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Transport Committee

Trains fit for the future?

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Transport Committee

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Summary

Transport is the largest source of carbon dioxide emissions in the UK, accounting for 27% of total emissions. Rail travel is a naturally low-carbon transport mode, comprising less than 2.5% of total transport emissions and about 0.6% of the UK's total emissions. Trains in Great Britain, however, still rely predominantly on diesel traction for their power. Railway traction accounts for the greatest proportion of emissions within rail, and these emissions are almost entirely from diesel train operation. Alternative, cleaner technologies are available and in use on parts of the network. Most notably, electrification has been in use for many decades to power trains. Battery and hydrogen-powered trains are in their relative infancy but provide the potential for a cleaner alternative to diesel traction.

In February 2018, the then Minister for Rail, Jo Johnson MP, challenged the rail industry to "remove all diesel-only trains off the track by 2040." In June 2019, the UK Government set legally binding targets to reduce net emissions of greenhouse gases by 100% relative to 1990 levels by 2050—commonly referred to as the "net zero" target. In response, all sectors of the UK economy—including rail—will be required to reach virtually zero or zero greenhouse gas emissions if the national net-zero emissions target is to be achieved. For rail to support the UK in achieving its net-zero legislative target, diesel operation would need to reduce and potentially cease.

In September 2020, Network Rail published its Traction Decarbonisation Network Strategy (TDNS). Network Rail examined the 15,400 single track kilometres (STK) of unelectrified track in Great Britain and assessed which decarbonised power source—electrification, battery or hydrogen—would be the most efficient replacement for diesel. The TDNS recommended 11,700 STK for electrification (76% of the available track), 900 STK for hydrogen (6%), 400 STK for battery (3%) and 2,300 STK for further analysis (15%).

We welcome the Department for Transport's reaffirmation that it is committed to removing all diesel-only trains by 2040, including freight trains. This will be a hugely important step in ensuring a greener, decarbonised rail network, which will be necessary for the Government to meet its legally binding net-zero target by 2050. The industry now needs a clear strategy from the Government on how to decarbonise the network. We recommend that the Department for Transport publishes a long-term strategy for decarbonising the rail network as a matter of priority. This should include a vision for what proportion of the future network will use electrification, battery, and hydrogen. This should be supported by appropriate costings, a credible delivery plan, and enabling targets and milestones.

Dedicated long-term investment will be essential to meet the considerable challenge of decarbonising the rail network by 2050. There are likely to be pressures on public spending in the coming years as the country recovers from the pandemic. However, measures to decarbonise our transport sector should be a Government priority. We call on the Department to work closely with other Government Departments, including the Treasury, to secure agreement on the levels of funding necessary to begin implementing a long-term decarbonisation programme of the rail network.

As recommended by our predecessor Committee in 2018, the best way to deliver efficient and cost-effective electrification is to establish a rolling programme of electrification over the next 30 years. A rolling programme of electrification should also support the delivery of the Government's "green industrial revolution" and "levelling up" economic disparities between the regions. The task of decarbonisation belongs to successive governments, but this administration must take the first steps towards meeting the 2050 "net zero" target. We recommend that the Department commits to a 30-year rolling programme of electrification projects and sets this out in its long-term rail decarbonisation strategy.

The scale of change required to meet the 2040 and 2050 rail decarbonisation targets is considerable. We believe it would be beneficial to start the electrification programme as soon as possible, rather than wait for the start of the next control period in 2024. This would also enable the industry to retain the workforce skills and experience it has developed through recent electrification schemes. In responding to this Report, if not earlier, the Department should publish the list of "no regret" electrification schemes identified by Network Rail and confirm which schemes they intend to deliver as a priority, the costs of doing so, and the timeframes.

We believe that battery and hydrogen technology should play an important part in decarbonising the rail network and should feature prominently in the Department's long-term decarbonisation rail strategy. New technology should be embraced although we recognise that at present both battery and hydrogen have limitations in that neither can deliver the energy demands required for high-speed rail and freight services. The Department must make the case within Government to ensure that hydrogen trains are fully incorporated within the forthcoming national Hydrogen Strategy. This will help ensure the roll out of this new technology is properly co-ordinated and supported by appropriate infrastructure. In its response to this Report, the Department should provide more information on how it intends, working with other Government departments, to support the growth of a domestic battery industry to ensure this form of technology can be utilised on the railway.

Encouraging modal shift from road to rail freight will be an essential part of ensuring the transport sector contributes to the net zero 2050 target. It is therefore crucial that any action taken to decarbonise the rail network does not have the adverse effect of distorting the competitiveness of the rail freight market and pushing freight onto the road. As part of its upcoming cross modal freight strategy, the Department should ensure there is a single cross-modal freight decarbonisation target including both rail and road freight.

Although the main focus of our inquiry was the decarbonisation of trains, our terms of reference also considered how to make trains fit for the future from an accessibility perspective. Public transport must be accessible to all and it is an unacceptable failure that several train companies have consistently failed to meet targets to make their trains fully accessible, despite having had 11 years to do so. In our view, the Department's response of extending the legal deadline and requiring monthly progress reporting does not treat this matter with the appropriate seriousness it deserves. In responding to this Report, the Department must set out how it will ensure the outstanding train

operators meet the legal requirement to make their trains fully accessible and what sanctions will be used if they once again fail to meet the deadline. We will monitor this situation closely.

