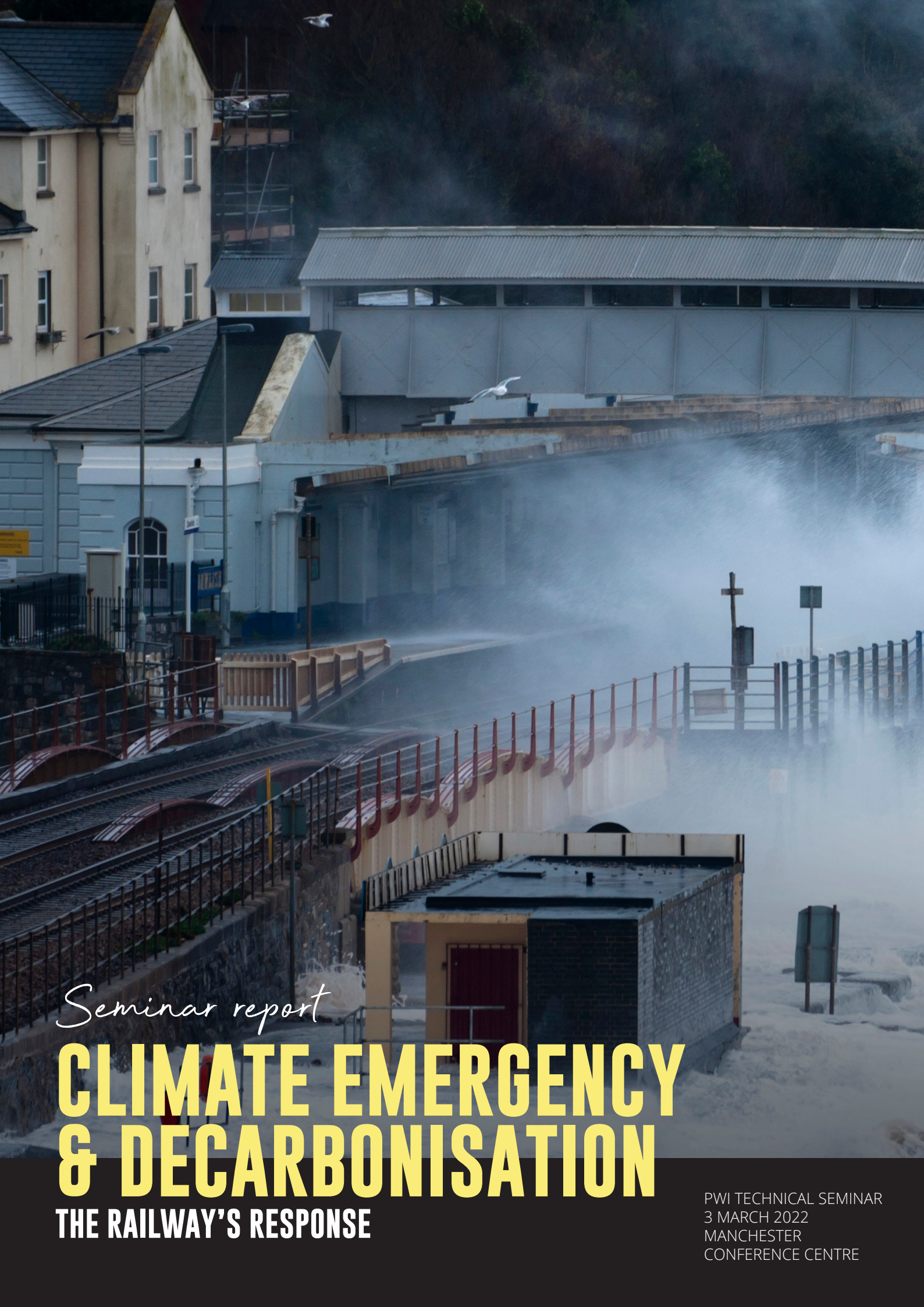




*Seminar report*

# CLIMATE EMERGENCY & DECARBONISATION

THE RAILWAY'S RESPONSE

PWI TECHNICAL SEMINAR  
3 MARCH 2022  
MANCHESTER  
CONFERENCE CENTRE



## AUTHOR: Chris Parker

Chris is a Chartered Civil Engineer, and a Fellow of the PWI and ICE. He has worked in the rail industry since 1972 retiring in 2004. His experience covered track and structures, design and maintenance and infrastructure management. After retiring Chris has remained active as a technical writer as well as writing reports for the PWI Journal and other organisations.

CHAIRS AM: JOAN HEERY - PWI MEMBERSHIP DIRECTOR | PM: PETER DEARMAN - PWI DEPUTY PRESIDENT

## WELCOME JOAN HEERY - PWI MEMBERSHIP DIRECTOR

The seminar morning session was opened by Joan, who is Chair of the PWI Climate Change & Adaptation Committee (CC&AC). She reminded delegates that the whole of the seminar was being recorded, and will be available to view through the new Institution website, which went live in early February.

