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Methodist Central Hall, Manchester



Planning Report | Energy Strategy Statement

Date: 06/03/24
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Crookes Walker Consulting Limited is registered in England & Wales | 05011466 |
Registered Office: One Express | 1 George Leigh Street | Ancoats | Manchester | M4 5DL

Revision Record

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			C. Culleton	*Gareth Rowlands*	*Gareth Rowlands*

Glossary of Key Terms

Abbreviation	Details	Abbreviation	Details
CIBSE	Chartered Institute of Building Services Engineers	Continuous operation	Uninterrupted running of a mechanical ventilation device, such as continuous mechanical extract ventilation or mechanical ventilation with heat recovery. The air flow rate provided by mechanical ventilation need not be constant but may be varied, under either manual or automatic control, in response to the demand for the removal of pollutants or water vapour
HVAC	Heating Ventilation and Air Conditioning	Ventilation	The supply and removal of air (by natural and/or mechanical means) to and from a space or spaces in a building. It normally comprises a combination of purpose-provided ventilation and infiltration
MVHR	Mechanical ventilation with heat recovery A mechanically driven ventilation system that both continuously supplies outdoor air to the inside of the dwelling and continuously extracts indoor air and discharges it to the outside.	ASHP	Air Source Heat Pump Technology
Extract ventilation	The removal of air directly from an internal space or spaces to the outside. Extract ventilation may be by natural means or by mechanical means (e.g. by an extract fan or a central system).	BMS	Building Management System
Purge Ventilation	Manually controlled ventilation of rooms or spaces at a relatively high rate to rapidly dilute pollutants and/or disperse water vapour. Purge ventilation may be provided by natural means (e.g. an openable window) or mechanical means (e.g. a fan).		
Natural Ventilation	Ventilation provided by thermal, wind or diffusion effects through doors, windows or other intentional openings without the use of mechanically driven equipment. For the purposes of this approved document, natural ventilation refers to a ventilation strategy using background ventilators and intermittent extract ventilation		

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1.0 Introduction

Crookes Walker Consulting have been appointed by the Methodist Central Hall to provide Building Services Consultancy advice and planning support with respect to the proposed redevelopment of the Methodist Central Hall Building in Manchester.

This report has been prepared to outline the proposed refurbishment Energy Strategy and support the project planning application. The report aims to summarise the following key elements pertaining to the regulated energy consumption of the building post completion:

The strategies outlined in this report will need to be developed as and when the scheme moves into the developed and detail design stages. To ensure optimum solutions are provided, the final design solutions may differ from the outline proposals contained herein. However, the design criteria and basis for design will look to be maintained.

2.0 Project Background

An overview of the project is summarised below. Full details of the development can be found within the main suite of documents issued as part of the planning submission.

2.1 The project

This report relates to the proposed redevelopment and refurbishment project at Methodist Central Hall. The building is located in central Manchester on Oldham St, Manchester M1 1JQ. The Central Hall is the home of the Methodist Church and houses several organisations including The Trustees for Methodist Church Purposes (TMCP), Nexus, Girl Guide Association and others. The building is managed by the Methodist Central Buildings Management Committee and offers office and meeting rooms and worship space for hire. The building also acts as support function for the homeless and ex-offenders. Several tenanted retail units are located at Leve 00 accessed from Oldham Street.

2.2 The Site

The site originally comprised a church building constructed c.1781. This was demolished c1883 in to make way for the present-day building. The Central Hall building was designed by the notable Architect, George Woodhouse, and opened to the public c.1886. The building was bombed during the Second World War with a subsequent reconstruction, restoration and repair project in 1953.The reconstruction projected reclaimed some of the original materials as well as provided new where necessary.

The building is located in central Manchester and is in a urban setting with the main access entrance from Oldham Street on the North-western aspect. Dale street bounds the building to the north/northeast and Spear street to the rear, southeast. To the south-southwest, the building is bounded to the adjacent adjoined building which comprises shopping units and offices.

The building is situated on the edge of the Smithfield conservation area with the Old Street elevation included in the conversation status.

2.3 Building Construction

The building is provided with accommodation across a basement (L-01), ground floor (L00), first floor (L01), second floor (L02), and Third Floor (L03). The roof area houses a small plant room and void space. The building accommodation generally comprises :

- Basement with a Café and plant/storage areas
- A ground floor entrance from Oldham Road along accessing a café and chapel space as well as ancillary areas (WC's, corridors and stairwells)
- A central main church hall with balcony on first floor level. Office space and ancillary areas
- A second floor comprising the balcony overlooking the main church hall as well as office space and ancillary areas
- A Third Floor comprising a further upper-level balcony overlooking the main church hall as well as office space and ancillary areas
- An accessible roof level area housing a small plant area
- An accessible courtyard is located to the southern aspect of the building providing a void from basement to roof level.



Figure 1: Building Site Plan & Location (Source: Google earth)

In addition a number of tenanted retail units are provided within the building, accessed from ground floor level each with individual storage area at the basement level.

The building is constructed from a steel framed structure with external structural ashlar type stone walls on Oldham Street and Dale Street. Much of the stonework is architecturally detailed on the piers and pediments etc. Spear street appears to be constructed from brickwork with stone returns.

Single pane glazed timber frame windows are installed to elevations on Oldham Street and Dale Street. Double glazed uPVC type windows are installed to Spear Street elevations and to

some courtyard windows. Some of the windows are fitted with secondary glazing with can be opened. The main entrance door is constructed from timber and is double height.

The roof comprises a pitched roof to the main hall and northwest side of the building and appears to be formed from a steel frame construction c/w timber purlins and concrete roof tiles. The pitched roofs are insulated. The remaining areas of the roof are flat and appear to be constructed from concrete with underlined insulation and asphalt or rubberised finish with led cover flashings or similar. It is understood that part of the Dale Street roof is constructed from some sort of flat single ply/rubberised membrane.

Internal finishes throughout the building vary throughout and a number a piecemeal/localised refurbishments have been undertaken across the years with more recent refurbishments completed in the GF Café and reception area. Some finishes, particularly within the Main Hall, are in-keeping with the original building construction and may date from such period. There are several plaques and memorials mounted upon the building internal walls.

