

ENERGY STATEMENT

Goetre Primary School

The following document is a compilation of design intent documents that;

- *Sets out the projected annual energy demands for heat and power from the proposed development against the appropriate baseline along with the associated CO₂ emissions.*
- *Demonstrates how these demands have been reduced via energy efficiency or low carbon energy sources and sets out the CO₂ emissions associated with the residual energy demand, and*
- *Considers the viability and technical feasibility of renewable energy technologies to reduce these demands.*

Comprising the following RIBA Stage 3 documents.

- **MEP Engineering Services RIBA Stage 3 Report**
- **TM54 Operational Energy Assessment**
- **Building Regulation Part L2 Compliance Report**

February 13

WSP UK Ltd.



Morgan Sindall Construction

Goetre Primary School

MEP Engineering Services RIBA Stage 3 Report

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Morgan Sindall Construction

Goetre Primary School

MEP Engineering Services RIBA Stage 3 Report

Merthyr Tydfil County Borough Council

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1 EXECUTIVE SUMMARY

1.1 SCOPE

WSP have been appointed by Morgan Sindall to undertake the Building Services Engineering design for the newly proposed Goetre Primary School. The site is located immediately to the south of Pen y Dre High School in Merthyr Tydfil.

This report has been prepared to describe the strategic and technical briefs for the proposed Environmental, Mechanical, Electrical and Public Health Engineering Systems (MEP) solutions for the proposed school.

The scheme is aspiring to achieve Net Zero Carbon in operation. This will be achieved by the use of high performing building fabric combined with low energy MEP services for the heating, ventilation, domestic hot water and lighting. Systems will be designed to maximise energy recovery where possible, while taking into consideration the overheating and operation of the building. The building will be operated on an “all electric” principle with no reliance on fossil fuels on site. The electrical energy use on site will be offset by the use of photovoltaics to generate power on site over the course of a year.

The strategies detailed in this report will be developed further during the detailed design stage and in conjunction with any future stakeholder discussions.

The following outlines a MEP philosophy which is based on our extensive experience in school design and feedback from clients on completed schools.

1.2 NOMENCLATURE

Items in red text are to be confirmed with the client.

Items in blue text are to be confirmed by the design team.



SUSTAINABILITY STATEMENT

2.1 ENERGY AND CARBON DIOXIDE EMISSIONS

The overall carbon dioxide emissions associated with the development will be minimised through the use of passive design and optimisation, intelligent controls, high efficiency MEP systems and low and zero carbon renewable energy systems where appropriate and whilst ensuring compliance and best practice in accordance with the regulations.

The energy demand of the building is being developed with consideration to the fabric of the building, MEP systems and their operational use.

2.2 MONITORING OF ENERGY USE

Energy use throughout the building will be monitored to enable the occupiers to control and reduce energy consumption. This will be provided by the use of a suitable control system and energy metering facilities.

2.3 WATER EFFICIENCY

Water meters will be used throughout to monitor water use, leakage and opportunities for consumption reductions as well as billing purposes.

2.4 CLIMATE CHANGE ADAPTION & GREEN COVER

There will be design actions taken to consider the effects of climate change and impacts upon the building environment and occupants. Some examples of considerations that are being reviewed are:

- Use of LED lighting with low heat output
- Adequate insulation of hot water and heating pipework and minimising of dead-legs to offset heat loss/gains.
- Future overheating mitigation.
- Allowances to increase or modify plant with minimal disruption.
- Decentralisation of services for future flexibility.

2.5 AIR QUALITY

There will be consideration given to the chosen plant and equipment within the building to mitigate and minimise any pollution sources, that could reduce air quality within and around the building.

Measures will be taken to ensure a suitable indoor air quality is achieved for the building and the areas therein.

Consideration during construction will also be adopted to ensure that emissions from site will be controlled and within acceptable limits. The areas of consideration during construction will be as a minimum:

- Air quality
- Noise
- Light pollution
- Water pollution and waste

2.6 UK BUILDING REGULATIONS PART L NARRATIVE

As a new non-domestic building in Wales, the development is required to demonstrate compliance with the requirements of UK Building Regulations Approved Document Part Volume 2 (2022 Welsh edition).

Compliance of Building Regulations AD Part L Volume 2 will require further dialogue with Building Control and/or an Approved Inspector to confirm.

2.7 BREEAM

It is understood that the school is to be designed to achieve BREEAM “Excellent”. WSP have been engaged in the BREEAM process from the start of the design process to inform targetable credits to help ensure that BREEAM Excellent can be achieved. WSP have significant experience in BREEAM Excellent schools.

2.8 SECURED BY DESIGN

The electrical systems will be designed such that they are coordinated with the secure by design strategy. This will include CCTV, security, access control, lighting etc as required.



2.9 MAINTENANCE

The ability to maintain building services is critical to the operation of a building after construction. All services will be specified so that they can be suitably maintained. In addition, this will prioritise the requirements under CDM to remove maintenance risks wherever possible.

Plant will be located to ensure adequate maintenance space is provided and all equipment can be serviced in accordance with the manufacturers' recommendations. Easy, safe access must be provided to all plant and equipment as required for normal operation and routine maintenance. All plant will be located in areas that can be accessed directly from communal areas.

3 ENERGY STRATEGY

3.1 NET ZERO CARBON

The UK Government’s ambition to move towards a low carbon economy has seen the implementation of a number of national policies for new and existing developments. These policies have been subsequently passed down through regional and local policies and often form part of the minimum requirement for any major work.

‘Sustainable Communities for Learning’ (formerly 21st Century Schools) requires all new build and major refurbishment projects to be designed and delivered to achieve Net Zero Carbon in operation, and a 20% reduction in embodied carbon.

DEFINING NET ZERO CARBON

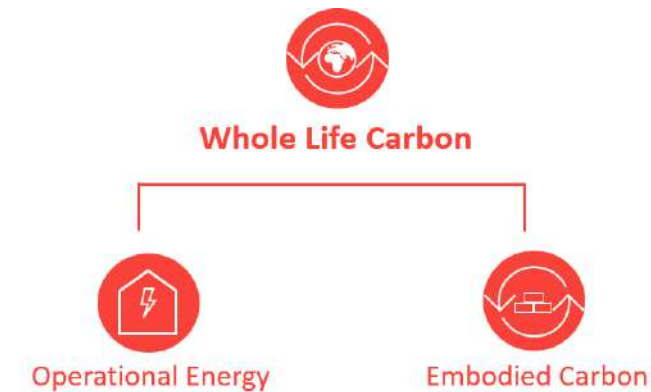
There are two principal definitions of Net Zero Carbon buildings across the UK construction industry at present, the first is from the UK Green Building Council (UKGBC), and the second is from the London Energy Transformation Initiative (LETI), both definitions of which refer to NZC in terms of operational energy and embodied carbon, with both frameworks requiring Whole Life Carbon assessments to be undertaken.

During the design stages of the neighbouring Pen Y Dre High School, the project team evaluated the pros and cons associated with both the UKGBC and LETI definition of NZC and whilst aspects of both definitions will be incorporated within the design, the project team’s preference was to utilise the UKGBC NZC (Operational Energy) definition, namely:

When the amount of carbon emissions associated with the building’s operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.

3.2 A WHOLE LIFE CARBON APPROACH

In recognition of the ongoing carbon impact associated with the operation of the building in use, and in accordance with UKGBC approach, the project team will take a Whole Life Carbon approach to NZC.

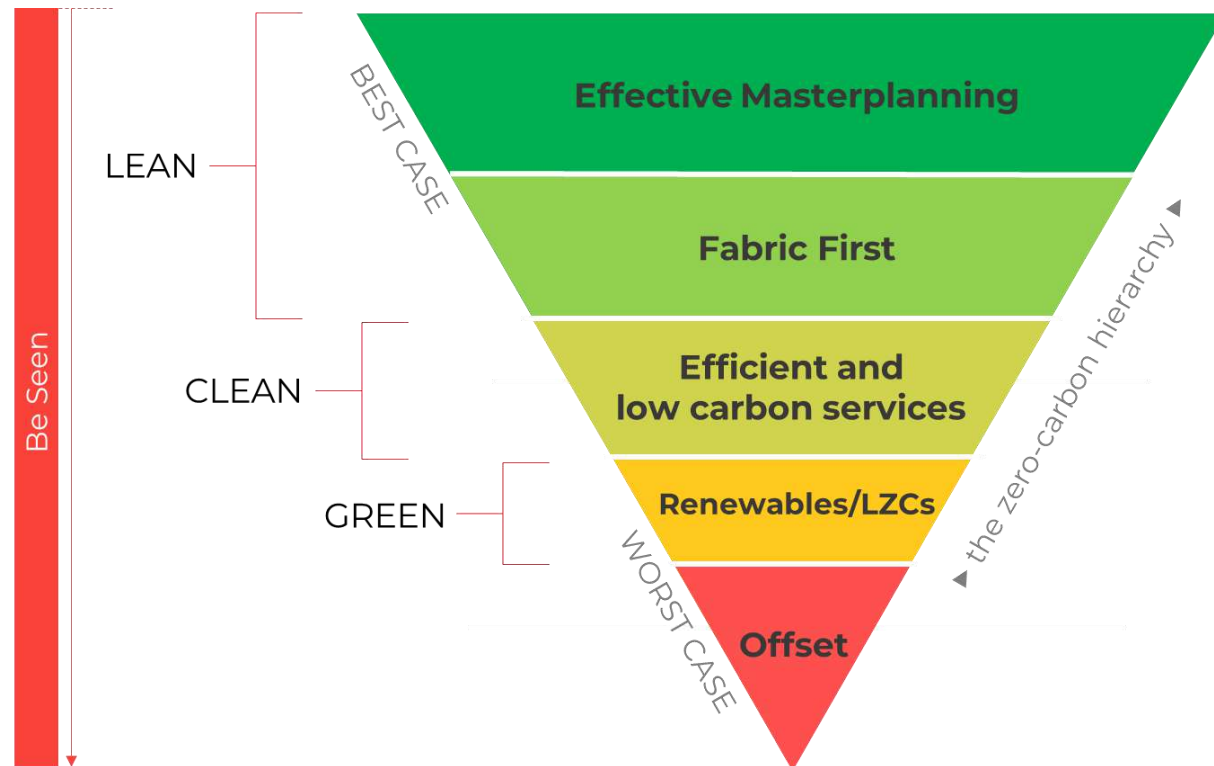


The Whole Life Carbon approach takes into consideration carbon emissions over a 60-year period associated with the operational energy consumption of the building. In addition, the Whole Life evaluation includes the impact of embodied carbon (assessment undertaken by others) over a 60-year period referred to as a Life Cycle Assessment (LCA) associated with the production, installation, maintenance and replacement, and processes at end of life of all proposed building components. Assumptions will be made regarding grid decarbonisation scenarios to 2050. Our approach is fully aligned with latest NZC guidance including, UKGBC, and RICS Professional Statement.

OPERATIONAL ENERGY

Operational energy refers to the energy consumed by a building associated with heating, hot water, cooling, ventilation, and lighting systems (regulated energy), as well as small and specialist equipment (unregulated energy). Accordingly, operational carbon represents the quantity of carbon emissions linked to the building’s operational energy usage.

WSP has decided to propose the adoption of an ‘Energy Hierarchy’ to the design of new and existing buildings. This is designed to be an effective design framework aimed to design better performing buildings. This hierarchy is developed to offer greater flexibility to the design team but at the same time, it offers a structured and efficient with the main aim to drive down the primary energy demand for new and existing building so to support the national efforts to reduce the carbon emissions of the built environment.

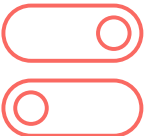


Energy Hierarchy	
BE LEAN	By implementing passive and active measures, it is possible to achieve a substantial decrease in the heating and cooling requirements of the building. The initial action should involve building geometry & massing optimisation collaborating with the architects by using parametric simulation. Improving the building fabric to decrease heat loss, followed by the implementation of functional building services to lower the base building load and energy demand.
BE CLEAN	After reducing building’s energy demand through the application of energy efficiency measures, we look to the source of the energy to be

Energy Hierarchy	
	consumed. It is our ambition to provide a scheme which does not rely on gas, or other fossil fuel, to meet the heat demand. A new building with net zero operational carbon does not burn fossil fuels, is 100% powered by renewable energy and achieves a level of energy performance in-use in line with recommended climate change targets. Energy efficiency is the focus in the design of the building services.
BE GREEN	The feasibility of a range of Low and Zero carbon Technologies (LZC) have been assessed in the context of the project. As well as the presently available viable options like photovoltaics and heat pumps, it is advisable to explore the viability of the other systems in greater depth during the subsequent design stages.
OFFSET	Finally, the school should consider allocating a budget to cover the potential offset payments required to offset the remaining carbon emissions.

BE CLEAN - BUILDING SERVICES DESIGN

Efficient building systems help the building to be fully functional and they can help reducing the base building load and energy demand. The following systems are proposed for the current design:

Element	Plant	Design rationale
	Mechanical ventilation with heat recovery (MVHR)	All occupied spaces are recommended to be served by MVHR units with a heat recovery seasonal efficiency of 80% and achieve a low specific fan power (SFP). Decentralising the ventilation plant allows for demand control which minimises energy use to only when it is needed.
	Decentralised “point of use” electric hot water generation	Circulating hot water loops and large storage volumes are a significant source of thermal energy loss. Pipe lengths are reduced, and storage volumes minimised.
	Lighting control	Lighting energy consumption can be reduced with the use of presence detecting and photoelectric sensors. All the building spaces to be provided by absence detection control except cabins where occupant manual control has been applied.
	Lighting power	High efficiency lighting should be provided throughout to significantly exceed the minimum requirements of the non-domestic building services compliance guide. This includes the use of high efficiency LED luminaries.

As part of this process, bespoke assessments in line with the CIBSE TM54 methodology shall be undertaken at each design stage so to confirm the achieved performance and to evaluate potential design changes.

BE GREEN - CURRENT AVAILABLE TECHNOLOGIES

Low or zero carbon technologies (LZT) are defined as all those systems that can generate energy both on-site and off-site. Heat Pumps (HP) are also part of this category, and their impact is evaluated within this chapter. Generally, renewable energy technologies can provide a source of energy that is not primarily based on the consumption of fossil fuels.

In accordance with the project requirements and feasibility, a number of LZT have been evaluated and the pros and cons have been presented.

AIR SOURCE HEAT PUMP (ASHP) 	A device which uses heat pump technology to provide heating and cooling, using electricity as a power source. Can be either ‘air-to-water’ or ‘air-to-refrigerant’
	PROS - Can serve a significant proportion of heating for certain types of buildings, including schools, offices, airports, sports facilities etc; - Can generate heat and chilled water with a seasonal coefficient of performance > 300%, with favourable conditions; and - It can gradually reduce the carbon footprint of the building thanks to the further de-carbonisation of the electricity grid.
	CONS - Not always effective at providing heat during periods of exceptional cold weather (<-10°C); - Rooftop plant / external plant requirements. - Not fully renewable since it uses fossil-fuel derived electricity with a high carbon factor. This factor, however, is expected to reduce significantly with the de-carbonisation of the grid; and - Can be more expensive to run, due to the higher tariff of electricity.

GROUND SOURCE HEAT PUMP (GSHP)



Similar to air source heat pumps this technology uses electricity to provide heating and/or cooling for buildings. Ground source heat pumps use the ground as the heat exchanger as opposed to the air

PROS

- Can serve a significant proportion of heating and cooling demands for certain types of buildings, including offices, hospitals, sports facilities etc.
- Can generate heat energy and chilled water with a seasonal coefficient of performance > 400%.

CONS

- Expensive solution due to the costs associated with excavating boreholes – typically £5-10k per borehole (providing around 5 kW heating and cooling each);
- Potential problems associated with installing pipework deep underground, due to leaks/ blockages.

At this site – high risk of hitting historic mining tunnels / shafts during works. Payback period can be long (40-60 years).

WATER SOURCE HEAT PUMP



Similar to air source and ground source heat pumps, this technology uses electricity to provide heating and/or cooling for buildings. Water source heat pumps use a body of water (a dock, for example) as the heat exchanger as opposed to the air or ground

PROS

- Can serve a significant proportion of heating and cooling for certain types of buildings, including schools, offices, airports, sports facilities etc; and
- Can generate heat and chilled water with seasonal coefficient of performance of up to 800%.

CONS

- Can only produce heat up to around 45°C, therefore hot water usually has to be boosted using other technologies.
- No local bodies of water close to this site makes its use unfeasible.

Licences may require (for open abstraction) to extract from/ discharge to water bodies (local Environment Agency for example) which can be a long process.

PHOTOVOLTAICS



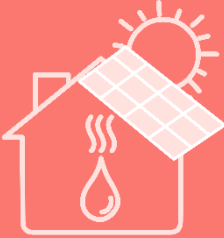
Panels or sheets which can generate electricity directly from sunlight, which can be installed on the roofs or facades of buildings, or as a standalone 'array'.

PROS

- Fully renewable (energy generated is from sunlight)
- Can offset a significant proportion of the building's electricity consumed.
- Can be installed on the roof of the building(s)
- 'Spare' electricity can be exported/sold back to the local distribution network (national grid), providing this is arranged and the correct equipment is installed. Surplus can also be stored if battery storage is provided.
- Electricity generation profile from PVs matches a school's occupancy profile, so most of the energy can be consumed on site.

CONS

- A significant area of clear, unshaded roof space is typically required with access for cleaning and maintenance.

SOLAR THERMAL COLLECTOR (WATER HEATING) 	Collectors which generate heat directly from sunlight can be installed on the roofs / walls of buildings to contribute towards satisfying the domestic hot water demand
	PROS - Fully renewable (energy generated is from sunlight). - Can reduce a building's hot water demand by up to 50% and be installed on the roof of the building. - Could generate income through Renewable Heat Incentive payments.
	CONS - A significant area of clear, unshaded and optimally orientated roof space is typically required with access for cleaning and maintenance. - Normally ineffective during winter and periods of cold weather. - Requires centrally generated, stored and distributed heat for hot water provision.

BIOMASS BOILER 	A type of boiler which typically uses wood chips, pellets or logs to heat water for space heating and domestic hot water, although other sources of biomass can be used
	PROS - Typically considered renewable (providing sustainable forestry techniques are used and locally sourced). - Can provide very low carbon heating given an appropriate location, within 30-40 miles of a sustainable woodchip source and with suitable access for deliveries and storage.
	CONS - Potentially high maintenance, particularly if woodchip is used - Not particularly effective when high cooling loads exist on the site – an alternative technology such as ground source heat pumps could serve heating and cooling loads with a single technology.

OTHER TECHNOLOGIES CONSIDERED	TECHNOLOGY	COMMENTS
	Fuel cells	No particular benefit to be gained. Sourcing hydrogen gas could be challenging.
	Wind turbines	Fully renewable, but not appropriate to the site or location.
	Anaerobic digestion	Lack of sufficient/suitable feedstock (organic waste). Space and maintenance intensive, therefore not appropriate to the development.
	Micro-hydro generation	No suitable moving water body available locally (waterfall for example).

EMBODIED CARBON

Traditional climate change mitigation efforts for buildings have prioritised the reduction of carbon emissions from operational energy consumption. However, with the improvements in building energy efficiency and the transition to decarbonised electricity, embodied carbon is projected to become a more significant contributor to a building's whole life carbon. It may account for 40-70% of the WLC for a new low carbon building.

The below identified key actions are proposed for this project to reduce the embodied carbon of a building and its constituent elements.



Actions	
Build Less	Efficiently size the building GIA.
Build Light	Reduce the weight of the building.
Build Wise	Reduce unnecessary materials (i.e., finishes, optimise the structure); and reduce on-site construction operations (i.e., MMC).
Build Low Carbon	Specify low carbon materials and use recycled materials.
Build for the Future	Allow for disassembly and re-use.
Build Collaboratively	All the people involved in the project should be part of the process.

Increasing the utilisation of recycled and reused materials in the new construction can yield numerous positive outcomes for society, economics, climate, and technological development. Recoverable steel profiles, concrete, and light fittings can be salvaged, processed, and repurposed in the new building, leading to minimised waste and greenhouse gas emissions and the potential for decreased.

The embodied carbon will be calculated by others.

3.3 FURTHER ASSESSMENTS

With the energy demand optimised the consultant can then model the building using IES VE dynamic software to determine:

- Compliance with the requirements of Welsh Building Regulations Part L.
- Compliance with Overheating Criteria TM52.
- The data exported for energy monitoring will be suitable for submission to K2n.

MEP APPROACH & STRATEGIES

The approach to the MEP systems within the building will be led by operational requirements and be integrated with the building design to meet the employer's requirements.

We will base the design approach on systems typical for such buildings. Our aspirations are outlined below.

4.1 DESIGN REGULATIONS AND STANDARDS

The design will comply with the following codes and standards:

- Planning Requirements
- Building Regulations
- Non-Domestic Building Services Compliance Guide (Wales)
- CDM Regulations 2015
- HSE Guidance
- British & EU Standards
- British Council for Offices (BCO) Guidance
- CIBSE Guidance
- BSRIA Guidance
- CIPHE Guidance
- Building & Engineering Services Association Guidance
- Water Regulations Advisory Scheme (WRAS)
- Electricity at Work Regulations 1989
- Health and Safety at Work etc Act 1974
- BREEAM 2018 'Excellent' project requirement
- Project Energy and Sustainability Statement
- Project Environment Report - Not available at this stage for review
- Project Fire Strategy - RIBA Stage 3 Fire Strategy Report (draft Issue) by Part B
- Project Acoustic Report - Not available at this stage for review
- Project Landscaping and Cleaning Strategy Report - Not available at this stage for review
- Project Façade Report - Not available at this stage for review
- Project Catering Consultant requirements - Not available at this stage for review
- Building Regulations Part M - Accessibility Report - Not available at this stage for review

- Project Reception Desk Requirements - Not available at this stage for review
- Flood Risk Assessment - Not available at this stage for review

4.2 SOFTWARE

The following software is proposed for calculations:

- IES VE
- Dialux
- Hevacomp
- Revit
- Trimble Prodesign

4.3 PLANT SPATIAL REQUIREMENTS

Plant spaces have been identified and provided to the project architect and incorporated into the proposed layout of the facility. Further spatial requirements may become apparent during the next stages.

4.4 ENERGY METERS

Energy metering will be provided in accordance with Building Regulations and CIBSE TM39.

Energy metering will be provided for electric, water, LTHW heating, fans/electrical inverter drives and pumps to record their energy usage.

K2N

Systems shall be metered in line with the requirements of K2n to provide operational energy data by use.

SUB-METERING

Sub-meters will be provided to major branches and be linked to the BMS.

Note: Small 'point of use' water heaters can be excluded from the sub-metering requirements. Only major energy consuming systems that have a measurable impact on the operational energy consumption need to be included.



4.5 CONTRACTOR DESIGN PORTION (CDP)

Sections of the building services installations will be specified in the basis of performance parameters. The following is a list of packages where the contractor will be responsible for completing the design and integrating with design of the building and MEP systems as a whole:

- Suppression installations inc. Sprinklers & hydrants
- Security Systems (including CCTV, access control, Intruder detection & alarm, barrier interfaces, control console etc)
- Intercom system
- Telecoms system
- IT installation - Cabling and Passive Equipment (Active equipment excluded and is by others).
- Fire Alarm System
- Refuge System (if required by the fire engineer)
- Induction Loops Systems
- Accessible WC alarm systems
- Radio / TV / Satellite Systems
- Lighting / Emergency Lighting Control Systems
- Power Factor Correction systems
- Lightning & Surge Protection Systems
- Supplementary bonding
- Specialist extra low voltage power installations
- Secondary containment (e.g. conduits) for power, lighting ancillary cabling etc.
- BMS and Controls Systems including all equipment interfaces
- Local cooling/variable refrigerant volume, split units
- Smoke damper control system
- Ductwork Fabrication
- Refrigerant based heating and cooling systems
- Rainwater harvesting system
- Renewable Energy Installations, including Photovoltaic Arrays and M&E system interfaces by experienced specialist companies.
- Any Prefabricated Systems, (e.g. Plant Pods, Toilet Pods, piping and cabling prefab sections etc.)
- Access hatches through plasterboard ceilings

The contractor will provide the engineering drawings, calculations, etc. to prove his selections for performance specified works. All information will be provided before work commences on site and in a reasonable time for comments to be issued.



4.6 PROPOSED INCOMING SERVICES

ELECTRICITY

To enable the construction of the new school, National Grid (NG) will provide a new Low Voltage Electrical Supply,

National Grid (NG) will provide a new High Voltage (HV) Switch and 11/0.4kV DYN 800kVA transformer located within a HV room within a new substation building, proposed to be installed on Goitre Lane. The transformer will be complete with all necessary earthing and protection systems. This will then supply the new school.

From the new substation, NG will provide a Low Voltage Electrical Supply to the school.

The new service connection will enable the provision of a dedicated supply to meet with the following characteristics:

- 400/ 230V (+10%/-6%)
- 50Hz (+1%)
- 500kVA (Agreed supply capacity)

The LV supply will enter the building and terminate into a NG cut out and meter within the plant room. The supply will then connect into the main LV switchboard located within plant room.

The supply will have an allowance of 25% spare capacity for future use.

Any ducts and / or containment required to facilitate the connection will be provided and installed by the contractor.

