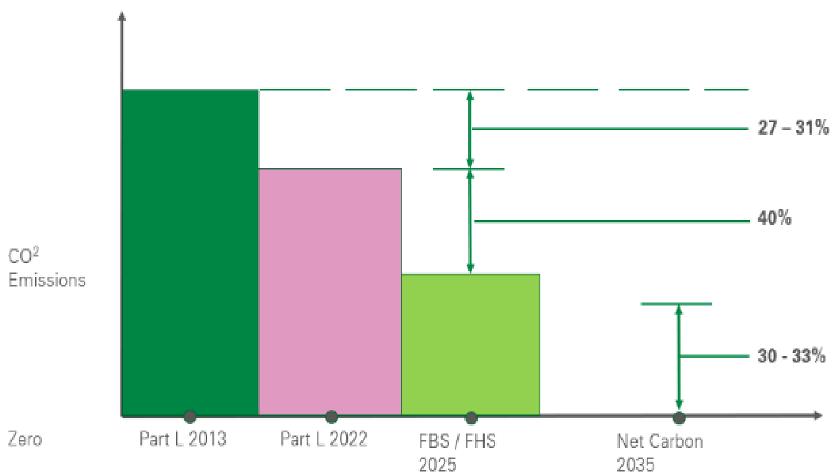


Figure 6 – Part L Reduction in Carbon emissions

The future building standards which will come into effect in 2025 will require CO_2 emissions to be further decreased by 40% in comparison to current figures.

A new performance metric has also been established; primary energy will become the principal measure replacing CO_2 emissions as the main metric. CO_2 emissions will become less effective as a measure of energy performance as the electricity grid becomes decarbonised. If not addressed, this could result in a dwelling with low CO_2 emissions complying with regulations, despite having excessively high energy consumption. Consequently, the Primary Energy metric has been introduced to ensure that energy efficiency is directly measured rather than assuming it is linked to CO_2 emissions.

7. APPRAISAL OF LOW CARBON SOLUTIONS

7.1. Summary

The strategic approach outlined, follows a specific appraisal of technologies at each stage of design and to achieve the overall goal of CO_2 reduction.

Overall, it becomes more expensive to implement carbon reduction measures the further along the design process as the opportunities to reduce demand diminish.

In this first instance it is therefore essential that the buildings 'passive measures' are optimised and the design Team have worked in close collaboration with the School and Client team to consider the future fit out demands.

The next stage is to adopt 'efficient technologies' such as heat recovery and variable speed drives etc. to meet the demand efficiency with the final approach of applying 'renewable and low carbon' technologies accordingly. Our approach has followed the following route:

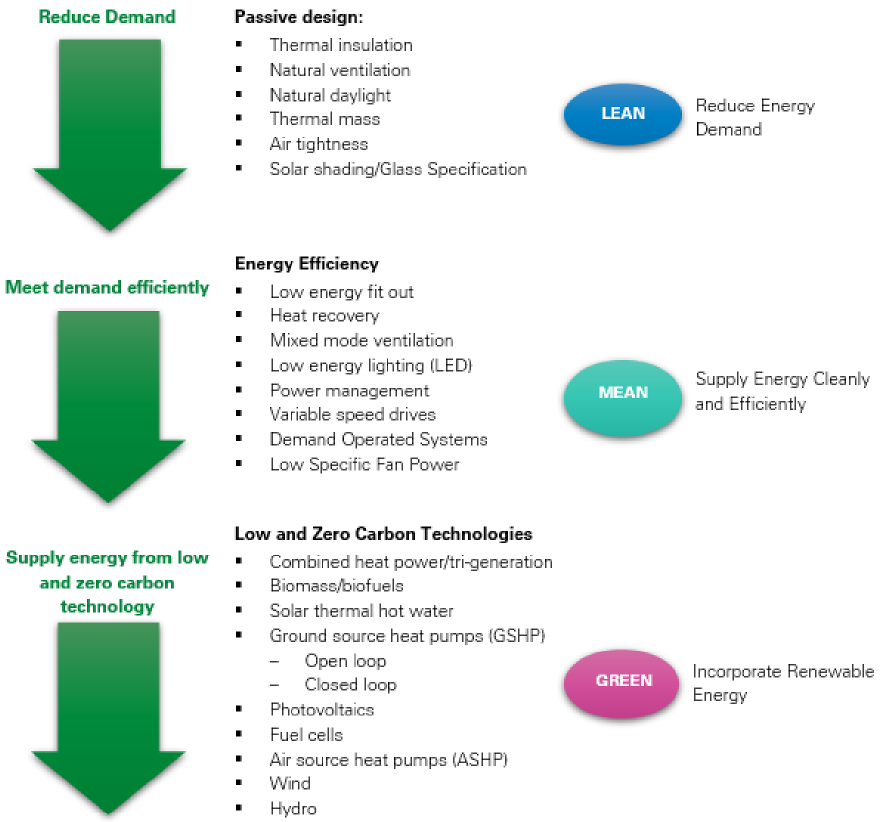


Fig 7 – Approach to Low Carbon Solutions

7.2. Passive Design Measures – (Reduce Demand – Be Lean)

This section looks at the proposed measures that will ensure the initial demand for energy in the building is low from the outset using passive measures.

