Whole Life Carbon Management in Rail

PWI Lunch & Learn 2023

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About Us

Our approach to carbon management is a core part of our Engineering Net Zero initiative, with a vision of:

"embedding sustainability in everything we do, progressing attitudes within the industry and aspiring to make all schemes in which we are involved net zero by 2030."

Atkins Whole Life Carbon Management Team

- Team specialising in carbon management on large infrastructure projects
- Work with whole supply chain to enable low carbon solutions
- Carbon quantification and reporting specialists
  - Developers of the Rail Carbon Tool

Session Overview and Aims

This session explores whole life carbon management for the rail industry in the context of the wider net zero agenda.

Aims:

To demystify carbon management and quantification to help people in the rail industry embed sustainability best practice

Provide guidance in effective use of carbon calculators such as the RSSB Rail Carbon Tool

Demonstrate case study examples of managing carbon on infrastructure projects and quantifying the benefits using the Rail Carbon Tool.

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Background

- Climate change is one of the critical global issues within today's society
- Meeting net zero emissions targets is therefore paramount to avoiding further impacts
- The transport sector represents around 27% of the UK's GHG emissions
- Traditional focus of carbon reduction efforts has been on operational emissions from fuel combustion
- As vehicles decarbonise through electrification, whole life carbon of transport infrastructure is becoming increasingly important

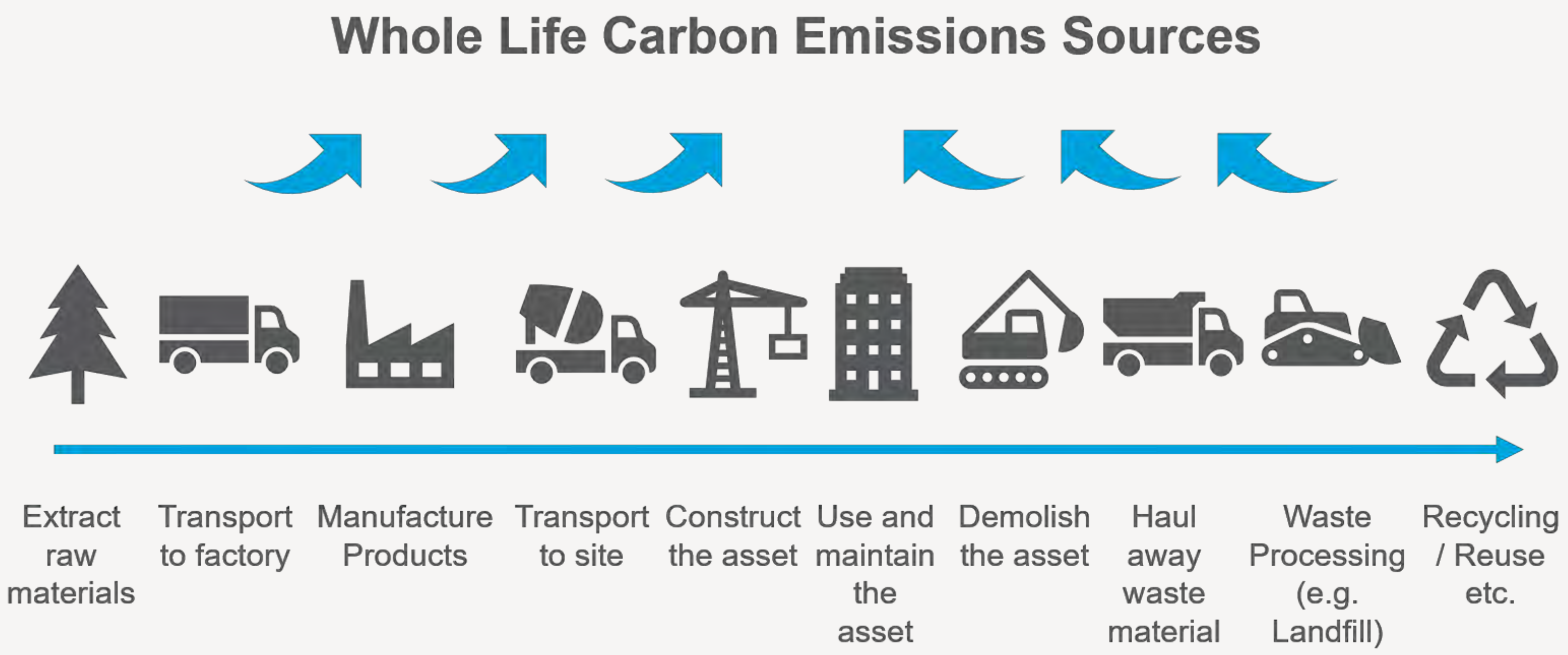
UK Net Zero Targets

- Paris Agreement of 2015 aims to keep global temperature rise this century below 2^{o}C (above pre-industrial levels) and encourage efforts to limit the temperature increase even further to 1.5^{o}C.
- In response, the UK statutory target for reducing GHG emissions was strengthened in May 2019 to focus on achieving Net Zero by 2050
- The Committee on Climate Change (CCC) defines 'Net-Zero' emissions as the point when the "total of active removals of carbon from the atmosphere offsets any remaining emissions from the rest of the economy"
- Understanding how to identify carbon emissions sources and then how to effectively manage those sources to create carbon reductions, is therefore paramount to achieving net zero.