2.4 Existing MEP Services

2.4.1 Incoming Services

Existing incoming services are as follows:

- Incoming Power – The main building is provided with a dedicated independent LV metered TPN and earth power supply derived from the local SPEN DNO statutory network in the local highway. The Authorised Supply Capacity (ASC) of the building is dedicated at 86kVA.
- Incoming Power - Retail units are understood to be provided with individual metered LV power supplies derived separately from the District Network Operator (DNO), SPEN infrastructure.
- Mains Water – a dedicated independently metered potable mains service, derived from the local United Utilities (UU) statutory network is provided. Sub-metered supplies are understood to be provided to the retail units
- Natural Gas – a dedicated independently metered LP natural gas service, derived from the local Cadent statutory network is provided.
- Natural gas – retail units are not provided with gas services
- Telecommunications – the building is provided
- Telecommunications – the retail units are provided with independent telecoms connectivity

2.4.2 Mechanical & Public Health Services

Water

The building is provided with a dedicated mains water supply enters the building from Spear Street with an United Utilities (UU) meter contained within the basement. Mains water distributes from the meter throughout the building serving potable draw-off points such as WHB's and sinks etc. A Water tank is contained within the pitched roof void and provides a cold-water down service to the WC's. Each retail unit is understood to be provided with sub-metering water supply used for billing purposes. Hot water is generally provided via local point of use electric storage heaters. A small electric hot water cylinder located in the basement serves the local WC's and community cafe kitchen. Hot water in the Tenanted retail units is understood to the generated by the tenants individually.

Natural Gas

The incoming gas main to the building is derived from the statutory infrastructure in Spear Street. The shippers meter is located within the south corner of the basement. Gas distributes from the meter to serve the boilers and catering equipment throughout the building.

Above Ground Drainage

Above ground drainage is provided to serve the building sanitary and kitchen accommodation in the form of the single stack gravity systems. Some stacks from accommodate adjacent to the courtyard routes externally and is installed in cast iron pipework. Drainage is understood to generally connect into an internal below ground system located within the basement.

Heating

Heating to the building is comprises a number of decentralised systems. Heating is generally provided via several small gas-fired system boilers as follows:

- Boiler 1 - serving the GF located within the Chapel store
- Boiler 2 - serving the FF eastern side of the building located in the WC area
- Boiler 3 - serving the FF westerns side of the building located in a cupboard
- Boiler 4 - serving the SF eastern side of the building located in a cupboard
- Boiler 5 - serving the SF western side and TCMP areas of the building located in a cupboard
- Boiler 6 - serving the TF eastern side of the building located in a store by the lift
- Boiler 7 - serving the SF western side of the building located in a WC
- Boiler 8 – serving GF rads in the basement
- Boiler 9- serving the main hall warm air heating located in the roof plantroom.

Heating is distributed via 2-pipe flow an return pipework serving panel and column radiators.

DX Heating and cooling

Local DX split/multi-split A/C systems are provided to specific meeting rooms, rooms for hire as well as the Chapel. Condensers are generally located externally at roof level with some also located in the Level 00 courtyard.

Ventilation

Ventilation is predominately provided using opening windows to offering purge ventilation throughout the building.

Catering areas are provided with local dedicated supply and extract fans ducted to atmosphere.

The main hall is provided with a displacement ventilation system consisting of a centrifugal supply fan located in the roof plantroom. A LTHW heater battery is provided before the fan (fed via a local boiler system no.9). Supply air is distributed via concealed ductwork to diffusers located in Level 01 midway up the walls. Air is extracted at the rear of the hall, A facility to recirculate air from the hall and reduce the heating requirement to the fresh air is provided using a manual damper control system.

Local extract fans are provided to WC areas. These consist of wall and ducted fans dependant on location and route to atmosphere.

Controls
Controls for mechanical services plan are generally in the form of local packaged controls

2.4.3 Electrical Services

Electrical
Th main hall building is provided with a dedicated incoming metered LV power supply rated and 300A 3-phase, earth and neutral. The supply is derived from the local statutory District Network Operator (DNO), SPEN. The supply enters the building in the basement on the Oldham road elevation. From the incoming cut-outs and statutory shippers meter the supply connects to a LV busbar switchboard via a main switch disconnector/isolator. From the busbar switchboard a number of isolated LV submains are derived connected to sub-distributing boards located throughout the building. Distribution boards are of various ages although some appear to obsolete in terms of availability of spare breakers and ancillaries. Some distribution boards have been recently replaced with new models as manufactured by Hager.

Retail units are understood to be provided with individual metered LV power supplies derived separately from the District Network Operator (DNO), SPEN infrastructure.

Small Power
The building is provided with various local small power installations to suit the relevant room needs. These are mostly in the form of surface and recessed switched twin socket outlets, switched and unswitched fused connection units as well as isolators for large items of plant and equipment. The method of wiring is unknown but given the age of the building there may be various wiring types with installations installed under various versions of BS7671.

CCTV & Security
A small CCTV is currently installed generally covering the GF common areas. The system is understood to comprise a number of POE camera's connected to a 16 channel DVR recorder.

Access Control and Intercom
An access control system is provided to Ground Floor entrance stairwells as well as the stairwells to the rear of the building. Access control is generally in the form of electronic maglock door closers operated via local fob access with push button egress.

Main entrance from the Oldham Road aspect is provided with automatic opening doors operating via Ceiling mounted PIR.

Retail units may have their own systems (CCTV and intruder) although these are interfaced with the main hall building systems.

PA/VA
There is no PA system installed throughout the building.

Specific meeting rooms are with display TV's. The main hall is provided with audio and visual systems in the form of projectors and microphone lectern connecting to wall mounted speakers

Fire Detection and Alarm
An analogue non-addressable fire detection and alarm system is provided generally comprising a main panel circa 7-8 years old, manual call points with smoke and heat detectors to specific areas. A copy of the building fire risk assessment has not been received at the time of writing but from discussions on site it is understood the system is a manual system with automatic detection in high-risk areas only (probably – category L5/M). The system is understood to provide c12No. specific zones interface with the retail via an interface per retail unit.

Retail units are understood to have their own individual fire alarm systems.

Lighting and emergency lighting
Lighting systems have been replaced in a phased manner over recent years with LED replacement lamps and/or fittings. It is understood around 80% of the building has been upgraded with the remaining elements provided with a mixture of T5/T8 fluorescent fittings.

Emergency lighting is provided in the form of the emergency conversion battery packs to general luminaries as well as standalone bulkhead fittings.

External Lighting
Limited external lighting is provided in the form of building mounted LED luminaries with some bulkhead fittings also installed.

Lighting protection
There is no lightning protection system currently provided to the building.

3.0 Proposed Energy Strategy

3.1 Energy Strategy and Enhancements

For the building to reduce operational energy consumption, it is essential that sustainable design and energy efficiency is integrated from first principles and embodied into the design and procurement process. Sustainability is a critical focus of the design, and the scheme will implement an approach based upon the "Energy Hierarchy Approach" to sustainable building design to minimise the potential impact of the building on the environment

The Energy Hierarchy Approach that will be followed in this context is described below:

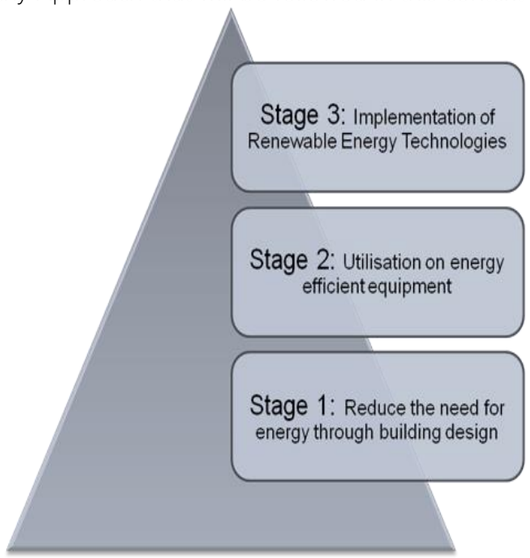


Figure 2: Sustainable Design and the Energy Hierarchy Approach

The following sections below detail the proposed specific approach to integrated sustainable building design for the scheme outlining the strategy for following each of the stages indicated in the figure above.

