Design Guidelines
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Network Rail

Low and Net Zero Carbon Plant Room Guide

Support structures
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Document Approval

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Disclaimer

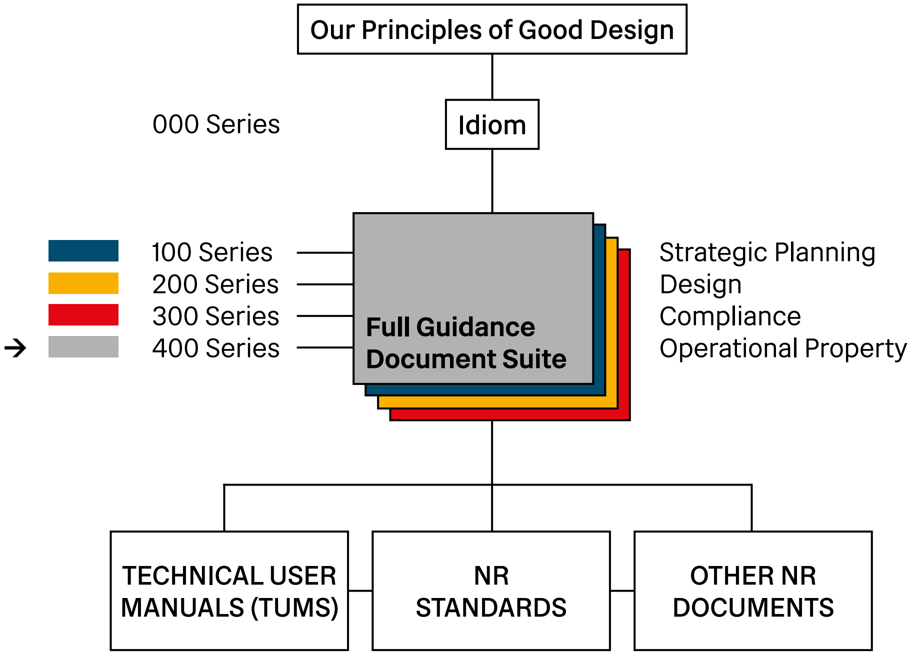
It is the responsibility of the Designer and / or Contractor to ensure that projects are compliant with all legislation. Compliance with this guidance does not absolve them of these responsibilities. This document is for guidance purposes only.

Where the guidance cannot be followed this shall be evidenced and an alternative shall be proposed to the project sponsor or Technical Authority.

How to use the guidance suite

The Network Rail Document Suite

You are here



References to other documents

- Code of Practice Guidance
- National Standard
- Network Rail document
- European Standard

Example:

European Standard

PRM TSI
Technical Specification for Interoperability: Accessibility for Persons with Reduced Mobility (2014)

A full list of relevant documents, and other guidance suite documents is contained in the appendix.

About this document

The Network Rail Low and Net Zero Carbon Design Guide presents Network Rail's requirements of key elements to consider when designing a plantroom, as well as when in a project's lifecycle key decisions should be made.

The intended audience for the guide are project managers, designers, and maintenance engineers to use throughout the project lifecycle to create low and zero carbon plantrooms, whether it be a new build or refurbishment.

This Design Guide is contained in a single document divided over four sections:

1

Section 1
Introduction:

Provides background information and overview of the PACE phases.

2

Section 2
Sustainability:

Introduces the Network Rail sustainability strategy and vision and discusses key concepts associated with this.

3

Section 3
Plantroom Design Considerations:

Provides guidance on considerations to assist efficient plantroom design solutions, which meet the principles and align with Network Rail sustainability targets

4

Section 4
Reporting:

Highlights the reporting framework that may be used by the building's asset management team around sustainability goals.

Contents

Hint and tips:
To quickly navigate through this document click on any of the sections or titles on this page.

To return to the contents page you can click on the Double Arrow symbol.

1

Low and Net Zero Plant Room Guide

Introduction

1.1 Setting the scene

Climate change is one of the most important challenges that our society faces today, and the consensus among the scientific community is that urgent action is needed if we are to avoid the worst of the impacts.

As part of a global response to climate change, an international treaty known as the Paris Agreement was adopted by 196 countries in 2015. This treaty aims to restrict rising global temperature to below 1.5ºC (compared with pre-industrialised temperatures), by dramatically reducing our consumption of fossil fuels.

The UK government has now enshrined this in law, and requires the UK to end its contribution to global warming by 2050 by bringing all greenhouse gas emissions to net zero.

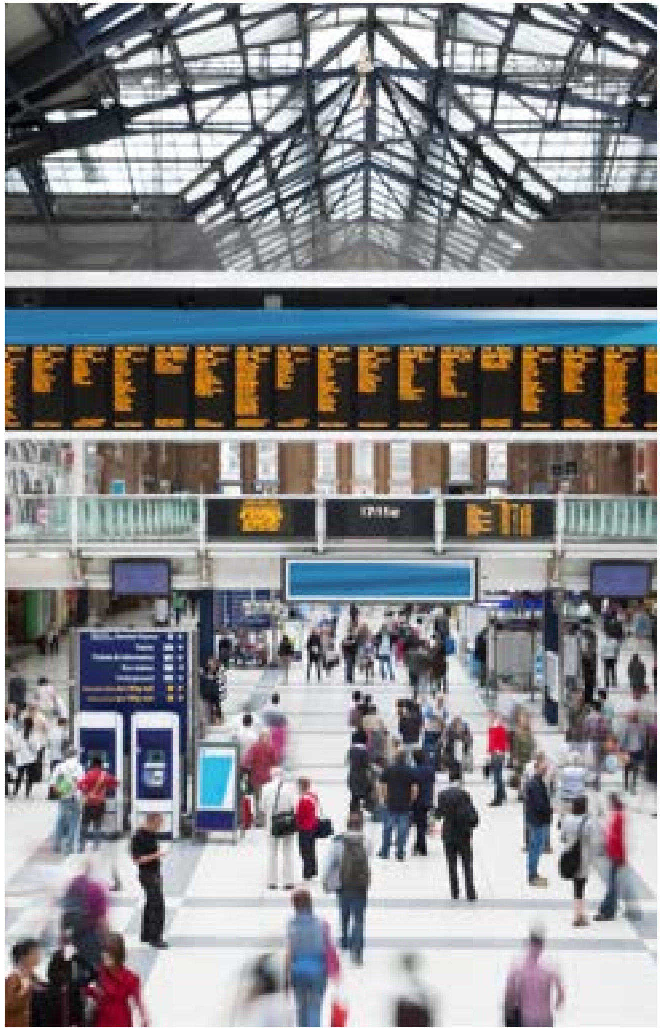
In UK, the built environment contributes to approximately 40% of the total UK carbon footprint, with almost half of this from energy use associated from buildings. The way we heat and power our buildings is at the heart of this, and a rapid decarbonisation of our building services will be required to meet UK and international climate ambitions.

Network Rail are custodians of a large and diverse infrastructure estate that includes some of the UK's most iconic buildings, such as St Pancras and King's Cross stations, but also a large lineside building portfolio. As an organisation that is committed to becoming Net Zero Carbon by 2050, it is vital that low and zero carbon designs are incorporated into all new and existing buildings.

This document has been created for project managers, designers, and maintenance engineers to use throughout their project's lifecycle to create low and zero carbon plantrooms, whether it be a new build or refurbishment.

The guide outlines key elements to consider when designing a plantroom, as well as when in a project's lifecycle key decisions should be made. Network Rail has produced several other guidance documents alongside this one (including the Climate Action Design Manual and the Buildings and Architecture Strategy). These should be used in conjunction with this guide, as delivering net zero will require a holistic approach to both building level design and sustainable plant rooms.

Asset managers and Building Services Engineers should also use this document to set key performance indicators (KPIs) and project performance reporting requirements in each project briefing pack to be adopted by the associated design team.



Liverpool Street station © Getty Images

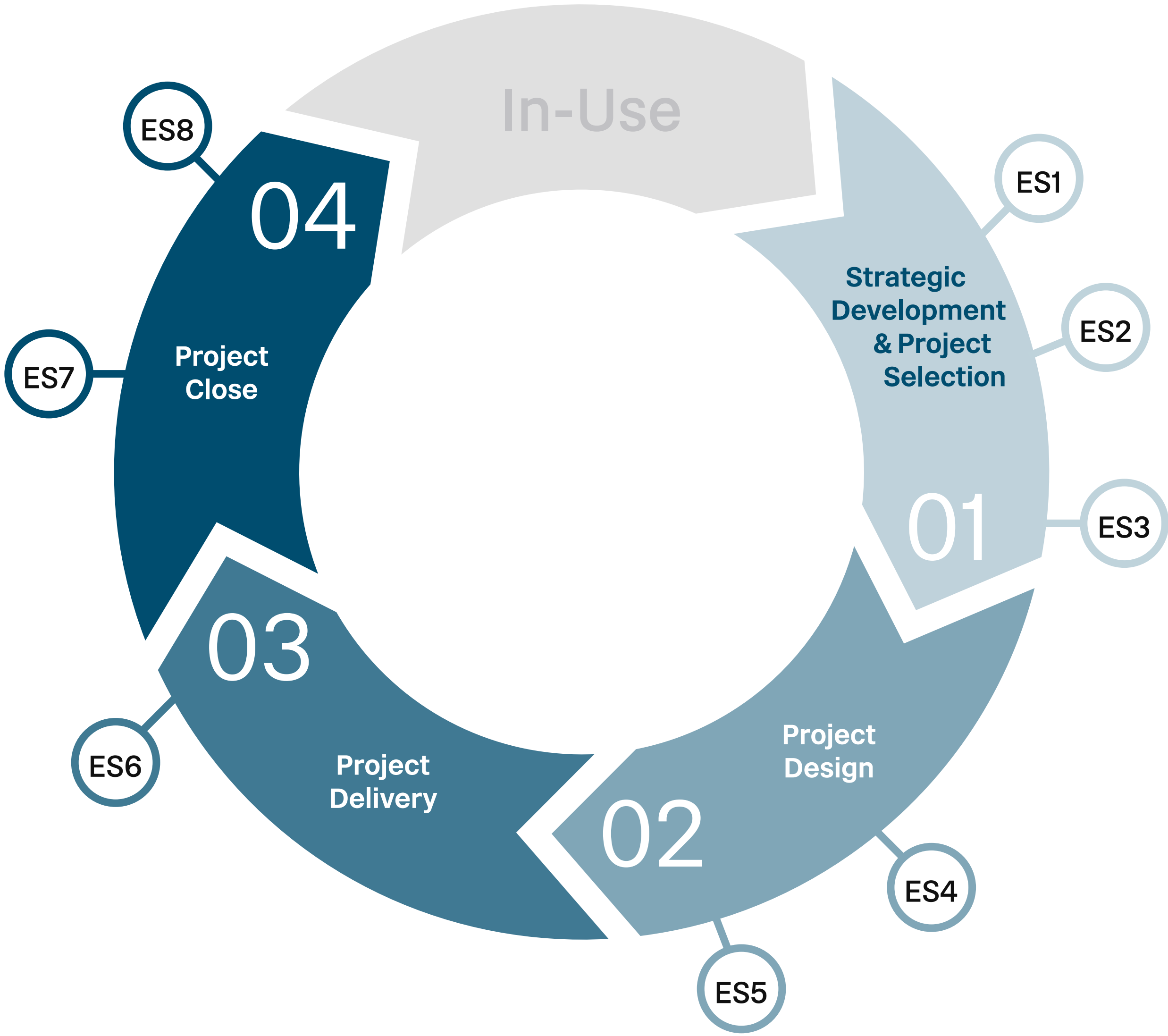
1.2 PACE phases diagram

Network Rail project management process PACE (Project Acceleration in a Controlled Environment) consists of four phases and eight distinct project milestones as shown in the diagram to the right.

Guidance is provided as to what should be considered and reported at each project milestone within section 4 of this guide.

In-use reporting is outside of the PACE framework but this is imperative to gather data to inform future project KPIs. The designer should consider metering and monitoring systems as part of the plantroom design to gather in-use data.

ES1	Client requirement defined and baselined
ES2	Constraints identified and project feasibility confirmed
ES3	Single option identified and endorsed
ES4	Design standards approved and Approval in Principal
ES5	Construction ready design approved
ES6	Construction complete
ES7	Project demobilised and handed back to sponsor
ES8	Contractual accounts settled, warranties transferred to maintainer, formal closeout



Low and Net Zero Plant Room Guide

Sustainability

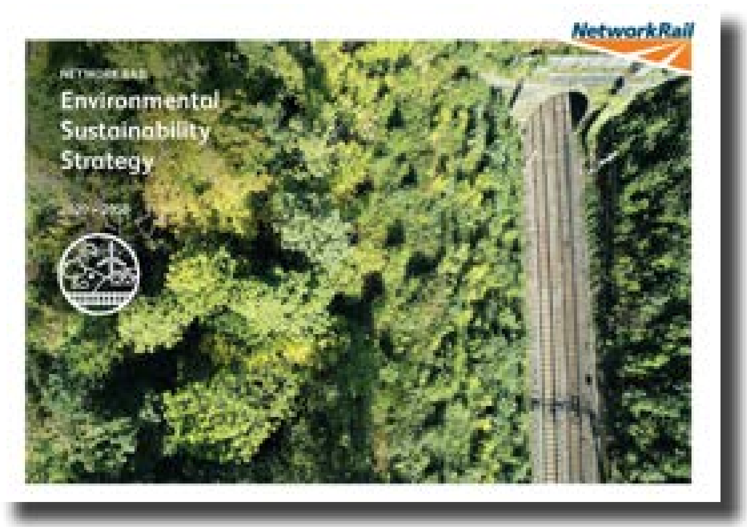
2

2.1 Our vision

2.1.1 Our strategy and vision

Delivering a sustainable railway network is at the heart of Network Rail's vision. Our vision is to serve the nation with the cleanest, greenest mass transport system, which is enabled by smart decision making to support long-term positive social and environmental impacts.