The **site location** is in York with **weather** typical of the Northern England. Mild conditions are present throughout the year, with relatively high rainfall and cloud cover expected throughout the year.

In terms of expected **building occupancy**, these are expected to be typical of a primary school with high occupancy in the weekday with limited evening and weekend use.

The following measures are to be incorporated in the design:

- Passive Design
  - Thermal Insulation and Thermal Bridging
  - Natural Ventilation / Mixed mode
  - Natural Daylight
  - Thermal Mass
  - Air tightness
  - Solar Shading
  - Low Energy Fit Out
  - Sub-metering
  - Adaption to climate change

These measures promote the reduction of Energy use and carbon emission in the first instance. The passive design features adopted mean that the building is well adapted to these risks.

Firstly, the energy demand has been reduced and therefore the building will be less affected by the decreased availability of energy. Secondly, the building will have a lower carbon footprint helping to stop the effects of climate change from increasing any further.

The expected increase in external temperatures could result in future overheating problems. Whilst the building cannot be relocated, by having low g-value glass, there is less solar heat gain entering the rooms. The demand for cooling has also been reduced through the adoption of efficient building services and by exceeding the u-values stated in the Building Regulations.

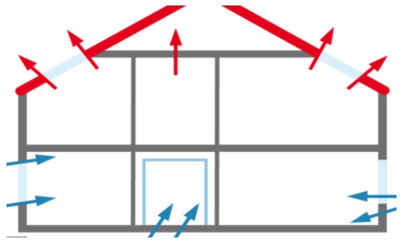
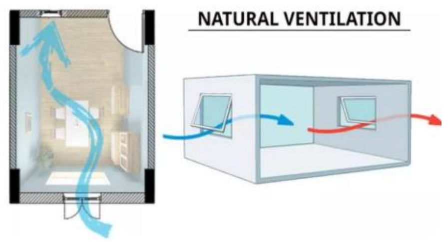
This combination of passive design measures act to stabilise the temperatures within the building and enable it to adapt to the likely extremes of both high and low temperatures.

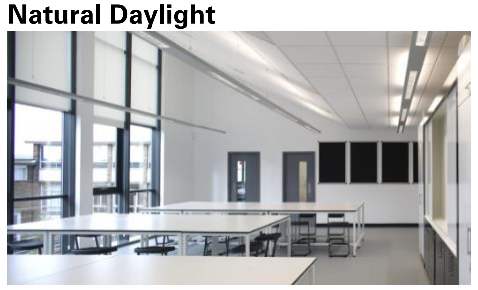
Key:
Y – Yes could be incorporated
P – Possible
N – Not appropriate

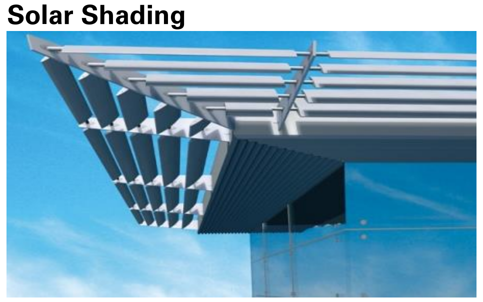
<table>
<tr><th>Measure</th><th>Description</th><th>Suitable For Consideration</th><th>Commentary</th></tr>
<tr><td>Thermal Insulation
</td><td>Thermal insulation is the reduction of heat transfer (i.e., the transfer of thermal energy between objects of differing temperature) between objects in thermal contact or in range of radiative influence.</td><td>Y</td><td>Insulation is central to low energy construction to reduce unnecessary heat loss.

The building will adopt a high level of thermal insulation to reduce heat loss and thus reduce overall energy demand.

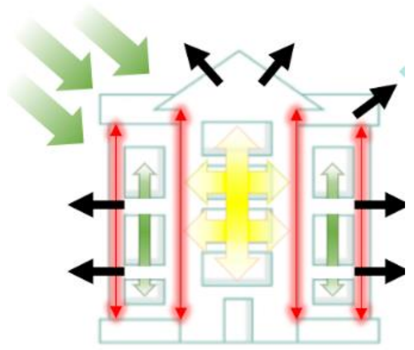
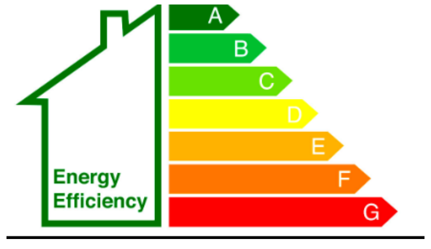
Thermal insulation is essential to minimise heat losses and worst acceptable U-values shown in the table will be matched or exceeded.