Connection Agreements –

The electrical contractor will be responsible for the appointment of the Employers preferred meter operator(s) and electricity supplier(s). As a minimum the Electrical Contractor will be responsible for the following:

- Providing any assistance necessary for the appointment of the Employers preferred meter operator(s)
- Overseeing the installation of the development's main electricity meters (import and export)
- Providing any assistance necessary for the appointment of the Employers preferred electricity supplier(s)
- Providing any assistance necessary for the engagement of NG to energise the system

The electrical contractor will be fully responsible for all negotiations required between the relevant parties to ensure that the new supply is energised, in a timely manner to suit commissioning and handover.

The contractor will make all necessary arrangements with the DNO and complete all necessary works, including but not limited to; excavations, ducting system, backfill including the removal of all excess arising materials and permanent reinstatement. All trenches must be blinded with graded sand before and after cable(s) are installed. The DNO covering this site is National Grid (NG).

Wayleaves

The main contractor will be responsible for overseeing the Wayleaves process to ensure that power can be supplied in accordance with the overall construction programme. The main contractor will be responsible for liaising between all relevant parties to ensure the required documentation is completed and signed accordingly.

INCOMING COMMUNICATIONS

The details of the proposed communication connection to the facility will be the responsibility of the client.

The design, supply, installation, implementation, testing and commissioning will be the responsibility of the specialist installer preferred by the client. The specialist will be responsible for the development of the design intent to provide a fully operational system to meet the client's agreed requirements.

The contractor is to allow for the installation of the communication connection in line with the client requirements and responsible for the provision of all additional containment required for a complete installation.

The contractor will include for liaising with Openreach to provide and install sufficient ducts/ containment, chambers etc. to receive all incoming new phone and fibre optic services to enter the building and connect to the new server cabinet on the ground floor, which will include for internal containment, as detailed on the containment layout drawing. The contractor will supply and install any incoming ducts/ containment to facilitate the connection into the switch room on the ground floor and terminate within an ONT (optical network termination) point.

The incoming telecommunications service cables will take the form of multimode armoured fibre optic cabling for the high-speed data connection, with multicore copper cabling being used for the telephony services.

It is the contractor's responsibility to undertake all necessary Openreach new works co-ordination, ordering, trenching, programming etc to allow the installation of new lines into the proposed development.



The contractor will be responsible for the coordination of all information and documentation to provide all technical assistance, attendance and co-ordination with the line providers throughout the duration of the works, ensuring the installation is carried out fully with all other site activities, installation dates and programme of work.

The contractor will be responsible for any associated works with BT for any existing infrastructure that may impact on the main construction project. i.e. removal of BT poles or existing lines.

Any ducts and / or containment required to facilitate the connection will be provided and installed by the contractor.

The client will be responsible for placing all initial orders for the procurement of new service lines including telephone, alarm and broadband/fibre. Telephone, alarm and broadband/fibre.

WATER & FIRE MAINS

Potable Water main

A new water connection will be provided to serve the new school. This will be done via a new connection from the Welsh Water mains running within the adjacent road to the site. The new connection will be provided with a new external meter situated at the site boundary in a dedicated underground chamber.

The proposed building potable water demand is low and it is anticipated that a new dedicated supply will be sufficient to serve the building. A new water storage tank is not desired by MTCBC.

The new potable supply will be metered with a new water meter located within the plantroom. The meter will be BMS compatible. A meter will also be installed at the site boundary and be linked to the BMS via ducted cable for leak detection.

The existing 1970 Welsh Water Main may need to be diverted away from the proposed site. This will be confirmed by DCWW and an allowance made for this.

Fire main

In addition, a new fire main will be installed to feed the sprinkler system/tank and hydrant tank.

This system will be metered not for consumption data but for leak detection of buried water pipework. Emergency systems such as fire hydrants and sprinklers need also to be covered by a leak detection system. The

leak detection system must cover all mains water supply between and within the building and the 'site boundary'.

Pipework material

Barrier pipe is required to all new buried pipework.

5 DESIGN CRITERIA

5.1 DESIGN STANDARDS AND CODES

The design will comply with the following codes and standards:

- British Standard Specification (BS) and European Standards (BS EN).
- British Standard Code of Practice (BSCP).
- CIBSE Guides to Current Practice and Technical Memoranda
- Institution of Electrical Engineers Regulations (IEE) (BS 7671).
- Institute of Plumbing and Heating Design Guide
- Water Supply (Water Fittings) Regulations
- Water Byelaws
- The Building Regulations
- Building Research Establishment (BRE) digest recommendations
- Building Services Research and Information Association (BSRIA) recommendations and guides
- Local Bye-Laws and/or Regulations.
- Manufacturer’s instructions and recommendations for installation/testing
- Health and Safety at Work Act
- CDM Regulations
- Radio Communications Agency
- Building Bulletins
- IGEM & Gas Safe
- WRAS
- Building Bulletins
- Employer Requirements (to be provided to WSP)

5.2 DESIGN CRITERIA

AMBIENT DESIGN CONDITIONS

The design of all thermal loads and selection of equipment will be based on the following ambient conditions.

Season	°C dry bulb	°C wet bulb
Winter	-5°C	Saturated
Summer	28°C	21°C

BUILDING THERMAL TRANSMITTANCE VALUES

The building thermal transmittance values (U – Values) calculations for the building elements will be assessed as part of the energy and environmental studies. It is anticipated the values listed below will be required as a starting point.

Building Element	U value (W/m ² ° C)
External wall	0.12
Rainscreen cladding to Sports Hall	0.10
External glazing, doors (overall average including frame)	1.40
Curtain wall (excluding opaque area)	1.20
Curtain wall (opaque area)	0.20
Roof	0.10
Floor in contact with ground / exposed floors	0.08



Building Element	U value (W/m ² ° C)
Doors	1.60

BUILDING AIR TIGHTNESS

Area	Air tightness
General	The air tightness for the building will be targeted at 2.0 m³/h/m² at a positive pressure differential of 50Pa for this school. 0.25-0.5 air changes per hour will be assumed for the space heating design.

CASUAL GAINS

Load	Gain
Lighting	8.0 W/m ²
Equipment (Class & Group Rooms)	10 W/m ²
Occupancy (sensible) Child/Adult	52/75 W per person
ICT loads	ICT loads to be confirmed by client.

INTERNAL TEMPERATURE DESIGN CONDITIONS

The schedule below states the proposed internal summer and winter design conditions based on the provided RDS, Building Bulletins and CIBSE Guide A. Overheating has been based on CIBSE TM52 to ensure adequate ventilation is provided to the classrooms.

Area	Winter ° C	Summer ° C
Classroom	20 ±2	To Comply with TM52
Group Room	20 ±2	To Comply with TM52
Offices	21 ±2	To Comply with TM52
Halls	20 ±2	To Comply with TM52
Circulation	19 ±2	N/A
Hygiene Room	21 ±2	N/A
Toilet	21 ±2	N/A
Store	15 ±2	N/A
Server	N/A	Limit to 28°C



VENTILATION SYSTEM DESIGN CONDITIONS & BB101

Ventilation rates will be designed to be compliant with TM52 and BB101 (2018) and/or CIBSE guidance where applicable. The schedule below states the proposed ventilation rates.

Area/space	Ventilation Rate
Classroom / teaching and learning spaces	Variable, based on demand (circa 5-8 l/s per person). Sufficient outdoor air will be provided to achieve a daily average concentration of carbon dioxide (CO₂) of less than 1000 ppm, during the occupied period, when the number of room occupants is equal to, or less than the design occupancy. The maximum concentration will also not exceed 1500 ppm for more than 20 consecutive minutes each day when the number of room occupants is equal to, or less than the design occupancy.
Halls	As above. Main halls are often used for more than one activity. Some are used for occasional activities, e.g. performances once a year in primary school halls. In these cases as the events are fairly infrequent it may be that standards can be relaxed slightly. For the majority of the time there may only be one or two class groups in many halls, e.g., 30 to 60 students using the space and much less outdoor air will then be needed to maintain the required CO₂ levels. Therefore CO₂ rates from general teaching and learning spaces apply also to halls.
Offices	10 l/s per person.

Area/space	Ventilation Rate
Rooms containing printers and photocopiers in substantial use (greater than 30 minutes per hour).	20 l/s per machine.
WCs and Showers	6 l/s per shower head/bath. 6 l/s per WC/urinal.
Kitchen	60 air changes will be used as an assumption until provided by kitchen canopy provider.
Cleaner's Stores	6 l/s extract ventilation will be provided to cleaners' rooms where there are sinks or where cleaning chemicals are stored. They can be added onto toilet extract systems where they are nearby.
Food and beverage preparation areas, e.g. in kitchenettes (not commercial kitchens or food technology rooms)	Intermittent air extract rate of 15 l/s with microwave and beverages to operate while food and beverages preparation is in progress (This is only required where these are located in individual rooms not where they are located in larger open plan office or circulation spaces).



NOISE CRITERIA

The following noise levels are attributed to the operation of M&E plant only (taken from CIBSE Guide A). These are subject to revision following detailed analysis by the acoustician.

Area/space	Criteria
Classrooms	NR30
Group Rooms	NR30
Circulation	NR40
Toilets/ Hygiene Rooms	NR45

LIGHTING LEVELS

Lighting within the new development will be designed to CIBSE Lighting Guides, BB90 and client brief:

Area/space	Horizontal Illuminance (lux)	Daylight Dimming [1]
Classroom/Staff room/Offices	300	Yes
Hall	300	Yes
Kitchen	500	Yes
Circulation Areas	100	Yes

Area/space	Horizontal Illuminance (lux)	Daylight Dimming [1]
Group Room	500	Yes
Plant Room	200	No
WCs	200	No
Store Room	100	No

[1] Where sufficient natural daylight is present.

DESIGN MARGINS

The design margin allowed is as follows:

- Heating system: +10%

This margin considers design changes that may take place as the building is developed further into future stages.

INTRUDER ALARM

Intruder alarm and hold up systems (IAHS) will comply with a Grade 3 system as in BS EN 50131 and all associated parts.

The system will include remote monitoring, the system will comply with BS 5979



FIRE ALARM SYSTEM

The fire alarm system will be provided in accordance with BS 5839 and Building Regulations Approved Document B.

The fire alarm system will be to Category L2 or where applicable, the fire alarm will be in accordance the recommendations of the fire engineering strategy.

MECHANICAL SERVICES ENGINEERING

6.1 INTRODUCTION

The mechanical services for the building have been proposed to provide a school that has low energy demand via passive measures and the use of energy efficient plant and equipment.

6.2 HEATING SYSTEM

The school will be primarily heated via air source heat pumps (ASHP) providing a circulating low temperature hot water (LTHW) system.

The ASHPs are to be heating only heat pumps suitable for commercial applications. The units will be arranged in reverse return in an external compound to provide LTHW at 45/40°C to the building plantroom via external pipework.

Air source heat pumps will be located on the plantroom rooftop. **Acoustic treatment may be required this shall be confirmed by the project acoustician.**

ASHP's are to be sized for 100% of the peak heating demand of the building down to temperatures of -5°C. the design is based on 7no. Mitsubishi CAHV-R450YA-HPB units.

Air source heat pumps will include appropriate automatically managed frost protection measures. The primary heating circuit will be dosed with 25% ethylene glycol.

Primary and secondary twin head pumps shall circulate LTHW around the building.

A plate heat exchanger to hydraulically separate the glycol dosed external primary circuit from the internal primary circuit. This minimises the volume of chemical required. The internal primary circuit shall then run LTHW at 43/33°C to reduce the size of the secondary pipework.

2no. Side stream filtration units to allow maintenance whilst maintaining continuity of service.

2no. 1,800 litre lagged buffer vessels shall provide the minimum system volume required of the air source heat pumps.

2no. combined vacuum degassers and pressurisation units shall ensure air is removed from the system.

The school's space heating requirement will be delivered via a zoned, pressurised, pumped, constant pressure, variable volume central heating systems serving;

Variable temperature emitters – such as radiators and underfloor heating manifolds
Constant temperature emitters such as fan convectors and heating coils within air handling units
Local control will be provided to each space via wall mounted thermostats complete with a link to the BMS.

UNDERFLOOR HEATING

Underfloor heating pumped manifolds will be located within secure, hidden locations which will be agreed with the project architect.

UFH Manifolds will mix the LTHW to a safe flow temperature suitable for the UFH loops. The pumps on the manifold will be sized to meet the pressure requirements of the underfloor zones which they serve.

Underfloor heating is unobtrusive but will limit the use of floor surface coverings. Surface coverings will be agreed with the project architect.

Teaching spaces will be provided with underfloor heating this will allow valuable wall space to be used for furniture and teaching aids.

RADIATORS

Wall mounted panel radiators will be used in WC's where floor areas do not allow adequate heating for underfloor heating.

MAIN HALL

The Main Hall will be served by either;

- fan convectors at high level
- fan convectors within the wall
- or duct mounted heating coils on the MVHR systems



LOW SURFACE TEMPERATURE

Traditional panel radiators with no low surface temperature casing can be used throughout on the basis that the LTHW temperatures shall be limited to 43/33°C flow and return. This will result in a mean water temperature of 38°C overall at the radiator.

On the basis that this is lower than the requirement of 43degrees from Managing the risk from hot water and surfaces in health and social care HSI6 (hse.gov.uk) and the HSE guidance states that “reducing the flow temperatures” is an acceptable means of reducing the risk of burns from hot surfaces.

All exposed heating pipework within areas accessible by Primary-age pupils, the community or the disabled would normally be insulated then boxed-in by the building contractor. Access panels would be installed to enable appropriate access to valves.

But if it is agreed that temperatures avoid the risk of scalding then thermal protection is not necessary.

This strategy will require agreement from the client.

An allowance shall be made for low surface temperature radiators and boxed in pipework until agreed.

6.3 COOLING SYSTEM

There are some spaces that are anticipated to require active cooling such as the server/comms room.

Direct Expansion (DX) cooling units will be utilised to serve these rooms. This would be done using internally mounted units connected to external condensing units.

Each system will be supplied with a wall mounted controller linked to the BMS. The Server rooms will be BMS set point controlled with the IT classrooms rooms controlled locally for set point and time scheduled through the BMS for teaching hours.

A local extract fan will be installed within the server/comms room in addition to a local DX split air conditioning unit. The mechanical extract will run if the room temperature is above 22°C and will shut off at 27°C when the air conditioning should activate.

6.4 PREVENTION OF OVER-HEATING & PROVISION OF FRESH AIR

North facing glazing and rooflights will help provide good daylight while minimising excess solar gains. Any residual spaces with glazing to the south will be treated with shading devices to control overheating. During the

overheating analysis some rooms may require modification to the ventilation strategy to ensure upper temperature limits can be maintained.

One of the key areas of school design as discussed in BB101 2018 is how to provide fresh air and so control CO₂ levels in winter when it is cold outside, and draughts are not wanted. With the use of heat recovery ventilation system for winter use the space can be heated by the room heat emitters, this heat is then drawn out via the fan where the heat is recovered via cross-flow heat exchanger. A local unit gives the most control for the teacher and limits expense of long runs of ductwork.

In addition to the mechanical ventilation systems, opening windows will be required to minimise overheating during peak summertime.

Decentralised units offer the function of night time purging securely without compromising the building security.

6.5 VENTILATION

Classrooms and all rooms with external surfaces will be provided with energy efficient ventilation systems incorporating heat recovery. All occupied rooms without external surfaces and meeting rooms will be provided with mechanical heat recovery ventilation units.

Natural ventilation via openable windows will not be the primary strategy for ventilation due to the high heat losses during the Winter period. Openable windows will be included only to supplement the mechanical ventilation systems during peak summertime when overheating is a risk.

Mechanical ventilation with heat recovery will be installed to serve toilets, changing rooms, cleaner’s stores and hygiene rooms.

A combination of mechanical ventilation/air conditioning will be installed to serve the server/comms room, comprising linked mechanical extract ventilation with motorised shutoff dampers and split air conditioning where cooling loads dictate.

TEACHING AREAS

Mechanical ventilation Heat Recovery (MVHR) units will be used to ventilate classrooms and teaching areas. The units will be located at high level and ducted to external louvres at high level that will be incorporated into the building façade. The MVHR unit will then supply fresh air to the back of the space.



During the winter months the fresh air will be heated via crossflow heat exchanger with the warm air from the space to supply tempered fresh air. This can mitigate against the unwanted cold draughts from open windows during the winter months.

During the summer months the unit will operate with a summer by-pass function to provide fresh air to the back of the space along with exhausting the hot air from the room. The MVHR units can also provide secure night cooling to help control temperature build up the following day due to the lower starting temperature of the school.

The units will be automatically controlled by room CO₂ & temperature sensors or time clock, with the option for manual control afforded to the teaching staff when required.

HALLS

Ventilation to Hall is to be by a fully automatic mechanical ventilation system with heat recovery and a CO₂ monitor.

KITCHEN

Demand ventilation without heat recovery is to be provided to the main kitchen with manual controls.

COMMUNITY AREAS

Community areas will be served by independent mechanical ventilation systems with heat recovery that will allow use out of ours of normal school operation to provide local control and minimise energy use.

SMOKE VENTILATION SYSTEM

There is no requirement for smoke ventilation.

AIR TRANSFER

Details of air transfer will be developed at the next stage. It is anticipated that the following will be required:

- Air transfer grilles
- Undercut doors and;
- “up and over” duct and fire damper arrangements.

FIRE DAMPERS

Fire and smoke dampers to be shown at the next stage.

6.6 CONTROLS STRATEGY

Each element of plant will be controlled via its own manufacturer supplied controllers for best performance and equipment monitoring. The central BMS system will be used for scheduling, meter monitoring and remote alarms.

The BMS will have user interface on a control panel in the plantroom. The graphical interface will be simple to use and allow the user to be able to adjust setting such as time clock setting with minimal training.

The system and all connecting systems will be open protocol.

A Trend open protocol Building Management System accessible from Merthyr Tydfil County Borough Council network will be provided to serve all areas of the school.

The system must:

- Permit time schedules to be configured for each heating zone with time and temperature profiling available for all space heating zones.
- Monitor the temperature and CO₂ levels in all teaching areas.
- Monitor and data log both the temperature and CO₂ sensors associated with the fully automatic natural ventilation systems.
- Monitor and store sufficient domestic hot and cold-water services temperature data to meet legionella codes of practice.
- Monitor and control all HVAC plant and associated equipment including incorporating a facility to remotely monitor and adjust all plant.
- Provide the facility to override all valves, fans, pumps, heating/ventilation sources and actuators will be able to be manually overridden.
- Provide the ability to export all data via a csv file.
- Provide monitoring data that should be based on the number of points agreed or on a constant timeframe with the ability for the data to be deleted after an agreed timeframe. This should also be able to be easily programmed in by the client.
- Be supplied with 3 full system software DVD to the client in case of catastrophic failure to enable a full re-install of the complete system as installed.



6.7 MECHANICAL METERING STRATEGY

The BMS system will monitor all meters provided. The metering strategy will be compliant with CIBSE TM 39. All meters will be provided with an M-Bus output to signal back to the BMS system to allow monitoring centrally. The sub-meters will be accessible to ensure that all gas, water and electrical energy consumption can be collected. This will aid understanding of where energy is being consumed and can assist in identifying any problems with certain areas or systems consuming unusually large amounts of energy.

Areas open to community use outside of school hours will be sub metered in order to allow for separate billing.

The metering strategy will align with Morgan Sindall's established arrangement with K2n.

PUBLIC HEALTH SERVICES ENGINEERING

7.1 DOMESTIC WATER SERVICES

New mains cold water services will be taken from the supply authority meter at the site boundary to rise in the main building plant room to supply potable water to all hot and cold-water outlets within the schools main building without storage tank.

Sanitary fittings generally will be infra-red sensor taps to all wash hand basins (WHB), proximity sensors to all water closets (WCs) and urinals, lever taps to all sinks.

COLD WATER SERVICES

The domestic cold water system design for the school will be a simple strategy for delivering sufficient supplies of cold water to meet the expected demand.

The cold water will distribute to each area via the corridor ceiling void and will be routed as far as possible to avoid areas where it may be subject to heat from other services.

HOT WATER SERVICES

Hot water service generation for the main school building will be via local electric water heaters. Water heaters will be of varying size depending on demand;

- 5 litre models for a single basin.
- 10 litre models for 2 basins or a kitchen sink.
- 15 litres for high usage sinks or up to 3 basins.
- 30 litres plus for cleaners’ sinks, light commercial.

All hot water outlets accessible by pupils, the community or intended for use as hand washing will be fitted with TMV3 capable of supplying a water temperature of 41°C.

Any sinks for use by staff will also be fitted with a TMV3 but the outlet temperature will be set to 50°C.

Cleaner’s sinks will not be fitted with a TMV3 but include a hot water warning sign.

It is anticipated that the hygiene room will contain one shower and this will be of electric type.

Unvented electric water heaters will be provided complete with the manufacturer’s vented kit. Expansion vessels will be of the ‘flow-through’ type to avoid stagnation and contamination of the system.

Electric water heaters will be located within IPS or locked cupboards. This will be coordinated with the project architect and FF&E designer.

RAINWATER HARVESTING (BY OTHERS)

A specialist contractor will design, supply install and commission a new rainwater harvesting system that will be designed to serve the toilet cisterns.

Rainwater is collected from roof surfaces and is passed through a particle filter. It is then stored in an underground tank. The water will then be used for non-potable use (with UV disinfection). The system will feature automatic pumps which run automatically according to the valve opening and closing.

The WC water circuit will be provided with a booster set and break tank that will be fed by the rainwater harvesting system. An additional MCWS feed will be provided for periods without rainfall.

Flow control devices will be required on water supplied from rainwater and serving the toilet facilities comprising solenoid vales linked to dedicated PIRs.

NON-POTABLE WATER SERVICES

WRAS Fluid Protection category 5 is required to serve the following outlets;

- Heating top-up
- Bin store
- PV washdown

The packaged booster set and break tank will be located within the plantroom.

External pipework will be lagged and trace heated.

The rainwater harvesting system serving WCs shall include a CAT-5 booster set and break tank for use when there has been no rainfall.



WATER QUALITY

Desktop sampling shows water at 58ppm as CaCO₃, which is classified as moderately soft. It does not have scale forming properties. Therefore, scale prevention is not necessary, however filtration is recommended for this water quality.

Water filtration

A 50-micron particulate filter will be provided with automatic backwash facility to the mains cold water serving the building.

Water Treatment

Water treatment plant will be provided to the top up to the primary air source heat pump circuit to ensure that the air source heat pump manufacturer required water supply criteria is ensured. This will consist of;

- A cartridge-based chlorine filter and;
- An automatic backwashing filter for iron removal

WET PLAY

The Nurseries will be provided with a bib tap from the potable water supply. The connection will be looped to minimise the dead leg and a backflow prevention valve will be provided.

7.2 ABOVE GROUND DRAINAGE

The above ground soil and waste water systems design for the school will be in accordance with BS EN 12056:2000. The design will be a simple strategy for effective and efficient removal of waste water to the foul sewer system. Drainage will be provided to all sanitary ware items.

The proposed drainage design will be a primary ventilated above ground drainage system. The number of penetrations through roof level will be minimised with the incorporation of AAVs where suitable. Where SVPs do vent to atmosphere at roof level, these will be complete with a vent cowl and terminate a minimum of 300mm above FFL.

The drainage from the kitchens will be provided with bio-remediation equipment and be provided as part of the kitchen specialist's package to treat waste locally. The kitchen drainage will incorporate measures to prevent grease contamination of the drainage installation.

Condensate drainage will be provided from items of plant as required.

7.3 FIRE PROTECTION SERVICES

Fire Hydrant

There are no recorded existing hydrants close enough to serve the new school so a new hydrant will be provided within 70m of the building entrance.

This will be capable of supplying 1,500 l/min. Welsh Water will not guarantee flowrates so a 45,000 litre charged static tank will be provided to feed the new hydrant in accordance with Approved Document Part B. This will be located externally above ground on a base with approximate dimensions of 5x4x3m (Length x breadth x height) or a variation thereof. The tank could also be buried if preferred but this makes maintenance somewhat more difficult and requires excavation.

A new, above ground fire hydrant tank will be provided with above ground fireman's connection point.

It has been observed that an existing fire hydrant is located on Goytre Lane that is circa 60m from the main building entrance but is not recorded on plans provided by DCWW.

No further fire hydrants are envisaged for the scheme. **This will be confirmed by the project fire engineer.**

Sprinkler System

It has been confirmed that an automatic sprinkler system is required for the development.

The sprinkler fire pump will be an electric / diesel pump.

This system will be designed by a specialist contractor with a dedicated supply will be provided from Welsh Water. **Current understanding is that this will be OH1.**

Firefighting Lift

There is no requirement for a firefighting shaft or lift.

Dry Fire Main

There is no requirement for a dry rising mains.



ELECTRICAL SERVICES ENGINEERING

8.1 INTRODUCTION

The electrical services for the building have been proposed to provide a school that has low energy demand via passive measures and the use of energy efficient plant and equipment.

8.2 LV DISTRIBUTION SYSTEMS

LV DISTRIBUTION

The electrical contractor will be responsible for the supply, installation and implementation of a new LV distribution system to serve the new extension. The new supply will enter the building into the switch room and terminate within a suitably rated 400V, 3 phase, 4 Wires 50Hz LV switchboard. The LV switchboard will be provided with spare ways equating to 25% of the total number of utilised out-going ways on the LV Switchboard itself.

Initial calculations have indicated that the anticipated electrical maximum demand for the facility will be circa 400kVA. This will require verification upon development of the detailed design.

The new LV distribution network will be provided in full accordance with the requirements of BS 7671 and this specification.