Strategy → **Vision** → **Core Priorities**



"**Our vision** is to serve the nation with the cleanest, greenest mass transport. We want to put passengers first, help passengers and freight users to make green choices, support local communities and be a good neighbour."

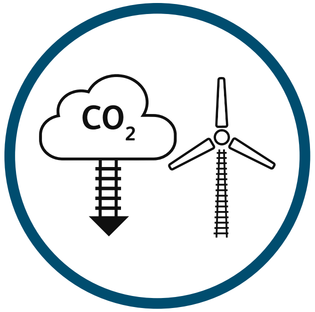
1. A low-emission railway
2. A reliable railway service that is resilient to climate change
3. Improved biodiversity of plants and wildlife
4. Minimal waste and sustainable use of materials

2.1 Our vision

2.1.2 Our core priorities

We have identified four core priorities which are at the heart of delivering our sustainability ambitions.

These core priorities will form the structure of this How To Guide in terms of setting out themed requirements and reporting tools in delivery building.



A low emission railway

We need to decarbonise our network by transitioning away from fossil fuels to clean, renewable, low-carbon energy.

Achieve net zero carbon emissions in line with Government targets and deliver continual improvements to ensure air pollution is reduced.

A reliable railway that is resilient to climate change

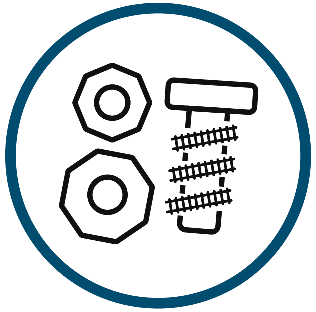
We want to minimise disruptions caused by more frequent weather events to ensure we can run the railway safely and on time.

Undertake climate risk assessments and implement adaptation and resilience measures to future proof assets.

Improved biodiversity of plants and wildlife

We want to protect, maintain and enhance biodiversity across our network.

Achieve no net loss of biodiversity across the network by 2024 and net gain by 2035. Introduce natural capital reporting against defined baselines by 2024.



Minimal waste and sustainable use of materials

We have to use less, manage unavoidable waste and contribute to a more circular economy which uses minimal virgin resources, and seeks maximises our asset's value across their lifecycle.

Reuse, repurpose or redeploy all surplus resources, design out waste and plastic pollution, and embed circular economy thinking by 2035.

2.2.1 Net Zero Carbon (NZC)

What is Net Zero Carbon?

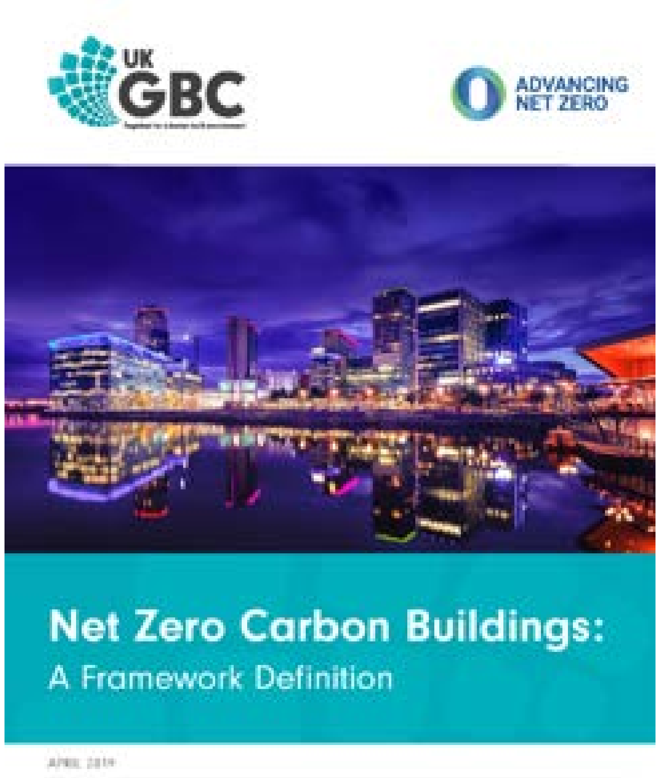
For the purpose of this How to Guide and its application to our asset plant rooms, our definition is aligned with the UK Green Building Council (UKGBC) definition of a Net Zero Carbon (NZC) building.

The UK Green Building Council issued a report in 2019 setting out a Framework Definition of a Net Zero Carbon Building. This definition is adopted for use within the how to guide.

The NZC framework sets out two important definitions for a Net Zero Carbon building:

- Net Zero Carbon in construction for new buildings and major refurbishments;
- Net Zero Carbon in operation for all buildings.

A notable aspect to this framework definition is that a NZC building is required to annually disclose in-use energy performance. A verified NZC building is therefore based on in-use data rather than modelling assumptions.



UKGBC Framework Definition for a Net Zero Carbon Building

2.2.2 Industry best practice

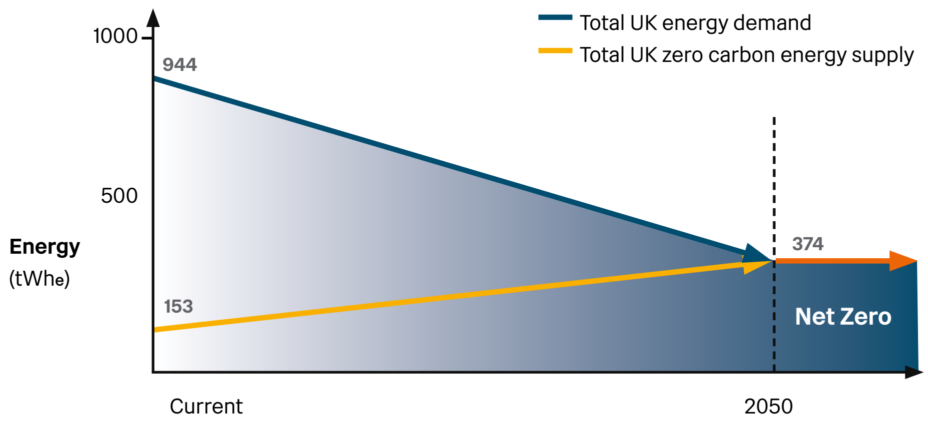
In response to the decarbonisation agenda, the construction industry has developed best practice approaches to help galvanise the industry and provide consistency in defining and delivering NZC buildings.

Whilst reducing carbon emissions is essential to meeting NZC targets, energy consumption is often used as proxy for achieving NZC. This is because as systems are electrified, the ability to meet electricity demand through renewable sources becomes the key sustainability driver.

The chart opposite identifies the amount of energy demand reduction required in order to meet the emerging supplies of zero carbon renewable electricity. This approximately equates to a 60% reduction in building energy demands across the UK built environment.

This shows that we cannot simply rely on electrification of services and the decarbonisation of the grid to reach Net Zero. Efficient services and demand reduction at the asset level are equally important.

The **Energy Use Intensity (EUI)** is a critical KPI, as it allows for a consistent, measurable performance metric which can be compared and aligned with best practice targets.



UKGBC Paris Proof Methodology

Key reporting metrics

Carbon Emissions (KgCO₂e/year)
Carbon Dioxide equivalent allows the emissions associated with all greenhouse gases to be captured in one metric, using a pollutant's Global Warming Potential to equate its emissions back to CO_2.

Achieving NZC will require net CO_2e emissions to be 0.

Energy Use Intensity (kWh/m²/year)
Energy Use Intensity (EUI) is a measure of energy consumption per 1m² of floor area, and considers the energy consumption of the **entire building.**

Best practice benchmarks exist for a variety of building typologies. For example, offices should achieve **55 kWh/m²/year** to be considered Net Zero Carbon. Bespoke EUIs should be derived and targeted for all Network Rail buildings.

2.2 Introducing key concepts

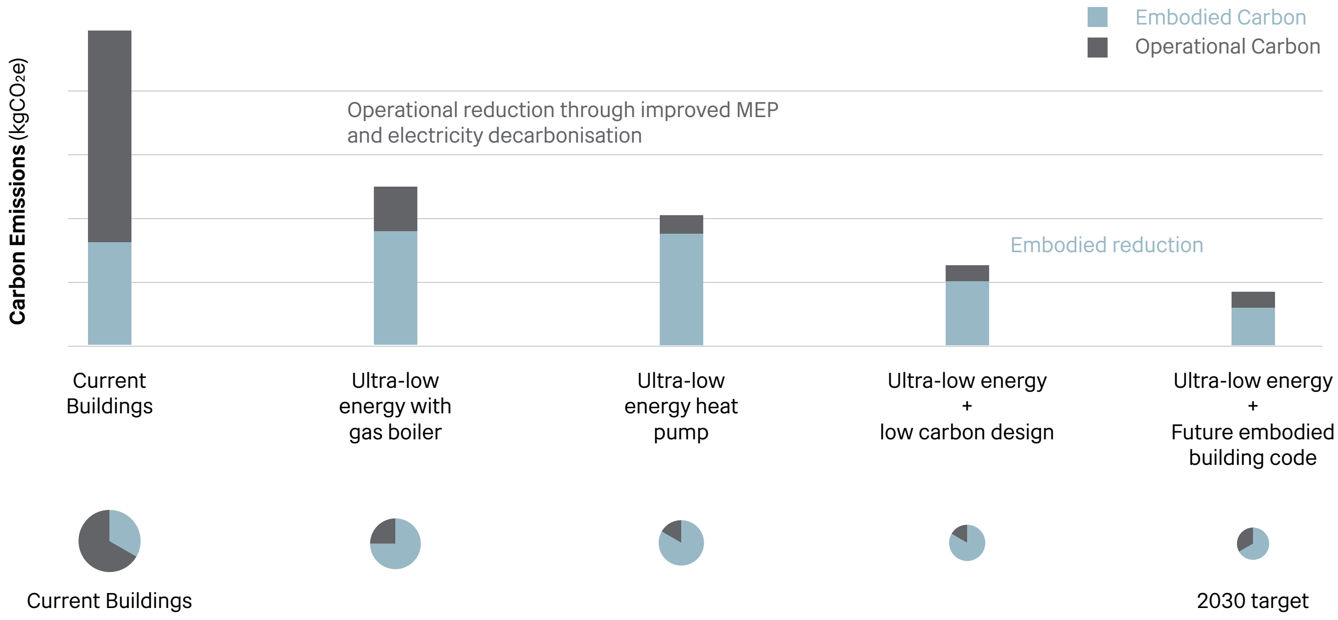
2.2.3 Industry best practice - embodied carbon

Embodied carbon emissions are those associated with the materials used in construction and ongoing maintenance of our buildings. This includes the emissions arising from manufacture, transportation, construction, maintenance, replacement, disposal and reuse (end of life) of materials, products and buildings.

Until recently, reducing operational carbon has been prioritised, with the upfront emissions from embodied carbon often being overlooked. However, the majority of embodied carbon emissions are happening now, during early construction and through the manufacture of materials and products that will eventually end up in our buildings.

As the amount of energy required to operate our buildings reduces (e.g. through decarbonisation of our electricity supply), the embodied emissions will contribute a greater proportion of the building's total carbon footprint.

We need to tackle our embodied carbon emissions immediately, through prioritising low-carbon material choices, championing the re-use of materials and products, and questioning whether a 'do-nothing' approach may be more sustainable than the alternative.



Projected future split of embodied vs. operational carbon in buildings

Source: LETI Climate Emergency Design Guide

Key reporting metrics

Carbon Emissions ($KgCO_2e/m^2$)
Carbon Dioxide equivalent is also used to measure embodied carbon, and is measured per m² of floor area (typically using Gross Internal Area) for comparison between buildings.

Total Kg CO_2 should also be monitored to understand the overall carbon impact of a development.

The UKGBC and LETI (Low Energy Transformation Initiative) best practice guidance specifies **<350$KgCO_2e/m^2$** of upfront emissions for new office developments (based on 2030 targets).

2.2.4 Whole life cycles

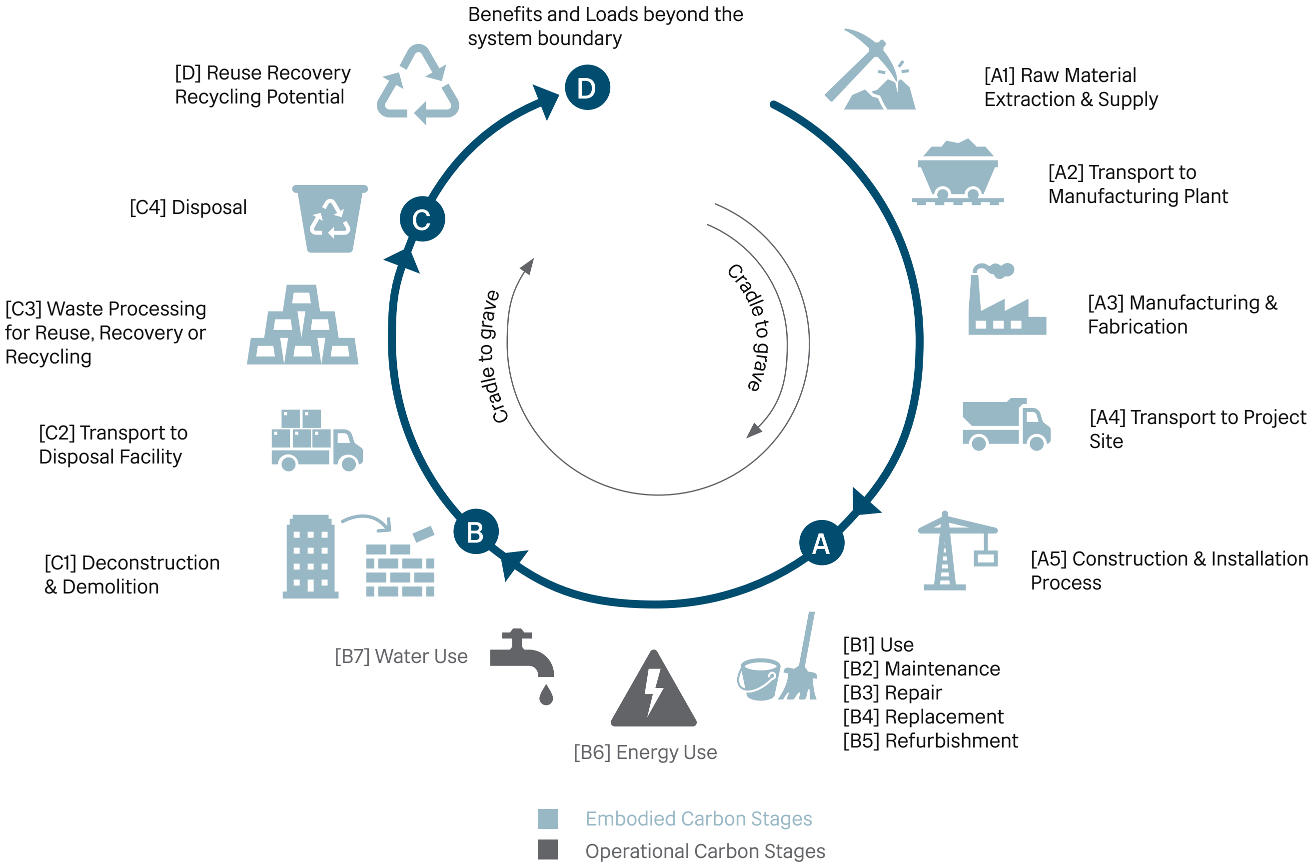
In every stage of a building's life cycle, the choices we make have an environmental impact, from the extraction of raw materials used in the manufacturing of MEP plant, to the end-of-life disassembly and disposal of equipment.