Table 4.1 Limiting U-values for new or replacement elements in new and existing buildings and air permeability in new buildings
<table>
<tr><th>Element type</th><th>Maximum U-value[1] W/(m²·K) or air permeability</th></tr>
<tr><td>Roof (flat roof)[2]</td><td>0.18</td></tr>
<tr><td>Roof (pitched roof)[2]</td><td>0.16</td></tr>
<tr><td>Wall[2][3]</td><td>0.26</td></tr>
<tr><td>Floor[4][5]</td><td>0.18</td></tr>
<tr><td>Swimming pool basin[6]</td><td>0.25</td></tr>
<tr><td>Windows in buildings similar to dwellings[7][8]</td><td>1.6 or Window Energy Rating[9] Band B</td></tr>
<tr><td>All other windows,[8][10][11] roof windows, curtain walling</td><td>1.6</td></tr>
<tr><td>Rooflights[12][13]</td><td>2.2</td></tr>
<tr><td>Pedestrian doors (including glazed doors)[14]</td><td>1.6</td></tr>
<tr><td>Vehicle access and similar large doors</td><td>1.3</td></tr>
<tr><td>High-usage entrance doors</td><td>3.0</td></tr>
<tr><td>Roof ventilators (including smoke vents)</td><td>3.0</td></tr>
<tr><td>Air permeability (for new buildings)</td><td>8.0m³/(h·m²) @ 50Pa</td></tr>
</table></td></tr>
<tr><td>Air Tightness
</td><td>Airtightness is the control of air leakage, i.e., the elimination of unwanted draughts through the external fabric of the building envelope. This may be achieved by the correct and proper installation of a vapour check or vapour barrier.</td><td>Y</td><td>The target for air tightness will significantly exceed the minimum requirements of Part L 2021 building regulations to reduce air infiltration and unwanted draughts through the external fabric of the building envelope and so heating and cooling energy demand will be lowered.</td></tr>
<tr><td>Natural Ventilation

</td><td>Natural ventilation is a method of supplying fresh air to a building or room by means of passive forces, typically by wind speed or differences in pressure internally and externally. During design, natural ventilation is first considered before mechanical ventilation because this reduces carbon emissions.</td><td>Y</td><td>Natural ventilation to be used in a mixed mode approach with mechanically powered ventilation using MVHR units to counter space overheating. This will help to reduce on site carbon emissions by the avoidance of operating electrically driven ventilation fans and cooling plant. The internal planning, building geometry and external topography will be optimised to take full advantage of natural ventilation.

Careful attention to the placement of openable windows and interior partitions can greatly increase the natural flow of air through a building by capturing the prevailing winds.</td></tr>
<tr><td>Natural Daylight
</td><td>Natural light is light that is generated naturally, the common source of which is the Sun. This is as opposed to artificial light, which is typically produced by electrical appliances such as lamps.</td><td>Y</td><td>To reduce the energy used for artificial lighting the natural daylight entering occupied spaces will be maximised by optimising window size and orientation. Dimmable lighting with photocells will sense if the illuminance level of the space has been met and reduce lighting levels as required. North facing windows are particularly effective at providing useful daylight and will be incorporated on the building.

The buildings orientation and fenestration strategy will take advantage of passive solar gains and natural daylight to reduce heating energy and the need for artificial lighting.</td></tr>
<tr><td>Solar Shading
</td><td>Solar shading is a method by which solar radiation in the form of heat and light can be mitigated in a building. While natural heat and light are essential in most buildings and modern architecture uses it more and more there are occasions when the levels are too high. This leads to overheating and too much light.
Solar shading is a general term for a range of methods used to reduce the amount of solar gain.</td><td>p</td><td>Whilst maximising daylight care must be taken to ensure that direct sunlight does not cause glare in the dwellings and does not cause excessive solar gains in summer which will cause spaces to overheat. This is managed by solar shading on affected windows. Some examples of solar shading are canopies, solar control glazing, balconies, internal blinds and curtains which could be adopted for the school. However, there is a balance between shading and daylight optimisation which may reduce the impact of canopies to provide solar shading.

