

1 Purpose

This document provides information on how to manage Capital Carbon while working on Design, Construction and Maintenance activities. This guidance is to support the *Level 2 Contract Requirements Environment standard NR/L2/ENV/015*.

1.1 Capital carbon compared to operational carbon

Based on the principles of Publically Available Specification PAS 2080:2016 – *Carbon Management in Infrastructure*, the term **capital carbon** covers greenhouse gas emissions arising from the creation, refurbishment, and end of life treatment of assets such as buildings and infrastructure. This differs from **operational carbon** which covers the greenhouse gas emissions associated with the operation and maintenance of assets during delivery of their function and services.

This guidance document is concerned only with the assessment and measurement of capital carbon contributions.

Figure 1 provides an indicative breakdown of the key elements included within capital and operational carbon emissions.

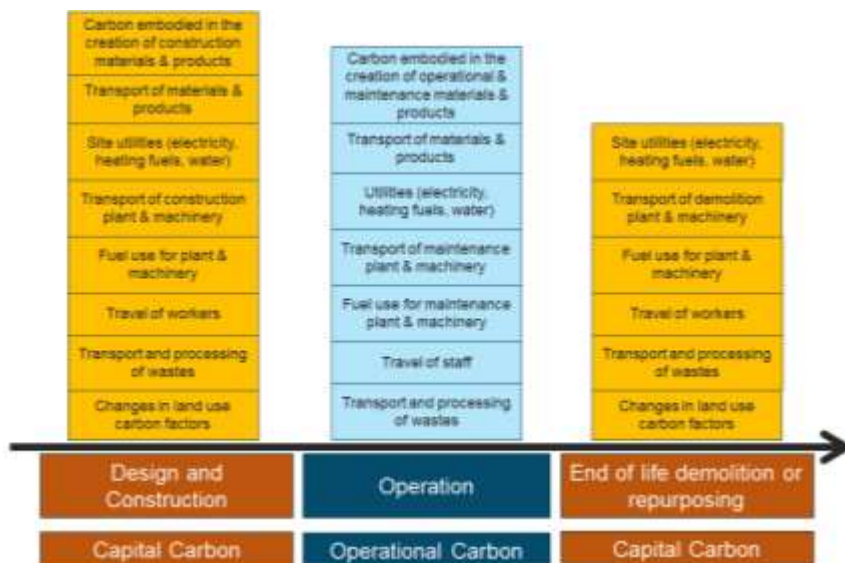


Figure 1 – comparison of key elements of capital and operational carbon footprints.

1.2 Network Rail criteria for formal capital carbon assessment

Under the terms of ESR-DC formal capital carbon assessment will be required as a minimum on all development works that meet **both** the following criteria:

- Project value \geq £1million

- encompassing track; structures; geotechnical/earthworks; electrification and fixed plant infrastructure; buildings

Capital carbon assessment may also be voluntarily applied where a project is of lower value, or primarily focused on more complex systems such as:

- Signalling and telecomms;
- Refurbishment of existing buildings;
- Fit-out of complex mechanical & electrical (M&E) building services;
- Maintenance.

Where project scope and contracted works includes both civil engineering **and** complex electrical and electronic services, control systems, signalling and telemetry; formal capital carbon assessment should be applied to the civil engineering works, but the elements involving complex services, controls, signalling and telemetry need only be included on a voluntary basis (see section 2.1.1).

1.3 Infrastructure Projects commitment

The Network Rail Infrastructure Projects Strategic Business Plan for CP6 includes the following commitment:

- All projects >£20m can demonstrate savings in capital carbon.

1.4 Benefits to Network Rail

Carbon efficiency is a good general indicator of resource efficiency so looking at ways to reduce carbon will often reveal opportunities for other beneficial changes and improvements. Accounting for carbon in the planning, design and construction of rail infrastructure can bring a range of benefits including:

- Efficient use of materials and other valuable resources;
- Improved value management and cost / time efficiency;
- Contribution to national carbon reduction goals;
- Recognition and enhanced reputation for achievements in sustainable development;
- Increased investor confidence for infrastructure developments with proven value and sustainability credentials.

1.5 Approved capital carbon assessment tool

Only the RSSB Rail Carbon Tool (RCT) is to be used to undertake capital carbon assessment on Network Rail projects.