It is therefore important to consider the carbon emissions associated with the entire lifetime of a product, bringing together both operational and embodied carbon to consider whole life.

The product Life Cycle stages can be broken down into the following:

- **A** - Upfront emissions (extracting raw materials, transporting, manufacturing and constructing products);
- **B** – 'In-use' emissions (running, maintaining and replacing equipment during its operational lifetime);
- **C** – End of life emissions (demolishing and disposing of equipment);
- **D** – The potential benefits associated with reuse, recovery and/or recycling at end-of-life.

Life Cycle Assessment (LCA) is a method to quantify the environmental impacts of each life cycle stage and can help to identify carbon 'hotspots'. This will enable conscious decisions to be made around specifying low-carbon material options.



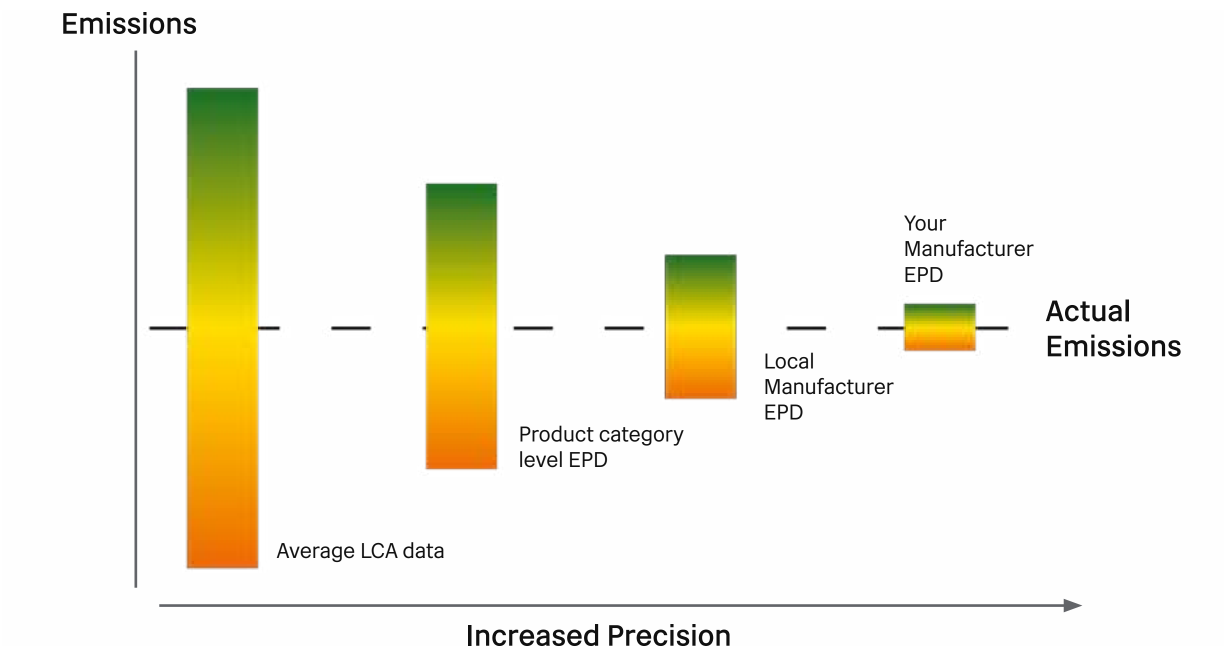
2.2.5 Understanding the environmental impact of materials

Environmental Product Declarations (EPDs) provide standardised and reliable data around the embodied carbon emissions for a specific product, and utilising them is a crucial step in performing a meaningful Life Cycle Assessment (LCA).

Whilst using EPDs may not in itself reduce emissions, it will support asset managers in making low-carbon decisions. By comparing the EPDs from multiple products, their environmental impacts can be accurately assessed, and the most sustainable option selected.

Requesting EPDs will also help to drive forward the sustainability agenda across the wider industry. As demand for EPDs increases (driven by requests from asset managers), product manufacturers will face greater pressure to quantify the emissions of their products and be held to a greater level of accountability.

Where EPDs have not been requested, or are not available, assumptions can be applied using the CIBSE TM65 (Embodied carbon in building services: A calculation methodology) to maintain a degree of accuracy. Otherwise, alternative EPDs from similar products or generic embodied carbon data based on LCA averages, with a large potential for error and uncertainty, would have to be used.



Level of accuracy associated with different sources of embodied carbon data – the more accurate the information, the more confidence can be applied to choosing the lowest carbon option

Reference: https://www.oneclicklca.com/epds-for-building-lca/

2.2 Introducing key concepts

2.2.6 Carbon hotspots in plant rooms

The Whole Life Carbon hotspots that are likely to be relevant to plant rooms include:

- Upfront emissions associated with the manufacture, transport and construction of new equipment;
- Replacement of MEP services when they reach end-of-life;
- The leaking of refrigerant based systems (e.g. Variable Refrigerant Flow (VRF), Heatpumps) due to their high Global Warming Potential (GWP);
- The in-use emissions associated with the day-to-day operation of the plant, particularly where fossil fuels are used.

Performing a full LCA will help to establish the most carbon intensive life cycle stages. Actions to limit carbon emissions across all stages (not just those highlighted in this section) should be considered.

Considerations

Upfront emissions (A1-A5)
Manufacturing new equipment

- Avoid building anything new at all
- Refurbish, retrofit & repair existing equipment
- Use reclaimed / second hand materials to promote circular economy

Replacement (B4)
Manufacturing of replacement equipment after end of life

- Minimise refrigerant charge
- Use packaged plant over piped systems
- Prioritise refrigerants with low Global Warming Potential (GWP)

Refrigerant Leakage (B1)
Leakage of refrigerant with a high Global Warming Potential

- Install durable equipment with a long lifespan
- Develop flexible designs to avoid 'early retirement'
- Employ robust maintenance plans

Operational emissions (B6)
Energy use in operation

- Reduce demand at an asset level
- Efficient design of MEP to avoid wasted energy
- Install fossil-fuel free services
- Generate renewable energy on/off site

2.2.7 Building level vs Plant level approaches

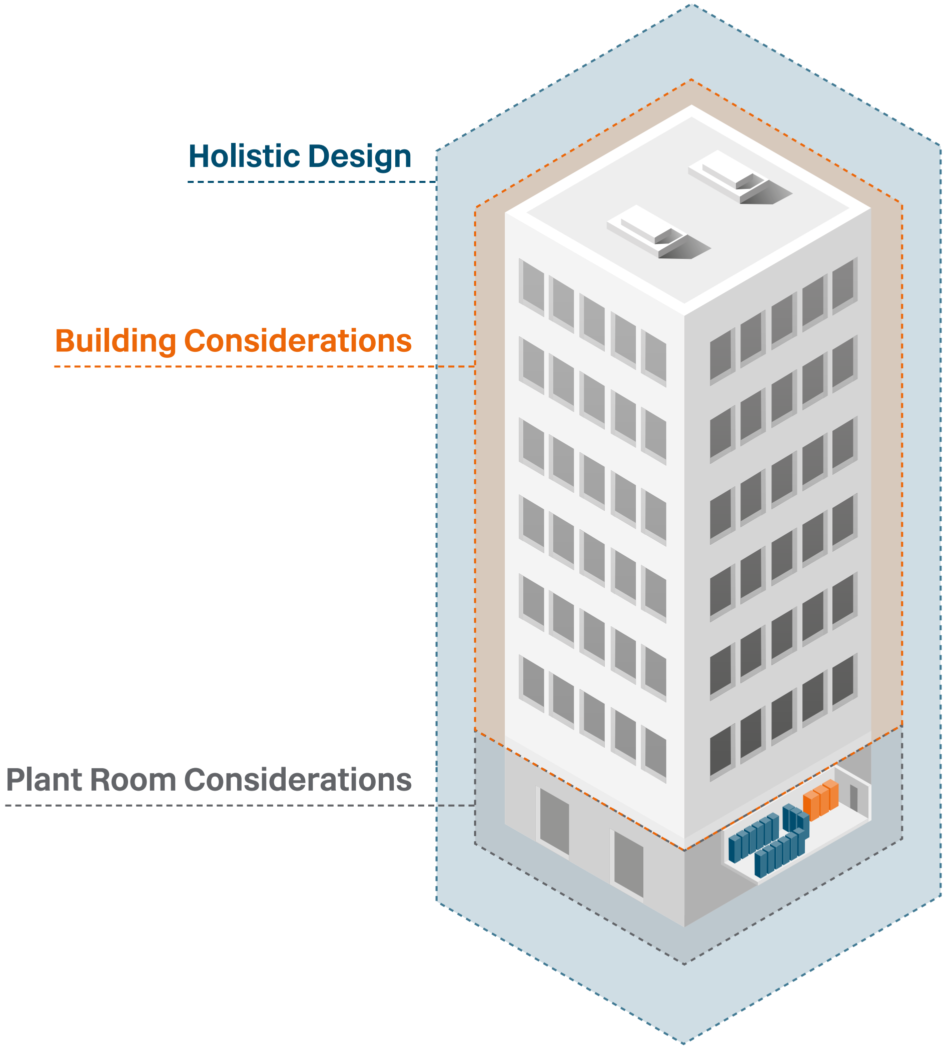
It is important to recognise that whilst this guide has a specific focus on sustainable plant rooms, a Net-Zero Carbon (NZC) strategy requires **holistic thinking** around the design of the entire building.

Asset-level approaches to sustainability need to be considered alongside plant-level servicing to successfully deliver NZC. This includes considerations around:

- Fabric insulation and airtightness;
- Building form & orientation;
- Prioritising passive measures and demand reduction;
- Floor-by-floor servicing strategy and how this links to the plant room equipment.

Effective communication between asset managers, and a clear understanding of KPIs at a building level will be required to deliver NZC plant rooms.

Plant room asset managers and engineers should have an awareness of the building level KPIs (such as EUI targets) and communicate with counterparts at the building asset level so that holistic, best-practice strategies are implemented.

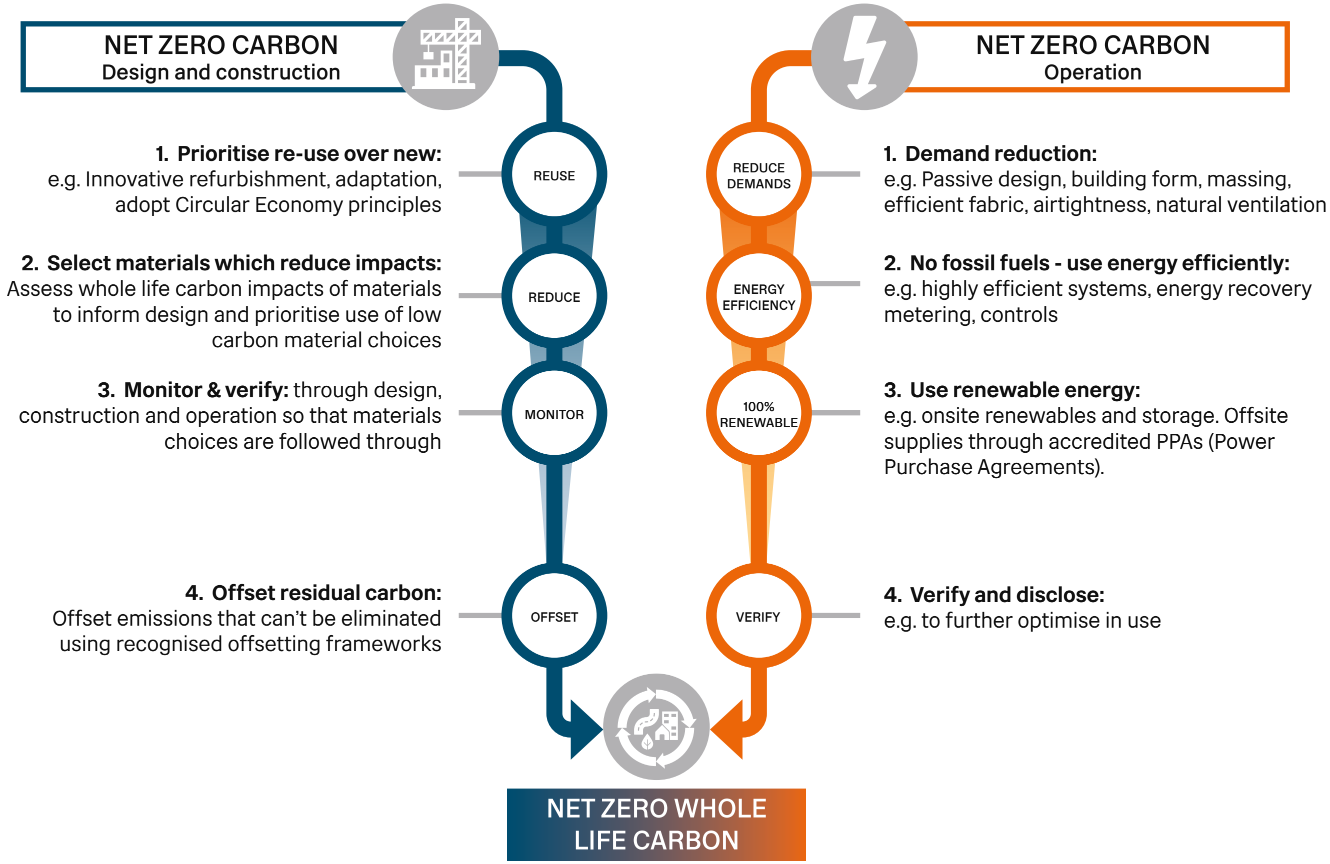


2.3 A low emission railway

2.3.1 Achieving a low emission railway

Achieving our ambition of a low emissions railway will require decarbonising our network by transitioning away from fossil fuels to clean, renewable, low-carbon energy.