GHG emissions in the Rail Industry

- Rail is one of the lowest carbon forms of transport, accounting for just 1.4% of the UK's domestic transport emissions, despite 9% of transport being carried out on the UK’s railways
- Over 40% of the UK’s railways are already electrified, enabling the transport of passengers and goods with minimal GHG emissions being released
- As electrification of the rail network extends, and the National Grid continues to decarbonise, this mode of transport is becoming even less carbon intensive.
- Emissions associated with the construction and maintenance of rail infrastructure will become the main source of emissions once trains are fully electrified.
- Consideration of the carbon emissions across the whole life of projects is therefore paramount to reaching net zero emissions in the rail industry
- The DfT’s plan ‘Decarbonising transport: a greener, better Britain’ states that a joined-up approach across the supply chain to managing whole life emissions will be critical to achieving net zero

What are Whole Life Carbon Emissions?



The sum of total GHG emissions that occur throughout the lifecycle of a project

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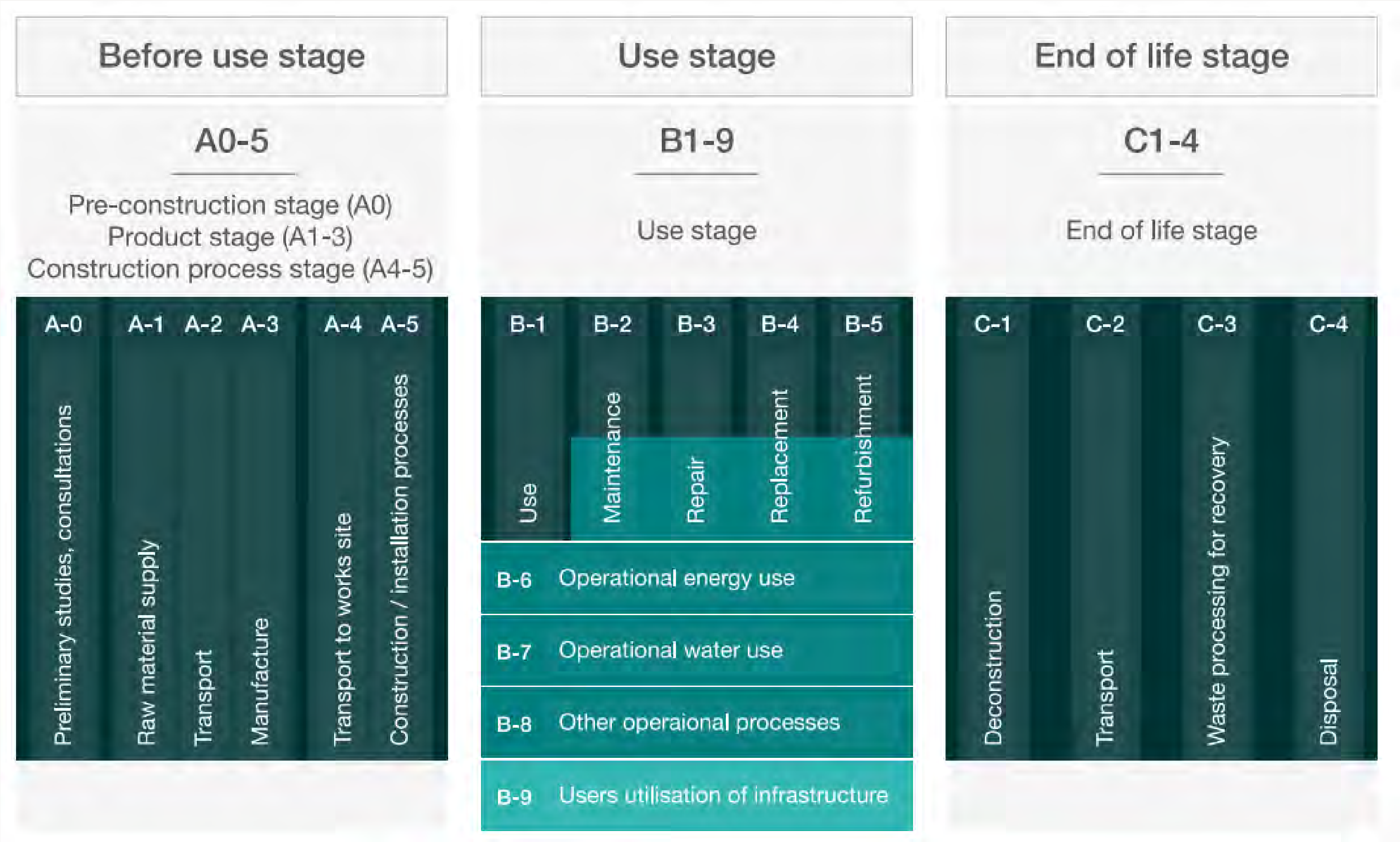
Whole Life Carbon Emissions

