



Sarum Academy

Science Building

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Energy Strategy and Net Zero Carbon in Operation

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Executive Summary

This Energy and Sustainability Statement has been prepared by Futura Bright to assess the proposed new science block at Sarum Academy, Salisbury. The report sets out the strategy for energy efficiency, low and zero carbon technologies, and compliance with relevant national and local planning policy requirements, with the overarching aim of achieving Net Zero Carbon in Operation.

The approach follows the nationally recognised Energy Hierarchy of Be Lean, Be Clean, Be Green. The modelling demonstrates progressive emissions reductions from a compliant baseline scenario through demand reduction, efficient systems design, and renewable energy integration.

Baseline emissions were modelled at 9.63 tCO₂/year in line with Building Regulations Part L 2021 notional specification.

Through passive design measures (enhanced insulation, glazing, airtightness) and active systems (high-efficiency lighting, hybrid/mechanical ventilation, and optimised controls), emissions were reduced by 49.2% to 4.89 tCO₂/year.

The incorporation of Air Source Heat Pumps (ASHP) for heating, hot water, and potential cooling further reduced emissions to 4.17 tCO₂/year, **achieving full Part L compliance.**

To offset remaining operational emissions, photovoltaic (PV) panels are proposed. A total of 94 x 425W panels are required to achieve Net Zero Carbon in Operation, to be roof mounted on the building, south facing at 30deg pitch.

Dynamic modelling (SBEM and CIBSE TM54) confirms that the building design, when combined with the proposed renewable energy strategy, will deliver compliance with Building Regulations Part L, Wiltshire Core Strategy Policy 41, and the Wiltshire Climate Strategy. The proposed approach ensures that the science block will operate to Net Zero Carbon standards, while maintaining cost-effectiveness, resilience, and alignment with the national direction away from fossil fuels.

In conclusion, the proposed development demonstrates a robust, future-focused strategy, embedding sustainability into the design through a fabric-first approach, efficient systems, and renewable technologies. With the

integration of ASHP and PV, the project provides a clear pathway for Sarum Academy to achieve its sustainability and carbon reduction commitments.

Introduction

Futura Bright have prepared this Energy Strategy document to outline the proposed fabric and systems needing to be installed to meet the relevant planning, Client, and funding criteria at proposed new Science Block at Sarum Academy, Salisbury, Wiltshire.

This report outlines the emissions reductions implemented to meet and exceed Building Regulations Part L, Local Planning Policy and additional Client requirements for the site to ensure that the building meets the 'net zero carbon in operation' standards.

Design measures which will reduce energy consumption and CO2 emissions of this development are outlined in line with the general nationally applied Energy Hierarchy of 'Lean', 'Clean' and 'Green' with emissions reductions presented at each stage, with calculations undertaken within SBEM software in line with Building Regulations 2021 methodology.

An additional assessment is then undertaken in accordance with CIBSE TM54 to assess and validate that the building achieved 'net zero carbon in operation'

THE PROPOSED DEVELOPMENT

Sarum Academy is a Voluntary Controlled Church of England secondary school located on Westwood Road, on the north-west side of Salisbury. Founded in 2010 and part of the Magna Learning Partnership Multi Academy Trust, it provides mainstream education for pupils aged 11–19. The school currently accommodates around 900 pupils (6FE/180 per year group) plus approximately 250 sixth form students, with over 750 pupils in total. Following a review and consultation with the Department for Education, the Academy plans to close its sixth form provision from September 2026, primarily due to changes in pupil needs and to streamline resources.

Located to the north west of Salisbury on Westwood Road, the broad proposals for the school include multiple phases of development to expand the school from a 6FE to a 10FE intake and accommodate more students after the sixth form closure. Plans include constructing a new block for science, LRC/ICT, offices, and group rooms; refurbishing existing science labs for Humanities, MFL, and Art; integrating SEN

provision within the main school; and expanding dining facilities. The works also involve building a new extension to house nine classrooms, relocating facilities, and creating external areas to meet the increased capacity. The development will occur in phases, with the 7FE target by September 2026, 8FE by September 2028, and the 10FE goal by 2035.

The 'Proposed Development' referred to within this report is the new construction of the science building which is the focus of the calculations outlined within this document.

FIGURE 1: REGIONAL LOCATION

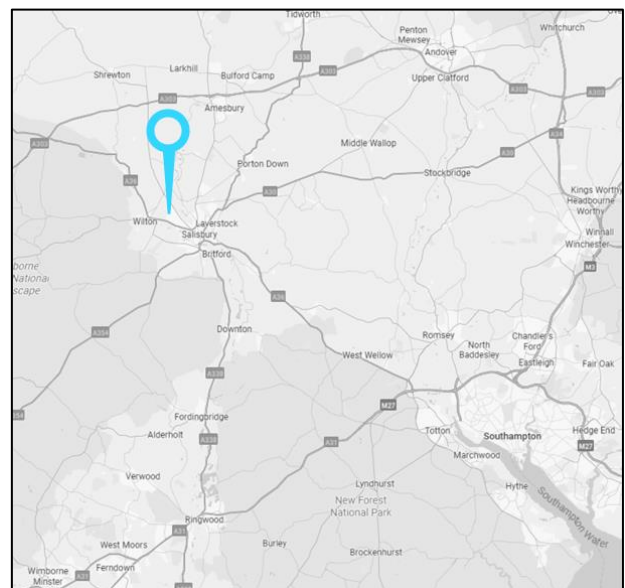


FIGURE 2: SITE BOUNDARY AND INDICATIVE LOCATION OF
NEW SCIENCE BLOCK



PLANNING POLICY AND PERFORMANCE REQUIREMENTS

Outlined below is a summary of the Planning Policy used to develop the energy strategy for the site, in addition to the regulations and guidance set out in Building Regulations Part L - Conservation of Fuel and Power:

Wiltshire Core Strategy 2015 - Core Policy 41: Sustainable construction and low-carbon energy

Climate change adaptation

New development, building conversions, refurbishments and extensions will be encouraged to incorporate design measures to reduce energy demand. Development will be well insulated and designed to take advantage of natural light and heat from the sun and use natural air movement for ventilation, whilst maximising cooling in the summer.

