



Project:

Star Radcliffe Academy

Report Title:

Energy Strategy Report

Client: Morgan Sindall

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1 Document History and Validation

1.1 Revision History

Revision	Issue Date	Reason for Issue
Rev-	11 August 2023	Stage 3 Submission
P01	18 August 2023	S4 - LAP Authorisation

1.2 Document Validation (Latest Issue)


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2 Introduction

Kennedy Redford have been appointed by Morgan Sindall, on behalf of the DfE and the Star Academy Trust, to provide consultancy advice in relation to the design and construction of the new Secondary Academy School to be located to the North side of Spring Lane Radcliffe M26 2SZ, previously the site of Spring Lane School.

The overall project has been developed based on the Department for Education (DfE) conceptual proposals and to achieve the DfEs Spec 21 briefing requirements for new build schools where possible unless specific requirements have been derogated against or agreed otherwise to meet the requirements of the trust and the needs of the students who will attend the school.

The purpose of this document is to outline the energy strategy for the project, and how this will address local and regional planning policy.

2.1 Development Details

The project consists of the erection of a new school building and all associated external areas. The new building will be approximately 6000m² over three stories. The overall development includes but is not limited to the construction of a new site entrance, access road, staff and visitor parking, pupil / parent vehicle drop off area, multi-use games area, sports playing fields and landscaping.

2.1.1 Planning Policy

The project will be designed and constructed to meet the national and local planning policies. The planning policy for the project will consider the National Planning Policy Framework (2021) ('NPPF') and the supporting National Planning Practice Guidance ('PPG') and the Local Plan Core Strategy (2016) and the saved policies of Unitary Development Plan (1996-2016).

2.1.2 National Planning Policy

The updated National Planning Policy Framework ('NPPF') was published by the Government in 2021, superseding any former iterations. It sets out the Government's planning policies for England and how these are expected to be applied.



2.1.3 Local Planning Policy

The Bury Council Planning Guidance (SDP16) criteria is highlighted below:

Clause 5a. Development should ensure the highest environmental performance.

- All new non-residential developments should aim to achieve at least a BREEAM rating of 'Very Good' with at least 25% reduction in CO2 emissions beyond the requirements of the 2006 Building Regulations Approved Document L (2006);
- Within these requirements, in new non-residential developments of 1,000 sqm2 or more and new residential developments of 10 units or more, developers should provide 10% of their predicted energy requirements on site/near site or through connections to a low carbon decentralised energy supply, unless it can be demonstrated, having regard to the type of development and its design, that this is not feasible or viable.
- In non-residential schemes developers will be required to provide evidence of on-site energy provision within their BREEAM assessment (design and post construction review). In residential schemes, developers will be required to achieve 1.2 points or higher under the Code for Sustainable Homes energy requirements.

Key Sustainability Points

- Developments should aim to achieve at least Level 3/Very Good rating against the Code for Sustainable Homes/BREEAM Standards;
- Developers should aim to provide 10% of their predicted energy requirements on site or through connections to low carbon decentralised energy supply;
- Sustainable design techniques which improve energy efficiency will be encouraged in all developments.

This section outlines the development's approach to achieve the Bury Council's planning requirements.

- The development will aim to comply with the existing Bury Council policy document, The Bury Unitary Development (UDP) adopted in 1997, and the Development Control Policy Guidance Note 16 (SDP16) adopted in October 2008.
- SDP16 item 5a states the requirement to improve on the 2006 Building Regulations Approved Document L by a minimum of 25% reduction in CO2.
- To calculate carbon emissions and reductions, the design was assessed under 'Part L 2013: Conservation of Fuel and Power' of the UK Building Regulations (which supersedes Part L 2006), using the National Calculation Methodology (NCM). A detailed energy model was created using Government approved software Integrated Environmental Solutions: Virtual Environment (IES: VE) 2019, in line with CIBSE AM11. The model was revised for each of the steps of the Energy Hierarchy to establish expected performance and satisfaction of the policy requirements.
- As part of the Energy Strategy an energy assessment has been carried out to benchmark the proposed energy strategy and evaluate its performance against the relevant Policies. The energy strategy will cover passive design elements, energy efficiency measures and low and zero carbon energy delivery systems and how they have been incorporated into the project.

3 Design Considerations

The following sections outline the design parameters used in the design stage Part L2A assessments of the proposed school.

