RTS refresh – Low Emissions Railway

Goals	Why?	Current position (2019)	Stepping stones in the next five years	Vision for 2025	Vision for 2040
Zero-carbon self-powered vehicles	Where maximum journey speeds are under 100mph, there is increasing optimism that hydrogen and batteries will deliver a cost-effective low-carbon alternative that still delivers against operational and timetable requirements.	There are around 2,500 <100mph diesel vehicles currently active, many of which run on lines unlikely to be electrified.	Standards for hydrogen and battery trains and associated infrastructure are adopted. Rail has a clear power-supply strategy, including lineside, onboard and hydrogen. In-service trials for hydrogen- and battery-powered trains.	Clear zero-carbon replacement plans for Sprinters (Classes 150-159).	All self-powered passenger vehicles are zero carbon.
Cheaper and less disruptive electrification	More electrification is fundamental to zero emissions, as well as giving great performance, reliability and operating cost benefits.	Concerns over cost and disruption following recent electrification schemes have undermined political support.	Standards and design for discontinuous electrification are adopted, including automated traction switching. Standards/incentives adopted to reduce the need for civil engineering while maintaining safety. Faster, more detailed and more effective planning and route clearance is enabled.	New electrification schemes are meeting cost and disruption criteria.	All high-speed and high-intensity lines are electrified.
Low carbon freight	There is currently no viable alternative to diesel power for rail freight that delivers the necessary power and go-anywhere capability. There is a need to maximise benefits from electrification, as well as from hybrid and bi-/tri-mode locomotives.	Rail freight, with its significant reliance on diesel, runs the risk of being penalised while alternative modes may be more carbon intensive and increase congestion.	Options, criteria and business case to retrofit traction options are developed. Clear understanding of where electrification could provide tipping point. Energy-optimised timetable and real-time train speed profiles are enabled for off-peak operation.	Clear understanding of options and funding for freight decarbonisation.	Clear role for rail as part of overall net zero logistics chain.
Increased energy efficiency	Reducing energy consumption (losses and useful consumption) is often a cost-effective way to reduce carbon and can have immediate benefits for existing rolling stock.	The industry is neither incentivised nor aligned to improve the efficiency of rolling stock.	There is a strategy for reducing losses, especially on DC network. Clear and agreed technical requirements for rolling stock efficiency and emissions reduction, including retrofit, are adopted.	Clear programme to reduce energy use is being delivered across the network.	Energy required per passenger vehicle km is minimised.
Reducing polluting emissions	Air quality is the most pressing environmental health risk in the UK. There is a need to balance the best route to long-term decarbonisation against the more pressing need to mitigate harmful air pollutants.	While overall emissions from rail are low, they can be significant locally. The industry currently has limited understanding of the scale, location and risk of emissions.	Low-cost intelligent emissions monitoring and risk mapping is in place. A programme of trials to test and compare mitigation options is delivered.	Robust mitigation is in place, based on risks.	Rail has a negligible impact on local air quality.