Aligning ourselves to industry best practice guidance will mean targeting Net Zero Whole Life Carbon, which means bringing together NZC in construction and operation.



Steps and hierarchy to delivering a Net Zero Carbon building

Sustainability

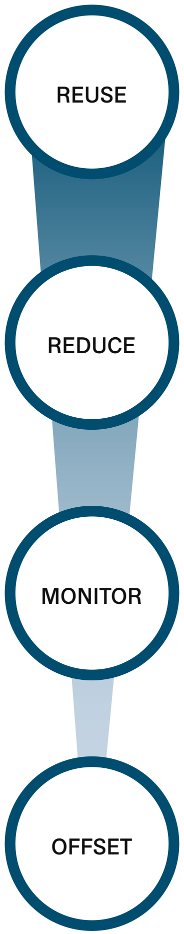
2.3 A low emission railway

2.3.2 NZC in Design & Construction

The design and construction of our plant rooms is a key opportunity for promoting sustainable choices from the get-go, both for new assets and refurbishments.

Prioritising the re-use of existing services, selecting materials with a **low embodied carbon content** and limiting emissions associated with the manufacture and transportation of equipment can all help to reduce our organisation’s carbon footprint.

Life Cycle Assessments are a key step in minimising embodied carbon. Appropriate methodologies, such as CIBSE TM65 should be followed aligning the approach to refurbishments and new construction to industry best practice.



Step 1: Prioritise re-use over new
Firstly, consider how re-purposing or adapting existing assets and systems can mitigate generating embodied carbon principles

Step 2: Select Materials with Reduced Impacts
Assess Whole Life Carbon impacts of materials and products to inform decision making and material choices

Step 3: Monitor & Verify
Material choices are followed through design, construction and operation of assets

Step 4: Manage Residual Carbon
Monitor and mitigate emissions that cannot be eliminated

Considerations

- Consider innovative refurbishment over new
- Adopt Circular Economy Principles

- Embed requirements to carry out a Whole Life Carbon assessment. This should be used to inform appropriate low carbon material selections.

- Continually review the procurement of materials to verify low carbon material choices are followed through

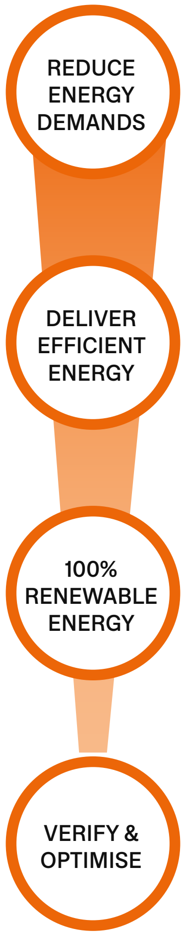
- Monitor and understand residual emissions. Consider frameworks to reduce these (i.e. offsetting, setting a carbon price to fund energy improvement schemes)

2.3.3 NZC in Operation

The day-to-day operation of our heating, cooling and ventilation systems can be a significant attributor to our building-related CO_2 emissions. Minimising the carbon emissions of plant room services is therefore essential to enabling a decarbonised estate.

Operational energy efficiency starts at an **asset level**, and a holistic approach to building performance is required so that plant room services can operate at their most efficient. Opportunities to reduce building energy demand should always be prioritised and asset managers should make certain that prerequisite operational energy improvements are met.

Operational energy models and Design for Performance methodologies can help to understand the operational energy hotspots associated with plant equipment and encourage low-carbon choices when replacing and optimising equipment.



Step 1: Demand Reduction
Firstly, consider how energy demands can be reduced for the asset. Doing this first is often the most cost-effective and impactful way to reduce consumption demands.

Step 2: Deliver Energy Efficiently
Asset is 100% fossil fuel free and served by the highest efficiency central plant and systems.

Step 3: Renewable Energy Generation
Maximise any on-site renewable provision & procure renewable electrical supplies through PPA.

Step 4: Verify and Optimise
Report and verify carbon emissions in-use annually and continue to optimise performance.

Considerations

- Solar shading devices, improved fabric efficiencies, e.g. U Values, compact building form and massing, improved airtightness, maximise use of natural ventilation and other 'free cooling' devices

- Heat pumps, LED lighting with controls, IT systems, manage energy use through BEMS (Building Energy Management System)

- Onsite renewables such as Solar PV (Photovoltaics) and Wind generation. Negotiate PPAs in procurement

- Annual energy audits and optimisation studies, e.g. CIBSE TM22 (Energy assessment and reporting methodology)

2.4 A railway resilient to climate change

Rising global temperatures have highlighted the need for our buildings to be able to cope with the challenges that a changing climate will bring.

Our buildings and plant rooms should be designed with climate adaptation in mind:

Mitigating Future Overheating Risk

- Providing adequate levels of thermal comfort both today and in the future;
- Modelling overheating and daylight availability using predicted future weather files;
- Using holistic building design thinking around form and orientation, to avoid 'bolt-on' solutions.

Resilient Species and Ecosystems

- Preserve neighbouring ecosystems;
- Introducing native species with a low sensitivity to environmental changes.

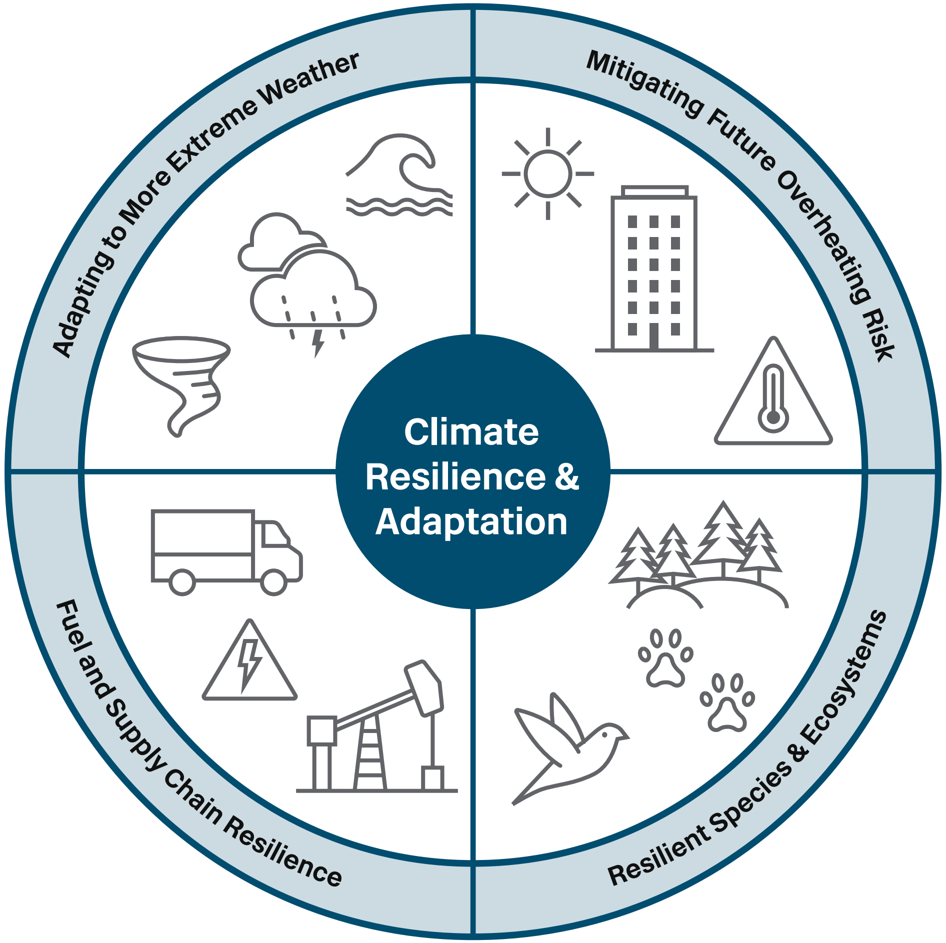
Fuel and Supply Chain Resilience

- Making choices which prioritise resilience in our supply chains and heating fuels (e.g. reducing reliance on fossil fuels and futureproofing renewable sources of heat generation).

Adapting to More Extreme Weather

- Designing with more extreme weather in mind;
- Avoiding future flood risk plains for new buildings;
- Providing adequate protection to equipment from more intense weather events.

Undertaking climate risk assessments is an essential step in future proofing our assets.



2.5 Improved biodiversity of plants and wildlife

2.5.1 Biodiversity considerations

The sustainable design and refurbishment of our plant rooms presents the opportunity to positively contribute to the biodiversity of plants and wildlife through the following considerations:

2.5.2 External Lighting Design

External lighting should follow guidelines from the Bat Conservation Trust including:

- Using low or high-pressure sodium lights or LEDs over mercury or metal halide lamps where possible;
- Directing lighting to where needed, including the use of hoods, cowls, shields etc. to avoid spillage onto areas of vegetation;
- Only lighting areas which need to be lit, and using the minimal level of lighting required to comply with building regulations;
- Using, where possible, movement sensors or timers on security lighting;
- Avoiding the use of lamps greater than 150 W or producing illumination greater than 0.5 lux.

2.5.3 Green Roofs

In locations with flat roofing, biodiverse green roofs can be constructed on the roof tops, incorporating a varied substrate depth and planted with a wide range of wildflowers with wood piles and bug hotels. Through careful planting, green roof habitats can support a broad range of invertebrates, birds and bats.

2.5.4 Loft / Roof Construction

The roof construction could be enhanced for use by bats:

- Part of roof of the loft could be pitched, incorporating a variety of bat tiles for crevice dwelling bats and vented ridge tiles for bats to enter the interior of the loft;
- A large void space could allow space for bats to fly, with the apex in excess of 2.8 metres and a width and length of 5 metres or more. It should be made of traditional hessian bitumen roofing felt or wooden sarking;
- Plant room equipment should be positioned so that it warms the loft for bats;
- There should be no external lighting around the entrance to the loft.

2.5.5 Bat and Bird Boxes

A variety of different types of bird and bat boxes could be installed. Different species will have different nest box requirements. Integrated boxes will be most appropriate as they have a longer life span and are less likely to be damaged or fall off in windy weather.

If you require more information on biodiversity please see https://www.buglife.org.uk/.

2.5.6 External Enhancements

Management of external habitats to create a mosaic of trees and wildflower grassland. Consider planting native species-rich hedgerow to connect to off-site habitats. Free-standing pollinator posts could be erected in sunny locations for invertebrates.

2.6 Minimal waste and sustainable material use

Embedding **circular economy principals** into the design, maintenance and disposal of our plant equipment is key to becoming a sustainable organisation.

This involves minimising the quantity of materials used, designing with longevity and adaptability in mind, and eliminating waste as far as possible.

The hierarchy to managing waste sustainably is described below.

Retain - If working with existing assets, explore retention, before demolition to improve carbon and financial savings.

Reuse - Reuse existing asset locally or offsite or import from another site. Extract materials full potential by keeping in circulation.

Reduce - Optimise space layout, system design and material quantities, design out waste.

Recycle - Recycle materials via upcycling before downcycling to increase element lifespan. This includes considering whether redundant plant can be **reclaimed** by other organisations e.g. gifting to local community buildings

Resource Efficiency

Conserving resources, increasing resource efficiency and sourcing sustainably

- Minimise the quantities of materials & resources;
- Specify and source materials and other resources responsibly and sustainably.

Designing Sustainably

Designing to eliminate waste

- Design for longevity, adaptability / flexibility and reusability / recoverability.

Managing Waste

Managing waste sustainably

- Explore retention, before demolition;
- Reuse existing assets to keep in circulation;
- Recycle materials via upcycling to increase lifespan.