Sustainable construction

New homes (excluding extensions and conversions) will be required to achieve at least Level 4 (in full) of the Code for Sustainable Homes.

Conversions of property to residential use will not be permitted unless BREEAM's Homes "Very Good" standards are achieved.

All non-residential development will be required to achieve the relevant BREEAM "Very Good" standards, rising to the relevant BREEAM "Excellent" standards from 2019.

Existing buildings

Retrofitting measures to improve the energy performance of existing buildings will be encouraged in accordance with the following hierarchy:

- i. Reduce energy consumption through energy efficiency measures
- ii. Use renewable or low-carbon energy from a local/district source
- iii. Use building-integrated renewable or low-carbon technologies.

Opportunities should be sought to facilitate carbon reduction through retrofitting at whole street or neighbourhood scales to reduce individual costs, improve viability and support coordinated programmes for improvement.

Renewable and low-carbon energy

All proposals for major development⁸⁷ will be required to submit a Sustainable Energy Strategy alongside the planning application outlining the low-carbon strategy for the proposal.

In all cases, including those listed above, proposals relating to historic buildings, listed buildings and buildings within conservation areas and world heritage sites should ensure that appropriate sensitive approaches and materials are used.

Safeguarding of the significance of heritage assets should be in accordance with appropriate national policy and established best practice.

In all cases the impact of these requirements on the viability of development will be taken into consideration.

Wiltshire Climate Strategy -2022-2027

Objectives

New buildings, including homes, to be **net zero carbon** and adaptable to climate change as soon as possible (including measures such as water efficiency)

Existing buildings in all sectors to be retrofitted to improve energy efficiency and decrease energy demand through low carbon technology

New and existing buildings to be adapted to climate change for both heating and cooling, and to include measures of benefit to the wider environment where possible.

POLICY AND DISCUSSION

The above outlined planning policy will be applicable to the site and the Proposed Development will need to meet these requirements.

In addition to this, the Net Zero Carbon in Operation requirement for the site will need to be demonstrated via separate assessment to model the estimated operational energy use.

Therefore, it is the aim of this report to demonstrate the following requirements are met:

Building Regulations Part L 2021 Compliance and emissions reduction in line with Planning Policy requirements

This report

Net Zero Carbon in Operation (TM54 Assessment)

This report

Overheating and BB101 Compliance

Separate Supporting Overheating Report

Energy Strategy

This section outlines the methodology and standards used to formulate the energy use and CO2 emissions reduction strategy.

THE ENERGY HIERARCHY

All energy strategies are required to be formed on the basis of the 'Energy Hierarchy'.

The energy hierarchy is outlined in various guidance provided by the Local Authority, as well as being general national best practice in developing appropriate strategies for ensuring energy use and associated emissions is reduced as far as practicable for each building.

The energy hierarchy – often also referred to as a 'fabric first' approach – ensures that passive and active efficiency measures are prioritised. With connections to local heat networks

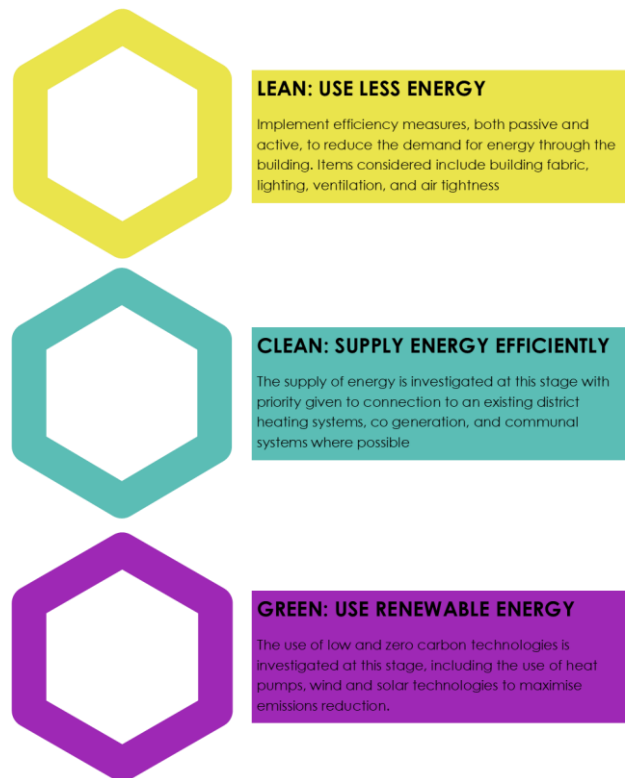
Energy and CO2 emissions reduction factors must be implemented in line with this hierarchy to demonstrate that a fabric first approach has been implemented, and that methods for servicing buildings are applied in the most environmentally appropriate way possible.

The Energy Hierarchy forms the basis for this Energy Strategy with improvements made to the proposed design through the implementation of emission reduction measures in line with the process outlined opposite.

Through the adoption of this approach, long term emissions reductions are secured through the implementation of efficiency measures first, with other 'green' technologies considered at the latter stages to provide heating, hot water and cooling (where applicable).

The above approach is also considered in conjunction with the new national direction of travel away from the burning of fossil fuels on site, and the consideration of other, broader factors such as building location, fuel supply, building usage, and maintenance issues, which also form part of the efficient on-going operation of the proposed development.