The design has optimised glazed area to provide sufficient daylight but minimise unwanted solar gain without the requirement for external solar shading. The halls glazed element are North and East facing again optimising daylight but minimising unwanted solar gain.</td></tr>
</table>

Thermal Mass 	Thermal mass is a material capacity to absorb, store and release heat. For example, bricks have a high capacity to store heat and are referred to as 'high thermal mass' materials. Insulation foam, by contrast, has very little heat storage capacity and is referred to as having 'low thermal mass'. A common analogy is thermal mass as a kind of thermal battery. Though thermal mass has always been an aspect of buildings, only in recent years has it evolved as a tool to be deployed in the conservation of energy. However thermal mass does not offer a 'one size fits all' concept.	**Y**	Thermal mass such as concrete can absorb large amounts of heat energy which prevents spaces from overheating. The thermal mass can be cooled overnight when the space is not occupied to further reduce energy needed for cooling when the space is occupied. It is proposed to use exposed soffits in classrooms to provide thermal mass.
Low Energy Fit Out 	A low energy fit out is an interior development of a building that is low carbon in its design, operation, and entire lifecycle.	**Y**	All goods and appliances should be highly energy efficient to reduce energy demand.
Sub-metering 	Building submetering is a meter within your building or facility for specific energy measurements.	**Y**	Power, lighting, and major plant will be metered to allow energy consumption to be pinpointed and reviewed if it is excessive. Baselines and targets will also be set to help reduce energy use.
Adaption to climate change 	Average temperatures for central England have risen by approximately 1°C since the 1970s and this has resulted in higher temperatures, changing rain patterns, rising sea levels, in addition to unpredictable extreme weather events such as floods, droughts and freezing winters. Risks of climate change include the increased likelihood of increased external temperatures which could lead to staff illness and therefore lower productivity, damage to equipment due to the high internal building temperatures in addition to increased cooling demand.	**Y**	An uplift in fabric improvements and façade design can maximise the retention of heat in winter and reduce solar gains in summer. These actions will help combat the extremes expected because of climate change.

7.3. Meeting Demand Efficiently - (Be Clean)

This section looks at technologies that will be used to ensure that energy demand is further reduced and met efficiently:

- Ventilation
- Heat recovery
- Demand Operated Systems
- Variable Speed Drives on fans and pumps
- Power Management
- LED Lighting
- BMS

Key:
Y – Yes could be incorporated
P – Possible
N – Not appropriate

Technology	Description	Suitable For Consideration	Commentary
Mechanical Ventilation Heat Recovery (MVHR) 	MVHR provides fresh filtered air into a building whilst retaining most of the energy that has already been used in heating the building. Heat Recovery Ventilation is one solution to the ventilation needs of energy efficient buildings.	**Y**	Hybrid mechanical ventilation will be provided to classrooms with other spaces having mechanical ventilation heat recovery units. The hybrid ventilation unit provides natural ventilation, hybrid mixing ventilation and low energy mechanical heat recovery in one compact unit. This offers a low carbon solution of providing ventilation to the building. For the mechanical ventilation heat recovery units fresh air is supplied, and stale warm air extracted by mechanical ventilation, heat recovery will be used to recycle up to 85% of the heat from the extracted air to warm the incoming fresh air. The re-use of waste heat in the mechanical ventilation systems can provide a significant step towards reducing CO2 emissions.
Demand Operated Systems 	The control of the heating, cooling, ventilation, and lighting systems is fundamental to the energy efficiency of buildings. The use of the following measures can reduce energy consumption: Zoned thermostatic control; Time control; Variable flow control; BMS (Building Management System) automated control; Lighting PIR (Passive Infra-Red Sensor) control; Daylight linked lighting control; CO_2 detection; and Energy management control	**Y**	Where ventilation, heating and cooling is provided to a space that may not always be in use, occupancy sensors will be used, this will be fundamental to the energy efficiency of each building. These will shut down the systems serving the spaces when they are not required and turn them back on instantly when they are required. The use of the following measures will be encouraged: Zoned thermostatic control; Time control; Variable flow control; BMS (Building Management System) automated control; Lighting PIR (Passive Infra-Red Sensor) control; Daylight linked lighting control; CO_2 detection; and Energy management control. The use of passive infra-red (PIR) for lighting,heating, ventilation will be adopted where feasible
Variable Speed Drives 	Variable speed drives and controls allow an energy system to modulate during periods of low demand. Using variable speed drive pumps therefore uses less energy than traditional pumps, which run at a constant speed.	**Y**	All pumps and fans would be provided with variable speed motors which will speed up and slow down as the demand increases or reduces to conserve energy. These can be used in conjunction with the demand operated systems to reduce the speed of pumps and fan motors to a minimum to conserve energy. Variable speed drives can be adopted on all fan and pump motors where possible to reduce energy consumption (Central Plant).