- Stage 1 measures - Fenestration replacement with new double-glazed windows (or secondary glazing provision).
- Stage 2 measures - LED lighting installations, building service plant controls.
- Stage 3 – Integration of appropriate LZC/renewable technologies to move away from fossil fuel systems.

3.2 Energy demand

In operation the building energy demand will be limited through a 'fabric first' approach which will ensure an integrated approach to sustainability is provided. The key features undertaken to reduce demand are as follows:

- Low Building Air Permeability with c.25%+ improvement upon the minimum of Building Regulations (England) 2022
- High performance building fabric with façade and fenestration with between c40-78% improvement upon the minimum of Building Regulations (England) 2022 (dependant on element)
- High performance fenestration in terms of solar control and day lighting with low emissivity (low-e) glass and high light transmittance value in order that the scheme can maximise daylight benefits throughout the year without increased risk of overheating
- Maximising the potential where practicable for natural ventilation within the building, to further reduce the need and energy consumption of the building through operation of fans and other mechanical ventilation
- Utilising the maximum amount of daylight to limit the energy consumption through lighting.

The table below summarises the key enhancements proposed for the building as part of an integrated sustainable approach to the design:

Building Element	Assumed Existing Values	Building Proposed Target Value
Walls	1.2 W/m^{2}K	1.2 W/m^{2}K
Ground floor	0.4 W/m^{2}K	0.4 W/m^{2}K
Roof flat Roof Pitched	1.8 W/m^{2}K 3.0 W/m^{2}K	0.12 W/m^{2}K
Glazing / Roof lights and Doors	2.7 W/m^{2}K	1.4 W/m^{2}K g-value = 0.5 Low e
Infiltration	15-25 m^3/h @ 50 Pa	8-10 m3/m2/h @ 50 Pa

** glare and LTV to be reviewed separately

*** To be reviewed as part of the operational energy modelling

The final details will need to be agreed with the Architect and PQS but it is envisaged that the occupied spaces would be treated at the thermal line with the entrance space treated as well insulated unheated lobby area. This will of course depend on the final agreed building configuration and layout.

Improving thermal performance will be critical to realising operational reductions in energy consumption and carbon emissions. The following energy reductions could be achieved through improvement in thermal performance:

Area/building	Assumed existing u-value (W/m2/K)	Target proposed u-value (W/m2/K)
Walls	1.2 W/m^{2}K	1.2 W/m^{2}K
Ground floor	0.4 W/m^{2}K	0.4 W/m^{2}K
Roof flat Roof Pitched	1.8 W/m^{2}K 3.0 W/m^{2}K	0.18 W/m^{2}K 0.15 W/m^{2}K
Glazing / Roof lights and Doors	2.7 W/m^{2}K	1.6-1.8 W/m^{2}K g-value = 0.5 Low e
Infiltration	15-25 m^3/h @ 50 Pa	6-8m^3/h @ 50 Pa

The above thermal upgrades could potentially be readily integrated into the proposed construction works through the roof and window replacement options/proposals. New replacement thermal elements would need to meet the minimum requirements of the new Building Regulations Part L v.2 with the minimum values exceeded wherever possible. Fenestration specifications however would need to align with conversation area requirements and improved secondary glazing has been assumed for the present. (Hence, a u-value assumed in excess of the limiting value in the building regulations)

Wall insulation improvements via internal linings have been reviewed but considered not to be viable and unlikely to be practicable and cost effective overall given the nature of the building and internal detailing around for example, window openings.

All proposed thermal elements will be reviewed by the Architect and manufacturers/suppliers etc to verify build-ups and interstitial condensation risks etc. Final thermal transmittance figures are subject to detailed design and may be subject to change to meet practical and buildability requirements.

3.3 Energy efficiency

To maximise the energy efficiency of the building in use the following building services systems are proposed to be integrated into the scheme:

- High efficiency LED lighting and emergency lighting installed throughout the building together with lighting control systems throughout. Including daylight dimming and automatic presence control.
- Where mechanical ventilation is necessary (e.g., internal spaces and toilet areas), high efficiency systems will be employed with heat recovery to ensure heat is not unduly wasted upon the building.
- LED lighting and controls throughout
- High efficiency mechanical ventilation extract fans when required. het recovery techniques to be employed where appropriate.
- Local point of use (instantaneous) electric water heaters for basins and sinks minimising storage
- Integration of main and sub-metering in order that residual energy usage may be monitored with out-of-range values appropriately targeted in order that energy demand can be further reduced in situ.

3.4 On-site renewable option appraisal

As part of the scheme design it is proposed to incorporate suitable on-site Low or Zero Carbon (Renewable) technologies where appropriate to further reduce the building demand as part of the energy hierarchy approach to the design and installation procurement.

This section of the document sets out the analysis and option appraisal as part of determining the most suitable and optimum on-site LZC technologies for integration within the building services solution.

To this end a systematic approach has been utilised assessing each of the standard industry recognised LZC renewable technologies for commercial buildings. The methodology for LZC assessment in the initial stages has followed the CIBSE TM38 approach to ensure only the most appropriate technologies are explored as part of the assessment. Following this assessment, the remaining feasible technologies have been investigated further to determine the most appropriate solution that offers the optimum solution in terms of energy demand reduction, whilst working within the Clients capital expenditure budgets and maintenance regime.

