GREAT BRITISH RAILWAYS

ANSWERING THE CALL FOR EVIDENCE

2022 started with a flurry of activity as the PWI prepared its response to the Great British Railways Transition Team's (GBRTT's) call for evidence to inform an intended Whole Industry Strategic Plan, also known as the WISP or Strategic Plan. With a submission deadline of 4 February, the timescale for assembling responses to GBRTT's questions was undoubtedly tight. Fortunately, a 'shout out' to Institution Fellows brought a wealth of experience and knowledge to bear on the task. After what felt like (but wasn't!) a near continuous run of online discussions and meetings from late December to late January, and a decision to focus on those questions with direct application to infrastructure and engineering, comprehensive responses were made on the PWI's behalf to three of GBRTT's six questions.

I can't thank enough the 30+ Fellows who volunteered and participated in this exercise, and particularly the three Fellows who each took on the role of principal editor for one of the questions; Michelle Nolan-McSweeney, Richard H Brown, and Joan Heery. The Fellows' highly active participation enabled the PWI to draw on engineering, organisational, logistical, commercial, and business management experience stretching from the 1960s to the present day, and from a wide range of perspectives. I confess that at the outset I was a little worried that this range of experience might make consensus difficult to achieve and that individual Fellows' conclusions might differ, perhaps even violently! In the event my fears were groundless and, whilst a variety of opinions were offered and some serious discussions ensued, differences turned out to be more apparent than real, and largely related to tone rather than substantive content.

THE QUESTIONS WE ANSWERED

GBRTT framed its questions with reference to the UK government's five 30-year strategic objectives for the rail industry. These industry objectives are:

1. meeting customers' needs;
2. delivering financial sustainability;
3. contributing to long-term economic growth;
4. levelling up and connectivity, and;
5. delivering environmental sustainability.

The 3 questions answered by the PWI were set around:

- application and delivery of the five strategic objectives in the context of likely societal, economic, and environmental trends, in a way that both better integrates rail transport into the UK's overall transport system, and is resilient to key uncertainties (question 1);
- delivery of financial sustainability (question 3), and;
- delivery of environmental sustainability (question 6).

The form and nature of the PWI's responses meant that, while each answer looked at the requested 5, 10, and 30 year time horizons, specific answers were not made against each horizon.

WHAT WE SAID

You can read the extensive PWI responses to the GBRTT call on our website at www.thepwi.org/gbrtt/ However, a number of common themes related to railway transport and GBR itself permeated all three answers and I thought it would be helpful to summarise here some of the themes that I thought particularly important.

Great British Railways
TRANSITION TEAM

ROLE OF RAILWAY TRANSPORT

The stable environmental and social assumptions that have underpinned Britain's approach to railway transport over the last 60 to 70 years are changing rapidly (as they must if the human race is to avoid global catastrophe). Much of the current UK railway network provides excellent connectivity and is in good physical condition but it is largely the result of the judicious pruning of the jumble of competing 19th century lines, carried out in the 1960s and 70s to suit the economic and social circumstances then prevailing. The nation's infrastructure, industry, social fabric, and transport requirements have changed dramatically since that time, but the shape of our railway network remains now largely as it was then. Whilst acknowledging capital funding constraints, it would be unwise to presume that the network and its current patterns of service are best-tailored to future transport demands.

With regard to integrating transport, GBR should look at the provision of network-wide journey opportunities, including time-efficient connections and easy transfers between rail and other public transport modes, rather than primarily focussing on 'in-franchise' origin-destination journeys. GBR should engage with efforts to develop integrated timetabling and ticketing between bus, tram, and train networks, so modes collaborate to offer attractive, seamless journey opportunities.

VALUE OF RAILWAY TRANSPORT

The financial sustainability of Britain's national railway network is a function of:

- industry revenues arising directly from providing transport services;
- social and environmental value of the industry's activities, funded by various arms of national, regional, and local government, and;
- industry costs.

Some social value models exist however the overall economic and social value of Britain's railway transport industry remains an under-explored area. A recent Railway Industry Association estimate suggests that rail transport accounts for around £12 bn of national economic production. However, that figure does not include evaluations of the social, economic, and environmental value delivered outside the railway industry. GBR must understand its direct revenues and costs, but it is imperative that it also develops its own understanding of the broader social and economic value which rail transport brings to the nation.

GBR must also employ a consistent methodology to assess and prioritise expenditure and investment on a "whole industry, whole life" basis, including placing financial value on sustainability and the reduction of CO2e emissions. Parallels with the highly successful 1988-94 industry work on the prioritisation of investment in safety initiatives could be helpful.

SUSTAINABILITY AND NET ZERO

The Network Rail Environment Strategy 2020-2050 provides a sound basis from which to develop an equivalent whole industry strategy. Adaptation to improve resilience to climate change will be an important ongoing priority workstream, including the early development of 'interim adaptation pathways' to guide remedial work and investment in the period to 2029, when longer term strategies and investment plans are forecast to be available.

In-career education and development of personal competence are critical to delivering a sustainable railway system. Complementing this, areas of technology which have significant potential to reduce the rail sector's impact on the environment and enhance biodiversity are:

- whole life carbon evaluation, influencing asset design, materials, and construction;
- asset life extension and reuse of materials;
- application of 'big data' techniques to predictive maintenance;
- green energy supply and sustainable local power generation;
- water re-use;
- intelligent vegetation management, and;
- traction electrification.

MODAL SHIFT

Potentially the railway industry's biggest medium term contribution to decarbonisation, GBR must develop agility in the development and implementation of projects facilitating modal shift. Facilities for intermodal freight are an obvious priority from both modal shift and industry revenue perspectives. GBR should also work with National Highways and academia to develop an analytical tool set to understand the true modal shift effects of options for passenger travel service design and provision. This should also be capable of assessing and quantifying the social and environmental value of the railway network and services, including valuing reductions (or increases) in carbon emissions.

THE BUSINESS OF RAILWAYS – CHALLENGE AND COST MANAGEMENT

If GBR is to be successful it must foster a comprehensive "value for money" culture and establish a clear line of sight between industry revenue streams and their associated costs. Recognising that the evolution to ever greater efficiency is a "whole business - long-term project", it must build organisational arrangements that facilitate and legitimise internal informed challenge, streamline business processes, and eliminate activities that don't add real value.

Suggested areas where efficiencies might be gained include:

- work programmes, which wherever possible should be set up on a rolling basis with stable work volumes;
- utilisation of the on track machine fleet, particularly in the integration of delivery of renewals-related and maintenance-related work;
- increasing the recovery of materials for cascade and reuse by revising the associated controls, incentives, and capacity;
- reviewing the engineering access regime (possession strategy) to ensure it is delivering whole-industry best value, rather than lowest engineering cost;
- incentivising the identification of low risk/ high benefit opportunities for standards change and developing these independently of specific projects, and;
- devising slicker arrangements for pulling fundamental scientific research up through technological readiness levels and into practical solutions to drive further cost and carbon efficiencies.

GBR CAPABILITIES AND PEOPLE

GBR faces the challenge of managing Britain's railway network through a period of change almost unprecedented in modern history. It will integrate the major components of the whole railway, and this will inevitably create tensions where available funding constrains costs and thus affordable work. GBR can create a unified "railway industry" ethos and team culture which pursues cost effectiveness and optimises revenue and social value added. It can incentivise the industry to develop the flexibility necessary to adapt service provision more rapidly to post-covid and Net Zero transport demand patterns.

From a project management perspective, the objectives and targets for GBR set out by government and the industry itself appear stretching and ambitious. Their delivery will depend critically on the prioritised application of funding and other resources, and their integration into the detail of general business processes and activities.

GBR has an opportunity (as an integrated railway operator) to fully understand and manage project and network risk, and to assess the value of holding more contractual and project risks itself. In this regard it should prioritise the development, support, and retention of competent experienced people to maintain "informed client" capability in strength and depth. Resource sharing with staff crossing from one team to another as workloads fluctuate can be used to broaden staff experience and capability in the totality of railway management, and close engagement with professional bodies can be used to enhance workforce competence and capability.

GBR must understand the factors likely to drive changes in government policy, have the capability to work collaboratively with government in policy development, and be able to respond rapidly and knowledgably to policy changes as they emerge. Its plans for financial sustainability should dovetail with national and devolved governments' strategies intended to deliver the UK's 2030 and 2050 decarbonisation objectives - and GBR should be able to demonstrate how its plans deliver reduced transport emissions at national and regional level.

WHAT NEXT?

The PWI will continue to support the establishment of GBR; a process dependent on the passing of parliamentary (primary) legislation. Realistically it is unlikely that GBR will come into being before 2024, but we'll keep Members updated on progress. In the meantime, I'd be interested in your thoughts on GBR and the PWI's contribution so far.

Stephen Barber
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Photo by Arthur Edelmans on Unsplash

Read the full text of the PWI responses here - www.thepwi.org/gbrtt/

GREAT BRITISH RAILWAYS

ANSWERING THE CALL FOR EVIDENCE

QUESTION 1

Great British Railways
TRANSITION TEAM

THE PWI
THE INSTITUTION FOR RAIL INFRASTRUCTURE ENGINEERING

Question 1 - Strategic Objectives for the Whole Rail Industry

1a) How would you apply these objectives to rail in your region or to your area of expertise within the transport sector? Do you have evidence you can share with us of how you have applied similar objectives in relation to rail, and do you consider the objectives to have missed any key areas?	**Introduction** GB Railways will have a fundamental role to play in supporting Britain's economic, environmental, and social ambitions, and the PWI is supportive of the Great British Railways purpose to create a simpler, better railway for everyone in Britain. To this end, the PWI is pleased to provide comment and evidence that can help shape the Whole Industry Strategic Plan, informed by our members' expertise and extensive knowledge of the sector. The five strategic objectives and ambitions for rail certainly resonate with those of the PWI; we believe these should be at the heart of a strategic plan that is sector-wide and takes into consideration a customer-led approach, greater industry joined-up working, and a sustainability focus, but also objectives and plans that are robust and affordable. Our own insights indicate that the application of business disciplines to optimising value measures more extensive than simple shareholder returns and applying these disciplines to infrastructure work are difficult. But both are ultimately achievable and can drive safe, effective, and efficient outcomes. Over the last decade, stakeholders' objectives and forward long-range plans have been developed for Network Rail's (NR's) Routes to achieve these, albeit with variable degrees of success. We believe that good leadership and commitment the strategic objectives by senior management and effective communication and culture change programmes will be needed going forward. Importantly, the success of GBR will need solid foundations around a fundamental principles which must include: safety across operations and infrastructure engineering; and focus on a strategic plan that delivers value for money and reliable performance through a more resilient and sustainable railway. **The here and now** • Where costs are currently constrained and are likely to be for at least the next 8 years to the end of CP7, there will be a negative impact on infrastructure performance and risk, not just immediately but in the medium and long term for infrastructure assets. Risk management techniques are likely to come to the fore instead of optimised asset management decision making. • Infrastructure safety and performance, people, and safety in general require the same focus as other objectives – they are not just a "given": railway history provides grim examples of where they have, erroneously, been taken for granted. Appropriate asset condition must be consciously recognised as a customer need, alongside other factors. (There is no sense in painting a station and providing accessible facilities if the station is shut due to the condition of the roof for example).

	• Where more sophisticated risk management or increased volumes of work are required from an organisation, the people accountable for delivery must be considered as well as how the organisation works in principle. A leaner, more cost efficient industry will not be well placed to weather any increase in work related stress and sickness. • Infrastructure needs to be delivered efficiently to avoid waste and duplication with minimum damage to the environment; especially the delivery of new electrification. **Looking ahead** • A successful railway transport industry (and the public transport sector more generally) will require commitment to plan and invest in the railway infrastructure for the long term, whilst remaining flexible enough to take advantage of changes or developments. European Railways, notably in Switzerland and Austria, have shown what can be possible. • A clear strategy for asset condition is required in conjunction with changes in organisation. Closer working with train operators will mean some efficiency in buildings assets for example, but the impact of organisational change must be forecast and mitigated. • Integration between infrastructure and rolling stock must continue to be improved, recognising the single system nature of the rail / wheel interface. • Reinstatement of routes should be considered to provide capacity, connectivity, levelling up, and diversionary alternatives. This is, particularly the case where significant route infrastructure remains in place: the ECML Leamside route for example, and there are others. • Traffic in some rail freight traffic sectors (notably intermodal) is already growing, with much further potential to drive sensible decarbonisation and emissions reduction. To enable plans for further significant growth, infrastructure such as track doubling, and three or four tracking will be needed to support more efficient mixed-traffic operation by separating services by speed characteristic. • Contracting out and “make vs. buy” considerations should factor in the volume, disposition, programme stability, and technical nature of workload, particularly that involving highly specialised tasks or technology. This should also consider the “informed client” expertise and the organisational strength and resilience needed to design, build, operate and maintain the railway system. Business planning cycles should be commensurate with a rate of organisational change that can reasonably be sustained.