3.1 Building Regulations Part L Compliance

The project will be designed to meet the standards set by Building Regulations Approved Document Part L2A, Conservation of Fuel and Power in New Buildings other than Dwellings.

Throughout this report carbon emissions are split into two categories:

- Regulated - Emissions associated with heating, cooling, hot water, lighting and any other fixed building services equipment (those covered under Building Regulations Part L2A and L2B).
- Unregulated - Emissions that are associated with small power and plug-in items and any other process of plant equipment (these are not covered by Building Regulations Part L).

3.2 Optimising Energy Use

The MEP services within the building will be designed with the aim to reduce CO2 emissions and reduce energy consumption and where possible achieve Net Zero Carbon in Operation (NZCiO)

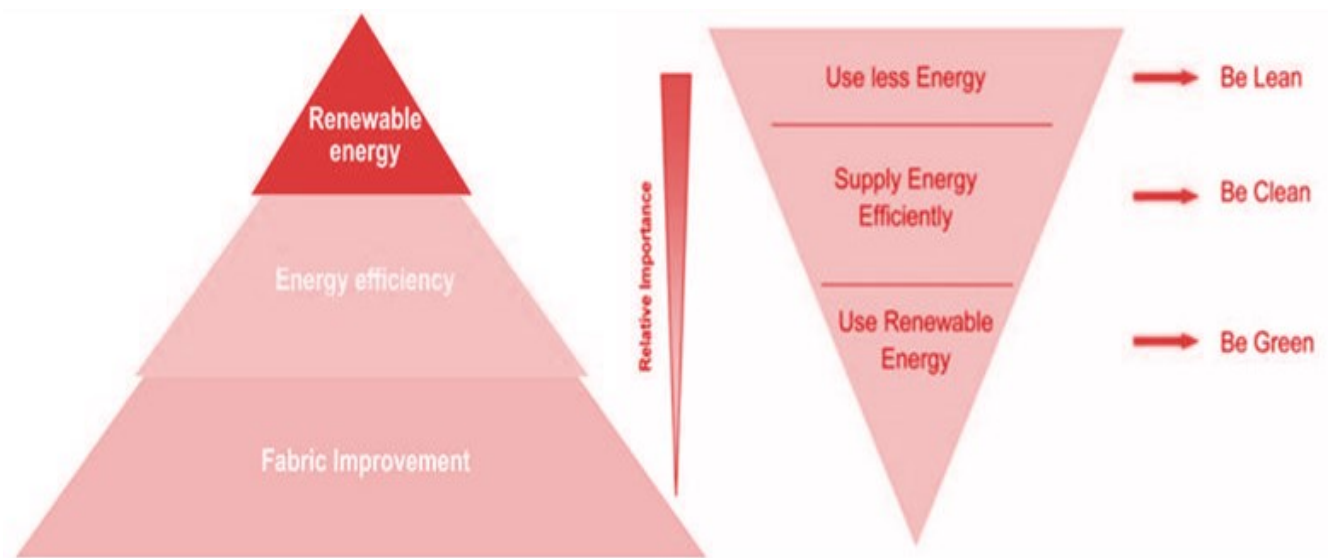


Figure 2 - Energy Hierarchy

The strategy for the project seeks to minimise energy usage, via the use of passive design measures in line with the energy hierarchy in the figure above. This includes design measures such as high building thermal performance, low air permeability & optimising the extent of external glazing to maximise natural day lighting without giving rise to excessive heat gains. Where possible the building will be designed to maximise occupant comfort while using the least amount of energy for energy intensive systems such as lighting, heating and cooling.

Wherever mechanical ventilation is provided due to function or for building regulations compliance it is both energy efficient and simple to operate and incorporates heat recovery to reduce space heating energy. Natural cooling through openable windows is proposed in general teaching areas during warmer weather so that energy intensive cooling systems are not required.

The design will provide effective and efficient environmental systems that are simple to operate and control, giving end users full control over their environment.

3.3 Energy Efficient Measures

This section of the report looks at measures that could be included to reduce energy demand and subsequent carbon emissions for the project.

The reduction of energy demand provides the greatest opportunity to minimise a building's potential carbon emissions. Design strategies that are typically given consideration include building form and fabric (passive design) and energy efficient building services (active design).

Focussing on passive design measures at an early stage in new build projects can often be the most efficient and cost-effective way to reduce energy consumption and carbon emissions.

