

Upper Brook Street Masterplan Williams / Alliance UBS Limited Energy Strategy Life Sciences



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PROPERTY ALLIANCE GROUP

UPPER BROOK STREET

MANCHESTER

ENERGY STRATEGY REPORT

LIFE SCIENCES BUILDINGS

REVISION P02



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CONTENTS

EXECUTIVE SUMMARY

1.0 INTRODUCTION

2.0 DEVELOPMENT PROPOSALS

- 2.1 Site Overview and Location
- 2.2 Development Proposals

3.0 ENERGY HIERARCHY

- 3.1 Low Energy Design Hierarchy
- 3.2 UK Buildings Decarbonisation

4.0 PLANNING POLICY

- 4.1 National Policy Framework
- 4.2 Manchester's 'Core Strategy Development Plan, 2012 to 2027'
- 4.3 BREEAM

5.0 REGULATORY REQUIREMENTS

6.0 APPRAISAL OF SOLUTIONS

- 6.1 District Heat Networks
- 6.2 Site Wide Energy Strategy
- 6.3 Decentralised Approach
- 6.4 Energy Consumption in Life Sciences Buildings
- 6.5 Building Energy Strategy Proposal
- 6.6 Sustainable Energy Technologies

7.0 CONCLUSION

APPENDICES

Appendix 1.0 - BRUKL's



EXECUTIVE SUMMARY

KJ Tait were appointed to provide an energy statement for the purposes of submitting a planning application for the proposed new Life Sciences buildings located at Upper Brook Street, Manchester. Note, the purpose-built student accommodation (PBSA) is captured under a separate specific document.

Reduction of carbon emissions and the environmental impact of the development is a key project deliverable and has informed all aspects of the design in order to minimise energy and carbon wherever possible.

R&D and laboratory buildings are process driven, with tightly controlled internal environments. They will be subject to tight regulatory standards due to the nature of the science undertaken. They may be highly serviced, with significantly more building services of much higher complexity compared to an equivalent sized office building. The nature of the science requires a high degree of resilience and constant operation and maintenance of the internal environment.

The development's energy strategy has been developed in accordance with the Be Lean, Be Clean, Be Green Energy Hierarchy and passes the 2021 Part L Building Regulations.

Typically, under the former regulations it would have been possible to demonstrate significant BER/TER improvements, however the nature of the new 2021 Part L regulations make it much more difficult to reach a compliant scheme without pushing the implementation of excellent u-values and high efficiency plant. However, by following good design principles, despite the high energy nature of the lab spaces we've achieved compliance without photovoltaic panels on two of the three buildings. Panels have however been included as a green measure to further reduce the carbon impact of the buildings, achieving an overall saving of between **9.3 and 4.8%** over the 2021 target emission rate. A building that passes the 2021 building regulations by default also exceeds the previous standards by 27%.

It is acknowledged that the new buildings are unlikely to be 'Zero Carbon' from day one, but should take a 'Zero Carbon Ready' approach, aligning with the national grid decarbonisation trajectory milestones. The buildings will have excellent u-values, high efficiency plant and conditioned without the use of on-site fossil fuels. The chosen strategy is adaptable to future changes and advances in technology that may make a centralised approach more attractive.

This Energy Statement complies with the policies and guidelines set out Manchester's Core Strategy Development Plan, 2012 to 2027'.



1.0 INTRODUCTION

KJ Tait have been appointed to provide an energy statement for the purposes of submitting a planning application for the proposed new Life Sciences buildings located at Upper Brook Street, Manchester. Note, the purpose-built student accommodation (PBSA) is captured under a separate specific document.

The purpose of the statement is to summarise the relevant policies, both National and Local to demonstrate how these have been carried-forward in the design.

This document serves to outline the preliminary low carbon design philosophy and energy strategy for the development. The strategy has been developed in conjunction with the “Energy Hierarchy” methodology which provides a staged and structured approach to achieving a low energy and emission building.

2.0 DEVELOPMENT PROPOSALS

2.1 Site Overview and Location

Three mixed-use buildings are proposed for the UBS Life Sciences site, incorporating laboratories, office and retail space. The 1.46 Ha site is situated on Upper Brook Street, near Ardwick, Manchester. Adjacent to the site are two University of Manchester campuses and the Manchester Royal Infirmary. At present, the site is occupied by several disused car garages. Nearby the site is the former Unitarian Chapel, a grade II* listed building which has been repurposed into student accommodation. Further to this, a residential area comprising mostly 2-3 story homes is found to the north-east and eastern border of the site.

There are currently permanent structures on the Site which will be demolished as part of the scheme.



Figure 1: Approximate site location of development

2.2 Development Proposals

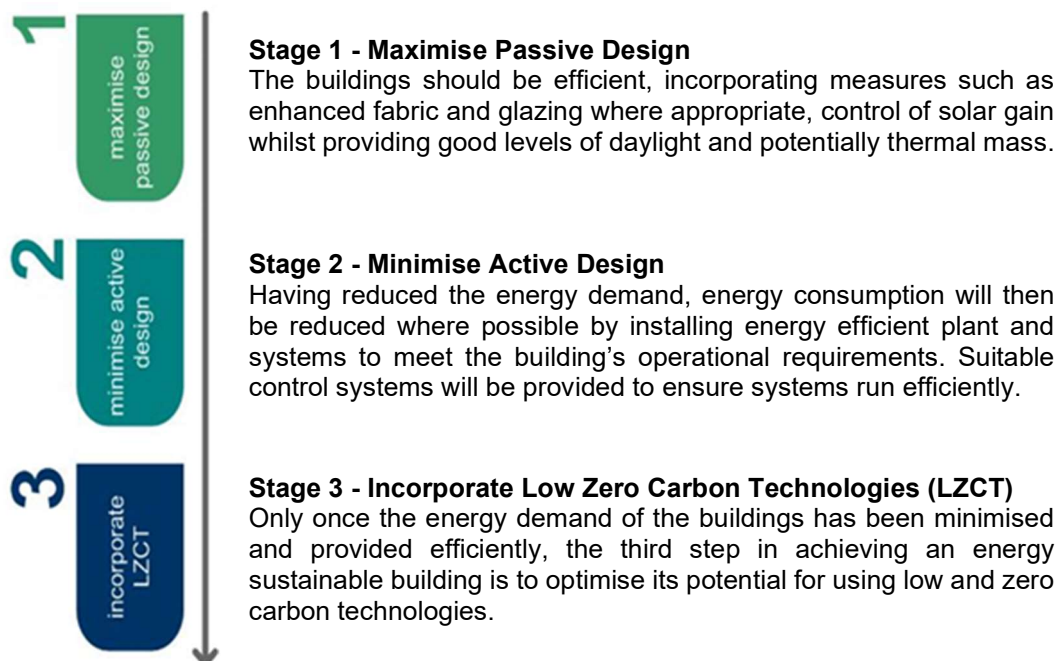
As noted at the beginning of this document, the PBSA elements of the site are described in a separate document. The life sciences buildings will provide approximately 45,874m² of combined laboratory and office space, with ground floor areas being available to publicly accessible amenities such as a doctor's surgery, cafés and other retail. The buildings will also house common conference and cycle storage / changing facilities.