The RSSB Rail Carbon Tool can only be accessed by authorised persons. Personnel requiring access to the RSSB Rail Carbon Tool can register for login and password details via: { HYPERLINK "<https://www.railindustrycarbon.com>" }

Each project should nominate at least one competent person to act as RCT Account Manager. RCT Account Manager(s) will hold the highest level of authority for setting up Network Rail projects in the RSSB Rail Carbon Tool, and for defining delegated authority, read-write access control, etc. to other persons.

2 Components of capital carbon assessment

2.1 Embodied carbon of materials and products

Carbon assessment should account for the embodied carbon emissions associated with the creation and manufacture of materials and products such as:

- Civil engineering construction raw materials, e.g. aggregates, concrete, etc.;
- Low complexity construction commodities, e.g. structural steel; rail; track sleepers & bearers; preformed building blocks / slabs / bricks; pre-cast concrete products; track chairs and fittings; insulation materials; cables and conductors; fencing products; etc.;
- Building and engineering elements assembled on site, or supplied prefabricated, using quantifiable materials and products of known dimensions e.g. OLE masts, bridges, shell and core buildings, etc.;
- Composite prefabricated elements manufactured from predominantly simple materials e.g. glazing panels, cladding & façade systems.

During 2018/19 work will be undertaken by RSSB and Network Rail to improve the collation of standardised embodied carbon calculations for conventional rail infrastructure asset elements that are repeatedly specified and installed. These calculations will be stored in the RSSB Rail Carbon Tool 'templates library' so that all project teams can utilise them. This will avoid project teams repeating frequent calculations and enable them to focus attention on carbon reduction opportunities.

2.1.1 Complex products

The assessment of embodied carbon emissions for complex products made from intricate electrical, electronic or mechanical components is understandably problematic, which is why current carbon assessment effort is focused more towards civil engineering assets and structures.

For complex products Environmental Product Declarations (EPDs) conforming to ISO 14025 and EN 15804 will become an important source of product information, particularly where they include a specific 'climate declaration'. Manufacturers and suppliers of products should be encouraged to provide EPDs and 'climate declarations' for their products.

2.2 Travel and transport carbon

Carbon assessment should account for carbon emissions associated with travel, transport and logistics:

- At least the top 10 bulk materials used on the project (by volume or weight). Transport carbon shall be calculated from final supplier's gate to Network Rail site based on travel distance, mode of transport, number of movements, etc.;
- Transport of construction plant and equipment from suppliers to site, based on travel distance, mode of transport, number of movements, etc.;
- Transport materials using rail or barges as an alternative to lorries;
- Transport of waste from site to the designated Materials Recycling Facility (MRF) or appointed place of legal disposal, based on travel distance, mode of transport, number of movements, etc.;
- Order materials from local suppliers where possible to reduce carbon emissions from transport;
- To reduce carbon emissions of travelling to and from site, opt to use public transport, walk, or cycle to work – see more information on your employer's cycle to work scheme. Alternatively, arrange to car share with colleagues, where travelling by car is unavoidable.

2.3 Capital carbon from utilities and machinery fuel consumption during construction, fit-out and commissioning

Carbon assessment should account for carbon emissions from site utilities consumption and fuel used by mobile plant and equipment, including:

- Direct metered and, where appropriate, sub-metered electrical consumption for site services, construction processes, offices & welfare, and testing / commissioning of new operational services;
- Thermal energy consumption (gas or fuel oil, etc.) for site services, offices & welfare, and testing / commissioning of new operational services;
- Potable and non-potable water consumption for site services, construction processes, offices & welfare, and testing / commissioning of new operational services;
- Fuel use for mobile plant and equipment, and site-based vehicles. For example,
 - Prioritise hybrid/fully electric vehicles over red-diesel or other hydrocarbon-based fuels;
 - Where fuel is necessary, opt for low carbon sources such as biofuel;
 - Unnecessary vehicle movements and journeys are to be avoided;
 - Tyre pressure is to be set at the appropriate level to obtain maximum efficiency;
 - Ensure that generators are specified to optimum efficiency loadings (75 to 80%);
 - Operate plant/vehicles in an efficient manner by minimising idling time and using the appropriate power only.

Utilities for construction, fit-out and commissioning activities and office / welfare accommodation should, wherever possible, be fed from discrete distribution board(s), sub-station(s) or supply pipes with primary meters, to enable project consumption to be readily separated from other local non-project loads.