LV SWITCHBOARD

The switchboard will be designed, manufactured, and tested to comply with the requirements of BS EN 61439-1 and meet the requirements for Form 4 Type 2.

The main LV switchboard will be located within the plant room, with top and bottom entry glanding plates.

The main switchboard will incorporate:

- A suitably rated main switch
- Suitable rated MCCB's for the OCPD's
- A main multi-function Modbus energy meter with pulse output
- Consumption meters for each outgoing sub main cable. Sub meters are to be MID approved.

All outgoing ways from the LV Switchboard will be afforded protection via dedicated (suitably rated) MCCBs and fuse-switches as indicated on the electrical drawings. In particular, the electrical contractor will note the following out-going ways that will be provided with particular arrangements:

- The sub-main supply to the Sprinkler Panel will be connected to the live side of the main incoming switch that serves the Main LV Switchboard. The main switch will be provided with appropriate and compliant labelling and warning signs to highlight this arrangement.
- The supply to the Fire Alarm Panel will be provided with a dedicated supply with appropriate and compliant labelling. The cover of the sub-main switch will be coloured RED labelled "Fire Alarm – Do Not Switch Off".
- Any supplies to life safety equipment will be provided with a dedicated supply with appropriate and compliant labelling. The cover of the sub-main switch will be coloured RED labelled appropriately.

The LV switchboard will be provided with a suitably rated 400V electronic surge protection device fitted as the first outgoing way after the incoming switch and protected by a 4-pole MCCB. The unit will be sized and selected by the LV switchboard manufacturer.

The LV switchboard will be fully labelled to include engraved traffolyte labelling to fully indicate incoming and outgoing services.

Adjacent to the LV Switchboard the electrical contractor will supply and install:

- A system schematic diagram mounted in a protective frame (A1 size min)
- Health & Safety posters, as required by H.S.E

SURGE SUPPRESSION

The electrical contractor shall employ a Surge Suppression Specialist to undertake the design development, supply, installation, testing and commissioning of surge protection system to meet the requirements of BS EN 62305-4 and section 534 of BS 7671. A surge suppression system shall be provided to the following:

- All incoming and outgoing Power / Lighting cabling
- All incoming and outgoing Data / Telecommunications cabling
- All incoming and outgoing CCTV / Security/Intercom cabling

Whilst surge protection is described under this section, it is anticipated that most surge protection devices, shall be supplied and type matched by the same supplier i.e.



- Surge protection integral with Distribution Boards or their individual circuits is to be provided by the LV Distribution equipment supplier
- Surge protection to other equipment is to be provided by the specific equipment supplier i.e. CCTV Cameras

SPRINKLER SUPPLY

A supply will be taken from the live side of the main incoming isolator of the incoming circuit protective device to a TP&N BS88 HRC fuse as indicated on the drawings. This will be used as the supply to the sprinkler pump. The final selection of the circuit protective device and cable size will be confirmed with the sprinkler pump manufacturer prior to installation.

The Electrical Contractor will install, wire and connect all required electrical services for the sprinkler pump room and system including but not limited to:

- Distribution Boards
- Main and Sub Main Supplies
- Small Power
- Lighting
- Electrical Heating
- Trace Heating
- Pump Supply's
- Fire Alarm

The sprinkler system will be networked with the fire detection and alarm system to indicate activation and fault condition on the fire control panel in the new building and the main school. Any ducts and / or containment required to facilitate the connection will be provided and installed by the contractor.

DISTRIBUTION BOARDS

Emanating from the main LV switchboard, a network of low-voltage cables located on cable trays will be installed to final circuit distribution boards, control panels and fixed loads including fire alarm panels located throughout the building.

The complete installation will be in accordance with the respective British Standards including BS7671 Requirements for Electrical Installations, (IET Wiring Regulations), and the current edition of the HSE requirements.

The boards will generally enable lighting and power loads to be metered and logged separately in accordance with Building Regulations Approved Document Part L.

Distribution boards will generally enable lighting and power loads to be metered and logged separately.

To facilitate the installation of Arc Fault Detection Devices (AFDD), hybrid distribution boards suitable for AFDD and non AFDD protective devices will be provided. Each outgoing circuits will be provided with individual energy monitoring sensors that are connected centrally to ensure the lighting and fixed power is separately metered. Alternatively, a dedicated AFDD distribution board will be provided in addition to individually split metered lighting and power distribution boards.

The distribution boards will generally be 400V, Three Phase, 50Hz Type B boards complete with four pole incoming devices or Singles Phase, 50Hz Type A boards complete with two pole incoming devices.

All distribution boards will be complete with lockable doors.

All outgoing ways will be complete with the necessary protection facilities to prevent electrical shock to the users, as outlined in the relevant regulations.

Final circuit protective devices will be Miniature Circuit Breakers (MCB's) or residual-current circuit breaker with overload protection (RCBO) and arc fault detection devices (AFDD's) in accordance with BS7671.

The electrical contractor will provide extension enclosures to distribution boards as necessary to ensure all control devices i.e. contactors, photo-cells and time-switch controls can be suitably housed.

All new switchgear and devices will be provided by the same.

Final circuit wiring is to be in the form of LSF single core cables routed above suspended ceilings supported by cable trunking. Where cables drop to accessories, they will be enclosed in galvanised metal conduit. Minimum cable size – 1.5mm² for lighting, 2.5mm² for small power.

Final circuits are to be generally wired in radial circuits unless otherwise specified.

All distribution boards will generally include:

- 400V TPN 50Hz Type B



- Integral incoming switch disconnect
- Surge Protection Device
- Of metal enclosure type with hinged lockable doors
- Earth tag on doors
- Earthing bar
- Neutral bar
- Protective shrouding on all busbars

Where required the Electrical Contractor will allow for extension enclosures to house all control devices.

All Distribution Boards will have a circuit chart included within a plastic protector located on the door of the distribution board.

No distribution boards will be installed within classrooms.

All switchgear and devices will be provided by the same manufacturer.

Metering - Main Switchboard

All meters to be linked to STARK metering management system. All meters to be supplied with data link for STARK.

The main switchboard will be provided with a multifunction digital meter to the incoming and all outgoing services. The outgoing meters will be MID approved and suitable for billing. All meters are to be pulse and Modbus compatible and linked to STARK metering system. The meters will be capable and configured to measure the following;

- Voltage
- Current
- Maximum Demand
- Power Factor
- Kilowatt Hours
- kVAR
- Harmonics

The Air Source Heat Pumps/Ground Source Heat Pumps will be separately metered in accordance with MCS metering requirements/specifications.

The meter for the Photovoltaic system will be linked to the STARK metering system.

Metering - Sub-Distribution Boards

All meters to be linked to STARK metering management system. All meters to be supplied with data link for STARK

All small power and lighting distribution boards to be provided with split metering such that the lighting and small power loads are metered separately. All meters to be Modbus and pulse compatible and linked to the BMS system. The meters will be capable and configured to measure the following:

- Voltage
- Current
- Maximum Demand
- Power Factor
- Kilowatt Hours
- kVAR
- Harmonics

The electrical contractor will allow for a separate meter for the photovoltaic system which will be in full accordance with MCS requirements/specifications. This will be a generation meter and will be located adjacent to the proposed inverter.

Private Wire Connection

The connection of the new school to the local Private Wire installation for Pen Y Dre is to be confirmed. At this stage allowance is to be made to facilitate the connection.

8.3 EXTERNAL SERVICES

A series of ducts/trenching will be provided as required. Coordination and all civil / ground works is to be allowed for.

Full details and co-ordination plus setting out of external services is to be by others to suit.

8.4 EARTHING AND BONDING SYSTEMS

The electrical contractor will design, supply, install and commission a complete earthing and bonding system in accordance with BS7671:2018 (A2:2022).



The electrical contractor will allow for a main earthing bar to be installed adjacent to the main LV switchboard.

The main earthing bar will be equipped with a test link to allow isolation of the main incoming earth.

The main earthing bar will be equipped with a test link to allow the testing of the lightning protection to take place.

The earthing system will retain system voltages within reasonable limits under fault conditions and ensure that the insulation breakdown voltages are not exceeded.

- All extraneous conductive parts will be bonded to the main earth terminal including the following:
- Lightning protection
- Building structure
- Incoming electrical services
- Incoming mechanical services
- Lifts
- Photovoltaic system

A dedicated earthing cable and earth bar will be provided to all server rooms / any IT rooms.

All earthing and bonding cables must be labelled at both ends.

All extraneous conductive parts will be bonded as close to the entry point into the building as is practically possible.

8.5 SUB MAIN CABLING

All sub-main cabling emanating from the main LV switchboard will run via the main distribution routes, terminating at mechanical control panel, distribution boards, fixed loads, photovoltaic array, fire alarm panels etc, as indicated on the layout drawings and electrical distribution schematic.

All internal and above ground external sub-main cables will be supported by medium gauge perforated galvanised steel cable trays. The cables will be tied to cable trays along their entire length. Metal tie wraps will be used to tie the armoured cables to the dedicated cable trays; all tie wraps will be cut short.

Generally, all below ground external sub-main cables will be directly buried in areas of soft landscaping and enclosed within suitable ducts under hard surfaces. In both cases, the cable trench will be refilled using sifted soil around the cables and Grade 1 back-fill.

“Power Cables” marker tape will be provided throughout the cabling route. All sub-main cables will be provided with tie on cable markers fully identifying the origin of the supply and the service fed.

Main and sub main cables will be generally copper XLPE/SWA/LSZH, thermosetting insulated and will generally be installed flat touching on suitable containment.

Where distribution cables and containment pass through fire compartments the penetration will be maintained to achieve the required fire rating.

All sub-main cabling to life safety and sprinkler systems will be of the enhanced fire rated cabling to BS 7629-1.

All cabling must comply with the requirements of BS7671:2018 (A1:2020) and must be installed on a dedicated containment system.

All cabling will be provided with cable markers fully identifying the origin of supply and service fed. This must be secured to each cable at each end of the cable.

All cabling will be sourced from a BASEC licensed supplier.

All sub-main cabling will be sized to allow for 25% extra capacity for future expansion.

8.6 CONTAINMENT

The electrical contractor will be responsible for the supply, installation, and implementation of a new containment installation across the development, as indicated on the electrical drawings and in this specification, to meet with the agreed requirements of the client.

A network of cable containment is to be installed throughout to allow the effective distribution and support of all electrical services.

Typically, distribution of cables will be carried out using exposed cable containment systems within the classrooms with sub-branches to serve individual rooms/spaces.

The containment will include for 25% future spare capacity.

Typically, the containment will be as follows:



- Galvanised metallic tray for LV sub main distribution cables.
- Galvanised metallic tray, trunking, and conduit for the lighting and small power final sub circuits from distribution boards.
- Galvanised metallic basket and conduit for IT structured cabling.
- Galvanised metallic basket for extra low voltage services including (lighting control, access control and intruder alarm cabling).
- Separate galvanised metallic basket and conduit for fire alarm cabling.

White multi-compartment Horizontal Dado trunking will generally be provided within the classrooms and offices.

Any UPVC Dado & Skirting Trunking installations will be Cat6A compatible. The Electrical Contractor will allow for all dado down drops to be supplied from above the ceiling to enable all power and data cabling to be installed.

Where for aesthetic reasons the use of dado down drops is not suitable steel galvanised conduit flush within the wall will be installed.

Areas of sealed / non- accessible ceilings will be provided with loop in conduit for each service.

8.7 PHOTOVOLTAICS

A PV array will be provided to meet the NZC requirements of the project, a 480kWp system is to be allowed for at this stage. Note, this is subject to development and may increase depending on the requirements to satisfy NZC.

The area required will be subject to the energy model for the building. Exact locations will be agreed with the architect and users to maximise the use of the building roof space.

The electrical contractor will be responsible for the design, supply, installation, and implementation of a new system.

The complete Photovoltaic system will be designed, manufactured, installed, set to work and commissioned by a Micro Generation Certification Scheme (MCS) registered specialist and will comply with relevant regulations and standards, in particular with G98, G99, BS EN 61194 and BS 7671.

All panels, supports and inverters are to be MCS compliant and manufactured to a suitable standard to meet the warranty and performance required of a UK MCS compliant solar generating system.

The system will be a stand-alone photovoltaic system consisting of PV modules using proprietary support brackets, inverters, and all associated metering and cabling. The system will be complete with maximum power point tracking to optimise the energy output from the system and track the maximum power point of each module individually.

Support brackets to be approved by roof contractor to ensure guarantee on roof is upheld.

PV optimisers to utilise Solar Edge Technology.

The system will be interfaced with the fire alarm to ensure the PV generation is shut down and isolated upon activation of the fire alarm system.

Metering at the LV switchboards will provide summary of energy generated for each system to allow performance monitoring and will be in a manner to enable data export. The system will be capable of performance monitoring through an online portal to allow remote monitoring and to allow local monitor or PC the display of performance and educational demonstration.

The panels will be connected to a smart generation meter, MPPT optimiser and inverter unit including a G99 relay to allow synchronisation with the mains supply, which will be connected to the main LV Switchboard via an appropriate meter. The PV specialist will be responsible for the G99 application.

During mains failure the PV inverters will be isolated to disconnect them from the electrical system. Upon restoration, and not before, the PV inverter will re-sync and run in parallel.

The contractor will provide a local power and structured cabling network point adjacent to the panel.

All cabling associated with the installation will be procured and installed by the specialist with all associated containment provided by the contractor.

All external cabling, containment and junction boxes are to be weather and UV resistant.

The contractor will provide earthing to both the DC and AC photovoltaic installations along with the mounting frame, all in accordance with BS 7671 and BS 7430.

Surge Protection

Surge protection device(s) will be installed to protect both ends of the PV system and will be coordinated with the general surge protection for the building.



Inverters

Suitably sized inverters will be supplied to convert the DC output of the PV array to 3 phase 400V AC.

Cabling and containment

Cabling on a dedicated containment system suitable for the environmental conditions will be installed.

8.8 SMALL POWER SYSTEMS

A small power system will be supplied to meet the requirements of the building users and client. The small power system will provide power for but not limited to:

- General power
- Mechanical Plant and associated systems
- Actuated louvres and windows
- External services
- Sprinkler and suppression systems
- Security systems
- Class Change System
- CCTV systems
- Access control systems
- Door entry and intercom systems
- Audio visual systems and equipment
- Public address systems
- Fire detection and alarm systems
- Emergency voice communication systems
- Induction loop system
- Data and telecommunication systems (ICT)
- Kitchen
- Hand Dryers
- Roller Shutter Doors
- Design technology equipment
- Teaching walls
- Intruder detection system
- Disabled access systems

- Automatic Windows / Louvres (natural ventilation)
- Lighting Controls

At the next stage of design workshops will be required to determine the exact locations, quantities and characteristics of all power supplies based on selected equipment and its respective location.

The design and installation will comply fully with the requirements of BS7671:2018 (A2:2022).

All power outlets are to be served from circuits provided with individual RCBO protection with a Type A characteristic. Type AC RCD elements will not be used.

The magnetic characteristic of the circuit breaker will be selected to suit the load it is serving.

The Electrical Contractor will allow for all general socket outlets and cleaner's socket outlets. The spacing between these will not exceed 15 metres.

The Electrical Contractor will supply and install small power outlets as required to serve all items of mechanical plant and specialist systems such as but not limited to:

Services for ICT Systems

ICT cabinets will be supplied via dedicated circuits from the local distribution board. One circuit will supply a 13A dual unswitched socket outlet and one circuit will supply each 230V 16A BS EN 60309-2 industrial socket outlet, per cabinet. The contractor will provide a 16Way Vertical PDU within each cabinet supplied via the industrial outlet. The unit will be in place to allow the installation and testing of all active equipment within the cabinet.

Emergency Stop (EPOs)

The Electrical Contractor will supply and install dedicated emergency power off buttons (EPOs) within the following areas:

- Kitchen
- Plant rooms
- All other high-risk areas

The EPOs will be installed around each area to allow all power (excluding Lighting, ICT equipment, Fridges and Freezers) to be disengaged via dedicated contactors located at the distribution board.

The resetting of EPOs will be done via key operated reset switches.



Hand Dryers

Low energy hand dryers will be installed within the WC's as indicated on the associated room data sheets.

Hand dryers will be as manufactured by:

Warner Howard – Air force – White - BC0323 / 1.1kW

The units will be supplied vial local fused connection units located 2.1mts AFFL.

All cabling to the units will be concealed.

Accessories

The finish of all accessories, including switches, will be provided to suit the particular location they are installed in.

All accessories are to be in accordance with Approved Document Part M and BS 8300 including mounting heights, ease of operation, visibility of switches and will be of the same finish and manufacturer whether they are installed flush mounted, within wall or mounted within multi compartment dado trunking.

All accessories are to have an IP / IK rating in line with the specific equipment that is being supplied and/or the location they are installed (wet area or external location).

All wiring accessories are to have dual high integrity earthing.

The installation may be surface mounted metal clad face plates in plantrooms, risers and floor/ceiling voids. In all other locations the installation is to be concealed within the building fabric and/ or dado trunking / desk joinery. Provision to be confirmed with the client.

All accessories will be clearly labelled with a distribution board and circuit reference. Labels will be printed type with bold black text on white background.

Acoustic Performance

Equipment penetrating acoustic walls will not be placed 'back to back' to aid the overall acoustic properties of the internal walls. If 'back to back' positioning cannot be avoided, the installation of acoustic putty pads (in addition to fire protection provisions) will be provided to maintain the required acoustic levels.

Acoustic seals are to be installed where any equipment including but not limited to cabling, cable containment systems, backboxes and accessories penetrate acoustic compartment divisions. The rating of the acoustic seal is to be equivalent to the rating of the compartment being penetrated, unless detailed otherwise.

Fire Performance

Fire barriers / stopping is to be installed where any equipment including but not limited to cabling, cable containment systems, backboxes and accessories penetrate fire compartment divisions. The rating of the fire barrier is to be equivalent to the rating of the compartment being penetrated.

8.9 ELECTRICAL VEHICLE CHARGERS

Electric Vehicle charging points will be provided to the parking area grouped into one location. The chargers will be provided with load management.

A dedicated EV Charger distribution board will be provided located in a local feeder pillar.

10 No. 7.4 Kw Dual point chargers complete with charging management will be provided.

8.10 LIGHTING SYSTEMS

The electrical contractor will be responsible for the supply, installation, and implementation of a new general lighting installation across the development, as indicated on the electrical drawings and in this specification, to meet with the agreed requirements of the client.

The internal lighting design will be provided to satisfy the relevant mandatory, legislative, and regulatory requirements, British Standards, Codes of Practice and Best Practice professional guidance publications including but not limited to:

- BS EN 12464-1: Lighting and Lighting - Lighting of Workplaces. Indoor Workplaces
- Building Regulations
- SLL Code for Interior Lighting
- SLL Lighting Guides



New artificial lighting will be installed throughout by low energy LED luminaires via a combination of suspended, recessed and surface mounted luminaires.

The design and selection of the lighting system will offer a calm and welcoming environment with good quality colour rendering (4000K lamp colour temperature).

In general, all lights will be dimmable with each light fitting having DALI ballasts. All luminaires are to be individually supported from the structure.

Samples of all luminaires proposed will be submitted to the client and architect for comment. Luminaires will not be ordered until full approval has been obtained.

Lighting Controls

The system together with their ancillary systems will be a Contractor Design Package (CDP). The final detailed design of the system configuration, components and interconnections will be undertaken by a specialist manufacturer/installer in accordance with the standards detailed in this specification.

The electrical contractor will be responsible for the design, supply, installation and implementation of a new the system.

It is proposed that a full DALI addressable lighting control and energy management system is to be installed that provides total light management by combining lighting controls, digital ballasts, drivers and sensors.

Lighting controls will be installed to aid in the conservation of energy whilst ensuring that a flexible and convenient method of lighting control is present. As a minimum, the lighting controls will meet the requirements detailed within Part L of the Building Regulations and BREEAM.

Manual control of luminaires will generally be provided by locally sited wall mounted grid type switches rated at 20 amps and ganged as required.

Occupancy sensors will be complete with an adjustable time delay setting and programmable for absence and presence detection.

Where sufficient natural daylight is present, a photocell override will be provided, which will dim or switch off the artificial lighting.

The finish of the accessories will be provided to suit the location they are installed in.

The basis of control will fully comply with the relevant standard and guides and will be in the form of:

- Manual Switching: Luminaires are manually switched on and off.
- Manual Dimmable Switching: The illuminance of the luminaires can be varied manually by a dimmer switch.
- Automatic: Luminaires are turned on automatically by occupant's movement and are switched off automatically when occupants exit the room after a time.
- Manual and Automatic: Luminaires are turned on automatically by occupant's movement and are switched off automatically when occupants exit the room after a time. Additionally, luminaires can be manually switched on and off.
- Presence Control: Luminaires are turned on automatically by occupant's movement and are switched off automatically when occupants exit the room after a pre-determined time. Additionally, the luminaires can be switched off at any point by operation of the manual switch.
- Absence Control: Luminaires are manually switched on. Luminaires are switched off automatically when occupants exit the room after a time.

Luminaire selection & control

Selection of luminaires will be as described below and as indicated within the luminaire schedule.

Circulation area – The lighting installation within the circulation areas will generally be via recessed LED circular luminaires. The control of the lighting in this space will be via automatic controls to provide presence detection.

Office - The lighting installation within the office will generally be via recessed 600x600 LED luminaires. The luminaires will satisfy the requirements of CIBSE Guide LG7. The control of the lighting in this space will be via automatic controls to provide absence detection.

WC's - The lighting installation within the WC's will generally be via recessed LED circular downlight luminaires. The control of the lighting in this space will be via automatic controls to provide presence detection.

Store & Cleaners - The lighting installation within the Store and Cleaners will generally be via surface mounted Linear LED luminaires. The control of the lighting in this space will be via automatic controls to provide presence detection.

Plant - The lighting installation within the Plant will generally be via surface mounted Linear LED luminaires with suitable ingress and mechanical protection. The lighting will be fully co-ordinated with the plant. The control of the lighting in this space will be via manual switching only.

General Classrooms – The lighting installation within the general classrooms will generally be via recessed 600x600 LED luminaires. The luminaires will satisfy the requirements of CIBSE guide LG5. The control of the lighting in this space will be via automatic controls to provide absence detection and local whiteboard control.

8.11 EMERGENCY LIGHTING

A new emergency lighting installation will be installed in compliance with the following:

- British Standards including BS 7671, BS 5266 and BS EN 1838, BS EN 12193
- CIBSE Codes for Interior Lighting
- The requirements of the Local Building Control Officer (BCO)
- Building Regulations

The electrical contractor will be fully responsible for the supply and installation of all emergency luminaires, as detailed within this specification.

To provide sufficient illumination in the event of a power failure, strategically positioned, stand-alone emergency luminaires with integral battery pack and inverter arrangement capable of providing illuminance in emergency conditions for a minimum period of 3 hours will be provided.

These luminaires will also be supplemented by dedicated non-maintained emergency “exit” luminaires. These fittings will be located as prescribed in the appropriate standards, to suit building control requirements and the fire strategy.

Emergency lighting will also be provided within external areas where occupants are required to travel to reach a place of safety.

All emergency luminaires will be fitted with a LED status indicator that is to be clearly visible at all times.

All emergency lighting and emergency lighting illuminated signs serving the building will be DALI and are to be connected to a central facility to test functionality and battery life.

The system will be capable of testing automatically to BS EN 62034. The system will include the following, but not limited to fault diagnostics indicating lamp, battery, and charger/inverter module status via LED indicators.

8.12 EXTERNAL LIGHTING

The electrical contractor will be responsible for the supply, installation and implementation of a new external lighting installation across the development, as indicated on the electrical drawings and in this specification, to meet with the agreed requirements of the client.

An external lighting scheme will be installed to provide safe movement around the site, freedom of access and security during the applicable hours of darkness.

The external lighting installation will be in accordance with the current relevant mandatory, legislative, and regulatory requirements, British Standards, Codes of Practice and Best Practice professional guidance publications including but not limited to:

- BS EN 12464-2
- BS 5489-1
- BS EN 12193
- BREEAM Assessment Criteria
- Building Regulations
- CIBSE/SLL Lighting Guides

The external lighting will be provided via building mounted and column mounted luminaires, complete with lamps and associated control gear, as per the external services layout drawing to the following areas: perimeter of the building.

The external lighting will minimise, as far as practicable, light pollution into adjoining areas and to the environment in general in accordance with ILP Guidance Notes for the reduction of obtrusive Light (GN01) whilst ensuring that the level of light is adequate for CCTV usage.

The external lighting design will be in compliance with BS EN 12464 – 2 Category E3.

The external lighting design will utilise LED light sources. These have a zero/near zero UV output which will limit the attraction certain insects have to the light source is what generally attracts flying insects.

The luminaires will have a colour temperature limited to 3000°K (with a lesser blue component in the light spectrum), which again limits the attraction to flying insects.

All external luminaires will be LED, vandal resistant and provided with security cover screws and costal protection finish and will be of a type to restrict upward light output.

All external will be IP65 minimum and will have minimum colour rendering of 60Ra.



The exterior lighting will be controlled via a separate time clock, contactor, and photocell arrangements. The photocell sensor will be mounted on the perimeter of the building. The location of photocells will be selected to give a true representation of ambient lighting levels with no interference from internal lighting systems or shadowing. All external luminaires will be controlled for use between 23.00 hours and 07.00 hours as the ILP's guidelines. The system will also be provided with a manual ON/OFF/AUTO override control facility.