- The industry must become more innovative and proactive in its search for new methods and materials. Whilst NR's move to trial the adoption of synthetic and recycled plastics in track sleepers and bearers is very welcome, it is notable that these technologies have been deployed in aggressive environments in their "home" countries and on other railway administrations for more than 25 years[i]. Heritage railways in Britain have pioneered low-cost level-crossing control systems[ii]. Low carbon, low weight electrification support structures were developed by British companies and launched in 2018 but have yet to be trialled here[iii] It is difficult to escape the conclusion that the railway system in Britain labours under a culture of inappropriate risk aversion, over-attachment to historic materials and practices, and a focus on competitive procurement which is anathematic to development and innovation.

- Change management processes need to look at lessons from the privatisation approach and ensure appropriate levels of safety validation and disposition statements across organisations, and at all levels. Efficient change management and change capability will be a clear prerequisite for success. (The pre-privatisation railway adopted principles of business leadership and business disciplines through market-focussed 'sectorisation', and adoption of quality management through its 'organisation for quality initiative' – 'OFQ').

- Changes are required in the organisational culture, applying equal managerial attention to cost, quality, and risk, and moving away from a tendency to risk aversion (see *innovation*, above) and the unnecessary costs it creates. When changing culture in this way care will also be required to ensure that considerations of 'first cost' do not dominate over 'whole life' benefits to the extent that important features which support safe and economic operation (now and in the future) are sacrificed.

- There needs to be a sense of collective and personal 'ownership' of projects, plans, and decisions in the sector if GBR's purpose is to be delivered. Importantly, critical asset investment and design decisions must be endorsed by those who will be accountable for the performance of the asset in service.

What's missing from the objectives?

- The objectives require a stronger focus on running the railway "as a business", that is subject to business leadership and disciplines, albeit with the objective of optimising value measures more extensive than simple shareholder returns. The "business" must include operations, engineering, and infrastructure. Superficial or indirect consideration of "whole industry" business, objectives, and targets will allow critical supporting objectivity to be lost (as occurred with Railtrack). A business ethos and approach is essential if GBR is not to slide into a departmental organisation and culture.

- There should be a more overt objective about joining up transport sub-systems to form an integrated transport system for Britain, and the role GBR is to play in this. GBR cannot deliver integrated public transport single handedly and the organisation

	will need to form and develop relationships with other transport providers and modes including, with reference to the delivery of modal shift, Highways England. Provision of 'connectivity' and the capture of related opportunities to make more journeys attractive by rail should be a clear aim. • A strategic people/workforce objective should frame plans for the resourcing of particular skills (e.g. track design, electrification installation) and the development or transfer of skills across the sector. Clear commitments about the industry itself, including; increased diversity, upskilling, skill retention, and resource strategy to address skills gaps appear to be missing and must be translated into the strategic objectives. • No less importantly, with regard to infrastructure, a GBR strategic objective to create a safe, performing railway should include building the safe and efficient utilisation of plant, machinery, and people into asset management plans. This is particularly critical where the delivery of "whole system" efficiency requires some subordinate decisions to follow an apparently suboptimal path. The use of high output track renewals plant is a good example of such situation, where a series of individual and apparently optimal project-based decisions can undermine the achievement of overall programme cost (and revenue) efficiency. It is the firm belief of the PWI that, with appropriate funding and educational cooperation, we and other established engineering institutions can support these objectives across our respective areas of expertise, and to provide the personnel and expertise required to develop and deliver training, education, and re-skilling.
1b) How is it possible to make progress against a number of the objectives simultaneously? Do any of the objectives have larger barriers associated with them than others, or do any objectives pose possible barriers to others? Where would you make the trade-offs?	**Moving forward** The objectives are clearly complementary when viewed over the long term: by meeting customers' needs and delivering environmental sustainability the other objectives of financial sustainability, economic growth and levelling up should follow. Consideration should, therefore, be given to addressing the objectives simultaneously by developing an integrated GB Rail strategy that reflects the system interfaces but also addresses current system complexity and thereby the likely barriers to success. This means developing associated plans for investment and long-term funding (beyond the traditional control period) with change leadership and change management integral to future change proposals. The PWI believes that strategic objectives cannot be effectively and efficiently delivered unless the accountability and responsibility for development and delivery of the strategy is crystal clear. Nor will it happen unless a well-developed, strategic (long-term) plan exists to deliver it, with clear 'ownership' for delivery. By way of illustration, the role that Regional transport authorities and county / city councils will play in developing future transport strategy must be clearly defined. The structure of current transport boards is complex, and it is essential that local authorities put

forward their transport initiatives and plans, but the current system and processes can 'fudge' accountability and responsibility. Whilst DfT's locus in the broad areas of linking up the UK (e.g. high speed connectivity) and coordination of transport strategy at a national level is clear and legitimate, the appropriateness of its interventions (and in some cases leadership) in regional transport planning and delivery is more questionable.

Below is an example and recent, November 2021, reaction by Transport for the North (TfN) to the national government's Integrated Rail Plan[iv] proposals, from TfN's interim chair.

> *"The leaders of the North, jointly with Government, have worked hard to come up with an evidence-led plan to help reverse the chasm of under investment over the last four decades to give passengers in the North a railway network fit for today and for generations to come. That doesn't mean a bit here and a bit there of minor upgrades to the existing network. It means transformational change for the whole rail network. That means building **HS2** and **Northern Powerhouse Rail** in full. That means good east-west connections, improved reliability and a better customer experience to bring about modal shift to meet our decarbonisation strategy. Whilst we have been working on our upgrade plans we have watched as billions have been poured into HS2 building work from London to Birmingham. We have watched as billions have been poured into Crossrail being dug out and built across the capital. It is time for the North to have its fair share. It's time for the North to have a proper railway network to allow our towns and cities, our businesses, and our people to thrive and grow for generations to come. It's time for real evidence of levelling-up."*

To fully succeed the rail strategy, it will have to dovetail into other national and regional strategies, such as land use and wider planning, and energy generation and transmission, so that they can be properly account for the rail transport network and its capabilities. By way of illustration, approval of planning for new regional logistics hubs should require them to have rail access (or the potential for convenient rail access) so that freight can be conveyed by rail over long distances and then conveyed to destination by electric lorries. Notably, south of Burton on Trent, on the Derby to Birmingham route, new logistics depots have been built alongside the railway without rail connections. We also have the situation where logistics depots are set up with rail connections, like the M&S depot at Castle Donnington, Derbyshire, where all movements are currently made by road transport. Firms who build logistics depots should be encouraged to provide rail facilities and incentivised to use them by government and local authorities.

The planning of new housing estates, hospitals or manufacturing facilities is also another area where the integration of public transport is generally poor and often non-existent. An example is to the western side of Derby where 4 very large housing estates, with 3000 homes have been built, without any method of transport into the city, other than by car. These estates, however, straddle a disused railway line which could have been used as the basis for a mass transit system into Derby from the West and North of the city. This could have also provided connectivity with towns to the north of Derby and an alternative route to

	Nottingham. In contrast, the development of 8,000 houses around Corby was directly supported by the reintroduction of a half hourly electric passenger train service south to London (though with no service provision to provide connectivity to the east or north). Looking ahead (see response 1c below), a report by UK FIRES[v] (a government sponsored research group) indicates that it is inevitable that the nation will have to reduce its dependence on car travel if "net zero" is to be achieved by 2050. This will require "political will" and will have a significant impact on the UK's manufacturing strategy, but associated moves towards road pricing or increased taxation, and environmental damage charges on cars, lorries, and vans could be used to facilitate increasing investment in public transport and reducing environmental impacts. Sources and forms of energy for rail transport will also change as we move to 2050 and it will be important to ensure that GBR's energy policy for rail transport dovetails into the greater use of electricity or hydrogen and continued reduction in use of fossil fuels. **What might be the barriers between objectives?** There must be a balance between the access required to handle traffic volumes and that required to access the infrastructure safely for inspection, maintenance, renewal, and enhancement. In infrastructure terms, there needs to be a balance in focus on safety (including asset safety), risk (including deteriorating assets) and people. The needs of customers and other stakeholders are important but asset condition, managing risks, and the competency and capability of industry people are the foundations which they assume are in place. These areas must be critically assessed and given equal focus to other customer needs to avoid internal industry conflicts or the create of barriers.
1c) What long-term trends in wider society, the economy, and the environment will affect these five objectives over the next 5, 10, and 30 years? Please give evidence to support your response.	**Current trends** Over the last two years the world has changed significantly. The covid-19 outbreak, and national lockdowns have transformed the way people work and travel, and with this comes significant commercial, operational and passenger implications. The Covid pandemic has introduced the concept of working from home and forecasts suggest that the working population will, where possible, continue to do so into the future. This hopefully will reduce the congestion and improve air quality, so is a positive in terms of the environment. That said, it may also reduce commuting on the rail network particularly into London and other major cities so is likely to have an adverse effect on rail revenue[vi]. As recently as December 2021, passenger rail usage continued to be affected by restrictions relating to the coronavirus (COVID-19) pandemic. A total of 248 million rail passenger journeys were made in Great Britain during the second quarter (Q2) of financial year 2021-22. This is up 85.8% compared with the 133 million journeys made in 2020-21 Q2 and the most journeys in a single quarter since the start of 2020-21. Nevertheless, usage remains considerably lower than before the pandemic with the 248 million journeys

this quarter equating to 55.4% of the 448 million journeys made in 2019-20 Q2. Changes in usage continue to vary by ticket type. The 211 million journeys made in Q2 using ordinary tickets equate to 69.0% of usage in 2019-20 Q2. By contrast, the 36 million journeys made using season tickets equate to 25.7% of usage in 2019-20 Q2. Many firms are offering reduced days in the week to undertake the work hours required (NWR for one) which increase the possibility of travel by rail for leisure purposes. Improved connectivity and through ticketing between the various forms of transport would also help with leisure travel. Total passenger revenue in Great Britain was £1.5 billion in 2021-22 Q2. This equates to 54.5% of the £2.8 billion in 2019-20 Q2 (when using 2021-22 Q2 prices)[vii].

Total traction electricity consumption in 2020-21 fell to 3,733 million kilowatt hours (kWh), a decrease of 12% compared with 2019-20. Total traction diesel consumption fell to 507 million litres, a decrease of 22%. The falls in energy consumption led to a reduction in estimated carbon dioxide equivalent (CO2e) emissions, with a combined total from electricity and diesel of 2,282 kilotonnes. This is the lowest emissions level since the start of the comparable time series in 2010-11. That said, due to the pandemic and a reduction in passenger kilometres, CO2e 'unit' emissions for passenger trains have increased by 316% from 35.2g to 146.5g CO2e per passenger km[viii].

As a result of various electrification schemes across Great Britain, 6,045 km of the mainline railway route is now electrified. This is 37.9% of all route length. In 2020-21 electrification of Midland Main Line between Bedford and Corby added 179 new electrified track km to the network. Three new stations (Bow Street, Horden, and Kintore) opened in 2020-21, bringing the total to 2,569 stations. The average age of rolling stock for all passenger train operators is 17.1 years, which has decreased by 0.3 years since 2019-20[ix].

Whilst any "future gazing" can be fraught with difficulty, especially given the above related to the pandemic, we can be certain that long-term trends in wider society, the economy and the environment will undoubtedly affect the PWI's five strategic objectives over the next 5, 10, and 30 years.

Societal trends and implications

The UK is projected to be Europe's most populous nation by 2050, with 83% living in urban areas, and rising. Population growth places a strain on transport systems and can impact on a range of factors including commuting patterns, expectations around flexible timetables rather than fixed, and less tolerance towards disruptive engineering work[x].

- 'Millennial' values are becoming the norm: technology savvy, placing importance on tasks rather than time, and being more adaptive to change.

