Low emissions

RTS Innovating across Britain's railway

GOALS | WHY? | STATUS IN 2024 | STEPPING STONES OVER THE NEXT 5 TO 8 YEARS | VISION FOR 2040

Cross-cutting stepping stones (goals 1–5)

- Develop an updated and agreed plan of the end-state traction choices on different parts of the network. ↗1,2,3,4,5
- Learn lessons from battery and multi-mode trains operating on the GB network and internationally. ↗1,2,3,4,5
- Improve understanding of power regulation and max power draw requirements to make the most of existing electrification and reduce overall energy consumption. ↗1,2,3,4
- Develop and demonstrate options for smart management of power supply and demand during train planning and real-time operations with the aim to accommodate the maximum number of electrically powered journeys within the capability of the power supply. ↗1,2,3,4 ↗Optimised train operations

Efficient new electrification (1)

Why?

Combined with modal shift, further electrification of the rail network is a fundamental step towards achieving the UK's 2050 net-zero target.

Future electrification – whether full or partial - must be affordable, deliver operational resilience, and cater for smart interactions with trains.

Status in 2024

Full electrification is recognised as the optimum choice for high-speed, high-intensity routes. Partial electrification, combined with multi-mode trains, is a viable contender on other routes.

A range of solutions, including voltage control clearances, insulated pantograph horns, and increased span lengths, have started to address the cost and disruption challenge associated with new electrification.

Stepping stones

- Embed adoption of the cost-efficient electrification solutions in all new electrification projects to reduce the cost and embedded carbon content.
- Continue to develop cost-efficient electrification optimised to the GB railway gauge.
- Revisit lower sector gauge to be able to implement the Merseyrail type conductor rail shroud on Southern region in the longer term.
- Review electrification assurance and authorisation process to improve efficiency and efficacy.

Zero carbon self-powered vehicles (2)

Why?

Battery and multi-mode operations can deliver the requirements of passenger trains on lower-speed, lower intensity routes.

As batteries and the associated charging infrastructure continue to improve, there is an opportunity to make the most of these developments.

Status in 2024

Train manufactures have continued to improve the capabilities of battery and multi-mode vehicles. Initial deployments have happened in GB and several other countries.

The procurement of further multi-mode fleets for the GB network has commenced but uncertainties remain, such as around whole-life costs, battery longevity, and ability to charge off existing electrification.

Stepping stones

- Agree whole-life costing and carbon framework to support capital investment decisions on possible different mixes of track and train traction choices on branch lines. ↗1,2,3
- Document lessons learned from Scotland, Core Valley Lines, Midland Main Line and TransPennine electrification schemes.
- Develop technical standards and commercial guidance, informed by whole-system considerations, to support the procurement and introduction of self-powered and multi-mode vehicles, and supporting infrastructure.
- Develop and agree operational control options to enable the reliable running and charging of battery trains. ↗2,3,4
- Develop and trial options for alternative power supply technologies / configurations on secondary lines (for example. Scott Transformers, Mini-SFCs). ↗1,2,3,4
- Agree technical and operational options for partial electrification to make best use of rolling stock and infrastructure capabilities, including charging opportunities for battery trains. ↗1,2,3,4
- Investigate solutions to de-risk and speed up transitions between traction modes, including carrying out a review of bi-mode changeover process to avoid manual interventions and make automatic solutions quicker. ↗2,3

Vision for 2040 (goals 1–2)

Progress towards a net-zero railway by 2050 is well underway. ↗1,2,3,4,7

All high-speed, high-intensity lines are electrified with high capacity, energy efficient systems that represent value for money.

Battery and multi-mode trains, supported by partial electrification, operate successfully and efficiently on the network.

Low carbon freight and on-track machines (3)

Why?

There is currently no viable alternative to electrification or (bio)diesel to deliver the power necessary for the full range of freight journeys on the GB network. Electric traction offers capacity and operational benefits over diesel.

Without action, rail freight risks being less favoured than other modes as they continue to decarbonise. This could cause long-term congestion and economic disbenefit if a lower proportion of freight is moved by rail.

Status in 2024

Industry is currently introducing bi-/tri-mode locomotives which are envisaged to deliver significant last-mile benefits and operational flexibility.

But traction electricity charges and spikes in electricity prices can make it more cost-effective to haul using diesel.

Industry is looking into maximising the benefits of future electrification for freight, including freight infill.