Low and Net Zero Plant Room Guide

Plantroom Design Considerations

3

3.1 Introduction

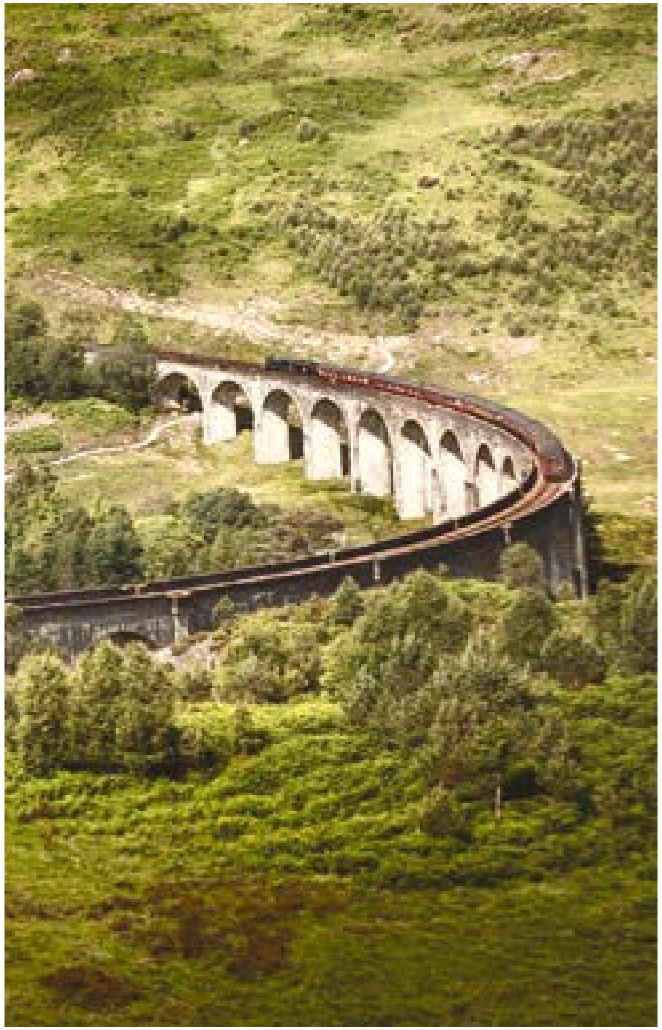
The following section has been created for designers to help cultivate and guide efficient plantroom design solutions, which meet the principles and Network Rail sustainability targets outlined in Section 2.

It is important to note that the information and topics found in this section have been created to act as prompt for designs to instigate a thought process; and should not be seen as rigid solutions that should be followed. The design team should look for innovative and creative ways to satisfy the project brief while minimising embodied and operation carbon usage.

The Network Rail asset manager will be keen to discuss new and innovative low carbon solutions with the design team, as the best ideas have the potential to inform Network Rail design guide changes, resulting in a larger and more impactful positive change across the entire Network Rail estate.

Step 1 of starting a new project is to run through the flow chart found on the next page. The purpose of this flowchart is to determine what level of feasibility study should be completed by the design team prior to completing the associated design. The completed feasibility study should be reviewed and discussed between the design team and Network Rail asset manager, then signed off prior to beginning the design.

The final point of this introduction is; feel empowered to collaborate, ask questions and share ideas; opening dialogue and discussing your design solutions will result in better, more sustainable solutions.



Plantroom Design Considerations

3.2 Feasibility flow chart

PACE Phase 1, ES1 Project Manager is to include feasibility requirements within project brief

Reactive faults → No feasibility

Planned maintenance → Project Assessment

Minor renewal → Partial Feasibility

Major renewal / New construction → Full Feasibility

No feasibility

1. No feasibility required.
2. Designers to consider low embodied carbon materials when undertaking works.

Project Assessment

1. Report looking at 3 options prior to completing final design/install, answers reported in kg of CO_2/m^2.
2. The 3 options will be a. do nothing, b. replace like for like c. optimise system to minimise energy usage.
3. It is important that all solutions (even like for like) are designed to suit the space's activities/ occupants. A non-compliant system cannot be installed in place of old system.
4. Designers to consider low embodied carbon materials when undertaking works.
5. The designer may use Static Modelling to calculate results.

Partial Feasibility

1. Partial feasibility to assess the carbon usage before and after the proposed works for **associated plant being replaced,** reported in kg of CO_2/m^2.
2. The feasibility should investigate building infrastructure, building demand loadings, spatial restriction, most suitable L/NZC technologies for building, operational & embodied carbon, outline additional measures required outside works to achieve L/ NZC status.
3. The designer may use Static or Dynamic Simulation Modelling (DSM) to calculate results.

Full Feasibility

1. Full feasibility to assess the **whole building** carbon usage before and after the proposed works, reported in kg of CO_2/m^2.
2. The feasibility should investigate building infrastructure, building demand loadings, spatial restriction, most suitable L/NZC technologies for building, operational & embodied carbon, outline additional measures required outside works to achieve L/ NZC status.
3. The consultant should use Dynamic Simulation Modelling (DSM) to calculate annual energy consumption.

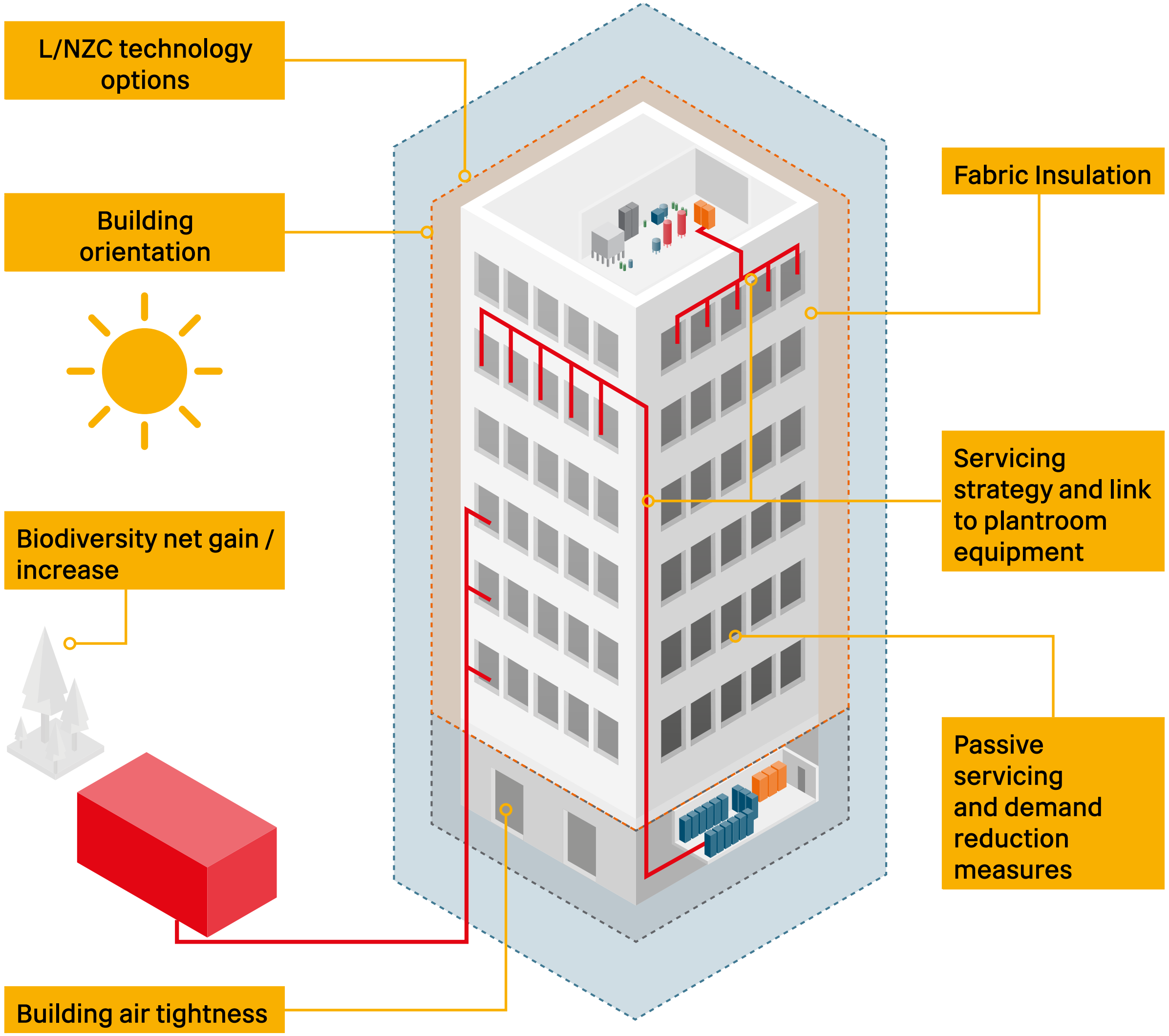
3.3 Holistic design

Whilst the scope of this guide is limited to the considerations for a low carbon plantroom, these elements should be considered holistically alongside the overall building and services systems design.

Clear communication and innovation between all parties responsible for design and installation is critical to delivering a L/NZC plantroom and this should be facilitated by the Network Rail Asset Manager or project manager.

Some key low energy design considerations which will impact on a low carbon plant room are as follows:

- Building Type (is it heating or cooling led);
- Building Location (site constraints/local weather conditions);
- Passive design (form/glazing ratios/orientation/ insulation/shading etc.);
- Energy supply (all electric opportunities, district heating/cooling opportunities);
- HVAC (Heating, Ventilation, Air-conditioning) systems (local/central, passive, heat recovery, high efficiency, controls, emitters etc.);
- Low or Zero Carbon Technologies (photovoltaics (PV), solar thermal, heat pumps (air, ground, water), wind turbines etc.).

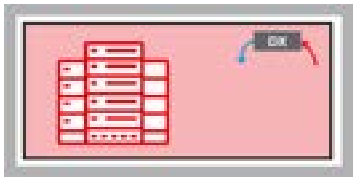


Plantroom Design Considerations
3.4 Building/plant room types

Network Rail owns, operates and manages a diverse property estate across Great Britain. The type of plantroom covered by this guide and the requirements of the building surrounding the plantroom should be understood by the designer in order to maximise opportunity for efficiency and reduction in operational and embodied carbon through design. Three plantroom types have been identified associated with typical Network Rail building uses.

Plantroom Type 1: Rail Infrastructure Equipment
Building unoccupied, contains infrastructure equipment. May be lineside or adjacent to occupied buildings/stations.

Usually has high equipment heat gains from rail infrastructure equipment.

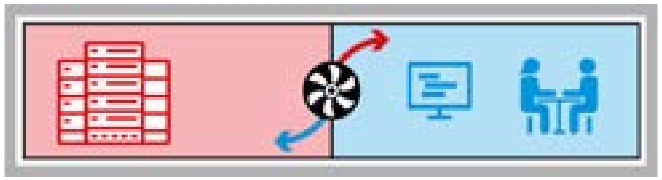


- Unoccupied
- **Rail Infrastructure Equipment** Building

Typical unoccupied lineside building

Plantroom type 2: Rail Infrastructure Equipment & People
Building occupied, contains infrastructure equipment. Small number of occupants and high equipment gains from infrastructure equipment.

Typically has heat gains from rail infrastructure equipment and people. Requires temperature control for Summer & Winter occupant comfort & infrastructure equipment.

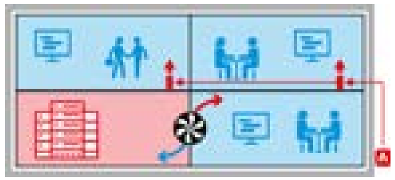


- Occupied
- Building for **people/rail infrastructure equipment**

Signalling Building

Plantroom type 3: People focussed
Building occupied, building's main function is to accommodate people i.e. office type building or maintenance accommodation building.Large number of occupants (potentially shift working), equipment is associated with people occupancy.

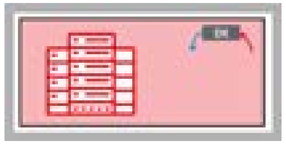
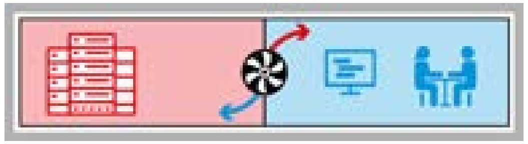
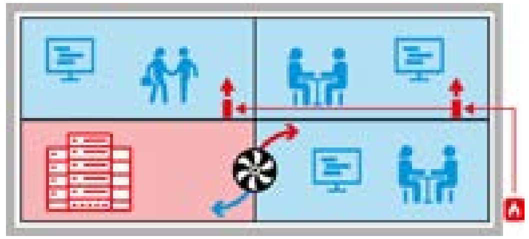
Typically has heat gains form people and equipment associated with the working practices of those people. Requires temperature control for Summer and Winter occupant comfort.



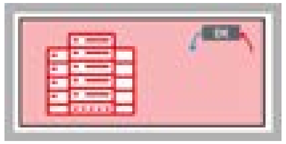
- Occupied
- Building for **people/rail infrastructure equipment**

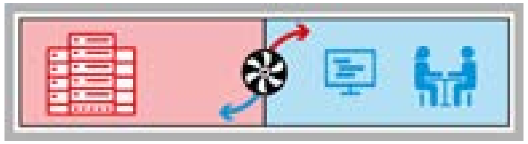
MDU (Maintenance Delivery Unit) Building

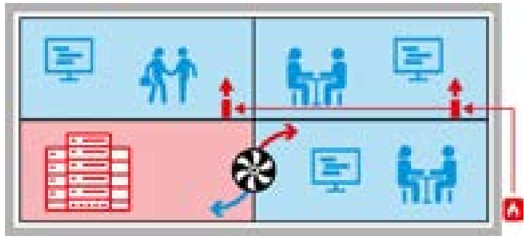
3.5 Operational considerations

			
REDUCE ENERGY DEMANDS	a. Can higher levels of infiltration be provided to increase passive design measures? b. Can cooling set point be increased to reduce energy? c. Can heating set point be lower to reduce energy use?	a. Maximise natural ventilation; b. Plant aligned with occupancy zoning to reduce system usage; c. Adaptive comfort control.	a. Maximise natural ventilation; b. Plant aligned with occupancy zoning; c. Adaptive comfort control.
DELIVER EFFICIENT ENERGY	a. Replace with energy efficient ventilation and air conditioning units.	a. Replace with energy efficient ventilation and air conditioning units; b. Utilise waste heat through heat recovery; c. Utilise waste heat distributed locally via from intelligent branch control (VRF) or Ambient Loop system.	a. Replace with energy efficient ventilation and air conditioning units; b. Utilise waste heat through heat recovery; c. Utilise waste heat distributed locally via from intelligent branch control (VRF) or Ambient Loop system.
100% RENEWABLE ENERGY	a. Consider Renewables (PV, Solar Thermal etc.).	a. Consider Renewables (PV, Solar Thermal etc.).	a. Consider Renewables (PV, Solar Thermal etc.).
VERIFY & OPTIMISE	a. Include metering and monitoring system for measuring and remote data collection.	a. Include metering and monitoring system for measuring and remote data collection; b. Integrate metering and monitoring with control system (BMS) for intelligent feedback to allow for automatic or remote adjustment.	a. Include metering and monitoring system for measuring and remote data collection; b. Integrate metering and monitoring with control system (BMS) for intelligent feedback to allow for automatic or remote adjustment.