	• As leisure demand increases, a London centric railway becomes less relevant. Demand for extra capacity and shorter door to door journey times is likely to increase for cross country, east-west, and other regional journeys. • An ageing population with more leisure time, but potentially less mobility, will be a significant market sector. • Ageing populations will have an impact on the design and choice of mobility solutions, and requirements for autonomous mobility on demand. Looking ahead, passengers will expect to have their travel integrated with other transport modes, and digital (automated), data driven, personalised, transport services available to them on their smart phones or tablets[xi]. • The sector will need to move to a 'consumer preference' mentality focused on meeting customer needs and providing reassurance that it is safe to use public transport again post- the pandemic. • Passengers want journeys in the future that are carbon neutral. There is increasing sustainability awareness which will likely play a role in modal choice[xii]. • Big data and the Internet of Things will pave the way for integrated and inter-modal transport solutions, allowing passengers to work or do what they need to do whilst travelling. GBR will have to continue to recruit and retain its workforce of the future from local communities and to attract those from more diverse backgrounds. In this context it appears likely that 'employer brand' is unlikely to come from GB Railways in the short term. An open question remains as to whether potential new entrants of the required calibre and number want to work a high proportion of night shifts and to undertake physical work on the infrastructure. The capability of regional populations to travel to a job using an integrated public transport system shows a major variance between those living near London and those elsewhere in the country. Local strategies need to flow into regional, national, and union connectivity strategies to eliminate conflicts. Increasing transport investment across the country would have a massive impact on the economic and societal benefits of 'levelling up', perhaps counterbalancing recent major projects like HS1, HS2 London to Birmingham, Thameslink and Cross Rail all of which are strongly London-centric[xiii]. Many of our larger and medium sized towns do not have a train station within the settlement. GBR should consider how such communities could be reconnected to the network; in the shorter term by putting in more 'parkway' stations with associated road transport links to adjacent towns; and perhaps in a longer timescale by constructing new rail links; both approaches encouraging traffic onto rail.

Economic trends and implications

Wider economic, social, environmental, and technological trends will change the role rail plays in the economy over the next 30 years. It will be for the sector to find new ways to generate growth and prosperity, in the knowledge that affordability will be a significant constraint in the future of GB Railways. Unless and until Covid-driven falls in passenger transport demand are reversed the rail system will be unable to cover its costs without some combination of; significant additional government support, a drive for efficiencies and innovation; and, potentially, reductions in service levels and investment.

The rail industry in 2020-21 was substantially affected by the coronavirus (COVID-19) pandemic. Fares income in Great Britain dropped by £8.6 billion to £1.8 billion, to historically low levels due to the impact of the pandemic. Government used emergency measures to keep train services running, which led to a large increase in train operator subsidy. Government funding of the rail industry in 2020-21 was £16.9 billion, an annual increase of £10.4 billion largely due to supporting train operators. Industry costs were £21.0 billion in 2020-21, which represents a £0.8 billion (3.8%) annual increase. Network Rail expenditure was £9.6 billion, an increase of £1.2 billion (14.0%), franchise train operator expenditure was £10.3 billion, a decrease of £0.4 billion (3.3%)[xiv].

As set out in the Williams-Shapps plan for Rail, train operators (previously franchised train operators) will compete for contracts awarded by GBR. Operating contracts will incorporate a range of different commercial arrangements, largely dependent on the principal market segment to which they relate. Whilst the level of financial risk taken by train operators is likely to differ by market segment, all must be incentivised to improve customer satisfaction and grow passenger revenues.

Freight transport links between ports and logistics hubs continue to grow in importance[xv]. GBR must facilitate further rail penetration of this market with better freight connections, and exploit opportunities to open up new networks and create new rail-centred distribution hubs.

The pandemic has highlighted the problems that arise when global supply chains are disrupted and, to encourage economic improvement and reduced instability, large firms may be encouraged to consolidate their supply chains in the UK. This would bring significant economic and environmental benefits. Rail transport could benefit where supply chain partners are based at a distance from manufacturing centres.

Regional bodies are likely to be given greater accountability. GBR will be challenged to bring public and private sectors together to fund future transport plans. Opportunities already exist for an increase in private funding, and this needs developing through building strong relationships with local authorities, regional mayors, suppliers, and others seeking to invest in the British railway network.

Data analytics, 3D printing, and intelligent robots are transforming how British industry and logistics work[xvi]. Advances in nanotechnology may lead to new materials that are lighter, stronger, smarter, greener, and cheaper: GBR must be equipped to recognise and capitalise on these developments to help create a more efficient, affordable, railway system. Digitisation can also support process optimisation[xvii]. But cyber-security risks associated with increased reliance on digitalisation of inspection, monitoring and control of infrastructure are likely to increase.

All that said, there is strong evidence and analysis indicating the current and future national economic benefits that flow from having a good rail transport network[xviii]. There is also the suggestion that an increase in domestic tourism post-pandemic will contribute to wider economic growth[xix].

Relocation from city to country and increased home working may decrease daily commuting into major cities but increase longer-distance travel[xx]. Longer-term trends are uncertain, but the overall effect may be to smooth demand over the network as a whole and thus release capacity for further growth, to the benefit of the economy.

The environment

A major long-term trend is the impact of climate change on behaviour, which may drive substantial increases in demand, both for passengers and freight. The urgency to move to a more sustainable society will put extra demand on low/zero carbon technologies such as electrification. Furthermore, decarbonisation and electrification of other industries and transport modes will put pressure on resources (people, hydrogen, generated electricity, batteries). The climate crisis threatens serious disruption[xxi].

- There will be system shocks, beyond covid-19, caused by such as the rising cost of fuel; and by constraints on available resources, resulting in high and volatile prices that may limit economic growth. Global consumption of resources will nearly triple to 140 billion tons per year by 2050; the availability of alternative fuels could help lower transportations costs significantly and transform the economy.
- Changes in temperature, more intense storm activity, increased flooding, and rising sea levels will affect infrastructure design, operation, and maintenance. The rail system will need to be far more resilient and adaptive to the crisis, especially where it has fixed infrastructure (where it is often difficult to change quickly).

The government has a legally binding Sixth Carbon Budget which aims to reduce emissions by 78% by 2035 compared to 1990 levels, and reach net zero UK carbon emissions by 2050. Net-zero means any emissions would need to be balanced by schemes to offset an equivalent amount of greenhouse gases from the atmosphere, such as planting trees or using technology like carbon capture and storage. Since 1990, the UK has reduced emissions by 44%[xxii].

	• Moving freight from road to rail is part of the solution and has the potential to help reduce emissions, as part of this a study showed that shifting from HGV road freight to rail could reduce greenhouse gas emissions by nearly a fifth (19%). The circular economy has a profound impact on supply chains. There is strong road, construction, and haulier / logistics industry lobbying on carbon issues, along with rail, and there has been significant investments by these other modes to improve sustainability[xxiii]. • Department for Transport (DfT) published their Transport decarbonisation plan in 2021[xxiv], which sets out plans to achieve a net zero emission rail network by 2050. This will save around 21-22 MtCO2e and achieve up to £1 billion in air quality benefits between 2020 and 2050. This could be achieved by further electrification of the rail network, leading to a removal of diesel passenger trains and investment in new electric locomotives for freight[xxv]. • There is an opportunity to develop local parcels hubs, for "final-mile" delivery by EVs. The World Economic Forum forecasts that further growth in e-commerce could lead to a 36% increase in urban last-mile deliveries by 2030 (The future of the last-mile ecosystem, 2020). • Development of freight EMUs for parcels, radiating from major distribution centres and capable of travelling on HS passenger paths[xxvi]. • To meet the Scottish Government's 2045 net-zero target there needs to a 57% switch to rail for journeys over 30km and 23% of truck tonne-km shifted to rail (Bill Reeve, Director of Rail for Transport Scotland in a presentation at COP26). To meet Cornwall Council's 2030 net-zero target, rail travel must double, and freight transferred from road to rail[xxvii].
1d) What are the key uncertainties you consider that the Strategic Plan must be resilient to in order to be effective over the next 5, 10 and 30 years?	Recognising the five strategic objectives at the heart of the strategic plan, it is important to use the foresight offered in the response to 1c above to inform where the PWI believes GBR needs to develop early resilience. • The volatility of British politics means that it is essential that the rail strategy is supported across parties/nations, with funding beyond the traditional 5-year control period. Recognising the ongoing sensitivity and vulnerability of railways to political change, GBR must also have strong contingency planning capability in this area. • A 10-year plan with a 30-year vision is optimal. A 5-year plan should be subsidiary to the 10-year plan. This will help ensure a long-term vision is maintained.

	• The ongoing impact of the pandemic requires managing and better forecasting, informed by 'big data', around demand for passenger transport and freight movements, and access to skilled people[xxviii]. • The pace of change and technological advancement should not be underestimated; implementation of AI and autonomous electrically powered road vehicles is close. • There will be cyber-security risks from increasing reliance on digitalisation for inspection, monitoring and control of infrastructure • The degree of modal shift from road to rail, driven by climate change, must be a key area of focus. Whilst various technologies for the "electrification" of heavy goods road vehicles are being studied, none currently appears mature or viable. By demonstrating flexibility and speed in customer responsiveness, GBR has an opportunity to grow rail penetration of the British freight transport market well in advance of the emergence of new emissions free heavy goods vehicle technologies that will compete with rail.
1e) Over the next 5, 10 and 30 years, which steps should the sector take to improve integration of rail with the wider transport system (including walking and cycling) in pursuit of these objectives?	**Introduction** Britain's railway system was never planned in a strategic sense in the way our motorway and trunk road system has been (and in the way some other national rail networks were). Britain's railways were proposed, financed, and built (largely in the 19th century) by private commercial companies, as they saw fit. Parliamentary involvement was limited to approving such schemes and government's primary role was to encourage competition within what was then a monopolistic mode of transport. By the early 20th century, the result was a complex network of lines with much duplication and overlap of service provision. Britain's current railway network is largely the result of the judicious pruning of this jumble of lines, carried out in the 1960s and 70s to suit the economic and social circumstances of that time. Britain's infrastructure, industry, social fabric, and transport requirements have changed dramatically since the late 1960s but our current railway system remains now largely as it was then. As noted above, many of our larger and medium sized towns do not have a train station within the settlement. Large 'new towns' have been planned and constructed with little or no consideration of railway transport, on the basis that the private car would provide for virtually all future transport needs. On the same basis, some significant transport corridors are effectively ignored by rail transport and a number of populous geographic areas are not well-served by rail other than for journeys to and from London. The stable environmental and social assumptions that have underpinned Britain's approach to rail transport over the last 60 to 70 years are changing rapidly (as they must if the human race is to avoid global catastrophe). GBR faces the challenge of managing Britain's railway network through a period of change almost unprecedented in modern history. Whilst much of the current British

railway network provides excellent connectivity and is in good physical condition, it would be unwise to presume that it best-tailored to the future demands it faces.

Integration of rail with wider transport systems goes hand in hand with punctuality, comfort, value for money and reliability, which in turn requires capacity and alternative routes (without bottlenecks). Sufficient capacity and route alternatives need to be implemented in an efficient and relatively short timescale to allow larger capital investments and upgrades to be achieved. Levels of capacity for freight and passengers required today should be properly understood, and then scenario-based estimates made for 5, 10, and 30 years from now, whilst remembering that successfully meeting customer needs may lead to the generation of new unplanned traffic.

Passenger transport

Regional transport authorities in conjunction with local councils should have the power to develop pedestrian and cycle routes as part of developing a robust and joined up transport strategy for each area. In many areas these could be built on railway land or on adjacent agricultural land so that rail routes provide connectivity for trains, walkers, and cyclists. The development of more walking and cycling routes should be made in conjunction with the rail strategy.

One of the observed downsides of having discrete TOCs since privatisation has been the lack of proper connectivity strategies at interchange stations. This can and should be corrected to smooth the seamless journey for passengers. Germany and Switzerland are good examples of well-integrated timetables (especially Switzerland); France and Italy much less so. The advantages of cross-platform interchange should be given a higher priority in planning stations, new track layouts and timetables. Connection times can then be reduced. Last-minute platform change notifications should be avoided.

As was evidenced in the response to 1c above, urgent consideration should be given to how trains, buses, and trams should integrate their timetables. Seamless, end to end, journeys will require improvement in facilities for bicycles on trains and at stations, if customers are to experience a properly integrated journey. Similarly, it will be important to understand future requirements for car users ('big data' and a shift to multi-modal travel[xxix]) including charging points at stations and investing in feeder services, so passengers do not drive to hub stations but use their local station. Opportunities exist to create a fully integrated national journey planner that provides all the details to get from 'A to B', including provision of cycle facilities, accessibility constraints and mitigations, and service alterations due to engineering work.