The energy strategy for the school will be developed to minimise the energy consumed by a lean, clean and green approach as defined below: -

- Lean - Use advanced building modelling and passive construction techniques as far as is cost effective to minimise energy demand. The energy demand of the development is minimised through prioritisation of passive design.
- Clean - Incorporate high efficiency systems and effective controls within the design to reduce energy consumption.
- Green - Incorporate renewable energy sources where necessary and economically viable to achieve the carbon emissions and energy targets.
- As part of the Energy Strategy an energy assessment has been carried out to benchmark the proposed energy strategy and evaluate its performance against the relevant Policies. The energy strategy will cover passive design elements, energy efficiency measures and low and zero carbon energy delivery systems and how they have been incorporated into the project.

3.3.1 Passive Design

Passive design options are those which utilise building form, massing, glazing and the natural surroundings of the site to reduce energy demand. The project is to be delivered to the DfEs Spec 21 brief and aims to deliver a school that is NZCiO.

Passive measures for the environmental systems in order to reduce the energy loads for the project can include the following:

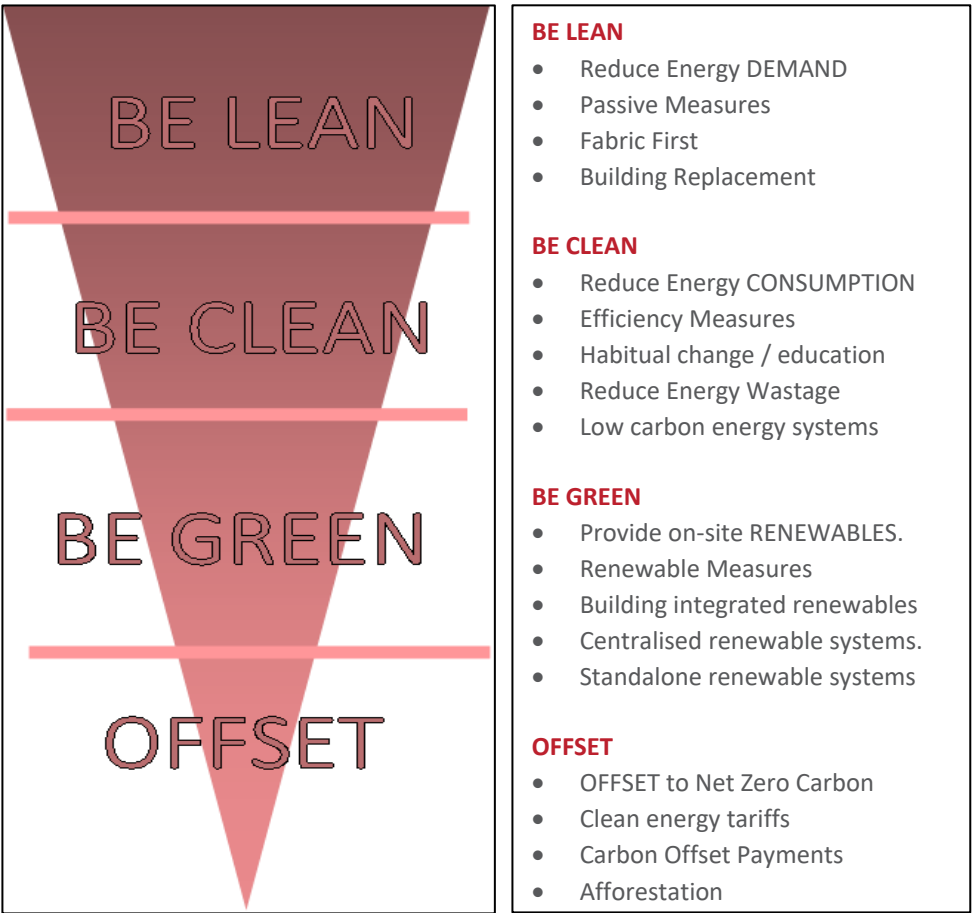
- Maximising thermal opportunities from solar gain through building orientation and limited over shading.
- Simplified building forms with a reduction in the surface area of buildings.
- High levels of insulation
- Development of an effective airtight building envelope and fabric.
- High performance glazing systems with window proportions optimised to suit location and building orientation.

- Window systems designed to facilitate natural ventilation with low energy, efficient ventilation units with heat recovery.

To reduce overall energy demand, the building will be specified have constructions and air tightness to meet or better the Part L notional building.