After thanking those responsible for the seminar, particularly the sponsors and the PWI NW Section, Joan moved on to discuss the reasons for the day's agenda, which was obviously a response to the climate crisis that we all face. She spoke too about the CC&AC that she chairs, further details of this are also available on the website. Joan then introduced the first speaker of the day, Tricia Williams, inviting her to make her Keynote Address.

## THE PATHWAY TO NET ZERO, AN OPERATOR'S APPROACH

TRICIA WILLIAMS  
CHIEF OPERATING OFFICER - NORTHERN TRAINS

Tricia leads the team responsible for the whole of the day-to-day delivery of the train service by Northern Rail. She joined the company in the middle of the pandemic, coming from a background of other regulated industries, including Manchester Airports Group and United Utilities. She began by describing who Northern are and what drives their strategy, saying that their train fleet of 400 units is the core of the business. One third of their trains are electric and a quarter of the network on which they run trains is electrified. There are four big maintenance depots.

Options for the future fleet are hybrid units, battery units or units powered by alternative fuels. They already have a few hybrid, retrofitted units, today. Currently their emissions are 364,774 t pa carbon dioxide equivalent. They have switched to LED lighting, use zonal heating at traincare centres & are working with suppliers, who are responsible for 28% of the current emissions.

Their approach addresses Scope 1, 2 and 3 emissions, which covers respectively: (i) direct consumption (fuel etc), (ii) bought in energy, (iii) emissions generated outside the company (by suppliers etc). Tricia emphasised that so far there is no industry standard definition of "net zero" so they are working to their own understanding of this pending an industry agreed protocol. They are aligning their trajectory with the Paris Agreement timescales, and also measuring and benchmarking against other transport modes. She noted that EMUs compare very favourably with electric cars on emissions per passenger mile, but DMUs, while far better than internal combustion engine (ICE) cars, are not good measured against electric ones. Tricia saw several risks and challenges, including the development of an industry standard, the question of the delivery of further rail electrification, the feasibility of other net zero energy sources, the ability of the supply chain to decarbonise and concerns about the availability of the required expertise.

Next steps she envisaged included: business plan commitments, development and agreement of a clear roadmap and science-based targets, and finally the agreement and implementation of an action plan. Tricia reminded us that surveys show that 61% of their customers want sustainability.

## THE RAILWAY IN 2050 – A YOUNG PERSON'S PERSPECTIVE

BISOLA AKONI  
TRACK ENGINEER (NW&C) - NETWORK RAIL (NR)

Bisola set the scene for her presentation by speaking about the targets that have been agreed for limiting temperature rise, by considering the shocking state of affairs that will exist in 2050 if we do not act effectively, and by thinking about what this means for the railway. Floods, slips, track buckles, falling trees, sea level rise and human stress are among the many things that can be expected to affect the rail system.

She spoke about asset management in a warming world, foreseeing that maintenance skills and prediction of asset behaviour would be very important. Business plans have to incorporate climate change

issues. Ballast will require greater attention. Risks to the other systems that railways rely upon will need to be managed. Challenges on the road to 2050, she said, include the fact that 28% of the workforce is currently older than 51. Economic, social and technical factors all need to be taken into account. Asset deterioration continues and there are limits to the resources available, both human and material.

Bisola had a vision for rail in 2050 despite these worries: decarbonised using electrification, battery power or other technologies. Resilient infrastructure. Effective use of technology and innovation such as 3-D printing and new energy sources. Application of effective sustainability solutions. Attracting talent and customers by being seen as effective and efficient in delivery of needs. She ended her presentation with a picture that she felt summed up where she hopes the rail system will be by 2050. Take a look at this via the website.

## DECARBONISING MATERIALS

DARREN SHARP - PRINCIPAL ENGINEER, TECHNICAL AUTHORITY, TRACK AND S&C, NETWORK RAIL  
BRIAN WHITNEY - ENGINEERING EXPERT - TECHNICAL AUTHORITY, TRACK AND S&C, NETWORK RAIL

Darren opened this presentation, speaking of NR's drive to decarbonise and its work on the CO<sub>2</sub> emitted during track renewals. He referred, like Tricia Williams, to Scope 1, 2 and 3 emissions. For track renewals, the biggest of these is Scope 3 emissions, those emissions coming with bought-in services and materials. This all matters, because of the climate crisis obviously, but also because there are government targets to be met. The DfT has set phased reduction targets for emissions by project value for each of the 3 emission scopes. Major projects (>£500m) are subject to targets that came into place in February 2022 and smaller ones (>£50m) are caught by enforcement from July the same year.