3.0 ENERGY HIERARCHY

3.1 Low Energy Design Hierarchy

In line with good design principles, the development will follow a structured approach to providing energy efficient buildings that minimise the impact on the environment. The relevant steps in this process are shown below.



This strategy broadly follows the “Be Lean, Be Clean, Be Green” energy hierarchy adopted by the London Plan, but widely recognised and adopted throughout the UK. The requirements presented in Manchester’s ‘Core Strategy Development Plan’, Policy EN4 also recommends this approach.

3.2 UK Buildings Decarbonisation

The impact carbon emissions have on the environment and our way of life has been well documented, particularly over the last 5 years with a number of leading global economies declaring a ‘Climate Emergency’. Commitments are being pledged around the world to make changes in an attempt to reduce the devastating effects of global warming.

The building industry, whether through construction, maintenance or operational energy is responsible for approximately half of the UK’s carbon emissions.

Tackling poorly performing buildings, removing the reliance on fossil fuels and ongoing monitoring is key to success. Every building is complex and bespoke. Even buildings which have been designed to have very low energy consumption will perform just as poorly as an inefficient building if not correctly controlled and managed.

A buildings operational emissions are typically tested and measured against the main fuel carbon emission factors set by the government (measured in kgCO₂/kWh). Until recently, these favoured gas as the lower impact of the two primary fuels, however due to the decarbonation of the national grid, electricity has reduced dramatically from a decade ago. This has been achieved primarily through investment of large-scale wind and solar energy.



Carbon Emission Factors

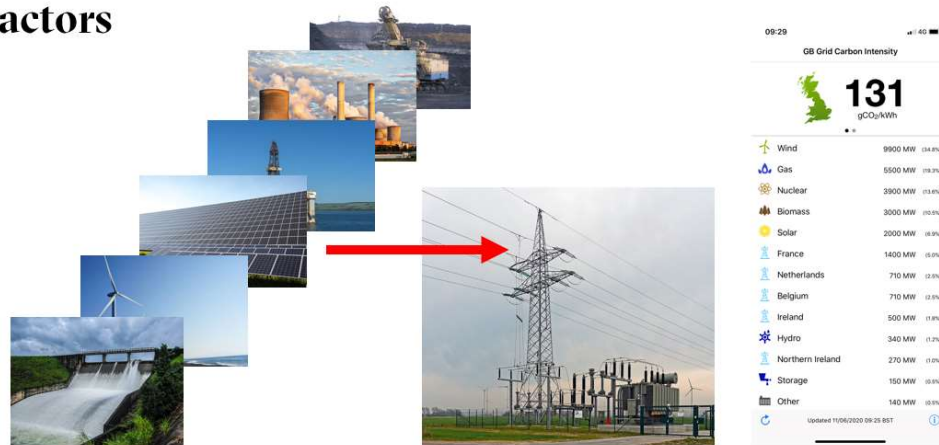


Figure 2: Graphic showing generator types serving the National Grid

Below is the comparison between the emission factors set in 2012 and the new emission factors now in force for new assessments.

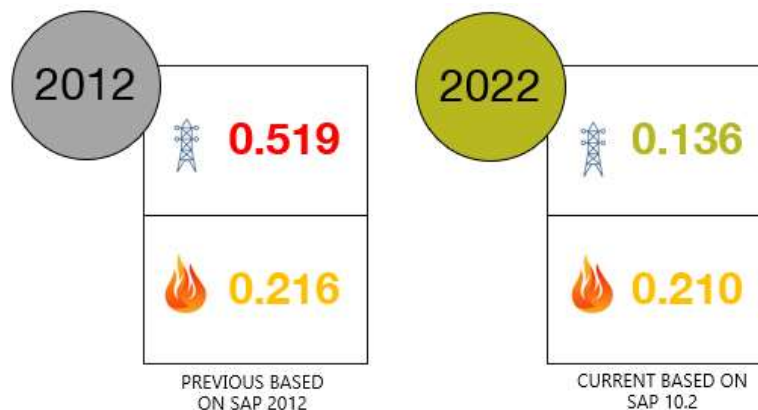


Figure 3: Graphic showing carbon emission factors.

The National Grid will continue to decarbonise over-time, predicted to hit 'near-zero' by 2050. This is why buildings which use electricity only as their main fuel are considered to be 'Zero Carbon Ready'. Gas is also anticipated to reduce over-time with the introduction of blended biogas and hydrogen, however it's unlikely this will happen within the short-term.

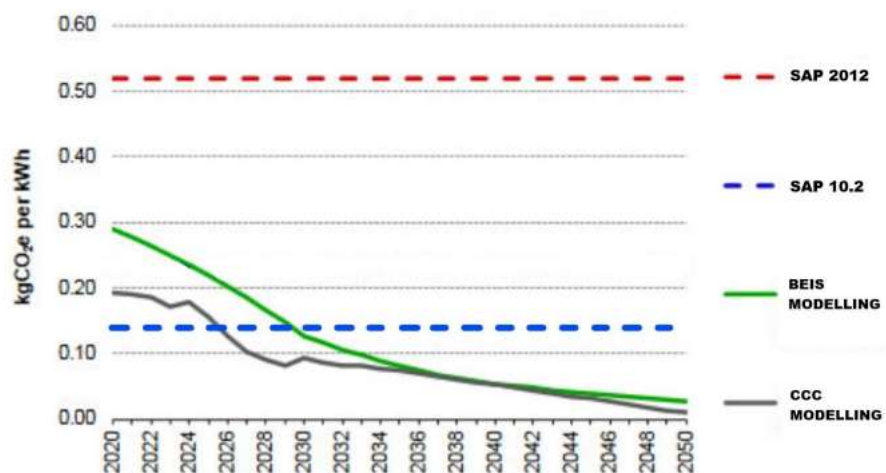


Figure 4: Graphic showing National Grid carbon reduction trajectory



4.0 PLANNING POLICY

The proposed development must adhere to the National Policy Framework and the relevant policies set out in Manchester's 'Core Strategy Development Plan, 2012 to 2027', adopted July 2012).

4.1 National Planning Policy

The updated National Planning Policy Framework (NPPF) document was published in February 2019. The NPPF states a clear presumption in favour of sustainable development. It supports the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, encouraging the re-use of existing resources, and the use of renewable resources.

Chapter 14 of the NPPF specifies the framework for climate change and energy where local planning authorities should:

- Ensure risks associated with vulnerable areas are mitigated through suitable adaptation measures which may include planning of green infrastructure
- Reduce greenhouse gas emissions through a building's location, orientation and design
- Provide a strategy for the implementation of renewable and low carbon energy and heat that maximises their potential
- Identify opportunities for developments to draw energy supply from decentralised, renewable, or low carbon energy supply systems and for co-locating potential heat customers and suppliers.