- Life cycle modules defined by PAS 2080
- Covers whole asset life



Source: PAS2080: Carbon Management in Infrastructure (2016)

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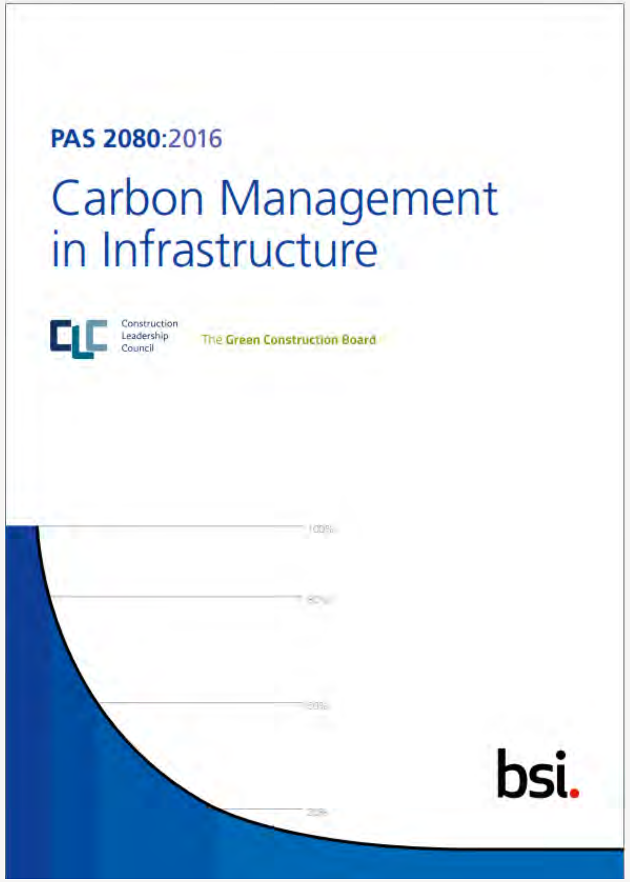
Managing whole life carbon in rail infrastructure

- PAS 2080 is the key technical standard for management of whole life carbon in infrastructure
- Aims to improve the management of carbon throughout the supply chain
- Enables evidence-based decision making and the identification of carbon reduction opportunities
- Provides a common framework for the whole supply chain, encouraging the right behaviours and approaches to deliver reduced carbon and cost



PAS 2080: Key Requirements

Leadership and Governance	Set an organisational strategy for carbon management. Assign roles and responsibilities so people understand the part they play in reducing carbon. Encourage challenging of the status quo.
The carbon management process	Integrate carbon management activities into standard project delivery processes. Ensure carbon information feeds into decision making from the earliest project stages.
Quantification of GHG emissions	Use relevant tools and processes to quantify and report carbon throughout project delivery to feed into decision making.
Target setting, Baselines and Monitoring	Set challenging carbon reduction targets against a defined baseline and establish KPIs to monitor emissions during project delivery.
Supply chain engagement	Engage the supply chain early. Collaborate with the whole supply chain from the earliest project stages to share carbon objectives and identify innovative low carbon solutions, removing any constraints to collaboration.
Continual Improvement	Seek the input of the whole supply chain to improving the carbon management process.