PAS 2080 "Carbon Management in Infrastructure" shows a systematic way for managing the whole-life carbon in infrastructure delivery. It covers the life cycle of infrastructure before use, during use and end of life. Darren described the Rail Carbon Tool that has been developed to enumerate the carbon implications of rail infrastructure. Currently it is only in use on the construction phase, but it will be extended to whole-life in due course. It shows that 41% of the carbon from track construction comes from the rail currently, 24% from sleepers & 15% from the use of locomotive power. Amusingly, Darren contextualised this by saying that a concrete sleeper is responsible for the same emissions as 39 cheeseburgers and 1 metre of CEN60 rail equates to 52!

He went on to discuss briefly some of the strategies for reducing the carbon emissions from the top 3 track renewal items. Low carbon manufacture of steel for rails is obviously a key issue and a challenge. Current examples included using composite sleepers made from recycled plastics, which is expected to lead to a reduction of 18% in emissions compared to G44 concrete sleepers. Full product acceptance is imminent. Other alternatives are being considered for sleepers, and work is going on to develop more carbon reduction through recycling rail pads, insulators & clips.

Next Darren described the present position with respect to whole-life track carbon. Figures yet to be formally validated suggest that Category 1 concrete sleeper track with a life of 30 years has a carbon dioxide emission equivalent of 31.2kg/m pa. If this could be changed to composite-sleepered track with reduced carbon-emission rail steel & the service life extended to 50 years by such means as using under-sleeper pads (USP), this emission rate might be reduced to only 10.72kg/m pa.

NR has a sleeper strategy that demands reduced carbon emissions and a sustainable design, they are looking to achieve circularity and are engaging with suppliers to drive down their emissions. They are striving to minimise waste and maximise the efficient use of materials. Future steps include: improved specifications, improved awareness, better re-purposing of site materials, validating carbon tools, strategizing track in line with NR Carbon Zero 2050 and nudging suppliers to think greener. At this point, Darren handed over to Brian Whitney.

Brian began by stating the importance of collective action. Singly we can do little, but together we can achieve enormous change. He reminded us that we ignore the weather at our peril. He pointed out that in 2018, as energy production reduced its carbon emissions through green initiatives, transport became the UK's greatest carbon dioxide emitter. Network Rail is a huge purchaser of energy, either the largest or second largest in the UK. The carbon dioxide emissions for concrete sleepered track renewal are about 100t carbon equivalent for every 250m of relay. That's roughly the same as 3 domestic air flights of over 500km. To reduce this, the service life of installed track needs to be increased by better design and construction. Brian gave some examples. Possibilities include using composite sleepers, use of low carbon steel production methods for rail, use of under sleeper pads (USPs).

He discussed some indicative levels of greenhouse gas emissions for various transport modes, and emphasised the imperative to get people out of cars and onto public transport, particularly rail. Even existing diesel trains, with reasonable occupancy rates, have lower emissions/passenger kilometre than internal combustion engine cars, and there is similarly a benefit to switching freight from road to rail. Brian discussed the differences between "initial carbon" and "whole-life carbon", saying that it was a complex business to properly account for emissions in either case. The use of "carbon tools" to assess the emissions implications of any given proposal needs to be approached with care in order to avoid false conclusions.

Discussing the opportunities for improvement, Brian emphasised that it is important to act early. Once an asset has been installed, it is too late. Trying to alter things after the event is likely to involve yet more emissions, and scrapping an asset before it is life expired means throwing away embedded carbon. Brian finished with a series of conclusions, including: initial carbon and initial cost are often in conflict, but whole-life cost and carbon tend to be well aligned over appropriate timescales, assessment timescales need to be correctly selected, system analysis is vital. We must extend the life of the ballast, for example, by using USPs. Modal shift must be encouraged. We need to work better as a system to cut costs and emissions. His final words were "We cannot afford to ignore climate change".

## TURNING TODAY'S WASTE INTO TOMORROW'S TRACK INFRASTRUCTURE

WILLIAM MAINWARING - SICUT ENTERPRISES LTD

William commenced by considering the drivers for change, particularly for changing sleepers. Environmental concerns and sustainability requirements, the NR Environment Strategy 2020/2050 and economic pressures are all included in these drivers. Sleepers and rail pads account for about 29% of the carbon dioxide embodied in track, so there is potential for significant emissions saving. NR has a strategy for the use of composite materials, and the new NR Standard TRK/039 for polymeric (composite) sleepers follows from the new ISO Standard for these.

Sicut composite sleepers are already in use in over 20 countries across the world and have been used in Europe since 2013. They are made in Middlesbrough from recycled plastic and glassfibre, and have been independently tested to international standards. Transport for London (TfL) has been using them since 2015, and NR was expected to give them full Product Acceptance by the end of March 2022 for Category 3-6 Track.

The advantages William claimed for the sleepers included durability, longer service life, reduced manual handling risks, and the absence, in most applications, of any requirement for special tools or resources.