RTS refresh – Data-Enabled Railway

Goals	Why?	Current position (2019)	Stepping stones in the next five years			Vision for 2025	Vision for 2040
Easy access to and sharing of data, including data for real-time system monitoring	Improves business efficiency and effectiveness. Government/industry policy. Timely data allows real-time system management and B2B and B2C decision-making (for customers, rail undertakings, and other data users).	A limited range of data is available through industry platforms/APIs. Most data sets are not available or accessible. A range of assets and other sources generate data in real time, but this capability is not widely exploited.	Identification of data sets, including static, real-time and legacy.	Data/service catalogue requirements.	Data/service catalogue build.	Accessible data sources covering all phases of the operational and asset lifecycles. Accessible data sources covering at least 50% of life cycle functions, with real-time data sources covering at least 25% of appropriate life cycle functions.	Co-ordinated means of identifying, publishing and accessing data sources to support industry and customer needs. Continuing availability of real-time data generated by rail assets and rail users.
			Description of railway system operational and infrastructure life cycles.	Static, legacy and real-time data-related functions of life cycles.	Mapping of data catalogue to functions.		
			Identification of access system users and use cases, and consolidation of data storage capabilities.	Prototype access system.	Mature access system.		
Robust industry-wide data governance	Sharing of data and assurance of data quality. More robust approach to data governance will help deliver benefits.	Several organisations are developing, or have developed, information management frameworks. The industry faces challenges in defining and sharing commercially sensitive data.	Agreement of information management framework (IMF) scope, including cyber-security issues.	Development of IMF principles.	Application of IMF.	100% development and agreement of information management framework principles. 50% of shared data sources generated by systems satisfying framework.	Industry-wide implementation and use of an agreed information management framework.
			Identification of governance-related metadata.	Incorporation of metadata into catalogue build.	Continued recording of metadata within catalogue.		
Capability to recognise and release value from data	Enables prioritisation and justification for making data available. More consistent approach to data release will help deliver benefits.	Traceability capabilities exist but are not used by the industry. There is limited research focusing on quantifying the benefits of opening up data sources.	Value chain case studies.	Rail-based valuing approach.	Rail-based data value assessment.	Traceable use of data sources covering all phases of the operational and infrastructure life cycles. Traceable use of data sources covering at least 25% of life cycle functions.	Comprehensive and continued understanding of costs and benefits (economic, societal, environmental) of providing and using industry data sources.
			Priority data set ‘wish list’.	Business cases for open or shareable data.	Increasingly available data.		
Capability for better data use	Advanced capabilities will help industry enhance customer experience and reduce costs.	Rail expertise exists for traditional analytics. Cross-industry competence in new areas is limited. Industry is exploring ‘big data’ analytics using several suppliers.	Identification of skill gaps.	Training, support and guidance.	Comprehensive industry skills.	Industry-wide, easy-to-use models, analytic tools and guidance supporting improved railway outcomes.	No fixed end goal, growing area of capability.
			Digital twin ‘framework’.	Clarity on digital twin building blocks and development stages.	Demonstrator of joined-up digital twin building blocks.		

