



Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

SUSTAINABLE CONSTRUCTION AND REFURBISHMENT PLAN

2025-2030

A future-ready institution where sustainability is embedded across education, research, operations and daily practice, honouring our responsibility to current and future generations.

UWTSD Group Environmental Sustainability Strategy

Mae'r ddogfen hon ar gael yn Gymraeg ac yn Saesneg | This document is available in Welsh and English

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1. Introduction

In 2019 the University of Wales Trinity Saint David (UWTSD) joined the Welsh Government in declaring a global 'climate emergency' in response to the findings of the Intergovernmental Panel on Climate Change report. UWTSD is committed to sustainable development and have incorporated the Well-Being of Future Generations (Wales) Act 2015 goals and ways of working into the strategic planning of faculties and professional departments.

This Plan will focus on both the construction of new estate as well as the refurbishment of existing and has been developed to set out targets in line with UWTSD's Carbon Reduction aspirations, as outlined in the Carbon Management Plan. This plan is a core deliverable to the Group Environmental Sustainability strategy, specifically Strategic Priority 1, Carbon Reduction, and Strategic Priority 3, Sustainable Estate.

Within these strategic priorities the UWTSD Group is committed to:

- 🌱 Meet UWTSD Group Scope 1 and 2 carbon reduction targets
- 🌱 Reduce energy consumption across UWTSD Group Estates
- 🌱 Increase kWh of energy from Group-owned renewable sources
- 🌱 Invest in the estate to deliver efficiencies and space-optimisation in a manner that promotes wellbeing in the learning environment

It is centred around the UN Sustainable Development Goals, specifically goals 9, 11 and 12. It is only through these methods that the university will meet its reduction targets for scope 1 and 2 emissions and have DEC energy ratings of B by the end of this management plan period.



2. Alignment with UWTSD Group Environmental Sustainability Strategy 2025-2030.

This Sustainable Construction and Refurbishment Management Plan supports the Sustainability Vision of the UWTSD Group Environmental Sustainability Strategy 2025–2030 by embedding sustainable design, low-carbon infrastructure and resource efficiency across the development and management of the University estate.

The plan contributes to the delivery of the Strategy through the three institutional pillars: Our People, Our Purpose and Our Place.

OUR PEOPLE: Through the development of high-quality, healthy and efficient buildings, this plan supports the wellbeing and productivity of staff, students and visitors. Sustainable construction practices will ensure that learning and working environments benefit from improved thermal comfort, natural daylight, air quality and access to green space, helping to create spaces that support positive learning outcomes and staff wellbeing.

OUR PURPOSE: By embedding whole life carbon assessment, sustainable design principles and low-carbon technologies within construction and refurbishment projects, this plan supports the University's mission to equip learners with the knowledge and skills required for a sustainable future. The University estate will also provide opportunities to support teaching and research activity, enabling construction projects to contribute to applied

learning, green skills development and sustainability-focused innovation.

OUR PLACE: The University's campuses and wider estate play a central role in demonstrating best practice in environmental sustainability. Through investment in low-carbon buildings, energy efficiency, renewable energy generation and biodiversity enhancement, this plan will contribute to the development of a resilient and sustainable estate that benefits both the University community and the wider regions in which the University operates.

Sustainable construction is therefore not solely an estates function but a key enabler of the University's wider sustainability ambitions. By integrating carbon reduction, resource efficiency and sustainable design into the development of the University estate, this plan supports the long-term transformation of the built environment while contributing to the delivery of the Environmental Sustainability Strategy and the transition to a low-carbon and resilient institution.

3. Building on Past Success

In 2024 UWTSD opened the new Innovation Matrix on the SA1 Waterfront Campus in Swansea. The building will achieve an EPC rating of A, a BREEAM rating of Excellent and the landlord areas will be net zero carbon in operation.