Moving on to the decarbonisation question, he showed figures for the embodied carbon dioxide of the sleepers and of installed track, demonstrating that their use could save about 200t/track km by comparison with the use of concrete sleepers. Further reductions are there too: the lower weight and reduced depth of the Sicut sleepers means logistical reductions, lower ballast depth is necessary owing to the reduced sleeper depth, and the sleepers may be reused or recycled when the track in question is taken out of use. Finally, there is the great benefit of using UK plastic waste directly in the UK and the avoidance of the use of timber or concrete.

William asked what was the cost of this carbon reduction and the other benefits? NR has carried out whole-life cost/benefit analysis indicating a whole-life saving of £40/sleeper pa. He said that the whole-life cost per kilometre of hardwood sleepers is £4.4m, with a carbon dioxide cost of 1,200t.

## QUESTIONS & ANSWERS WITH THE SPEAKERS

The Q&A led to significant discussion of how we become more agile as an industry, with contrasts being offered between the UK/EU rail industry and that in the USA, where composite sleepers have,

it was said, been in use since the 1990s. This led on to discussion of the differences in standards between the UK & the USA, and the reasons for these. A further discussion centred on how we can attract more talent into rail.

## RAIL FREIGHT RESURGENT – THE OPTIMUM ZERO CARBON TRUNKING MODE

JULIAN WORTH - CHAIR, RAIL FREIGHT FORUM - CILT

Julian recommended the adoption of a “can do” mentality. Rail freight can do it, as shown by recent non-coal freight traffic statistics, the highest on record. Intermodal traffic is 40% of all UK rail freight, driven by supermarkets, among others. Construction traffic makes up 20%, with other bulk traffic, like steel and biomass another 30%. Rail traffic growth has been driven by the decarbonisation of supply chains, abetted by the HGV driver crisis. Businesses are publicising their use of rail to get public approbation for their decarbonising efforts.

Julian said that there is a new model of logistics, involving trunk haulage by rail and local distribution by battery electric truck. There are now 37t battery HGVs with a range of 100km. However, he sees no credible alternative to diesel for long distance trunk haulage by road (say >200km), hence the use of rail for such traffic. Hydrogen (even if green, by no means certain) uses three times the energy of electric power. Electrified road service (ERS) he sees as operationally a non-starter, and battery electric vehicles are not practicable with current technologies over trunk haul distances. In contrast, 2/3rds of the trunk rail network is already electrified, leaving only around 800 route miles to do.

He challenged the common view that the scope for modal shift is limited, citing DfT statistics. The key is aggregating HGV loads to form trainloads. With most HGV routes running on core road corridors that parallel rail routes, this is not difficult to envisage. Few customers besides Tesco have trainload volumes to shift, so aggregating loads will be needed.

Key flows will be those between 200 and 300km, and realistically this amounts to around 200m tonnes pa. This implies trebling current trunk rail haulage. Julian calculated that, assuming a 13 hour day, we would need to shift about 26 trains each way/hour using 775m intermodal trains and 2000t bulk trains.

The challenges in this were considered, including: WCML (S) which needs HS2 to free up capacity, WCML(N) that needs new, long passing loops and flighting of trains, Felixstowe to the Midlands & North (F2M&N), which requires doubling between Felixstowe & Soham and Ely, and the cross-London route, that needs the implementation of the London Freight Strategy. There are a few other smaller issues like the upgrading of certain junctions, eg, Didcot.

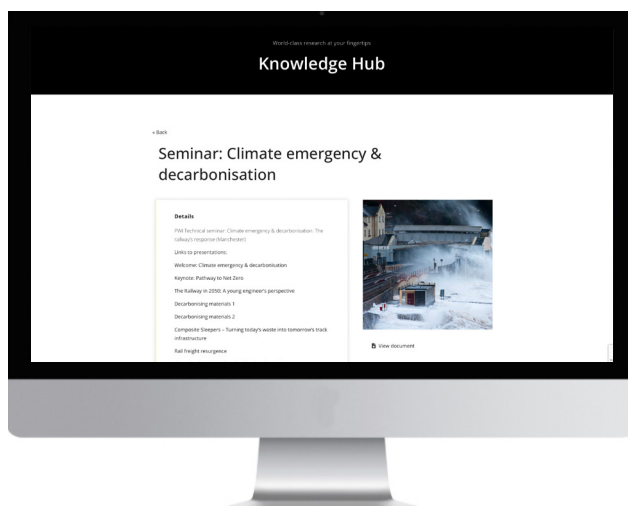
Julian suggested that to deliver all this, we need to consider the use of OLE to a lower specification for freight and regional passenger services at <75mph, as well as a general significant reduction in costs.

Finally, he spoke about the required strategy for terminals. He said that the “golden triangle” in the East Midlands is looking good, with strategic freight terminals, and the position generally with national distribution centres is also acceptable. Where real work is needed is with the regional distribution centres, and work is needed to create and improve these. Getting these right will be the key to future rail freight growth.