Power Management 	Power management is a computing device feature that allows users to control the amount of electrical power consumed by an underlying device, with minimal impact on performance. It enables the switching of devices in various power modes, each with different power usage characteristics related to device performance.	**p**	Power factor correction can be used on the electrical supplies of a building to improve energy efficiency. This is not wholly suitable to the site due to the efficiency of the infrastructure.
LED Lighting 	An LED lamp or LED light bulb is an electric light that produces light using light-emitting diodes. LED lamps are significantly more energy-efficient than equivalent incandescent lamps and can be significantly more efficient than most fluorescent lamps	**Y**	LED fittings will be used throughout the scheme to limit the energy associated with internal and external lighting. LED lighting controls will be used throughout in areas with demand operated controls. Typically, this will be in the form of PIR sensors in small spaces and microwave sensors in larger areas.
BMS Optimisation 	A building management system is a computer-based control system installed in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power systems, fire systems, and security systems.	**Y**	The building may be provided with an intelligent building management system that will learn how the building operates and optimise the function of the ventilation, heating, and cooling systems to minimise energy use.

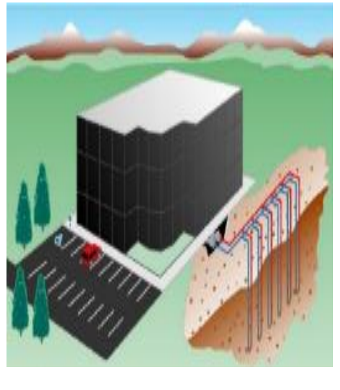
7.4. LZC Technology - (Be Green)

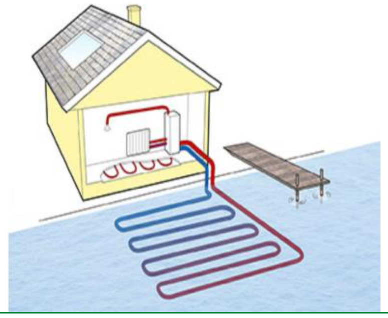
The following Low Zero Carbon (LZC) technologies have been identified and reviewed against their suitability for the proposed school:

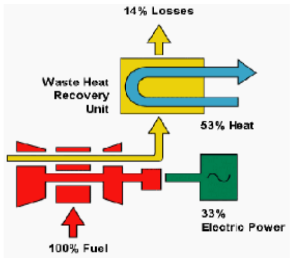
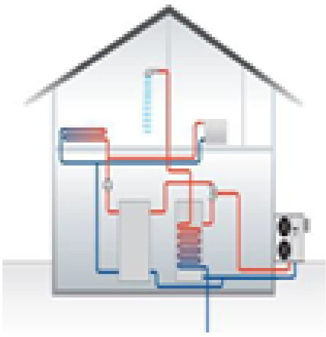
- Solar Water Heating
- Ground Source Heat Pumps
- Water Source Heat Pumps
- District Heating
- Biomass
- Wind Power
- Photovoltaic Electricity Generation
- Combined Heat and Power
- Air Source Heat Pumps
- Battery Storage

These services are described in more detail below and their suitability discussed.

Key:
Y – Yes could be incorporated
P – Possible
N – Not appropriate

Technology	Description	Suitable For Consideration	Commentary
Solar Thermal Water Heating 	Solar thermal water heating systems use heat from the sun to pre-heat domestic hot water. Solar thermal water heating systems are generally composed of solar thermal collectors and a fluid system to move the heat from the collector to a storage tank to store the heat for subsequent use. The system requires solar panels on the roof, ideally south facing, linked to hot water storage cylinders.	**N**	The solar energy collection and pipework distribution strategy would centre on collecting and storing thermal energy in cylinders or tanks in plant rooms. The roof space would be better utilised for Photovoltaic panels and as such there would be limited space to utilise this technology therefore not proposed for the school. In addition, demand for hot water during the warmer months will be lower therefore limiting the effectiveness of solar panels for hot water production.
Ground Source Heat Pumps 	Ground Source Heat Pumps (GSHP) can be used to extract heat from the ground by circulating a fluid through a system of pipes buried underground to a heat exchanger which transfers the energy to the distribution network. This can provide space heating and/or domestic hot water. Ground source heat pumps have the advantage that they can act as a source of both heating and cooling for the buildings. Ground source heat pumps are either open-loop (abstracting and rejecting water to the aquifer below the site) or closed-loop. aquifer below the site) or closed loop using boreholes and energy piles.	**N**	GSHP's have an average COP of 4.5 meaning that for every unit of electricity used to pump heat, 4-6 units of heat are produced making it an effective way of heating a building. However, the efficiency of the system is dependent on the low distribution temperatures from the low-grade heat. There is land available for boreholes/pipework therefore this system could be implemented. But due to logistical constraints and programme related issues it considered to not be the most effective solution for the school.