3.3.2 Active Design

Active design relates to the energy efficiency measures that can be included within the building and the proposed environmental systems to reduce energy consumption. All services will be designed to meet or improve upon the minimum recommended performance contained with the UK Government Non-Domestic Building Services Compliance Guide (2013) where necessary.



4 Energy Strategy

This section outlines the projects energy strategy and the approach to achieve the DfEs technical requirements and the local Council’s planning requirements.

As part of the Energy Strategy an energy assessment has been carried out to benchmark the proposed energy strategy and evaluate its performance against the relevant Policies. The energy strategy will cover passive design elements, energy efficiency measures and low and zero carbon energy delivery systems and how they have been incorporated into the project.

4.1 The Energy Hierarchy

In order to achieve this, a “Steps to low carbon” methodology is to be followed as the design progresses, which includes (in order of consideration):

- 1. The consideration and incorporation of passive design solutions, where feasible.
- 2. The incorporation of energy efficiency measures through the design of services and improved fabric performance.
- 3. Calculation of the predicted design energy consumption rates and associated annual CO2 emissions for the development in comparison with the Building Regulations.
- 4. Assessment of the viability of incorporating low and zero carbon energy sources.

4.2 Demand Reduction – Be Lean

4.2.1 Envelope

The development will first and foremost seek to reduce its energy demand in line with five basic principles:

- 1. Continuous thermal insulation
- 2. Airtightness
- 3. Thermal bridge free
- 4. High-performance windows
- 5. Ventilation systems with heat recovery

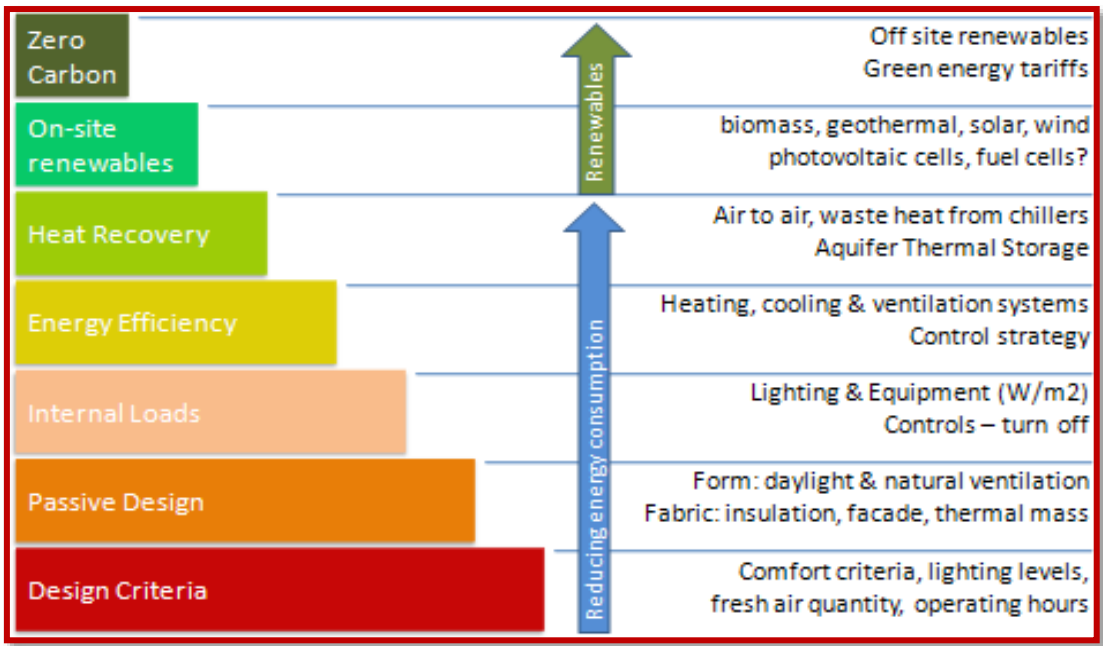


Figure 3 - “Steps to low carbon” methodology

These principles focus on achieving a continuous, well insulated envelope which is both airtight and thermal-bridge free. High performance glazing provides a positive energy balance whilst improving thermal comfort. Where required centralised AHUs with heat recovery ensures a continual supply of fresh air with minimal heat loss.

An air leakage rate of 3m3/(hr.m2)@50Pa is being targeted for the proposed project. Good air tightness could be achieved by prefabrication of several key building components under factory conditions, robust detailing of junctions and good building practices on site.