FIGURE 3: THE ENERGY HIERARCHY



MODELLING AND CALCULATIONS

The Proposed Development is a 'new construction' and therefore falls under Building Regulations Part L1, as applied to new build constructions. Consequently, modelling for this development has been undertaken with certified SBEM software within IES Virtual Environment (2024) in accordance with Building Regulations Part L 2021. The model constructed is based on the latest drawings from the Architectural Team, and is fully compliant with CIBSE AM11.

The building was modelled in its entirety, with fabric as regulated building systems added to the model to simulate the buildings regulated building emissions in line with Part L requirements.

Various simulations were conducted based on the a suite of options provided for the building by the Design Team before the following specification and emissions reduction measures were settled upon.

The modelling within this section of the report has been conducted in tandem with the TM54 modelling to ensure that the specification decided upon met Planning, Building Regulations and wider requirements.

Emissions Reduction Strategy

The following section outlines the emissions reduction strategy employed within the Proposed Development to meet Planning Policy Requirements. All improvements in the performance of the Proposed Development are measured from an energy baseline based on a Building Regulations Part L compliant design.

BASELINE EMISSIONS

The energy baseline forms the basis for which all subsequent improvements are measured and is based on the dimensions and orientation of the Proposed Development, but incorporates the 'Notional Specification' outlined within Approved Document L. To pass Building Regulations requirements, the Proposed Design must outperform the Notional (Target) dwelling on the following 3 metrics:

Emissions Rate (ER): the yearly emissions associated with regulated energy use per m² of GIA

Primary Energy Rate (PER): the yearly energy required to be generated to supply the dwelling with needed power measured in kWh/m²/year.

The minimum requirements of Building Regulations within this notional baseline express the above metrics as a 'Target' and are therefore prefixed with a 'T' (TER and TPER). Those for the proposed building are prefixed with a 'B' (BER and DPER), representing the building as modelled.

To report on the emissions from a Baseline scenario, a model was created of the proposed building with the minimum requirements for fabric and plant efficiencies based on those included within Approved Document L. This represents the emissions that would be emitted by the proposed building if it were constructed to the minimum requirements of Building Regulations Part L.

The development of a baseline model like this allows the emissions reductions at each stage of the energy hierarchy to be demonstrated fully.

Calculations undertaken on the Proposed Development show the baseline emissions as presented below.

FIGURE 4: BASELINE EMISSIONS

KgCO ₂ /m ² /yr	TFA	TonnesCO ₂ /year
5.62	1714.2	9.63

LEAN: DEMAND REDUCTION MEASURES

In line with the Energy Hierarchy, Passive and Active efficiency measures have been prioritised to reduce energy use and emissions.

Both Passive and Active measures have been considered as part of the design process.

Passive measures are elements of the design and construction which limit heat losses and therefore energy use and emissions.

Active measures are technological systems and equipment which, whilst using energy, save more than they use to enhance the efficiency of the building as a whole.

Passive Design Measures

The following U-values have been used as the basis for the energy calculations:

TABLE 1: PROPOSED FABRIC U-VALUES SUMMARY

Passive Item	Proposed U-Values	Part L min. req. U-Values
External Wall	0.14	0.26
Ground Floor	0.14	0.18
External Door	1.60	1.60
External Window	1.20	1.60
Roof	0.10	0.18
Roof Lights	2.20	2.20
Air Permeability	<3.0 m ³ /hr/m ²	<8.0 m ³ /hr/m ²

As a whole, the building is to be highly insulated beyond the minimum requirements of Building

Regulations Part L - as illustrated above - to reduce heat loss and minimise the heat demand of the building. These improved fabric components will work in conjunction with a significantly reduced building air permeability to assist in the reduction of heat losses and associated emissions generation.

Construction at this stage is expected to be of a steel frame type. The development makes good use of thermal mass within the building with concrete floors and masonry incorporated within the external wall build out – balancing the management of internal overheating during the summer period, and high response heating in the winter.

Thermal bridging – whilst not considered in regulations calculations for non-residential spaces – will be considered at the design stage to ensure that heat losses here are minimised as far as practicable.

Active Design Measures

As the building is a heavily serviced environment – due to use and occupation density – active design measures will be maximised to minimise energy use.

To maximise the efficiency of the building as a whole and provide the level of comfort and air changes needed within specific areas, a combination of fully managed mechanical ventilation, and hybrid ventilation systems are proposed in various spaces throughout the building.

Mechanical ventilation, where installed, is a fully managed system that provides controlled air changes within a space. Through the use of heat exchangers, it ensures efficient ventilation while maintaining good indoor air quality and reducing energy losses.

Natural Ventilation with Heat Recovery (NVHR) - also often referred to as hybrid systems - provide controlled ventilation by combining natural airflow with heat recovery technology. They allow fresh air to enter the space while recovering heat from the outgoing air, maintaining indoor air quality and comfort while reducing heat losses and improving overall energy efficiency. A mechanical fan is provided to enhance ventilation rates where the natural input cannot meet requirements.

The majority of the building utilises hybrid ventilation, with some elements of mechanical ventilation where required.

Lighting is also being enhanced through the use of high efficiency fittings and lighting controls to ensure that lighting is only in operation when and where required, and is using energy efficiently. Whilst the lighting design is yet to be fully finalised, a minimum lighting efficacy of 100lm/W has been proposed at this stage.

Heating (and cooling) controls will also be optimised with rooms stats and a centralised timer control to ensure rooms are conditioned only where and when required.

A summary of the emissions reductions as a result of these measures is provided below:

FIGURE 5: LEAN EMISSIONS

KgCO ₂ /m ² /yr	TFA	TonnesCO ₂ /year
2.81	1714.2	4.82
Reduction over Baseline		49.95%

The combination of both active and passive efficiency measures within the building – including enhanced fabric, ventilation, lighting and heating/cooling controls act to significantly reduce the modelled emissions from the building with a **49.95% reduction** evident from the implementation of these measures alone.

NOTE: Building Regulations Part L Compliance is achieved through efficiency measures only.