8.13 PUBLIC ADDRESS / SOUND SYSTEM

The contractor will provide a complete and functional Public Address, Class Change & Lockdown System, including but not limited to the installation, testing and commissioning of, speakers, housings, microphones, zone controls and amplifiers within dedicated racks, cabling, containment, and accessories.

A multi zone system will be provided with paging microphones 2 number provided at an agreed location with the ability to page any individual zone or combination of zones or as required.

Speakers will be included to cover all areas including all, Teaching Rooms / Areas, Offices, Corridors, Main Halls, Dinning Areas and as agreed.

An Audio replay unit and time unit will be provided to relay the class change notification the system will be easily programmable for the change to winter / summertime schedules.

The system will be fully interfaced with the Fire Alarm and all audio enhancement systems will be disabled when fire alarm sounders are in operation.

All Offices, Administration, Community, Main Hall(s) areas including other areas as agreed by the client and design team will have a local volume control installed.

8.14 INTRUDER ALARM SYSTEMS

The system will be a grade 3 intruder alarm system will be installed throughout the school by a Specialist NSI, NACOSS Gold or SSAIB and LPCB accredited contractor.

The system will comply BS EN 50131-1:2006+A2:2017.

As a minimum, all rooms on the ground floor including all WC's and plant rooms with an external window or door, will be provided with intruder detection.

The system will be provided with a minimum of 16hr battery backup.

The system will provide sequential detection so that a confirmed alarm signal will be sent to a remote monitoring centre upon activation of a single device.

All detectors will be housed in a single unit, the units will incorporate 1 no PIR detector and 1 no Dual Technology detectors.

The intruder detection system will comprise of-

- Grade 4 signalling
- Grade 3 Door contacts to all external doors
- Grade 3 Sequential detectors complete with Mask monitoring
- Remote Keypads to set and unset the system including 5 no fobs.
- External sounders and beacons

The system will be linked to an external monitoring centre separately to the fire alarm system so that upon activation of an alarm and / or fault a signal is provided to allow notification to the emergency service or keyholder. To facilitate this the system will incorporate dual path signalling via a standard PTSN landline and mobile 4G roaming world SIM. As provided by CSL DualComPro. 12 months connection to the monitoring centre will be provided as part of the contract.

All external doors will be protected using a 24/7 monitoring facility via the sites Intruder alarm.

Each door leaf will be monitored using a magnetic read switch capable of automatically generating and alarm condition on the system.

The alarm condition will register at all keypads within the main reception area, providing a descriptive text of its location and producing an audible warning. Local audio/visual indication will also be provided adjacent to each monitored door set.

An override key switch will be installed adjacent to each monitored door set which when operated will allow egress through the door set without setting off an alarm.

On key reset, the monitoring for the door will be reinstated. A framed diagram of the building will also be included in line with the text description on the remote indicator keypad within main reception.



8.15 ACCESS CONTROL SYSTEMS

An IP based networked door access system will be provided to the school. All doors as indicated on the layout drawings will be provided with access control as indicated below.

The system will be designed and installed by an NSI, NACOSS Gold or SSAIB and LPCB accredited contractor.

The system will provide two step authentication at each door.

All requirements for each door are shown on the layout drawings.

All magnets are to be monitored so that the system can register a locked door.

All non-secure doors will be fitted with a reader and keypad to the secure side and push to exit and emergency break glass on the non-secure side.

All secure doors will be fitted with a reader and keypad on both sides. An emergency break glass will be provided to both sides of the door.

All emergency break glass units are to be provided with plastic covers to prevent unintentional action. All breakglass units within main reception, and class / teaching areas are to be fitted with plastic covers incorporating audible warning of use.

A network outlet at each controller linked back to a dedicated switch within the local ICT rack will be provided.

Each door will be linked to the fire alarm system via a dedicated interface unit.

1 copy of Net 2 pro software for the management of the system. The contractor will supply the PC for the management software and will match the recommended specification by Paxton will be provided.

A dual sided colour card printer as Magicard 600 and 1 copy of CardPresso XS software for on-site card printer will be provided.

100 printable access cards, lanyards and cardholders will be provided.

8.16 AUDIO VISUAL INTERCOM UNIT

The main entrance door, kitchen entrance, flying start entrance and community entrance will have an audio/visual intercom linked back into the reception area and local spaces. All intercom receivers will be complete with remote release.

The intercom unit will incorporate a touch screen, pan/tilt camera, two-way communication, built in keypad and token reader. The unit will be rated for external use IPX5 minimum.

The unit will be linked to hearing loop; the induction loop panel will be a compact unit within an IP enclosure the unit will be suitably locally located to ensure the emitted magnetic field will function correctly.

A desk mounted colour touch screen entry monitor for linking to the door entry intercom will be provided as shown on the layout drawings. The unit will provide two-way video communications with the door entry intercom and allow for release of the door. The unit will be provided with all associated power supplies and desk stands.

8.17 CCTV SYSTEMS

The electrical contractor will be responsible for the design, supply, installation, and implementation of the system.

The contractor will provide a complete and functional CCTV system within the building and external areas, including the installation, testing, and commissioning of, CCTV Cameras, housings and columns, Matrix switching and controls, monitors, digital recording equipment, cabling, PoE plus switch, containment and accessories.

The CCTV systems will be provided in full accordance with the following regulations:

- BS 7671 – IET Requirements for Electrical Installations.
- British Standards, including Codes of Practice and associated Statutory Acts.
- NSI (NACOSS) Codes of Practice – CCTV / Access Control / Intruder Detection
- BS EN 50132 – Requirements for CCTV Systems
- BS 7958 – Code of Practice for the Management and Operation of CCTV.
- BS 7807 – Code of Practice for the Design, Installation and Servicing of Integrated Systems.
- Data Protection Act 1998 – CCTV Codes of Practice
- National Security Inspection (NSI) Code of practice NCP104
- Client's insurers
- Police authority crime prevention measures.

In general, the system will be provided and installed to minimise the risk of equipment damage arising from acts of vandalism or any deliberate attempt to render equipment inoperable, as such CCTV cameras will be suitably IP rated.

The new CCTV system will be provided to cover, but not limited to, the following areas:

Internally



- Reception
- Circulation
- Corridors
- Externally
- Perimeter of building.

All cameras are to be 'power over Ethernet' (POE) type to negate the need to provide separate power supplies for the cameras.

The equipment will be fully maintainable by others and is not to be provided with manufacturer restrictive access codes.

The recording, operation, interrogation and viewing of the CCTV cameras will be undertaken within the main reception and office areas of the building.

2 No 24" wall mounted/ desk mounted HD TFT flat screen colour display monitor will be provided.

The systems will be capable of both day and night surveillance with all images displayed on all identified screens/monitors.

A network video recorder (NVR) will be located within the building data cabinet. The unit will be sized to accommodate the required quantity of camera plus 20% spare capacity for future expansion, with a minimum storage of 20TB. The system will contain an Aruba POE switch to form a complete system, including patch leads for both switch and unit ends.

The NVR will provide recorded images for the last 31 days. The system will have the facility for the administrator to select sections of the recordings and copy to a separate removable drive, while continuing to operate and record as normal. Access to recorded images will be by a unique identifier password.

Internal CCTV cameras will be fixed dome type set to provide the optimum view in each location and capable of self-learning video analytics. External CCTV cameras will be fixed position variable zoom.

The internal IP system will be capable of zooming to any part of the frame without the loss of quality or pixilation, with each camera using the software to achieve maximum picture and recording coverage.

The CCTV cameras will be colour, weatherproof (where appropriate) to IP66 standard and have a video resolution of no less than 1080p in colour mode and have integrated lens, backlight comparison and low light level of 0.75Lux.

All cameras will be complete with integral motion sensors so when activated resolution and frame rate per second will increase to ensure facial recognition.

The systems will include the supply and installation all necessary CCTV signage in accordance with the CCTV Code of Practice within the Data Protection Act 1998.

The Electrical Contractor will be responsible for the provision of all power supplies, wire ways etc. as required by the specialist supplier.

The overall system will be based on a modular design to allow its future expansion.

8.18 FIRE DETECTION AND ALARM SYSTEM

The system together with their ancillary systems will be a Contractor Design Package (CDP). The final detailed design of the system configuration, components and interconnections will be undertaken by a specialist manufacturer/installer in accordance with the standards detailed in this specification.

The electrical contractor will be responsible for the design, supply, installation, and implementation of new the system.

The system will be provided to meet the requirements of but not limited to,

- The Fire Engineer/Architect
- BS5839 Fire detection and Fire alarm systems for buildings
- Building regulations
- BS 9999 Fire safety in the design, management, and use of buildings
- BS 7671 IET Requirement for Electrical Installations.
- BS EN 54 Fire Detection and Fire Alarm Systems

This does not pre-empt the use of other standards and regulations which may form part of the listed terms that are required by local bylaws, including building Control and Fire officer comments, together with fire engineer risk assessments.

The fire alarm and detection system will be Category Type L2, designed and installed in accordance with the recommendations of the fire engineering strategy and with BS 5839 Part 1:2017.

The system will be able to be networked and remotely monitored.



A fully analogue addressable fire alarm and detection alarm system complying with current British Standards BS 5839 and Building Regulations Approved Document B will be installed.

The system components and protocol will be manufactured by the same manufacturer and use an open protocol that can be easily editable or extendable if any devices to be added in future.

The fire alarm and detection system will comprise of automatic high-performance point detectors, manual call points, audible and visual alarms, fire alarm panel, fire alarm repeater panel and associated ancillary equipment.

There will be sufficient standby power within the fire alarm panel for a minimum of 24 hours normal operation followed by activation for 30 minutes. The batteries will have a minimum life expectancy of 5 years.

In areas where occurrence of false alarm is likely to happen combined smoke/heat/carbon monoxide detectors will be provided.

The manual call points will be provided with approved hinged plate protective clear covers to avoid accidental operation. These will be surface mounted all point stoppers with integral sounders and anti-tamper break seal.

Void detectors will also be provided in voids above 800mm and those ceilings below 800mm that include items of high risk as per the existing system.

All devices will be located in accessible positions such that ongoing maintenance access is not restricted or impeded.

Generally, automatic and interface devices will be finished in white, and wall mounted sounder beacons and manual call points finished in red.

Activation of the fire alarm system will sound an evacuation alarm. The contractor will provide interfaces, as a minimum but not limited to the following items of equipment.

- Sprinkler System Control Panel
- Door hold open devices
- Access Control Systems
- Lifts
- Mechanical Control Panels
- Ventilation Controls
- BMS
- Emergency voice communication system

The system will be programmed with a delay period for all interfaced equipment to ensure these are not disrupted during the weekly routine testing.

The fire alarm system will operate on a single knock activation; whereby the operation of a single break glass or automatic fire detection will result in the evacuation of the entire building.

The cables for the fire detection and alarm systems will be in red sheathed enhanced fire resisting cable in accordance with the requirements of BS 5839-1.

Fire alarm cabling will be run on dedicated cable basket installed in metallic conduit where drops to sounders and accessories are made.

The fire alarm will be raised by the use of electronic sounders with an identical tone to those used throughout the building. Sounders will be supplemented with flashing beacons in the following areas.

- Plant Rooms
- Kitchens
- Where ambient noise levels are expected to be high
- To meet requirements of Part M building regulations (e.g. sanitary areas)

All devices will be permanently labelled showing loop address and device number, handwritten labels will not be accepted.

A framed fire zone plan drawing will be fitted next to the main panel.

The system will be linked to an alarm receiving centre so that upon activation of an alarm and / or fault a signal is provided to allow notification to the emergency service or keyholder. To facilitate this the system will incorporate dual path signalling via a standard PTSN landline and mobile 4G roaming world SIM. As provided by CSL DualComPro or equal and approved. 12 months connection to the monitoring centre will be provided as part of the contract.

8.19 FACILITIES FOR THE DISABLED

WC CALL ALARM SYSTEM

The electrical contractor will be responsible for the design, supply, installation, and implementation of the system.

A WC call system is to be designed, provided, installed, and commissioned by the electrical contractor in accordance with BS8300 and Building Regulations Approved Document Part M.



WC call to be as the following:

- Disabled WC's linked to the staff room and reception.
- This system will also be linked to the BMS to allow remote monitoring.

The system will identify the location of any person who is in difficulty and will comprise of the following components as a minimum:

- Ceiling pull cords - with integral reassurance lamp
- A reset unit installed within the WC, accessible from the WC.
- Overdoor/ceiling indicator unit with sounder
- Call alarm panel
- Ancillary equipment

Each system will only be resettable within the location where the call was made.

Toilet alarm panel will be installed within the main reception office to alert staff of an activation of the call system. Final location of panel to be confirmed by the client.

The system will have an integral battery back-up facility providing a minimum autonomy of 3hours. All controls cables will be Euroclass CCa and LSOH.

AUDIO FREQUENCY INDUCTION LOOP SYSTEM (AFILS)

The electrical contractor will be responsible for the design, supply, installation, and implementation of the system.

An AFIL systems is to be provided in accordance with Approved Document M, BS 8300, BS 7594 and BS EN 60118-4.

Hard wired AFIL systems will be provided to the Hall, Community Kitchen, Community Room and Interview rooms and will generally consist of an induction loop installed beneath the floor and be complete with driver, a microphone and associated ancillary equipment.

2 No. Additional portable AFIL systems will be provided.

8.20 IT AND DATA INSTALLATION

The electrical contractor will be responsible for the design, supply, installation, and implementation of a new the system.

The contractor will employ the services of a specialist contractor to install, test and commission a complete Voice/Data network system in accordance with BS EN 50173 and BS EN 51174.

The contractor will supply, install, and commission floor mounted 47U data cabinets to serve the requirements of the building.

Allowance to be made a 15U Wall mounted cabinet within Flying Start, provision TBC.

The cabinets will be provided with all necessary cable management and removable panels and doors, sized to suit the requirements for each area of the new building and future expansion, and will adopt the numbering system utilised site wide.

The cabinets will be provided with all active hardware including racks PoE plus switches for voice and data, patch panels, patch leads, server, and multi-way power distribution bars.

PoE plus switches to be 48v to ensure compatibility with CCTV and to be a minimum of 2 layers with 20% spare capacity. Switches to be manufactured by HP Aruba.

The contractor will supply, install, and commission the required connections between the BT ONT (Optical Network Termination) point and the data cabinets, including but not limited to containment, multicore copper and fibre.

A horizontal structured cabling system is to be provided throughout the building to facilitate the IT, Telecoms and AV requirements. The cabling to the will be Level CAT 6A F/ UTP Copper cables, Low Smoke Zero Halogen type Euroclass CCa.

The installation will ensure that no final data cable is greater than 90m in length.

Wireless access points will be provided, where the numbers and positions will be determined by the contractor. The contractor will provide dual data outlets to each WAP. PoE access points to be Aruba.

Telephone lines to be provided via VOIP and PSTN, which are required to all staff working areas. The contactor will allow to supply all Cisco IP handsets allow 30 No for the school, positions to be agreed.

Quantities and locations of data outlets should be sufficient for a modern building to allow various layout of furniture and equipment. Faceplates, plugs and terminations are to be from one of the following manufacturers: AMP, ADC Krone, Hellerman Tyton or Molex or equivalent. The network is to be fully tested by the contractor and test details made available to the client.



All back boxes will be installed by the contractor with face and terminations undertaken by the specialist data contractor.

IT outlet plates will be provided to meet the requirements of drawing, to be used in conjunction with, but not limited to the following equipment:

- Telephone Handsets
- Computers
- Interactive white board/Screens
- Audio/Visual equipment
- Video information systems
- Wireless systems
- CCTV system
- Access Control System

The Voice services will be delivered by VOIP with messaging services.

Summary of ICT responsibilities:

	Spec / design	Budget	Install
Horizontal structured cabling	Contractor in line with Spec.	Contractor	Contractor
Rack / Cab	Contractor in line with Spec.	Contractor	Contractor
Containment	Contractor in line with Spec.	Contractor	Contractor
Cooling	Contractor in line with Spec.	Contractor	Contractor
UPS	Contractor in line with Spec.	Contractor	Contractor

	Spec / design	Budget	Install
Backbone / Fibre	Contractor in line with client Spec.	Contractor	Contractor
Active equipment	Contractor in line with client Spec.	Contractor	Contractor
Wireless access points	Contractor in line with client Spec.	Contractor	Contractor
Post installation wireless field strength survey and addition of any necessary wireless access points cabling to same	By Client	By Client	By Client
Audio Visual	Contractor in line with Spec.	Contractor * associated containment by Contractor	Contractor

8.21 AUDIO VISUAL INSTALLATION

Audio visual provision will be provided within the teaching areas, which will consist of interactive whiteboards and controls, which will be provided by the client.

The following connections will be provided at each teacher control station/ desk within dado trunking:

- Soundfield IRRX2 systems including loudspeakers and adjustable line level connection points.
- HDMI connection
- VGA connection
- USB composite
- Audio connectivity at the teachers desk



8.22 STAGE LIGHTING & POWER

A fully functioning stage lighting and power system for performances within the Main Hall will be provided. At this stage of the design as a starting point we would propose the following.

Equipment & Cabling

All equipment (except induction loop amplifier) to be mounted in 16U portable flight case.

The equipment Will plug into a wall mounted patch panel which will contain sockets for:

- Speakers
- Induction loop
- DMX
- HDMI/VGA

AMX panel to be custom programmed to operate the projector and screen.

Main Hall Audio System

The system will comprise the following equipment/controls:

- 1 No. Mixer Amplifier
- No. Cabinet Loudspeakers complete with wall brackets.
- 1 No. CD/USB/SD Player
- 1 No 16U Portable Flightcase/rack
- 2 No. Hand Held Radio Microphone System

Main Hall Lighting System

The system will comprise the following equipment/controls:

- 1 No. 8 metre Internally wired lighting bar C/W 8 no 13a & 2 no DMX I/O
- 1 No. Zero 88 Juggler 24 Lighting Desk (or equal and approved).
- No. 36x8w RGBW Par64 LED Fitting (or equal and approved).
- 1 No. DMX wall connection point

Main Hall Projection System

The system will comprise the following equipment/controls:

- 1 No. Optoma W515 6000 Lumen Projector (or equal and approved).
- 1 No. 3.5m Sapphire Electric Screen (or equal and approved).
- 1 No. 8 Button AMX Novara Control Panel (or equal and approved).
- 1 No. laptop Connection Point

It is proposed that a workshop is undertaken to finalise the details.

8.23 LIGHTNING PROTECTION SYSTEMS

A Specialist Lightning Protection installer (SLP) will undertake a risk assessment to determine the provision of a lightning protection system in accordance with BS EN 62305 and BS7671.

If the results of the risk assessment identify the requirement for a LPS, the lightning and surge protection systems will be designed and installed in accordance with the recommendations of BS EN 62305 to offer optimum protection of the building, the buildings integral equipment, staff and the public against the effects of a lightning strike.

The SLP will design, supply, install, test and commission a complete structural lightning protection system to satisfy the results of the risk assessment.

The design will also comply with, but not limited to: -

- BS EN 62305 Protection against lightning (Parts 1-4)
- BS 7671 IET Wiring Regulations 18th edition and associated guidance notes.

The specialist will be a member of the of the national federation of master steeplejacks and lightning conductor engineers registered under BS EN ISO 9000 for quality assurance.

The building will incorporate inconspicuous installation techniques i.e. using the structure of the building as part of the lightning protection system wherever possible.

The proposed lightning protection system will provide protection against lightning utilising an air termination network, roof conductors, down conductors, bonds to exposed permanent metal parts, air terminals, testing points, earth terminations and earth electrodes.

The whole of the structure will be protected with a fully interconnected lightning protection system i.e. no part of any structure should be protected in isolation.



It is proposed that the roof network will be installed above all roof coverings.

Final connection to earth will be made via earth electrodes to form a type A earth termination system. Comprehensive earth resistivity measurements will be taken in the locations of all earth electrodes and will utilise the data collected to determine the proposals for the lightning conductor earth network.

8.24 EARTHING AND BONDING SYSTEMS

The system together with their ancillary systems will be a Contractor Design Package (CDP). The final detailed design of the system configuration, components and interconnections will be undertaken by a specialist manufacturer/installer in accordance with the standards detailed in this specification.

The electrical contractor will supply, install, and commission an earthing system in full accordance with BS 7671 and BS 7430.

The earthing will provide sufficiently low impedance to facilitate satisfactory protection and operation of protective devices under fault conditions.

The earthing system will retain system voltages within reasonable limits under fault conditions and ensure that the insulation breakdown voltages are not exceeded.

All extraneous conductive parts will be bonded to the Main Earth Terminal including the following:

- Lightning Protection
- Building structure
- Incoming Electrical services
- Incoming Mechanical Services
- Cladding
- Sprinkler System

All services entering the building will be bonded as close to their entry point as practically possible. All earthing conductors will be fully labelled at both ends of their length.

8.25 MAINTENANCE

12months maintenance of the complete electrical installation including the fire alarm installation after each phase is completed will be provided.

This will include the following:

- 2no Seasonal commissioning of lighting controls
- 1No visit at 11months to clean and inspect all luminaires
- Inspect and clean all switchgear.
- 1No visit at 11months to test all emergency lighting for 3hr duration.



9 NEXT STAGE

The following is key information required for items that will be considered at the next design stage:

- Development of RIBA Stage 3 MEP information to stage 4.
- Room data sheets to aid with the development of:
 - Ventilation requirements
 - Cooling requirements
 - Water requirements
 - Drainage requirements
 - Power requirements
 - Data requirements
- Security workshop
- Fire strategy development (by others)
- Sprinkler systems.
- Fire evacuation procedures.
- Fire extinguishers.
- Any gas suppression systems
- Emergency voice communication systems
- Exit signage.
- IT/AV requirements.
- Confirmation of provision of Wi-Fi access points.
- Requirements for external power supplies / controls.
- Plant spacing finalisation.
- Confirmation of external lighting requirement for ecology.
- Data/ Comms requirements
- Confirmation of PV array requirement for NZC.
- Private Wire connection.



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Merthyr Tydfil County Borough Council

TM54 OPERATIONAL ENERGY ASSESSMENT

Goetre Primary School





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EXECUTIVE SUMMARY

This report has been prepared by WSP based on the guidelines set out within CIBSE TM54 - Evaluating Operational Energy Performance of Buildings at the Design Stage.

This document was produced to provide the TM54 assessment for the proposed Goetre Primary School building in Merthyr Tydfil, Wales. In particular, this report has been conducted to generate the predicted operational energy consumption figures for the building.

These predicted figures are produced from a thermal model that is not using the National Calculation Methodology (NCM) predefined profiles for energy consumption but attempts to predict a more realistic energy consumption based on expected profiles of occupant behaviour and equipment usage.

To determine the operational energy use of the proposed project, dynamic simulation modelling (DSM) has been undertaken using IES-VE, accredited software, which has been selected and applied in accordance with CIBSE TM54.

The TM54 assessment estimated results are as follow:

- The assessment shows an overall annual energy consumption in the region of 272-285 MWh/year.
- The highest energy consumption is reported for the domestic hot water (DHW) which accounts for the 24% circa of all the energy demand.
- The second item in the list is the energy used for catering which accounts for 20% circa of the total energy demand. General equipment electricity and server energy demand account for 19% of the total equipment energy.
- Heating requirements and lighting for the overall building each contribute approximately 13%.
- Among all categories, auxiliary energy and cooling energy represent the smallest proportions at around 10% and 0.4%, respectively.

It is critical that all the specified parameters and performances are achieved, and the finalised calculation reiterated before procurement to ensure they meet the requirements. The intention of this assessment is to bridge the gap between the NCM methodology results and the actual energy performance of the building. However, occupant behaviour and consequent energy consumption is difficult to predict accurately and therefore a gap between the results presented in this report and actual metered energy data is still possible to be seen during the regular usage.

LETI COMPARISON

LETI has proposed a set of targets (performance and design criteria) for educational building and this a widely used as metrics to compare the performance of all the new (and existing) school buildings.

The performance of Goetre is currently estimated to exceed the recommended energy consumption LETI target. Whilst the heating space demand is below the recommended target (10.7 – 11.3 kWh/m²/year for Goetre, 15.0 kWh/m²/year LETI target), the overall energy consumption is above the recommended 65 kWh/m²/year figure. This is mainly due to catering and equipment energy demand which alone constitute 40% circa of the entire energy demand. Also the currently simulated operating hours are not typical of a school and this is deemed to have increased the off-of-hours energy demand.

It is expected that the equipment consumption will be reduced once that specific information of the equipment will be received at the next stage.

With regards to the catering energy, the model has allowed for the energy consumption in line with the Client feedback and expected operation. Some reduction can be achieved on this item at the next stage if the number of meals per day is reduced or if more detailed data about the kitchen equipment is received.