In the longer term and based on real examples in Scotland[xxx] and elsewhere in Britain, GBR should examine the potential benefits and business cases associated with railway line opening, reopening, or construction. This should including routes that provide the opportunity for walkers, cyclists and other leisure travellers to use the train to access national parks, e.g. reopening of the

Ambergate to Buxton railway which would allow visitors to use rail services, instead of road, to access the Derbyshire Peak district for leisure activities. Road charging offers one mechanism to fund such re-openings and complementary bus services could provide comprehensive park access through an integration of transport[xxxi].

Rail freight

Finally, we turn to freight, where we offer the following, informed by the fact there is a much clear evidence that rail freight is more sustainable than road alternatives. Moving freight by rail can be up to 76% more environmentally friendly than road haulage (Network Rail, Value and importance of rail freight, 2013)[xxxii].

Detailed economic studies undertaken in the early 1990s demonstrate clearly that rail freight shows cost advantage where traffic flows are dense (even over relatively short distances). Over longer distances the advantage increases so that less dense flows are also viable. The major drivers of cost inefficiency are transhipments between modes (where they would otherwise not be required) and intermediate train remarshalling. Thus, trainload port-to-distribution hub, hub-to-hub, or manufacturer-to-hub flows are particularly suitable for rail. A high (and growing) volume of aggregates and other minerals are already transported by rail in Britain, reducing the environmental impact of the many lorry journeys that would otherwise be required.

The cost advantages of rail increase significantly when external costs are also considered and this will be significant as environmental impacts and sustainability become ever more important considerations over the next few decades. In many cases long distance rail freight is quicker, quieter, much more efficient than lorries and is far better for the environment.

The movement of freight between Europe and the UK is an obvious target for rail where the rail-borne freight volumes through the tunnel are low despite the tunnel running below its maximum capacity (only 2% of the total rail freight in the UK). There has been hardly any increase in rail-borne traffic since the channel tunnel was opened. This is, to a degree, the result of the narrow commercial optimisation of revenue from roll-on-roll-off shuttle traffic, though periodic disruption on the French rail network has played a part in stymieing growth. GBR should revisit the key drivers of modal choice on cross-channel freight flows and their environmental impact.

The EU is currently looking at increasing rail freight by 100% from around 17% of total freight traffic, a significant increase[xxxiii]. Brexit notwithstanding, GBR should consider participating in this study. Rail freight traffic between the UK and China is another potential growth area as the capacity of rail links across Europe and Asia is developed. Flows from China to the EU have grown significantly during the pandemic. (China - UK transit times are typically 16-18 days by rail, and 40-44 days by container ship.)[xxxiv]

	Whilst being careful to recognise the implications of UK's departure from the EU, GBR should consider, with government, the adoption of similar aligned objectives for rail freight. There is clearly a need to identify national intermodal hubs where freight can quickly and readily transfer to small road transport. Containers of 6m lengths can be utilised to transport direct from node to point of need. Over the longer term Britain could consider the removal of all road freight over the weekend as in Germany, France, and Switzerland (which currently means the UK sees 'continental' road traffic at weekends, when it's not allowed to travel in large parts of mainland Europe). Whilst structure gauge constraints may preclude widescale adoption in Britain, the continental use of 'roll on roll off' stock for transporting lorries on rail wagons may be viable on 'continental gauge' lines in the UK, including HS1, HS2 and other proposed new lines. GBR should consider the costs of opening more routes for additional freight traffic. Initiatives could include: • Development of a speedy and straightforward way of connecting new freight facilities to the network to facilitate new flows, commensurate with number of trains forecast to use facility. Current site by site one-off schemes offer potential customers very poor value for money. • Track lowering under 'tight-clearance' bridge structures which could be undertaken with a reduction in ballast depth. The industry already has the technology to do this. Depending on detailed site conditions the work can be executed in one, or a series of, relatively short possession(s), however the implications for track asset life need to be considered and derogations from (current) standards obtained. Unfortunately, when looked at on a case by case basis the cost of such assessments and derogations can form a significant proportion of the scheme cost (and discouraging further such initiatives). There is a strong case for establishing a set of clearly understood engineering options which could be called off on a "menu" basis without costly bureaucracy. The British railway industry has now had a strategic freight plan for over 10 years. There has been much talk of "dynamic freight loops" and faster turnout speeds from loops (though perhaps not as much action on these). In reality freight operators do not wish their services to be looped, preferring effective through train pathing between passenger services. It is not always possible to increase freight traffic at night on many routes, particularly as that can reduce the time available for the maintenance necessary to sustain high performing assets. More trains, and more tonnage, equals more wear which requires more interventions to sustain those assets (such as track) which wear or degrade under traffic loading. Clear decisions on the priority to be given to electric haulage for freight have still to be made and the utilisation of diesel power for freight haulage appears to be with the industry for a significant time to come. A clear commitment to electrification on through freight routes and in "heavy-haul" electric traction is

	important, with either nodal points for motive power change where the overhead wires stop, or investment in electric traction with "last mile (in reality last 10 or 15 mile)" battery or diesel capability. Realistically it appears that the industry could aim to achieve the maximum potential for rail freight with a traffic increase of 69% by 2030[xxxv].

[i] Fibreglass/resin materials in Japan, and recycled plastics in the USA.
[ii] Level crossing control using safety critical programmable logic controllers (PLCs) is in service on the Romney Hythe and Dymchurch Railway.
[iii] Mott MacDonald and Moxon, integrated overhead line equipment structure (OLS)
[iv] Integrated Rail Plan for the North and Midlands, DfT, November 2021.
[v] Absolute Zero - report by UK Fires (Cambridge University, November 2019).
[vi] Changing Track: The Future of Rail – PA Consulting, 2020
[vii] Passenger rail usage 2021-22 Quarter 2 – ORR Data Portal, December 2021
[viii] Rail Emissions 2020-21 – ORR Data Portal, August 2021
[ix] Rail Infrastructure and Assets 2020-21 – ORR Data Portal, October 2021
[x] UK natural capital: urban accounts – Office of National Statistics, August 2019
[xi] Future of Rail 2050 – Arup, 2017
[xii] Consumer mobility survey – May 2021
[xiii] https://publications.parliament.uk/pa/cm200607/cmselect/cmpubacc/189/189.pdf ; https://www.bbc.co.uk/news/uk-england-13140243; and https://www.ukonward.com/wp-content/uploads/2021/10/network_effects.pdf
[xiv] Rail industry finance (UK) 2020-21 – ORR Data Portal, November 2021
[xv] Changing Track: The Future of Rail – PA Consulting, 2020
[xvi] Future of Rail 2050 – Arup, 2017
[xvii] Why The Future of Rail Operations is Digital – Boston Consulting Group (BCG), 2018
[xviii] https://www.oxera.com/wp-content/uploads/2018/07/RDG-booklet-Final-Sept-15.pdf.pdf ; https://committees.parliament.uk/writtenevidence/23253/pdf/ ; https://etrr.springeropen.com/articles/10.1007/s12544-017-0233-0 ; and https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7413664/pdf/main.pdf
[xix] https://www.statista.com/statistics/1123835/coronavirus-impact-on-holiday-planning-uk/
[xx] https://www.countryliving.com/uk/wildlife/countryside/a33530319/city-dwellers-move-countryside-pandemic/
[xxi] Future of Rail 2050 – Arup, 2017
[xxii] Rail Emissions 2020-21 – ORR Data Portal, August 2021
[xxiii] Eurostat Energy Statistics 2018
[xxiv] Transport decarbonisation plan – DfT, July 2021
[xxv] In 2020, Network Rail published a Traction Decarbonisation Network Strategy, which aims to provide recommendations for Government 'to inform decisions required to remove diesel trains from the network, achieve net-zero legislative targets, and identify the capital works programme required to achieve this'.
[xxvi] https://orion.railopsgroup.co.uk/
[xxvii] The Cornwall Transport Plan to 2030

[xxviii] The COVID pandemic has demonstrated that operating services with "just enough" train crew staff will not address times of difficulty. With the creation of GBR it will again be possible for up skill crew to operate across many routes and operators with "spare" crew at booking on points to fill gaps rapidly as they occur. Currently with the fragmented, non-aligned operator's principal, staff shortages cannot be covered. Training is a continuing issue; Freight cannot get route knowledge on passenger trains so new drivers are not coming through so well. There is huge crossover between TOCs and FOCs for trained drivers as they all try to cut training costs and overheads by "poaching" trained staff. This should be better managed once re integrated.

[xxix] Rail Sector Deal – December 2018

[xxx] Edinburgh-Bathgate, Airdrie-Bathgate, Larkhall, Alloa, and the Borders Railway.

[xxxi] There would be many other areas in the UK that would benefit from a similar approach, e.g. Northumberland, the Lake District, Torbay, Yorkshire, and the New Forest in Hampshire.

[xxxii] https://www.riagb.org.uk/RIA/Newsroom/Publications%20Folder/Why_Rail_Electrification_Report.aspx

[xxxiii] https://www.europarl.europa.eu/RegData/etudes/BRIE/2021/694246/EPRS_BRI(2021)694246_EN.pdf and https://www.railfreight.com/railfreight/2020/12/11/rail-freight-transport-at-the-centre-of-europes-mobility-strategy/?gdpr=accept

[xxxiv] https://www.honouroceanshipping.com/freight-train-railway-shipping-cost-from-china/?gclid=EAIaIQobChMI06685_Sf9QIV6ujtCh0lpQ4gEAAYAyAAEgJGIfD_BwE

[xxxv] *Future potential for modal shift in the UK rail freight market* – Arup (for DfT), 2016

GREAT BRITISH RAILWAYS

ANSWERING THE CALL FOR EVIDENCE

QUESTION 3

Great British Railways
TRANSITION TEAM

THE PWI
THE INSTITUTION FOR RAIL INFRASTRUCTURE ENGINEERING

	Question 3 - Delivering Financial Sustainability
Where are the most significant opportunities and barriers to delivering financial sustainability in the rail sector over 5, 10 and 30 years and how do we achieve/overcome them?	**Introduction** Whilst originally financed, constructed, and operated as private businesses, the operation, maintenance, and development of the Great Britain's national railway network has required significant support from public funds, in various forms, since 1956[i], and perhaps earlier if due account is taken of industry circumstances in World Wars 1 and 2, and the intervening years of economic depression. The British network is not alone, sustaining railway networks in all comparable developed countries has required similar application of public monies over the same time period. In the 21st century the financial sustainability of Britain's national railway network is thus a function of: • ***industry revenues*** arising from the provision of transport and related services to individual customers; • ***social and environmental value*** ascribed to the industry's activities and funded by various arms of national, regional, and local government (e.g. acting as a catalyst for economic growth, as an agent for reducing environmental damage, and as a provider of critical community transport such as London commuting or connections to otherwise isolated communities), and; • ***industry costs*** arising from operation, maintenance, and development of railway transport services. Each of these three factors is discussed below. Given the area of expertise of the PWI and its members, the discussion on industry costs is primarily related to infrastructure engineering and management. The discussion on industry costs is also more extensive than that on revenues and social and environmental value, however important points are raised in all three areas. **Industry Revenues** *Passenger traffic* Since privatisation the railway industry has been highly successful at growing passenger customer revenue. Prior to the covid induced collapse of passenger traffic in Spring 2020, passenger journeys in England grew by 160% between 1995/96 and 2019/20, albeit traffic levels were broadly flat from 2015/16[ii]. Over the same period and adjusted for CPI inflation, long distance rail fares rose by c70% in real terms and other passenger fares by c40%[ii]. *Freight traffic*

	Having peaked in 2013/14 and following the dramatic reduction in power station coal traffic caused by the closure of coal-fired stations and their replacement by more CO_2e friendly methods of electricity generation, total English freight traffic is now at a similar level to that in 1998/99[ii]. The loss of coal traffic has been largely countered by increases in intermodal and construction traffic albeit freight revenues have fallen by 7% since 2015/16[ii]. Today there is significant frustrated demand for freight traffic, especially to and from ports[iii]. Constraints in both pure capacity[iv] and structure gauge clearance are keeping freight traffic and its associated revenues off rail. The slowness in dealing with such capacity issues is a cause of great frustration among port operators and freight forwarders. Faster progress would bring immediate environmental benefits from modal shift and faster revenue growth. *Future revenue growth* Opportunities for revenue growth in the short term will be associated with identifying and adapting service provision to post-covid transport demand patterns. These are unlikely to stabilise quickly, and adaptation will require the industry as a whole to demonstrate a flexibility and speed of response not characteristic of post-privatisation industry governance and planning processes. The intention to form GBR, with its attendant "whole industry" ethos, provides a positive backdrop and framework within which the industry can be incentivised to develop the necessary flexibility. Moving beyond the short term future, unlike the world of franchised services, where rail operators were primarily focussed on their internal origin and destination traffic flows, GBR has the opportunity to look more widely at the provision of network-wide journey opportunities, including the facilitation of time-efficient connections and easy and convenient transfers between rail and other public transport modes. The pressure on all elements of society to reduce and eliminate carbon emissions should inform GBR's (and the wider industry's) efforts to achieve revenue growth. Arguably the industry should be seeking to increase revenues through true modal shift (i.e. journeys transferring from a more polluting mode to a lesser one, which has a beneficial effect on emissions), rather than encouraging growth in overall transport demand (i.e. increasing overall demand for transport, which has a negative impact on emissions). Looking to the future, GBR will require a sophisticated analytical tool set, particularly to understand and evaluate the true modal shift effects of options for passenger travel service design and provision. Whilst 25 years ago this would have been impractical, large volumes of anonymised data on road traffic flows are now collected, including useful information on origins and destinations. Cooperation with Highways England (and the equivalent bodies for Scotland and Wales) and academic research bodies would make

such a tool set a more realistic proposition. From the perspective of financial sustainability, this analytical tool set should also be capable of assessing and quantifying the social value of the railway network and services.