RTS refresh – Optimised Train Operations

Goals	Why?	Current position (2019)	Stepping stones in the next five years	Vision for 2025	Vision for 2040
Real-time optimisation of train operations	Real-time optimisation of train operation can significantly improve train performance by reducing variability of driving and utilising train feedback for regulation decisions. This will also improve energy efficiency.	Acceleration, braking and coasting are under driver control. Connected Driver Advisory System (C-DAS) has limited use. Junction optimisers are very rarely fitted. Traffic management (TM) has undergone initial deployments. Shared understanding of where to deploy different solutions is limited, and transitions between different solutions is challenging.	Wide roll out of C-DAS. Learn lessons from Thameslink mainline deployment of automatic train operation. Prioritised deployment of junction optimiser. Industry-wide approach to quantifying the benefits of real-time optimisation of driving. Pilot of assisted braking technology (ABDO). Strategic deployment of driving support systems to maximise benefits and reduce transition complexity. Trial and fitment of ETCS – Limited Supervision, with Train Protection and Warming System (TPWS) on non-ETCS infrastructure for SPAD prevention. Improvements in TM including crew and rolling stock resources, necessary for significant disruptions where trains might be cancelled or turned back. Wider roll-out of TM to support, and where appropriate automate, decision making for minor perturbations in the timetable.	Reduction of variability in acceleration, braking and coasting on a significant number of routes. Significantly reduced train accident risk. Strong business case in place for widespread roll out of TM based on positive results from early implementations, in term of delay minimisation.	Real-time optimisation of train speed profiles across the network and reduced energy costs. TM implemented on the majority of the network. Algorithms continue to improve.
Signalling and train capabilities for shorter headways	Ability to fit more trains on those parts of the network that are full. Greater utilisation also reduces unit costs, improving fleet and infrastructure productivity. .	Reliable braking, particularly in low adhesion, remains a challenge. Trains are assumed to have uniform performance by type (freight, sprinter). These classifications are not well suited to modern rolling stock, which run the risk of not being in a position to take advantage of their enhanced braking and power capabilities.	Double rate variable sanders for all new trains. Double rate variable sanders retro-fitment plan. Magnetic Track Brake for all new frequent-stop services. Rationalisation of train classes and applicable speeds. Reduced variability in train performance: homogeneous braking and acceleration characteristics, and doors and interior layouts optimised for dwell times. Optimised ETCS braking curves. Committed long term deployment plan for ETCS Level 2. ETCS Level 3 hybrid trial. Early exploration of options to use virtual coupling / convoying in congested bottlenecks. Agreed operational concept and system design for virtual coupling / convoying in GB.	Predicable and reliable braking not affected by railhead conditions. New ETCS Level 2 schemes are in progress. Trial demonstrates reliability and capacity of ETCS Level 3. Better understanding of virtual coupling at bottlenecks and the costs and benefits.	Trains have similar performance characteristics that make it possible to run trains closer together. Widespread implementation of ETCS Level 2 improved safety, capacity and punctuality. ETCS Level 3 is the standard solution for new schemes. Increased capacity at key bottlenecks thanks to virtual coupling / convoying.
Improved degraded operations, and flexible train planning and re-planning	There is a big opportunity to increase the dependability of operations in a digitalised network through improved management of traffic in degraded operation and making train planning and re-planning easier, quicker and more robust.	The timetabling process has a long lead time and the working timetable generated doesn't learn from actual running times. The 'short-term' and 'very short-term' planning processes do not allow the flexibility that rail freight needs to be competitive. Passengers could also greatly benefit from. Degraded Mode Working System (DMWS) has been developed but not yet live piloted.	Single common model of GB rail infrastructure, used for all planning and train control systems. Greater integration of real-time information to provide reliable insight to customers and staff. Demonstrators from the 'Dynamic train planning' call increase short-term planning flexibility and robustness. Development of simulation tools that reflect the complexity of the railway network. Validation of simulation tools using real world data to build confidence in results. Working timetable development uses simulation tools and learns from actual train performance. Mainline trials of DMWS solutions. Further development of existing DMWS for productised solution and roll out.	and faster recovery. Train paths are added easily and reliably at short notice. Increased quality of service in (predictable) disturbances Improved working timetable allocates allowances optimally, decreasing the risk of significant disruption if perturbations occur. Fewer reactionary delays from signalling or power failure.	Planning and re-planning of trains to meet customer needs can be done and communicated in near real-time.