4.2 Manchester's 'Core Strategy Development Plan, 2012 to 2027'

This is the key document in Manchester's Local Development Framework and covers a period of 15 years from 2012 to 2027. The local development framework consists of a number of specific planning policies, the most relevant of which (to this report) are outlined below.

Policy EN 4 - Reducing CO₂ Emissions by Enabling Low and Zero Carbon Development: The council will seek to reduce fuel poverty and decouple growth in the economy, growth in CO₂ emissions, and rising fossil fuel prices, through the following actions:

- All development must follow the principal of the Energy Hierarchy, being designed:
 - to reduce the need for energy through design features that provide passive heating, natural light and cooling
 - to reduce the need for energy through energy efficient features such as improved insulation and glazing
 - to meet residual energy requirements through the use of low or zero carbon energy generating technologies.
- Wherever possible new development and retrofit projects, including energy generation plant, must be located, and designed in a manner that allows advantage to be taken of opportunities for low and zero carbon energy supplies.
- Where possible new development and retrofit projects will be used as a mechanism to help improve energy efficiency and provide low and zero carbon energy supplies to existing buildings.
- Where appropriate new development and retrofit projects will be required to connect to and/or make contributions to low or zero carbon energy scheme and/or to incorporate provision to enable future connection to any existing/potential decentralised energy schemes.
- The use of building material with low embodied carbon in new development and refurbishment.



12.25 - Reduction in CO₂ emissions is seen as a major component in mitigating climate change. In this regard, areas of Government policy give rise to the following three national and regional targets:

- A national reduction in CO₂ emissions by 34% in 2020 and by 80% in 2050, (from a 1990 baseline) to which buildings will need to make a proportionately higher contribution, as set out in the Climate Change Act 2008.
- 'Zero' carbon targets for all new housing by 2016 and for all new non-residential development by 2019, for which preparation will be required (See table 12.3).
- A national increase in renewable energy capacity by 15% by 2020 as set out in the UK Renewable Energy Strategy, which will require an uplift in current levels

Policy EN5 - Strategic Areas for low and zero carbon decentralised energy infrastructure: Within Manchester it is considered that the following strategic areas, indicated on the key diagram, will have a major role to play in achieving an increase in the level of decentralised, low and zero carbon energy supplies available:

- The Regional Centre, which also includes the Oxford Road Corridor and Eastlands
- District Centres and associated major development sites
- Airport Strategic Site
- Strategic housing location
- Strategic employment locations

Within these areas new development, regeneration and retrofit projects, will be expected to take place in the context of more detailed proposals for decentralised low and zero carbon energy infrastructure in the form of energy proposals plans. The Council will work with all relevant stakeholders, which may include developers, landowners, residents, community groups, private sector partners, utilities companies, neighbouring authorities and other public sector bodies, as appropriate, to bring forward such plans.

Where investment or development is being undertaken into or adjacent to a public building / asset or district heating network, full consideration shall be given to the potential role that these can have in providing an anchor load within a decentralised energy network or in creating opportunities for CO₂ reduction funded by contributions.

Policy EN 6 - Target Framework for CO₂ reduction from low or zero carbon energy supplies: Application for residential development of 10 or more units and all other development over 1,000 m² will be expected as a minimum to meet the target shown in Tables 1 or 2, unless this can be shown not to be viable. This should be demonstrated through an energy statement, submitted as part of the Design and Access Statement. Such a statement will be expected to set out the projected regulated energy demand and associated CO₂ emissions for all phases of the development.

Developments smaller than the above threshold but involving the erection of a building or substantial improvement to an existing building will also be expected to meet the minimum target, where viable, but will not be expected to submit an energy statement.

The target framework relates to three broad development locations and their potential for low and zero carbon, decentralised energy. The areas are defined as follows:

- Target 1 Network development areas: locations where the proximity of new and existing buildings, the mix of uses and density of development provide the right conditions to support district heating (and cooling)
- Target 2 Electricity intense areas: location where predominant building type has an all-electric fitout such as retail units and leisure complexes
- Target 3 Micro-generation areas: locations where lower densities and a fragmented mix of uses tend to mean that only building scale solutions are practical.



Target	% Minimum Requirement
Target 1: Network development area	CHP/district heating anchor or connection or where not feasible a 15% increase on Part L 2010
Target 2: Electricity intense buildings (Applies to commercial uses with high proportion of emissions from electricity use (>45 kg CO₂/m²))	10% increase on Part L 2010
Target 3: Micro generation area	+ 15% increase on Part L 2010

Where the CO₂ emissions reduction required under any future revision to Part L of the building regulations becomes greater than the '% Minimum requirement', the reduction required under building regulations would apply.

Where the Council identifies an 'allowable solution', for example within an energy proposals plan, that would produce higher carbon reductions at no extra cost than that of achieving the '% Minimum requirement' (or required under building regulations if greater) the higher percentage reduction will be required. The cost comparison is based on the cost of incorporating the 'allowable solution' at design stage.

The energy statement will be required to be submitted at the outset of any proposed development (outline application or before). Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO₂ mitigation, subject to the energy statement incorporating evidence such as modelling to demonstrate compliance.

Guidance on what the energy statement should contain and how to decide which target applies to a development proposal is given in Appendix A of 'Manchester's Local Development Framework, Core Strategy Development Plan Document, Adopted 11th July 2012'.

Policy EN8 - Adaptation to Climate Change: All new development will be expected to be adaptable to climate change in terms of the design, layout, siting and function of both buildings and associated external spaces. In achieving developments which are adaptable to climate change developers should have regard to the following, although this is not an exhaustive list:

- Minimisation of flood risk by appropriate siting, drainage, and treatment of surface areas to ensure rainwater permeability
- Reduction in urban heat island effect through the use of Green Infrastructure such as green roofs, green walls, increased tree cover and waterways
- The need to control overheating of buildings through passive design
- The opportunity to provide linked and diverse green space to enhance natural habitats which will assist species adaptation.

Developers will be permitted to use green infrastructure elements such as green roofs, green walls, street trees and waterways to contribute to compliance with CO₂ mitigation under Policy EN6, subject to evidence to quantify their contribution to compliance.



4.3 BREEAM

Manchester City Council make reference to a BREEAM rating being explored under an 'Environmental Standards Statement' for all new planning applications. This should include a BREEAM pre-assessment rating which should demonstrate a rating of at least 'Very Good'.

A pre-assessment has been carried-out by Certified (refer to separate report), demonstrating a rating of 'Excellent' should be possible, with a target score of 76.14%.

5.0 REGULATORY FRAMEWORK

The new buildings will follow the regulatory requirements set-out in the Part L building regulations. Part L 2021 came into effect in June 2022. This was a long-anticipated update to the compliance calculation methodology, acknowledging the fact that carbon emission factors for example used in the former version were outdated, favouring fossil fuels rather than grid supplied electricity.