Water Source Heat Pumps 	Water Source Heat Pumps (WSHP) work in a similar way to GSHP, with the exception that the pipes are submerged into a river, stream, lake or the sea. The fluid is pumped through the system and absorbs energy from the surrounding water. WSHP can be either an open-loop or closed-loop system.	**N**	No suitable water courses nearby with enough volume.
District Heating 	Energy sources include heat from CHP and to a lesser extent, geothermal. The feasibility and viability of connection to the district heating mains related to both the proximity of the network and the forecasted annual heat demand.	**N**	There are no local district heat networks within the vicinity of the proposed school.
Biomass 	Biomass heating systems burn biomass material in a biomass boiler to heat water in the same way that gas boilers burn gas. Biomass materials include all land and water-based vegetation, e.g., wood chips, wood pellets, wood waste and fast-growing coppice trees such as willow. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a low carbon process. Biomass boilers require fuel storage for the fuel source.	**N**	Wood chips require a large storage area, usually equivalent to the plant room size. Maintenance requirements and reliability are an issue with biomass boilers therefore not considered for this site.
Wind Power 	Wind power is one of the cleanest and safest methods of generating electricity. Wind turbines use the wind's forces to turn a rotor which in turn generates electricity. Wind power is used in large scale wind farms for national electrical grids as well as in small individual turbines or building integrated turbine. As the UK is one of the windiest countries in Europe, wind power is one of the best sources of renewable energy – dependent upon location.	**N**	Wind Power is not deemed suitable for the school due to proximity of housing and visual impact.
Photovoltaic Electricity Generation 	Photovoltaic (PV) modules are devices or banks of devices that use the photovoltaic effect to generate electricity directly from sunlight. Until recently, their use has been limited due to high manufacturing costs. In buildings current applications include PV on the roof, PV curtain walling systems and PV louvred external shading devices. Typically, photovoltaics would be installed on a south facing roof.	**Y**	The school will have a significant electricity demand therefore, no potential issues with utilisation, i.e., availability will match demand. The PV panels are used to generate electricity reducing CO2 emissions. As the capital cost has dropped significantly in recent years PV panels are considered attractive and will support the school's requirement to be NZCiO.

			It is proposed to utilise a bio solar roof to provide biodiversity and carbon reduction. The proposed PV array for the school will utilise a 525sqm PV installation with east and west orientated modules.
Combined Heat and Power (CHP) 	A CHP unit provides heating as well as electrical power. The electricity generated by the CHP plant can be distributed around a development and into the electrical network if needed. The use of this co-generation improves the overall efficiency of the primary energy delivered to the site with a corresponding reduction in the development's CO2 emissions. The amount of thermal energy provided by the CHP unit will be dependent on the calculated thermal base load for the buildings.	**N**	Not considered as is not compatible with future de-carbonisation of the grid and reduction of use of fossil fuels
Air Source Heat Pump 	Air source heat pumps work in a similar way to GSHPs but extract thermal energy from the surrounding air and transfer it into water. Air source heat pumps can be fitted on the façade or on the roof, but care should be taken when mounting the units to avoid any acoustic problems associated with operating the fans as the outdoor units typically operate with sound levels in the range 55 - 60dB(A). The efficiency of ASHP is measured by Coefficient of Performance (CoP); this is the ratio of units of heat output for each unit of electricity used to drive the system. Average CoP is around 2-4 although some systems may produce a greater rate of efficiency.	**Y**	The ASHP system does offer an attractive solution in terms of the de-carbonisation of the grid and the omission of the requirement for natural gas to the site. This technology is feasible to generate heating and hot water for the school kitchen.

7.5. District Heating Network

The proposed site is in a residential area of York. A review of available sources of information have not identified any current or planned district heating networks in the area. Therefore, it is considered that connection to a current or future district heating network will not be available for the proposed school development.

However, as the school heating systems are to use low temperature hot water the building could be adapted to accept a heating network connection if one was available at a future date.

8. PREDICTED CARBON EMISSIONS

8.1. Overview

An initial BRUKL assessment based on the new 2021 Part L building regulations has been undertaken using proprietary modelling software known as IES with output results tabulated below. Scenarios have been modelled with and without PV panels to demonstrate the benefit of the bio-solar roof from a carbon reduction and energy saving perspective.

The proposed heating system will be ASHP and the use hybrid / natural ventilation systems for most of the teaching spaces.

The following BRUKL results relate the current stage of design and will be subject to a design development due to the next stages and confirmed as part of the As Built information. .