Table 1-1 – LETI performance comparison (TM54 Operational Energy)

End use	Lower End LETI target	Upper End Goetre achieved performance
Energy consumption (kWh/m ² /year)	65.0	81.1 – 85.0
Heating space demand (kWh/m ² /year)	15.0	10.7 – 11.3

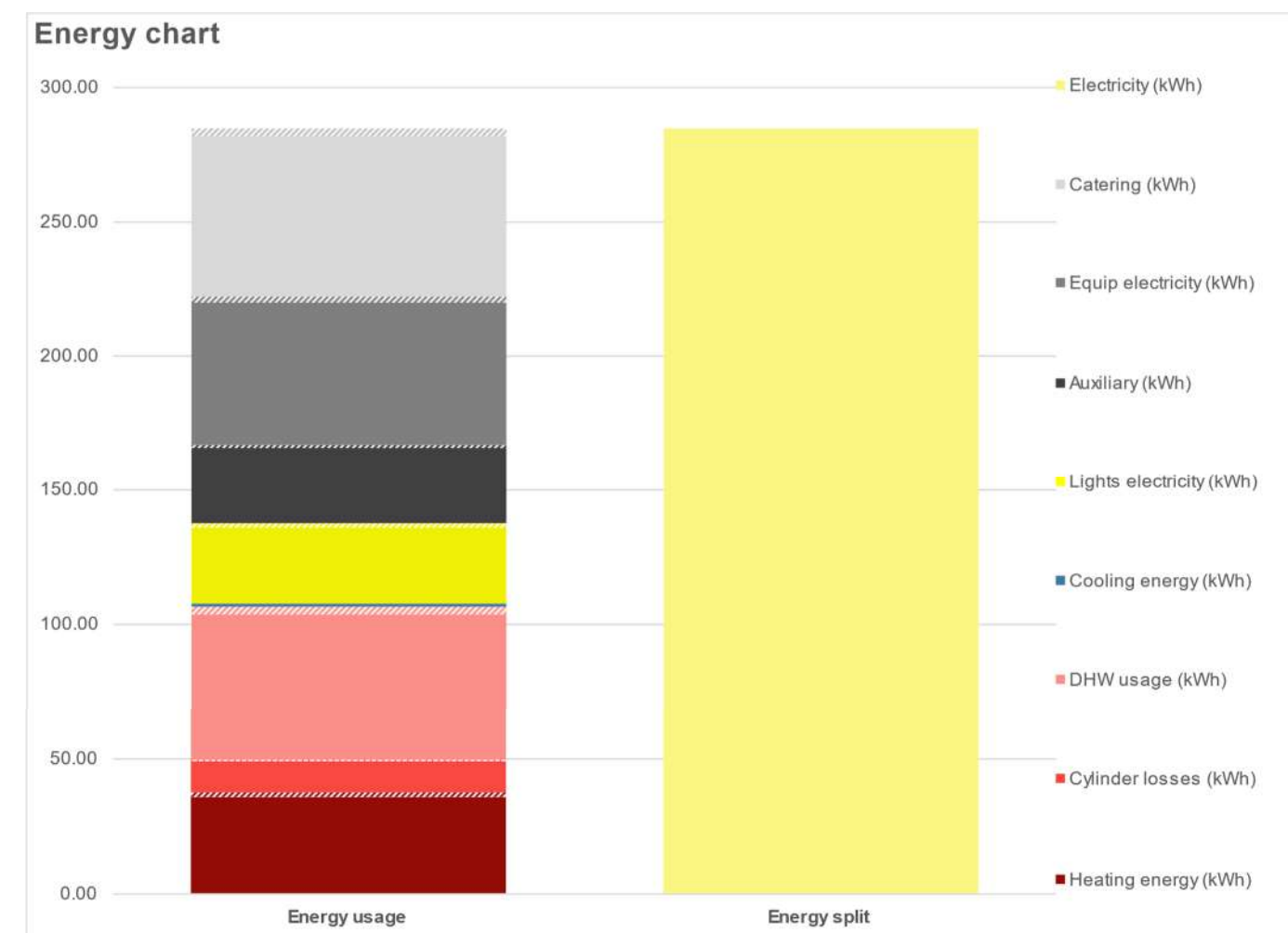


Figure 1-1 – Predicted Energy use breakdown of the proposed Goetre Primary School.

1 INTRODUCTION

The climate emergency is driving a requirement to deliver highly performing buildings, with operational energy use consistent with net zero targets. CIBSE TM54 Evaluating operational energy use at the design stage provides guidance on the tools and techniques that can reliably and robustly model in-use energy performance based on design proposals that can be used to inform design decisions.

CIBSE TM54 was originally issued to cover the 'performance gap' between the expectations around the performance of new buildings set out by Part L of the building regulations and the actual in use energy performance. This gap is mainly due to omission of unregulated energy use in the Part L compliance model, where items such as small power (electrical appliances e.g., PCs), elevators, catering facilities, external lighting, server rooms etc. are not included.

CIBSE TM 54 gives clear guidance on how to evaluate operational energy use at the design stage giving an indication of the real energy use and carbon dioxide emissions. The estimated energy use of the building can then be assessed against energy generation from renewables to demine the NZC Operational Energy status of the building.

The calculations include items of plant and equipment, usually not included in the Part L compliance model such as:

- Small power;
- External lighting;
- Catering facilities;
- Server rooms; and
- Elevators/Escalators etc.

Complex systems (i.e., heating, cooling, auxiliaries and domestic hot water) are evaluated using a dynamic simulation model (DSM) that provides an accurate estimation of energy use if compared to steady-state calculations.

The report will cover all aspects of energy use detailed above to calculate the building's energy consumption and the required energy generation to demine the NZC Operational Energy status.

Typical Buildings

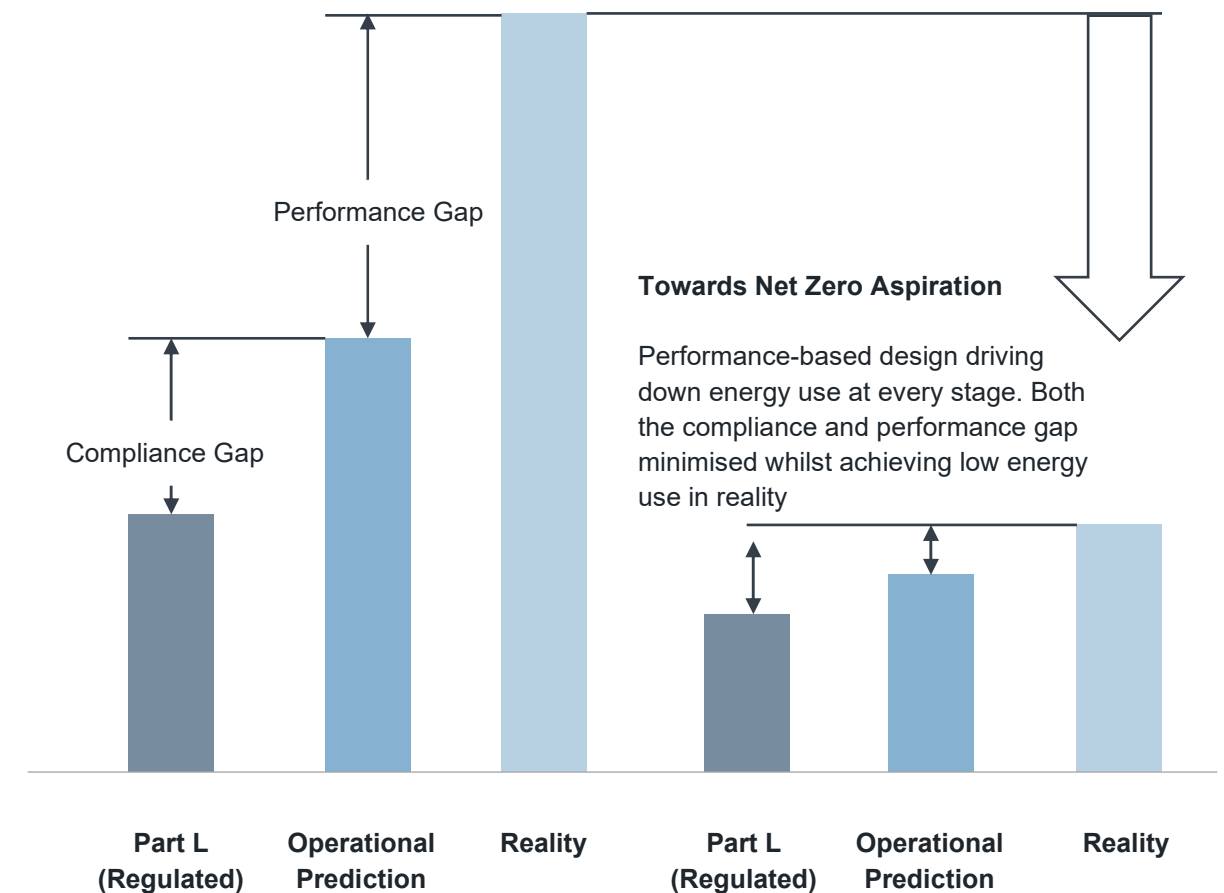


Figure 1-1 - Energy Performance Modelling Can Help with Dual Aims: Reducing the Performance Gap and Producing Better, Lower Energy Use Buildings (CIBSE)

The Figure 2-1 shows the proposed site plan for the school.



3 TM54 METHODOLOGY

The TM54 methodology provides better calculation for operational energy usage of non-domestic buildings and supplies an informed indication of range of energy use, carbon emission and running costs. The estimation uses simplifications and assumptions that try to describe the way the real building would operate, but do not provide an exact picture of the operational performance.

The methodology follows a step-by-step process as summarised in the figure on side. At the outset, a data-gathering exercise is undertaken in Steps 1 and 2 to acquire more information about the intentional use of the building, including operating hours and occupancy figures. The TM54 methodology describes that energy consumption calculations for step 3-9 (internal and external), lifts, small power (such as PCs and TVs), catering (cooking equipment and refrigeration), server equipment and 'other' equipment unique to the project are performed by simple calculation methodologies outside a DSM (Dynamic Simulation Model). However, the demands and operational times for the above items can be input directly into IES's ApacheSim dynamic simulation model as a more progressive approach. In Step 10 the internal gains are input into the DSM so that the heating, cooling and ventilation systems reflect the actual real-life usage of the building for more accurate energy consumption figures compared to the standardised approach of Part L. The energy demand and consumption from space heating, cooling, fans and pumps along with any humification and dehumidification where applicable is then calculated within the DSM in Steps 11 and 12.

In Steps 13 management factors are applied to account for potential increased energy use if the building is not well managed and maintained. Finally, in Steps 14-16 a sensitivity analysis is undertaken to demonstrate how the energy use of the building could be affected by future changes such as increased occupancy figures or climate change. At the end of this process, the results are presented in Step 17.

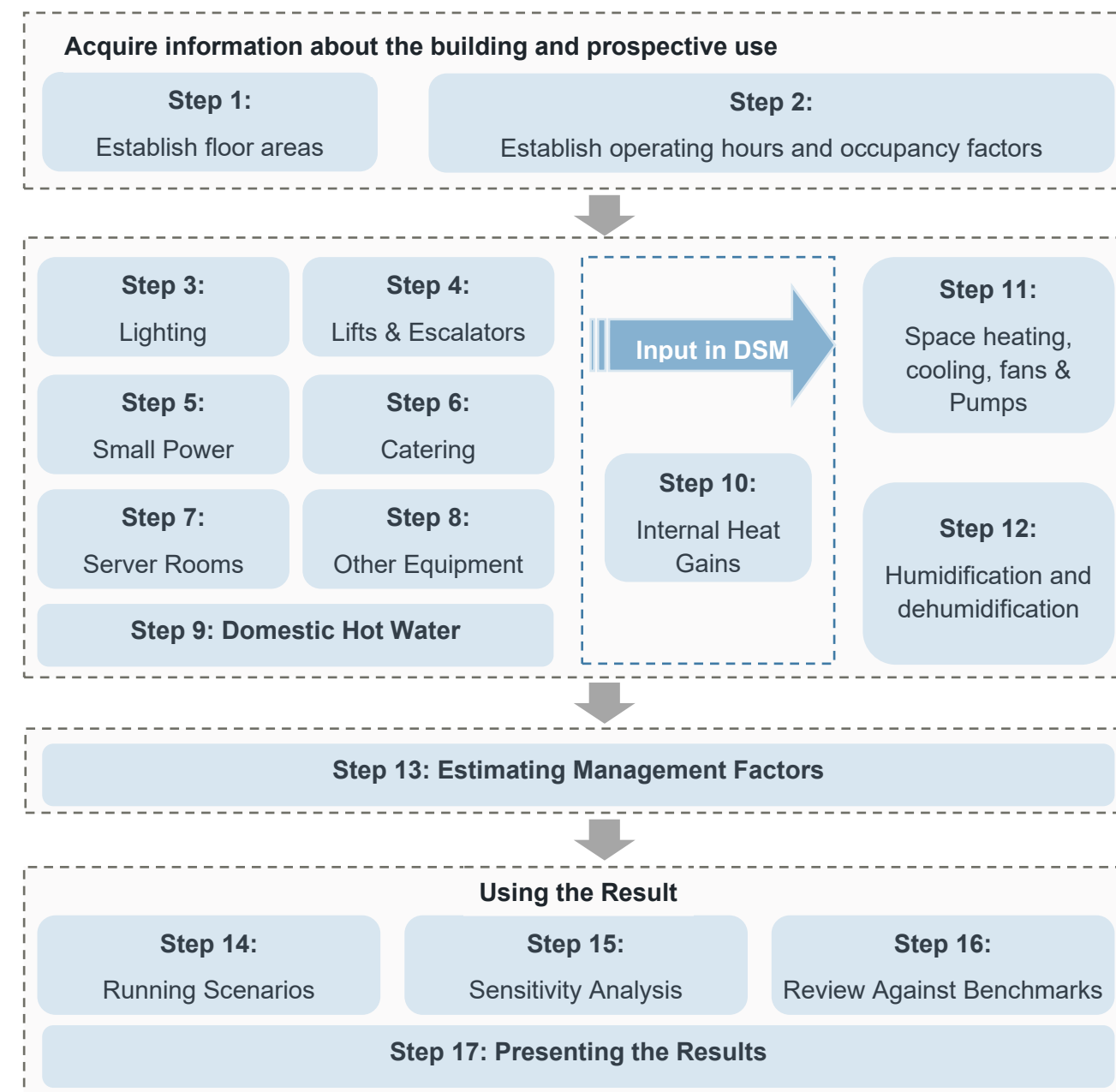


Figure 3-1 - Methodology for Evaluating Operational Energy Use at The Design Stage (CIBSE)

4 DSM CALCULATION

A Dynamic Simulation Model (DSM) has been produced for the development, which simulates conditions within the building based on the building's construction, internal loads & usage patterns (lighting, occupancy and small power, etc.) and on weather data based on location.

4.1 DSM MODELLING PARAMETERS

A model was constructed using the IES VE, version 2023.3.1.0. building performance modelling software and populated with accurate data to represent the local climate, building type, building fabric and building services. Occupancy and use profiles are based on the data provided by the Client through a questionnaire and expected patterns over a twelve-month period (January – December), for the calculation of the predicted energy consumption.

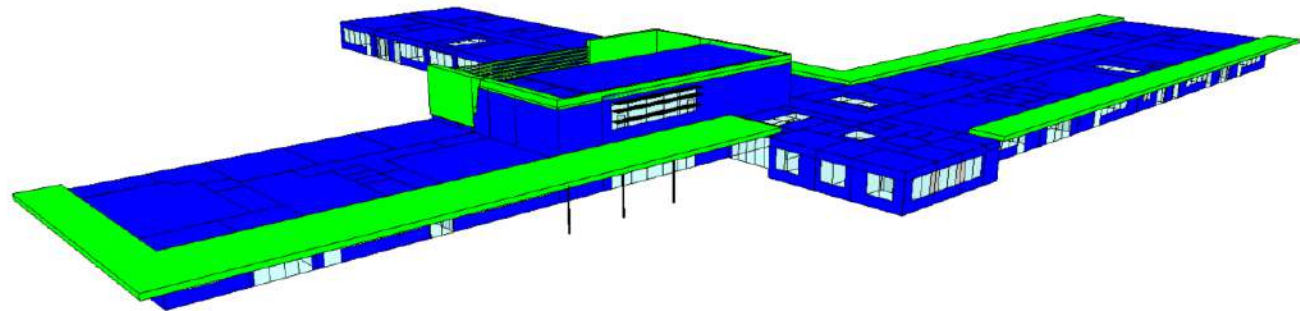


Figure 4-1 - Model geometry created in IES-VE software.

4.1.1 ARCHITECTURAL INFORMATION

The thermal model was created using the following architectural drawings/model provided by Lawray Architects:

Table 4-1 - Architectural information

Date Received	Information
January 2024	26CB01-LAW-XX-XX-M-A-0002.rvt

Note:

The thermal model has been based on the listed model above. If the design is subject to changes, an update may be required.

4.1.2 WEATHER DATA

Simulation Weather Data: Cardiff_DSY1_2020High50_.epw

4.1.3 CONSTRUCTION MATERIALS

The U-Values of the constructions are shown below:

Table 4-2 - Envelope thermal performance

Building Element	Actual Building U-Values (W/m ² K)
External Wall	0.12
External Wall (Cladding to Hall)	0.10
Ground Floor	0.08
Roof	0.10
Window	1.20
Glazed Door	1.40
Rooflights	1.70
Solid door	1.60
Building air permeability target	3.00 m ³ /m ² .h @ 50Pa

The key solar properties of the glazing used in the model are shown below:

Table 4-3 - Glass parameters

Glazing Specification	Actual Building
Light Transmittance:	71%
G-Value:	0.40

4.1.4 INTERNAL CONDITIONS

Internal conditions have been set based on the information provided by the client and current mechanical design.

4.1.5 OPERATIONAL TIME & OCCUPANCIES

Operational hours and occupancies are determined based on client feedback obtained through TM54 questionnaires. The school's annual opening days are established by considering holiday periods, including 2 weeks for Christmas, 2 weeks for Easter, 3 weeks for half-term, and 5 inset days. It has been acknowledged that the school operates during summer holidays from 9:00 to 13:30, and this

information has been incorporated within the thermal model. In instances where specific details were unavailable, reasonable assumptions were applied.

For a comprehensive overview of occupancy hours, lighting specifications, and equipment profiles, please refer to Appendix A. The holiday schedule is detailed in the table below.

Table 4-4 - School holiday schedule

Duration	Holiday
December 18-January 03	Christmas vacation
February 13-February 21	Half term+ inset day
April 03-April 18	Easter vacation
May 22-May 30	Half term+ inset day
October 23-October 31	Half term+ inset day

4.1.6 HEATING & COOLING SETPOINTS

The heating and cooling setpoints adopted for the development are detailed in the table below:

Table 4-5 - Heating and cooling setpoints

Room Type	Heating Setpoint	Cooling Setpoint
Classrooms & Offices,	21°C	Not cooled
Meeting & Staff Rooms	20°C	Not cooled
Hall/Servery	20°C	Not cooled
Circulation	19°C	Not cooled
WC	21°C	Not cooled
Server rooms	16°C	18°C
Store, plant	Not heated	Not cooled

4.1.7 APERTURES

To model the natural ventilation strategy of the building, apertures have been included in the thermal model and assumed to open as detailed below:

Table 4-6 - Window apertures

Aperture Type	Schedule
Openable external Windows	When indoor temp > 23°C & When indoor temp > outdoor temp; Or When CO ₂ level > 800ppm
Openable external Windows (Catering Kitchen)	When indoor temp > 23°C & When indoor temp > outdoor temp; Or When CO ₂ level > 800ppm
Internal doors	Open continuously (15% of the total area)
External doors (teaching areas)	When outdoor temp > 15°C (8:00-15:00)*
External main door	During occupancy hours (8:00-17:00)*

*Summer operational hours (9:00-13:30) are considered in the profiles.
The operation of the external doors within the classrooms has been based on the general concept that when the external temperature is not too low, the pupils will be playing outside with the teachers keeping the door open. When the external temperature instead drop below the threshold, the external doors are assumed to be closed.

The main entrance doors to the building have been assumed open when the building is occupied to simulate the increased infiltration and to the continuous operation.

4.1.8 SHADING DEVICES

The architectural design, including external shading elements, has been modelled and taken into account in the assessment.

4.1.9 HEATING SYSTEM DETAILS

The heating is produced through an Air Source Heat Pump (ASHP) system, primarily distributed through underfloor heating to the majority of spaces. However, specific spaces such as Offices, Staff and Group Rooms, as well as some WCs and Cloakrooms, are equipped with radiators. Air heating is utilised for the kitchen, while the server room employs a DX split system to offer both heating and cooling. The heating system efficiency details are described in the Table 4-7.

Table 4-7 - Heating systems specifications

Heating System Detail		
	System 1	
	Rooms applied	Community Office, Deputy Head Office, Group, Staff and Quiet Room & WCs
	Emitter type	Radiator
	Heating method	ASHP

Heating System Detail		
	SCoP	3.57
System 2		
Rooms Applied	Teaching spaces, Circulation, WC, Cloaks	
Emitter type	Underfloor heating	
Heating method	ASHP	
	SCoP	3.57
System 3		
Rooms Applied	Hall	
Emitter type	Air distribution	
Heating method	ASHP	
	SCoP	3.57

4.1.10 SPLIT SYSTEM DETAILS

The Server Room is served by a DX split system, served by an ASHP, which provides the heating and cooling. The rest of the spaces in the building are not mechanically cooled and are only naturally or mechanically ventilated.

Table 4-8 - Cooling system specifications

VRF System		
System 1: ASHP-DX split		
Rooms applied	Server Room	
SCoP	4.2	
SEER	6.8	

4.1.11 VENTILATION SYSTEM

The ventilation approach implemented at Goetre Primary School involves comprehensive management through mechanical ventilation, complemented by the strategic use of open windows to mitigate the risk of overheating in the summer. This precise control is facilitated by the integration of locally installed Mechanical Ventilation Systems with Heat Recovery (MVHR) which effectively adjust the airflow rate according to the specific room requirements. Further details are provided below.

Table 4-9 - Ventilation systems specifications

Ventilation		
	System 1	
	Rooms applied	All spaces
	System Type	MVHR
	Heat Recovery efficiency	Varied (86%-91.9%)
	Heat Exchanger type	Plate heat exchange
	Specific Fan Power (SFP)	Varied (1.0-1.6 W/l/s)
	System 2	
	Rooms applied	Kitchen
	System Type	Air handling unit (AHU)
	Heat Recovery efficiency	Run-around coil
	Heat Exchanger type	Plate heat exchanger
	Specific Fan Power (SFP)	1.7 W/l/s

4.1.12 DOMESTIC HOT WATER SYSTEM

The Domestic Hot Water (DHW) systems have been modelled based on the information received on the current design. Some spaces have a direct electric point-of-use (PoU) system with no storage whilst other spaces are served by a direct electric water heaters with small DHW storage units. Details can be found in the Table 4-10. In addition to this, the following allowance have been made:

- A DHW demand of 4.58 ltr/day has been assumed for each pupil; and
- The kitchen will utilise DHW to prepare 675 meals daily, accounting for breakfast for 50% of the students and lunch for 100%, with an allocation of 2.02 litres per meal.

Table 4-10 - Domestic hot water (DHW) details

DHW System Detail		
System 1		
Rooms applied	Catering Kitchen	
DHW heating method	Direct electric (PoU)	
Storage unit	EWH-00	
No. of unit	3.0	
Seasonal efficiency	100%	

DHW System Detail		
Thermal store volume	N/A	
Storage losses	N/A	
System 2		
Rooms applied	Single WCs & Cleaners	
DHW heating method	Direct electric	
Storage unit	EWH-05	
Thermal store volume	Unit size	5.0L
	Number of units	19.0
	Total storage volume	95.0 litres
Storage losses	0.35 KWh /day/unit	
Seasonal efficiency	100%	
System 3		
Rooms applied	Nursery classes & associated WCs	
DHW heating method	Direct electric	
Storage unit	EWH-10	
Thermal store volume	Unit size	10.0L
	Number of units	5.0
	Total storage volume	50.0 litres
Storage losses	0.48 KWh/day/unit	
Seasonal efficiency	100%	
System 4		
Rooms applied	Classrooms, Staff, Community Kitchen	
DHW heating method	Direct electric	
Storage unit	EWH-15	
	Unit size	15.0L
	Number of units	32.0

DHW System Detail			
		Total storage volume	480.0 litres
	Storage losses	0.62 KWh/day/unit	
	Seasonal efficiency	100%	

4.1.13 LIGHTING

The lighting calculations provided by the electrical design team have been used to account for the lighting energy usage. Daylighting has been applied to all the suitable rooms and external lighting energy usage has been also considered.

No allowance has been done for the lighting control as it is difficult to estimate the energy savings arising from the controls alone. It is recognised that a reduced lighting energy demand can be achieved but in the current assumption is deemed to be the “worst scenario” with regards lighting and it is deemed suitable for the scope of this assessment.

Room-level inputs can be found in the electrical specification, however high spec LED luminaires have been specified and bespoke lighting calculations carried out and incorporated into the building modelling. Being the current design at RIBA Stage 3, not all the designed spaces had the calculation undertaken. Where information is not available, the values used for other similar spaces have been used as reference.

It is recommended that the calculations for all the spaces are undertaken at the next stage and the achieved performances used to inform the revised thermal model.

5 UNREGULATED ENERGY CONSUMPTIONS

management factor should be accounted for in the calculation results, representing how well the building is likely to be managed. The initial TM54 estimation assumes a management factor of 10% as upper end applicable to all the considered end-uses.

CIBSE TM54 was originally issued to cover the 'performance gap' between the expectations around the performance of new buildings set out by Part L of the building regulations and the actual in use energy performance. This gap is mainly due to omission of unregulated energy use in the Part L compliance model, where items such as small power (electrical appliances e.g., PCs), elevators, catering facilities, external lighting, server rooms etc. are not included. The unregulated energy consumptions are as below.

5.1 EXTERNAL LIGHTING

The external lights & façade lights have been considered in the simulation model as unregulated energy and been included in the TM54 operational energy calculation. The external courtyard lights are assumed to be used six hours per day for each day of the year.