Where mains connections are not possible consideration should be given to hybrid / renewable alternatives.

Sub-metering shall also be provided for site facilities, fixed plant or processes with foreseeably high energy or water consumption, as this will enable improved interpretation and management of consumption. For example, site offices and welfare facilities should be sub-metered separately from site-based activities.

Staff behaviours often play a big part in energy efficiency, so training and communication strategies should focus on encouraging and promoting behaviour changes and ‘switch off’ schemes for lighting, water and heating.

Note: Reporting of utilities consumption and plant / machinery fuel use is already a requirement within the Network Rail Infrastructure Projects HSE KPI platform, so the data management parameters described above should be well established in IP.

Note: Where project teams are deployed into a multi-occupancy NR office building they do not need to collate energy consumption for this accommodation.

3 Carbon management activities and responsibilities through key project work stages

Network Rail is ultimately accountable for leading and creating a culture where carbon reduction is a value metric for delivery of new rail infrastructure.

The following RACI matrices (see definitions) set out illustrative activities and responsibilities for carbon management through the project work stages:

Strategy (broadly equivalent to GRIP stage 1 - output definition)	Client / Asset Owner	Lead Designer	Constructors	Product / Material Suppliers
Define carbon reduction as a strategic project requirement / outcome within the Client Requirements Document (CRD) and /or Route Requirements Document (RRD).	R/A	C	I	I
Consider setting a project carbon reduction target.	R/A	C	I	I
Establish the governance arrangements (e.g. progress review meetings and leadership decision making) through which performance against project requirements and targets will be tracked and reviewed.	R/A	C	I	I
Establish early engagement with value chain partners.	R/A	C	I	I

Brief (broadly equivalent to GRIP stage 2 – pre-feasibility)	Client / Asset Owner	Lead Designer	Constructors	Product / Material Suppliers
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Embed carbon reduction requirements in procurement activities for top tier suppliers and challenge suppliers to deliver innovation.	R/A	C	C	C
Define the reference baseline (the design solution and construction delivery method that would most closely represent the conventional rail infrastructure solution).	R/A	R	I	I
Define the scope and system boundaries of carbon assessment for the project.	R/A	C	C	C
Specify the use of the RSSB Rail Carbon Tool for carbon emissions quantification.	R/A	C	C	C
Maintain engagement with value chain partners.	R/A	C	C	C

Concept and Definition (broadly equivalent to GRIP stage 3 – option selection)	Client / Asset Owner	Lead Designer	Constructors	Product / Material Suppliers
Define the outline Rail Carbon Tool project tree, folders and packages structure that will best describe the rail asset groups impacted by the project. Plan subordinate folders and packages to collate asset subcomponents, products, materials, and activities to be included in the carbon assessment.	R/A	R	C	I
Quantify the reference baseline (the design solution and construction delivery method that would most closely represent the conventional rail infrastructure solution).	R/A	R	C	C
Quantify ‘high level’ capital carbon estimates for significant alternative options. Note: High level means only sufficient accuracy to: <ul style="list-style-type: none"> highlight carbon hot spots (i.e. the design and construction elements with the greatest carbon emissions); establish indicative option variance against the reference baseline. 	I	R/A	C	C
Challenge the need for a new asset.	R	R/A	C	C
Assess, so far as possible, the whole-life impacts of carbon reduction changes to the chosen ‘reference baseline’ asset design or construction methods, by considering cost, quality, technical performance, durability, life expectancy, maintainability, etc.	I	R/A	C	C
Maintain engagement with value chain partners.	R/A	C	C	C

Design (directly equivalent to GRIP stages 4 - single option development and 5 – detailed design)	Client / Asset Owner	Lead Designer	Constructors	Product / Material Suppliers
Detailed quantification of anticipated project carbon emissions compared to the reference baseline and reduction target (where set).	R	R/A	C	I
Detailed analysis of carbon hot spots (design and construction elements with the greatest carbon emissions).	R	R/A	C	I
Engage value chain to seek innovation and identify opportunities for carbon reduction by design and/or construction method. Note: OPTION DEVELOPMENT workshop(s) may be used to focus the value chain on carbon reduction innovation. OPTION DEVELOPMENT workshop(s) may also be used to address other related resource efficiency objectives such as designing out waste.	R	R/A	C	C
Confirm which carbon reduction solutions or changes to construction methods will be applied and approved without compromising the engineering integrity of the design, or other project success criteria or benefits realisation.	R	R/A	I	I
Set out design and construction specifications to deliver carbon reduction.	R/A	R	C	C
Prepare a ' <i>Design-stage Capital Carbon Reduction Report</i> ' to confirm which design and construction method carbon reduction solutions were specified, and state the estimated carbon and cost reduction compared to the 'reference baseline' rail infrastructure solution and target (where set).	R	R/A	I	I