4.2.2 Unregulated Energy

Unregulated energy is those uses that fall outside the typical scope of building regulations. This includes energy used through cooking, computers, external lighting and other ‘plug loads’ which are typically under the control of the occupant.

Addressing these loads, which often form a significant portion of a building’s overall energy consumption, is key to reducing energy consumption to levels required for Net Zero Carbon. This will be achieved through the specification of energy efficient white goods, lifts, and other appliances.

4.2.3 Cooling and Overheating

The proposed development has been designed to minimise its use of energy intensive cooling systems through passive and energy efficient measures.

4.2.4 Minimising internal heat generation

Plug-loads and occupant densities associated with the building’s activities cannot be altered beyond the client’s brief. Therefore, the only area that can be targeted is the lighting. Low energy, high efficacy, LED lighting will be used throughout the development to minimize internal heat gains.

4.2.5 Reducing the amount of heat entering the building

The development facades have undergone design review to control the amount of solar gain entering internal spaces. The façade elements have been specified with a low solar transmission (g-value) in all facades.

4.3 Low & Zero Carbon Technologies – Be Green

The following renewable technologies were considered for inclusion within the project:

- Solar Photovoltaics
- Wind Power
- Gas or Biomass CHP
- Micro Hydro Power
- Solar Hot Water
- Heat Pumps (Ground and Air Source)
- Biomass

4.3.1 Solar Photovoltaics (PV)

Solar PV could be installed on the roof of the building. This roof space could accommodate a number of PV panels which would reduce the overall electricity demand for the development. PV cells convert solar energy directly into electricity.

The advantage of photovoltaic cells is once they are installed, they require minimal maintenance over their operational life and have no primary fuel requirements.

During the initial modelling, PV panels were modelled and were required to comply with local planning policy and DfE energy targets. Installation of PV panels will also help to achieve the DfE target of NZCiO and have been included as part of the project.

4.3.2 Heat Pumps

4.3.2.1 Ground Source Heat Pumps (GSHPs)

GSHPs require either boreholes or ground loops to extract heat from the stable ground temperature. This requires substantial ground works and can be significantly more expensive when compared to other, more traditional heating systems. To connect to traditional wet heating systems such as radiators, these may need to be oversized.

4.3.2.2 Air Source Heat Pumps (ASHPs)

ASHPs are feasibly possible and may be suitable if further carbon savings above what is currently being achieved are desired. The increased cost above traditional gas boilers would also have to be acceptable. ASHPs are less expensive than GSHPs, however this would need careful design with low temperature heat emitters to improve overall system efficiency. Including low temperature heat emitters would require underfloor heating or larger radiators.

ASHPs exchange heat between the outside air and a building to provide space heating in winter and cooling in the summer months. Heat pumps supply more energy than they consume, by extracting heat from their surroundings and can supply as much as 4kW of heat output for just 1kW of electrical energy input. The efficiency of these systems is inherently linked to the ambient air temperatures.

Domestic hot water will be provided to all areas via ASHP and will utilise high temperature refrigerant, such as CO₂, which operate efficiently at the high temperatures that DHW generation demands.

ASHP systems enable significant emissions savings over a conventional gas boiler heating system, particularly when factoring in the decarbonisation of the electrical grid.

4.3.3 Other Technologies

Other technologies were considered, however are not considered appropriate for the development. These include:

- Wind Turbines:
 - The output from wind turbines is highly sensitive to wind speed. Hence it is essential that turbines should be sited away from obstructions, with a clear exposure, or fetch, for the prevailing wind. The urban nature of the site means these are not considered appropriate for this development. Wind turbines could be installed at the development, for these to be viable an average wind speed of 5 m/s is required. If this wind speed is achieved at the site, wind turbines are still unlikely to be feasible for the school. The turning of turbine blades can create shadow flicker which can be disruptive to building occupants nearby. Furthermore, the noise and vibration caused from the turbine rotation could be disruptive.
- Biomass:
 - Biomass in the form of logs, wood chips and wood pellets are classified as a renewable source of energy since 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 they will typically reduce net CO₂ emissions by over 90%. However, biomass boilers and their associated NO_x emissions would impact local air quality and therefore are not considered feasible for this development.