5.2 GENERAL EQUIPMENT (SMALL POWER, COMPUTERS, PROJECTORS, ETC)

Equipment has been modelled to be in use based on the room level operation profiles. Each item of equipment has a nameplate power and a diversity rate to determine the total energy consumption for equipment per room but has been reported as a total power for the space. At this stage of the design, no detailed information about the internal equipment is available so reasonable assumptions have been done. Further information on the assumed internal gains is available in Appendix A.

5.3 ANCILLARY SYSTEM (SERVER, FIRE ALARM & SECURITY)

These include the server, the fire alarm system, and the security alarm system. These systems are expected to run 24/7. The server energy consumption is reported in the additional equipment energy and no security or fire alarm system has been considered in the calculation.

For the server room, a maximum load of 3.0 kW has been assumed with a variation profile between 40% and 80% during the night and day respectively.

5.4 CATERING

The Catering Kitchen is designed as a full-scale kitchen which will serve the meal for the pupils of the school. The energy consumption data per meal has been adopted from the 'Environmental targets, energy audits and benchmarking data from TM50' (details can be found in the appendix B). For the base case, the good practise value has been adopted. The combined energy consumption includes the fossil fuel and electric energy. As the building is full electric, it is expected to be more efficient than the fossil fuel. Hence, a 50% improvement from the fossil fuel energy consumption has been assumed. Furthermore, an 90% diversity factor has been considered for the calculation of number of meals that would be served by the kitchen for each day.

5.5 MANAGEMENT FACTORS (MF)

The calculations assume that the building is well managed, with the systems being well maintained and energy use is being monitored and managed.

However, the real building operation might not be reflected in the ideal performance described so far, resulting in a higher than predicted energy use. To account for this discrepancy, an overall

6 OPERATIONAL ENERGY RESULTS

The Energy Use Intensity in MWh/yr, calculated through the TM54 operational energy assessment, is presented in the table below. The primary energy demand in the proposed facility is attributed to DHW systems, ranging from 66 to 69 MWh/yr, primarily due to direct electric systems. Following closely are the electricity needs for the equipment and the fully electric catering kitchen accounting for 54 to 56 MWh/yr and school equipment at 53-55 MWh/yr. Additionally, the overall building's heating requirements (36-38 MWh/yr) and lighting electrification (34-36 MWh/yr) each contribute around 13%. The smallest shares of the total energy requirement are assigned to auxiliary energy (approximately 28-30 MWh/yr) and cooling energy (around 1 MWh/yr).

SENSITIVITY ANALYSIS

In the modelling process, where information was unavailable, assumptions were made. These assumptions primarily pertained to the operation of the building. Additionally, standard figures for hot water consumption were employed, and supplementary assumptions were made to encompass the operation, maintenance, and energy requirements of the Catering Kitchen.

To present an appropriate range for the estimated energy usage, a reasonable margin was adopted in line with the current understanding of the usage, level of details and software assumptions. This factor reflects the current level and quality of the available information. This margin is indicative of the prevailing depth and reliability of the available data. The lower end of this range serves as an indicator of the potential energy consumption when the building operates with a strong focus on energy reduction. Conversely, the upper end represents the anticipated energy consumption for a building that follows standard operational practices. Consequently, it is probable that the ultimate energy consumption will fall within this specified range.

LETI COMPARISON

London Energy Transformation Initiative (LETI) was established to support the transition of the capital's-built environment to net zero carbon. Despite being originally aimed at London, the LETI standards have been widely adopted across the sector in the UK and provide a useful reference point for the energy consumption of buildings.

LETI guidance recommends a new designed school achieved an overall energy demand of 65kWh/m² per annum and an annual space heating demand of less than 15kWh/m²/year.

We have calculated the internal GIA for the school to be in the region of 3,350m² and this value has been used to calculate the relevant metrics.

Table 6-1 – LETI performance comparison (TM54 Operational Energy)

End use	Lower End LETI target	Upper End Goetre achieved performance
Energy consumption (kWh/m ² /year)	65.0	81.1 – 85.0
Heating space demand (kWh/m ² /year)	15.0	10.7 – 11.3

Table 6-2 - Energy consumption breakdown (TM54 Operational Energy)

End use	Lower End	Upper End
Heating energy (MWh/year)	36.02	37.73
Cooling energy (MWh/year)	0.96	1.00
Auxiliary energy (MWh/year)	28.17	29.51
Equip electricity (MWh/year)	52.92	55.44
Lights electricity (MWh/year)	34.28	35.92
DHW usage (MWh/year)	54.31	56.90
Cylinder Loss (MWh/year)	11.34	11.88
Catering (MWh/year)	53.84	56.40
Total (MWh/year)	271.84	284.78

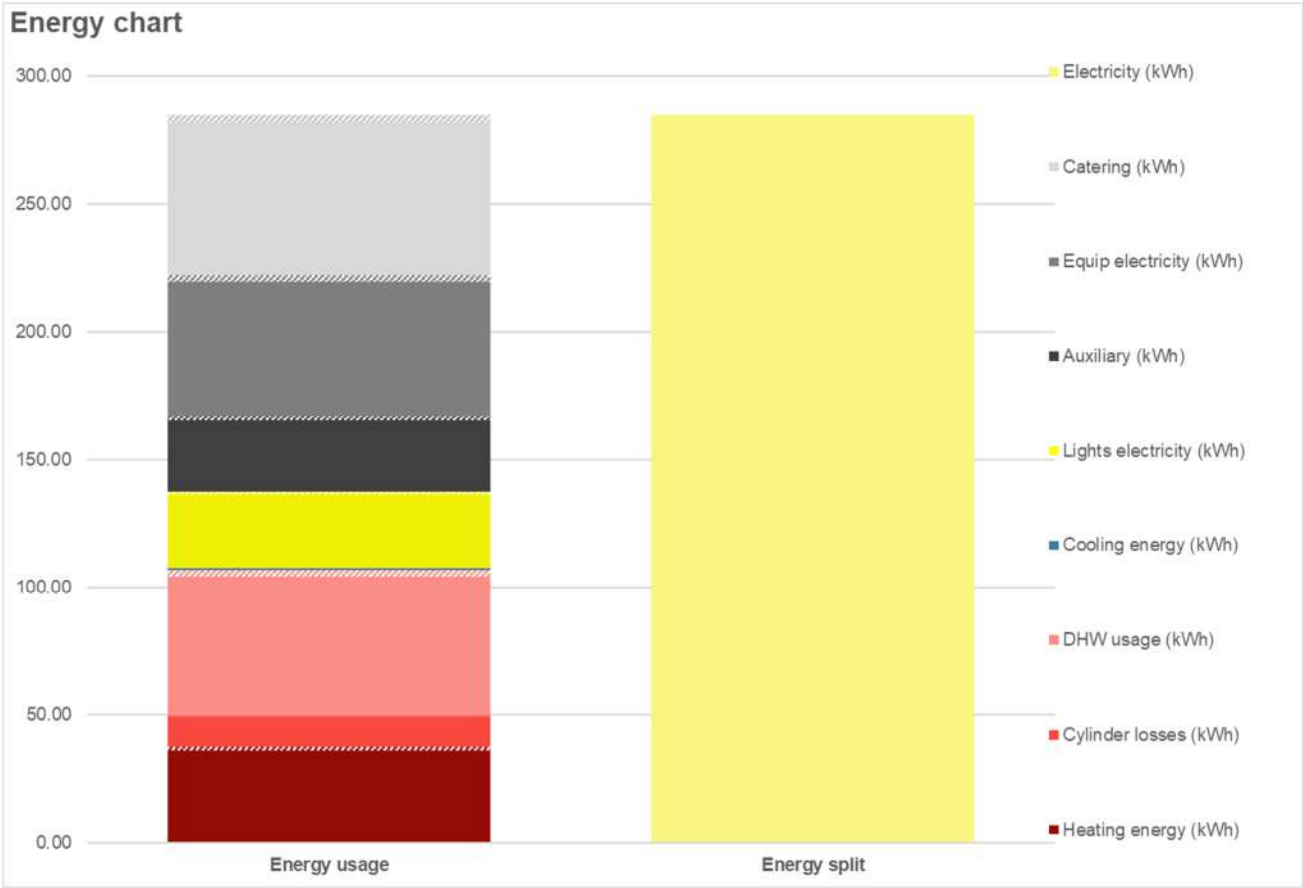


Figure 6-1 - Energy demand breakdown TM54 Operational Energy.

7 CONCLUSION & RECOMMENDATION

This document has been prepared to provide an evaluation of the projected operational energy consumption for the proposed Goetre Primary School, in alignment with the TM54 methodology. This assessment primarily concentrates on forecasting the energy requirements of the proposed building, without considering any contributions of potential renewable sources.

In this evaluation, there has been no consideration for photovoltaic (PV) allowances, and the primary emphasis of this report is on predicting the energy demand for the school. Our understanding is that the Client aims to achieve a Net Zero Energy in operation status, relying on the energy production from renewable sources, specifically through photovoltaic systems (PV), to fully offset the energy demand. Following the findings of this assessment, we recommend permitting an annual energy generation of approximately 285 MWh/year.

The thermal model has been populated based on Client and Design Team information, with accurate data to represent the local climate, building type, building fabric and building services. Occupancy and use profiles are based on expected patterns over a twelve-month period (January – December), for the calculation of the predicted energy consumption. Where accurate information was not available, assumptions have been made.

The TM54 assessment estimated results are as follow:

- Based on the TM54 assessment, The study shows an overall annual energy consumption in the region of 272-285 MWh/year. The primary energy demands in the proposed facility are driven by DHW systems, accounting for 24%. Significant contributors include the fully electric Catering Kitchen at 20% and school equipment at 19%, emphasising the electricity needs of equipment. Heating requirements and lighting electrification for the overall building each contribute approximately 13%, while auxiliary energy and cooling energy represent the smallest proportions at around 10% and 0.4%, respectively.
- The primary factor contributing significantly to the total energy consumption is the use of electricity for Domestic Hot Water (DHW).
- The second highest impacting energy demand is catering. Preparing the meals on site for the pupils has the second highest energy demand of the project. The catering energy consumption calculation is based on the 'Operational' targets, energy audits and benchmarking data from TM50' reference data. To calculate the actual energy use in operation, specialist data should be used to predict the real-life scenario.
- Equipment electricity is deemed to be the third highest end-use energy demand item of the list: few factors have impacted this result with the server energy having a substantial impact on the total general equipment energy usage as well as cooking equipment provided in for the Community Kitchen. It has been assumed that a local server will be installed on the building and its energy consumption is included in the estimated figure.
- The heating and lighting energy consumptions is comparatively low due to the good envelope specification, good airtightness and the high performing ASHP system and daylight dimming system respectively.
- Auxiliary energy and cooling systems constitute the least significant contributors to the overall energy consumption of the proposed building.

Based on the undertaken assessment and on the correction, factor applied, it is estimated that the proposed Goetre Primary School building energy demand will be between 272-285 MWh per year.

These figures could be used as reference to compare the metered data from a post-occupancy assessment to identify areas of poor performance and, if required, suggest remedial actions.

LETI COMPARISON

LETI has developed a set of recommendations to guide the industry toward designing efficient buildings that are in line with the UK Government and Paris Agreement commitments. LETI has proposed a set of targets (performance and design criteria) for educational building and this a widely used as metrics to compare the performance of all the new (and existing) school buildings.

The performance of Goetre is currently estimated to exceed the recommended energy consumption LETI target. Whilst the heating space demand is below the recommended target (10.7 – 11.3 kWh/m²/year for Goetre, 15.0 kWh/m²/year LETI target), the overall energy consumption is above the recommended 65 kWh/m²/year target. This is mainly due to catering and equipment energy demand which alone constitute the 40% circa of the entire energy demand. With regards to the equipment consumption, a server has been included in the model to reflect what is currently proposed but not specific information is available with regards to the equipment provided to the various spaces. It is likely that at the next stage, this item can be reduced once that specific information of the equipment will be received. Also the currently simulated operating hours are not typical of a school and this is deemed to have increased the off-of-hours energy demand.

With regards to the catering energy, the model has allowed for the energy consumption in line with the Client feedback and expected operation. Some reduction can be achieved on this item at the next stage if the number of meals per day is reduced or if more detailed data about the kitchen equipment is received.

Table 7-1 – LETI performance comparison (TM54 Operational Energy)

End use	Lower End LETI target	Upper End Goetre achieved performance
Energy consumption (kWh/m ² /year)	65.0	81.1 – 85.0
Heating space demand (kWh/m ² /year)	15.0	10.7 – 11.3

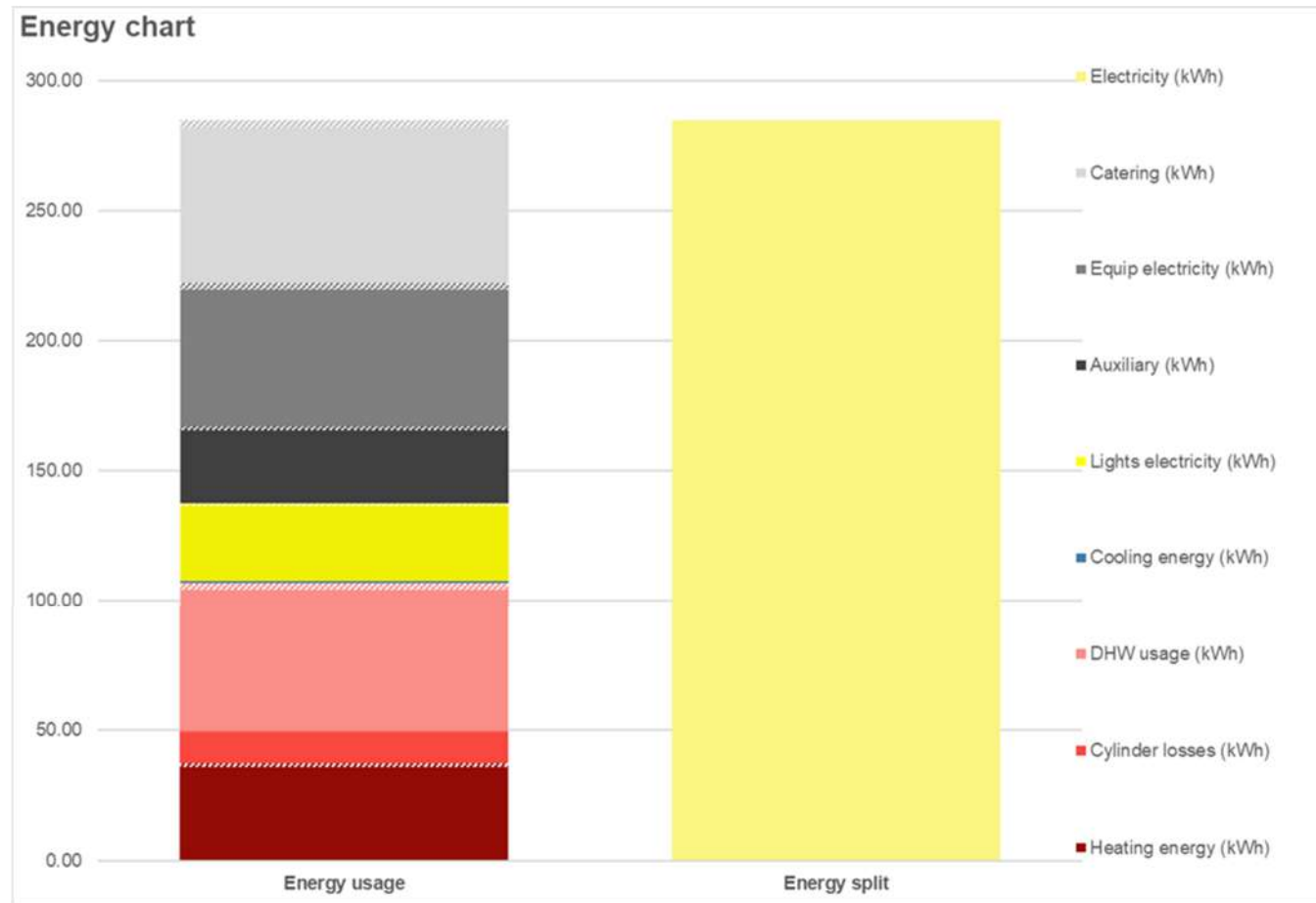


Figure 7-1 - Energy demand breakdown TM54 Operational Energy.

Appendix A

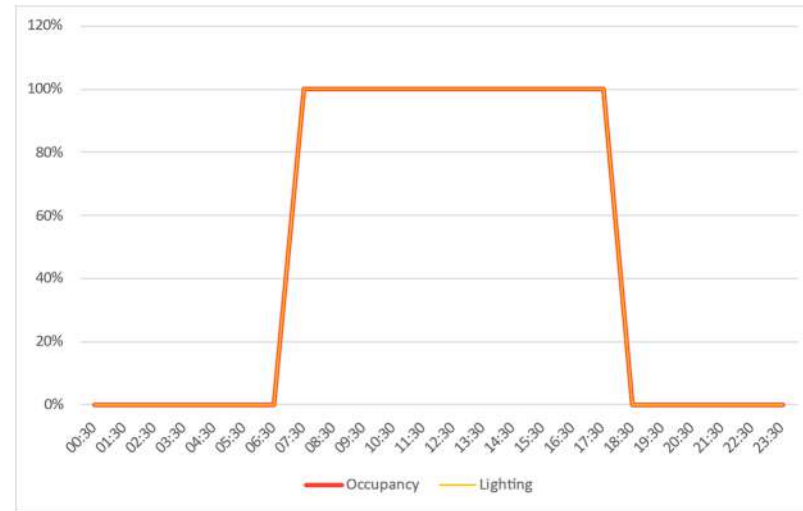
OCCUPANCY, LIGHTING & EQUIPMENT PROFILES



Table A-1 - TM54 questionnaire for predicting occupant behaviour and schedule.

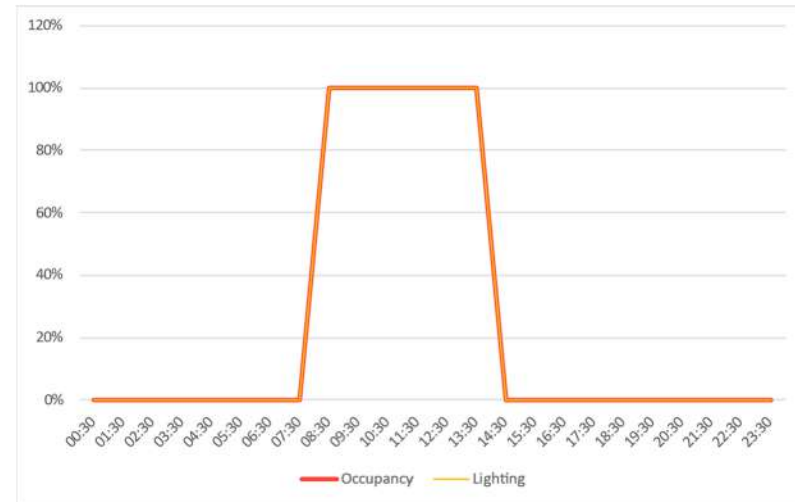
Circulation

People	10	m ² /pp
Lighting gain	4	W/m ²
Equipment gains	0	W/m ²



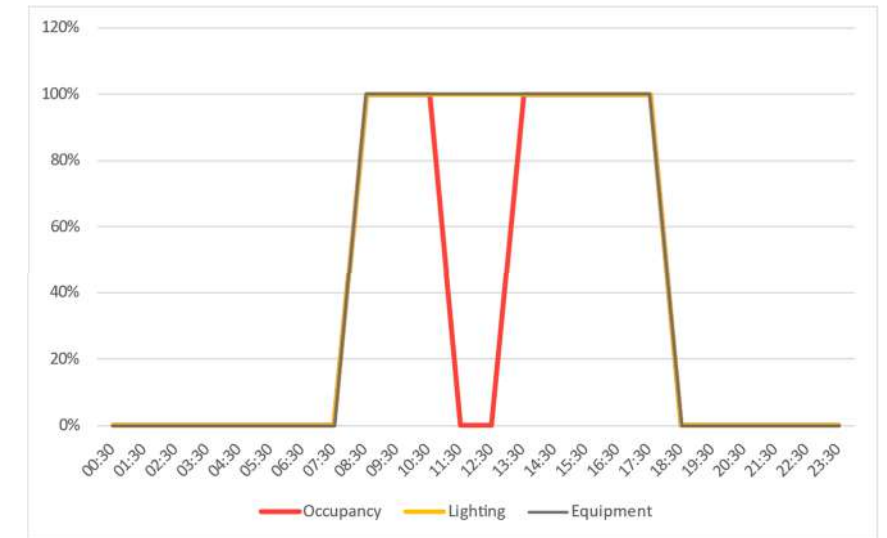
Circulation (Summer)

People	10	m ² /pp
Lighting gain	4	W/m ²
Equipment gains	0	W/m ²



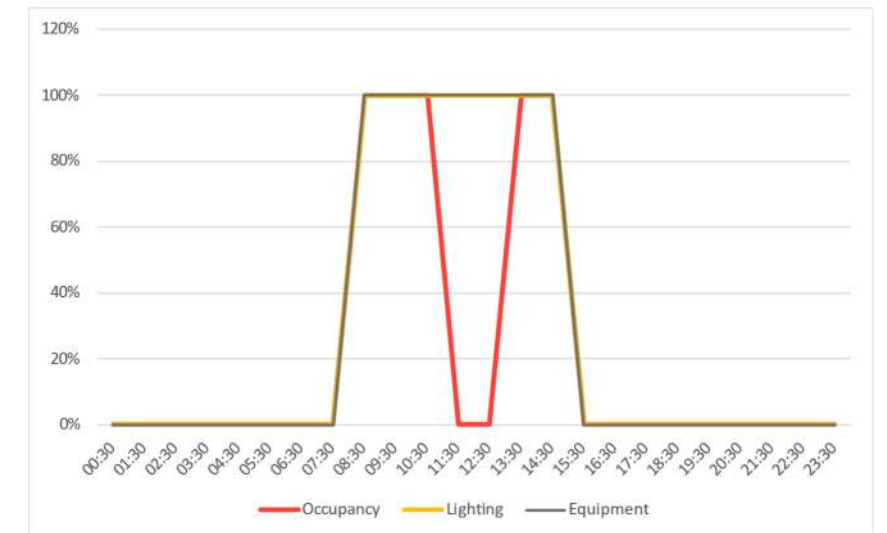
Classroom/Teaching Area

People	32	pp
Lighting gain	8	W/m ²
Equipment gains	5	W/m ²



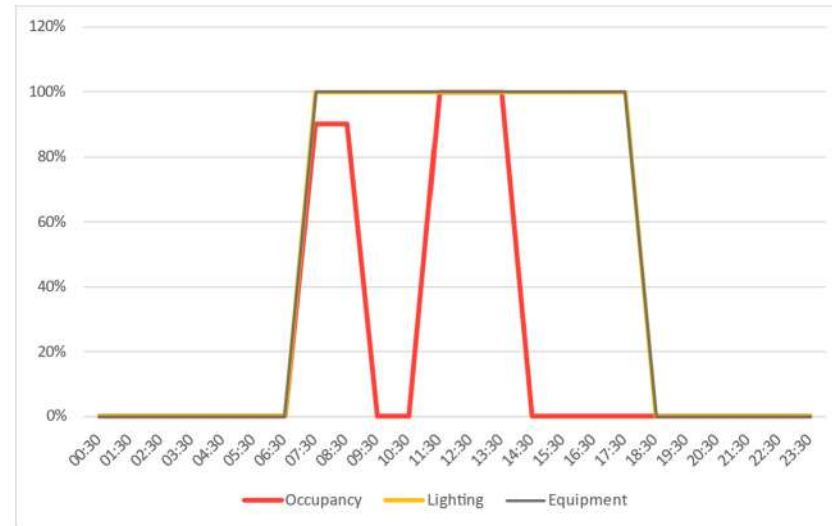
Classroom/Teaching (Summer)