The compliance methodology, although updated, is similar to the previous regulations with exception to the new performance metric. This has been introduced in order to more effectively measure a buildings performance, which becomes less relevant when assessing against CO₂ emissions alone. This ensures all new buildings are built to minimise overall energy consumption, as well as emissions.

6.0 APPRAISAL OF SOLUTIONS

Dynamic modelling of the proposed buildings has been carried out using IES software and the estimated regulated carbon emissions for each building are shown in the following sections.

Buildings have been modelled in compliance under a combination of 'Industrial Process' and 'Universities and Colleges' buildings. Once these building types are selected in the model we're then allowed to choose from a specific list of room uses, like Meeting Room, Corridor, Lab etc. The building / room type selected dictates the energy assumptions in the model. Most spaces are straightforward when it comes to selecting a room type, but the laboratories can vary – particularly when it comes to speculative lab space. Most of the laboratory areas have adopted the 'University and Colleges' option, which we feel is most appropriate given the anticipated use.

The proposed tenant spaces are intended to be built as shell only, i.e. with no services installed. For the purposes of the BRUKL calculation a split of 70% lab and 30% write-up / office space has been allowed. These areas are assumed to utilise the central landlord heating, cooling and ventilation systems, so efficiencies are known. Items which will be installed by a prospective tenant have been assumed. These assumptions are achievable for incoming tenants and requirements will be communicated through a tenants fit-out information pack.

It should be noted that the emission results at this stage are estimated and are based on the design and specification at time of writing. Final products and equipment selections, e.g. plant efficiencies, fit-out type etc may affect the final emissions figures however these will be closely monitored through the design and construction process to ensure compliance can still be achieved.

6.1 District Heating Networks

Current policy acknowledges that energy generated by centralised power stations can be inefficient. Many of these centralised schemes were put in place when the carbon emission factors for gas were much lower than electricity, meaning it was more environmentally friendly to produce electricity from CHP (whilst utilising the waste heat) than it was to use grid supplied



electricity. However as grid-electricity emissions have reduced significantly, unless the primary heat-source changed to a LZCT, like a heat-pump, or waste heat – natural gas CHP heat networks now look less attractive.

Manchester City Council have been working in partnership with Vital Energi to create the Manchester Civic Quarter Heat Network, however this is not within an economic distance to the proposed site and therefore also discounted.

6.2 Site-wide Energy Strategy

For a masterplan of this scale a central energy centre may typically be considered. This would sometimes be driven by a planning requirement, difficulty integrating plant at a local level or because it offers some direct benefit.

As there are likely to be numerous tenants with varied operational working patterns, a central energy centre may become inefficient. For example a handful of tenants may require heating all year which could become uneconomical (distribution losses and ancillary power).

As most of the buildings on site will be speculative, little is known about the future tenants requirements. Services for life sciences buildings will vary significantly. This makes planning via a central energy centre much less straightforward. The provision may either be grossly oversized and become inefficient to run, or not be large enough and require additional plant at a local level.

We therefore feel the decentralised approach would offer the best flexibility, reduce potential abortive work / waste and capacity risks.

6.3 Decentralised Approach

A key objective of the proposed development is to provide comfortable, reliable, practical and flexible buildings, which minimise energy consumption and associated carbon emissions while adopting a whole-life approach to the design of sustainable buildings.

In recent years, there has been significant reduction in the carbon intensity of the National Grid. This has resulted in a move away from the use of natural gas in generating heat for buildings and this change is a key element of the energy strategy to reduce carbon emissions. Therefore no piped fossil fuels will be supplied to site. All buildings will be fully electric, or supplied by other on-site renewable technologies.

It is acknowledged that the new buildings are unlikely to be 'Zero Carbon' from day one, but should take a 'Zero Carbon Ready' approach, aligning with the national grid decarbonisation trajectory milestones.

Central plant serving each building will generally be landlord owned and operated, with expandable provision to suit tenants' specific needs. Although incoming tenants would be bound by minimum building regulation standards, providing core services with shell buildings in this way ensures an economy of scale can be achieved, as well as localised energy recovery which would not otherwise be possible.

Tenant guides will be provided which outline how tenants should fit-out their spaces whilst aligning with the low energy aspirations for the site. This will include recommendations on any heating / cooling production, heat recovery and controls for larger systems.

6.4 Energy Consumption in Life Sciences Buildings

R&D and laboratory buildings are process driven, with tightly controlled internal environments. They will be subject to tight regulatory standards due to the nature of the science undertaken. They may be highly serviced, with significantly more building services of much higher complexity compared to an equivalent sized office building. The nature of the science requires a high degree of resilience and constant treatment of the internal environment.



6.5 Building Energy Strategy Proposal

The proposed MEP systems shall be designed to:

- i. provide a robust and resilient installation, capable of maintaining the specified internal environment
- ii. be energy efficient and exclude local fossil fuel use
- iii. serve the range of uses and be adaptable to accommodate change
- iv. assist in achieving the targeted sustainability targets
- v. be simple to operate and maintain
- vi. be quiet in operation to minimise external and internal noise.

Although there's no set carbon emission target stipulated for new non-domestic developments in the City of Manchester (Core plan was written around savings against 2010 compliance standards, which 2021 now significantly exceeds) calculations have been undertaken to ensure the proposal minimises its overall carbon emissions and environmental impact.

6.5.1 Be Lean: Passive Design – Reducing Energy Demand

The first step when considering a low energy design is to reduce demand and increase efficiency. Ambitions for energy efficiency have been set early and will be monitored through each stage of design and construction.

Passive design measures will be optimised across the development and, in conjunction with active measures, such as efficient building services systems will reduce demand. Building designs have been optimised to limit heat loss, reduce cooling loads by limiting solar gain and optimise the use of natural light and ventilation (where appropriate).

The following has been considered and optimised:

- Enhanced u-values, generally following LETI guidance which have been weighted against value / loss of GIFA. An efficient building envelope will reduce the heating and cooling requirements of the building and the associated CO₂ emissions. The target thermal performance criteria for the building fabric are as follows:

Fabric Element	Performance Value
External Wall	U-Value = 0.15 W/m ² K
Ground/Exposed Floor	U-Value = 0.12 W/m ² K
Roof	U-Value = 0.12 W/m ² K
Windows	U-Value = 1.6 W/m ² K
	G-Value = 0.35
Air Permeability	8 m ³ /h.m ² @ 50 Pa

- An air-tightness test will be carried-out, with instructions for tenants where the building envelope might be pierced in future.
- Balancing natural daylight with overheating, shading, glazing solar performance, beneficial gains etc. Glazing on the facades of the buildings shall be of low g-values (enhanced value to the south façade) with good levels of light transmission to limit solar gains. This will help reduce unnecessary mechanical cooling demand and optimise natural light / view-out where appropriate.
- Space planning, strategic placement of various room types. Spaces which are less reliant on natural light, or could potentially block useful access to the external façade have generally been located in the centre of the building. Areas where larger extents of glass may be preferred, such as the main entrance area, have been orientated on façades less susceptible to overheating.