ACTIVE COOLING AND THE COOLING HIERARCHY

Within highly serviced and mechanically ventilated buildings the use of cooling cannot always be avoided. This is based on the need to control the internal environment of the building and manage air changes and temperature conditions – removing variables of external air flow and user intervention – ensuring the net zero carbon in operation target is achieved.

The use of this strategy to achieve NZC in operation has resulted in cooling being required in some areas to maintain comfortable internal conditions. However, its use will be limited by a number of passive measures which:

1. Reduces the amount of heat entering the building through orientation, shading, high albedo materials, fenestration, insulation and the provision of green infrastructure
2. Minimises internal heat generation through energy efficient design
3. Manages heat within building through exposed internal thermal mass and high ceilings
4. Provides Passive Ventilation opportunities where possible
5. Provides Mechanical Ventilation where natural ventilation is not possible or adequate.
6. Provides active cooling to spaces where needed, to maintain internal conditions.

CLEAN: HEATING INFRASTRUCTURE

'Clean' energy solutions prioritise the use of available, existing heating networks, community heating and combined heat and power where this is feasible to support and enhance the growing number of heating networks throughout the country.

District Heating Networks & Community Heating

The buildings location does not facilitate connection to any exiting communal networks within the surrounding areas or buildings.

Co-Generation

Whilst the use of cogeneration can be beneficial in some instances, heat load is typically required to be high and/or consistent for these to work effectively and efficiently. Due to the high levels of insulation installed within the properties, the heat loads are likely to be low and therefore the use of cogeneration is not deemed suitable in this instance.

In addition, the use of CHP on the site would utilise gas as fuel, going against the national directions of travel away from on-site fossil fuel combustion.

Building Level Systems

As a result of the above system analysis, the proposed development will implement a building level heating (and cooling) system utilising low and zero carbon technologies.

GREEN: LOW & ZERO CARBON TECHNOLOGIES

The Proposed Development intends to maximise opportunities in incorporating Low and Zero Carbon (LZC) technologies as part of its energy strategy in line with the requirements of local planning policy and Client desires for a Net Zero Carbon in Operation Building.

This section outlines the feasibility of a range of renewable energy technologies for the proposed development. The assessment considers each LZC technology for their viability by means of:

- Technical Feasibility
- CO₂ savings offered
- Other potential impacts

Local constraints, considerations and restrictions are also considered where these are thought to be relevant to the application of the technology.

Systems Discussion

The application of differing systems to provide heating, cooling and hot water to the proposed development has been discussed with the design team to ensure that any proposals not only meet the requirements of emissions reductions, but also form part of a comprehensive strategy on the site which meets the needs of the client, and is feasible both technically and financially.

The use of electricity throughout the site forms a key part of this strategy, and is in line with the general national direction of travel away from the burning of fossil fuels on site.

In initial discussions, the preference was for the use of electricity on the site as the sole source of power. This reduces connection costs associated with the running of gas from a suitable mains supply, and will enable the site to benefit from future grid decarbonisation whilst also emitting no on-site emissions.

Whilst the use of panel heaters or direct electric underfloor heating would be more cost effective to construct and install, this would not be beneficial to building operator, who would

experience higher utility costs. In addition, this approach would require additional renewable technologies to provide appropriate emissions offset to meet the Net Zero Carbon in Operation standard required. Therefore, a more appropriate strategy which balances the construction and budgetary constraints of the site and its visual outlook, client and planning aspirations has been proposed.

As part of the assessment, and brief summary of the unviable technologies for the site are outlined below.

UNVIALE TECHNOLOGIES

Biomass

A biomass system would offer a heating system fuelled by plant-based materials such as wood, crops or food waste. A biomass system would only be able to generate heating and hot water through the combustion of biofuels such as woodchip or wood pellets. These fuels offer a high energy content per unit of volume. Cooling, where specified, would be required via a separate system.

A biomass boiler occupies a larger floor area than a conventional gas-fired boiler with the additional requirement for locations to be provided for fuel storage. The burning of biofuels such as wood pellets expel exhaust gases which contain substantially more NO_x emissions and particulate matter than its gas boiler equivalents, which would have a negative impact on the local air quality and would be contrary general air quality guidance and the national direction of travel away from the burning of fossil fuels on site.

As such the use of this technologies is not deemed appropriate for this site based on location and use.

Solar Thermal

The use of solar thermal technology has the potential to provide emissions and energy offset through roof mounted panels. However, unlike PV (discussed below), the maximum limit for solar thermal is based on hot water load, rather than available installation space.

The use of solar thermal has the potential to provide additional heat input to the domestic hot water system, supplementing that provided by the main heat source. However, due to the sites location and outlook, the use of roof mounted technologies is not favoured on this site with the preference being for a system approach with minimal visual impact, which also maximises emissions offset where possible.

Ground Source Heat Pumps (GSHP)

Heat pumps in general use the compression and expansion of a refrigerant to generate useful heat which can be utilised for both space heating and hot water. Some heat pump systems can also be used for cooling where this is required. The use of heat pumps is becoming increasingly favourable due to reducing costs, and the increasing thermal efficiency of buildings making the application of the technology more viable. Generally, heat pumps either use air or the ground as the heat source dependant on site limitations.

The Coefficient of Performance of the system is the ratio of heat energy produced, relative to the electrical energy used to operate the heat pump. Typically this is 3:1 or 4:1 and is why heat pumps can be deemed as low carbon/renewable technologies, and how energy use and CO₂ emissions savings are made.

Due to the lower flow and return temperatures delivered through heat pumps, these are best accompanied by oversized radiators, underfloor heating and/or fan coil units to maximise heat emission at the point of use and ensure sufficient heat is delivered to maintain comfortable internal conditions.