People	32	pp
Lighting gain	8	W/m ²
Equipment gains	5	W/m ²



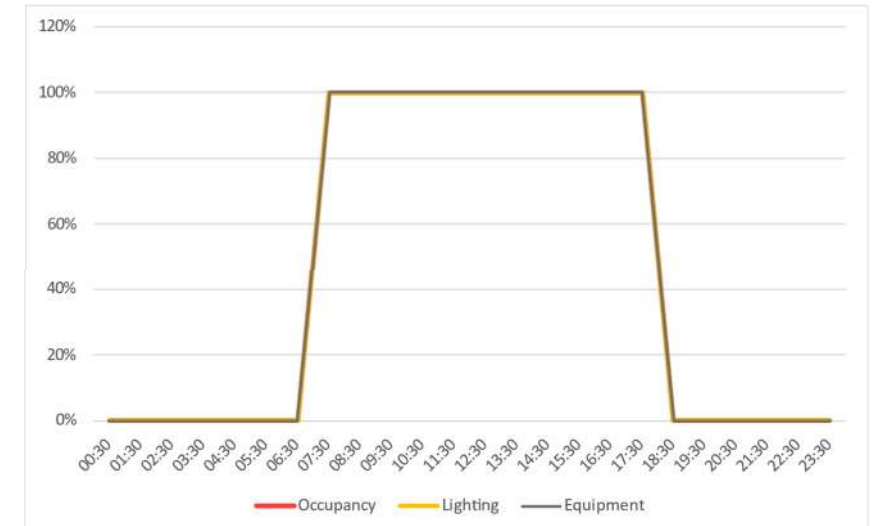
Hall

People	225	pp
Lighting gain	4.0	W/m ²
Equipment gains	2.0	W/m ²



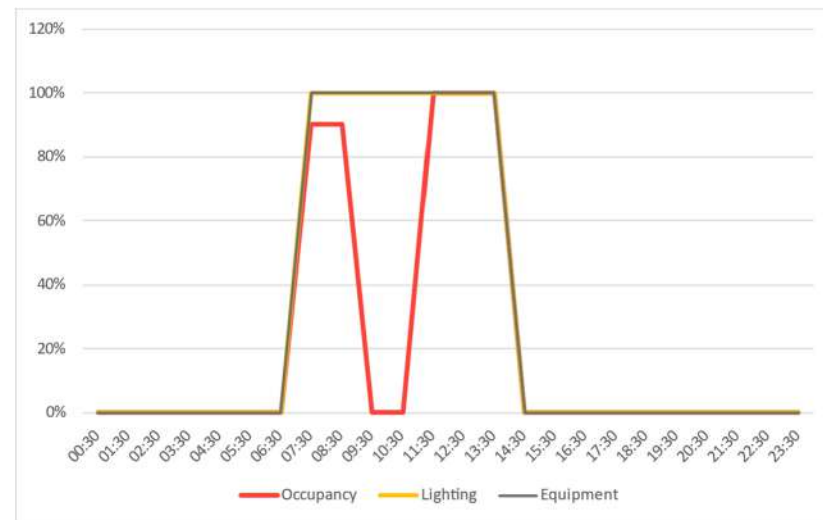
Office

People	6.0	m ² /pp
Lighting gain	8.0	W/m ²
Equipment gains	10.0	W/m ²



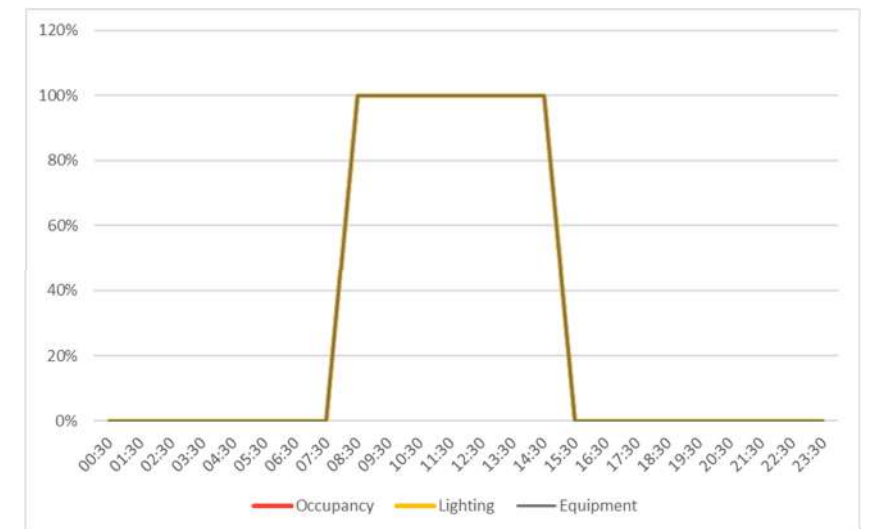
Hall (Summer)

People	225	pp
Lighting gain	4.0	W/m ²
Equipment gains	2.0	W/m ²



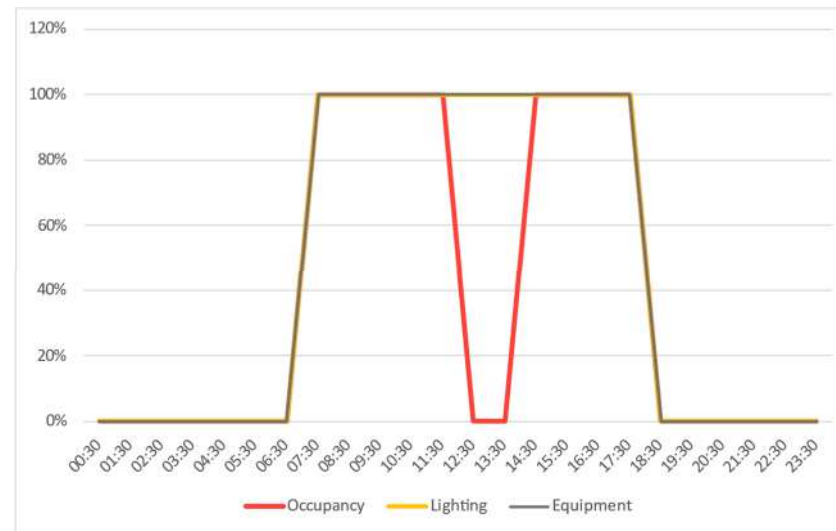
Office (Summer)

People	6.0	m ² /pp
Lighting gain	8.0	W/m ²
E Equipment gains	10.0	W/m ²



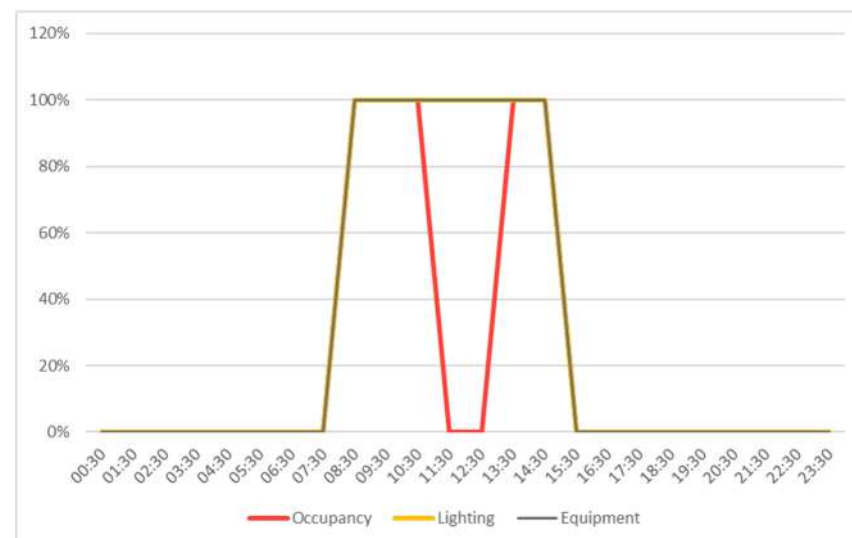
Meeting

People	4.0	m2/pp
Lighting gain	8.0	W/m2
Equipment gains	10.0	W/m2



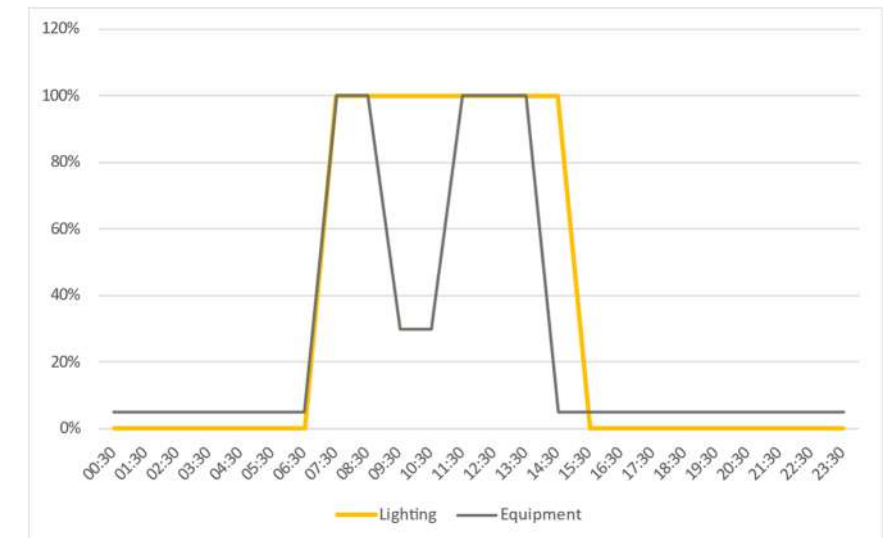
Meeting (Summer)

People	4.0	m ² /pp
Lighting gain	8.0	W/m ²
Equipment gains	10.0	W/m ²



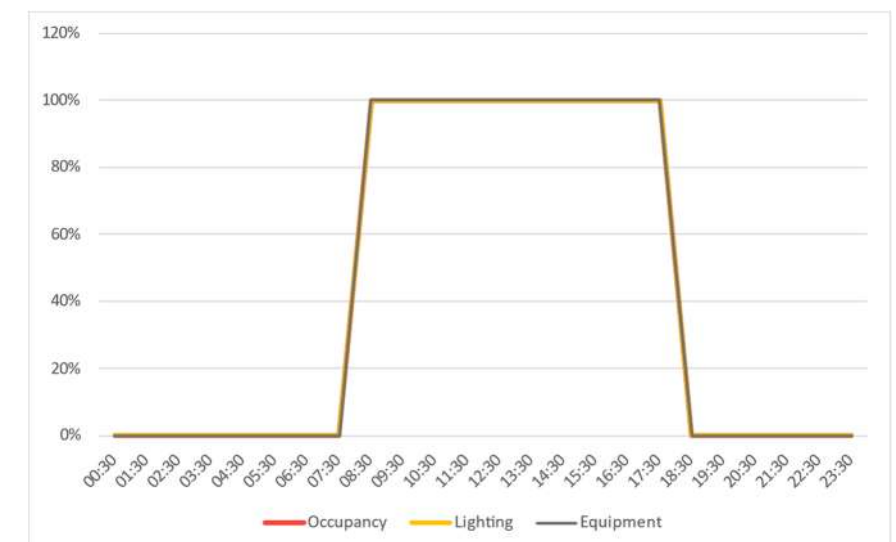
Servery/Kitchen

People	N/A	
Lighting gain	6.0	W/m ²
Equipment gains	2.7	kW/ m ²



Community Spaces*

People	4.0-8.0	m ² /pp
Lighting gain	4.0-8.0	W/m ²
Equipment gains	10.0	W/m ²
Equipment gains (Kitchen)	162	W/m ²



*The Community spaces were presumed to have extended operational hours, including twice-weekly availability until 9 pm, along with operational hours on Saturday mornings. This assumption was made in consideration of feedback from the Client.

Appendix B

TM54 QUESTIONNAIRE FOR PREDICTING OCCUPANT BEHAVIOUR AND SCHEDULE



Section	Details	Comments
1.00	Occupancy & Building Use The effect of building occupancy needs to be considered to inform the input data for the calculations. Please answer the following questions:	
1.1	What are the normal days/hours of operation of the building?	Mon fri:6.30am – 7.00pm Sat-Sun: 9 am 3 pm WSP comment: - Only some area will be used. Control strategy will be important to reduce the energy usage; and - A new BMS system will be installed so energy consumption could be metered in detail.
1.2	When do the cleaner staff, school staff and pupils will start to arrive?	Site team:6.30am – 7.00pm Cleaner Staff: 3:00 pm School staff: 8.20am (Nursery – Yr 2) 8.20am (Yr 3 – 6) Pupils: 8.45am (Nursery – Yr 2) 8.30am (Yr 3 – 6) WSP comments: School will be cleaned every day either in the morning or in the evening.
1.3	When do the cleaner staff, school staff and pupils will leave?	Cleaner staff:7.00pm School staff: From 3.10pm (Nursery – Yr 2) From 2.55pm (Yr 3 – 6) Staff meetings will take place every Tuesday (term-time) until 4pm. Pupils: 3.00pm (Nursery – Yr 2) 2.45pm (Yr 3 – 6)
1.4	How many pupils, staff and other service personnel will regularly occupy the school?	Primary: 25 staff + 130 (at the start) 210 pupils WSP comments: The design allows for a maximum of 210 pupils in the school. The current forecast assumes 130 pupils will use the school the first year and then the number will gradually increase up to the maximum capacity.

Section	Details	Comments
1.5	Will there be requests for extended hours of operation?	Yes. Extra-curricular activities will run Mon - Thurs evenings (term time) until 4.15pm. The main hall and classrooms may be in use during this time. The main hall will be bookable for community use 4.15pm – 7.00pm. WSP comments: - Few activities will be run in the afternoon, so part of the school is likely to be occupied; - Main hall will be rented for events during the weekdays from 4:30 to 7:00 and during the weekends; - The main hall will be separately metered for energy consumption and tax purpose. The space should allow for flexible usage and be separately controlled; and - Discussion are on-going in defining the part of the building that will be accessible for non-curricular activities. This will inform the heating and control strategy.
1.6	What would the standard building usage be during the weekends?	The main hall will be bookable for community use during the weekend 9.00am – 3.00pm.
1.7	What would the standard building usage be during the short breaks (i.e. Christmas, Easter, short breaks up to 1 week)?	The main hall will be bookable for community use 9.00am – 3.00pm. Cleaning and estates staff will access the building during this time (excl. Christmas break). Site team is full time.
1.8	What would the standard building usage be during the long breaks (i.e., summer break or other breaks longer than 1 week)?	The main hall will be bookable for community use 9.00am – 3.00pm. Cleaning and estates staff will access the building during this time.
1.9	When will the building be cleaned?	WSP comment: See comments above.
1.10	Are there any out-of-hours operational requirements? If yes, please provide details.	WSP comment: See comments above.
1.11	Will the security arrangement require lights on and plant/equipment to be running? If yes, please provide details.	WSP comment: External lights / security alarm / CCTV on based on the needs.

Section	Details	Comments
1.12	Will there be provision of IT rooms or other energy intensive equipment (i.e., server, plotters or other big equipment)? If yes, please provide details.	- Laptop charging trolley (30 laptops); - iPad charging trolley (30 iPads); - Server and switches in comms room (investigate energy consumption); - Colour photocopier in resource room (no plotters, just A3 printers); - IT breakout space with 8 workstations (reception included 2 workstation and 1 in the resource room – 1 in the main hall – deputy heads office) + staff PC in each room- C-touch interactive board in each classroom; - Fridge, washing machine, tumble dryer and dishwasher in utility room; - Kitchen PC; and - Electric boiler.
1.13	Will there be a kitchen facility on site, and will the meals be prepared on-site? If yes, please provide details.	WSP comment: - There is a kitchen on site. Design has been already proposed and it is under evaluation; and - The canteen will be serving breakfast (for a reduced number of people, not expected to have all the pupils having breakfast in the morning) and lunch (1 meal per pupil in line with usage).
1.14	Is there any other element the design team should be aware of?	n/a

Table 2. Environmental targets, energy audits and benchmarking (table 7.7), TM50.

Table 7.7 Environmental and operational energy usage benchmarks per meal served

Facility	Standard	Environment (kW·h/meal)			Operational (kW·h/meal)			Combined (kW·h/meal)		
		Fossil fuel	Elec.	Total	Fossil fuel	Elec.	Total	Fossil fuel	Elec.	Total
Coffee shop	Good practice	0.36	0.21	0.57	0.54	0.32	0.86	0.90	0.53	1.43
	Typical	0.41	0.24	0.65	0.62	0.36	0.98	1.03	0.60	1.63
Fast food outlet	Good practice	0.21	0.36	0.57	0.32	0.54	0.86	0.53	0.90	1.43
	Typical	0.30	0.39	0.69	0.44	0.59	1.03	0.74	0.98	1.72
Restaurant:										
— fine dining	Good practice	2.12	1.26	3.38	3.19	1.88	5.07	5.31	3.14	8.45
	Typical	2.41	1.41	3.82	3.62	2.11	5.73	6.03	3.52	9.55
— staff	Good practice	0.99	0.58	1.57	1.48	0.88	2.36	2.47	1.46	3.93
	Typical	1.12	0.66	1.78	1.69	0.98	2.67	2.81	1.64	4.45
— themed	Good practice	0.83	0.49	1.32	1.24	0.73	1.97	2.07	1.22	3.29
	Typical	0.94	0.55	1.49	1.41	0.82	2.23	2.35	1.37	3.72
— traditional (full service)	Good practice	1.04	0.62	1.66	1.57	0.92	2.49	2.16	1.54	4.15
	Typical	1.19	0.69	1.88	1.78	1.04	2.82	2.97	1.73	4.70
Hotel:										
— business/holiday	Good practice	1.69	0.97	2.66	2.54	1.46	3.00	4.23	2.43	6.66
	Typical	3.38	1.36	4.74	5.08	2.03	7.11	8.46	3.39	11.85
— luxury	Good practice	2.12	0.97	3.09	3.17	1.46	4.63	5.29	2.43	7.72
	Typical	3.81	1.36	5.17	5.72	2.03	7.75	9.53	3.39	12.92
— small	Good practice	1.27	0.97	2.24	1.91	1.46	3.37	3.18	2.43	5.61
	Typical	2.54	1.36	3.90	3.81	2.03	5.84	6.35	3.39	9.74
School:										
— primary	Good practice	0.27	0.05	0.32	0.41	0.08	0.49	0.68	0.13	0.81
	Typical	0.39	0.08	0.47	0.59	0.11	0.70	0.98	0.19	1.17
— secondary	Good practice	0.26	0.06	0.32	0.39	0.09	0.48	0.65	0.15	0.80
	Typical	0.34	0.08	0.42	0.52	0.12	0.64	0.86	0.20	1.06
Hospital	Good practice	0.2	0.6	0.8	0.3	0.09	1.20	0.5	1.5	2.0
Ministry of Defence:										
— officers' mess	Good practice	1.76	1	2.76	2.64	1.5	4.14	4.40	2.50	6.90
— senior ranks' mess	Good practice	1.56	0.88	2.44	2.34	1.32	3.66	3.90	2.20	6.10
— junior ranks' mess	Good practice	1	0.56	1.56	1.5	0.84	2.34	2.50	1.40	3.90



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Merthyr Tydfil County Borough Council

PART L2 COMPLIANCE

Goetre Primary School





Merthyr Tydfil County Borough Council

PARL L2 COMPLIANCE

Goetre Primary School

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Signature	<i>TMokhtari</i>		
Checked by	Alberto Gallotta		
Signature	<i>Alberto Gallotta</i>		
Authorised by	Joseff Morris		
Signature			
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EXECUTIVE SUMMARY

This report summarises the inputs and outcomes of the thermal modelling exercises undertaken to demonstrate compliance with regulatory guidance for energy and carbon performance on the proposed Goetre Primary School in Wales. This forms part of the RIBA Stage 3 submission.

WSP has worked collaboratively with the wider design team to reach a building envelope and services specification which meets the regulatory requirements and targets imposed:

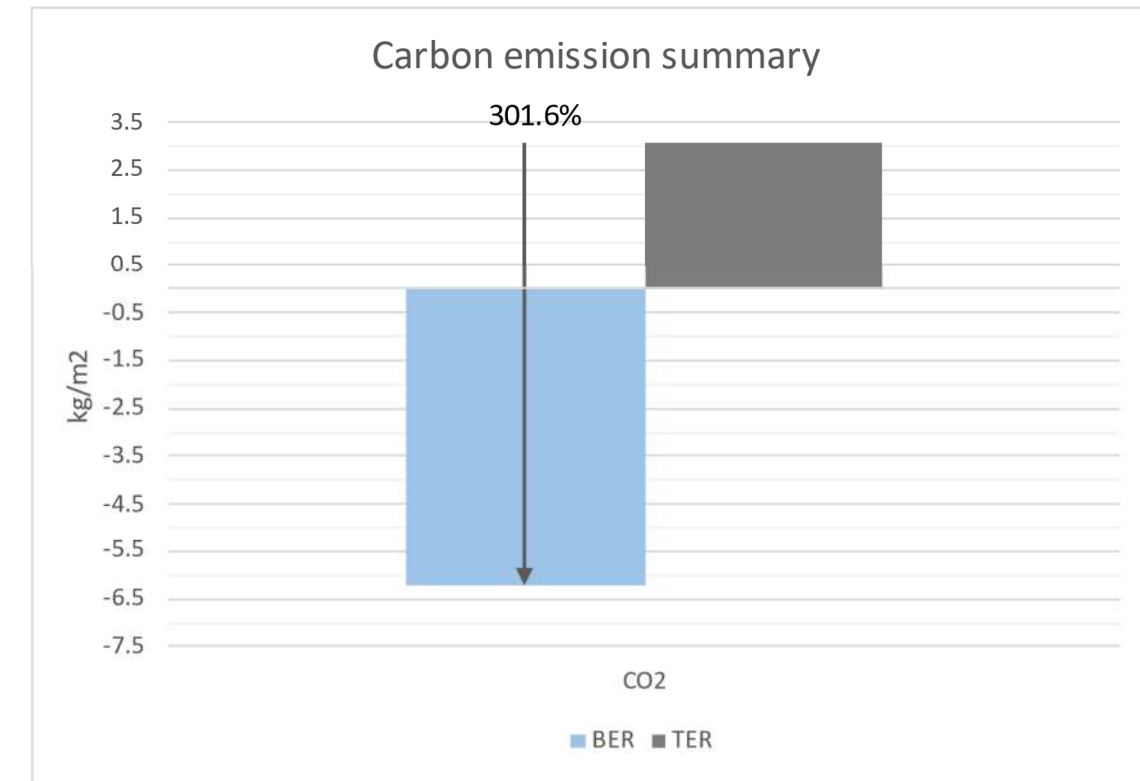
- National planning policy: UK Building regulations Part L2 Wales (2022) – Conservation of fuel and power for buildings other than dwellings

A thermal modelling exercise was undertaken to establish the specification that would be necessary to achieve compliance with Part L2 Wales 2022.

Results relating to the policy items above are as follows:

- The building was shown to pass the L2 assessment, with a reduction of carbon emission of more than 300% (3.09 kg.CO₂/m² for the Notional building and -6.23 kg.CO₂/m² for the Actual building), using the standardised National Calculation Methodology.
- The building must also exhibit a Primary Energy Consumption (BPEC) lower than the Target (TPEC). This was shown to be the case, with a reduction over the Target of 19.3 to -73.55.
- The building must adhere to minimum fabric standards for thermal elements and air permeability.
- The specification currently assumes that all minimum performance standards will be substantially exceeded, in line with the Stage 3 mechanical specification.

Figure 1 - Notional and Actual buildings carbon emission summary.



PLANNING POLICY CONTEXT

BUILDING REGULATION PART L2

The new Part L of the Building Regulations is developed with the aim to improve the energy efficiency requirements and to reduce the associated CO₂ emissions for the regulated energy use in new commercial buildings in Wales.

An extract of some of the key requirements for new building (other than dwellings is reported) below:

Achieving the Target Emission Rate and Primary Energy Consumption

The building carbon emission rate (BER) must not exceed the target carbon emission rate (TER), as calculated in line with the 2021 National Calculation Methodology using approved modelling software. The BER and TER are calculated based on the regulated demands of space heating, space cooling, lighting, fans and pumps and domestic hot water heating. Unregulated energy such as plug loads, lifts and escalators are not considered.

In addition, Part L2 Wales (2022) requires the building primary energy consumption (BPEC) to be no greater than the target primary energy consumption (TPEC).

Limits on Design Flexibility

Each individual element of building fabric and fixed building services must comply with its respective minimum standards as described within the Part L Approved Document 2022.

It should be noted that to comply with the TER, the general performance parameters will need to exceed these minimum standards. The limits on design flexibility exist only to define a backstop in cases where the design team wishes to trade off a poorly performing element against a higher performing element. For example, a design team may choose to relax the requirement for building air tightness to the minimum standard, but they would then need to significantly improve the lighting efficiency or some other component to compensate for the increase in heating energy.

Table 1 - Minimum requirement, Part L2 Wales (2022)

Building fabric element	Limiting value for new buildings	Limiting value for new and replacement elements in existing buildings
Roof (Flat Roof)	0.20 W/m ² K	0.18 W/m ² K
Wall	0.26 W/m ² K	0.26 W/m ² K
Floor	0.22 W/m ² K	0.22 W/m ² K
Windows	1.60 W/m ² K	1.8 W/m ² K
Roof windows, curtain walling	1.8 W/m ² K	1.8 W/m ² K
Rooflights	2.2 W/m ² K	2.2 W/m ² K
Pedestrian doors (including glazed doors)	1.8 W/m ² K	1.8 W/m ² K

Building fabric element	Limiting value for new buildings	Limiting value for new and replacement elements in existing buildings
Vehicle access and similar large doors	1.30 W/m ² K	1.5 W/m ² K
High-usage entrance doors	3.00 W/m ² K	3.5 W/m ² K
Roof ventilators (inc. smoke vent)	3.00 W/m ² K	3.5 W/m ² K
Air permeability	8.00 m ³ /(h.m ²) at 50Pa	NA

Limiting the Effect of Solar Gain in Summer

For each space in the building that is occupied, or mechanically cooled, reasonable provision must be shown for limiting the effects of solar gain in summer. For the purposes of Part L, this could be demonstrated by showing that for each applicable space, the aggregated solar gains from April to September are less than a calculated limit. This test is automatically carried out as part of the Part L analysis and the results are shown on the Building Regulation UK Part L report (BRUKL).

(Post Completion) Building Performance Consistent with the BER

In order that the intended performance in use of fuel and power is achieved, buildings must be constructed and equipped so that the performance is consistent with the BER as calculated at the completion of the building work.

Provision for Energy Efficient Operation in Building

The owner of the building should be provided with sufficient information about the building, its fixed building services and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is intended and reasonable in the circumstances. A way of showing compliance with this requirement would be to produce a building logbook that may draw upon other documents such as the Operation and Maintenance Manuals.