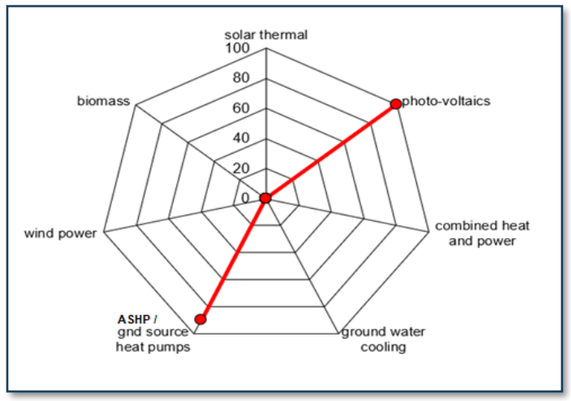


Figure 3: Summary Assessment Results from CIBSE TM38 Renewable Assessment Tool

The key drivers in line with CIBSE TM38 initial assessment criteria for the assessment of LZC technology of the project as follows:

0 - Cost effectiveness

1 - Energy/$C0_{2e}$ savings
2 - Technology Risk
3 - Image and Marketing

The table below outlines the justification for discounting renewable energy technologies as part of the design process and renewable appraisal:

Technology	Initial Viability Appraisal	Justification / Notes
Biomass	☒	Site Constraints and limited space for fuel store make this option unviable.
On Shore Wind Turbine	☒	Urban wind not usually viable. Therefore, unlikely to be able to locate in situ on site. Wind speeds may be an issue as partially sheltered by local topography (would likely need to be located on third party land) as well as planning issues for the residents and town itself.
Solar Thermal	☒	Unlikely sufficient hot water demand to offer benefit
Ground/ Air Source Heat Pump (GSHP/ASHP)	☑	ASHP technology is propsoed for implementation to act as the main wet heating generator replacing the existing decentralised boiler plant. GHSP would not be a viable solution given the location and lack of external grounds or borehole locations. .
Combined Heat and Power (CHP)	☒	Limited high temperature heat demand/run hours throughout the year mean this system would not be recommended
Ground Water Cooling	☒	Limited space and building cooling requirements mean that this technology is not suitable for this scheme.
Photovoltaics (PV)	☑	Building Orientation and available roof space means that roof mounted PV array would be a viable option

The table below undertakes a further assessment of the LZC technologies considered viable from the initial CIBSE TM38 assessment. This assessment comparatively assesses key influences factors such as cost effectiveness, reliability, and maintenance as well as energy/$C0_{2e}$ impact.

Technology	Cost Effectiveness	Reliability	Maintenance Requirements	Energy / C02 savings	Final Viability Appraisal
Photovoltaics (PV)	High (low Cost)	High	Low.	High	☑
Air Source heat pump	Medium	Medium	High	Medium	☑

The assessment above indicates that Photovoltaics (PV) have an opportunity for a high potential impact on the building energy and $C0_{2e}$ performance whilst working within the capital restraints of the client budget. In addition, the comparative minimal maintenance requirements also offer benefit in operation for the end user in that both technologies are simple to integrate with limited routine inspection against other viable systems. Therefore, the detailed assessment will move forward with integrated building roof mounted Photovoltaics (PV) array. ASHP will also offer opportunities for energy reduction compared to standard electric heating systems. This will form a key part of any roadmap for net zero operational carbon dioxide emissions.

Viable Technology Background

Photovoltaic Array

Photovoltaic systems (PV systems) are a renewable energy technology which transforms the energy from the sun into electricity using photovoltaics. This photovoltaics, also known as solar panels, provide a reliable green energy solution.

A solar PV system is a sustainable, low-maintenance option for anyone who wants to contribute to a greener environment, as the system in operation does not cause any pollution or emissions and has numerous advantages.

Photovoltaic systems use photovoltaic cells to collect solar energy from the sunlight and converts it into direct current (DC) electricity. The reflection of the sunlight will create an electric field across photovoltaic systems, causing electricity to flow. The DC electricity will be transported to an inverter, which will convert this DC power into alternating current (AC). This AC power is the type of electricity which is used for the electric appliances in your home, also referred to as AC load.

Photovoltaic systems generally consist of several individual components: the solar PV array, a charge controller, a battery bank, an inverter, a utility meter, and an electric grid. The correct installation of all these components determines how efficient the solar panels are in operation. However, a charge controller and battery bank are optional. Even though these two

components help you store and, as such, make better use of your generated electricity, they could also increase the total price of the photovoltaic installation.

Even though solar PV arrays produce power when they are exposed to sunlight, the other components are required for properly converting, distributing, and storing the energy that has been produced by the solar panels.

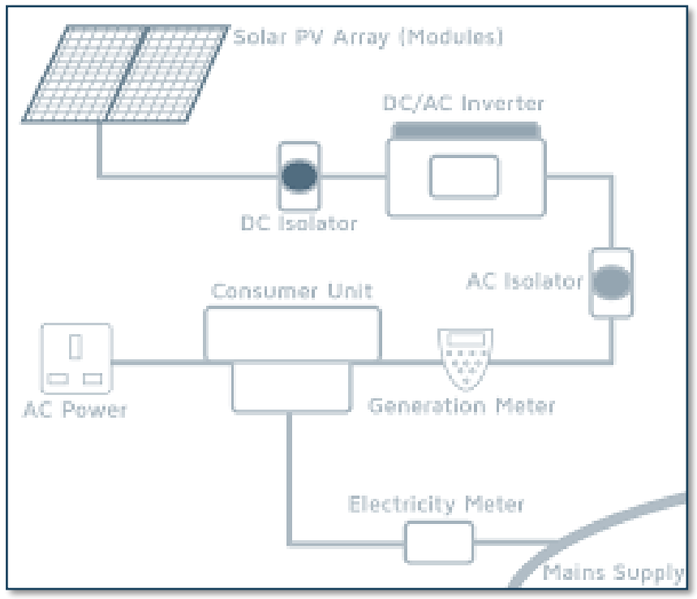


Figure 4: PV Array Component Schematic

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Air Source Heat Pump (ASHP) Technology

ASHP will also offer opportunities for energy reduction and decarbonisation albeit perhaps at lower cost effectiveness/higher capital outlay compared to PV with a higher technology implementation risk. As the main aspect of the brief is decarbonisation, options for the retention of natural gas (e.g., hybrid ASHP and boilers) have not been included in the assessment.

Heat pumps are an effective and energy efficient way to produce hot water to heat a building. They work by absorbing heat from the environment and transferring it to a refrigeration fluid, which is compressed to increase its temperature. This heat is then transferred from the compressed fluid into the central heating system, to use for both heating and hot water.

The main difference between the two main types of heat pumps is simply where they get heat from: air source heat pumps (ASHPs) absorb heat from the air whereas ground source heat pumps (GSHPs) absorb heat from the ground. This works via the wet central heating systems to heat radiators. Heat pumps work similar to a refrigerator: they absorb heat and transfer it to another medium, such as water. There are various types of heat pump available on the UK market but generally the types fall into the following categories:

- High Temperatures – the heat pump will be able to generate water for heating at around 75°C which is generally similar to that required for most heating systems. Therefore, the existing radiators can be retained.
- Low Temperature - the heat pump will be able to generate water for heating at around 50°C to obtain maximum efficiencies. This water temperature is lower than that required for the heating system and therefore additional/supplementary radiators are required for retrofit installations to maintain comfort during the heating season.

A well installed and maintained ASHP can last typically for 15-20 years can offer high energy efficiencies particularly when delivering water at lower supply temperatures. A Heat pump's efficiency is measured across a season and known as the season Coefficient off Performance or sCOP. This is a measure of how much each unit of heat output is achieved for every unit of electricity inputted. Good heat pumps achieve sCOP's of 3-4 but this is dependent on location and the connected heat system installation. ASHP's work better at higher external ambient temperatures but consume more electricity as the external ambient temperatures reduce. In most parts of the UK temperatures stay above freezing for most of the year, particularly near coastal locations. ASHP's will produce noise externally but providing the unit and location is carefully chosen this should not impact internally or externally.