Ground Source Heat Pump feasibility on the site is primarily predicated on the availability of space for a ground loop to be installed. These are usually located 1-2m below ground level and can require a large surface area – sometime 3 times that of the heated area of the dwelling – to allow effective and efficient use of this technology. The site plan would indicate that this would not be possible.

An alternative is that boreholes are provided, to allow the collection of heat via vertical

collection pipework. The use of boreholes is costly to install due to the pilling rigs needed for their drilling and installation. Therefore, the use of GSHP at this stage is not considered viable for this site based on the site location and immediate surroundings,

PROPOSED TECHNOLOGIES

In light of the above assessment, the following technologies are proposed to provide a comprehensive approach to emissions reductions, whilst recognising the technical, budgetary and physical constraints of the buildings location and design.

Air Source Heat Pumps (ASHP)

Whilst GSHP systems have been considered as not appropriate for the proposed development site at this stage, Air Source Heat Pumps are considered to be a more technically and financially viable option.

Air Source Heat Pumps work in a similar way to GSHP systems, but with the collector medium being the air. The heat from the air is collected via an external condenser unit which uses a fan (or set of fans) to drive air flow over the collector element. ASHP has the potential to provide heating, hot water, and cooling through a variety of system types. The technology of ASHP is rapidly developing, and can provide significant savings in emissions and energy use in the majority of applications without the high implementation costs associated with ground source applications.

There is a marginal drop in performance when compared to GSHP, but the lower capital costs of installation, and the greater flexibility of plant location and type also make ASHP a feasible option for the site.

The use of ASHP within the proposed development is proposed to supply heating and hot water required throughout the building. Heat will predominantly be delivered through the use of radiators.

The use of this technology will provide a non-intrusive solution to emissions reduction, which fits with conventional heating systems, and is capable of providing the majority of heating and hot water requirements, supplemented by

the efficiency measures outlined at the start of this assessment.

Due to the recent changes in the emissions associated with electricity associated with the rapid decarbonisation of the National Grid, and the high efficiency of heat pumps in general, the use of ASHP to provide heating and hot water for the proposed dwellings provides a large amount of emissions offset, with no impact on the general usability of the dwellings.

Through the use of improved active and passive efficiency measures, the Proposed Development meets Building Regulations Part L Compliance with the following BER/TER and BPER/TER.

TABLE 2: BUILDING REGULATIONS COMPLIANCE PERFORMANCE - NO PV

TER	BER	TPER	BPER
kgCO ₂ /m ² /yr		kWh/m ² /yr	
2.90	2.40	30.84	25.33

Based on the above, there is **not a need further renewable or low/zero carbon technologies required to meet Building Regulations Part L**. However, the following technologies do have a potential for installation.

The application of the efficiency measures and the use of a heat pump results in the following emissions reductions.

TABLE 3: GREEN EMISSIONS – ASHP ONLY

KgCO ₂ /m ² /yr	TFA	TonnesCO ₂ /year
2.40	1714.2	4.12
Reduction over Baseline		57.22%
Reduction over Lean		14.52%

Photovoltaic Panels

Photovoltaic (PV) panels are a popular method of harnessing energy from the sun to provide some – if not all – electrical demand through renewable energy generation.

Typically, panels are roof mounted and the proposed development does have a large expanse of flat roof where these can be located, in addition to the potential for panels to be installed on adjacent buildings to further offset energy use and emissions.

PV panels are available in an array of output sizes, dependant on the emission offset required, electrical requirements, and the budget available for their purchase and installation. A typical panel is of approximately 400W peak output, and measures approx. 1m x 1.75m in size.

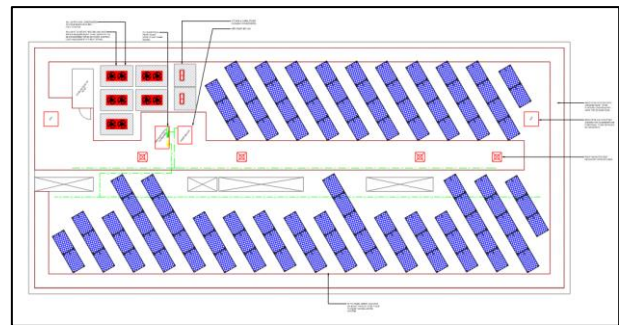
In this instance a panel of **425W peak** output has been used as part of the modelling process with all PV proposed as south facing with 30 deg. tilt for optimum performance.

In general, panels are arranged in series and connected back to the building via an export compatible meter system. This allows the PV to provide power where there is demand for it, with any excess being stored on site within potential battery storage, or exported to the National Grid in return for payment back to the building owner by the energy supplier.

The proposed development has approximately 925m² of flat roof. However, with some allowance for plant space, roof lights and a 1m stand off from the perimeter this leaves approximately 650m² of roof space available for the application of PV.

Based on an initial calculation, this allows the potential for up to 101 no. PV panels to be installed on the roof.

FIGURE 6: INDICATIVE PV LAYOUT



Additional PV is required to reduce to meet the Net Zero Carbon in Operation requirement for the building, with calculations (discussed further, below) indicating that a total of **94no. panels will be required (south facing, 30deg pitch) to offset the remaining emissions.**

ENERGY STRATEGY SUMMARY

It has been shown that through a combination of enhanced efficiency measures – improved building fabric, glazing, lighting and ventilation systems – and the incorporation of ASHP to supply heating the proposed development can meet and exceed Building Regulations Part L requirements.

Supplementary PV is to be included on the available roof space to further offset emissions with 94 no. 425W PV panels proposed to offset all regulated and unregulated emissions – this is explained further in the next section.

The below table shows a summary of the emissions reduction from each stage of the energy hierarchy based on Building Regulations Part L (SBEM) modelling.