SOFTWARE, LOCATION AND GEOMETRY

The Part L2 assessment is undertaken using accredited thermal modelling software. The model is a virtual representation of the building’s location, form, situation, fabric, and services specification. Details of the model inputs can be found in this section.

Software

The compliance model was built using IES Virtual Environment Software, using its VE Compliance (UK and Ireland) module which is dynamic software approved for assessing Part L2 2022 Wales regulated carbon emissions (as per current legislation).

Site Location and Weather Data

The site location is set to Cardiff with CIBSE weather data taken from the Cardiff Test Reference Year file. In accordance with the National Calculation Methodology for Wales, this is the dynamic weather data that is required for use by all new non-domestic buildings in Wales and has been used for the actual and notional building model runs.

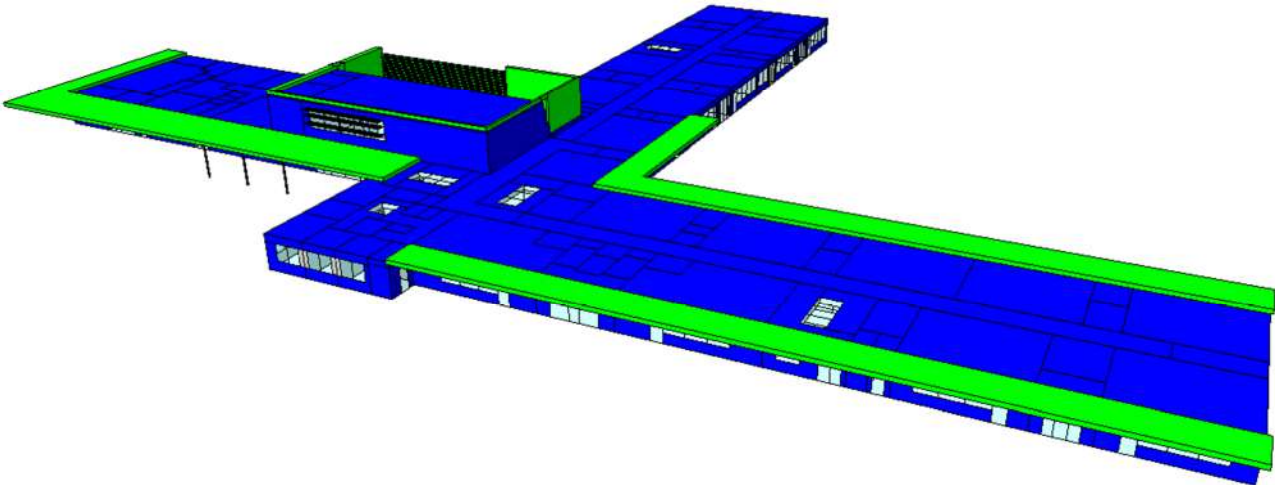
Geometry

The model geometry has been built according to the latest architectural floor plans and elevations.

Table 2 - Architectural information references.

Date Received	Information
January 2024	26CB01-LAW-XX-XX-M-A-0002.rvt

Figure 2 - Model Geometry – View from south- East



THERMAL MODEL INPUTS

Building Fabric

The building fabric has been specified with improved thermal properties to reduce the heating and cooling energy demand, and thus improve the primary energy (BPEC/TPEC) and CO₂ emissions (BER/TER). The fabric properties are described below:

Table 3 - Thermal Envelope Performances

Fabric Detail	Value
Ground floor U-value	0.08 W/m².K
External wall U-value	0.12 W/m².K
Roof U-value	0.10 W/m².K
Windows including frame	1.20 W/m².K
Glazed doors including frame	1.40 W/m².K
Rooflights including frame	1.40 W/m².K
External door	1.60 W/m².K
Glazing g-value and light transmission	0.40 and 71%
Building air permeability target	3.00 m³/m².h @ 50Pa

NCM Activity Types and HVAC Systems

The NCM building type selected is D1: Primary or secondary School (Primary). NCM templates have been assigned at room level consistent with their use, relative to their closest match within the NCM database.

Heating System Details

The heating is generated by ASHP. Variable speed pumps facilitate the efficient circulation of water on the radiators and on the Underfloor Heating System (UHS), ensuring a comfortable and consistent temperature throughout the space. The heating system efficiency details are described in the table below.

Table 4 - Heating system Details

Heating System Detail	
System 1	
Rooms applied	All except - Storage, Cupboards, Plant rooms
Emitter type	Radiator/UHS
Heating method	Air Source Heat pump
SCOP	3.57

Pump type	Variable pressure sensors within the pump
System 2	
Rooms applied	Kitchen
Emitter type	Centralised warm air via AHU
Heating method	Air Source Heat pump
SCOP	3.57

Ventilation System Details

The ventilation strategy employed for Geotre Primary School entail a full control via mechanical ventilation. This strategy is supported by opening windows to help alleviating the overheating risk during summer. This tight control is achieved via locally installed Mechanical Ventilation Systems with Heat Recovery (MVHR) able to regulate the airflow rate based on the rooms' need. Below are the specific details outlining the components of the mechanical ventilation systems:

Table 5 - Ventilation system details

Mechanical Ventilation- AHUs	
MVHR system	
Rooms applied	Classrooms, Office, Hall & WCs and other constantly occupied spaces
System Type	MVHR
Heat Recovery efficiency	86-92%
Heat Exchanger type	Plate Heat Exchange (PX)
Specific Fan Power (SFP)	1.00 – 1.60 W/l/s
AHU	
Rooms applied	Kitchen
System Type	AHU
Heat Recovery efficiency	n/a
Specific Fan Power – supply (SFP)	0.80 W/l/s
Specific Fan Power – extract (SFP)	0.90 W/l/s

Cooling System Details

Cooling is delivered through a DX split system, served by an ASHP catering to the Server Room. From a compliance perspective, this energy should be considered as part of the unregulated demand, so it is not directly assessed.

Domestic Hot Water

The demanded hot water in the building is mainly provided by direct electric water heaters. Several small storage vessels are located across the building with different capacity (and storage efficiency) based on the served rooms’ need. The various DHW systems have been combined in one single item for the purpose of the simulation with the overall storage made up by the sum of all the litres of the vessels and the calculated storage loss calculated as weighted average of the single items. The details of the DHW system are listed below:

Table 6 - Domestic Hot Water details

DHW System detail	
System 1	
Rooms applied	Entire building
DHW heating method	Electric Point of Use
Seasonal efficiency	100%
Thermal store volume (l)	745
Storage losses (kWh/l/day)	0.03970
Circulation loop (m)	30
Circulation losses (w/m)	7.00

Lighting Controls

Lighting energy consumption can be reduced with the use of presence detecting and photoelectric sensors. Absence and presence detecting sensors both reduce energy consumption, but at differing levels. The lighting control strategies for room types can be seen below:

Table 7 - Lighting controls

Room type	Lighting Control Strategy	Daylight sensors and dimming
Teaching Spaces	Absence detection	Yes
Offices, Staff & Meeting Rooms	Absence detection	Yes
School Hall	Manual	Yes
Kitchenette	PIR	Yes (where possible)
Kitchen	Manual	No
Community kitchen (classroom)	Manual	No
Circulation	PIR	Yes (where possible)
WCs & Changing Spaces	PIR	No
Quiet room	Manual	No
Clock room	PIR	Yes

Lighting Power Densities

Lux level input method has been used in the model to assess the impact of the lighting design in the overall energy performance.

Room-level inputs can be found in the electrical specification, however high spec LED luminaires have been specified and bespoke lighting calculations carried out and incorporated into the building modelling. Being the current design at RIBA Stage 3, not all the designed spaces had the calculation undertaken. Where information is not available, the values used for other similar spaces have been used as reference.

Electrical

Building-level electrical parameters can be found below:

Table 8 - General control settings

Detail	Value
Building electric power factor	>0.95
Do lighting systems have provision for metering?	Yes
Does metering warn of out-of-range values?	Yes

RENEWABLES

The PV panels are set on the available fixed roof space. It is our understanding that the building is aiming to achieve the Net-Zero in operation status. This is achieved through a very efficient design and the deployment of a significant amount of PV on-site. The Part L model is based on the currently estimated PV annual energy yield. Details of the Photovoltaic array specification can be found below:

Table 9 - Renewable system details

Detail	Value
Total PV Annual Yield	290 MWh/yr

CONCLUSION

This assessment has been undertaken in accordance with the Part L 2022 Wales regulations for non-domestic buildings.

The Part L 2022 Wales provides a breakdown of energy consumption by end use of the actual and notional building. The result of the assessment is used to assess compliance of the new proposed Geotre Primary School.

The assessment outcomes indicate that the building is achieving satisfactory performance in terms of heating and cooling energy requirements, primarily attributed to the notable level of insulation achieved by the envelope.

For DHW a comparison against the Notional building highlights a slightly higher consumption in the proposed strategy. This variance can be attributed to the high-volume storage and secondary distribution necessary for the on-site Kitchen.

The auxiliary energy consumption significantly surpasses the Notional building value, primarily influenced by the Specific Fan Power (SFP) of the ventilation units. The increased mechanical ventilation, mandated by compliance with CIBSE TM52 and BB101 for Educational Buildings, is a driving factor. Despite the outcome of this study, we consider the mechanical ventilation system to be very efficient with an optimised SFP.

It should be noted that, the inclusion of a substantial PV system in the building design makes a noteworthy contribution to onsite electricity generation and carbon emissions offset when needed. This is mainly driven by the Client’s ambition to deliver a Net Zero in operation Energy school which has significantly increased the PV allowance for the scheme.

The building was shown to pass the assessment, with the ‘Actual’ building exhibiting more than 300% reduction in the carbon emissions over the ‘Notional’ building (-6.23 kgCO₂/m² and 309 kgCO₂/m² respectively). Key results are presented in the BRUKL document in Appendix A.

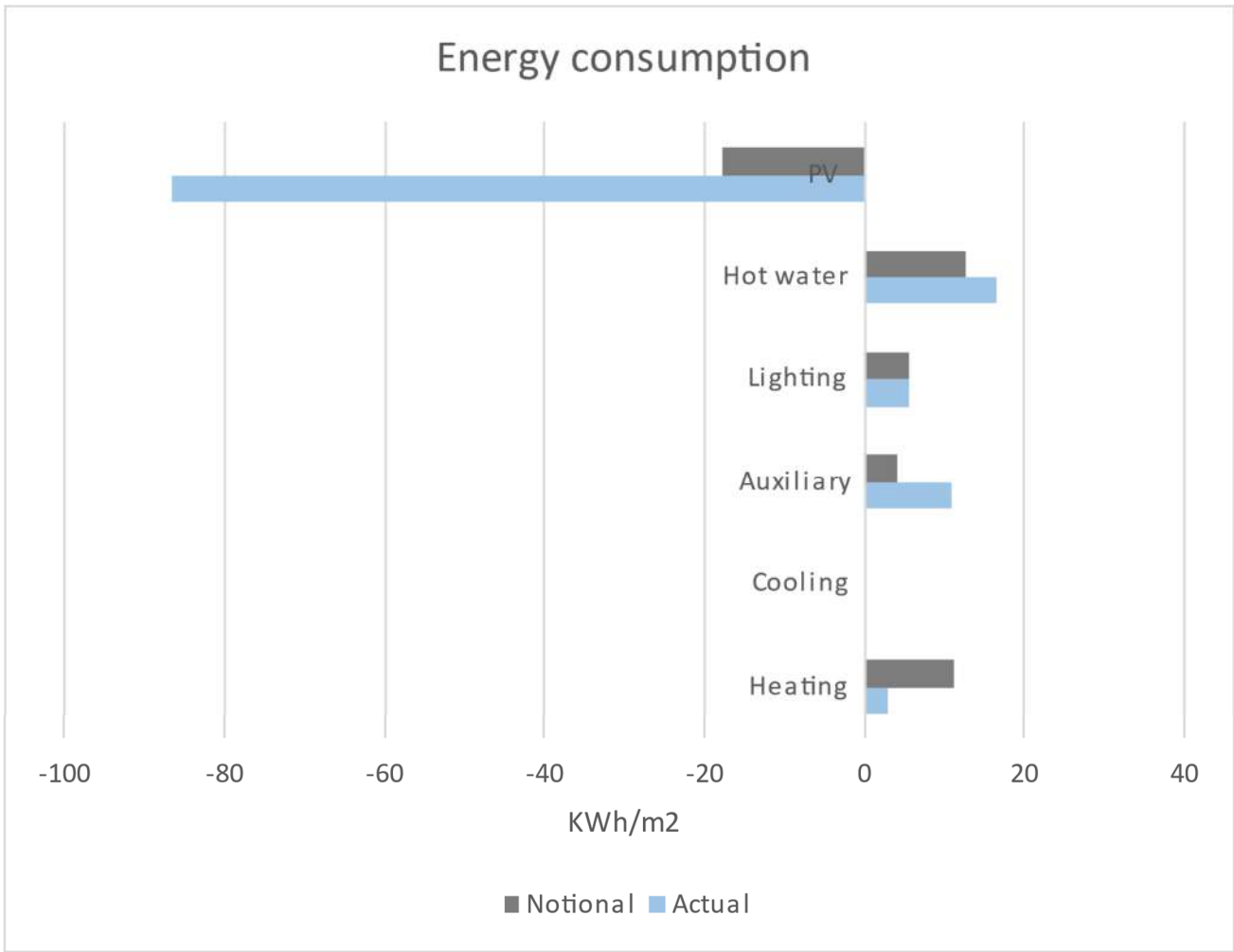
Some of the rooms are exceeding the “Criterion 3: Solar Gain Check” but is not deemed a significant issue for the following reasons:

- No active cooling is proposed for the scheme, hence an increase in the solar gain will not entails an increase in the energy demand for the building;
- A bespoke overheating assessment has been carried out which has confirmed that all the spaces comply with the overheating criteria.

Figure 3 - Energy consumption breakdown of the Goetre Primary School.

The CO₂ emission and primary energy rates of the building must not exceed the targets

Target CO ₂ emission rate (TER), kgCO ₂ /m ² :annum	3.1
Building CO ₂ emission rate (BER), kgCO ₂ /m ² :annum	-6.2
Target primary energy rate (TPER), kWh _{PE} /m ² :annum	19.3
Building primary energy rate (BPER), kWh _{PE} /m ² :annum	-73.55
Do the building's emission and primary energy rates exceed the targets?	BER <= TER BPER <= TPER



Zone name	ID of system type	SFP [W/(l/s)]									HR efficiency	
		A	B	C	D	E	F	G	H	I	Zone	Standard
	Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		
Kitchen 2	-	-	-	1.5	-	-	-	-	-	-	-	N/A
Kitchen 3	-	-	-	1.2	-	-	-	-	-	-	-	N/A
LRB_1	-	-	-	1.2	-	-	-	-	-	-	-	N/A
LRB_2	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Meeting_Room	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Nursery A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Nursery B	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Nurture_Room	-	-	-	1.5	-	-	-	-	-	-	-	N/A
Office 1	-	-	-	1.5	-	-	-	-	-	-	-	N/A
Office 2	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Office_3	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Quiet 1	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Quiet 2	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Reception 1	-	-	-	0.3	-	-	-	-	-	-	-	N/A
Reception 2	-	-	-	0.3	-	-	-	-	-	-	-	N/A
Reception 3	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Sick_Bay	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Staff	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Staff WC & Shower 1	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Staff_WC 1	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Staff_WC 2	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Staff_WC 3	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Staff_WC 4	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC000001: WC 1	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 2	-	-	-	1.5	-	-	-	-	-	-	-	N/A
WC 3	-	-	-	1.5	-	-	-	-	-	-	-	N/A
WC 4	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 5	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 6	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 7	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 8	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 9	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 10	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 11	-	-	-	1.5	-	-	-	-	-	-	-	N/A
WC 12	-	-	-	1.2	-	-	-	-	-	-	-	N/A
WC 13	-	-	-	1.5	-	-	-	-	-	-	-	N/A
WC 14	-	-	-	1.5	-	-	-	-	-	-	-	N/A
WC 15	-	-	-	1.5	-	-	-	-	-	-	-	N/A
WC 16	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_1 A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_1 B	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_2 A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_2 B	-	-	-	1.2	-	-	-	-	-	-	-	N/A

Zone name	ID of system type	SFP [W/(l/s)]									HR efficiency	
		A	B	C	D	E	F	G	H	I	Zone	Standard
	Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1		
Year_3 A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_3 B	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_4 A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_4 B	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_5 A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_5 B	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_6 A	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Year_6 B	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Hall	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Circ 2	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Foyer 1	-	-	-	1.2	-	-	-	-	-	-	-	N/A
LRC	-	-	-	1.5	-	-	-	-	-	-	-	N/A
Group_Area	-	-	-	1.5	-	-	-	-	-	-	-	N/A
Teaching_Crossroads	-	-	-	1.5	-	-	-	-	-	-	-	N/A
Community_Room	-	-	-	1.2	-	-	-	-	-	-	-	N/A
Community_Room	-	-	-	1.2	-	-	-	-	-	-	-	N/A

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]		Efficacy [lm/W]	Power density [W/m²]
	Standard value	95		80	0.3
Acc_WC 1		170		-	-
Acc_WC 2		165		-	-
Acc_WC 3		172		-	-
Acc_WC 4		170		-	-
Acc_WC 5		164		-	-
ALNCO		138		-	-
Circ 1		213		-	-
Circ 3		228		-	-
Circ 4		175		-	-
Circ 5		166		-	-
Circ 6- Core		176		-	-
Circ 6- Perimeter		182		-	-
Circ 7- Core		198		-	-
Circ 7- Perimeter		202		-	-
Cleaner 1		51		-	-
Cleaner 2		61		-	-
Cloaks 1		195		-	-
Cloaks 2		195		-	-
Cloaks 3		196		-	-
Cloaks 4		196		-	-
Cloaks 5		220		-	-
Cloaks 6		220		-	-
Cloaks 7		156		-	-

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]	
	Standard value	95	80	0.3	
Cloaks 8	200	-	-	-	
Community_Food	114	-	-	-	
Community_Kitchen	174	-	-	-	
Community_Library	114	-	-	-	
Deputy_Head_Office	131	-	-	-	
Fam FLo Lobby	259	-	-	-	
Fam_Flo	138	-	-	-	
Flying_Start	112	-	-	-	
Group_Room	113	-	-	-	
Head	127	-	-	-	
Hygiene	108	-	-	-	
Immersion & Comm Corridor	238	-	-	-	
Immersion_Room	98	-	-	-	
Interview	144	-	-	-	
Kitchen 1	194	-	-	-	
Kitchen 2	110	-	-	-	
Kitchen 3	89	-	-	-	
Lobby & Buggy Store	66	-	-	-	
LRB_1	139	-	-	-	
LRB_2	138	-	-	-	
Meeting_Room	109	-	-	-	
Nursery A	142	-	-	-	
Nursery B	142	-	-	-	
Nurture_Room	82	-	-	-	
Office 1	137	-	-	-	
Office 2	123	-	-	-	
Office & WC Lobby	263	-	-	-	
Office_3	159	-	-	-	
PE_Store	68	-	-	-	
Plant	80	-	-	-	
Quiet 1	151	-	-	-	
Quiet 2	152	-	-	-	
Reception 1	138	-	-	-	
Reception 2	138	-	-	-	
Reception 3	180	15	9		
Server	43	-	-	-	
Sick_Bay	133	-	-	-	
Staff	110	-	-	-	
Staff WC & Shower 1	140	-	-	-	
Staff_WC 1	148	-	-	-	
Staff_WC 2	187	-	-	-	
Staff_WC 3	187	-	-	-	
Staff_WC 4	187	-	-	-	

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]	
	Standard value	95	80	0.3	
Stage_Store	64	-	-	-	
Storage	75	-	-	-	
Store 1	90	-	-	-	
Store 2	91	-	-	-	
Store 3	120	-	-	-	
Store 4	78	-	-	-	
Store 5	78	-	-	-	
Store 6	107	-	-	-	
Store 7	78	-	-	-	
Table Store	65	-	-	-	
WC000001: WC 1	106	-	-	-	
WC 2	194	-	-	-	
WC 3	196	-	-	-	
WC 4	107	-	-	-	
WC 5	107	-	-	-	
WC 6	107	-	-	-	
WC 7	107	-	-	-	
WC 8	170	-	-	-	
WC 9	170	-	-	-	
WC 10	114	-	-	-	
WC 11	114	-	-	-	
WC 12	185	-	-	-	
WC 13	101	-	-	-	
WC 14	126	-	-	-	
WC 15	122	-	-	-	
WC 16	199	-	-	-	
Year_1 A	139	-	-	-	
Year_1 B	139	-	-	-	
Year_2 A	139	-	-	-	
Year_2 B	139	-	-	-	
Year_3 A	139	-	-	-	
Year_3 B	139	-	-	-	
Year_4 A	139	-	-	-	
Year_4 B	139	-	-	-	
Year_4_Nurture_Room_Corridor	224	-	-	-	
Year_5 A	139	-	-	-	
Year_5 B	139	-	-	-	
Year_6 A	139	-	-	-	
Year_6 B	139	-	-	-	
Hall	184	-	-	-	
Store_&_PE_Store_Circ	480	-	-	-	
Circ 2	198	-	-	-	
Foyer 1	165	-	-	-	

General lighting and display lighting		General luminaire		Display light source	
Zone name		Efficacy [lm/W]		Efficacy [lm/W]	Power density [W/m²]
	Standard value	95		80	0.3
LRC		147		-	-
Group_Area		97		-	-
Teaching_Crossroads		164		-	-
Community_Room		96		-	-
Community_Room		99		-	-

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

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
ALNCO	NO (-14%)	NO
Community_Food	NO (-36.8%)	NO
Community_Kitchen	NO (-69.8%)	NO
Community_Library	NO (-36.9%)	NO
Deputy_Head_Office	NO (-15.3%)	NO
Fam_Flo	NO (-13.6%)	NO
Flying_Start	NO (-28.9%)	NO
Group_Room	NO (-94.4%)	NO
Head	NO (-32.2%)	NO
Immersion_Room	NO (-45.8%)	NO
Interview	NO (-95.5%)	NO
Kitchen 2	N/A	N/A
Kitchen 3	NO (-61.2%)	NO
LRB_1	NO (-69.8%)	NO
LRB_2	NO (-59.5%)	NO
Meeting_Room	NO (-41%)	NO
Nursery A	NO (-70.2%)	NO
Nursery B	NO (-68.7%)	NO
Nurture_Room	NO (-28.5%)	NO
Office 1	NO (-77.5%)	NO
Office 2	NO (-81.5%)	NO
Office_3	NO (-43.8%)	NO
Quiet 1	N/A	N/A
Quiet 2	N/A	N/A
Reception 1	NO (-78.1%)	NO
Reception 2	NO (-60.7%)	NO
Reception 3	NO (-71.1%)	NO
Server	N/A	N/A
Sick_Bay	NO (-94.6%)	NO
Staff	NO (-71.9%)	NO
Year_1 A	NO (-61.8%)	NO
Year_1 B	NO (-77.9%)	NO
Year_2 A	NO (-62.4%)	NO
Year_2 B	NO (-63.1%)	NO
Year_3 A	NO (-18%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
Year_3 B	NO (-26.7%)	NO
Year_4 A	NO (-57.1%)	NO
Year_4 B	NO (-20.3%)	NO
Year_5 A	NO (-41.8%)	NO
Year_5 B	YES (+15.7%)	NO
Year_6 A	YES (+12%)	NO
Year_6 B	YES (+15.6%)	NO
Hall	NO (-41.5%)	NO
LRC	YES (+5.4%)	NO
Group_Area	YES (+46%)	NO
Community_Room	NO (-71.6%)	NO
Community_Room	NO (-92.4%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters		
	Actual	Notional
Floor area [m ²]	3342.8	3342.8
External area [m ²]	8359.1	8359.1
Weather	CAR	CAR
Infiltration [m ³ /hm ² @ 50Pa]	3	3
Average conductance [W/K]	1515.86	0
Average U-value [W/m ² K]	0.18	0
Alpha value* [%]	32.49	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	2.86	11.29
Cooling	0	0
Auxiliary	10.8	4.06
Lighting	5.51	5.4
Hot water	16.6	12.7
Equipment*	21.23	21.23
TOTAL**	35.78	33.46

^{**} Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	86.58	17.75
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
<i>Displaced electricity</i>	<i>86.58</i>	<i>17.75</i>

Energy & CO₂ Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m ²]	34.56	36.86
Primary energy [kWh _{PE} /m ²]	-73.55	19.3
Total emissions [kg/m ²]	-6.23	3.09

HVAC Systems Performance

[illegible]

Key to terms

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

Key Features

The Building Control Body is advised to give particular attention to items whose specifications are better than typically expected.

Building fabric

Element	U _{i-Typ}	U _{i-Min}	First surface with maximum value
Walls	0.2	0.12	CC00000A:Surf[1]
Floors	0.2	0.08	CC000000:Surf[0]
Roofs	0.15	-	
Windows and roof windows	1.5	-	
Personnel doors	1.5	-	No personnel doors in building
Vehicle access & similar large doors	1.5	-	No vehicle access doors in building
High usage entrance doors	1.5	-	No high usage entrance doors in building
U _{i-Typ} = Typical individual element U-values [W/(m²K)]			U _{i-Min} = Minimum individual element U-values [W/(m²K)]

Air Permeability	Typical value	This building
m³/(h.m²) at 50 Pa	5	3



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