3.6 Embodied considerations







REUSE

a. Refurbish, retrofit, repair existing equipment;
b. Avoid new construction where possible.

REDUCE

Select materials which reduce impact by:

a. Specify reclaimed / second hand / circular economy sourced new equipment (from across the estate?);
b. Use durable equipment with a long lifespan;
c. Flexible designs to avoid ‘early retirement’;
d. Minimise refrigerant charge, use low GWP refrigerants;
e. Design efficiently.

MONITOR

a. Measure whole life carbon at stages in design and throughout construction;
b. Use suppliers whose products have Environmental Product Declarations;
c. Robust maintenance plans.

OFFSET

a. Report embodied carbon emissions information to allow residual carbon to be managed.

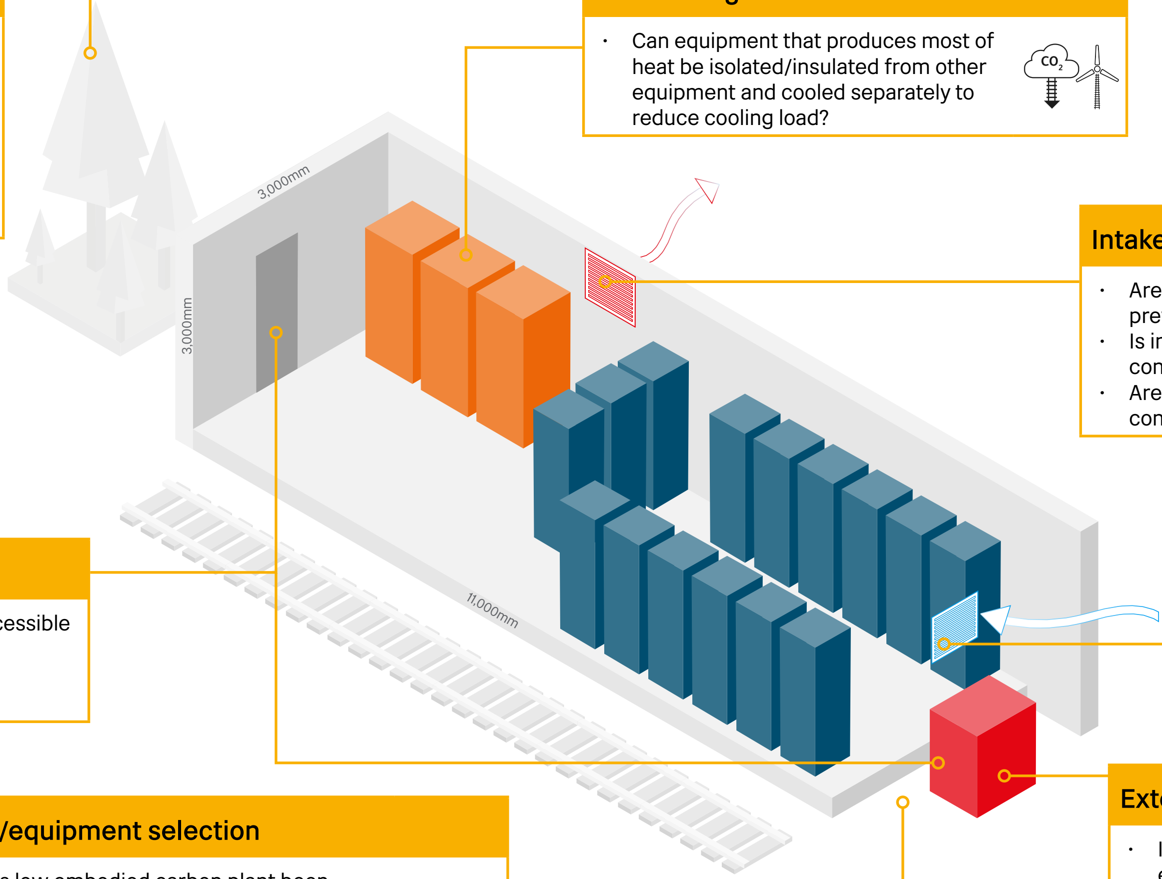
3.7 L/NZC Plantroom considerations

Biodiversity

- Is local biodiversity maintained or enhanced? Consider green roof, bat/ bird boxes.
- Has external lighting been designed with biodiversity in mind, is this controlled?

Plant configuration

- Can equipment that produces most of heat be isolated/insulated from other equipment and cooled separately to reduce cooling load?



Intake & exhaust location

- Are these sufficient distance to prevent short circuiting?
- Is intake located away from source of contamination i.e. diesel train exhaust.
- Are these located so that pressure is consistent and evenly balanced?

Access & maintenance

- Is plantroom and external plant accessible for maintenance?
- What is proximity to track?
- Can this be safely maintained?

Plant/equipment selection

- Has low embodied carbon plant been selected?
- Does plant procurement programme take into account technology upgrades and future-proofing?

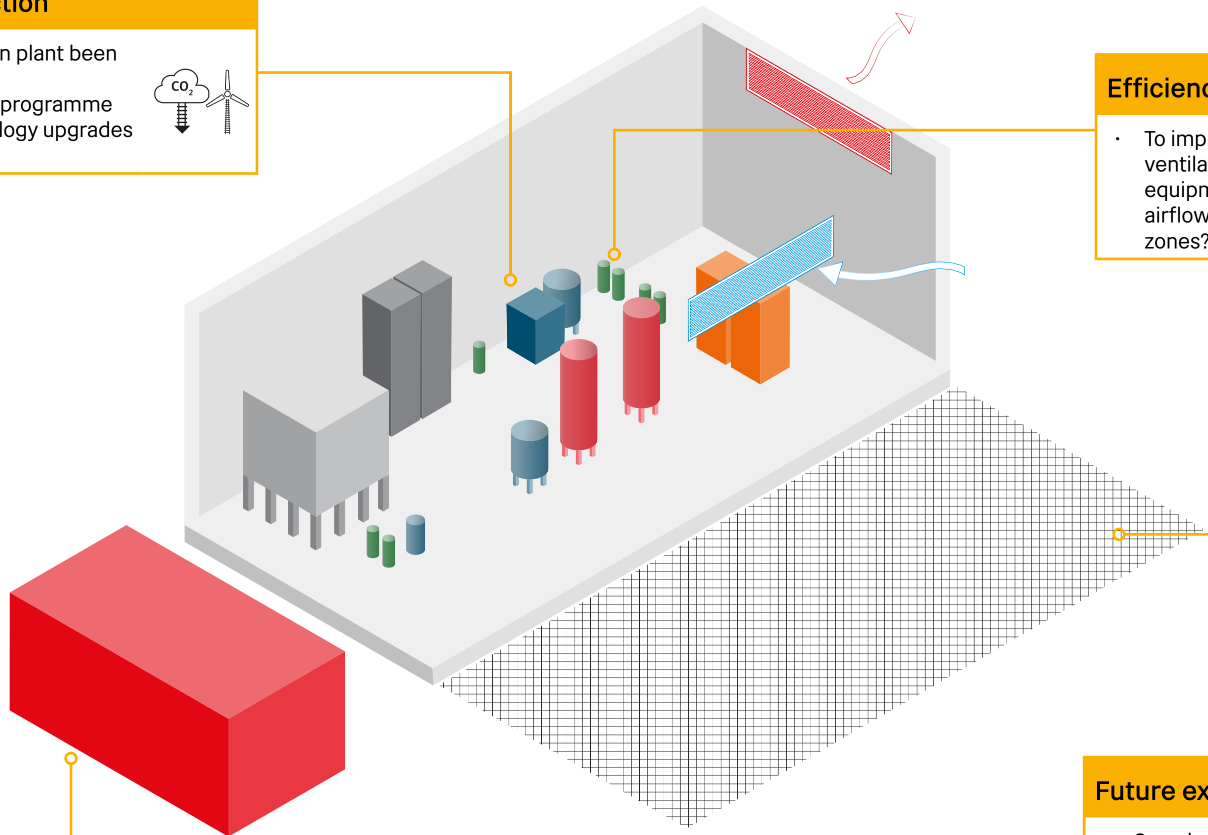
External environment

- Is plant located suitable for environment? i.e. close to coast in high salinity area may cause corrosion.
- Is plantroom in flood risk area?

3.7 L/NZC Plantroom considerations

Plant/equipment selection

- Has low embodied carbon plant been selected?
- Does plant procurement programme take into account technology upgrades and future-proofing?



Efficiency

- To improve efficiency of passive ventilation can clearance around equipment be increased to allow airflow and prevent concentrated ‘hot’ zones?

Future expansion

- Can plantroom be easily extended if required.
- Can additional space be claimed if third party equipment is added post-handover?
- Can passive ventilation be extended to avoid the need for mechanical cooling if additional plant is added?

Climate change resilience

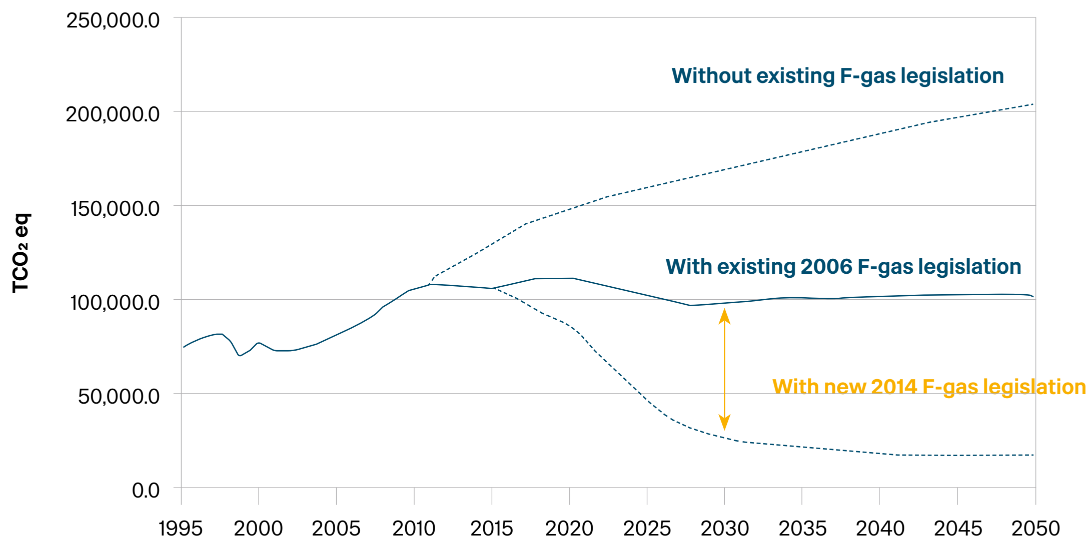
- Increased global temperatures should be accounted for when selecting internal and external plant/equipment.
- Can equipment be chosen that will work at higher temperatures to reduce energy for cooling? Consider lifespan of equipment operating at higher temperature.

3.8 Impact of refrigerants

Many buildings across the Network Rail estate require equipment that utilises refrigerants. These refrigerants can contribute to a large proportion of a building's whole life greenhouse gas (GHG) emissions. The impact of these GHG emissions is measured in terms of their contribution to global warming compared to an equivalent mass of CO_2, this is known as the Global Warming Potential (GWP) of a refrigerant.

Selection of a refrigerant with a low Global Warming Potential (GWP) is critical when aiming to achieve a low carbon refrigeration systems.

The Fluorinated Greenhouse Gases Regulations 2015 aim to cut F-gas emissions by two-thirds by 2030 when compared to 2014 levels. When designing air conditioning systems, buildings should be designed to operate using refrigerants with low GWP, whilst also avoiding the use of hydrofluorocarbons (HFCs).



The updated 2015 F-gas legislation aims to reduce F-gas emissions by two-thirds by 2030

Key design considerations

When selecting a refrigerant to be used in heating and cooling applications, the following should be considered:

- Thermophysical properties;
- Technological issues;
- Economic aspect;
- Safety;
- Environmental factors;
- Additional skills required for maintenance;
- End of life/disposal requirements.

But first...

Consider the use of refrigerants – are they needed? Can passive design be utilised to limit/reduce the need for heating and cooling systems?

The building should be considered holistically in terms of it's form and function. NR/GN/CIV/100/04 Climate Action Design Manual for Buildings and Architecture provides useful guidance for reference.

3.8 Impact of refrigerants

Refrigerant based heating and cooling systems have been based around R410a over recent years. This has been based on its low toxicity and low flammability, being classified as an A1 refrigerant under ISO 817. However, it does have a high global warming potential (GWP) at 2088 (i.e. 1kg of R410a is 2088 times more harmful than 1kg of Carbon Dioxide).

Due to the negative impacts of refrigerants, the first step should be to avoid or minimise the use of refrigerants in the first place. As such, passive design measures should be explored to remove the need for cooling systems. However, where they are still required, the use of air to water air source heat pumps and chilled water based cooling systems are growing. These systems reduce the amount of refrigerant required and also limit it to the heating/cooling generator, usually located on the roof, keeping refrigerant out of the buildings they serve.