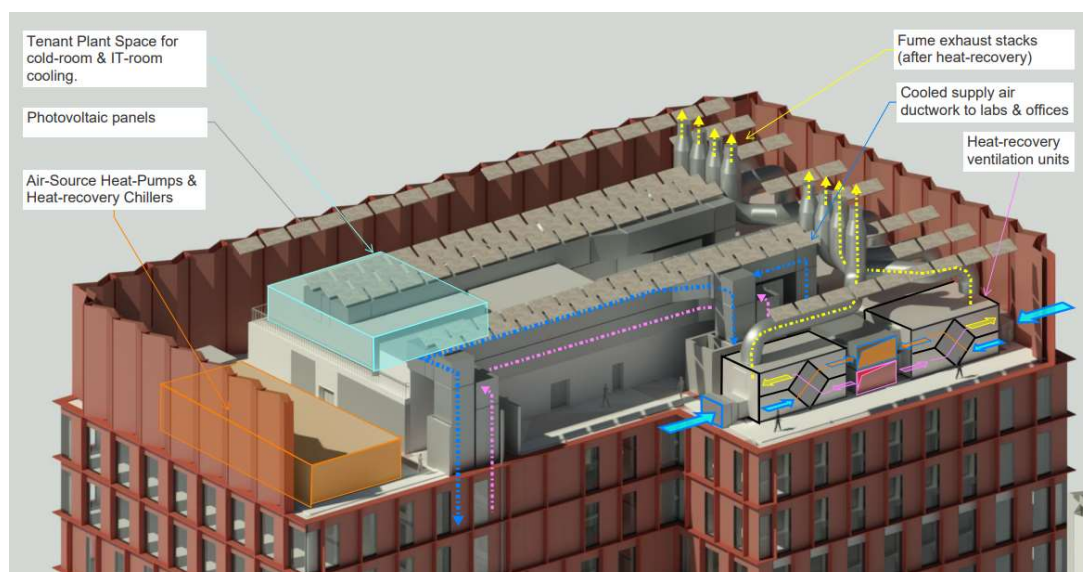
6.5.2 Be Clean: Supply Energy Efficiently & Active Measures

Having reduced demand, energy consumption will then be reduced where possible by installing energy efficient plant and systems to meet the building's operational requirements. Suitable control systems will be provided to ensure systems run efficiently.

This stage would also typically include an investigation into local district heating networks. There are no conveniently located district energy networks of interest or secondary waste heat sources within close proximity of the proposed site.

The following measures were adopted at this stage:

- All new M&E equipment will be selected from the high performance / efficiency range.
- Low volume sanitary fittings will be used to reduce water consumption by limiting unnecessary draw-off and hot water demand.
- Heating and cooling systems will have centralised controls to ensure these can be defaulted to correct levels at the end of the day where appropriate and prevent unnecessary use out of hours.
- Core ventilation systems will incorporate heat recovery and have volume controls based on occupancy in write-up areas.
- Luminaires will adopt high efficiency LED's with enhanced controls.
- Smart metering and controls will be implemented to enable energy use to be monitored, reported and opportunities for optimisation identified.
- Although Heat-Pumps are often classified under renewables, when they provide both heating and cooling they are not recognised as such under BREEAM. They have therefore been included at this stage.
- Adiabatic Cooling. By adopting adiabatic cooling techniques, the reliance on traditional cooling systems, such as energy-intensive refrigeration-based air conditioning, can be significantly reduced. Adiabatic cooling takes advantage of the natural properties of water evaporation, which absorbs heat from the surrounding air, thereby lowering its temperature. By introducing fine water droplets into the air supply, the evaporation process occurs, resulting in a substantial reduction in air temperature. As the reliance on energy-intensive cooling equipment decreases, the associated carbon footprint is also reduced.





6.5.3 Be Green: Low & Zero Carbon Design – Renewable Technologies

An options appraisal was carried out to assess the available low and zero carbon technologies (LZCT) and their potential implementation within the development. Several technologies are not suitable for the development and were discounted. These are discussed in Section 6.6 of this report for information purposes only. The incentives selected for this site have been set-out below.

Photovoltaics

Photovoltaics (PV), which convert sunlight into electricity are being proposed for the development. Renewables that produce electricity rather than heat are much more versatile as the energy can almost certainly be used on site.

Panel locations have been reviewed throughout the stage 2 process and will most likely be situated at roof level. Due to the extent of roof plant required to service the laboratories, panels will be mounted on a purpose made canopy / gantry. Outline PV outputs / yields are noted below.

	Building 1	Building 2	Building 3
PV Array Area, sqm	464	288	240
Total Output, kWp	92.8	57.6	48
Annual Generation, kWh	71,138	37,913	31,594

Air Source Heat Pumps (applied under the ‘Be Clean’ Study)

No gas-fired plant will be used within the base build and electricity will be used as the primary energy source to take advantage of electricity’s lower carbon intensity. Heating and cooling will be generated centrally using air source heat pumps (ASHP) mounted on the roof of each building. Some of the heat pumps will allow simultaneous heating and cooling, recovering heat from within the building to optimise energy efficiency.

There are efficiency benefits possible by the high coefficient of performance (COP) of an ASHP, reducing the primary energy use and respective emissions. For example, for every 1 kW of electricity consumed, around 3 or 4 kW of useful heating or cooling energy is provided.

Although an ASHP system that is capable of providing both heating and cooling to the building is not technically accredited as a renewable technology under BREEAM, it’s use will benefit the operational efficiency of the building and respective carbon emissions that come with the use of an ASHP. This technology has the potential to bring the greatest overall energy and carbon reduction to the project (compared to Natural Gas, or a direct electric solution), whilst still providing a robust and resilient system.



ASHP Example

Heating and cooling will be distributed to each Tenant demise with heat meters provided to meter and monitor energy use.



6.6 Sustainable Energy Technologies

This section includes the technologies considered for the development, however were discounted for the reasons described within the narrative.

6.6.1 Sand Batteries

Storage is a key part of energy conservation and the ongoing journey to Zero Carbon. Energy generation and energy demand don't always align, so storage can help smooth peaks and troughs. It can also ensure surplus energy generated on site can be retained on site, rather than either wasting or selling to the grid at a much lower cost than it would cost to buy-back.