TABLE 4: REGULATED EMISSIONS REDUCTION SUMMARY

Stage	TonnesCO ₂ /year	Reduction
Baseline	9.63	
Lean	4.82	49.22
Clean	4.82	0.00
Green	-0.4	104.15

The above shows that the proposed building specification offsets all regulated emissions as calculated through SBEM (Building Regulations Part L) calculation methodology.

The following section details the calculated of both regulated and unregulated emissions based on dynamic thermal modelling, and the emissions offset through this method to prove Net Zero Carbon in Operation compliance.

Net Zero Carbon in Operation

The Proposed Development is also required to meet the planning requirements for a Net Zero Carbon in Operation.

Whilst the assessment in the previous section of the report (Energy Strategy) focusses on the reduction of regulated emissions, and models these in accordance with Building Regulations Part L Compliance, further emissions are produced by the buildings operation, which is not included within these calculations.

As such an additional modelling exercise has been undertaken in accordance with CIBSE TM54, which enables accurate modelling of the buildings operational energy use and subsequent emissions. This assessment is able to predict operational energy consumption based on realistic occupancy patterns, system performance, and climatic conditions.

Regulated Emissions: the emissions released from a building as part of the operation of regulated plant and fittings to provide heating, ventilation, cooling and lighting

Unregulated Emissions: The additional emissions released from the buildings operation based on use profiles – such as small power, lifts – to give a realistic estimation of the buildings total energy use (and therefore emissions) during operation.

Net Zero Carbon in Operation requires all regulated AND unregulated emissions to be offset on site.

CALCULATION METHODOLOGY

Modelling for the whole building has been undertaken within IES Virtual Environment with enhanced modelling through Version 7.0.17.0 of the Apache Calculation Engine. This methodology is developed to be more detailed than traditional SBEM modelling which would be undertaken for Building Regulations Compliance. This allows a greater degree of detail and flexibility to be included within the modelling.

The broad methodology for the modelling and results is based on 'CIBSE TM54 Evaluating Operational Energy Performance of Buildings at the Design Stage'. CIBSE TM54 is a Technical Memorandum focussed on predicting operational performance modelling at design stage, and the calibration of models for evaluation of energy in-use to provide an accurate performance of new buildings. TM54 outlines the approach adopted by CIBSE to provide a practical framework to undertake building energy modelling at design stage to improve as built building performance, bridging the performance gap.

The assessment results will be compared to benchmark figures for anticipated energy use from CIBSE guidance TM46 (Energy Benchmarks) and CIBSE Guide F (Energy Efficiency in Buildings), for standard energy efficiency in buildings. This TM54 assessment will compare the anticipated energy usage from the design model, with the 'typical' and 'good' energy benchmark figures outlined within the CIBSE Guidance.

As summarised below, TM54 outlines structured criteria to identify an understanding of procedures to undertake an effective modelling and validation exercise:

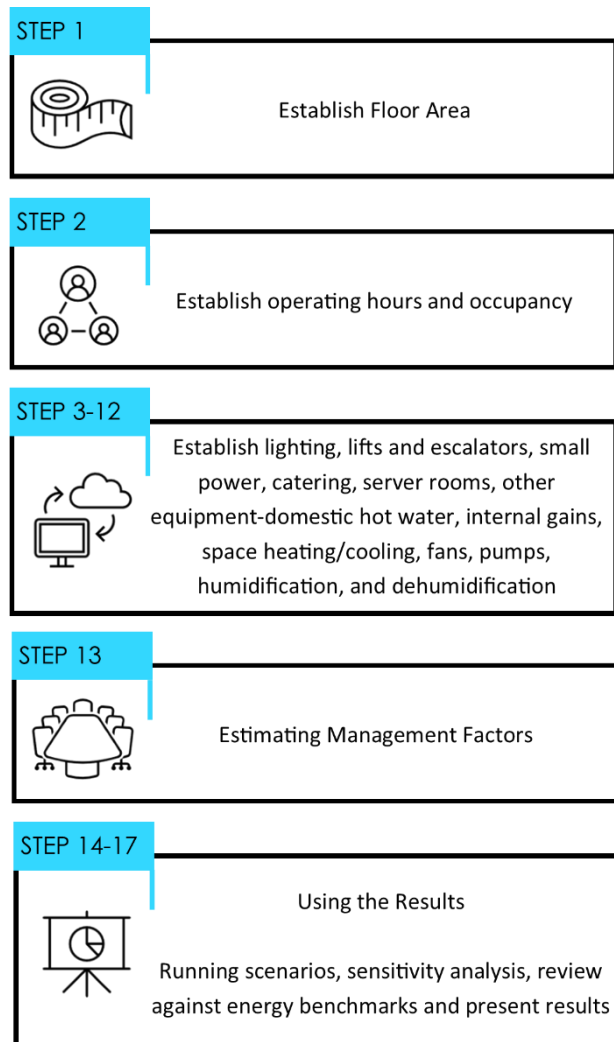
- Modelling approaches and their potential impact on the performance gap
- Validation of calibrated energy simulation models
- Evaluation of energy performance in-use and identify causes of the performance gap.

The modelling procedure undertaken by Futura Bright Ltd follows the following strategy:

- **BUILD:** Construct an appropriate and accurate model with IES Virtual Environment.
- **CALIBRATE:** Utilising information on how the building will be used, using industry guidance and reflecting this 'real life' performance within the model.
- **MODEL:** Run the modelling results within Apache Calculation Engine to confirm energy use.
- **IMPROVE:** Improve the model based on Client specified criteria and re-run the calculations to measure and document improvements.

To ensure an accurate as designed model (reflecting in-use operation) is achieved, a dynamic 3D model was produced within IES VE, in accordance with CIBSE AM 11.

FIGURE 7: METHODOLOGY FOR EVALUATING OPERATIONAL ENERGY AT THE DESIGN STAGE



It should be noted that the calculations within a TM54 Assessment are still estimates, and results will only show Net Zero Carbon in Operation for the design as it is proposed. Actual operational figures may vary dependent on use.