From a construction perspective, the building benefits from high levels of insulation and mechanical ventilation with heat recovery in winter in order to keep the energy loadings at a minimum. In the summer months, offices will make use of natural ventilation to remain temperate and comfortable for building users. The summer ventilation strategy has been stress-tested in thermal models to ensure that it is future proof for global warming projections. The street is naturally ventilated via the clerestory windows and air source heat pumps heat the building via underfloor heating. Radiant panels will also be used to provide hot water. The glazing is designed to optimise daylighting while minimising solar gains in the summer. All offices benefit from high efficiency LED lighting and daylight dimming. The roof is covered with 465m² of highly efficient monocrystalline photovoltaic panels. The electricity generated by those PV panels will be utilised in the building; and the amount generated over the course of a year will be sufficient to serve users in the landlord areas of the building.



4. Achieving Net Zero Requirements

Figure 1 - Low Energy Transformation Initiative (LETI)



The construction industry is responsible for almost half of carbon emissions in UK. The UK Green Building Council have provided 5 steps to help reduce these.

1. Avoid fossil energy use altogether and minimise operational energy consumption
2. Minimise embodied carbon both upfront and during the life cycle of the building
3. Achieve carbon reductions by exporting surplus energy or with carbon sequestration
4. Depending on your methodology, limits may apply to energy use and embodied carbon
5. Offset residual emissions using offset mechanisms in line with your methodology

Within its construction and refurbishment activities UWTSD will take a whole life carbon approach considering both the embodied carbon and the operational carbon.

Embodied Carbon: The carbon emissions emitted producing a building's materials, their transport and installation on site as well as their disposal at end of life.

Products	Transport
Construction	Maintenance and replacement
End of life disposal	

Embodied emissions arise from producing, procuring and installing the materials and components that make up a structure and is normally the major element of embodied carbon. The building envelope, services, and interior fit-out make up the remainder. These also include the lifetime emissions from maintenance, repair, replacement and ultimately demolition and disposal.

Operational emissions result from energy consumption in the day-to-day running of a building. These include but are not limited to carbon emissions associated with heating, hot water, cooling, ventilation, and lighting systems, equipment, and lifts.

<p>Regulated loads:</p> <ul style="list-style-type: none"> → Heating → Cooling → Hot water → Lighting → Pumps and fans 	<p>Unregulated loads are plug loads such as:</p> <ul style="list-style-type: none"> → Cooking → Appliances → TVs → Computers → Any other electrical equipment

UWTSD will adopt a holistic and established structured approach to reduce carbon emissions across the whole lifecycle of the development which will in turn minimise running costs. The relevant steps are outlined below:

<p>1) TEAM Collaboration</p>	<ul style="list-style-type: none"> •To maximise embodied carbon savings, team interaction and communication is core.
<p>2) REFUSE Build Less</p>	<ul style="list-style-type: none"> •Reusing structures and materials as a first principle will have the greatest savings than using new.
<p>3) REDUCE Lean Design</p>	<ul style="list-style-type: none"> •Lean construction practices will reduce material use, improve performance and increase value.
<p>4) LOW CARBON Sustainable Materials</p>	<ul style="list-style-type: none"> •Specify low carbon materials and reduce reliance on carbon intensive materials.
<p>5) FUTURE PROOF Longevity</p>	<ul style="list-style-type: none"> •Consider materials with reduced need for replacement or wastage.

5. Embodied Carbon Assessment

For any construction or refurbishment projects over £500,000 or covering more than 700 sqm, it will be a requirement to have an assessment of the embodied carbon completed and an action plan to identifying steps to reduce these to be produced. The reference period for the operational carbon impact is to be done over 60 years set out in BS EN 15978.

The embodied assessment will be undertaken in accordance with the RICS Professional Statement Whole Life Carbon Assessment for the Built Environment 1st edition November 2017 and BS EN 15978. The assessment will be produced using Oneclick LCA (or equivalent) which is an industry recognised and accredited LCA tools. This is an all-approved software tool covering BS EN 15978.

Table 1 below outlines the building parts, based on the BCIS breakdown, that should be covered in the whole life assessment, as applicable to the project. The sub-sections provide guidance on defining what needs to be taken into account for the complete whole life carbon assessment of the built project and should consider all building components and works relating to the project, including any external works within the site boundary.

A complete whole life carbon assessment should cover all items listed in the project's Bill of Quantities (BoQ), cost plan or as identified in other design information (drawings, specifications, etc.) that fall under the building element categories specified in Table 1 below.