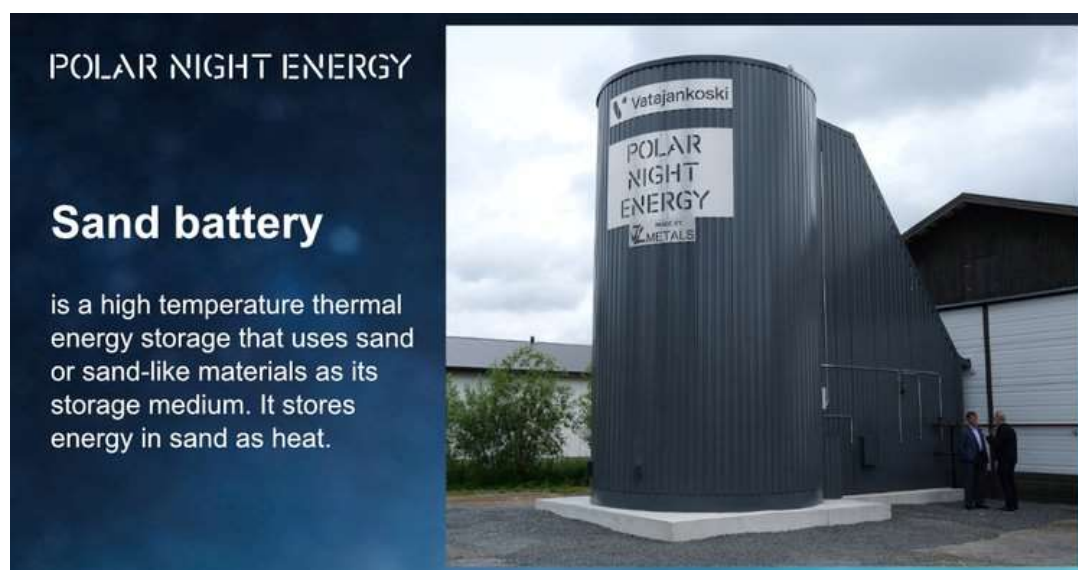
Researchers in Finland have patented a method of storing excess energy in a cost-effective way. Excess electricity produced by a wind turbine, or PV panels for example might normally be stored in Lithium batteries – however although much work has been done to improve these they're still expensive and use rare materials. Instead, engineers are using sand, one of the cheapest and most abundant materials on earth.

The battery itself is essentially a large, very highly insulated vessel full of normal sand.

- When excess energy is produced, an electric heating coil connected to ductwork blows super-heated air over 650°C into a network of tubes running through the vessel.
- This can heat the sand to between 400 and 600°C (perhaps more, further improving energy density).
- The heat can be stored for months with very low losses. The system can discharge at a rate of 100 kW, and stores up to 8 MWh.
- Heat is extracted from the system with an air to water heat exchanger – producing high-grade heat for buildings and domestic hot water.

In terms of its suitability for the Life Sciences site, it would only be worthwhile if there were very large amounts of surplus energy generated on site. Our expectation is that renewable electricity generation on site will be limited by practical restraints, and due to the very high-power demand posed by life science activities, demand will certainly out-strip supply at all times.

For this reason, this solution will not be considered further at this time.



Credit – Polar Night Energy

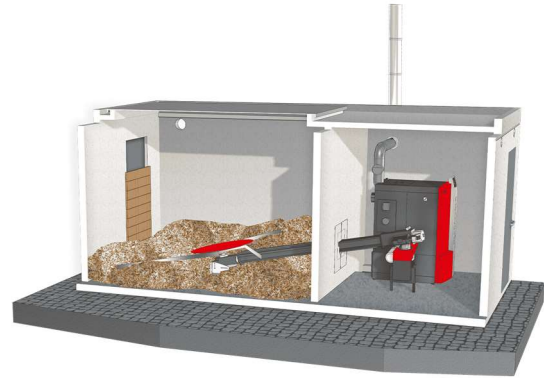


6.6.2 Biomass

Burning wood chip, or pellets to generate heat became more popular on a commercial scale around 10 years ago when the renewable heat incentive was in place. This allowed businesses to install biomass heating plant and effectively be re-imbursed for each kWh produced by the government. When the scheme ended there was decline in uptake. There were also poor installation examples which caused reliability issues and put off many businesses off utilising it.



Wood Pellets (left) / Wood Chip (right)



Typical Biomass Boiler / Feed arrangement

Interest in biomass has increased recently following turbulent fuel costs and the drive to reduce carbon emissions. Biomass (assuming fuel is sustainably sourced) emits around 75% less CO₂ than natural gas and costs approx. 65% less based on current tariffs. Also, unlike a heat-pump solution, it produces high-grade heat meaning the heat is versatile and better suited to large existing buildings which may otherwise struggle to adapt to lower flow temperatures offered by other sustainable sources.

Where a biomass solution might offer a relatively cheap and sustainable source of energy, there are still concerns around reliability of truly sustainable long-term sources of fuel and the argument that particulates produced by burning biomass contribute to air-quality issues.

We see the implementation of biomass as a short, to medium-term solution to bridge the gap in carbon emissions on existing sites, allowing building services in older buildings to be gradually upgraded to low-grade heat solutions. New buildings can be built to operate on low-grade heat from heat-pumps for example, therefore the availability of high-grade heat is less of an issue.

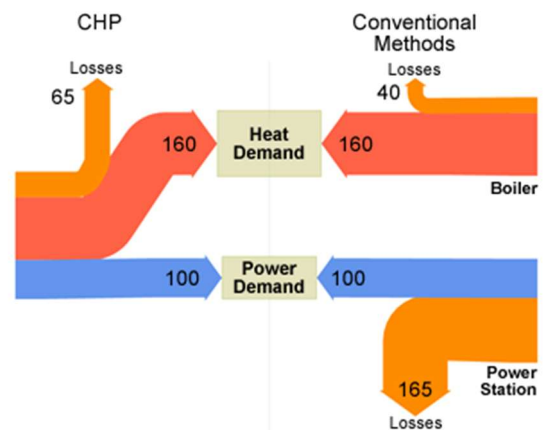
For the reasons above we would not immediately recommend a biomass boiler on this site.



6.6.3 Combined Heat and Power (CHP)

Combined Heat and Power refers to energy generation equipment that produces both useful heat and power combined. Its most common form is a natural gas engine / turbine which is used to drive an electrical generator, producing heat as a by-product. Typically a CHP engine will produce a 30/60 ratio of electricity/heat, with around 10% losses.

CHP installations are very common in large energy centres and communal heating networks. When they were most common, 1 kWh of electricity taken from the national grid would be responsible for 0.519 kgCO₂, however 1 kWh of gas would produce just 0.216. This was due to generation losses suffered by power stations, which rejected waste heat to atmosphere rather than being utilised. CHP's instead burned gas, with a lower carbon emission factor to produce electricity, but also using the waste heat making the process more efficient than grid supplied electricity.



Tedom CHP engine - credit - Tedom

As the national grid has continued to decarbonise however, 1 kWh of electricity is now only responsible for 0.136 kgCO₂. Therefore when considering generation losses, CHP no longer offers any carbon reduction benefit against an equivalent grid connected power / natural gas installation. It also doesn't align with aspirations to negate the use of on-site fossil fuels.

For these reasons we feel CHP is no longer a viable option for sites such as Upper Brook Street and is therefore discounted.



6.6.4 Solar Thermal

Solar Thermal harnesses energy from the sun similar to photovoltaics, however produces heat rather than electricity. This is a high-grade heat which can be used for domestic hot water storage, or in some cases process heating – i.e. for a swimming pool.