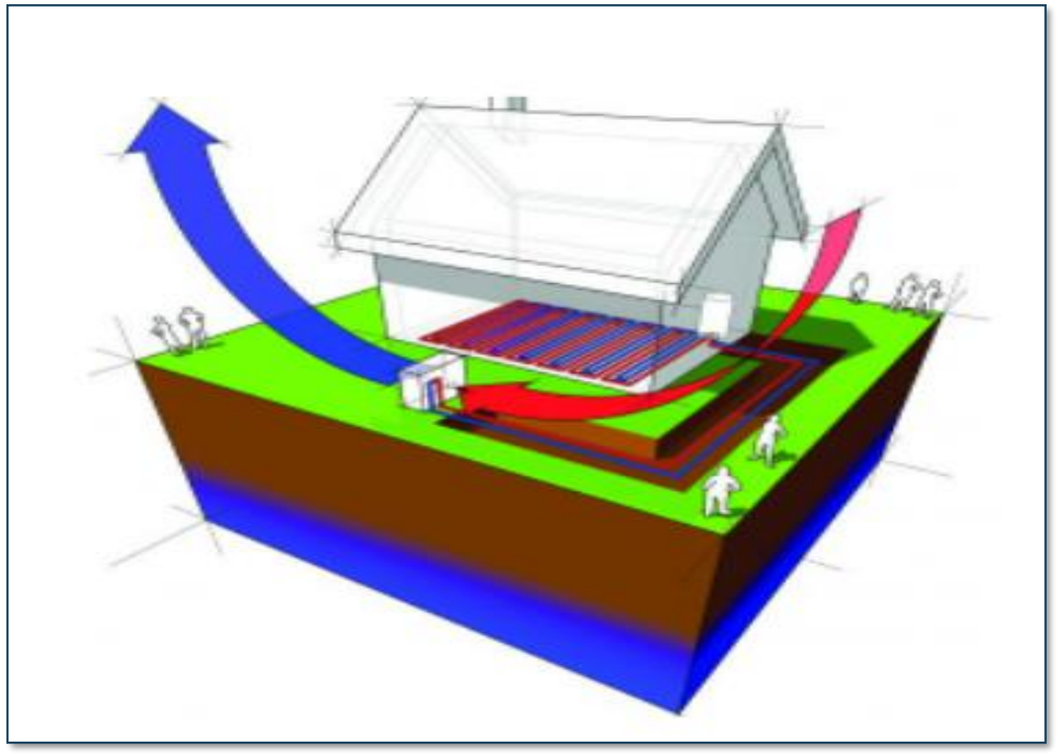


Figure 5: ASHP Externally located and connected into building

3.5 Technology Analysis

An outline qualitative assessment for the applicable technologies is undertaken below:

3.5.1 Roof Mounted PV Array

A roof mounted PV array comprising of a number of monocrystalline PV panels and inverters could be provided connecting the main building electrical infrastructure. When generating on-site renewable LV electricity the incoming grid energy consumption would be reduced. When the building is unoccupied it is assumed, electricity would be exported, generating a small income under the Standard Export Guarantee (SEG) arrangements. This would require agreement with the local DNO and energy shippers.

Each Photovoltaic module has a maximum output of 455W each and typically measures 1778mm Height / 1054mm Width / 36mm Depth with a weight of 21kg each.

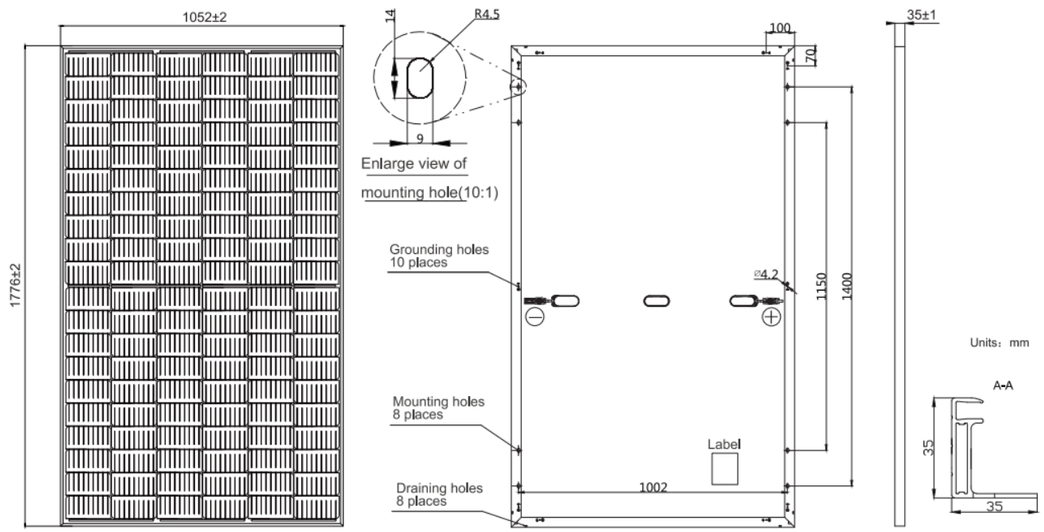


Figure 6: PV cell dimensions

A simulation has been conducted for this option, detailing the resulting output on load, energy and carbon reduction. The results of the simulation for Option 3 can be seen below:

Number of PV Panels	45-55 @ 460W
PV SQM	c.121 m2
Number of PV Inverters (G99 Compliant)	1
Installed DC Power	25 kWp
Annual Energy Generated	22,900 kWh/yr
Equivalent Energy Cost @ 16.8 / p/kWh	£3,852.00/yr
CO2e Emission Saved per Annum	5.33 tons

3.5.2 ASHP's

Low Temperature ASHP technology will be considered for the main heat generator for the wet LTHW heating systems. In order to achieve the required energy savings and operate in an effective manner, ASHP should be integrated only after (or in conjunction with) fabric and fenestration improvements. It has been assumed for the desktop simulation exercise, that the fabric energy improvements outlined in section 6.2 (c48-51%) are implemented and that wet LTHW heating would typically be around 50% of the current coverage based on the overall servicing strategy detailed in Option A in section 6.7. The remainder of the building would be heated/cooled via VRF heating and cooling technology.