Table 1

Ser	Sub-Section	Building Part
0	Facilitating works	0.3 & 0.5 Temporary/Enabling Works
		0.4 Specialist groundworks
1	Substructure	1.1 Substructure
2	Superstructure	2.1 Frame
		2.2 Upper floors incl. balconies
		2.3 Roof
		2.4 Stairs and ramps
		2.5 External Walls
		2.6 Windows and External Doors
		2.7 Internal Walls and Partitions
		2.8 Internal Doors
3	Finishes	3.1 Wall Finishes
		3.2 Floor Finishes
		3.3 Ceiling Finishes
4	Fittings, furnishings, and equipment (FF&E)	4.1 Fittings, Furnishings & Equipment
5	Building Services / MEP	5.1-5.4 Services
6	Prefabricated Building and Building Units	6.1 Prefabricated Building and Building Units
7	Work to Existing Building	7.1 Minor Demolition and Alteration Works
8	External works	8.1 Site preparation works
		8.2 Road, Paths, Paving and Surfacing
		8.3 Soft landscaping, Planting and Irrigation Systems

		8.4 Fencing, Railings and Walls
		8.5 External Fixtures
		8.6 External Drainage
		8.7 External Services
		8.8 Minor Building Works and Ancillary Buildings

Annex A identifies the key collaborative activities required at each RIBA stage to ensure embodied carbon emissions remain as low as reasonably possible.

6. Operational Carbon Assessment

All construction and refurbishment projects should have an operational carbon assessment completed with an associated action plan aimed at reducing the operational carbon. This would be done using the methodology detailed within the Chartered Institute of Building Services Engineers (CIBSE) Technical Memorandum 54 (TM54) “Evaluating Operational Energy Use at the design stage”.

Any design approach to reduce operational carbon should begin with efforts to reduce a buildings energy demand before the introduction of complex mechanical systems. This is the principle behind a fabric first approach.

The operational carbon of a project can be assessed at the design stage (and throughout the construction process) by using software to predict the likely buildings energy use. This information can be used to assess the effectiveness of different systems such as heating, hot water and photovoltaics and their impact on operational carbon

The steps to achieving a net zero carbon – operational energy are outlined below. Refer to UKGBC framework for further details.

Reduce Operational Energy Use

- Reductions in energy demand and consumption should be prioritised over all other measures

Increase Renewable Energy Source

- On-site renewable energy source should be prioritised

Zero Carbon Balance

- Any remaining carbon should be offset via the purchase of off-site renewable energy

Measurement and Verification

- Annual energy use and renewable energy generation on-site must be reported and independently verified in-use each year for the first 5 years.

Annex B identifies the key collaborative activities required at each RIBA stage to ensure operational carbon emissions remain as low as reasonably possible.

7. UWTSO Sustainable Design Principles

All new construction and refurbishment projects undertaken by the University of Wales Trinity Saint David will be guided by a set of sustainable design principles. These principles ensure that developments not only meet net zero carbon ambitions but also support environmental protection, resource efficiency, biodiversity, and the wellbeing of building users. The following principles will be applied throughout the project lifecycle and embedded within the design process from the earliest concept stage.

Whole Life Carbon Approach

All projects will adopt a whole life carbon approach that considers both embodied and operational carbon emissions across the full lifecycle of the building, including construction, operation, maintenance, refurbishment and end-of-life disposal. Design teams will prioritise carbon reduction through efficient building form, material selection and operational energy performance before considering offsetting mechanisms.

Fabric First Design

The University will adopt a fabric-first approach to building design, prioritising high levels of insulation, airtightness and thermal performance in order to minimise energy demand. Passive design measures such as orientation, solar shading, natural ventilation and daylight optimisation will be prioritised to reduce reliance on mechanical systems.

Low Carbon and Responsibly Sourced Materials

Projects will prioritise materials with lower embodied carbon and verified environmental performance. Design teams should consider materials with Environmental Product Declarations (EPDs), responsibly sourced timber certified by schemes such as FSC or PEFC, and low-carbon alternatives such as recycled steel and low-carbon concrete mixes. Where feasible, materials should be selected based on durability, reparability and recyclability.