Construction, Commissioning, Handover and Close-out (directly equivalent to GRIP stage 6 - 8)	Client / Asset Owner	Lead Designer	Constructors	Product / Material Suppliers
Embed carbon reduction requirements in procurement activities and challenge the value chain to deliver innovation beyond the design specification.	R	C	R/A	C
Detailed quantification and recording of project carbon emissions based on as built information. Note: As built information should include all facets within the carbon assessment scope and system boundaries that were agreed for the project, including for example quantified materials usage, transport, site-based utilities and machinery fuel use, etc.	I	I	R/A	C

Confirm any additional carbon reductions that will be possible by changing value chain construction methods / materials / logistics / site behaviours, without compromising other project success criteria (including safety) or benefits realization.	I	C	R/A	C
Prepare an <i>As-Built Capital Carbon Reduction Report</i> to confirm the overall carbon reduction from the 'as-built' design solution and actual construction activities, compared to the 'reference baseline' and target (where set).	R	C	R/A	I

4 Gateway Review Outputs

The following five key outputs may be adopted as gateway review outputs / milestones:

- Carbon reduction specified as a project deliverable in the Client Requirements Document (CRD) and/or Route Requirements Document (RRD);
- Carbon variance of key options known before option selection;
- Confirmation of key carbon hotspots at Approval in Principle (AIP);
- Design-stage carbon reduction report - comparing anticipated project carbon achievements against the reference baseline and target (where set);
- As-built carbon reduction report - comparing actual project carbon achievements against the reference baseline and target (where set).

5 Case Studies

Carbon reduction achievements should be summarised into easily communicated case studies to help share successful outcomes with other projects. A case study should typically include the following core elements:

- Name of project or package
- A suitable project description
- An executive summary of the project's capital carbon learning outcome(s)
- Confirmation of what was included and excluded from the project carbon assessment, along with other boundaries and assumptions
- How roles and responsibilities for carbon assessment were managed
- What reference baseline was used to compare and quantify carbon and cost reduction
- What carbon reduction was achieved, compared to the reference baseline
- What cost reduction was achieved, compared to the reference baseline
- Any other transferrable project learning.

A case study template is available on { HYPERLINK "<https://safety.networkrail.co.uk/home-2/environment-and-sustainable-development/energy-and-carbon-management/capital-carbon/>" }.

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

Appendix

Terms and definitions

Baseline

The scenario, and associated carbon emissions, that would occur if planned measures to reduce carbon were not applied. This marks a defined starting point from where a comparison is made.

Note: For Network Rail the reference baseline would be the design solution and delivery method that most closely represents the conventional rail infrastructure solution before any new, innovative carbon reduction measures were applied.

Capital carbon

The greenhouse gas emissions arising from the creation, refurbishment, and end of life treatment of assets such as buildings and infrastructure.

Carbon reduction

The process of minimising greenhouse gas (GHG) emissions during the planning, development, delivery and operation of new or refurbished infrastructure assets, or during the end of life treatment of assets.

Carbon dioxide equivalent (CO₂e)

The unit for comparing the global warming impact of any type, or multiple types, of greenhouse gases by calculating the equivalent mass of carbon dioxide that would have the same impact.

Note: Carbon dioxide equivalent is calculated by multiplying the mass of a given GHG by its global warming potential.

Carbon hot spot

A rather subjective term used to denote and highlight aspects during the creation, refurbishment, or end of life treatment of assets, where the carbon emissions (or carbon dioxide equivalent emissions) are particularly high.

Note: Carbon hotspots can provide a useful guiding principle to focus attention on finding reductions in the more carbon intense aspects. However, hotspots should not distract from seeking efficiency gains in all parts of the carbon value chain.

Climate Declaration

A single-issue declaration, normally within the context of an Environmental Product Declaration (EPD), but focused on the carbon footprint of a product. The emissions of greenhouse gases of a product are reported in kg CO₂ equivalents from the different life cycle stages of the product.