RTS refresh – Easy to Use Railway

Goals	Why?	Current position (2019)	Stepping stones in the next five years			Vision for 2025	Vision for 2040
Real-time cross-modal information	To make it easier for passengers to manage their door-to-door journey, including during disruption.	Websites to plan door-to-door journeys exist but don't push live running information and help to re-route customers during disruption.	A digital platform (including information at stations and on trains) underpins new apps and services from the wider market that cover door-to-door needs.	Improvements in the timeliness, reliability and accuracy of the information available. Information interface for smartphones, hearing aids and station navigation tools.	Personalised information sent to customers based on their tickets (Magstripe ticketing options retired).	Customers receive real-time information on the combination of modes for their journeys (including delays and alternatives when these occur), minimising stress, lost time and costs.	A personalised, easy and relevant multi-modal door-to-door information experience with rail at its heart.
Cross-modal flexible ticketing	To allow passengers to easily buy rail as part of their door-to-door journey. To bring new demand as new mobility services develop and environmental awareness grows.	Ticketing is complex and not customised. Limited cross-modal ticketing covering mainly urban areas and the train-bus combinations.	National rail pay as you go to cover all frequent, shorter and cheaper journeys (including city, regional and intra-regional). Account-based ticketing suggests trips and offers that might be of interest.	Smart ticketing on mobile to improve reservation and personalisation for less frequent, longer, more expensive journeys.	Open data and right commercial agreements enable multi-modal ticketing provision.	Payment and reservation experience for rail is easier for all journeys. Increased passenger confidence that they've got a valid ticket at the best value.	Door-to-door reservation and payments are the norm, and rail always appears as an option when appropriate.
Customer-centric railway – people	To offer customers personalised services and assistance that makes travelling by rail easier and more enjoyable.	Minimal customisation and personalisation of train services. Focus of accessibility is mainly on step-free around stations. Individual customer data on their journeys is not used.	The necessary underpinning customer data is developed. Key step-free solutions (eg. humps and low-floor trains) are standardised and in service.	Customers are keen to share their data because use is fair and clear and there are benefits to them. Tools and measures to cater for less visible disabilities are piloted and rolled out.	Open data and AI enhance the level of customisation of support and services. Account-based digital assistance makes booking and providing assistance easier.	Information on passenger movements and preferences allows customised support and services that make travelling by rail an appealing option. Measures and tools in place to support customers with all disabilities.	The level of customised support, convenience and inclusivity delivered by rail compares favourably with other modes. Inclusive design widely applied to rail.
Customer-centric railway – goods	Making railway attractive to freight so that it can maintain and expand its share.	New connections for freight customers take too long to build or reinstate. Freight operating hours are constrained by signal box closures. Freight speeds are constrained by conservative ETCS braking curves.	GRIP process adjusted to reflect time-sensitivity of freight connections. ETCS rollout planning incorporates improvements in freight path availability and quality, e.g. optimisation of ETCS braking curves.	Processes to validate signalling change schemes accelerated. ETCS Operational Concept reflects freight needs.	Timetabling processes amended to keep freight trains rolling. Open-source ETCS software descriptions of infrastructure.	Connections can be built/reinstated within six months of request. ETCS developments and roll out are used to improve freight access.	It is easy for freight customers to use rail freight.
Good arrangements for the first and last mile	To make it easier for customers (passenger and freight) to use rail as part of their door-to-door, multi-modal journey.	Customers are expected to find their own way for the first and last mile, with rail only offering limited and traditional services and facilities.	Improve parking and connection facilities for existing modes (including electric vehicles) at stations.	Develop operational concepts and facilities for emerging modes (including micro-mobility).	Actively pursue partnerships with last-mile providers.	Rail operators offer complementary mobility services that help passengers from door to door.	All rail passengers have their first and last mile needs easily covered. Railway plays a key role in the provision of door-to-door, not point-to-point, transportation.
Reliable and fast on-board connectivity	To enable customers to be always connected if they so choose.	Phone and mobile data coverage on trains is patchy and unreliable.	Free wifi available on over 80% of train journeys.	All medium and large stations to have free wifi.	5G trials progressive roll out.	Good on-board connectivity is a given when travelling by rail.	