Julian's conclusions were:

- Battery HGVs for regional distribution (61-74% HGV tonnes)
- More than 1/3rd of HGV tonne kms well suited to rail
- Together 90% of HGV trips doable with existing technology. ERS not required
- Modal switch of trunking to rail – additional 200m tonnes rail traffic
- +2 paths/hour on most routes, +3 or 4 WCML and F2M&N
- Latent spare capacity, due to fewer passenger trains post Covid
- Grade separation of key junctions, plus ETCS
- HS2 release of capacity on WCML(S) – freight guarantee
- F2M&N/WCML(S) capacity enhancement
- 750-800 route miles of (lower cost) freight electrification

All the above is achievable if we start now, both capacity and wiring.



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## THE ROLE OF MODAL SHIFT & RAIL IN TRANSPORT DECARBONISATION

PETER COLES - TRANSPORT FOR THE NORTH (TFN)

Before starting his presentation, Peter did put in a comment about the previous talk, saying that he hoped that we will not totally discount hydrogen, and giving brief reasons for this. He moved on to his own presentation, saying that what he was about to present relates to the North of England.

He told us that others have said “decarbonisation is not about stopping people doing things, it’s about doing things differently”. He proceeded to examine this statement by looking at different possible decarbonisation strategies and their effects upon CO2 emissions. This analysis, he said, suggests a significant gap between the decarbonisation trajectory already agreed and any of the possible scenarios over about 20-25 years. This means we “bust our budget” for emissions. Discussing some possible paths to decarbonisation, Peter said that we need a reduction in car mileages, by modal shift, of around 14% and a similar cut in HGV mileages. Modal shift is essential.

Inequality of impact is a big concern around decarbonisation. People with disabilities seem to suffer the most, but other groups are also affected. TfN research is examining the issues and causes; one of the most significant factors seems to be the lack of car access, combined with the degradation of bus services. A graphic Peter displayed showed household energy footprint by household income group. Reducing carbon can actually reduce exclusion, for example, by improving public transport and widening its use.

Peter told us that he wished to rephrase the quotation that he mentioned earlier, so that it becomes “It’s not about stopping people going to places, it’s about doing different things to access those places”.

This will require change on a personal level for us all. The “big Cs” are cost and convenience, and these must be got right. He talked about road pricing, and said that the Transport Select Committee report on 25/02/22 was not good enough. This said that motoring costs should not be increased overall. Public transport costs are presently far too high compared with motoring costs, and this must be rebalanced. That is likely to involve increases in motoring costs, not just cuts in the cost of public transport.

Peter reminded of some key facts, for example, that rail travel is already one of the least CO2 intensive means of transport, even on non-electrified trains. Almost 1/3rd of all miles travelled are on trips of over 50 miles, and of that 1/3rd, half are for leisure.

The biggest opportunity for decarbonisation comes through modal shift now, not through further decarbonisation of rail transport. We need to move from road to rail, especially for longer trips, rail must cater to the leisure market and rail freight has to be increased at the expense of road. The use of off-peak passenger services for rail freight has to be considered to assist here.

Challenges to overcome include: intra-regional leisure travel isn’t adequately catered for, similarly, the first & last miles of journeys. Carriage of baggage and pets needs to be considered and made easier.

The objective has to be to change the psychology of leisure travel so that people no longer say “let’s go out in the car today” but rather “where shall we go today?”.

Peter ended by considering some issues for the leisure market in the North. He offered the example of “The Alpine Pearls”, saying we should look it up online. Then he described some examples of “first and last miles” solutions; the Derwent Valley Car Club, the Lake District Travel Pods, ebikes and instant car hire schemes were mentioned.

## QUESTIONS & ANSWERS WITH SPEAKERS

There was discussion of rail freight enhancements vs passenger ones. It was said that the enhancement of freight had been going comparatively well until the Henty Review, but after that it stopped.

The importance of outputs rather than inputs was underlined. A switch from HGV transport on the road to diesel rail will save 66% of the CO2 emissions. A second discussion asked how to stop the very wealthy simply buying their way out of things. There were no easy answers to that!

## AFTERNOON SESSION

CHAIR: PETER DEARMAN - PWI DEPUTY PRESIDENT

Peter introduced the afternoon with some brief comments about the importance of reducing the costs of electrification, quite rightly one of his favourite themes. He then proceeded to hand over the floor to the first speakers of the afternoon.

## IMPROVING WEATHER WARNING SYSTEMS & RAILWAY RESILIENCE

PROF. BRIAN HADDOCK - HEAD OF SEASONAL & WEATHER RESILIENCE - NETWORK RAIL  
PROF. PAUL DAVIES - CHIEF CLIMATOLOGIST - THE MET OFFICE

Brian Haddock began this presentation, speaking about the Convective Alert Tool (CAT), a tool developed to improve NR’s response to weather by predicting convective storms of the type that contributed to the crash at Carmont/Stonehaven. It forecasts such events in real time using weather radar precipitation data, alerting Route Control should a convective storm occur near a line of route. A formalised process then follows, to impose speed restrictions in the area potentially at risk. This has been one of the outcomes from the work of the Weather Advisory Taskforce (WATF), chaired by Dame Julia Sligo and instigated after Carmont.