Stepping stones

- Assess freight power options based on the capabilities of the electrified network, plans for future traction energy, and freight-specific technology developments.
- Evaluate options for self-powered wagons, including utilising regenerative braking technology, to improve acceleration capabilities that unlock new pathing options.
- Develop path modelling capabilities that consider whole-system impact and benefit to UK PLC, including economic and carbon impacts of rail freight.
- Improve traffic management utilising C-DAS to enable better on-the-day regulation decisions that are underpinned by improved freight pathing algorithms. ↗2,3,4
- Assess actual performance of novel low-carbon fuels, and the feasibility and costs of associated engine changes.
- Explore the feasibility of intelligent / dynamic freight consist arrangements to reduce aerodynamic drag.
- Explore optimised electrification designs and solutions for secondary freight-only routes.
- Explore options for integrated charging facilities for both road and rail at terminals.
- Assess low-cost electrification options at terminals.

Vision for 2040

There is a clear role and relevance for rail as part of an overall net-zero logistics chain.

Intelligent energy management (4)

Why?

Existing electrified lines face an increasing demand for power from electric and multi-mode services.

Better understanding of real-time power demand and capacity, coupled with a strategy for alleviating constraints and reducing energy losses, is crucial to a low-emission railway.

Status in 2024

Numerous areas have declared power supply constraints, and more are anticipated in the next Control Period.

The development of the whole-system thinking required to improve the management of power supply and demand has started but is still in its infancy.

Stepping stones

- Assess the technical and economic viability of using lineside energy banks to complement traction power supply.
- Further assess and pilot the technical and economic viability of using lineside renewables to complement traction power supply.
- Develop a range of options to remove / alleviate existing energy supply constraints on main lines. ↗1,3,4
- Improve measurement of energy consumption of trains, including energy quality experienced by trains running under the wires.
- Develop mechanisms to bring together consumption data to have a better whole-system view.
- Explore costed options to reduce losses on the DC network.

Vision for 2040

Network traction power constraints are actively managed, with plans in place to remediate.

Traction energy consumption is minimised. Demand for electrical power is managed dynamically to make the most of available capacity.

Cleaner air (5)

Why?

Air quality is the most pressing environmental health risk in the UK, generating the urgent need to mitigate harmful pollutants from rail.

Status in 2024

The understanding of the scale and location of air pollution on the network has increased, with some mitigations being trialled.

Stepping stones

- Establish the air-quality benefits of hydrotreated vegetable oil and synthetic fuels.
- Improve understanding of the impact of station ventilation solutions
- Consider vulnerabilities and potential improvements of HVAC systems on trains.
- Review technologies to support train idling reduction initiatives.
- Develop options and business case for retrofittable air quality mitigations, such as exhaust treatments.

Quieter railway (6)

Why?

The growth of housing in rail proximity, and demand for services to run for longer hours, make the noise pollution generated by rail increasingly unacceptable.

Status in 2024

The underlying causes of noise relating to wheel squeal and engines are poorly understood, making prevention and mitigation challenging.

Stepping stones

- Test and deploy affordable solutions to gain proactive awareness of noise hotspots and their evolution over time.
- Develop and trial solutions that alert level crossing users at the crossing itself.
- Improve understanding of noise generated by engines and explore auxiliary power solutions to minimise it.
- Bring together noise and vehicle dynamics experts to understand and mitigate the causes of wheel-rail noise.

Vision for 2040 (goals 5–6)

Air pollutants and noise from rail operations are minimised to protect the health and wellbeing of the workforce, customers, and local communities.

Lowering embodied carbon of key material (7)

Why?

Key materials, such as steel and concrete, which make up the fabric of the railway, have high levels of embodied carbon.

As a significant purchaser, rail has a role to play in driving the reduction of embodied carbon.

Status in 2024

Initiatives across the industry have started to look at the role rail can play as a significant buyer of concrete and steel.

Alterative carbon-friendlier materials are being trialled for rail applications, but there is limited clarity on the required performance level.

Stepping stones

- Identify best practice from other sectors on recycling and circular economies, including incentive mechanisms.
- Investigate life-cycle of traction batteries, including possible second use in rail, to minimise environmental impact and maximise whole-life value. ↗2,3,7
- Steel, concrete, quarry economy - improve carbon quantification for the whole lifecycle of these materials including definition of the most appropriate boundaries from different questions and analysis.
- Develop emission benchmarks for specific assets to inform design targets.
- Test low-carbon concrete alternatives against performance specifications.
- Improve steel scrap cycle to enable and monitor an integrated scrap route that keeps good quality rail scraps in GB.
- Learn lessons from the early deployment of existing composite solutions to inform further use and research needs.

Vision for 2040

The embodied carbon of rail assets is well understood and continues to be driven down.