A desktop preliminary simulation has been conducted for this option, detailing the resulting output on load, energy and carbon reduction. The results of the simulation are provided below:

Element	Details
Est. Plant Capacity	c. 168kWp (To cover 50% of building heat demand)
Degree Days	1867 HDD
Est. sCOP	2.5 Htg
Est. Annual Heating Demand Energy	71,205.11 kWh/yr
Est. Annual Electrical Demand Energy (ASHP)	18,738.19 kWh/yr
Emitters	. All new LTHW wet heating would be changed and replaced to new lower mean water temperature heating to suit ASHP technology.
Carbon emissions displaced	8 -12 $TC0_2e/yr$

4.0 Proposed Building Services

4.1 Mechanical and Public Health Services

4.1.1 Water Systems

The existing statutory metered mains water supply (MCWS) will be retained to serve the building. From the meter and stop valve a new mains cold water supply will serve a small potable break tank and duty/standby booster pump system c/w expansion devices etc will be provided to ensure guaranteed water pressures are facilitated. The tank and booster plant will be in the LGF plantroom. Boosted cold water will distribute from level -01 plantroom to serve all appliances within the building.

Sub-metering, linked to the Main Hall Building new BMS will be provided to the supplies serving retails units in order to allow billing of the tenants. Sub-metering will be MID Certified suitable for formal metering and billing purposes.

Hot water within the Main Hall building will be provided local via under sink exposed instantaneous and/or storage type electric water heaters to suit the application. Storage type units will be located under accessible vanity units or similar concealed position agreed with the Architect. Where showers are indicated on the architectural plans, it is envisaged that local electric showers will be provided rated a 9kW minimum.

Water for external irrigation purposes will be provided via a dedicated small Cat 5 booster tank serving a building mounted external hose-union bib-tap within a lockable enclosure.

All new pipework will be copper half hard BS1057 c/w lead free capillary fittings within plantroom areas and pressfit fittings elsewhere. Pipework to be fully insulated throughout and suitably finished/protected within risers and plantrooms. No flexible connections will be used for wash hand basin terminations.

4.1.2 L.P Natural Gas Systems

As part of the heat decarbonisation strategy for the building, no natural gas services are to be proposed to be utilised. The existing supply could be retained to serve any commercial catering appliances (subject to development of a commercial catering strategy) although consideration will be given to all electric catering (e.g. condensing ovens. induction hobs etc) as part of any strategy to reduce carbon dioxide emissions.

4.1.3 Central Heating System

A central heating system would be proposed to serve the building. The system would be designed to cover the following areas:

- Entrance and reception areas – served via underfloor heating (assuming floor construction can be adapted to accommodate insulation and underfloor heating systems/screed etc e.g. via a suspended system or similar)
- Stairwell's and corridors – served by LTHW radiators
- WC's – served by LTHW radiators (LST to accessible WC's)
- Supplies to AHU heating coils where required

The general heating strategy would involve moving away from several individual systems to a central system comprising a number of zones. The proposed system would be designed for low mean water operating temperatures in order to facilitate integration of ASHP technologies.

The heating system will generally comprise external ASHP's located within an external plant compound located at roof level. LTHW will be distributed from the external plant compound via pre-insulated pipework entering the LGF plantroom underground. The system will generally comprise the following:

- Air-to-water air source heat pumps complete with hydronic pack and associated buffer vessel to act as the primary heat provider.
- Suitably sized buffer vessel to be a packaged unit with integral PHE and pump set/pressurisation c/w controls will be considered if completely separate circuits are necessary for frost protection risk mitigation.
- Twin head primary circulation pump (Constant Speed)
- Pressurisation unit and expansion vessels
- Manual chemical dosing pot.
- De-aerator/micro-bubble/dirt separator.
- All necessary compliant isolation valves, balancing valves, temperature sensors etc to ensure a fully working system.
- Strainers, Air vents and drain cocks
- Temperature and pressure gauges
- Test points on inlet and outlet connections to all appliances
- Expansion vessel/fill system.
- Vertical Low loss header

Subject to funding arrangements and payback periods, initially the heat generation could be via gas fired condensing boilers in the interim with the ability to readily change to ASHP technology in future years. The heating system would need to be design for low mean water temperatures and dT's (e.g. 50/40°C or similar)

From the vertical low loss header, secondary heating circuits will be derived. The final number of circuits will be determined to suit the required zoning of the building based on building occupancy, orientation and set-point requirements etc. Typically, secondary heating systems will be provided as follows:

- Twin head circulation pump set (Variable Speed)
- 3-port Mixing valve to limit flow temperatures

Where secondary heating circuits are to be hydraulically separated from the primary circuit, additional pressurisation unit and expansion vessels, manual chemical dosing pots and de-aerator/micro-bubble/dirt separator will be provided.

The heating system shall be configured for highest potential energy savings via the use of a variable volume pumping strategy, differential pressure control valves as well as pressure independent control valves etc. To this end pumping speed shall be controlled to maintain the necessary constant pressures across the remote pressure controlled sub-branches.

Heating to spaces served via the LTHW heating system would be generally via LTHW radiators with consideration given to use of underfloor heating in some areas (e.g. Double height entrance area) to maximise the energy savings via use of lower water temperatures and increased COP's and optimised ASHP performance. Radiators will be provided with TRV's and LSV's.

Where employed, UFH systems will be provided with a pumped flow and return manifold located local to the zone served. Each individual space will be provided with a wall mounted controller to allow for occupant control over set-point.

Local window contactors will be provided on all openable windows to enable the interface provision of heating in event of windows being opened, as an energy saving measure.

If appropriate and beneficial in terms of energy consumption, discrete rooms/ancillary areas including store and toilets will be provided with wall mounted electric panel heater(s), complete with integral electronic thermostats, auto-thermal cut-outs, suitable IP ratings (typical IPX4) and be typically constructed from durable epoxy-polyester powder coated steel casing with upward-facing grilles together with temperature resistant nylon thermoplastic moulded parts. The heaters will be finished in commercial white. The heaters will be CE marked and BEAB approved. Each heater will be provided with a touch control system offering temperature selection and pre-set programmes and will also include open window recognition.

All pipework within the plantroom will be installed in medium grade steel, screwed up to 50mm and welded 65mm and above. Outside of the plantroom pipework will be installed in e copper half hard BS1057 c/w lead free capillary fittings. External connecting pipework from the plantroom to the ASHP external plant compound will be installed in medium grade steel pipework screwed/welded to suite. Pipework to be fully insulated throughout and suitably finished/protected via pop-rivetted stucco aluminium within risers, externally and plantrooms.

4.1.4 VRF/DX Cooling Systems

Heating and comfort cooling will be provided to the meeting rooms, TMCP and offices via appropriately sized VRF indoor in cassette/ducted/wall mounted units, suitable for the room finish and ceilings. The VRF system will provide simultaneous heating and cooling with heat recovery capabilities to each space. The indoor units will generally be selected at medium speed to limit the noise generated / meet the acoustic requirements. Where the calculated heating / cooling loads dictate, multiple units may be provided in each room to meet the required loads and / or provide the required coverage to ensure occupant comfort. A wall mounted controller in each room will be provided to allow for occupant control over set-point and will also allow for timer programmable control.

Local window contactors will be provided on all openable windows to switch off the indoor units in event of windows being opened, as an energy saving measure.

The VRF outdoor unit(s) is envisaged to be located on the roof plant deck.