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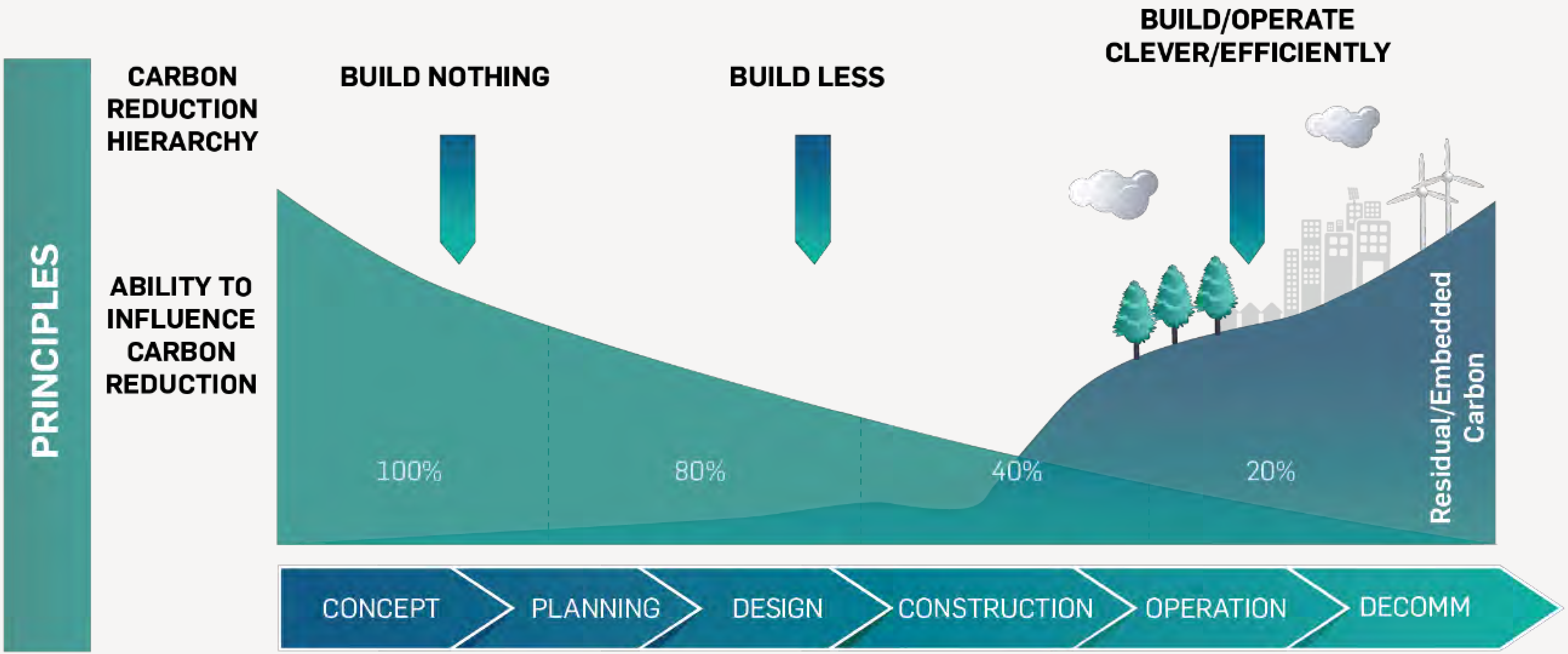
Integrating Carbon Management into Project Delivery

The carbon reduction hierarchy



Whole life carbon assessment - Fundamentals

GHG Emissions = activity data X emission factor

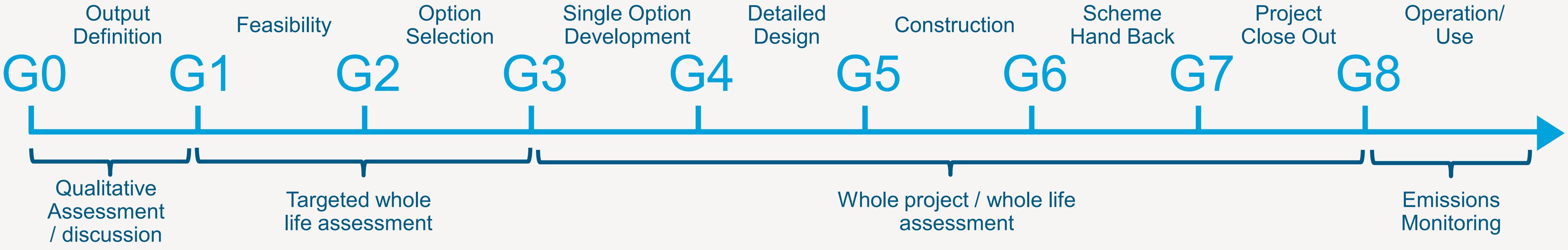
- Carbon calculation is simply multiplying project activity data (e.g. a quantity of material) by a relevant carbon factor.
- Carbon emissions are expressed in carbon dioxide equivalents (CO_2e). CO_2e represents the global warming potential of all GHGs released by an activity, put in the context of carbon emissions.
- A carbon factor is a coefficient representing the average emissions associated with a single unit of a specific source (e.g. the average emissions associated with the production of 1 tonne of concrete).
- Carbon factors are provided by various carbon factor libraries and cover all processes across the project lifecycle including products/materials, vehicle transport, construction processes, fuel, energy and water use as well as end of life processes.

Whole life carbon assessment – Carbon Modelling

There are several components that must be understood before carrying out any carbon modelling:

- The life cycle of the project/asset, and where the measurable emissions sources exist.
- Data sources, including project-specific input data as well as appropriate carbon emissions factors.
- A robust assessment methodology that is aligned with relevant technical standards (e.g. PAS 2080).
- A defined system boundary, outlining the physical and geographical boundaries to be included in the assessment as well as all inclusions and exclusions within that boundary.
- A reference study period, which defines the time-period for the assessment, and consequently the range of operational activities for which emissions will be accounted for (e.g. energy required during operational lifetime, maintenance/replacement requirements).