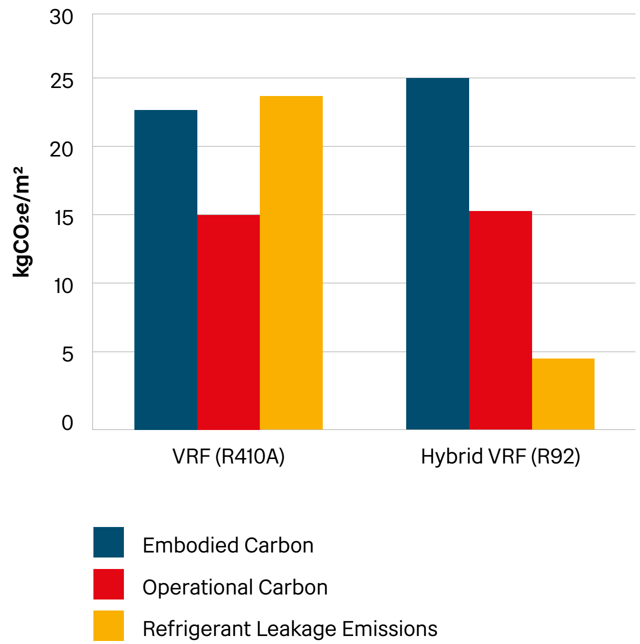
Lower Toxicity	Higher Toxicity	
A3	B3	Higher Flammability
A2	B2	Flammable
A2L	B2L	Lower Flammability
A1	B1	Non-Flammable

ISO 817 Refrigerant Classification Scheme

Where the use of refrigerants is unavoidable, traction is growing within the industry for lower GWP refrigerants due to the environmental benefits they provide as well as the F-gas regulations. Selection of refrigerant gases should be carefully considered based on application, requirements and building design. There is a growing trend for A2L refrigerants to be used for buildings which have a lower GWP, but come with a higher flammability risk (often in specific environmental conditions). Refrigerants such as R32 with a GWP of 675 (68% lower impact than R410a) are becoming much more common, but often with reduced distribution within the building and with leak detection systems incorporated. Hybrid systems using R32 refrigerant with final distribution being water based systems are on the increase.

Where refrigerant is maintained within the central plant only (Air Source Heat Pumps (ASHPs) and Chillers) even lower GWP refrigerants are now being considered such as R513A (GWP 572). In certain circumstances, generally in high demand domestic hot water applications, the likes of CO_2 (GWP 1) ASHPs are now being used, but these need very specific requirements to be successfully employed as they generate high heat, but require a very low input temperature.

Below is an example of the carbon impact of refrigerant leakage when compared against the operational heating and cooling energy for a low energy office building (Note: this doesn't look at full operational energy of the building) and the embodied carbon of the heating and cooling system infrastructure, over a 20 year period – both with a R410A system and a R32 system.



WLC 20 Years

3.9 Modern Methods of Construction

3.9.1 Utilising Modern Methods of Construction

The use of Modern Methods of Construction (MMC) on Network Rail projects should be discussed by the design team during the kick off meeting of each project. MMC is the manufacture of plantroom elements offsite, meaning the on-site activities are limited (as much as possible) to the assembly and commissioning only.

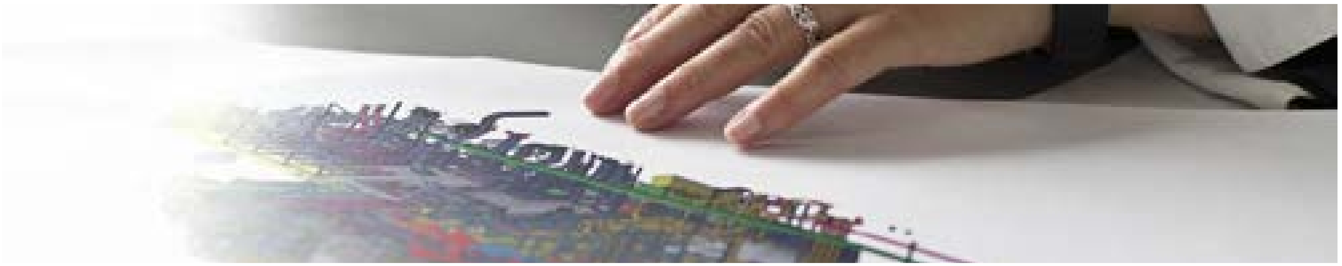
When implemented effectively, MMC construction offers both increased quality and reduced embodied carbon when compared to more traditional construction methods. When MMC methodologies are extrapolated across a large portfolio such as that of the Network Rail estate, these can offer significant improvements in the drive to low and net zero plantrooms. Standardisation across the estate may also help simplify maintenance as plantrooms will look, operate, and require the same parts, saving operational expenditure.

Some examples of MMC techniques are: -

- Heating system pipework/header manifolds;
- MEP system prefabricated skids;
- Entire plantroom modules.

3.9.2 Advantages for prefabricated plantrooms

- Factory environment is cleaner with safer conditions for operatives and provides a more accurate and precise product;
- All snagging can be completed in the factory;
- Commissioning can be carried out before delivery;
- Plantrooms or plant components can be tested in the factory. Some on site testing remains, but this is greatly reduced;
- Plantrooms can be removed from the critical path on the project programme;
- Reduce hot works on site;
- Reducing construction time on site (which has a cost impact);
- Optimising the design to increase standardisation across the estate (operational impact and longer-term cost impact);
- Reduction in the number of site construction personnel (cost and operational impact);
- Facilitation of effective maintenance (operational impact);
- Efficiency in delivering plant and materials to site (cost and programme impact);
- Off-site manufacturing based upon Building Information Modelling (BIM) and 3D modelling, constructed in a clean factory environment can improve the quality of the design which will lead to operational improvements over the life of the installation.



3.10 Controls and metering

3.10.1 Monitoring & control of energy use

Effective control and metering of energy usage is a key aspect to creating energy efficient buildings, it is therefore important that when creating plantroom packages that the designer incorporates the following advice. The following will give Network Rail the ability to finetune plant setpoints therefore maximising its efficiency; and log building performance to highlight when a building is operating outside of normal limits, i.e.

a. If a building is using more energy than expected, Network Rail can investigate and correct the cause, resulting in energy saving overall;
b. If a building is performing well operationally as well as consuming less energy, Network Rail can investigate the reason for this, then build these reasons into future project briefs through a system of championing best practice and continuous improvement.

3.10.2 Controls

It is Network Rail's preference to use the manufacturers control packages supplied by and with the associated piece of equipment being installed, over a bespoke Building Management System (BMS) package. A bespoke BMS should only be adopted where integral controls cannot achieve project brief requirements i.e. incorporation of a number of different equipment manufacturers.

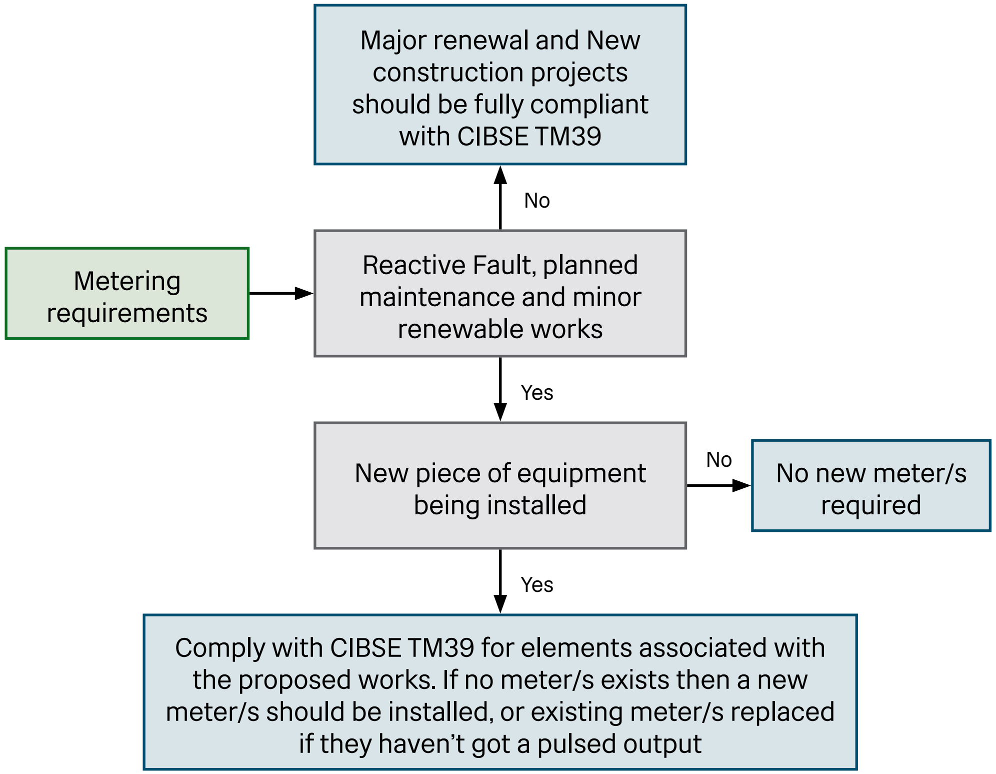
Each new piece of plant should be supplied with a controller which enables remote monitoring, as well as generating a fault signal to pass to a central database/ network.

3.10.3 Metering

Metering should be designed in accordance with building regulations and CIBSE TM39 (Building energy metering guidance). All new meters should have a pulsed output to enable remote monitoring by a central metering system/database.

3.10.4 Metering requirements flowchart

It will not always be possible to install new metering on a project i.e. repairing a leaking pipe would not justify installing new metering. We have therefore created the following flowchart to instigate a conversation within the design team to determine whether new metering should be installed as part of the proposed project.



4

Low and Net Zero Plant Room Guide

Reporting

4.1 Reporting framework

This section highlights the actions that should be taken by the building's asset management team to help us to meet our sustainability goals. These are intended to enable all aspects of sustainability to be considered throughout the construction and operation of our plantrooms.

Specific KPIs are not set at this stage, as each plantroom will require bespoke solutions based on individual circumstances. The asset management team may need to seek additional guidance when developing KPIs that are appropriate to the specific building, and should communicate with the building-level asset managers to develop holistic sustainability plans.

The following reporting structure should therefore be considered as a framework for continual improvement, with ongoing monitoring, verification and optimisation required to meet requirements.

4.2 Action plan

The reporting framework set out in this chapter set out a number of key actions that should be undertaken during the ongoing maintenance, refurbishment or new construction of a plant room.

For each action point, the subsequent reporting tables (Section 4.4 onwards) detail who is responsible for the action, at what point in the PACE cycle it should be performed (Section 1.2), the feasibility stage that the action is relevant to (Section 3.2), and the success criteria for completing the action.

A condensed Action Plan checklist is available at the end of this guide in Appendix A. The Asset Management Team should familiarise themselves with the reporting tables in this section and refer back when completing the checklist during plant room works.

Key

Ref
LER Low Emissions Railway
CCR Climate Change Resilience
MAT Waste & Materials
BIO Biodiversity

Who?
AMT Asset Management Team
PWD Project & Works Delivery
ST Sustainability Team
EC External Consultant
(optional depending on internal expertise)

When?
Links to PACE milestone (see **Section 1.2**)

Feasibility Stage
Reactive faults
Planned maintenance
Minor renewal
Major renewal / New construction

Category Reference | Responsible party and relevant PACE milestone | Overview and description of the reporting action | Feasibility stage that reporting criteria applied to | Criteria that need to be met for the reporting action to be achieved

Cat	Ref	Who	When	Requirement	Description	Reactive faults	Planned maintenance	Minor renewal	Major renewal / New construction	Success Criteria
Operational Carbon	LER01	AMT, PWD, ST, EC	ES1	Implement prerequisite building interventions.	Consult with the Project & Works Delivery Team to confirm the energy hierarchy has been followed.				●	Formal meeting with representative from PWD & ST attended (with input from EC where required). Pre-requisite building interventions discussed and agreed.

4.3 Prerequisite target setting

Some of the success criteria listed in the Action Plan are dependent on pre-requisite targets and strategies already being in place for the building (listed in the table opposite).

The Asset Management Team should familiarise themselves with these targets and strategy documents, even before any maintenance or refurbishment works are required.

Where targets / strategies are not already in place for individual buildings, the Asset Management Team should consult with the Route Asset Manager to highlight gaps and help develop the required documentation.

This should be performed as a priority, as the success of certain Action Plan criteria is reliant on this information being available.

Ref	Prerequisite Item	Description	Should contain targets / information relating to:
P1	Energy Use Intensity (EUI) target (Whole building)	A target relating to the annual energy consumption for the whole building, adjusted for floor area. Should be aligned to industry best practice and informed from energy benchmarking of existing Network Rail Assets.	Energy Use Intensity (kWh / m^2 / year).
P2	Embodied Carbon targets (Whole Building Lifecycle)	Targets relating to the embodied carbon emissions of Lifecycle stages over the lifetime of the building. Should be aligned to industry best practice targets for relevant building typologies.	Upfront Carbon Emissions, Stages A1 - A5 (kgCO_2e / Year). Whole Lifecycle Carbon Emissions, Stages A1-B5 & C1-C4 (kgCO_2e / Year).
P3	Waste Management Strategy	Sets out targets for the amount of waste diverted from landfill, and protocols to be followed with regards to waste management.	Operational waste diverted from landfill (%). Non-hazardous construction waste diverted from landfill (%).
P4	Circular Economy (CE) Strategy	A document which demonstrates how CE thinking should be embedded into all aspects of design, construction and operation. Should identify opportunities to benefit from CE principles, such as saving resources, materials and money.	Materials & building elements reused (%). Materials reusable at end of life (%). Local community opportunities identified for the gifting of redundant equipment / materials.
P5	Materials Passport	A digital document containing quantities, carbon content and sustainability information for all plant room materials (e.g. pipework, services, foundations, structure, etc.). To be informed by EPDs where available.	Quantities of plant room equipment / materials. Embodied carbon content of plant room equipment / materials (informed by LCA / EPD).