8.2. Summary of inputs into the BRUKL model

The specific inputs using in the BRUKL are as follows

Target Building Fabric U-Values:

BUILDING FABRIC ELEMENT	ADOPTED U-VALUE (W/M2K)	LIMITING U-VALUE (W/M2K)	G-VALUE
Windows	1.1	1.6	0.4
Exposed Floors	0.15	0.18	
Roof	0.15	0.18	
Walls	0.15	0.26	

Target air permeability value:

AIR PERMEABILITY	WORST STANDARD	ACCEPTABLE	THIS BUILDING
$M_3/(h.m^2)$ at 50 Pa	8		3

8.3. Results

Bio solar roof with extensive PV array

The results of the model for the proposed building are as follows: -

Energy Consumption by End Use (kWh/m2)

ELEMENT	ACTUAL	NOTIONAL
Heating	7.15	6.7
Cooling	0	0
Auxiliary	1.04	5.46
Lighting	4.93	7.46
Hot Water	4.27	5.65
Equipment	18.87	18.87
TOTAL	17.39	25.27

The contribution from the proposed PV installation will displace 38.78KWh/m^2 electricity.

The subsequent carbon emissions saving identified are as follows:

Criterion 1: The calculated CO_2 emission rate for the building should not exceed the target

Target CO_2 emission rate (TER), kgCO_2/m^2. annum	3.56	
Building CO_2 emission rate (BER), kgCO_2/m^2. annum	**-2.52**	
Target primary energy rate (TPER), kWh/m^2.	37.82	
Building primary energy rate (BPER), kWh/m^2/yr	**-30.77**	
Do the buildings emission and primary energy rates exceed the targets?	**BER=<TER**	**BPER=<TPER**

9. NATURE AND LANDSCAPE

A diverse mix of greenery will be incorporated into the site, both accessible across the site inclusive of an extensive bio solar roof.

The project will incorporate biodiversity enhancements and new habitat space and strive for a biodiversity net gain across the site.

External and internal lighting design will be considered to minimise any negative impact to existing wildlife and residents.

A habitat and landscape maintenance strategy will be produced for the site. Please refer to Landscape Strategy and Ecology report for further details

10. WATER USAGE

The new school will be provided with low use water fittings with appropriate control measures to minimise water consumption and waste.

Water consumption will be reduced through the water saving hierarchy. Firstly, the demand will be reduced through use of low water flow fittings to meet best practice requirements in line with building regulations. Water efficient sanitaryware and appliances can help reduce site water consumption and as well as demands on wastewater services and are passive measures which require no behavioural change by the user.

11. RESPONSIBLE USE OF MATERIALS AND REDUCTION OF WASTE

A key objective of the project is to use materials responsibly and reduce waste.

A hierarchical approach to material use endeavours to minimise material use from the outset through:

- Efficient design and construction processes
- Low impact and locally sourced materials where viable
- The use of reclaimed elements, materials with recycled content, reusable materials, where feasible.
- Use of responsibly sourced materials to help reduce the whole life environmental impacts of the development, which will consider the life cycle of the material from its source to its potential reuse.

The building will be designed to minimise waste generation through the construction phase though the use of modern methods of construction, where applicable.

A pre-demolition audit will be commissioned to identify opportunities for material re-use from the existing buildings and advise on re-usability of materials and fittings - either on-site or in other unconnected projects, to be explored during technical design phases.

12. SUMMARY

This report has set out the methodology in which the design team have approached the design of the proposed new school and how the strategies of the school, York City Council and the Government guidelines have been adopted.

12.1. Energy and Carbon Reduction

Passive Measures – Lean

In the first instance, the team have looked to maximise passive measures to reduce the initial load of the building in terms of heating and anticipated lighting loads with the following measures.

- Fabric first approach with U Values beyond minimum Part L compliance.
- Optimum form for the new school to minimise external wall area and associated heat losses
- Air tightness significantly beyond minimum Part L compliance
- Glazing proportions optimised to provide good daylighting but limit unwanted solar gain.
- Improved glazing specification (G Value of 0.4) that limits the amount of unwanted solar gain to avoid overheating

Energy Efficiency Measures – Mean

The next stage of the design development was to establish energy efficiency measures to meet the demand of the building, these being: -

- Hybrid ventilation units for the classrooms
- Mechanical ventilation heat recovery to rooms other than classrooms.
- Low specific fan power ratings to ventilation fans
- High efficiency LED lighting throughout
- Demand operated lighting where appropriate
- Variable speed drives for any major pumping of ventilation plant

Renewable and Low Carbon Technologies – Green

The final aspect of the design has been to establish what renewable and low carbon technologies can be adopted. Following the appraisal of the building and site, air source heat pumps will be used to generate heating for the development and hot water for the domestic kitchens.

12.2. Nature and Landscape

The enhancement of the current planting and provision of an extensive bio solar roof will enhance the current nature and landscape. The smaller footprint of the new school will support the improvement in biodiversity across the site.

The design of the new building and external lighting has been developed to be low impact to minimise disturbance to local wildlife and minimise nuisance to residential properties in the vicinity of the school site.