Whole life carbon assessment – Levels of assessment



- Whole life emissions should always be considered, but don't always need to be quantified
- At earliest stages, qualitative discussion may be all that is required
- When feeding into early project decisions a targeted assessment may be appropriate, covering only the necessary life cycle stages and project elements
- In later stages, the whole project emissions performance should be tracked and compared back to the project baseline

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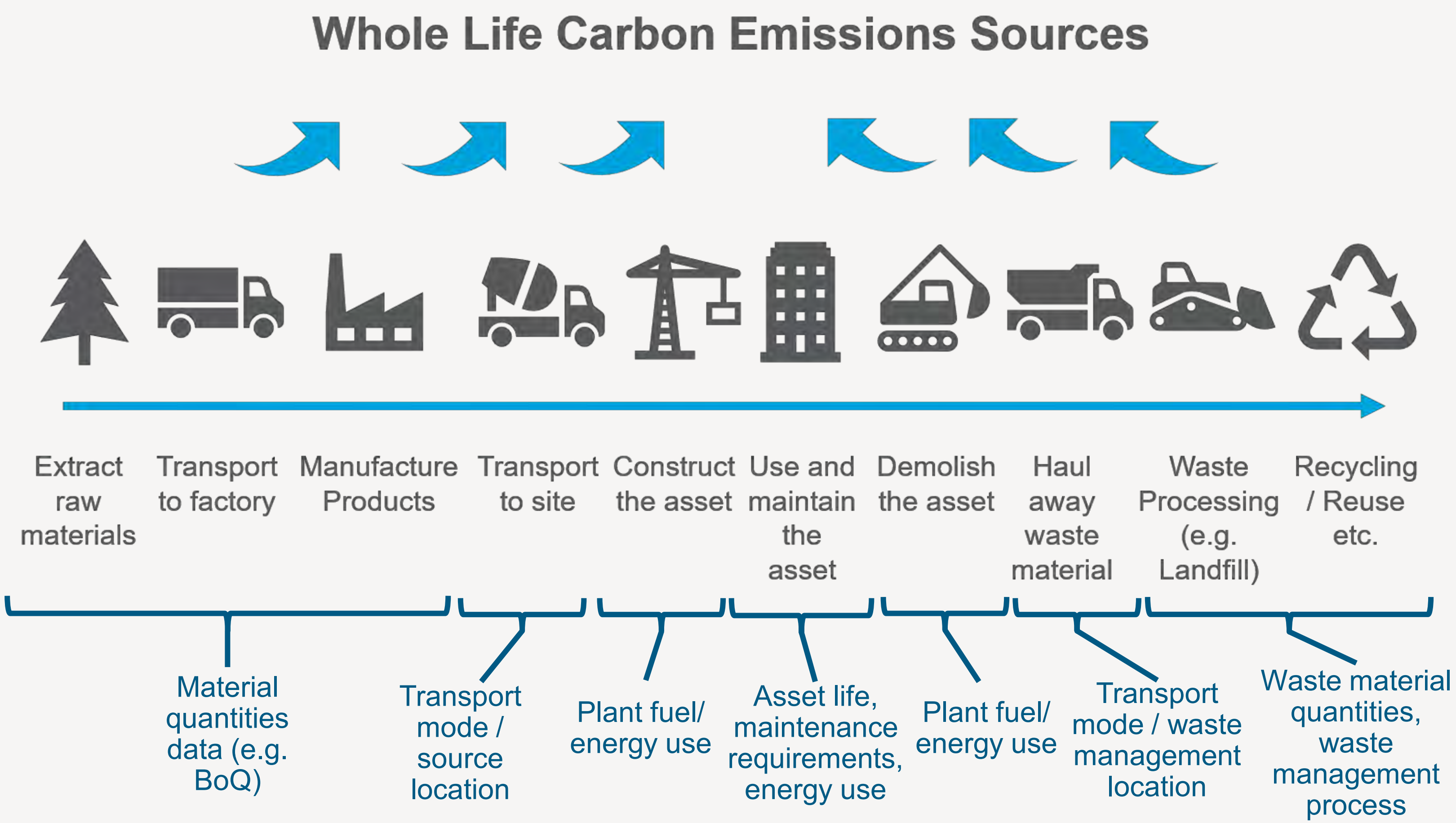
Whole life carbon assessment – Data collection