Paul took over from here, beginning his section of the presentation with some history of the Met Office, which was founded following a disaster at sea. This exemplifies how such events have resulted in changes historically, as with Carmont.

Next, he described the Weather Forecasting Science and the Data Decider Tool. These offer NR access to the latest forecasting capabilities in order to explore and exploit them and improve decision making. It is expected, inter-alia, to advance the understanding of links between past earthworks failures and weather, rainfall intensity and duration and antecedent conditions. The Met Office is procuring the world’s largest supercomputer that will facilitate such activities. The Decider Tool is a prototype, kilometre scale forecasting system for the rail network. It is intended to forecast where weather will not make a route unsafe, as well as where it will do so. The final piece in the plan is the people. The WATF proposes creating an Academy that will act to transform the culture of decision making within NR, necessarily a collaborative exercise, Paul said.

## NATURAL CAPITAL LABORATORY

TONY MARSHALL - ECOLOGY LEAD - AECOM

Thanks are due to the presenter here, who had come in at short notice when his colleague, Robert Spencer, was unable to attend the seminar.

The Natural Capital Laboratory (NCL) is a 100-acre site called Birchfield at Whitebridge, near Inverness. A joint venture between the private owners of the site, AECOM, the University of Cumbria and Lifescape, is managing and monitoring the site. The intention is to rewild the site whilst collecting data and monitoring using innovative technologies. Natural capital accounting is to be undertaken, and a key objective is to communicate the outcomes widely.

The natural capital accounting is to be performed by digital means. It will account for all stocks/assets, physical flows and monetary flows. The normal approach to this typically involves Excel spreadsheets giving static results for a technical audience, and requiring regular manual updating. In contrast, here AECOM has developed the first digital interactive natural capital accounting system for the NCL. Data collection uses innovative technologies such as repeatable

drone video fly-throughs, multi-spectral cameras, RTK positioning and a digital twin of the site.

An example of the workstreams going on is that monitoring the aquatic ecology. An initial baseline of data was set up, and subsequent repeated surveys have monitored changes. An innovative tool being used is the eDNA sampling of water on the site. Life-forms interacting with the water leave traces of their DNA, so that analysis of water samples can identify them and indicate their presence. This has shown the existence of a number of life-forms on the site whose presence had never previously been known.

Visualisation is being developed using a 3-D site model and building virtual reality (VR) models with sound. These will be developed for both present and future conditions, to show how things change. These VR models are excellent for stakeholder engagement. The University is monitoring biodiversity at ten stations throughout the site, using such equipment as camera traps and audio monitoring.

Future work planned includes monitoring of peatland in a raised bog area, artistic residences, the identification of "missing" species and expanding the NCL to link to a network of similar sites across the country and the world.

## LEEDS FLOOD ALLEVIATION SCHEME – A PROJECT CASE STUDY

HANNAH DODD - MOTT MACDONALD  
PETER CHARLESWORTH - MOTT MACDONALD

Peter opened this presentation, saying that this project exemplified the delivery of multiple benefits through collaborative working across several organisations.

The scheme was initiated following the occurrence of a series of floods in Leeds. Seven occurred, over a five year period, starting with the Boxing Day flood in 2015. The agreed way forward involved a project board representing multiple stakeholders, with the intention of carrying out both screening and monitoring of the relevant catchments and the construction of civil engineering works, all to prevent or alleviate future flooding. The business case was developed around capital expenditure of £112m to deliver benefits of £450m.

Project measures included soil and land management, developing woodland in catchment areas and other "soft" techniques in addition to "hard" engineering. An app was developed that pulls together all manner of information about the scheme and issues that affect it. Work is now well under way on the scheme, with, for example, about 300,000 trees planted out of a total of 2 million proposed.

Hannah continued the presentation, speaking about the requirement to justify the carbon emissions implicit in the civils works. The project team worked with the University of Edinburgh to determine the carbon emissions effects of floods, to see whether the avoidance of

such emissions as a result of stopping future floods could be offset against the project's emissions.

The University team collected data from the 2015 flood, which enabled them to demonstrate that the emissions from flooding would be many times those of the proposed project works. Thus, the avoidance of just one similar flood to the 2015 one would more than justify the emissions of the proposed works. The success of this approach has resulted in the development of another app for use in similar exercises.

Peter described in some more detail the sort of work that the project is now undertaking. These include flood walls and glazed panels, embankments, pumping stations and upstream flood storage with a flood control structure. This is all designed to protect against a 1 in 200-year flood.