Social and Environmental Value

Historically, various mechanisms have been devised between government and railway management to support the ongoing costs associated with unremunerative (commercially loss-making) passenger services, the latest iteration being subsidies for franchised passenger services. These mechanisms have invariably related to costs rather than to value.

Over the last 30 years and more large public sector projects, including transport projects, have used cost-benefit analysis in an attempt to quantify the social, and more recently environmental, benefits (and costs) generated by particular schemes. Whilst government has set clear rules for CBA, it remains something of an inexact science. This is particularly the case where individual schemes form part of wider proposals intended to deliver economic and/or environmental benefit and where it is difficult to ascribe portions of the overall benefit to individual supporting schemes.

It is not clear to the PWI whether forward government policy seeks a long term real reduction in monetary support for the railway industry irrespective of the social and environmental benefits the industry delivers (or is capable of delivering), or whether government is willing to consider stable or potentially increased monetary support in recognition of industry delivery of increased levels of such benefits (particularly those relating to decarbonisation, including modal shift). Messages in recent government policy and strategy publications relating to the British railway industry are mixed. Undoubtedly, government would wish for both a reduction in the industry's call on public funds and an increase in the social and environmental value it delivers. In giving this response to the GBRTT Call for Evidence, the PWI does not presume to second guess government policy: the matters discussed and opportunities identified in the response are equally valid in the context of an expanding, stable, or diminishing GB railway network, and in the context of differing sources and amounts of public funding.

In reality and given the slow but steady growth in awareness of the implications of climate change and the likely levels of societal adjustment (identified by UK FIRES[v]) required to achieve net zero by 2050, government policy on transport appears likely to change, perhaps more rapidly than at any time over the past 60 or 70 years and evolving over time. It will be important that GBR:

- is well informed on the factors likely to drive and influence such changes;
- has the capability to work collaboratively with government in policy development, and;
- can respond rapidly and knowledgably to policy changes as they emerge.

Whilst individual rail industry companies have adopted social value models and initiatives, the overall economic and social value of Britain's railway transport industry remains a somewhat under-explored region. The Railway Industry Association recently estimated that in 2019 the UK railway industry contributed £43 bn in economic production to the UK of which rail transport itself accounted for £12 bn[vi]. These figures do not include evaluations of the social, economic, and environmental value created outside the railway industry. Illustrating this latter point, it is difficult to envisage a large modern functioning city without a supporting rail network, however it remains difficult to determine and account for the value to society of such essential support.

GBR's plans for financial sustainability should dovetail with the overall government strategy intended to deliver the UK's overall 2030 and 2050 high level decarbonisation objectives. GBR should be able to demonstrate how its physical plans help to deliver transport emissions reduction at national and regional level. In this regard, in addition to accounting for other measures of social value and benefit, it is important that GBR and other industry bodies which hold funding budgets adopt the government's good practice in the valuation of greenhouse gas emissions: for policy, strategy and scheme appraisal, evaluation, and prioritisation[vii].

Industry Costs (Infrastructure)

Introduction

Significant changes in technology, legislation, engineering philosophy, and accounting rules and practices over the 26 years since industry fragmentation, coupled with difficulty in accessing comparable detailed records relating to the industry prior to 1996/97, make the drawing of quantified comparisons between a past integrated organisation and the more recent fragmented industry structure difficult to draw. In the discussion below, whilst some reference is made to quantified costs, the PWI has not attempted to make comprehensive comparative assessments, rather we have attempted to focus on cultural and behavioural characteristics of integrated and fragmented organisations and the way those characteristics have influenced practices which in turn drive costs. The intention of looking back is to identify and draw clear distinction between good and sub-optimal principles and practices to inform the formation and development of GBR.

Discussion

Internal Challenge and Value for Money

During the 1980s, in the then integrated railway, the departmental functional structure was transformed into a matrix structure of business segment focussed "sectors", and functional "regions" (under the umbrella of British Rail). The sectors spread a strong culture of resource efficiency and value for money and used this, within the matrix organisation, to challenge longstanding assumptions, policies, and practices within the functional regions. Principles of business efficiency were pursued in an

environment of constructive challenge, creative tension, and (generally) collaboration. Strong themes of innovation, efficiency, and accountability generated better optimised business outcomes, especially in terms of resources (human and material) where directly applied, and through well-formulated contracts where utilised.

The practice of constructive and informed challenge was built into the organisation structure partly by establishing a small number of positions occupied by experienced mid-career engineers who were specifically tasked with identifying and developing new materials, methods, and practices and assessing their potential impact on the business "bottom line". Through collaborative peer review, these positions also had a role in confirming that production groups delivered optimised resource use and expenditure. Efficient game-changing practices were developed through innovation, by "borrowing" from careful study of the way other railway administrations operate, and by examination of "what if…' scenarios.

The sectors evolved and, in 1990, started a migration from the matrix structure to become vertically-integrated business units with effective control of their costs, and accountability for revenues across their activities. Under the umbrella of British Rail, whilst the sectors were analogous to subsidiary companies, the integration of operations and cooperation necessary for a single railway network to function safely and effectively was achieved by requiring them to abide by a carefully tailored suite of "trading rules" and by an organisation design which included significant elements of countervailing power between sectors. The culture and practice of constructive challenge and creative tension was maintained by a British Rail headquarters based "business review" organisation, reporting directly to the group chief executive and comprising a small group of discipline and functional experts capable of critical analysis of sector policy and performance.

'Value for Money' (VFM) is an idea beyond that of accounting probity. It is very much part of a business culture that, if it pervades an organisation, increases effectiveness, and aligns organisational priorities and activities to present and future business needs. So, whereas efficiency contributes to an input or output, VFM is key to the outcome. VFM links across from engineering and operations, to present and future commercial demand, and to the defined outcomes sought. It is this link that was vital in contributing to the success of the business sectors within the pre-1994 integrated railway and to overall financial improvement within that railway[viii]. Principles of clear accountability and VFM brought transparency and led to better decision-making and appropriate controls.

Importantly, the VFM concept is not restricted to narrow commercial considerations but can, where appropriate, be extended to include social and environmental cost and benefits. Railway transport should play a leading role in contributing to the reduction in carbon emissions required to protect human existence. Whole-life carbon-related costs and benefits of capital and renewal works (together with associated targeted reductions) including those embedded in materials and through to eventual asset replacement, reuse, and disposal should be transparently incorporated into VFM assessments. By extending and adapting the scope of the

	Traction Decarbonisation Network Strategy[ix] and Network Rail's Environmental sustainability strategy[x] to cover all aspects of GBR activity, GBR has the opportunity to build the costs and benefits of emissions reduction and wider sustainability considerations into Value for Money ethos and practice, building programmes and projects into an integrated industry strategy with a visible tangible value. The VFM concept should also encompass major route upgrades and national initiatives such as vegetation control and climate-change driven infrastructure programmes such as earthworks stabilisation and strengthening of coastal defences. Railway infrastructure comprises long-term assets requiring a careful mix of maintenance, renewals, and new investment. GBR will face the dichotomy of the need for long-term investment in infrastructure and operations against the need to align everyday costs and revenue: a challenge which continues to face railway organisations across the globe. This alignment can be particularly demanding for secondary and tertiary routes. Well-targeted investment in technology, processes, plant, and the asset itself can reduce (and has reduced) maintenance costs but only if pursued to completion and accompanied by active measures to ensure that associated cost reductions are delivered. Unfortunately, such benefits capture has not always been realised in practice[xi]. This is a hard discipline to follow and maintain but is essential in achieving the goal of consistent value for money. Restructuring of the industry towards privatisation in the early 1990s separated wheel from rail. The management of infrastructure and associated operations passed to the infrastructure owner (Railtrack, and later Network Rail). Importantly, this change meant that the infrastructure manager lost visibility of the industry's discrete revenue streams, replaced by a regime of regulated access charges, notionally linked to cost causation. Accountability was largely internalised, except at the highest levels where a combination of financial regulation and government control was applied. The creation of GBR presents an opportunity to re-establish a clear sight line between industry revenue streams and their associated costs and to build organisational arrangements that facilitate and legitimise internal informed challenge (creative tension) and foster a comprehensive VFM culture[xii]. The clear lesson from the period 1982 to 1989 is that properly incentivised, facilitated, and coordinated changes in culture and organisation can deliver significant cost reduction, revenue growth, and business improvement but that the evolution to greater efficiency is a "whole business", long-term project. *Costs and Work Programmes* Aggregate railway transport industry costs have grown in real terms since the fragmentation of the British national network operator in the mid-1990s. More recently, between 2015/16 and 2019/20 network infrastructure maintenance costs in England increased by c30% from £1.15 bn to £1.49 bn over a period when passenger carryings and revenue were broadly flat and when freight traffic and revenue declined[ii]. Over the same period expenditure on renewals fell by c14% to £2.41 bn[ii].

	Major problems in the scoping, planning, and delivery of mega projects including the West Coast Main Line Route Modernisation (WCRM) and Great Western Main Line Electrification programme (GWEP) led to very large cost and timescale overruns and are well documented in National Audit Office reports[xiii]. The failure on the Great Western Main Line Electrification programme caused the government to halt the national electrification programme agreed with the industry in 2012. Benchmarking costs of capital works in the UK against European railways[xiv] has demonstrated that UK costs are high by comparison. In 2011, the McNulty Report[xv] noted that Britain's railways exhibited an efficiency gap of 40% against four European comparators - France, Netherlands, Sweden, and Switzerland, almost exactly the reverse of the conclusion of the similar 1989 work, recorded by Gourvish[xvi], when British costs were found to be 40% cheaper than their continental equivalents. While the UK has now left the European Union, the comparisons were made at a time when UK was bound by the same European legislation applied across member states. In CP5, the widely publicised problems with electrification costs and programme delays provoked much reflection and investigation. The Railway Industry Association (RIA) undertook a wide ranging and in-depth investigation and published a report in 2019 entitled 'The Electrification Cost Challenge'[xvii]. The report noted that British scheme costs were high measured against comparable European schemes in Germany, Denmark, and Switzerland. The differences were largely identified as existing as a result of large British projects tending to create booms and busts in demand compared with rolling programmes based on annual volumes and continuity of work. There is no doubt that, where they can sensibly be established, rolling programmes with stable work volumes are better placed to deliver efficiently than a series of one-off projects. Whilst there is little public evidence that the positions reported by the EU, McNulty, and RIA have improved, the current industry Project Acceleration in a Controlled Environment (PACE) and Swift Pragmatic and Efficient Enhancement Delivery (SPEED) initiatives offer some grounds for optimism. Pe-privatisation, properly value-engineered and incentivised processes played a critical role in the efficient and timely delivery of large scale industry projects such as electrification of the East Coast Main Line. Programmes of infrastructure work should be identified as early as possible and should remain steady to enable planning of recruitment and training throughout the industry. Whilst the detailed content of such forward workbanks should be identified to facilitate economy in delivery, some flexibility to alter (or swap) individual item priorities should be retained as deterioration rates are not always reliably predictable, particularly in earthworks and structures (and some track work) where degradation rates are often weather-dependent. Track renewal works continues to be delivered as a rolling programme. Whilst accounting practices and allocation of overhead and ancillary costs make historical cost comparisons impractical, management documentation from the early 1990s suggests that, here too, costs have increased well above the rate of inflation. It is difficult to be definitive, but a contractual and delivery structure

which discourages the sharing of resources, and the optimisation of their use and costs at a pan-industry level, has undoubtedly played a part in cost escalation.