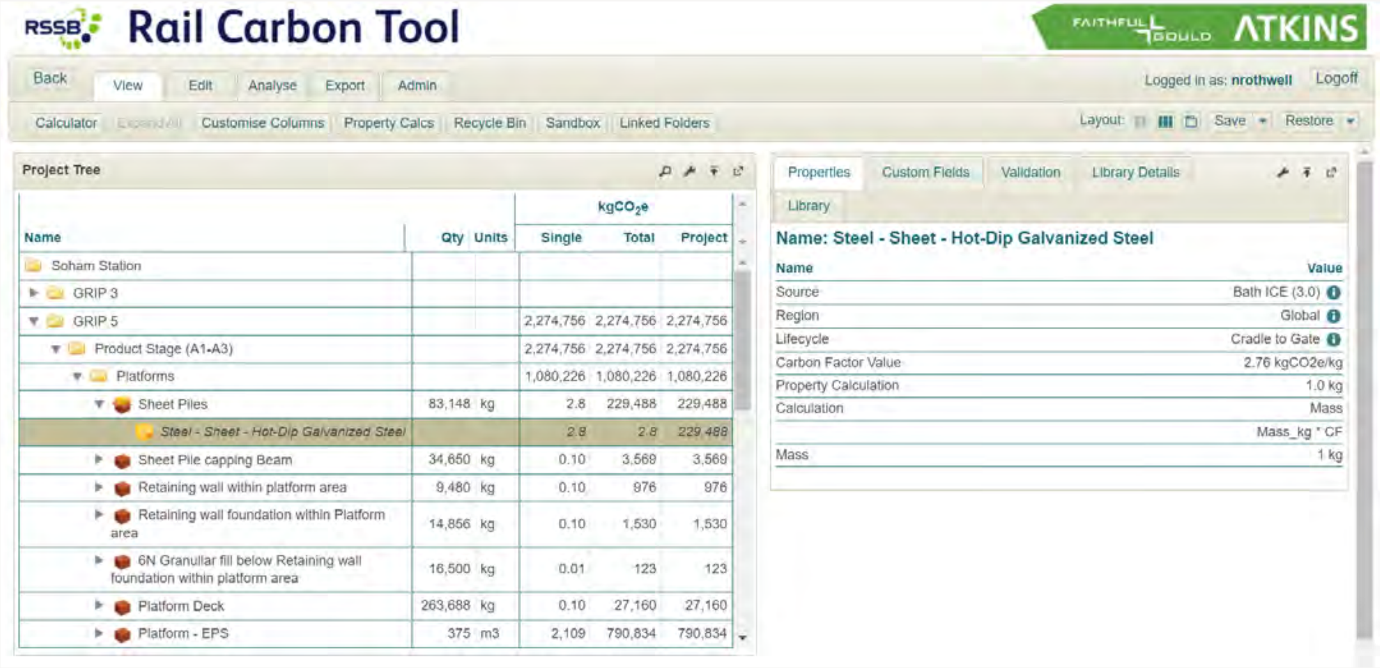
- Assumptions / estimates required at early project stages
- Requires early engagement with all disciplines / stakeholders
- A lot of data already captured as part of normal project processes
- Important that all stakeholders know their role early on e.g., providing data

Whole life carbon assessment – Benefits

- Most effective when feeding into optioneering stages and project decision making
- Enables project teams to identify carbon hotspots, where the opportunities for carbon reduction are greatest
- Enables project teams to make more informed sustainable choices
- Whole life consideration ensures that all emissions are considered across the project lifetime, not just the upfront carbon
- Whole life carbon reduction regularly aligns with whole life cost reduction

The Rail Carbon Tool

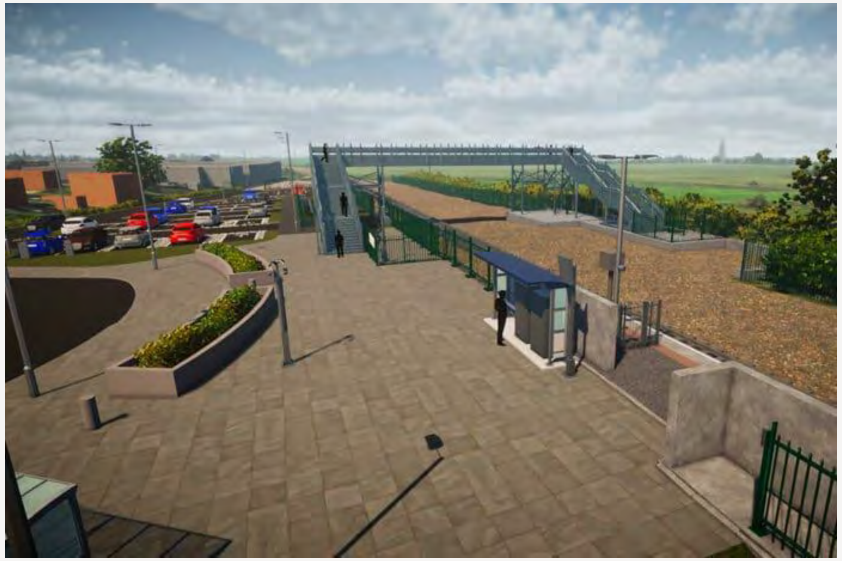
- Freely available, web-based, carbon tool for the Rail Industry
- Premium carbon factors embedded (e.g., Inventory of Carbon & Energy)
- Capable of whole life carbon calculation
- If correct methodology is followed, can adhere to principles of PAS 2080
- Hosted by RSSB, developed by Atkins