RTS refresh – Reliable and Easy to Maintain Assets

Goals	Why?	Current position (2019)	Stepping stones in the next five years	Vision for 2025	Vision for 2040
Enhanced asset reliability and availability	Reliability that is appropriate to the role of assets in the system reduces disruption to services and drives cost efficiency through less maintenance. Services should only be disrupted as a last resort when assets fail. Increasingly complex railway systems raise the likelihood of service disruption through faulty interactions of assets or sub-systems.	Rate of failures expected (at high level), but timing unpredictable resulting in over-cautious inspection and maintenance or emergency intervention and delay. Response to faults can overlook, or take insufficient account of, wider operational implications. Individually reliable components and systems can interact to delay trains.	Identify assets to be prioritised for improved reliability and availability, based on their performance impact. For high-priority assets and their operations: • Identify and assess asset improvement options • Review fault response to ensure services can keep running with minimal disruptions. For high-priority assets, pilot and roll out improvements to the assets themselves, their management, and the fault response. Agree principles and rules to report defects and repairs to allow system-level diagnosis of complex faults. Pilot cross-industry reporting system to prove its benefits in managing complex faults. Increase the range of assets covered by this reporting system and feed enhanced system-level requirements into design specifications.	Improved reliability by designing refinements to assets that have high performance impact. Improved availability by accommodating failures to in-service assets with 'smarter' operations. Knowledge is routinely applied to improve system reliability.	All assets performing with a known and appropriate level of reliability at component, sub-system and system levels and causing minimum disruptions.
Safe and rapid Inspection and repair of assets	Targeted interventions based on asset conditions and minimised downtime for maintenance and repairs can have significant positive impact on both costs and customer satisfaction. Lower risk to staff and less disruption can be achieved by more automated inspection and repair methods, and decision support.	Progress towards optimal inspection and monitoring, but remote inspection and monitoring (RCM) and non-destructive testing is only used for a limited set of assets. Where deployed, RCM is starting to move staff away from live operational environments. Most maintenance and repairs require rolling stock being temporarily removed from service or track possessions. Safety-driven initiatives to reduce workforce risk are focused on improving current procedures.	Identify which high-priority assets could best use RCM, aligned with available sensor and comms technology. Agree with industry and ORR the safety and economic case for condition-based inspection and maintenance. Identify assets suitable for robotic and AI inspection and maintenance. Deploy RCM systems to priority assets and use the data to optimise inspection, servicing and replacement schedules based on asset conditions and performance. Demonstrate robotic and AI inspections in live environments with remote supervision from staff. Prove initial robotic and AI repair concepts. Develop and deploy RCM systems to more assets. Evolve RCM algorithms to improve their prediction accuracy. Roll out of robotics and AI inspection. Demonstrate robotic and AI repair solution in live environments.	Condition-based inspection and maintenance (optimised for practicability) is widely used, replacing periodic inspection and maintenance. Widespread use of robotics and AI to identify – and in some cases rectify – asset faults. Staff have been trained to focus on remote supervision, leading to fewer and shorter withdrawals from service or track possessions.	All assets inform owners about health, degradation of performance and remaining service life. Railway maintenance is highly automated. Staff typically co-ordinate automated repairs in live operational environments, often remotely.
Future assets specified for step-change in reliability, availability and whole life cost	Future railway systems are designed to minimise single points of failure and deliver reliable service. Upgrades of asset are affordable and can deliver lower operating costs and a higher performing railway. Opportunity to create high-value safe roles for our workforce designed to exploit new asset capability.	The case for, and path to, next generation assets is not always clear. New generation asset design is not always driven by reliability and availability, especially at a system level. Design thinking and enhancements to the current generation of assets provide insights to inform new specifications. Renewals and mid-life refurbishment present opportunities but are often used to replace like-for-similar.	Incorporate targets for Mean Time To Repair and Between Failures and ease of repair in asset specifications and sub-systems. Develop revised design specifications incorporating design for reliability and avoiding single point of failure. Use revised specifications when replacing assets. Explore the future relationship between people and technology/ equipment. Optimise the roles of people and technology in design. Pilot new operating concepts. Identify priority retrofit solutions to deliver a step-change through asset upgrades. Develop tools to plan and assess the case for transitions to step-change performance of assets. Apply the tools to inform industry planning.	Maintenance strategy, and installation requirements for maintenance, are always specified at design stage. Key train and infrastructure requirements or equivalents specify system-level outputs and long-term asset strategy.	Assets designed for availability through non-disruptive repair, renewal, cost and sustainability. New assets developed for reliability at system level, which avoid single points of failure and include in-built health monitoring. Future transitioning and re-purposing of assets considered as part of design.