Circular Economy and Resource Efficiency

Construction projects will support circular economy principles by designing buildings for longevity, adaptability and eventual disassembly. Opportunities to reuse existing building components and incorporate recycled materials will be explored where feasible. Projects should also consider how materials can be recovered and reused at the end of the building's lifecycle.

Biodiversity and Green Infrastructure

New developments and refurbishment projects will aim to protect and enhance biodiversity across the University estate. This may include the use of native planting, habitat creation, sustainable landscaping, and the incorporation of green infrastructure such as green roofs, rain gardens or wildlife habitats. Where feasible, projects will include biodiversity enhancements such as bird and bat boxes or pollinator-friendly planting schemes.

Water Efficiency

Projects will incorporate water efficiency measures in order to reduce water consumption and support sustainable resource management. This may include the installation of low-flow fixtures, efficient irrigation systems, rainwater harvesting or greywater reuse systems where appropriate.

Climate Resilience and Adaptation

Buildings must be designed to perform effectively under future climate conditions. Designs should consider overheating risk, increased rainfall intensity and other climate-related impacts. Passive cooling strategies, sustainable drainage systems (SuDS) and resilient material choices will be used to ensure buildings remain comfortable, safe and operational under projected climate scenarios.

Healthy and Comfortable Buildings

Sustainable buildings must support the health and wellbeing of their occupants. Design strategies should therefore prioritise access to natural daylight, good indoor air quality, appropriate thermal comfort, acoustic performance and access to green space. Buildings should create environments that support productivity, wellbeing and learning.

Sustainable Construction Practices

Construction activities should minimise environmental impacts during the building process. Contractors will be expected to implement environmental management measures to reduce waste, minimise emissions, and maximise the reuse and recycling of materials. Construction waste should be managed in line with the University's waste management principles, aiming to divert waste from landfill wherever possible.

Learning and Innovation

Where appropriate, construction and refurbishment projects should support the University's educational mission by acting as living laboratories. Opportunities may be explored for students and researchers to engage with sustainable design, construction and building performance monitoring as part of teaching and research activities.

8. Legislation and Guidance

In January 2020, the Low Energy Transformation Initiative (LETI) published a [Climate Emergency Design Guide](#) which established design targets for all new buildings to achieve net zero carbon by 2030.

Current Part L Building Regulations for England (2021 Edition) and Wales (2022 Edition) have lower emissions targets of 27% and 28%, respectively, reduction in average CO₂ emissions relative to Part L 2013 and 2014 editions for non-domestic buildings.

The following standards are considered the key references that govern and provide the framework for practitioners to undertake a Life Cycle Assessment (LCA):

- 🌱 ISO 14040: 2006 (Environmental Management: Life Cycle Assessment - Principles and Framework)
- 🌱 ISO 14044: 2006 (Environmental Management: Life Cycle Assessment - Requirements and Guidelines)
- 🌱 BS EN 15804: 2012 (Sustainability of Construction Works: Core Rules for the Product Category of Construction Products – Environmental Product Declaration (EPD)).



In January 2020, the Low Energy Transformation Initiative (LETI) published a Climate Emergency Design Guide which established design targets for all new buildings to achieve net zero carbon by 2030.

LETI, as with UKGBC NZCB Framework Definition defined net zero carbon as whole life carbon, including both Operational Carbon and Embodied Carbon.

Building specific Operational Carbon targets including Energy Use Intensity (EUI) targets, space heating demand, and renewable energy generation are established for individual development types, including Residential, Offices, and School.

Embodied Carbon KPIs

With regards to embodied carbon design targets, LETI established the following Key Performance Indicators for all non-domestic new buildings:

Best Practice 2020

- < 600 kgCO₂e/m² (GIFA)
- 30% materials from re-used sources
- 50% materials from re-used sources

Best Practice 2030

- < 350 kgCO₂e/m² (GIFA)
- 50% materials can be re-used at end of life
- 80% materials can be re-used at end of life

The established KPIs restrict the embodied carbon intensity targets to include: “Products, transport and construction of substructure, superstructure, MEP, façade and internal finishes (A1-A5). Figures exclude timber sequestration.”