The VRF BC Controller unit, transferring energy from the outdoor unit to the individual indoor units, will be located within the ceiling void above the circulation space to minimise any noise impact. From the BC Controller, refrigerant pipework will run to each indoor unit, within the ceiling void, mounted on cable tray / basket.

Refrigerant pipework for the outdoor unit is envisaged to run up internally via risers and voids connecting the indoor BC controllers and indoor units in turn.

Local window contactors will be provided on all openable windows to enable the interface provision of heating in event of windows being opened, as an energy saving measure.

4.1.5 Ventilation Systems

Th Main Hall will be provided with a new replacement air handling unit providing heating, cooling and fresh air. Air distribution would be determined in conjunction with the finishes, architectural and seating requirements. In order to provide the most optimum solution. a displacement ventilation system would be proposed within the main hall to provide and comfortable environment, with low noise system that is energy efficient. The displacement system would comprise the following general components:

- Central roof mounted Air Handling (AHU) Plant
- Supply distribution ductwork dropping down the lower level, 01 main hall.
- Air distribution via low level wall mounted air diffuser terminals. Air terminals will have the facility to operate in displacement mode (cooling) and heating mode (mixing).
- Additional air distribution can be provided though the upper hall level 02 seating via jet nozzle diffusers.
- Air would be extracted via the rear/ceiling of the hall and recirculated back to the AHU

The AHU will comprise a dedicated external roof mounted, high efficiency system with suitable filtration, heat recovery, high efficiency fans, delivering tempered air.

The Mosaic level -01 café, Toilets, cleaners' stores, and corridors will be provided with MVHR systems to provide dedicated mechanical extract in accordance with the building regulations Part F. Fans for the toilet will be located in or above the ceilings with ducting routed directly to suitably sized louvres on the façade, Fan will be controlled via PIR detectors within each space with adjustable overrun facility. Where a toilet area is greater than two WCs, there shall be a mechanical ventilation system with supply and extract; supply ventilation shall be at 85% of extract to ensure that air is entrained into the space to avoid odours emanating from the WCs. Make-up air will be introduced via the corridor using door transfer grilles and door undercuts as appropriate. Such MVHR systems will be capable of operating in the necessary trickle and boost ventilation modes. The MVHR units will connect to ceiling mounted supply and extract diffusers, and to fresh air intake and exhaust air louvres mounted within the building façade on the corridor side of the extension, via insulated steel ductwork.

Consideration to integrate natural ventilation and air intakes with the courtyard aspect in order to make use of the cold air affect for free cooling.

Remote areas such as single WC's or cleaners stores may be provided with local mechanical extract as a more practicable solution than MVHR in this instance.

Ductwork will be installed in accordance with BESA DW 144. Fire and if necessary, fire/smoke ventilation dampers will be provided in accordance with Building Regulations Part B and Fire Strategy.

The ventilation systems will be provided with suitable room and atmospheric side attenuation to meet the acoustic performance requirements set out by the Acoustic Engineer. Suitable air filtration systems will be provided as appropriate for the location of the equipment.

General offices and meeting spaces would be provided with opening windows to provide natural ventilation. However, some rooms where natural ventilation is not appropriate (e.g. where external noise or occupancy density is considered a major impact), MVHR systems will be considered.

Stairwells will be provided with natural ventilation via opening windows.

General stores will be unventilated.

4.1.6 Control Systems

A simple Building Management System (BMS) based on the latest generation BACnet 'open' communication protocols as defined in ANSI/ASHRAE Standard 135-1995 to minimise the cost of providing integration and to allow interoperability between building systems and control vendors. The BMS shall be provided to interface, monitor and control systems and plant/equipment as appropriate. Proprietary packaged controls will be interfaced and monitored by the BMS. The BMS system will be connected/networked to the existing site-wide system.

The BMS shall be as simple as possible and complex inter-connected control systems will be avoided. The control of the Building Services systems shall be operable within the affected space and local to the end users. A web-based graphical interface will be provided. for each major plant item; menu driven for selection; monitoring and control of all major plant items; global and individual control and adjustment of operating times/temperatures for each operating zone; monitoring and reporting of fault/trip conditions and critical alarms.
Energy usage will be monitored via a real-time energy monitoring and targeting plantroom. Sub-metering will be provided with a local display on the submeter with centralised recording, monitoring, and trend logging, with sampling at a minimum of every 15 minutes. The system will be connected to a cloud-based real-time energy management system to permit interrogation, benchmarking, monitoring, and targeting of energy consumption and C02e emissions.

The BMS and Energy Management systems will provide the following functionality:

- Occupant comfort - maintain the environmental internal conditions that are appropriate to the activity within the space.
- Energy and carbon emissions - reduce energy consumption and carbon emissions through efficient use of installed Building Services systems.
- Space flexibility - the environmental conditions of the internal spaces shall be flexible where required. Safe operation - The Building Services systems shall be safe to operate and maintain.
- Information - inform the end users about the environmental conditions that affect their thermal comfort. This also extends to informing the end users about energy consumption and carbon emissions.

The BMS outstation controls panels will be in the plantroom and provided complete with suitably rated Type 3 surge arresters complying with BS EN 62305-4 .

A combination of central automatic control and packaged controls (to proprietary system) will be provided to control mechanical services systems.

Final positions for services termination points will be agreed with the project Architect in the following Workstage.

Further discussions with the End Users and Building Management Team around controls will be required to determine the precise requirements and interfaces however the principles of the BMS would be as follows:

- Automatic control of main plant and systems including central heating systems
- Interface with package control systems such as VRF and/or DX heating/cooling systems, ventilation systems (AHU/MVHR)
- Monitoring of key plant and systems such as mains water, water tank conditions, booster pumps and water distribution temperatures.
- Monitoring of key energy consuming plant via metering of key systems:
    - Lighting
    - Power
    - HVAC/Fans
    - Central heating
    - VRF DX Cooling/heating systems
    - Sub-metering of Tenanted retail units (suitable for billing purposes with MID certified meters)
    - Ability to log and interrogate metered data
- Ability to interrogate plant and metered data via simple graphic interfaces.

4.1.7 Testing & Commissioning

The Mechanical Services installation will be fully tested and commissioned in accordance with British Standards, CIBSE Guides and all other relevant standards and guidelines. A soft-landings approach to building handover will be followed using BSRIA soft-landings approach. All test results and certification will be included by the Contractor within the O&M manuals.

4.2 Electrical Services

4.2.1 Incoming Electrical Distribution/ Supplies

An upgraded statutory power supply will be provided to the building derived from the statutory infrastructure. Refer to section 4.2 for details.

4.2.2 Electrical Distribution

The building will be provided with a new suitably sized TPN MCCB 400A 16-way power-board (Memsheild or similar) to BS EN 61439-1 provided c/w all necessary switch disconnectors and MCB's etc. distribution board., split metered for lighting and power. The board shall be suitably fault rated for the source rating and provided with local isolation and type 1 surge protection. From the new building main power board sub-mains will distribute to distribution throughout the building. All new Distribution boards will be fitted with Type 2 surge protection devices.