The technology is best suited where a heat-demand is still present during sunny conditions, which does not align with most buildings which have a lower, or almost zero demand during these times. Buildings with a high hot water demand, high dehumidification requirements, or perhaps swimming pools are a good fit for this technology. Typically, office and life science applications are predominantly cooling-led during these periods and would therefore not be compatible.



Viessmann Solar Thermal Collector – Roof Mounted Example



Viessmann Solar Thermal Collector – Wall Mounted Example



6.6.5 Façade Mounted Solar PV

This solution uses similar technology to a traditional roof mounted PV system, however rather than mounted horizontally, is instead mounted on the vertical plane.

We carried-out an assessment to test the benefit of this solution over a traditional roof mounted array. This may have been attractive to avoid building a support system over the plant-deck.

We found however that the useful output per m² of PV was significantly reduced, firstly due to the lower potential output of the panels but also the fact lower solar irradiance is available. Compared to a optimally designed roof PV array, an equivalent south facing façade system would only produce between 75 and 20%

For this reason, façade mounted PV has been discounted.

6.6.6 Ground Source Heat Pumps

The technology behind a ground source heat-pump (GSHP) is essentially the same as an air source heat-pump, with exception to the rejection / absorption medium. Rather than using air, an open, or closed circulation loop is buried underground. This allows the heat-pump to take advantage of a relatively stable ground temperature throughout the year, where an ASHP would need to adapt to the range external ambient temperature experienced in the UK.

However, as this site is unlikely to provide a heating / cooling balance (which is an important factor in GSHP efficiency) it is unlikely to be viable. Also, in the southern part of the UK the external ambient temperature is relatively close to the ground temperature likely to be experienced, so little or no efficiency benefit can be gained over an ASHP.

For these reasons, as well as the additional capital cost this would likely attract, GSHP's have been discounted.

6.6.7 Wind Power

Wind derived energy is the most dominant renewable contributor in the UK, but this is mainly at National Grid scale. The investment in wind turbines is responsible for one of the greatest reductions in grid generated carbon in the last decade.

On a smaller scale however, the implementation of wind technology comes-up against a number of barriers and challenges.

- Wind turbines are most effective with high 'hub-heights', ensuring stronger and more consistent air streams. Lower hub-heights are less effective as wind is likely to be more turbulent, caused by both urban and geographical features.
- A greater number of smaller turbines could be implemented, however these would offer lower overall generation and the separation required between turbines could become prohibitive for the site.
- The height of the proposed buildings would cause additional obstructions and turbulence, forcing the hub-height above the top of the tallest structure, meaning a very large turbine would be required.
- Certain safety distances need to be adhered to. For example, a very large turbine may need to be positioned 10 rotor diameters away from any occupied buildings. This is to avoid issues with flicker and safety should a blade become damaged or detached.
- Turbines should be set-back from public roads by their maximum blade tip height + 10%.
- Higher hub-heights will inevitably attract greater scrutiny from a planning perspective.
- Generation is difficult to predict. Typically during the planning of larger turbines, a manometer station will be set-up to measure the average wind speeds over the course of a year to ensure optimum positioning is achieved.



Despite the above, there are examples throughout the UK where turbines have been integrated into business parks and industrial estates, however these areas are arguably less sensitive to some of the points above. A very large turbine could generate large quantities of energy for the site and make a bold environmental statement, but for the reasons noted above we do not believe a wind-turbine solution, either on a large, or smaller scale would be practical on this site.



Green Park Business / Industrial Park, Newport

6.6.8 Ambient Loops

As noted earlier in this report, an ambient loop, sometimes known as a ‘condenser loop’ can be worthwhile in scenarios where mixed site uses are available. For example, where laboratories would reject large quantities of heat for substantial parts of the year, other uses such as residential may be able to re-use this heat for domestic hot water. The speculative nature of the laboratory buildings however makes it very difficult to predict the quantity and availability of waste heat for re-use. Adopting a core strategy based on assumptions which may turn-out to be incorrect could result in a fundamental conflict and savings that can never be achieved in practice.

We would recommend however that each building is provided with a pipe incomer position at ground level which would allow buildings to be connected in future if opportunities did arise.

6.6.9 Battery Storage

Battery storage is becoming more widespread where excess energy can be stored on site rather than selling to the grid, or where they can form part of a demand response system to relieve pressure on the national grid.

In the case of this development, the only excess generation would be via the solar PV array. However, as life sciences buildings have very high and consistent electricity demand, it is unlikely any excess will be available – and certainly not sufficient to merit a battery storage facility.

A demand side response arrangement may be of interest to the client from a financial point of view, however this would not necessary form part of the site-wide sustainability strategy. For this reason it has not been explored further in this energy strategy report.



7.0 PREDICTED CARBON EMISSIONS

To establish a baseline emissions scenario for comparison, the building systems were modelled exactly as the final scheme, however with gas fired boilers as specified as the main heating source. The buildings were subsequently modelled with increment improvements to demonstrate the impact of various recommendations. These results are included in the first table for each building. A comparison has also been made in the second table between a compliant building with all passive and active measures applied, against the building with PV also applied.

Building 1

Building 1	kgCO ₂ /m ²	tCO ₂	kWh/m ²
Baseline	115.64	2357.18	351.96
ASHP	73.73	1502.93	187.46
ASHP + MVHR	16.20	330.18	87.66
ASHP + MVHR + Adiabatic AHU	14.84	302.40	49.91
ASHP + MVHR + Adiabatic AHU + PV	14.67	299.13	46.42
Total savings with all technologies	87.31%	87.31%	86.81%

Building 1	Regulated Carbon Dioxide Emission Savings, kgCO ₂ /m ²
Baseline, Part L compliant scheme incl. active & passive measures	7.3 (BER) 7.6 (TER)
Part L compliant scheme incl. PV	6.9 (BER) 7.6 (TER)
Reduction over Part L 2021	9.3%

The building was found to meet compliance with all incentives including only passive and active measures. PV was not required to pass the Part L assessment, however has been added to the scheme to reduce its carbon emissions further.



Figure 2: IES model representation building 1



Building 2

Building 2	kgCO ₂ /m ²	tCO ₂	kWh/m ²
Baseline	111.53	1445.17	332.48
ASHP	68.35	885.65	155.96
ASHP + MVHR	18.90	244.86	86.80
ASHP + MVHR + Adiabatic	16.16	209.34	49.09
ASHP + MVHR + Adiabatic + PV	14.75	191.19	46.16
Total savings with all technologies	86.77%	86.77%	86.12%

Building 2	Regulated Carbon Dioxide Emission Savings, kgCO ₂ /m ²
Baseline, Part L non-compliant scheme incl. active & passive measures	5.1 (BER) 5.0 (TER)
Part L compliant scheme incl. PV	4.8 (BER) 5.0 (TER)
Reduction over Part L 2021	4.8%

The building was found to fail compliance with all incentives including only passive and active measures. PV was required to pass the Part L assessment. Once added however, the whole building.