Case Study 1: Soham Station Redevelopment

A carbon assessment using the Rail Carbon Tool

Situation



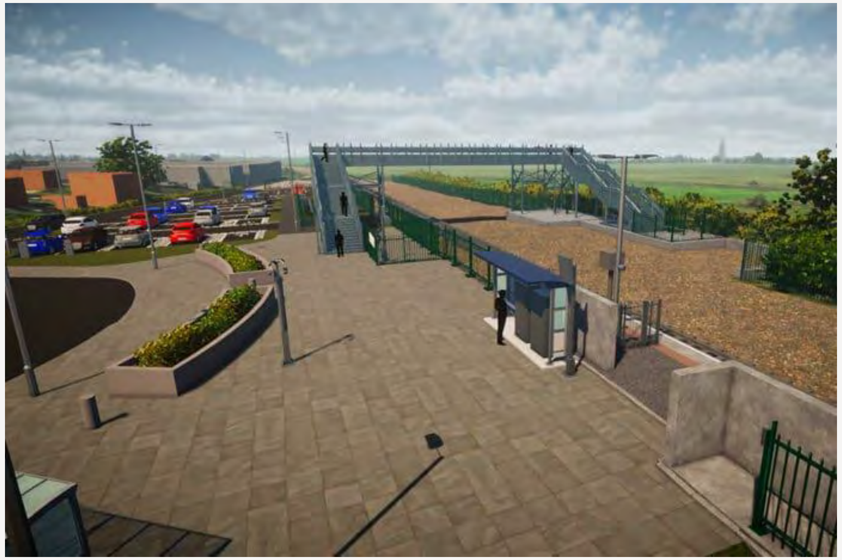
- Soham Station, Cambridgeshire, closed in the 1960s. Following a long campaign to rebuild it, the station was reopened in December 2021.
- During design optioneering Atkins used the principles of PAS 2080 to make low-carbon decisions and then quantified carbon in the Rail Carbon Tool, feeding into the wider options appraisal.

Client Issues

- Network Rail needed to decide what type of platform should be built at the station as well as understand the carbon benefits of design decisions that were made.
- A targeted assessment of five platform options was required - considering cost, constructability, and carbon, and a full project assessment was required to quantify the carbon benefit of design changes throughout options appraisal stage.

Case Study 1: Soham Station Redevelopment

A carbon assessment using the Rail Carbon Tool



Atkins Solution & Added Value

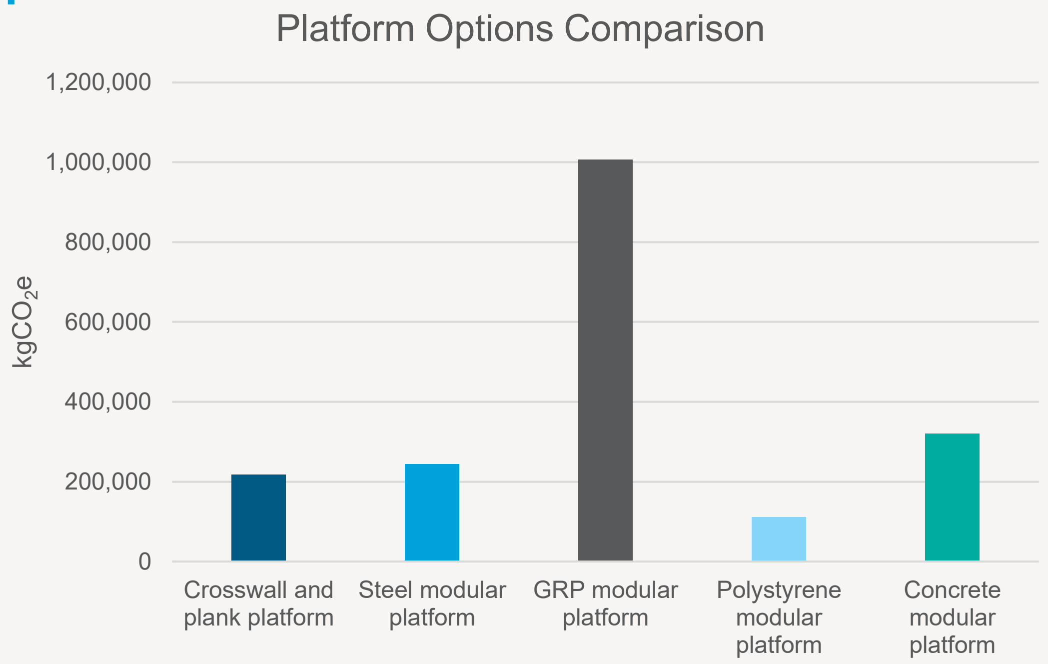
- Atkins used the Rail Carbon Tool to carry out a targeted assessment of platforms, including:

1. Red brick, crosswall and plank platform
2. Steel modular platform
3. Glass Reinforced Plastic (GRP) modular platform
4. Polystyrene modular platform
5. Concrete modular platform

- Low carbon solutions were sought within all aspects of the overall design, by integrating the principles of the carbon reduction hierarchy and by carrying out carbon reduction workshops
- A full carbon model was also developed covering the whole station, including the footbridge, access road and car park, shelters, signalling structures and the platform.
- The full model was used to identify carbon hotspots and subsequent reduction opportunities as well as demonstrating how carbon had been reduced throughout the options appraisal stage.