4.2.3 Photovoltaic (PV) Array

A roof mounted PV array will be provided to provide the building with on-site renewable energy provision. The size of the array will be based on maximising the available accessible roof area. The PV system will be designed where possible to suit the architectural building and roof configuration. The system will generally comprise a series of strings/arrays connected to DC/AC inverters connecting into the building electrical infrastructure. Consideration for battery storage to further reduce the building grid power consumption will also be undertaken to maximise consumption/utilisation of on-site generated power.

4.2.4 Small Power

General small power in the extension areas will be provided by a network of 13A switched socket outlets as required to serve the following supplies.

- General use power
- ICT power
- Cleaners use sockets
- Access control
- Mechanical supplies
- AV equipment and supplies to clever touch screens/TV's.
- Induction loops where applicable.
- Lighting control modules
- Intruder/Security system equipment
- Projectors/screens (If applicable)
- Fire alarm panels
- Hand dryers
- Water coolers

Generally, RCD/RCBO socket protection will be provided as required by the relevant Regulations. Fixed items of equipment will be served locally by suitably rated connection units/isolators.

All electrical accessories will be in accordance with all DDA legislation and mounting heights will comply with DDA. Dado trunking shall be fully DDA and CAT 6 data cabling compliant.

Power and data to serve the Workstations will be wired within low level dado trunking 2-compartment wired and fixed the back of the perimeter desks as per the existing installations on site. All dado trunking will be Cat 6 compliant. Floor boxes will be provided where specifically requested by the end users and will be either fed from below for upper floors or chased into the screed with concealed trunking at level -01.

Depending upon the individual areas concerned, the method of earthing will relate to the activities/equipment being used and may vary between areas.

All ELV and LV cables shall be fully segregated on individual ELV and LV containment in accordance with BS 7671:2018 A3:2020.

Dedicated power supplies to any new mechanical control panels and fixed equipment will also be provided. Power to main mechanical panels/equipment will be dedicated and form part of the sub-main distribution system.

Additional wall mounted cleaners' sockets will be installed within storerooms and circulation areas as required, generally on 15m spacing.

All new lighting circuits will be RCSD/RCBO protected at the mains distribution boards.

4.2.5 Mechanical Power

Power supplies will be provided to local internal equipment such as fans, water heaters, pumps etc, DX cooling units. These supplies will be metal clad outlets mounted above ceilings. External plant and equipment such as ASHP's will be provided with suitable IP rated external power supplies.

Power supplies will be provided to local internal equipment such as panel heaters, fans and water heaters as required. These supplies will be metal clad outlets mounted above ceilings.

4.2.6 General and Emergency Internal Lighting

New energy efficient LED lighting c/w suitable controls will be provided throughout each building

The lighting installations will comply with BS EN 12464-1:2021 Lighting of Indoor Workplaces & CIBSE Codes for Interior Lighting.

Luminaires will be selected and installed to provide a high illuminance uniformity ratio, noise free operation, excellent visual comfort, they shall be aesthetically pleasing installation and be harmonised with the interior.

Lighting throughout the offices and rooms-for-hire spaces will utilise LED suspended and/or recessed lay in modular luminaires to suit the building aesthetic. Lighting will be sub-metered separately from all other power requirements. The lighting will be designed to allow the teaching wall area of lighting to be separately zoned and switched.

Storage and back of house areas will be lit by recessed circular LED luminaires.

Office areas will be provided LED luminaries controlled via absence-controlled microwave infra-red presence detectors. A dimmer plate will be provided within the board room.

Circulation and amenity areas will be provided LED downlighters controlled via presence detection.

WC's will be provided with similar downlighters suitably IP rated luminaires.

An allowance for specialist feature or interior design themed lighting will be provided to the entrance and mosaic café rooms.

Kitchen lighting will be suspended linear or recessed luminaires suitable sealed to prevent ingress of grease and facilitate regular cleaning.

The Main hall with be provided with new replacement lighting system in the form of high-efficiency LED linear suspended or recessed (to suite the aesthetic and ceiling finish) fittings /w automatic DALI controls. the controls will enable individual dimming and switching of the front rows closest to the display wall. Other remaining lighting rows will be dimmed and switched separately. Automatic absence detection will also be provided switching off lighting when the space in unoccupied after an adjustable period of time.

Stage lighting in the form of a stage lighting rig with LED floodlights. The system will be a specialist lighting element and will need to be discussed with stakeholders.

All lighting efficiencies will be not less than 110 Lumens/Circuit Watt.

The system will primarily employ local switching, be flexible and expandable and provide a high degree of built-in tolerance, thereby providing scope for tuning the system to meet user requirements as they become apparent and/or change. Where appropriate it will also incorporate energy management facilities such as daylight and occupancy detection, with absence detection control being used wherever practical.

Dedicated controls will be provided to storerooms in the form of PIR devices.

All proposed lighting to the refurbished rooms and spaces with large perimeter window expanses will also be fully dimmable with the appropriate dimming controls logic included. Lighting to the larger spaces will be wired via LCM's (Lighting control modules) to allow for controllability. Meeting rooms and offices will be provided

The emergency lighting installation will consist of emergency luminaire units (either standalone or combined fittings as appropriate) to provide 3hr operation and meet with BS5266:2017 criteria. All emergency luminaires shall have a three-hour battery capacity and feature local key switch testing facility. All escape exists will be provided with maintained illuminated "EXIT" signs.

All exit signs will be c/w appropriate European style legend.

4.2.7 Testing & Commissioning

The Electrical Services installation will be fully tested and commissioned in accordance with British Standards, IET 18th Edition Wiring Regulations, CIBSE Guides and all other relevant standards and guidelines.

5.0 Energy Strategy Summary

The energy strategy for the propsoed building follows the energy hierarchy approach with fabric improvements utilised as a first principle. Minimising demand through efficient systems and controls is employed with electrification of heat through heat pumps providing decarbonisation of heat. A summary overview of the proposed energy strategy is provided below:

Energy Hierarchy Stage	Element	Included in the Scheme ?	Details
Stage 1	Walls	✗	Not deemed practicable and cost effective
	Ground Floors	✗	Not deemed practicable and cost effective
	Roof	✓	
	Windows	✓	Add secondary glazing where none currently provided
Stage 2	Improved LED Lighting and Controls	✓	New LED lighting and controls including day light dimming
	Heat Recovery Ventilation	✓	Where mechanical ventilation provided, high efficiency fans and heat recovery to be employed
	Local Electric point of use water heaters	✓	Local heat water heaters moving way from fossil fuels for hot water generation.
	Controls and Monitoring	✓	Heating controls and energy monitoring systems to be employed
Stage 3	ASHP technology	✓	Heat pump technology to be used for heating
	PV Array	✓	Roof mounted PV array to be provided