1 Purpose

This document provides information on how to design for goods, materials and assets to reduce operational carbon for those working in Design, Construction and Maintenance activities. This guidance is to support the *Level 2 Contract Requirements Environment standard NR/L2/ENV/015.*

According to the Chartered Institute of Building Services Engineers (CIBSE) Carbon emissions from the UK's non-domestic buildings are responsible for 18% of the UK's total emissions while industrial processes are responsible for 22%. Though this document primarily covers conservation of fuel and power in buildings, the principles apply to all assets within the Network rail portfolio.

For buildings, relevant approved Documents L2A and L2B (For England), The Building Regulations 2010 (For Wales) and the Scottish Building Standards 2015 (For Scotland) spell out considerations on how to conserve energy in buildings in both new and existing buildings.

Operational carbon refers to the carbon dioxide (CO_2) emitted during the lifespan of an asset as a result of its operations - lighting or heating for example. Therefore, Network Rail assets should be designed and constructed in a way that facilitates low carbon production, considers and enables the use of renewable energy sources and improves energy efficiency.

If you are new to this topic, please read the through { HYPERLINK "https://safety.networkrail.co.uk/home-2/environment-and-sustainable-development/energy-and-carbon-

2 Asset energy metering

The requirement to meter energy in buildings is mandated in the UK through the relevant Building regulations freely available from the { HYPERLINK "https://www.planningportal.co.uk/info/200135/approved_documents" }s. The mandate calls for sub-metering at any final distribution board in non-domestic premises with a floor area greater than 500 square metres. The Regulations also require automatic meter reading and data collection in buildings with a total floor area greater than 1,000 square metres. This metering requirement extends to all large energy consuming assets in the Network Rail estate.

Installing a meter will not save energy on its own. It is action taken as a result of installing meters and using the information the meters provide that can achieve quantifiable energy savings.
Automatic Meter Readings (AMR) for electricity and gas will provide Network Rail with accurate information on the amount of energy being consumed. These meters eliminate the need for estimated bills and manual meter readings. These meters enable:

- Multiple tariffs that measure consumption over set times;
- Improved accuracy of forecasting of the energy demand at different times of the day for the consumer and the national grid;
- Provision of added-value information for improving energy management.

Industry standards stipulate that these meters are installed for all new supplies; while Network Rail stipulates that any refurbishment or supply adjustment activities should involve replacement of old meters with MID (Measuring Instruments Directive) compliant meters. In addition, compliant electronic sub-metering for key areas/equipment should be included in all new and refurbished assets, including the capability to electronically retrieve data outputs in terms of meter advance/meter readings for import into the Network Rail data base – Energy Link.

Metering of assets is mandated in NR/L1/ELP/27000 - Policy Requirements for Electrical Power Assets and NR/L3/ENV/305 – How to change Utility Supplies.

3 Lighting

Lighting generally accounts for approximately 30% of electricity use in Network Rail buildings, and as a result, it is essential to consider the most energy efficient methods in relation to design and maintenance and operation of lighting installations.

3.1 Design of lighting installations

Lighting installations should be designed to achieve maximum energy efficiency in all Network Rail assets in order to reduce operational costs and carbon footprint.

Lighting specifications at stations are covered in the { HYPERLINK "http://www.rssb.co.uk/standards-and-the-rail-industry" } for Lighting at Stations (RIS-7702-INS Issue 1).

Energy consumption should be considered at an early stage of the development of lighting proposals refer to BS EN 15193-1: 2017: Energy performance of buildings - Energy requirements for lighting (from BSI via Network Rail subscription), this includes prioritising the use of high energy efficient lights; provision of controls (manual or automatic) to enable lighting to be turned off or dimmed when full output is not required. Manual controls should be accessible to those who need to use them and should be clearly labelled, whilst automatic controls should enable manual override by building users, e.g. to enable lighting to be switched off when not required even if presence is detected. Use of available natural light should be maximised and automatic controls for lighting installations should detect presence and levels of natural light:

The asset owner and maintainer should have good information regarding the use, operation and maintenance of the lighting equipment to permit efficient use of energy.

3.2 Maintenance of lighting installations

Maintenance of lighting installations is essential in achieving optimum efficiency, as even the most energy efficient light bulbs and fittings can be compromised due to lack of maintenance. Therefore during maintenance:

- Ensure that the maintained illuminance is achieved throughout the life of the luminaire(s) by including details of the maintenance procedures that apply for lighting schemes.

4 Optimising ~~Building~~ building design

The structure and architecture of signalling rooms, offices, stations and other facilities should be designed to be energy efficient by.

- Taking into account the opportunity to make use of natural light;
- Ensuring buildings are designed with Building Management Systems (BMS) where appropriate;
- Ensuring buildings are sufficiently insulated to prevent heat loss. For example, select the most effective wall and roof insulation, as a minimum adhering to current building regulations;
- Ensuring free cooling is maximised where possible.

Not only will these methods reduce energy consumption for heating and cooling, but it will reduce costs, improve internal comfort levels and minimise carbon emissions.

4.1 Renewables

- Incorporate renewable energy into the design of buildings and other infrastructure, such as solar PV panels, solar thermal installations or any suitable renewables, providing they are economically feasible. Carrying out a low carbon study including cost benefit analysis with a whole life cost perspective during early GRIP stages (1-3) is recommended in order to implement this;
- Where the economic case for renewable technology does is not sufficient to support inclusion in initial design, include in the design the capability of retrofitting renewable systems at a later date;
- Ensure that the renewable energy scheme is registered for Feed-In Tariffs (also known as FITs) which is a government scheme that pays organisations and people for creating their own "green electricity". Other financial mechanisms exist such as Power Purchase Agreements (PPAs), benefits from Annual Investment Allowance and Asset Finance mechanisms and these should be considered at time of design;
- The government has incentives for businesses investing in energy-saving plant or machinery that might otherwise be too expensive called the Enhanced Capital Allowance (ECA). The list is available on the { HYPERLINK "https://www.gov.uk/guidance/energy-technology-list" \l "enhanced-capital-allowance-eca-scheme" }. First year allowances let businesses set 100% of the cost of the assets against taxable

profits in a single tax year. This means the company can write off the cost of the new plant or machinery against the business's taxable profits in the financial year the purchase was made.