Case Study 1: Soham Station Redevelopment

A carbon assessment using the Rail Carbon Tool



Targeted Assessment Findings

- Atkins identified through the targeted platforms assessment, that the Polystyrene Modular solution had the lowest associated carbon emissions, as illustrated in figure 3.

Key benefits & success factors

- The targeted assessment of platforms demonstrated the most carbon efficient solution (polystyrene modular) delivered a carbon reduction of 49% against the baseline option (crosswall and plank).
- Based on the results of the platforms carbon assessment and the wider aspects of the options appraisal, the client chose the lowest carbon platform solution
- Through embedding the principles of the carbon reduction hierarchy into the design decision making process, Atkins were able to achieve further carbon reductions, resulting in a reduction of 18% across the whole station design

Case Study 2: Maryhill Electrification

A carbon assessment using the Rail Carbon Tool

Situation

- The project involved electrification of Maryhill railway line that runs between central Glasgow and Anniesland
- The existing road bridges crossing the tracks at three locations did not have enough clearance to fit the required OLE equipment
- Either the bridges needed to be raised or the track underneath and nearby platforms needed to be lowered.

Client Issues

- Comparison required of the costs and benefits of raising the bridges or lowering the track at three locations
- Greenhouse gas (GHG) emissions assessment required to consider the environmental impact of the two options

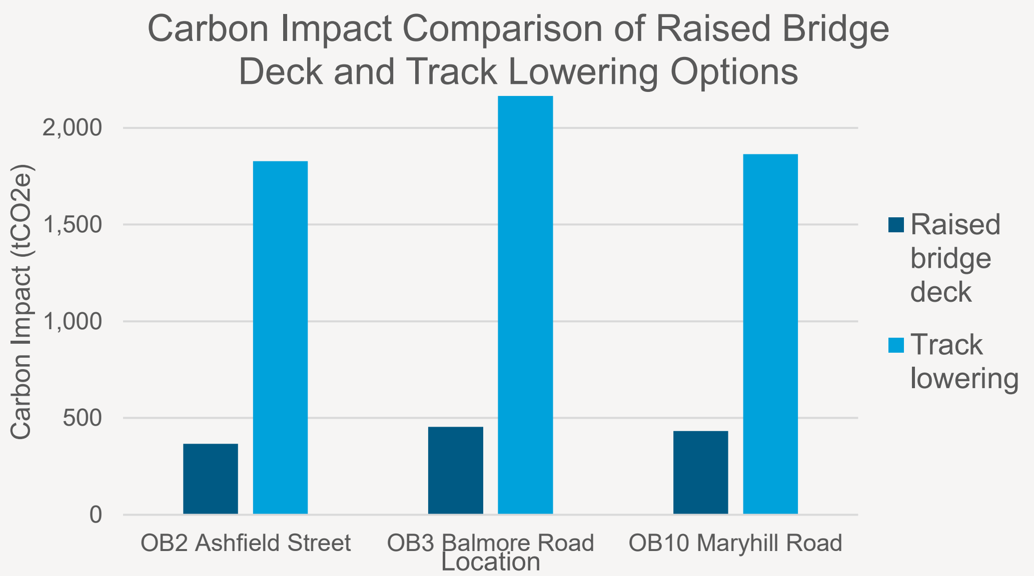
Case Study 2: Maryhill Electrification
A carbon assessment using the Rail Carbon Tool

Atkins Solution & Added Value

- Atkins used the Rail Carbon Tool to carry out a whole life carbon assessment of the two route clearance options at each location.
- Atkins' carbon and engineering teams gathered the whole life data, which included:
  - Material BoQs data
  - Transportation distances of materials, and mode
  - Construction processes including fuel & energy use
  - Operational processes and maintenance requirements
  - End-of-life treatment of materials

Case Study 2: Maryhill Electrification

A carbon assessment using the Rail Carbon Tool



Whole life assessment results

- Overall, the raised bridge options have a considerably lower carbon impact than the track lower options
- However, this was in contrast to the overall preferred option of lowering the tracks, as a result of the increased disruption of raising the bridges.

Key benefits & success factors

- Whilst the preferred option was to lower the tracks, despite a higher carbon intensity, the whole life assessment enabled the identification of various carbon hotspots within the track lower option, and associated reduction opportunities e.g.:
  - Targeting reductions in the quantities of high-impact materials such as reinforced concrete within the conarch and parapet components
  - Maximising the reuse of site-won materials elsewhere on site
  - Use of rail for material transport and electric/hybrid plant on site

Q&A

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