Figure 3: IES model representation of building 2



Building 3

Building 3	kgCO ₂ /m ²	tCO ₂	kWh/m ²
Baseline	108.90	1193.74	324.25
ASHP	18.51	202.96	152.86
ASHP + MVHR	15.85	173.76	85.67
ASHP + MVHR + Adiabatic	14.45	158.45	48.06
ASHP + MVHR + Adiabatic + PV	14.36	157.38	45.18
Total savings with all technologies	86.82%	86.82%	86.07%

Building 3	Regulated Carbon Dioxide Emission Savings, kgCO ₂ /m ²
Baseline, Part L compliant scheme incl. active & passive measures	5.0 (BER) 5.1 (TER)
Part L compliant scheme incl. PV	4.7 (BER) 5.1 (TER)
Reduction over Part L 2021	8.2%

The building was found to meet compliance with all incentives including only passive and active measures. PV was not required to pass the Part L assessment, however has been added to the scheme to reduce its carbon emissions further.



Figure 4: IES model representation of building 3



8.0 CONCLUSION

Reduction of carbon emissions and the environmental impact of the development is a key project deliverable and has informed all aspects of the design in order to minimise energy and carbon wherever possible.

The development's energy strategy has been developed in accordance with the Be Lean, Be Clean, Be Green Energy Hierarchy and passes the 2021 Part L Building Regulations.

Typically, under the former regulations it would have been possible to demonstrate significant BER/TER improvements, however the nature of the new 2021 Part L regulations make it much more difficult to reach a compliant scheme without pushing the implementation of excellent u-values and high efficiency plant. However, by following good design principles, despite the high energy nature of the lab spaces we've achieved compliance without photovoltaic panels on two of the three buildings. Panels have however been included as a green measure to further reduce the carbon impact of the buildings, achieving an overall saving of between **9.3 and 4.8%** over the 2021 target emission rate. A building that passes the 2021 building regulations by default also exceeds the previous standards by 27%.

It is acknowledged that the new buildings are unlikely to be 'Zero Carbon' from day one, but should take a 'Zero Carbon Ready' approach, aligning with the national grid decarbonisation trajectory milestones. The buildings will have excellent u-values, high efficiency plant and conditioned without the use of on-site fossil fuels. The chosen strategy is adaptable to future changes and advances in technology that may make a centralised approach more attractive.

This Energy Statement complies with the policies and guidelines set out Manchester's Core Strategy Development Plan, 2012 to 2027'.



APPENDIX 1.0

BRUKLS



Appendix 1.1 – Building 1 Final Technologies BRUKL

BRUKL Output Document



Compliance with England Building Regulations Part L 2021

Project name

**UBS Building 1 - ASHP with MVHR & PV
[Adiabatic AHU]**

As designed

Date: Tue Jun 13 10:25:59 2023

Administrative information

Building Details

Address: Upper Brook Street, Manchester, M13

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.21

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.21

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

Foundation area [m²]: 1650.81

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	7.73
Building CO ₂ emission rate (BER), kgCO ₂ /m ² .annum	6.89
Target primary energy rate (TPER), kWh _{eq} /m ² .annum	84.17
Building primary energy rate (BPER), kWh _{eq} /m ² .annum	74.29
Do the building's emission and primary energy rates exceed the targets?	BER ≤ TER BPER ≤ TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _o -Limit	U _o -Calc	U _i -Calc	First surface with maximum value
Walls*	0.26	0.15	0.15	0000000B:Surf[3]
Floors	0.18	0.12	0.12	0000000A:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	0900000A:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	0000000B:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _o -Limit = Limiting area-weighted average U-values [W/m ² K] U _o -Calc = Calculated area-weighted average U-values [W/m ² K] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m ² K NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	10



Appendix 1.2 – Building 2 Final Technologies BRUKL

BRUKL Output Document



Compliance with England Building Regulations Part L 2021

Project name

**UBS Building 2 - ASHP MVHR & PV
[Adiabatic AHU]**

As designed

Date: Tue Jun 13 10:27:13 2023

Administrative information

Building Details

Address: Upper Brook Street, Manchester, M13

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.21

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.21

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

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 1334.36

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	5.04
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	4.76
Target primary energy rate (TPER), kWh _{eq} /m ² annum	54.86
Building primary energy rate (BPER), kWh _{eq} /m ² annum	50.97
Do the building's emission and primary energy rates exceed the targets?	BER <= TER BPER <= TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _{a-Limit}	U _{a-Calc}	U _{i-Calc}	First surface with maximum value
Walls*	0.26	0.15	0.15	00000000:Surf[2]
Floors	0.18	0.12	0.12	00000000:Surf[0]
Pitched roofs	0.16	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	0500001E:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	00000000:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _{a-Limit} = Limiting area-weighted average U-values [W/m ² K] U _{a-Calc} = Calculated area-weighted average U-values [W/m ² K] U _{i-Calc} = Calculated maximum individual element U-values [W/m ² K] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. ^ For fire doors, limiting U-value is 1.8 W/m ² K NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	10



Appendix 1.3 – Building 3 Final Technologies BRUKL

BRUKL Output Document



Compliance with England Building Regulations Part L 2021

Project name

**UBS Building 3 - ASHP MVHR & PV
[Adiabatic AHU]**

As designed

Date: Tue Jun 13 10:28:32 2023

Administrative information

Building Details

Address: Upper Brook Street, Manchester, M13

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.21

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.21

BRUKL compliance module version: v0.1.e.1

Certifier details

Name: Name

Telephone number: Phone

Address: Street Address, City, Postcode

Foundation area [m²]: 1470.85

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	5.1
Building CO ₂ emission rate (BER), kgCO ₂ /m ² annum	4.68
Target primary energy rate (TPER), kWh _{pe} /m ² annum	55.46
Building primary energy rate (BPER), kWh _{pe} /m ² annum	50.15
Do the building's emission and primary energy rates exceed the targets?	BER <= TER BPER <= TPER

The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Fabric element	U _a -Limit	U _a -Calc	U _i -Calc	First surface with maximum value
Walls*	0.28	0.15	0.15	00000008:Surf[1]
Floors	0.18	0.12	0.12	00000008:Surf[5]
Pitched roofs	0.18	-	-	No pitched roofs in building
Flat roofs	0.18	0.12	0.12	0400002B:Surf[0]
Windows** and roof windows	1.6	1.6	1.6	00000008:Surf[0]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors ^Δ	1.6	-	-	No personnel doors in building
Vehicle access & similar large doors	1.3	-	-	No vehicle access doors in building
High usage entrance doors	3	-	-	No high usage entrance doors in building
U _a -Limit = Limiting area-weighted average U-values [W/(m ² K)] U _a -Calc = Calculated area-weighted average U-values [W/(m ² K)] * Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows. ** Display windows and similar glazing are excluded from the U-value check. *** Values for rooflights refer to the horizontal position. Δ For fire doors, limiting U-value is 1.6 W/(m ² K). NB: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.				

Air permeability	Limiting standard	This building
m ³ /(h.m ²) at 50 Pa	8	10