Before the scheme commenced it was possible to identify many additional benefits, beyond the flood protection aspect. While carrying out riparian works, it was possible to enhance habitats, install nature-based solutions like green walls and enhance certain existing infrastructure to the benefit of people and wildlife. The carbon management approach employed used a "bill of quantities". Emissions factors were applied, carbon footprints were evaluated, a target setting workshop was held and carbon hotspots were identified. Optioneering and target setting ensured optimal results. So far, the project has as-built carbon data for the first sub-zone of the scheme, and can show a carbon reduction of 34%.

In conclusion, Peter listed the success factors: collaboration, strong top-down leadership, delivery team engagement and collaborative planning.

## SOUTH-WEST RAIL RESILIENCE PROGRAMME

SARAH FRASER - NETWORK RAIL WALES & WESTERN

The storms on the south-west coast of England in 2014 will not be forgotten for a long time, and their consequences for that part of the country and its rail link are continuing today. Sarah said that based on current understanding, this kind of storm is estimated to have a return period around 80 years. What is more, sea level rise and beach erosion imply that this may be an over-optimistic estimate.

In addition to the well publicised sea wall collapse and associated wash-out of the track near Dawlish, one month after the storm a cliff collapse occurred near Woodlands Avenue, Teignmouth. NR obviously responded immediately to clear the railway and restore the train service, but a long-term solution was imperative that would prevent similar events in future, or significantly reduce their likelihood.

A study was undertaken with clear aims. It took a 100 year climate-change view using 2016/17 UKCP09 data, considering medium risk scenarios, with high risk ones used as a sensitivity assessment tool. Sarah did not go through the findings in detail, but they are listed

in her full presentation. Five priority sites were identified, and the project has now dealt with three of these. One of the remaining two has proved to be too complex to be dealt with fully for now, and so some interim actions have been introduced to mitigate the worst risks. Work continues on the other.

Sarah described the phases of the works in some detail, and it is worth reading her presentation or viewing the recording to see the full story. Some relevant highlights include the use of low-carbon concrete in suitable locations (it is not appropriate to use in direct exposure to the sea, apparently), the construction of an "avalanche shelter" structure below an unstable slope on Phase 3 adjacent to the North Portal of Parson's Tunnel and the use of "pure" geotechnical solutions like soil nailing and mesh on Phase 4, between Dawlish and Holcombe. Most of these works are on very confined sites, often access is poor or near impossible, and there are environmental factors like protected species (Cirl Buntings and Sea Lavender, for example).

Part way through the works, on 7 December 2021, Storm Barra intruded. The infrastructure performed as expected, but three trains did not, failing and causing delays.

The priority site that is proving so difficult to resolve is Phase 5, Parson's to Teignmouth. This stretch has 1/3rd of all the high risk sites for instability. The rail corridor here is extremely narrow, between the beach and the cliff. The proposal was to create new land and sea wall outside the existing sea wall, so that the railway could be sluiced away from the cliffs. Room would then be available to buttress the cliffs and stabilise them. Unfortunately, there was strong opposition at public consultation, because of the loss of beaches implicit in the proposal. Network Rail has withdrawn for now, to gather more data and reconsider.

It is hoped that new ideas can be developed that reduce both environmental impacts and the carbon footprint.

## QUESTIONS & ANSWERS WITH SPEAKERS

There was discussion about the possible abandonment of the coast route at Dawlish, but the suggestion from the floor was not seen as practicable given that so much of the Okehampton route has been sold and built over.

Peter and Hannah had described Leeds City Council as an innovative client, and they were asked about this. Peter said that