There appear to be opportunities for more effective utilisation of the railway industry's on track machine (OTM) fleet, particularly in the integration of delivery of renewals-related and maintenance-related work. Network Rail has already achieved in the field of train-borne (and latterly drone-borne) systems to capture and utilise large quantities of asset condition data as part of a condition-based maintenance strategy, however associated cost reductions are difficult to identify. Inevitably, opportunities to analyse this data and use the resulting information to optimise maintenance and renewal interventions will continue to present themselves and must be exploited: importantly though the maximum benefits will only be captured where corrective work is properly scoped and where, subsequently, the appropriate machines and staff with the appropriate skills are deployed.

Risk and Waste

Developments in the management of network infrastructure since privatisation have followed a bumpy path, including an early period where the importance of engineering was ignored and engineers marginalised, with an adverse impact on client knowledge and understanding; and where an overall increase in resources followed on from recognition that some "double-marking" at the client-contractor interface was essential. The capacity of the Schedule 4 and Schedule 8 access compensation regimes to create perverse incentives remains, as does the danger of multiple accumulation and pricing of risks (often unrealised) at sequential contract interfaces. There is an understandable tendency for contracting parties to wish to pass perceived risks down the contractual chain, but this can have perverse effects. For example, if a client stresses a requirement for a railway that will be maintenance free for 120 years, this can reduce the incentive to make deigns economical. Major projects including WCRM, GWEP, and Crossrail have highlighted the risks associated with multi-layered contract structures, where it is unclear whether the transaction costs and accumulation of overheads and profits at sequential contract interfaces have been balanced by client cost savings or improvements in delivery efficiency.

In creating a new structure, GBR has an opportunity (as an integrated railway operator) to better understand and manage overall risk, and to assess the value of holding more contractual and project risks itself, particularly those that materialise relatively rarely. It goes without saying that the management of risk should lie with those best able to understand it and who are incentivised to minimise the overall associated cost.

More recent and positive developments have seen the importance of engineering recognised; the successful integration of new technology into asset inspection regimes; strengthened assurance around the identification and delivery of maintenance tasks; increased devolution of responsibility for management of infrastructure and operations to Regions and Routes; and further measures to improve workforce safety. That said, there are still instances of waste in the system. An example is the lack of reuse

of serviceable track materials, in particular the absence of cascading rail from primary to secondary routes. This practice is highly efficient and effective (particularly where direct "site to site" transfers are made) but was abandoned as the industry was fragmented. Not all "pre-used" rail is suitable and good planning is critical but significant cost benefits were achieved pre-privatisation and could be again.

Whilst some cascade capability was established at Whitemoor over a decade ago, in the era of climate change and decarbonisation there is much more that can be done in the cascade and reuse of materials[xviii]. Reuse and cascade of materials appears to be an area where devolution to Regions and Routes could clarify and align incentives, and grow capability. Adjustments to renewals contracting regimes, where recovery of serviceable materials is weakly incentivised, present a further opportunity.

Waste of a different kind can be created where railway assets, often with a potential life measured in decades (if not half centuries), are not installed or maintained to an appropriate quality. The quality of good design and installation is critical to achieving optimum asset life. The waste consequent on decisions to sacrifice asset life for short term financial or reputational gain (for example to rush a sub-standard install to avoid a possession overrun) should be consciously considered within a "whole industry, whole asset life" context when such decisions have to be faced.

Of course, the start point for any project or renewal should be to ask whether the work is really necessary, or whether a better solution exists to give a lower whole-life cost. In many cases, including track renewals, life extension interventions can offer better long-term value and the options for extending life should always be considered.

Structure and People

The structure of GBR should follow established good management practice with as few layers of management as practicable, though acknowledging the scale of the organisation. Similarly, responsibilities and accountabilities should be clearly defined, and key engineering management roles should be occupied by competent professional engineers.

The industry's experience of the management and delivery of capital works over the last 25 years is mixed. Many large and "mega" projects have been contracted out to alliance consortiums which effectively take full control of definition, design, and delivery. In this model, the industry relies upon the contractor and consultancy supplier base to define and undertake all works and the client has little incentive to grow expertise: indeed, the client may be criticised for seemingly over-intrusive oversight of projects. Whilst smaller programmes have been successfully delivered to time and budget, the clear lesson from rail industry mega projects is that no organisation can successfully manage contractors delivering complex major projects unless it is itself an informed client.

Similarly in planning engineering access (possessions: see below) for intrusive work, it is important for overall system efficiency and economy that a culture of "informed and healthy challenge" exists between those requesting possessions and those granting them,

	and particularly between those who operate the railway and those who engineer it. The safety of the railway system is dependent on having responsible, competent, and informed staff (and particularly engineers and operators) who are able to properly assess balances of risk and act accordingly. GBR has a clear opportunity to develop, support, and retain competent people to maintain "informed client" capability in strength and depth and to adjust the contracting and commercial approach adopted for mega projects. System safety, effectiveness, and efficiency all argue that GBR should prioritise these objectives. Efficiency in engineering and operations argues for greater use of shared resources with staff crossing from one team to another as workloads fluctuate, for example between track renewals and track maintenance, and between operational and engineering planning. Such flexibility would also tend to broaden staff experience and create workforce more informed on the totality of railway management. Professional bodies such as the PWI, Chartered Institute of Railway Operators, and Institution of Railway Signal Engineers are also very well-placed to enhance workforce competence and capability through the continuous professional development required of members, and through in-career high-level railway-focussed education and training. *Possessions Strategy* Prior to privatisation, a very high proportion of major engineering works were undertaken in possessions of around 16 hours (with a Sunday finish at 16.00). The then passenger businesses recognised that with new highly productive track plant available, it would be possible to reduce major possession work to 12 hours, allowing the tracks to be returned to the operators by 12.00 on Sunday. Then (as now) in commercial terms this would have been extremely advantageous as Sunday had become an ever increasingly important day for leisure and other weekend travel. Privatisation effectively halted the development of this engineering access strategy and, since 1997 weekend possession times have tended to lengthen rather than shorten. In 2004 the partial adoption of "high output" track renewal equipment and techniques appeared capable of reviving the concept of a seven-day railway, with most track renewals being undertaken in 7 or 8 hour possessions. In more recent years two factors: i) a single point focus on narrowly defined engineering costs; and ii) very clear and very strong management and contractual incentives focussed on the complete avoidance of possession overruns have again increased the use of long (and very long) possessions and the extension of unproductive "possession buffer time". Today possessions cause regular and extensive weekend network disruption, have a negative impact on passenger revenue and customer perception, and incur significant Schedule 4 costs. Weekday multi-day "blockades", whilst understandable in the context of a Covid-induced collapse in transport demand, similarly undermine (in the longer term) public perception of railways as a truly dependable form of transport. By way of comparison

transport end-user interests in Switzerland appear better protected: there the Federal Railway allows six hours for engineering 'white periods' at night and the supply chains there have adapted their engineering activities to suit this access.

An integrated GBR will again have the opportunity to consider the whole industry costs and revenues associated with the engineering access regime and will be in a position to develop possession strategy and possession planning principles optimised to deliver best value for money. Observation of the detailed arrangements for protecting the interface between rail traffic and engineering work on other railways (and knowledge of previous development work in Britain) suggests that Britain's arrangements in this area could also be made more efficient. Developments in the field of command and control (sometimes still referred to as signalling), including European Train Control System (ETCS) and other digital systems, also offer opportunities to grant engineering access more quickly and to improve the viability and efficiency of work in shorter "no-trains" periods.

It is a "given" that sufficient engineering access to maintain and renew the railway network is necessary. However, previous experience in Britain and current practice on other railway administrations shows that the industry is more than capable of innovating and adapting the way engineering work is delivered to suit a variety of less intrusive possession patterns with the potential to deliver greater overall value for money.

Technical Development, including the Wheel/Rail Interface

University-based railway research groups have been nurtured by EPSRC (Science Research Council) the over the past 20 years, culminating in establishment of the UKCRIC research alliance, and effectively replacing the capability of the railway's internal Derby-based research body, largely lost when the industry was privatised. Whilst much good research work has been done, notably relating to management of the wheel/rail interface, there remains significant scope for closer engagement between the operational railway and research. GBR has a clear opportunity to devise more effective arrangements for pulling fundamental science research up through the levels of technological readiness and into practical solutions that will drive further cost and carbon efficiencies.

Though asset performance at the wheel-rail interface has been much improved over the last 25 years, particularly since the 2000 Hatfield derailment, the interface remains a critical source of risk and its management drives significant industry maintenance and renewal costs for both infrastructure and rolling stock.

Advances in measurement and monitoring technology have made practical the equipping of service train vehicles to routinely provide infrastructure condition monitoring data. Such systems applied to the interfaces between vehicles and the infrastructure can secure safer operation, improve service performance and increase the focus of maintenance and asset renewal on that which

is necessary as opposed to that which is routine. On-asset monitoring technology has similarly become cheaper and much more widely applicable. GBR will be well placed to take a cross industry view and lead further deployment of these technologies.

A number of emerging technologies, notably active suspensions and independently driven/braked wheels (trialled on freight vehicles on railway administrations outside the UK) appear to offer a significant reduction in wear and tear damage, and consequent costs, at this system interface. GBR in owning responsibility for costs on both sides of the interface will be well placed to investigate and sponsor developments in this field, with the potential for significant reductions in industry costs and increases in asset availability.

Standards

The last 30 years has seen the development of a sophisticated and wide ranging standards regime covering engineering and operational activity on the railway system. The regime enables less experienced personnel to accomplish in a consistent and safe manner many of the tasks which previously fell to more experienced engineers (and often required the exercise of judgement on a case by case basis). The scale and scope of the regime means that many in the industry are unfamiliar with the detailed requirements of standards and their underpinning rationale.

Clear processes are already in place to facilitate standards challenge and to use risk assessment to support derogations and instances of temporary non-compliance. However, these processes can be both time consuming and complex, and they carry the risk that the change, or agreement to non-compliance, requested may fail (with a consequent potential requirement for expensive and/or disruptive remediation). This has resulted in an understandable reluctance to challenge standards (even where the risks associated with non-compliance are low and the cost benefits are high), and uncertainty as to the circumstances in which challenge or non-compliance would be appropriate. As financial pressure on the industry increases it will be important to take advantage of such low risk/high benefit opportunities. There is an opportunity to facilitate standards development by encouraging challenge and investing in development independent of specific projects.

Summary of Opportunities for GBR

GBR will integrate the major components of the whole railway. That integration will inevitably create tensions as available funding constrains costs and thus affordable work. That said, as GBR is shaped to deliver a service to its passenger and freight customers, its integrated “whole railway” management structure can create a unified ethos and team culture which seeks to live within its means; to pursue cost effectiveness, and; to optimise revenue earnings, social value, and industry costs.

Industry Revenues

- Increased agility in the development and implementation of projects, notably capacity expansion for intermodal freight, has the potential to drive early increases in traffic volumes, modal shift, and industry revenues.
- The intention to form GBR, with its attendant "whole industry" ethos, provides a positive backdrop and framework within which the industry can be incentivised to develop the flexibility necessary to adapt service provision to post-covid transport demand patterns.
- GBR has the opportunity to look more widely at the provision of network-wide journey opportunities, including the facilitation of time-efficient connections and easy and convenient transfers between rail and other public transport modes, rather than primarily focus on in-franchise O&D flows.
- GBR should (in conjunction with Highways England and academia) develop an analytical tool set, particularly to understand the true modal shift effects of options for passenger travel service design and provision. The tool set should also be capable of assessing and quantifying the social and environmental value of the railway network and services, including valuing reductions (or increases) in carbon emissions (see Social Value below).