- A biomass boiler could be installed to provide heating and hot water for the site. In order for a biomass boiler to be feasible, there needs to be sufficient space on site for a fuel store with space for fuel delivery.
- To ensure fuel security, the Carbon trust recommends that 2 weeks of fuel be stored on site. The space required for this would be sufficient and is not available at the site.
- For biomass to be considered low carbon, fuel needs to be delivered from a supplier within 60 km of the site.
- Solar Thermal:
 - Solar thermal collectors utilise solar radiation to heat water for use in buildings. Solar collectors are typically designed to meet a development's base heat load, associated with its domestic hot water requirements. However, the complexities involving the integration of pipework as well as the limited available roof space means that solar thermal collectors are not considered feasible for the development.
 - Solar thermal collectors on the roof are technically feasible, this would require careful design to incorporate SHW with traditional gas boilers and thermal storage. The use of SHW would offset the use of gas boilers at a rate of 0.216 kgCO₂/kWh, compared to PV panels which offset electricity use at a rate of 0.517 kgCO₂/kWh.
 - Due to the increased carbon reduction that can be achieved through the use of PV panels, SHW will not be given consideration moving forward.
- Micro Hydro Power
 - There is no capacity for micro-hydro power on this site since there are no local water courses available.
- Combined Heat and Power (CHP)
 - For combined heat and power to be feasible there needs to be a high, constant heat demand within the development such as a swimming pool.
 - Gas fired CHP systems can also produce large amounts of NO_x emissions when compared to a gas boiler. This can have a negative impact on local air quality and is not the preferred option for the scheme.

5 Energy Assessment

The proposed development will be required to comply with Building Regulations Approved Document L2A (and the 2013 and 2016 amendments).

5.1 Calculation Methodology

To calculate carbon emissions and reductions, the design was assessed under ‘Part L 2013: Conservation of Fuel and Power’ of the UK Building Regulations and the building has been modelled using IES 2019 to simulate the performance of the building at hourly intervals for a full test year and as required by Building Regulations, building occupancies, room heating set-points, ventilation rates and illumination levels have been modelled according to the National Calculation Method (NCM). The NCM enables calculation of the energy consumption required to deliver a defined level of comfort and service provision, based on standardised occupancy conditions.

5.1.1 Weather Data

CIBSE/Met Office Hourly Weather Data Test Reference Years (TRYs) are available for 14 locations across the UK. The dynamic weather file used in the analysis for Part L2A (2013), which supersedes Part L 2006. is the CIBSE Manchester Test Reference Year (TRY05) in accordance with the National Calculation Methodology (NCM). CIBSE approved ‘Test Reference Year’ weather data for Manchester, the nearest available to the proposed site, has been used in the simulation.

For Part L 2021, the dynamic weather file used for the Regulations 24-27C analysis is the CIBSE Manchester Test Reference Year (TRY2016), as stipulated in Part L Volume 2 of the Building Regulations. The building has been deemed to be partially exposed.

5.2 Building Fabric

To comply with Criterion 2 of Part L2A, heat gains and losses must be limited through thermal elements and other parts of the building fabric, by meeting the limiting U-value and air permeability standards and by reasonably limiting thermal bridging. The following table outlines these fabric design parameters and limiting values, confirming compliance against this requirement.

Table 1: Designed Building Fabric

Building Element	Design values
Floor average area weighted U-value (W/m2K)	0.12
Roof U-value (W/m2K)	0.12
Wall U-value (including curtain walling) (W/m2K)	0.15
Curtain walling (W/m2K)	1.1
Doors	1.1
Rooflights	1.1
External window (including frame) average area weighted U-value (W/m2K)	1.1

Façade total solar transmission g-value	0.35
Glazing visible light transmission (VLT)	0.70
Air permeability @ 50 Pascals (m3/(hr.m2))	3

5.3 MEP Systems

Ventilation - Mixed mode ventilation utilising openable windows and a natural ventilation heat recovery (NVHR) unit will supply the bulk of general teaching spaces. Natural ventilation via openable windows with heating via radiators or radiant panels with provide the perimeter staff rooms, studios and large halls.

Energy Recovery - Natural Ventilation with heat recovery is proposed for the classrooms via restricted openable windows as primary ventilation and assisted natural ventilation units. The units will mix external air with warmer internal air, providing tempered fresh air to the classroom, avoiding cold draughts during cooler seasons. The units will be controlled automatically by room CO2 and temperature sensors or time clocks with the option for manual boosting.

Heat recovery will be provided to a seasonal efficiency of 85% in all mechanically ventilated areas apart from toilet areas which shall have heat recovery of 75% seasonal efficiency.