- Wales Building Regulations Technical Standards Part L

The current version of Part L sets maximum CO₂ for whole buildings. The regulations apply to both the construction of new buildings and the renovation of existing buildings (with a total surface area over 1,000m²) and also sets a reduction in CO₂ emissions of 28% for non-domestic buildings and 37% for domestic buildings compared to 2014 regulations.

These high targets mean that even with high fabric and energy efficiency, Low or Zero Carbon Technologies will become even more cost effective for compliance.

UWTSD will stay abreast of any changing legislation or guidance in this area and update plans accordingly.

9. SMART Targets

In order to proactively manage all SMART (Specific, Measurable, Achievable, Relevant and Time-bound) targets for Sustainability related Management Plans the targets relating to this plan are held in the “UWTSD Sustainability SMART targets” document.

This document contains a responsible person, stakeholders, reporting mechanism and actions for each year of this plan. These are aligned to this plan and the Welsh Government Public Sector Decarbonisation targets. They represent a mix of practical infrastructure changes, behavioural shifts and engagement strategies to ensure a systematic approach to reducing carbon emissions.

Targets can be found here:

https://uowtsd.sharepoint.com/teams/Sustainability_7fuztl_GRP/Shared%20Documents/General/Policy%20&%20Strategy/Strategy%202025-2030/UWTSD_SMART_Targets.xlsx

10. Monitoring and Reporting

The Sustainability Construction and Refurbishment Policy will be delivered by the UWTSD Sustainability Team in collaboration with professional services.

Sustainability Team Project Review – The Sustainability Team will be invited to complete sustainability reviews at RIBA stage 2, 3 and 4.

Monitoring of performance will fall within the governance framework established under ‘Strategic Priority 6: Monitoring and Reporting’ of the UWTSD Group Environmental Sustainability Strategy.

Oversight will follow the Group’s three-line assurance model:

Operational Oversight

- 🌱 Director of Estates
- 🌱 Head of Sustainability and Environment
- 🌱 Estates Project Board
- 🌱 Sustainability Steering Group (SSG)
- 🌱 Integration into Sustainability Action Plan
- 🌱 Annual KPI reporting

Governance Oversight

- 🌱 Resources and Performance Committee
- 🌱 University Council

External Assurance

- 🌱 Green Dragon Level 5 Environmental Management System
- 🌱 People and Planet Results
- 🌱 Annual external audit

Progress will be:

- 🌱 Reported annually through the UWTSD Sustainability Report
- 🌱 Integrated into institutional KPI dashboards
- 🌱 Aligned where appropriate with recognised frameworks

Document version control

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Annex A – Embodied Carbon RIBA Stage Activities

RIBA Stage	Action
RIBA Stage 2: Concept Design	<ul style="list-style-type: none"> A workshop will be arranged to aid in collating the building element information required for the embodied carbon assessment as detailed in Table 1;
	<ul style="list-style-type: none"> The embodied carbon of the building elements provided will be calculated utilising the available Stage 2 information;
	<ul style="list-style-type: none"> A report will be produced highlighting the environmental impact and embodied carbon benchmark of the development;
	<ul style="list-style-type: none"> A second workshop will be arranged to discuss where material changes could be introduced to reduce the embodied carbon;
	<ul style="list-style-type: none"> An updated embodied carbon report will be produced which will highlight any carbon changes made and the embodied carbon benchmark of the development.
RIBA Stage 3 to 4: Design	<ul style="list-style-type: none"> Four workshops will be arranged to discuss and track material, and subsequently carbon, changes to the design;
	<ul style="list-style-type: none"> The embodied carbon of the building elements provided will be calculated utilising the available Stage 4 information;
	<ul style="list-style-type: none"> An updated embodied carbon report will be produced which will highlight any carbon changes made and the embodied carbon benchmark of the development.
RIBA Stage 5 to 6: Construction	<ul style="list-style-type: none"> Two workshops will be arranged to discuss and track material, and subsequently carbon, changes to the design;
	<ul style="list-style-type: none"> The embodied carbon of the building elements provided will be calculated utilising the available Stage 6 information;
	<ul style="list-style-type: none"> A final embodied carbon report will be produced which will highlight any carbon changes made and the embodied carbon benchmark of the development.