Reporting

4.4 Action plan - A low emissions railway

Cat	Ref	Who	When	Requirement	Description					Success Criteria
Operational Carbon	LER01	AMT, PWD, ST, EC	ES1	Implement prerequisite building interventions.	Consult with the Project & Works Delivery Team to confirm the energy hierarchy has been followed.				●	☐ Formal meeting with PWD / ST. ☐ Pre-requisite building interventions discussed & agreed.
Operational Carbon	LER02	AMT	ES1	Calculate Energy Use Intensity (EUI) target (Whole building).	Calculate EUI for the whole building prior to improvements and quantify reduction needed to reach the whole building EUI target (**P1**).				●	Whole building EUI target calculated. Reduction required to meet target EUI understood.
Operational Carbon	LER03	AMT, EC	ES3	Identify and prioritise energy efficient options.	Follow guidance in Section 3 of this document.			●	●	Energy efficient options specified in proposed design.
Operational Carbon	LER04	AMT	ES3	Low carbon fuel choice.	The generation of heating and DHW should be fossil-fuel free, or provided by a low-carbon heat distribution network.		●	●	●	Low carbon fuel source specified in proposed design.
Operational Carbon	LER05	AMT, EC	ES4, ES5	Size plant equipment appropriately.	Use an appropriate modelling methodology (Section 3.2) to calculate the most efficient equipment size needed to meet building demand.		●	●	●	Plant sized appropriately for the demands of the building.

4.4 Action plan - A low emissions railway

Cat	Ref	Who	When	Requirement	Description					Success Criteria
Operational Carbon (cont.)	LER06	AMT	ES4, ES5	Calculate expected CO_2 savings.	Use an appropriate modelling methodology to calculate the expected CO_2 savings from proposed design options.	●	●	●	●	Proposed design reduces CO_2 emissions compared to existing / business as usual (BAU) design.
	LER07	AMT, EC	ES4, ES5,	Calculate expected EUI improvement.	Use CIBSE TM59 Dynamic Simulation Modelling to calculate the expected whole building EUI for proposed design options.				●	Proposed design improves EUI compared to existing / BAU design.
	LER08	AMT, PWD, ST	ES4, ES5, In-Use	Achieve EUI Target (Whole Building).	Proposed solution achieves the whole building EUI target (**P1**) in both design (using CIBSE TM59 Modelling methodology) and operation (based on 1 year of in-use energy data).				●	Whole Building EUI target achieved in design. Whole Building EUI target achieved in operation.
	LER09	AMT, EC	ES4, ES5,	Meet Minimum Energy Efficiency Standards (MEES).	The design proposal should meet a minimum EPC of band B to futureproof against incoming legislation.				●	Proposed design achieves EPC B using certified model.
	LER10	AMT	In-Use	Implement metering strategy.	Install adequate sub-metering of installed equipment and record meter data at half-hourly intervals to enable monitoring and optimisation.		●	●	●	Plant equipment sub-metered. Data set to record at half-hourly intervals (minimum).

4.4 Action plan - A low emissions railway

Cat	Ref	Who	When	Requirement	Description					Success Criteria
Embodied Carbon	LER11	AMT, EC	ES3	Quantify Embodied Carbon Emissions.	Perform Life Cycle Assessment to quantify embodied carbon emissions of design options.		●	●	●	LCA performed for design options.
	LER12	AMT, EC	ES3	Develop Whole Life Carbon model.	Develop Whole Life Carbon Model to identify materials and MEP setups with the lowest carbon impact.			●	●	Whole Life Carbon Modelling performed for design options.
	LER13	AMT, EC	ES3	Prioritise low embodied carbon materials.	Identify low-carbon material alternatives to existing solutions. This should be informed by EPDs / LCA / Whole Life Carbon model (**LER11, LER12, MAT04**).	●	●	●	●	Low embodied carbon materials / products specified in proposed design as an alternative to business-as-usual approach.
	LER14	AMT	ES4, ES5	Choose Low GWP Refrigerants.	Prioritise refrigerants with a low Global Warming Potential and maintain equipment over it's lifecycle to minimise refrigerant leakage.		●	●	●	Refrigerant with lowest available GWP specified.
	LER15	AMT, EC	ES6, In-Use	Report embodied carbon emissions.	Record embodied carbon emissions of ongoing maintenance / refurbishments and track against embodied carbon targets **(P2).**	●	●	●	●	Embodied carbon emissions quantified and recorded against targets.

4.5 Action plan - Resilience to climate change

Cat	Ref	Who	When	Requirement	Description					Success Criteria
Climate Change Resilience	CCR01	AMT, EC	ES2	Flood Risk Assessment.	Appoint consultant to perform flood risk assessment so that future flood plains are avoided.				●	Flood Risk Assessment performed.
	CCR02	AMT, ST, EC	ES2	Climate Risk and Vulnerability Assessment (CRVA).	Identify risks to the construction / operation of the building in relation to climate change, and put in place measures to mitigate these (e.g. flooding and extreme weather risk, resilience of fuel supply in future climates, etc.).			●	●	CRVA performed.
	CCR03	AMT, EC	ES4, ES5	Perform Thermal Modelling.	Appoint consultant to perform thermal simulations using predicted future weather files to assess impacts of warmer weather on the chosen fabric and MEP strategy.			●	●	CIBSE TM59 Overheating assessment performed.
	CCR04	AMT, EC	ES4, ES5	Specify climate resilient species.	Climate resilient species should be considered for selection when targeting biodiversity net gain (if required by **BIO01**, **BIO02**).				●	Species selection approved by ecologist.

4.6 Action plan - Improved biodiversity

Cat	Ref	Who	When	Requirement	Description					Success Criteria
Biodiversity	BIO01	AMT, ST	ES1	Establish biodiversity requirements.	Determine whether Biodiversity Baseline assessment and Biodiversity Net Gain requirements are relevant.				●	Biodiversity Net Gain requirements agreed with Sustainability Team.
	BIO02	AMT, EC	ES1, ES6	Achieve Biodiversity Net Gain.	Implement suggested habitat creation, restoration and conservation strategies to achieve Biodiversity Net Gain compared to baseline (if required in **BIO1**).				●	Validated improvement in biodiversity following refurbishment / construction compared to baseline (using Biodiversity Metric 3.1).
	BIO03	AMT, EC	ES4, ES5	BREEAM compliant external lighting.	If external lighting is required, surrounding wildlife should not be detrimentally affected.				●	External Lighting strategy sufficient to achieve BREEAM ENE03 and POL04 credits.

4.7 Action plan - Materials & Waste

Cat	Ref	Who	When	Requirement	Description					Success Criteria
Materials & Waste	MAT01	AMT	ES6, In-Use	Implement waste management strategy.	Diversion of waste from landfill in line with waste management targets (**P3**).	●	●	●	●	Appropriate waste diverted from landfill through recycling / re-use. % Waste sent to landfill recorded against Waste Management targets.
	MAT02	AMT	ES4, ES5	Design for Circularity.	Design for longevity, adaptability & flexibility, with end-of-life considerations in mind. In line with CE statement (**P4**).			●	●	Design incorporates actions identified in Circular Economy statement.
	MAT03	AMT	ES6	Prioritise material re-use.	Identify redundant plant equipment which could be repurposed to support other Network Rail initiatives and / or local communities. In line with CE statement (**P4**).	●	●	●	●	Waste materials that can be re-used in Network Rail or re-gifted to local communities identified.
	MAT04	AMT	ES3	Procurement of materials with an EPD.	Request EPDs for specific equipment from manufacturers to aid LCA decisions. Where these are not available, follow CIBSE TM54 methodology.	●	●	●	●	EPD requested from manufacturer for all material / product options.
	MAT05	AMT	ES6, In-Use	Develop a materials passport.	Contribute to the ongoing capture of sustainability information for plant equipment and materials (**P5**).	●	●	●	●	Material Passport updated with ongoing maintenance / refurbishment.

Gleneagles Railway Station
Platform 2

Appendix A
Glossary

BAU	Business As Usual
BEMS	Building Energy Management System
BIM	Building Information Modelling
BMS	Building Management System
BREEAM	Building Research Establishment Environmental Assessment Method
CE	Circular Economy
CIBSE	Chartered Institution of Building Services Engineers
CRVA	Climate Risk and Vulnerability Assessment
DHW	Domestic Hot Water
DSM	Dynamic Simulation Modelling
EPD	Environmental Product Declaration
EUI	Energy Use Intensity
GHG	Greenhouse Gases
GWP	Global Warming Potential
HFC	Hydrofluorocarbons
HVAC	Heating, Ventilation, Air-conditioning
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
L/NZC	Low/Net Zero Carbon
LED	Light Emitting Diode
LETI	Low Energy Transformation Initiative
MEES	Minimum Energy Efficiency Standards
MEP	Mechanical, Electrical and Plumbing
MMC	Modern Methods of Construction
NZC	Net Zero Carbon
OPEX	Operational Expenditure
PPA	Power Purchase Agreement
PV	Photovoltaics
UKGBC	UK Green Building Council
VRF	Variable Refrigerant Flow

Appendix A
Reference documents

A wide range of Network Rail and industry-wide documents and guidance notes were used in compiling this Guide.

Below is a list of the most relevant standards and guidance documents referenced within this Guide. These documents are drawn from a range of sources and have been used in the development of this Guide. The list is not intended to be exhaustive but provide the user of this Guide with a sound basis upon which to develop any station scheme.

Relevant Network Rail Standards and Guidance documents:

- Network Rail Operational Property Design and Construction Handbook
- Network Rail Managed Stations Wayfinding and Design Guidelines and Specifications
- Network Rail Sustainability Policy
- Network Rail Environmental Policy
- Network Rail Investment in Stations – A Guide for Promoters and Developers
- Network Rail Passenger Surveys: Network Rail Key Performance Indicator Study (2009)
- Network Rail Stations Strategy and Plan for CP4
- Network Rail Stations RUS
- NR/L2/P3M/201 - Project Acceleration in a Controlled Environment

Other useful documents:

- DfT Accessible Train Station
- Design for Disabled People: A Code of Practice
- DfT Better Rail Stations Report
- DfT Secure Stations Scheme –Guideline 8: Crime Reduction Strategy
- DfT The Stern Review on the Economics of Climate Change
- DfT The Eddington Transport Study: Transport's Role in Sustaining the UK's Productivity and Competitiveness
- DfT National Station Improvement Programme – Final Report
- DfT WebTag Guidance
- DfT TRANSEC Compliance Framework
- Railway Safety and Standards Board – Group Standards
- TfL Interchange Best Practice Guidelines
- TfL Interchange Signs Standards
- London Underground Limited Station Planning Standards and Guidelines
- London Cycle Design Standards
- London Travel Watch Station Standards Report
- CABE Building for Life: Great Places to Live
- CABE Delivering Quality Places
- CABE The Value of Urban Design
- CABE Urban Design Principles
- DPTAC – Disabled Persons Protection Policies
- English Heritage Managing Heritage Assets
- English Heritage Protocol for the Care of the Government Historic Estate (2009)
- The Equality Act 2010
- The Town and Country Planning Act – Permitted Development Rights
- Railway Safety Principles and Guidance
- National Technical Specification Notices (NTSNs) Railway Safety and Standards Board – A Guide to RSSB

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PLANTROOM DESIGN CONSIDERATIONS

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Section 4
REPORTING

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Appendix A
Action plan checklist

Cat	Ref					Success Criteria	Achieved?	Comments
Low Emissions Railway	LER01				●	Formal meeting with PWD / ST.	☐	
						Pre-requisite building interventions discussed & agreed.	☐	
	LER02				●	Whole building EUI target calculated.	☐	
						Reduction required to meet target EUI understood.	☐	
	LER03			●	●	Energy efficient options specified in proposed design.	☐	
	LER04		●	●	●	Low carbon fuel source specified in proposed design.	☐	
	LER05		●	●	●	Plant sized appropriately for the demands of the building.	☐	
	LER06	●	●	●	●	Proposed design reduces CO_2 emissions compared to existing / BAU design.	☐	
	LER07				●	Proposed design improves EUI compared to existing / BAU design.	☐	
	LER08				●	Whole Building EUI target achieved in Design.	☐	
						Whole Building EUI target achieved in operation.	☐	
	LER09				●	Proposed design achieves EPC B using certified model.	☐	
	LER10				●	Plant equipment sub-metered.	☐	
						Data set to record at half-hourly intervals (minimum).	☐	
	LER11		●	●	●	LCA performed for design options.	☐	
	LER12			●	●	Whole Life Carbon Modelling performed for design options.	☐	
	LER13	●	●	●	●	Low embodied carbon materials / products specified in proposed design as an alternative to business-as-usual approach.	☐	
	LER14		●	●	●	Refrigerant with lowest available GWP specified.	☐	
	LER15		●	●	●	Embodied carbon emissions quantified and recorded against targets.	☐	
Climate Change	CCR01				●	Flood Risk Assessment performed.	☐	
	CCR02			●	●	CRVA performed.	☐	
	CCR03			●	●	CIBSE TM59 Overheating assessment performed.	☐	
	CCR04				●	Low carbon fuel source specified in proposed design.	☐	
Biodiversity	BIO01				●	Biodiversity Net Gain requirements agreed with Sustainability Team.	☐	
	BIO02				●	Validated improvement in biodiversity following refurbishment / construction compared to baseline (using Biodiversity Metric 3.1).	☐	
	BIO03				●	External Lighting strategy sufficient to achieve BREEAM ENE03 and POL04 credits.	☐	
Materials & Waste	MAT01	●	●	●	●	Appropriate waste diverted from landfill through recycling / re-use.	☐	
						% Waste sent to landfill recorded against Waste Management targets.	☐	
	MAT02			●	●	Design incorporates actions identified in Circular Economy statement.	☐	
	MAT03	●	●	●	●	Waste materials that can be re-used in Network Rail or re-gifted to local communities identified.	☐	
	MAT04	●	●	●	●	EPD requested from manufacturer for all material / product options.	☐	
	MAT05	●	●	●	●	Material Passport updated with ongoing maintenance / refurbishment.	☐	

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