All equipment and plant will exceed the minimum requirements of the Building Services Compliance Guides. This document provides guidance on the means of complying with the requirements of Approved Document Part L2 of the Building Regulations for conventional space heating/ cooling systems, hot water systems and ventilation systems.

All fans and pumps will be specified with variable-speed drives, which will reduce their energy consumption by more than two-thirds compared with equivalent constant speed alternatives, by only supplying the required flow rate to meet the demand.

Heating Plant - To help decarbonise the building, the primary heating source will be ASHPs. This means that there is no requirement for natural gas and that carbon savings should improve over time as the carbon factor of grid electricity reduces. The heating and cooling systems are to be appropriately zoned, with local fast responding controls.

Natural light is maximised throughout, where practicable, with appropriate glazing design. This allows electric lighting energy consumption to be reduced during daylight hours, reducing running costs and CO2 emissions.

Installing efficient low energy light fittings internally and externally can significantly reduce a building’s overall lighting load hence lowering its annual CO2 emissions. The development will reduce the energy consumption by the specification of low energy, high efficacy LEDs to all areas. Appropriate lighting controls and occupancy controls will reduce the lighting energy use where appropriate and will be installed in line with Part L to aid in the conservation of energy. Occupancy sensors will be complete with an adjustable time delay.

Domestic Hot Water - ASHPs will be used for DHW with most DHW demand located close to the plant room to minimise distribution losses.

Cooling plant - cooling is proposed in the first-floor server room and general teaching spaces such as ICT studios and the LRC where extensive ICT equipment will be used i.e. One PC / laptop per student. The design aims to prevent the use of refrigerant cooling by providing enhanced mechanical ventilation in these rooms, but should this not be possible then cooling will be provided via ASHP’s with a minimum SEER of 4.

All sanitaryware is proposed to be low flow type, this includes dual flush WCS, low flow taps and shower and low water consuming white goods (where specified).

5.4 Energy Model Inputs

The Part L model incorporated the following design parameters to demonstrate compliance.

Table 2 - Energy Model Inputs

System	Modelling Input
Heat Generation - ASHPs Efficiency	95%
Ventilation Heat Recovery Efficiency	85%
Ventilation Specific Fan Power (SFP)	1.5W/l/s
DHW Efficiency	100%
DHW Storage Losses	0.025kWh/litre/day
PV Efficiency	20%
PV Area	1,594m²

6 Results

The energy consumption & carbon emissions for the development have been calculated using the assumptions outlined in the previous section. All occupancy and equipment gains are specified within the NCM internal conditions for each room. The calculated energy consumptions for the building are shown in the following table.

Table 3 - Calculated energy use

End Energy Use	Annex 2H Benchmark Brief	Star Project Brief Proposed Control Option EUI	Proposed Scheme Energy kWh/m²
Heating	8	1.1	1.1
Internal Lighting	5	3.8	3.5
Fans	5	4.4	4.1
Pumps	inc in fans and pumps	0.3	0.3
Lifts	1	1	1
Building related services	2	2	2
External lighting	6	6	5
Cooling (Server Room)	0	0	0
Catering	7	7	7
Small power	25	14	18
Hot Water	8	No allowance**	2
Total	67	39.6	44

Table 4 - BRUKL Report Energy & Compliance Summary

Target (TER) (kgCO2/m2)	13.8
Building (BER) (kgCO2/m2)	- 16.6
Improvement %	>100%
Part L Pass (Y / N)	YES
Pass 25% beyond Part L (Y / N)	YES

Once the demand reduction measures, energy efficient building service systems and renewable technologies were all applied to the dynamic energy model, the IESE VE software was used to generate a Building Regulation United Kingdom Part L (BRUKL) Report. This report specifies the energy and fuel conservation effort as it outputs the proposed building’s CO2 emission rate (BER) and compares it against the CO2 emission rate from the notional building known as the target CO2 emission rate (TER).

The overall results presented in this report shows that the proposed building complies with England Building Regulations Part L 2013. In addition, the 25% improvement over Part L target set out in the Bury local strategy is achieved.

As per the initial targets, PV has been maximised on available roof space as well as a PV array on an external standalone canopy which provides a total of 1594m² of PV system array generating circa 264,000kWh (This is subject to change during detailed design and refining the PV layout and efficiencies during the detailed design. The current proposals plus the inclusion of the PV systems noted allows the project to achieve NZCiO operation.