Annex B – Operational Carbon RIBA Stage Activities

RIBA Stage	Action
RIBA Stage 1 : Preparation and Briefing	<ul style="list-style-type: none"> The project shall be in line with the requirements as set out within this briefing document including energy targets and project boundaries.
Stage 2 : Concept Design	<ul style="list-style-type: none"> Develop the concept design in accordance with the metrics and boundaries detailed in this brief including; microclimate analysis, orientation and building layout, form factor, glazing ratio, fabric optimisation, patterns of use, services strategy and renewables strategy
	<ul style="list-style-type: none"> Retrofit - identify any areas for improvement and key barriers. Thermographic surveys and air pressure testing to be undertaken to identify areas of air leakage, thermal bridges and cold spots
	<ul style="list-style-type: none"> Retrofit - Assess existing building fabric to determine its current u-value and potential improvement considering best value, practicality, associated embodied carbon and reductions in heat loss
	<ul style="list-style-type: none"> Key Proof-of-Concept calculations including preliminary operational energy calculations aligned to the energy use intensity targets
	<ul style="list-style-type: none"> Determine the suitable form of heating and hot water for low carbon heating without the use of fossil fuels e.g. through using the LETI Heat decision tree
	<ul style="list-style-type: none"> Undertake life cycle cost analysis whole life carbon analysis
	<ul style="list-style-type: none"> Implement the most significant carbon and energy reduction measures into the design
	<ul style="list-style-type: none"> Maximise the on-site renewable energy generation through baseline modelling
	<ul style="list-style-type: none"> Investigate the use of demand response and energy storage opportunities
	<ul style="list-style-type: none"> Undertake a design workshop with key members of the Client and Design Teams to go over findings, discuss proposals and establish risk items
	<ul style="list-style-type: none"> Retrofit - A Retrofit Plan will be created with risk constraints and other information based on achieving the NZC targets based on programme and budget
	<ul style="list-style-type: none"> Undertake life cycle cost analysis whole life carbon analysis and implement the most significant carbon and energy reduction measures into the design
	<ul style="list-style-type: none"> Project programme including Soft Landings
	<ul style="list-style-type: none"> Responsibility Matrix for Net Zero Carbon – Operational Energy
<ul style="list-style-type: none"> Net Zero Carbon – Operational Energy Risk Register 	
Stage 3 : Spatial Coordination	<ul style="list-style-type: none"> Undertake detailed operational energy calculations using CIBSE TM54 methodology, taking into account both regulated and unregulated energy, to evaluate the energy demand of the proposed building and its energy use in operation against the Net Zero Carbon – Operational Energy targets.
	<ul style="list-style-type: none"> Operational Energy assessment to be documented demonstrating Net Zero Carbon – Operational Energy, design measures and assumptions used including occupancy patterns and unregulated energy uses such as equipment, catering and server equipment for review by the UWTSO.
	<ul style="list-style-type: none"> Develop on-site renewables design, demand response and energy storage strategies