Social and Environmental Value

- GBR should be well informed on the factors likely to drive and influence changes in government policy, particularly in the area of decarbonisation, climate change, and related emerging technology. The organisation should have the capability to work collaboratively with government in policy development, and be able to respond rapidly and knowledgably to policy changes as they emerge.
- GBR's plans for financial sustainability should be drawn up to dovetail with the government strategy intended to deliver the UK's overall 2030 and 2050 decarbonisation objectives. GBR should be able to demonstrate how its physical plans help to; deliver transport emissions reduction at national and regional level, and include and account for other measures of social value and benefit.

Industry Costs

Internal Challenge and Value for Money

- Re-establish a clear line of sight between industry revenue streams and their associated costs and, recognising that the evolution to ever greater efficiency is a "whole business, long-term project", build organisational arrangements that both facilitate and legitimise internal informed challenge (creative tension).

- Foster a comprehensive Value for Money culture.
- Build the costs and benefits of emissions reduction and wider sustainability considerations into the Value for Money ethos and practice, bring related programmes and projects into an integrated industry strategy with a visible tangible value.

Costs and Work Programmes

- Where they can sensibly be established, rolling programmes with stable work volumes should employed, as they are better placed to deliver efficiently than a series of one-off projects.
- GBR should build on the PACE and SPEED initiatives and continue the value engineering of project management processes, including aligning incentives to whole industry goals.
- Work programmes should be identified as early as possible and should remain steady to enable planning of recruitment and training throughout the industry. The detailed content of forward workbanks should be identified to facilitate economy in delivery, but flexibility to adjust (or swap) individual item priorities should be retained to allow for unpredictable asset deterioration rates.
- Opportunities for more effective utilisation of the on track machine fleet, particularly in the integration of delivery of renewals-related and maintenance-related work should be explored. Continue to exploit opportunities to use the analysis of asset data to optimise maintenance and renewal interventions.

Risks and Waste

- GBR has an opportunity (as an integrated railway operator) to better understand and manage overall risk, and to assess the value of holding more contractual and project risks itself, particularly those that materialise relatively rarely.
- Review the controls, incentives, and capacity around the recovery, cascade, and reuse of materials. Revise these as necessary to increase the recovery of materials for cascade and reuse, thus supporting carbon emissions reduction objectives and to delivering efficiencies.
- When looking at recovery measures to avoid a possession overrun, consider the impact on asset quality and lifespan from a "whole industry, whole life" perspective so that long term value is not disproportionately sacrificed to achieve immediate benefit.
- Include asset life extension options when considering asset renewal proposals.

	Structure and People • Prioritise the development, support, and retention of competent experienced people to maintain "informed client" capability in strength and depth. • Use resource sharing with staff crossing from one team to another as workloads fluctuate and to broaden staff experience and capability in the totality of railway management. • Consider how engagement with professional bodies can be used to enhance workforce competence and capability. *Possessions Strategy* • Consider whole industry costs and revenues associated with the engineering access regime to develop a possession strategy optimised to deliver industry best value for money, rather than lowest engineering cost. • Exploit the opportunities presented by developments such as ETCS and other digital systems which grant and protect engineering access more quickly to improve the viability and efficiency of work in shorter "no-trains" periods. *Technical Development, including the Wheel/Rail Interface* • GBR has a clear opportunity to devise more effective overall arrangements for pulling fundamental science research up through the levels of technological readiness and into practical solutions that will drive further cost and carbon efficiencies. • Consider expanding the wider use of on-asset monitoring and equipping further service train vehicles with measurement and monitoring technology to provide infrastructure condition monitoring data; all focussed on delivering safer operation, improving service performance, and better focussing resources on that asset maintenance and renewal work which is truly necessary. • Investigate and sponsor new technological developments in the wheel/rail interface field to optimise asset availability and whole industry/system costs. *Standards* • Encourage the identification of low risk/high benefit opportunities for standards change, derogation, or temporary non-compliance. Invest in and develop these independently of specific projects.

[i] T. R. Gourvish British Rail (BR 1948-1973 A Business History (1986) pp396.
[ii] National Audit Office – A financial overview of the rail system in England (April 2021).
[iii] Modal Switch of Freight to Rail, pages 72 - 77, (Modern Railways, September 2021) and Rail Freight Ready to Support Net Zero", pages 62-68, (Modern Railways Review, 2022), both Key Publishing.
[iv] See extensive industry press reports of delays in improving line capacity between Soham and Ely and at Ely North Junction. (There are other well reported examples.)
[v] Absolute Zero - report by UK Fires (Cambridge University, November 2019).
[vi] The Economic Contribution of UK Rail, Oxford Economics / Railway Industry Association (November 2021).
[vii] Valuing Greenhouse Gas Emissions in Policy Appraisal (Department for Business, Energy & Industrial Strategy September 2021).
[viii] Two examples of VFM from the Business Sector structure: (a) Increased use of differential maximum speeds on secondary routes for passenger and freight traffic, each with their particular axle loadings, to optimise track life and use of scarce resources, (b) Use of steel sleepers in track renewal on urban routes where use of short mid-week night possessions became feasible through the ability to manhandle these sleepers which are lighter than concrete ones.
[ix] Traction Decarbonisation Network Strategy (Network Rail, July 2020).
[x] Environmental Sustainability Strategy (Network Rail, 2020).
[xi] Non-implementation of the 'modular switch' concept which would have permitted mid-week renewal of switch and crossings in 8-hour possessions. Procurement of 12 customised mobile 'flash-butt welding' machines and their subsequent sale due to non-use. Procurement followed by sale of modern 'high-output' reballasting systems.
[xii] The evidence for the effectiveness of this approach can be found in the commercial success of BR's business sectors in the late 1980s and the way they operated to achieve this, bringing innovation, growth, resource productivity, profitability improvement and subsidy reduction. BR in 1989 was 40% more efficient than eight comparable rail systems in Europe used as benchmarks, whereas in 1979 BR was no more than 14% more efficient. By 1993/4 BR's burden on the taxpayer was £724 million less than in 1982, equivalent to a reduction of 73%, and most elements of BR's costs reduced, including maintenance costs which declined significantly (Gourvish T, 'British Rail 1974-1997: From Integration to Privatisation', Oxford, 2004). Nonetheless, the legacy of underinvestment and well-publicised operating losses meant BR and railways in general were in low public esteem and there was customer dissatisfaction with service quality (Wolmar C, 'On the Wrong Line', Aurum Press Ltd, 2005).
[xiii] Modernising the Great Western railway report (November 2016); The Modernisation of the West Coast Main Line report (November 2006); both by the National Audit Office
[xiv] Study on the competitiveness of the Rail Supply Industry – Final Report (Ecorys in cooperation with VVA and TNO, for the European Commission, September 2019)
[xv] Realising the Potential of Rail in Great Britain (McNulty Report, 2011)
[xvi] British Rail 1974-1997: From Integration to Privatisation (Gourvish T, Oxford, 2004)
[xvii] Electrification Cost Challenge (Railway Industry Association, March 2019)
[xviii] A good example in recent times (2007) was the cascade and reuse of redundant bridge girders from the WCML at Lichfield to Croston on the secondary line between Ormskirk and Preston, providing a saving of £100K as well as environmental benefits.

GREAT BRITISH RAILWAYS

ANSWERING THE CALL FOR EVIDENCE

QUESTION 6

Great British Railways
TRANSITION TEAM

THE PWI
THE INSTITUTION FOR RAIL INFRASTRUCTURE ENGINEERING

	PWI answer to Question 6 – Delivering environmental sustainability
6.a) What is a stretching yet realistic ambition for this objective and what measures can we most effectively use to consider success over the coming 5, 10 and 30 years? What are the interventions over that period which will be the maximum value for money, and what evidence can you share to support your views?	**Delivering Net Zero** The British government and Network Rail have each published policy documentation addressing this subject. Target timescales are bound into these and the ambition of achieving net zero by 2050 is clearly acknowledged. Relevant documents are: • Decarbonising Transport: A Better, Greener Britain[i] • Rail Environment Policy Statement: On Track for a Cleaner, Greener Railway[ii] • Traction Decarbonisation Network Strategy[iii] • Network Rail's Environmental Sustainability Strategy (2020-2050)[iv] The Rail Environment Policy Statement sets out government's priorities for the railway transport industry with a simple pictorial representation in Section 4, covering net zero, biodiversity, and air pollution. Network Rail's Environmental Sustainability Strategy contains a comprehensive set of science-based targets. From today's perspective and from a general project management point of view, the broad objectives and targets set out in these documents appear stretching and ambitious in their own right. The PWI has not developed a clear view on the deliverability of the proposed policies and actions, though we can note that their delivery will depend critically on the prioritised application of funding and other resources, and their integration into the detail of general business processes and activities. The principal burden of delivering these policies and strategies will fall to those companies which deliver railway transport services and those which construct, maintain, and renew the associated assets. The PWI is a Professional Engineering Institution (PEI) committed to supporting the British railway industry. The Institution is fully alive to the issues of sustainability and the need to mitigate and reduce human impact on the earth's climate and ecosystem. The PWI does not itself deliver transport or engineering operations, but we are acting to contribute to the implementation of current government and Network Rail policies, and to the success of the railway industry in the UK. As a PEI the PWI is committed to integrating consideration of sustainability and, more specifically, emissions reduction and climate change adaptation, into its core activities. These are:

- the professional development of engineers, technicians, and others who manage or work on railway infrastructure; supporting them in developing their competence and capability;
- supporting employers who seek to enhance the competence and capability of their staff (workforce capability workforce is a critical factor in delivering sustainability objectives);
- sharing knowledge and good practice amongst all branches of the railway infrastructure engineering community, and transferring knowledge from the wider engineering sphere to the railway industry (and vice versa);
- delivering extensive and relevant technical information and technically focussed events;
- working with other PEIs and the Engineering Council to set and maintain professional engineering standards;
- as a member of the Joint Board of Moderators (JBM) working with universities to influence the content of university courses, reflecting in them the most up to date scientific and social knowledge and understanding.

Recognising the climate change and decarbonisation challenges in railway infrastructure, in 2020 the PWI established a collaborative Climate Change and Decarbonisation Committee. This draws on the expertise within our membership to share developing understanding, solutions, and best practice; enabling change by fostering their adoption.

An Industry Strategy

From its work to date, the PWI has concluded that Network Rail's Environmental Sustainability Strategy should be adopted by GBR to become the foundation of a future whole industry strategy, developed with wider industry input. Continued advances in the knowledge and understanding of climate change science and of wider sustainability effects, progress in the delivery of carbon emissions reduction, and evolution of government policy mean that the strategy will undoubtedly be adjusted over time, but this well thought out document makes an excellent starting point for the British railway industry.

It is important that the industry remains up to date with the developing scientific understanding of sustainability and climate change and the maintenance of good links between GBR and academia will be fundamental to this.

Value for Money and Prioritisation

When looking at value for money, and particularly where funding is constrained, the industry must employ a consistent methodology to assess and prioritise expenditure and investment (on a "whole industry, whole life" basis), including placing financial value on sustainability and the reduction of CO_2e emissions. Recent guidance from government on the value of

emissions reduction[v] is important but there may be helpful parallels with the highly successful work carried out by the railway industry in the late 1980s and early 1990s on the evaluation and prioritisation of investment in safety initiatives.

On the basis of current understanding, the PWI has identified 5 themes which encompass delivery of the major railway industry contributions to sustainability and decarbonisation:

- electrification;
- materials, construction, and whole life carbon;
- energy supply;
- education and competence, and;
- encouragement of modal shift.

Electrification.

Government has recognised the role that electrification should play in delivering decarbonisation and has set ambitious policies for further electrification of the rail network, to be delivered at a cost that is affordable. The railway industry, led by Network Rail, has responded, publishing the Traction Decarbonisation Network Strategy (TDNS) in September 2020 and building on the recommendations of the Railway Industry Association's 2019 *Electrification Cost Challenge* report. The PWI believes that to deliver net zero by 2050 it will be critical for GBR to work to deliver an electrified network in line with the TDNS, starting with the many available "no/low regrets" elements and subsequently, as the electrified network grows, updating plans to reflect changes in traffic requirements and available technologies.