After 1 no. year of operation, a post construction assessment could be carried out (a TM63 Assessment) which will better reflect real life conditions, and allow the strategy to be amended based on real-time use.

SOFTWARE

A simulation model has been built for the purposes of making a suitably accurate

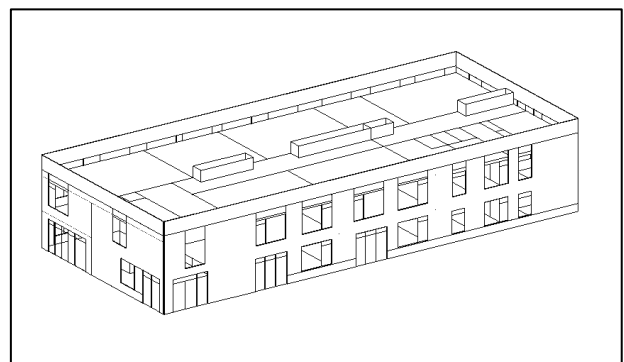
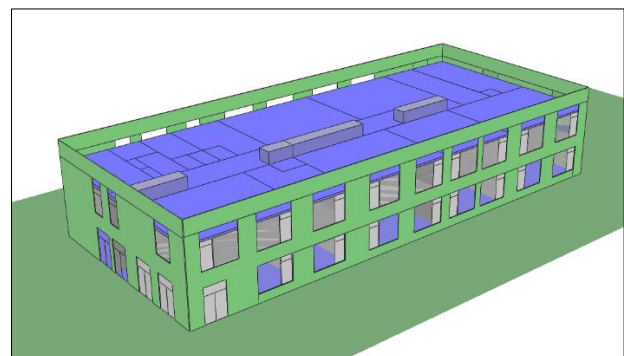
Energy Strategy and Net Zero Carbon in Operation

prediction of the building's future energy consumption. This includes consideration of the building location, massing, envelope, thermal loads, system efficiencies and other energy consuming systems.

The geometry of the model has been built in IES VE 2025 and analysed with the Apache simulation module. This program is fully accredited under CIBSE TM33.

Computer building simulation provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all of the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone.

FIGURE 8: 3D RENDER OF THE IES MODEL



DESIGN SPECIFICATION

As part of the modelling process, the dynamic model was constructed in accordance with the building systems included within the Energy Strategy above, supporting MEP specification, in line with the requirements of the National Calculation Methodology (NCM).

ACTIVE SYSTEMS AND BUILDING SERVICES

High-efficiency systems were specified to support low carbon emissions while ensuring indoor comfort. These include:

Heating and Cooling:

The building is equipped with high-efficiency air source heat pump systems, predominantly, delivering:

- Heating efficiencies of up to 3.2 COP.

Hot Water Generation:

- Provided via proposed ASHP system with COP of up to 2.65

Ventilation:

- A combination of local mechanical ventilation systems, hybrid ventilation systems and MVHR is proposed throughout the building.

Lighting:

- Lighting achieves a high luminous efficacy of 100 lm/W as a minimum, with a mixture of manual and

TM54 USE MODELLING

As part of the TM54 Assessment the design-stage operational energy consumption was reviewed using the Part L energy model. This involved adjusting user profile patterns in line with National Calculation Methodology (NCM) guidance, applying anticipated occupancy profiles to better reflect the building's expected real-world energy performance. The results were then compared against industry benchmarks, Part L predictions, and TM54 modelling scenarios.

The simulation established energy demands across a broad spectrum of operational categories, with input parameters derived from a combination of:

- NCM Modelling Guide (current version)

- BRUKL output (Apache, IES Virtual Environment v7.0.28)
- Manufacturer data where available
- CIBSE benchmarks and guidance (Guide F)

The following steps were taken:

Establish Operating Hours and Occupancy Factors

The occupancy profiles have been developed based on anticipated actual building usage data, in conjunction with National Calculation Methodology (NCM) guidance for school buildings. Standard profiles for the primary occupied areas have been set according to expected usage patterns.

The HVAC and equipment usage schedules align closely with the building's occupancy profile.

Lighting

Lighting efficacy and power densities have been aligned with the BRUKL data, applying an efficacy of 100 lm/W across all areas. This establishes the W/m² values based on the specific floor areas. Lighting energy consumption has been calculated using the NCM methodology, with allocations based on the corresponding W/m² derived from the 100 lm/W efficacy.

Occupancy profiles and control strategies, such as presence detection and daylight dimming, were factored based NCM schedules for school use and proposed controls by the MEP consultant and Client.

Lifts & Escalators

Energy use for lifts was estimated following the CIBSE benchmark Guide F for Typical office buildings.

The lift energy consumption has been calculated based on the number of floors and daily runs based on the assumption of an 6-8 person lift occupancy.

Small Power & Equipment

Small power loads were derived using CIBSE Guide F benchmarks, accounting for:

- General office equipment
- Lab energy use and ventilation where required.

- Electronic display devices in teaching spaces
- Small power use by pupils in line with NCM recommendations.

Load diversity and management factors were applied to reflect real-world operational patterns.

Catering

There is no major catering loads within in the building. Small power loads have been accounted for where required.

Server Rooms

Equipment loads have been assumed based on NCM guidance for a facility of this type.

Domestic Hot Water (DHW)

The hot water demand was modelled based on the system specified in the BRUKL with usage based on NCM schedules for school use.

Internal Gains

Occupancy, equipment, and lighting gains were modelled according to NCM standard profiles for school environments based on the room type and expected occupancy profiles.

Typically 32 no. people per classroom has been used as a basis for gain calculations.

Space Heating and Cooling

Heating and cooling demands were based on the ASHP systems identified in the BRUKL:

- Heating COP has been set at 3.2.

Usage has been based on NCM schedules for school use for the times of operation expected.