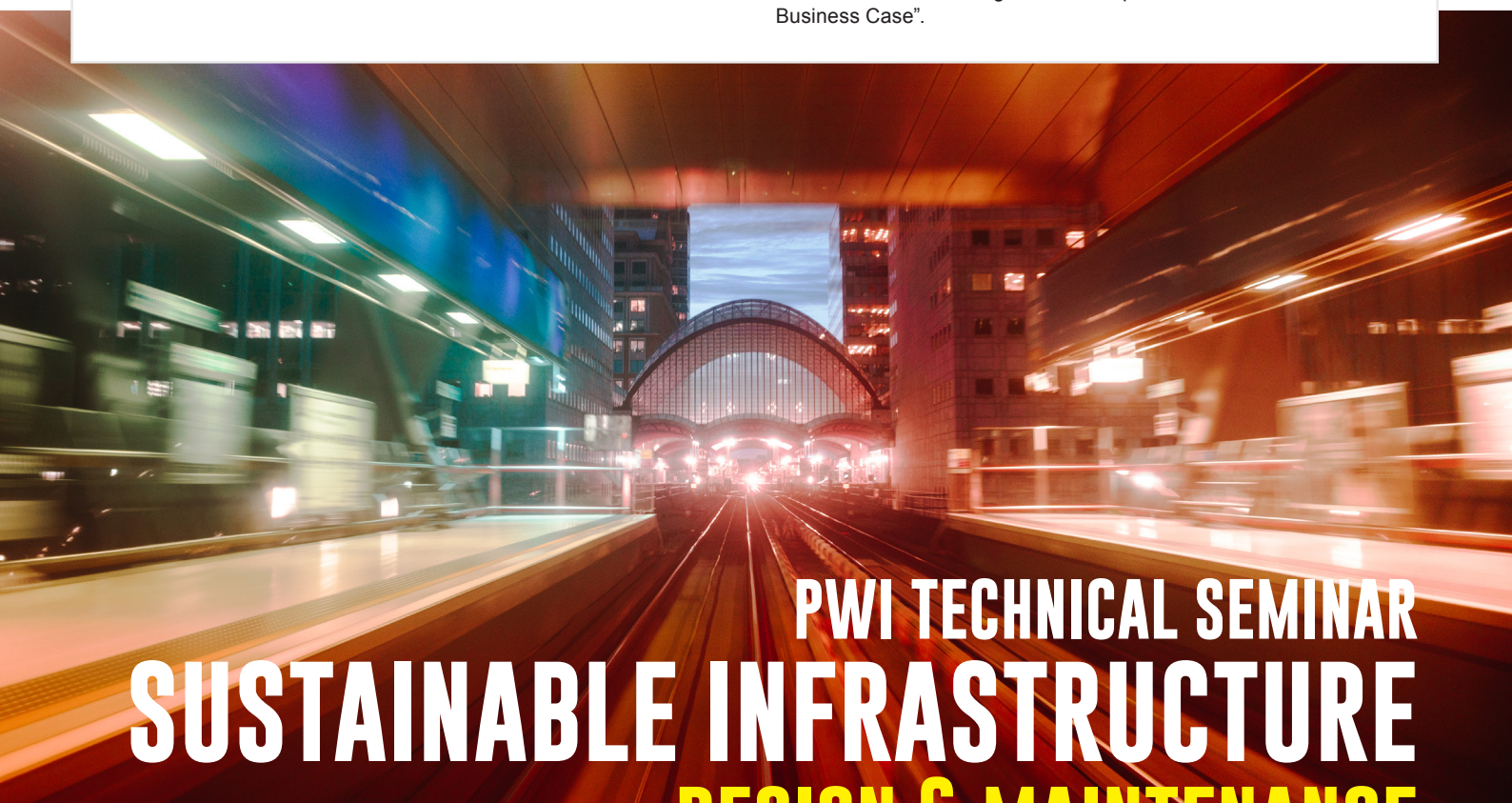
they had looked at innovative ways to build a business case, and had also been willing to compress timescales by allowing construction to begin before design completion. Other issues discussed included the relevance today of storm return periods, the use of "natural capital accounting" in schemes and working with local rail partnership groups.

One delegate ended the Q&A by recommending that everyone should go home, and if they haven't already done this, work out their own CO2 footprint, then "check on yourselves".

## CLOSING REMARKS

PETER DEARMAN - PWI DEPUTY PRESIDENT

Peter kept his remarks short, thanking the PWI NW team for their hard work in creating & running this event, asking those who have not already done so to join the PWI and finally, recommending the PWI conference in Glasgow on 21st April 2022, "Electrification – the Business Case".



# PWI TECHNICAL SEMINAR SUSTAINABLE INFRASTRUCTURE DESIGN & MAINTENANCE

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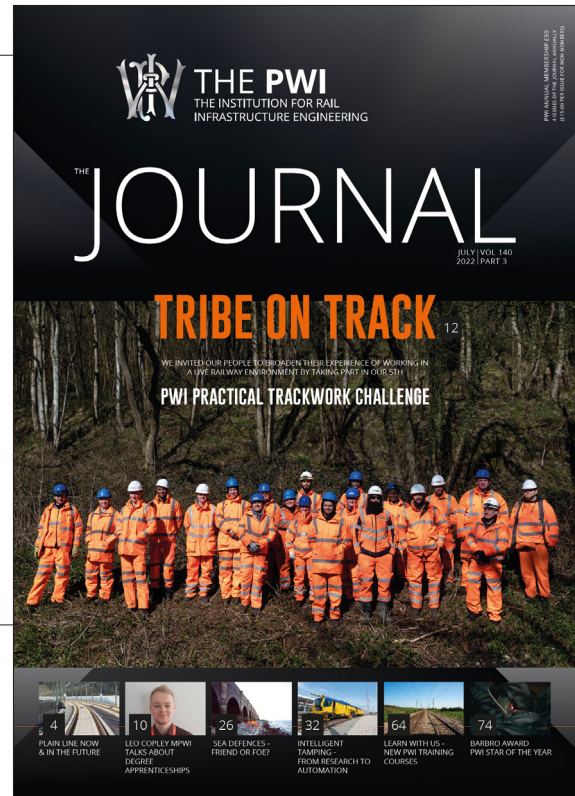
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