In recent years the PWI has opened its membership to include those from the electrical disciplines. Whilst still young, this initiative is developing strongly and over the next 5 to 10 years we expect to significantly increase our membership within this community. We intend to educate, share knowledge, and promote debate amongst this community (and the wider PWI membership) as to more efficient methods of working from design; through construction and maintenance; and into decommissioning, recovery, reuse, and recycling. In 2021 we ran a seminar specifically looking at cost effective minimum clearance electrification which attracted one of our largest audiences in a quest for information. The theme of efficient delivery of electrification schemes will remain for future seminars and discussion forums. The PWI has also embarked on a high level technical training programme specifically targeted at those from an OLE background or with a strong interest in this technology. These components, together with employer provided training and development, will help to deliver a highly competent workforce.

Materials, Construction and Whole Life Carbon

Zero emissions will drive a rapid transition in material requirements. Significant reduction in demand for some ores and minerals, particularly those associated with steel and cement, are likely along with a rapid expansion of demand for materials associated with electrification. It seems likely that there will be opportunities for consolidation in the currently diffuse businesses of secondary material collection, processing, inventory, and supply.

Reuse of materials is top of the waste management hierarchy. New steel in particular is considered to have 25 times the environmental impact compared to reuse. GBR could target reuse of concrete sleepers and rail from main line renewals for branch and secondary lines. Even worn rail and sleepers could have up to 50 years life when cascaded. Targets should be set for % reuse increasing from 5 to 30 years. Relaying methods will have to develop to better facilitate the cascading of materials. Above all, the priorities and incentives encouraging material recovery, reuse, and recycling applied by and to Network Rail Routes, asset managers, track renewal contractors, and Network Rail Route Services will need to be aligned and strengthened. The PWI could act as a channel for the dissemination of information throughout the membership and as a mechanism for knowledge sharing and learning in support of this.

Energy Supply

The railway industry's energy requirements will change as we move to 2050. GBR will require an energy policy for rail transport that dovetails into the potential use of far more electricity (and potentially hydrogen), synthetic low/no-net emission fuels, and less diesel. From engineering data available it is more than clear that batteries themselves are currently environmentally polluting and that fossil fuel generation of electrical supplies will not be sustainable into the future. Power from nuclear fusion offers the prospect of an almost inexhaustible source of energy for future generations, but - so far - the technology presents serious and unresolved engineering challenges[vi].

Education and Competence

Along with other PEIs and members of the Joint Board of Moderators (JBM), the PWI has a role in influencing the content of university courses to ensure future graduates are ready to serve industry's and wider society's needs. The Royal Academy of Engineering (RAE) is also vocal on the subject and is leading work to define what the engineer of the future looks like, to which the PWI is contributing.

UK SPEC is the Engineering Council's document which defines the broad competences required by professionally registered engineering in the UK. In 2021 the Engineering Council changed this document, placing increased focus and importance on sustainability and the environment. The PWI and other PEIs are considering proposals to make knowledge and understanding of

	the United Nation Sustainable Goals (UNSDGs) a key part of the professional registration process. Under these proposals candidates will have to demonstrate how their roles and work link back to UNSDGs. The PWI, with other PEIs, also works closely with the National Engineering Policy Centre (NEPC – the policy evaluation and setting group within the Royal Academy of Engineering) and supports NEPC work on the path to net zero as outlined in the paper Net Zero: A systems perspective on the climate challenge[vii]. **Encouraging modal shift** Over the long-term the impact of climate change on behaviour appears likely to drive a substantial increase in the demand for low and zero emissions transport for both passengers and freight, perhaps counterbalancing and overtaking the reduction in rail commuting and business travel consequent on an explosion in the use of electronic communications and media. Environmental sustainability is much higher on the priority list of younger generations than those of 30 or more years ago. This younger group appears to have a greater willingness to embrace use of a public transport network in place of the private car, placing a premium on the integration of rail transport with active travel and other public transport modes. The Rail industry, with its green credentials, is well placed to seize the opportunities presented by young people in the travel market and to enlist their support in driving general moves to favour low carbon transport systems. It is also important to recognise that the shape of Britain's current railway system was determined in the late 1960s when the jumble of lines (built largely in the 19th century to no strategic plan) was pruned to suit the country's mid-20th century economic and social circumstances. Many of our larger and medium sized towns do not now have a train station within the settlement. Large 'new towns' have been planned and constructed with little or no consideration of railway (or any other form of low-carbon) transport, on the basis that the private car would provide for virtually all future transport needs. On the same basis, some significant transport corridors are effectively ignored by rail transport and a number of populous geographic areas are not well-served by rail other than for journeys to and from London. The stable environmental and social assumptions that have underpinned Britain's approach to rail transport over the last 60 to 70 years are changing rapidly (as they must if the human race is to avoid global catastrophe) and, whilst much of the current British railway network provides excellent connectivity and is in good physical condition, it would be unwise to presume that the current network shape or pattern of services is best-tailored to delivering modal shift or wider integration with other public and active transport. Modal shift will not occur by accident: it will require aligned policies, incentives, and plans from the railway industry, and more generally from transport planners and politicians. Modal shift will be facilitated by development of Britain's rail system as the core of a comprehensive network of public transport journey opportunities, not just city centre to city centre but encompassing towns and villages and providing a multiplicity of attractive journey opportunities.

	On current estimates, the Scottish Government's 2045 net-zero target requires a 57% switch to rail for journeys over 30km, and 23% of lorry tonne-km to shift to rail (Bill Reeve, Director of Rail for Transport Scotland in a presentation at COP26). To meet Cornwall Council's 2030 net-zero target, rail travel must double and freight be transferred from road to rail (The Cornwall Transport Plan to 2030). These examples highlight the scale of the challenge facing the British railway transport sector. Internationally, other countries and transport systems are adopting a range of initiatives to encourage low or no carbon travel and particularly to increase the attractiveness of railway services. Examples include: Talinn, Estonia where fare-free public transport for residents has been provided since 2013, causing rail patronage to increase by c25%, and; Luxembourg (a country of some 600,000 people) which introduced free travel across buses, trams, and trains in 2020. Whilst such schemes may not be relevant to current circumstances in Britain, their progress and impact should be followed and watched with interest. A less radical option to improve the attractiveness of British passenger rail transport could see the use of rail discount cards extend beyond young people, pensioners, and families travelling together. For the last 25 years Germany has successfully used a discounted rail fare scheme more inclusive than that in operation in the UK. The transfer of freight from road to rail transport is dealt with at length in the response to question 1, however the current suppression of potential traffic, particularly intermodal flows to and from ports, caused by network capacity or gauge clearance issues appears an area of immediate potential.
6.b) What use can the rail sector make of emerging or existing technologies to reduce its impact on the environment and enhance biodiversity over the next 5, 10, and 30 years, and, in a proportionate and cost-effective way, help national and regional authorities to meet their	The PWI has identified 7 areas of technology which have significant potential to reduce the rail sector's impact on the environment and enhance biodiversity. These are: • Life extension and reuse of materials; • Comprehensive extension of predictive maintenance; • Asset design; • Sustainable power generation; • Road/rail plant; • Water re-use; • Vegetation management. **Life extension and reuse of materials.**

environmental objectives?	So far as infrastructure is concerned the rail industry should make enhanced use of life extension techniques to ensure we maximise the value of infrastructure assets. The premature renewal of assets is counter-productive in environmental terms. The industry has lost the ability to effectively cascade its assets from high density, fast rail corridors to slower speed tertiary routes. At present, there does not appear to be a detailed, robust, logical, strategic asset cascade policy that prescribes utilisation of recovered assets that has been costed and budgeted. In this way a reduction in the manufacture of new materials can be realised by greater use of serviceable items. Currently, materials operating at 100+mph at 22.30 on a Saturday suddenly become scrap at 23.00: this cannot be right when provision of sustainable infrastructure is the priority. The industry appears to have become over-complicated and less innovative in its use such valuable and high-embedded carbon assets. **Comprehensive extension of predictive maintenance** Today's state of the art technologies include fully automated inspection, big data analysis and software predictions of degradation so that such "degrading assets", for example track, approaching a required intervention can be repaired before they fail. Many component subsystems have been in place for some years, however these have yet to be properly integrated to provide seamless asset management. This is an opportunity that could be remedied by adopting a "whole industry" approach to development. **Asset Design** Use of good practice engineering techniques and drawing on whole industry competence could be used to look at each major asset and design out weaknesses to ensure useful life is extended with inspection/maintenance access requirements during the asset life also being reduced. Historically, railway industry asset policy and procurement have tended to prioritise lowest initial cost over whole life costs. More recent changes, the move to using CEN60 rail for example, have demonstrated an encouraging trend to consider whole life impacts. As industry funding is tightened there will inevitably pressure to reverse this, and it will be important to ensure that a focus is maintained on make the best trade-offs possible between first and whole life costs within the funding available. **Sustainable power generation** Though not a core railway activity, GBR will be well placed to pursue sustainable power generation from wind, solar, hydro, and tidal sources. Power generated could be stored using a combination of batteries, hydro pump storage, and green hydrogen production through electrolysis from surplus solar and wind energy. Such generated and stored power could be put towards delivery of electrified train services. Importantly, investment in power distribution infrastructure across UK and Europe is

	required, in addition to local, small scale grids making use of Electric vehicle batteries when stationary (Vehicle-to-Grid technology). Alternative industry power sources, for example from nuclear, air propulsion, or magnetic levitation, including energy flooring that generates electricity from footfall at stations[viii] should be considered. **Road/rail plant** Large on track machines (OTMs) used for production-line renewals, high-output maintenance, and other specialist tasks could replace road/rail plant, and 'eco-friendly' freight locomotives could be used to haul engineering vehicles at higher speeds than can be attained by self-propelled OTMs. The maximum speed of 'next generation' locomotives, plant, and unpowered vehicles should be increased, to reduce the consequential impact of engineering train movements on the timetabling of revenue-earning trains. From an OTM perspective, EV charging points should be provided at every machine stabling siding to enable the supply chain to switch its road vehicle fleets from diesel powered to electric. **Water re-use** Rainwater harvesting technology should be installed at all stations and railway boundary buildings to supply toilet flush, irrigation, and vehicle wash water requirements. All new railway buildings should be specified to meet Passivhouse Standards so that no additional energy is required for space heating or cooling. **Vegetation Management** Vegetation on railway earthworks has become a major problem since the introduction of mechanised maintenance in the mid-1960s (nearly 60 years ago) when mowing of lineside grass ceased. Comprehensive guidance on lineside vegetation management exists[ix] but its application appears somewhat patchy. GBR should promote the seeding/planting of suitable, low maintenance, ground cover plants that would assist in stabilising cuttings and embankments. Areas remote from the running line should be listed and prioritised for rewilding: in association the applicability of government incentives for this (as are planned for farming) should be explored.
6.c) How can rail best invest in climate resilience, supported by smarter forecasting, planning	The Network Rail Environment Strategy (2020-2050) details four key workstreams that the organisation is pursuing to better understand and manage climate resilience. These are: • Research and development to understand the vulnerability and prioritisation of assets and the real cost of weather and climate change.

and technology, over the next 5, 10, and 30 years and what evidence do you have to support your view?	• Routes developing their own asset weather and climate change adaptation plans. • Updating of policies, standards, and procedures to include mitigating the impacts of climate change. • The production of long term regional adaptation pathway strategies and investment plans by 2029. The PWI broadly supports this approach and recommends this current strategy is transferred to GBR and used as the foundation for a whole industry strategy. The PWI notes that Network Rail is close to completing a review and update of its policies, standards, and processes to reflect long-term climate projections. The production of long term regional adaptation pathway strategies and investment plans by 2029 appears to dovetail with the government funding plans noted within the strategy. However, there would appear to be space between 2022 and 2029 to develop interim adaptation pathways to guide remedial work and investment during the intervening 7 years, particularly as this is an area where new learning will come to the fore at pace and policy and strategy will require alteration.

[i] Decarbonising Transport: A Better, Greener Britain, Department for Transport, 2021.
[ii] Rail Environment Policy Statement: On Track for a Cleaner, Greener Railway, Department for Transport, July 2021.
[iii] Traction Decarbonisation Network Strategy, Interim Programme Business Case, Network Rail, July 2020.
[iv] Network Rail's Environmental Sustainability Strategy (2020-2050), September 2020.
[v] Valuing Greenhouse Gas Emissions in Policy Appraisal (Department for Business, Energy & Industrial Strategy, September 2021).
vi World Nuclear Association website (August 2021).
[vii] Net Zero: A systems perspective on the climate challenge, National Engineering Policy Centre, 2020.
[viii] Arup – Future of Rail 2050.
[ix] Lineside Vegetation Management Manual NR/L2/OTK/5201 March 2020 and documents referenced inter alia (Network Rail).