5 Heating

Heating systems emit warmth to the interior of buildings to provide comfort, or are used to heat rail points on track. While buildings should be designed first and foremost to prevent heat loss, heating systems can be designed to function in an energy efficient manner.

Incorporating the generation of heat from renewable heat sources, may qualify for the Renewable Heat Incentive (RHI). Generators of renewable heat for non-domestic buildings can be paid for heat which they generate and use themselves. The RHI tariff depends on which renewable heat systems are used and the scale of generation (Contact the Central Energy team for details). The annual subsidy lasts for 20 years for non-domestic buildings. Example technologies that qualify are: Biomass (wood fuelled) boilers, Biomass pellet stoves with integrated boilers providing space heating, Ground to water heat pumps, Air to water heat pumps, Solar thermal panels. The list is available { HYPERLINK "https://www.ofgem.gov.uk/environmental-programmes/non-domestic-rhi/about-non-domestic-rhi" }.

5.1 Design

- Design heating systems to work in conjunction with BMS or other appropriate automatic control mechanism;
- Do not specify oversized heating systems;
- Consider controls which use both optimisation and forecasting algorithms;
- Consider the end use of the building and its specific heating needs;
- Consider decentralised heat and review local district heating sources if available in vicinity and viable.
- For general guidance please refer to Building Regulations Part L2A and L2B (England), The Building Regulations 2010 (For Wales) and the Scottish Building Standards 2015 (For Scotland)

5.2 Construction and commissioning

- Provide detailed operation manuals for heating systems and controls, and allow for specialist handover training to the building managers/users after construction and commissioning;
- Alter heating systems for seasonal changes. For example, recommission systems during/in preparation for winter months and check in spring/summer to ensure optimum operation throughout the year;
- Regularly review BMS setpoints to keep them matched to changing building operation regimes.

6 Cooling and ventilation

Cooling and ventilation systems are installed with the intention of optimising comfort for those in operations of the building. However, these systems should be designed in a way that reduces energy consumption or does not exceed what is necessary. The section below explains how this can be implemented.

6.1 Design

- Designers should adopt energy efficient components and systems (e.g. high-efficiency chillers, heat pumps, heat recovery from cooling systems, etc.) where possible;
- Ensure plant is not oversized for purpose;
- Electric steam humidification can have severe implications for electricity consumption, CO_2 emissions and electricity costs. The peak use of humidifiers tends to coincide with the coolest weather when electricity is also at its most expensive. Alternative humidifier solutions should be considered;
- Design all cooling equipment to be compatible with variable speed control for optimum plant efficiency;
- Include all vent plant with heat recovery;
- Employ natural ventilation and free cooling techniques wherever possible.

6.2 Server rooms

- Must meet respective Building Regulations i.e.
  - Part A – Structure; Part B – Fire Safety; Part C – site preparation and resistance to contaminates and moisture; Part E – Resistance to the passage of sound; Part F – Ventilation; Part L – Conservation of Fuel and Power; Part M – Access to and Use of Buildings for the Disabled Regulatory Reform (Fire Safety) Order.
- Employ free cooling techniques wherever possible;
- Use the heat generated to provide heating to adjacent offices where possible
- Carry out annual audits of server rooms to ensure continued optimum efficiency and identify additional opportunities for energy saving;
- Follow best practices as provided by the Green Grid and EN50600 standard series.

7 Encouraging behavioural change

It is common that while intentions are present to develop a low carbon building, these often fail to translate into reality. This is due to issues that can occur at all stages of a project not only during design and construction but also in operation.

7.1 Design

- The aim of making the building low carbon in-use must be communicated pre-design, including during contractor selection through use of sustainable procurement techniques;
- Low-carbon in use objectives should form part of the GRIP planning process to ensure integration in design;
- Early GRIP stages should engage best practice assessment methods such as BREEAM and CEEQUAL to influence design decisions, with low-carbon in use considerations given specific priority;
- Follow best practices and refer to available guidance on sustainable design;
- Ensure adequate predictions of energy efficiency;
- Robustly test the design at regular stages through the process;
- Ensure building controls and systems are not overly complex to enable effective use in operation;
- Design buildings to facilitate low-carbon incentives such as switch-off schemes (e.g. accessible controls).

7.2 Construction and commissioning

- Deliver the intent of the design on-site;
- Ensure commissioning is adequate and completed to a satisfactory standard;
- Ensure means of measuring and managing the building systems' performance once operational. This can be through metering and sub-metering, circuit logging, monitoring through Building Management Systems or combinations of these and other methods;
- In addition to regular reviews of monitored data, revisit the building after an agreed time to review operational energy use vs. design consumption to assess the scale of performance gap, and where necessary provide effective interventions to address the gap;
- Consider appointing a specialist, or series of discipline specialists, responsible for driving the low carbon goal throughout the project if not already present.
- Ensure that handover to maintainer/operator is comprehensive and includes sufficiently detailed carbon/energy efficiency information and requirements.

Designers/constructors should remain involved after the building has been completed to ensure the building is functioning and being utilised in the way it was intended.

To view all environment and social KPIs and how they are to be reported, please refer to the *KPI Guidance Note NR/GN/ESD23*.