Climate Declarations may be published based on a registered EPD, or where full information about the other types of environmental impact of the product is available upon request. In the latter case the Climate declaration shall give information on how to obtain information on the full environmental impact from the declared product.

Cradle to gate

A specific system boundary which covers the GHG emissions associated with the creation of materials and products from the extraction of raw materials, processing and manufacturing, but only as far as the product manufacturer's factory gates. This is a restricted scope of assessment and can only be used to represent the 'embodied carbon' of the specified products or materials.

Cradle to site

An extended system boundary which covers the cradle to gate GHG emissions of materials and products, but with the addition of GHG emissions from transporting the products to the work site where they will be used.

Embodied carbon

Refers to the GHG emissions associated with the manufacture of materials and products. This equates to the system boundary definition cradle to gate.

Note: The term embodied carbon can only truly be used in the context of products or materials. The wider term capital carbon can be used at an asset level as it potentially encompasses all GHG emissions associated with the creation, construction and end of life treatment of entire assets such as buildings or infrastructure.

Environmental Product Declaration (EPD)

A verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products. The relevant standard for Environmental Product Declarations is ISO 14025, where they are referred to as "type III environmental declarations". A type III environmental declaration is created and registered in the framework of a programme, such as the International EPD® System. EPDs need to be stated as 'conformant with ISO 14025'.

Note: Having an EPD® for a product does not indicate or imply that the product is environmentally superior to alternatives — it is simply a transparent declaration of the life-cycle environmental impact.

Global warming potential (GWP)

A factor describing the radiative forcing (global warming) impact of one mass-based unit of a given greenhouse gas, relative to the same mass-based unit of CO₂, over a given period of time.

Greenhouse gases (GHGs)

Gaseous constituents of the atmosphere, both natural and anthropogenic (man-made), that absorb and

emit radiation at specific wavelengths of the infrared spectrum when emitted by the Earth's surface, atmosphere or clouds.

Note: The name greenhouse gas was applied because the gases allow radiation from the sun to pass through but absorb the lower energy infrared radiation that is reflected from the Earth's surface, atmosphere or clouds. In this way they warm the Earth's atmosphere in much the same way as the glass in a greenhouse.

Note: Six main GHGs are recognized including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF₆).

Land use carbon

Changes in land-use can directly affect the exchange or retention of greenhouse gases between terrestrial ecosystems and the atmosphere. Clearing woodland for development, or changing from woodland to an alternative type of vegetation will result in changes in carbon storage factors. Similarly the provision of new woodland can increase the carbon storage factors associated with the land.

Operational carbon

The greenhouse gas emissions associated with the operation and maintenance of assets during delivery of their function and services.

RACI Matrix

A conventional method for representing the allocation of duties across a range of project participants and stakeholders, in accordance with the following terminology:

R – Responsible – Allocated to any parties who are expected to deliver and implement a designated action. It is acceptable to have multiple responsible parties for an action.

A – Accountable – Allocated to the single party who is deemed to be 'accountable' for overseeing and assuring that designated actions have been completed, normally by other parties. It is normal convention to have only one accountable party for each action. The Accountable party may also be responsible (R), but could be accountable only with no delivery responsibilities.

C – Consult – Allocated to any party whose opinion is considered to be valuable as a consultee when developing solutions or delivering actions. Responsible parties should be taking the views of Consultees into consideration.

I – Inform - Allocated to any party who needs to be informed about outcomes but does not need to be consulted when developing the solution.

System Boundaries

The criteria that specify the life-cycle, spatial or temporal scope of a carbon assessment.

Note: It is important to be transparent about which factors have been included and/or excluded from a carbon assessment so that resultant data can be interpreted with proper understanding of the context and constraints, particularly if the data might be compared with other assessments.

Target

The desired quantity of carbon emissions (defined either as an absolute value, or as a reduction amount against a baseline value) that an asset or programme of works is to achieve during infrastructure delivery.

Note: A target should be specific and appropriate to an asset or programme or works. It must be measurable and time-bound.

Value chain

Organisations and stakeholders involved in creating and managing infrastructure assets, including asset owners/managers, designers, contractors, and product/material manufacturers/suppliers.

Whole life carbon

The sum of GHG emissions from all stages in the life-cycle of a product or asset and within the specified system boundaries of the product or asset.