12.3. Water Usage

The use of low water use fittings will be adopted throughout the new school to minimise water consumption and demand on the wastewater network.

12.4. Responsible use of materials and minimise waste

A hierarchical approach to material use endeavours to minimise material use from the outset through:

- Efficient design and construction processes
- Low impact and locally sourced materials where viable
- The use of reclaimed elements, materials with recycled content, reusable materials, where feasible.
- Use of responsibly sourced materials to help reduce the whole life environmental impacts of the development, which will consider the life cycle of the material from its source to its potential reuse.

The building will be designed to minimise waste generation through the construction phase though the use of modern methods of construction, where applicable.

13. CONCLUSION

This report identifies the Sustainability Strategy for Hempland Primary School in support of the planning application.

The sustainability credentials for the school have been driven by the Specific Sustainability brief for the school which goes beyond regulatory compliance and City of York Planning requirements.

It has reviewed and proposed low and zero carbon technologies and presented the results from an initial BRUKL assessment. The results for the proposed school demonstrate significant energy and carbon reduction beyond building regulatory and planning requirements

The adopted strategy has sought to reduce the carbon emissions for the building using a lean, mean green approach and these findings have been applied to the building.

The adoption of a fabric first, energy efficient design combined with the extensive PV installation, proposed as part of the bio solar roof, will provide a significant annual yield offsetting the school's annual energy consumption. This supports the schools' sustainable estates strategy to be Net Zero Carbon in Operation .

The summary results from the assessment show that the proposed school building provides a reduction in carbon emissions of over 240% compared to the notional building. This therefore demonstrates compliance with the City of Yorks requirements.

In addition, and in line with the school specific sustainability brief the new school and external area will improve the current biodiversity of the site, use less water and seek to minimise material use and waste as part of the construction phase of the project.

14. APPENDIX 1 – BRUKL

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

230620 Hemplands Part L 2021 Model — As built

Date: Tue Jun 20 10:25:28 2023

Administrative information

Building Details

Address: Address 1, City, Postcode

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.20

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.20

BRUKL compliance module version: v6.1.e.1

Foundation area [m²]: 1225.71

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

Target CO_2 emission rate (TER), $kgCO_2/m^2annum$	3.56	
Building CO_2 emission rate (BER), $kgCO_2/m^2annum$	-2.52	
Target primary energy rate (TPER), kWh_{PE}/m^2annum	37.82	
Building primary energy rate (BPER), kWh_{PE}/m^2annum	-30.77	
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	0.15	0.15	L0000003:Surf[8]
Floors	0.18	0.15	0.15	L0000003:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.15	0.15	L0000003:Surf[1]
Windows** and roof windows	1.6	1.1	1.1	L0000003:Surf[2]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	1.6	1.6	L0000003:Surf[11]
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building

$U_{a-Limit}$ = 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

NB: 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
m³/(h.m²) at 50 Pa	8	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	2207.9	2207.9
External area [m²]	3838.8	3838.8
Weather	LEE	LEE
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	999.46	1188.31
Average U-value [W/m²K]	0.26	0.31
Alpha value* [%]	25.04	10

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

Building Use

% Area	Building Type
	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
100	**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
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	7.15	6.7
Cooling	0	0
Auxiliary	1.04	5.46
Lighting	4.93	7.46
Hot water	4.27	5.65
Equipment*	18.87	18.87
TOTAL**	**17.39**	**25.27**

* 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/m²]

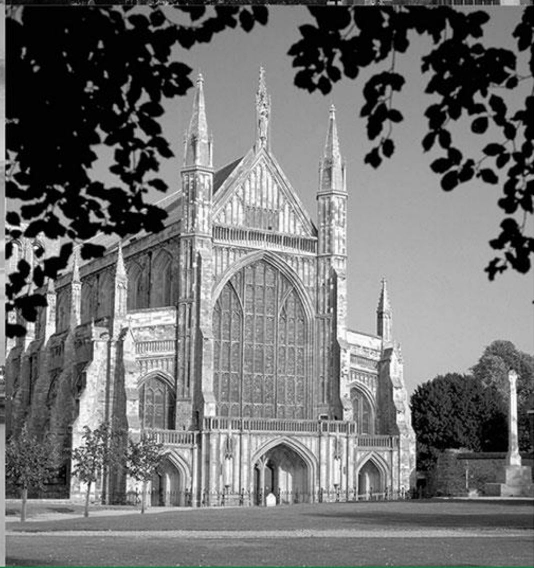
	Actual	Notional
Photovoltaic systems	38.78	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*38.78*	*0*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	85.35	67
Primary energy [kWh_{PE}/m^2]	-30.77	37.82
Total emissions [kg/m²]	-2.52	3.56





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