	<ul style="list-style-type: none"> Undertake thermal comfort assessment in line with BB101 to ensure the proposals also comply with avoidance of overheating requirements
	<ul style="list-style-type: none"> Develop metering strategy to ensure the energy use of the building can be measured and analysed effectively, with the usage broken down into the categories of the operational energy calculations and major energy use items metered separately.
	<ul style="list-style-type: none"> Retrofit - The Retrofit Plan will be updated including retrofit strategy, phasing, whole-life value and design
	<ul style="list-style-type: none"> Constructability review to ensure cost effectiveness
	<ul style="list-style-type: none"> Cost plan and procurement strategy to ensure project budget and programme can be met
	<ul style="list-style-type: none"> Disclose where metrics and boundaries cannot be achieved and state reasons why for review by UWTSD.
	<ul style="list-style-type: none"> Update Net Zero Carbon – Operational Energy Responsibility Matrix and Risk Register
Stage 4 – Technical Design	<ul style="list-style-type: none"> Update detailed operational energy calculations with design developments and ensure Net Zero Carbon – Operational energy targets are still being achieved. Update Operational Energy assessment document for inclusion within tender documentation
	<ul style="list-style-type: none"> Finalise requirements and targets for Net Zero Carbon – Operational Energy in specifications and tender documentation
	<ul style="list-style-type: none"> Confirm building envelope specification and complete detailed design ensuring targets are achieved such as U-values, thermal bridging and air tightness
	<ul style="list-style-type: none"> Develop heating and hot water systems and check suitability with building requirements whilst aligning with Net Zero Carbon - Operational Energy targets
	<ul style="list-style-type: none"> Ensure metering strategy is incorporated within the documentation including predicted energy use
	<ul style="list-style-type: none"> Building Management Systems to be developed and requirements to be included within the documentation
	<ul style="list-style-type: none"> Retrofit - The Retrofit Plan will be updated including retrofit strategy, phasing, whole-life value and design
	<ul style="list-style-type: none"> Update Net Zero Carbon – Operational Energy Responsibility Matrix and Risk Register confirming responsibility for management during construction and commissioning
Stage 5 : Manufacturing & Construction	<ul style="list-style-type: none"> Ensure contractors understand the projects requirements for Net Zero Carbon – Operational Energy
	<ul style="list-style-type: none"> Update operational energy calculations to account for design changes and reject substitutions or omissions if they compromise the projects Net Zero Carbon – Operational Energy targets
	<ul style="list-style-type: none"> Update operational energy calculations to account for renewables design changes and ensure correct output is used
	<ul style="list-style-type: none"> Ensure quality control measures are in place for proper installation such as air tightness details, insulation, M&E services
	<ul style="list-style-type: none"> Ensure contractors understand commissioning requirements
	<ul style="list-style-type: none"> Ensure contractors understand monitoring and metering requirements

	<ul style="list-style-type: none"> Undertake regular site inspections to ensure installation meets quality requirements
	<ul style="list-style-type: none"> Consider the use of thermal performance tests and thermographic surveys where building fabric targets are lower than previous projects to validate design during construction and identify any issues
	<ul style="list-style-type: none"> Undertake multiple air tightness tests at key stages of construction where applicable to ensure air tightness targets are achieved
	<ul style="list-style-type: none"> Retrofit - The Retrofit Plan will be updated including works complete and future recommendations
Stage 6 : Handover	<ul style="list-style-type: none"> Review final construction including any rectification work on items identified during construction including insitu thermal performance, thermographic or air tightness testing to verify works meet project requirements
	<ul style="list-style-type: none"> Update the detailed operational energy calculations for the as built building including for any changes and update predicted energy use
	<ul style="list-style-type: none"> Ensure commissioning and testing has been completed and the M&E systems operate in line with the requirements – flow rates, control strategies, set points, metering etc.
	<ul style="list-style-type: none"> Ensure the appropriate building users are trained and understand the building systems and documentation is in place for future reference
	<ul style="list-style-type: none"> Check the Building Management Systems are set up to monitor and log metering in line with the metering strategy requirements
	<ul style="list-style-type: none"> Measure actual output of on-site renewables and benchmark against initial targets and modelling
	<ul style="list-style-type: none"> Check demand response and energy storage systems are operating correctly
	<ul style="list-style-type: none"> maintenance team to be given full instruction on proper maintenance of low carbon and renewables installations
Stage 7 : In Use (12 month post occupancy)	<ul style="list-style-type: none"> For the first year's occupation the building systems should be fine tuned to suit actual building usage.
	<ul style="list-style-type: none"> Energy usage should be reviewed regularly and areas of higher-than-expected energy usage should be investigated
	<ul style="list-style-type: none"> Ensure the metering system is operating correctly and validated against utility meters
	<ul style="list-style-type: none"> Energy efficiency assessments to be included within post occupancy evaluation to ensure occupant satisfaction with building conditions
	<ul style="list-style-type: none"> Building energy usage to be compared against targets to ensure compliance
	<ul style="list-style-type: none"> Seasonal commissioning and testing of all installations to ensure systems operate correctly over the seasons and ensure efficiency is maintained
	<ul style="list-style-type: none"> Monitor renewables, demand response and energy storage systems to ensure correct operation



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