Fans and Pumps

Specific fan powers (SFP) and pump energy were established from the BRUKL data and aligned with NCM guidance.

SFPs for ventilation systems ranged from 0.1 to 1.5 W/l/s, consistent with compliance modelling outputs.

Usage has been based on NCM schedules for school use for term time operation.

Humidification & Dehumidification

No humidification or dehumidification energy has been accounted for.

ENERGY COMPARISON

A comparison has been undertaken between the results highted by the Building Regulations Compliance Modelling as part of the Energy Strategy (above) and the advanced TM54 modelling to determine Net Zero Carbon in Operation.

TABLE 5: 'REGULATED' AND 'TOTAL' ENERGY USE
COMPARISON

'Regulated' Energy Use (Building Regs)	'Total' Energy Use (TM54)
16.46 kWh/m ² /year	21 kWh/m ² /year

As can be noted from the above, regulated energy accounts for 78% of the total predicted energy use of the building based on amended building profiles adjusted in accordance with the Clients expected building use practices.

The high density of occupants, and the expected processes to be undertaken within the building result in the unregulated energy use contributing significantly to total energy use of the building, and therefore the total anticipated emissions.

OFFSET TO NET ZERO CARBON IN OPERATION

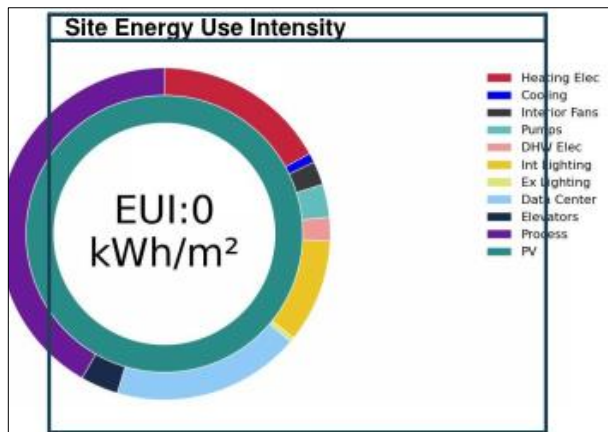
As a result of the above analysis, renewable energy technologies will be required to be specified to achieve the net zero carbon in operation target.

Solar PV

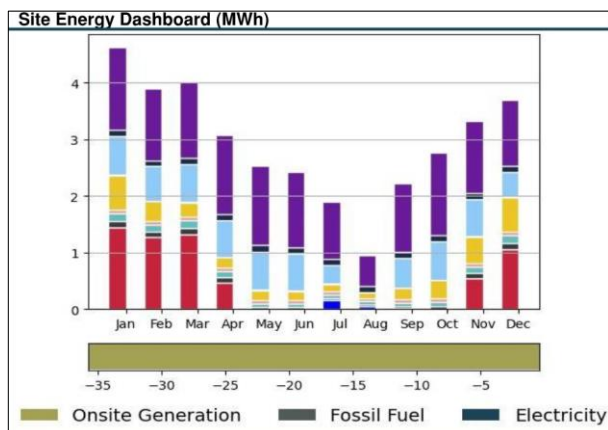
As outlined within the Energy Strategy above, the use of Solar PV is the preferred method of offsetting the total energy use within the building.

Initial calculations suggest that the total PV needed to achieve this, under optimal conditions (south facing, ~30 deg. Pitch) is **39.95kWp – 94no. 425W panels**, which is achievable given the current roof layout. See Figure 6 above.

FIGURE 9: LIKELY USE ENERGY REPORT



Annual Energy Consumption (kWh/m²/year) & CO2 kgCO2/m²/yr			
Energy End Use	Site Energy	Source Energy	CO2 Emissions
Heating Fossil Fuel	0.0	0.0	0.0
Heating Electricity	3.7	5.9	0.6
Space Cooling	0.2	0.2	0.0
Fans Interior	0.5	0.7	0.1
Heat Rejection	0.0	0.0	0.0
Pumps	0.7	1.1	0.1
DHW Fossil Fuel	0.0	0.0	0.0
DHW Electricity	0.5	0.7	0.1
Interior Lighting	2.2	3.3	0.3
Exterior Lighting	0.1	0.1	0.0
Receptacle	0.0	0.0	0.0
Data Center	4.0	6.1	0.6
Cooking Fossil Fuel	0.0	0.0	0.0
Cooking Electricity	0.0	0.0	0.0
Elevators & Escalators	0.8	1.2	0.1
Refrigeration	0.0	0.0	0.0
Process	9.1	13.8	1.3
TOTAL (ex renewables)	21	33	3



As is evident from the Energy Use Intensity (EUI) displayed being zero, the application of PV on the building enables Net Zero Carbon in Operation to be achieved.

Conclusions

Dynamic modelling has been undertaken on the proposed new school science building at Sarum Academy, Salisbury, to determine the performance requirements of the building to meet Building Regulations Part L and Net Zero Carbon in Operation requirements.

Calculations show that through the adoption of an enhanced building fabric, advanced ventilation and associated controls, and efficient lighting, in addition to the use of air source heat pumps for heating and hot water provision, the proposed building is able to meet Building Regulations Part L compliance.

Further calculations have been undertaken to calculate the buildings operational energy use, to enable appropriate renewable energy technologies to be specified to meet the Net Zero Carbon in Operation requirement set by the Local Authority.

In total, it has been calculated that a total of 94no. 425W PV panels will be required to offset all remaining emissions from the building, resulting a net zero carbon operation.

Measurements indicate that this can be installed on the roof of the proposed building with optimal orientation and pitch, resulting in all regulated and unregulated emissions being offset on site.

Overall, the buildings proposed design and specification takes a robust approach to efficient design, utilising modern and effective heating and ventilation plant to limit energy use and emissions. The design has the potential through the use of PV to achieve net zero carbon in operation standards.



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