1 Introduction

1. Transport is the largest source of carbon dioxide emissions in the UK, accounting for 27% of total emissions.[1] Rail travel, however, is a naturally low-carbon transport mode, comprising less than 2.5% of total transport emissions and about 0.6% of the UK's total emissions.[2] Partly due to its relatively green credentials, successive Governments have, over recent decades, aimed to encourage more people to travel by train (rather than more polluting transport modes, most notably cars.) This approach has been effective, with the number of rail passenger journeys more than doubling between 1994 and 2018.[3] In comparison, since 2002 car journeys have reduced by 13%.[4]

2. Trains in Great Britain, however, still rely predominantly on diesel traction for their power. Railway traction accounts for the greatest proportion of emissions within rail and these emissions are almost entirely from diesel train operation.[5] An estimated 62% of the network (6,124 miles or 9,855 km) is still powered by diesel.[6] Alternative, cleaner, technologies are available and in use on parts of the network. Most notably, electrification has been in use for many decades to power trains. Currently, 38% of the rail network in Great Britain (3,759 miles or 6,049 km) is electrified.[7] Battery and hydrogen-powered trains are in their relative infancy but, again, provide the potential for a cleaner alternative to diesel traction.

The Government's climate change commitments

3. In recent years, the UK Government has announced several aspirations and targets concerning the decarbonisation of the rail network. In February 2018, the then Minister for Rail, Jo Johnson, challenged the rail industry to "remove all diesel-only trains off the track by 2040 and produce a vision for how the rail industry will decarbonise".[8] The 2040 target referred to both passenger and freight diesel services, although it did not include diesel hybrid trains. Subsequently, the Scottish Government committed to decarbonising passenger-only rail services in Scotland by 2035.[9]

4. In June 2019, the UK Government set legally binding targets to reduce net emissions of greenhouse gases by 100% relative to 1990 levels by 2050—commonly referred to as the "net zero" target.[10] In response to this, all sectors of the UK economy are beginning to outline the infrastructure work and investment required to achieve this target. Some areas of the economy, such as aviation and agriculture, will be very difficult to decarbonise. Therefore, other sectors such as rail, will be required to reach virtually zero or zero

1 Department for Business, Energy and Industrial Strategy, 2019 UK Greenhouse Gas Emissions, February 2021
2 Rail Industry Decarbonisation Taskforce, Final report to the Minister, June 2019, p8
3 Department for Transport, Rail factsheet, December 2018, p2
4 Department for Transport, NTS0303: Average number of trips, stages, miles and time spent travelling by main mode: England, August 2020
5 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p10
6 Office for Road and Rail, Rail Emissions and Rail Infrastructure and Assets 2019–20, November 2020, p4
7 Office for Road and Rail, Rail Emissions and Rail Infrastructure and Assets 2019–20, November 2020, p1
8 "Let's raise our ambitions for a cleaner, greener railway", Jo Johnston speech, February 2018
9 "Ambitious plans to transform Scottish rail network unveiled" Scottish Government press release, June 2020
10 Climate Change Act 2008, Schedule 1

greenhouse gas emissions if the national net-zero emissions target is to be achieved. For rail to support the UK in achieving its net-zero legislative target, diesel operation would need to reduce and potentially cease.[11]

5. Network Rail has said:

> Although rail contributes less than 1% of the total UK annual greenhouse gas emissions it is in the unique position of currently being the only transport mode capable of moving both people and heavy goods using a zero-carbon solution. As a result, rail has a huge potential role to play in decarbonisation of the UK economy by providing reliable, green transport for goods and people.[12]

Key industry reports for the decarbonisation of the rail network

6. Several significant reports by key rail industry stakeholders on the decarbonisation of the rail network have been published in the past two years, some in response to each other. Two key themes run within these reports: first, it is possible for the railway to decarbonise to meet the Government's 2040 and 2050 targets, and, secondly, that electrification is currently the most effective way of achieving this, supported by hydrogen and battery in certain circumstances. The key reports are summarised below.

The Rail Industry Decarbonisation Taskforce

7. In response to the Department for Transport's challenge to remove all diesel-only trains from the network by 2040, the rail industry established in 2018 the Rail Industry Decarbonisation Taskforce ("the Taskforce"). The Taskforce comprised Network Rail, the Rail Delivery Group (RDG), the Rail Safety and Standards Board (RSSB) the Railway Industry Association (RIA), the Rail Freight Group (RFG) and several rolling stock companies. Its "mission" was to "move UK rail to the lowest practicable carbon energy base by 2040, enabling the industry to be world leaders in developing and delivering low carbon transport solutions for rail."[13]

8. The Taskforce published an 'Initial Report to the Minister' in January 2019 setting out "credible technical options" for decarbonising the train network. Its main conclusion was that electrification is currently the most carbon efficient replacement for diesel traction. However, electrification was not a "silver bullet" and hydrogen and battery power would in some scenarios be the most cost-effective solution.[14]

9. The Taskforce published its 'Final Report to the Minister' in July 2019, a month after the "net zero" 2050 target became law.[15] The Taskforce concluded that "the removal of diesel-only passenger trains from the national rail network by 2040 and the whole industry contributing to the government's net zero carbon target by 2050, is achievable."[16] The emphasis on "diesel-only passenger trains" was a deliberate divergence from the

11 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p6
12 Ibid.
13 Rail Industry Decarbonisation Taskforce (TFF0029)
14 Rail Industry Decarbonisation Taskforce, The Initial Report to the Minister, January 2019
15 Rail Industry Decarbonisation Taskforce, Final report to the Minister, June 2019
16 Ibid. p4

Department's original aspiration to remove "all diesel-only trains" off the track, due to particular challenges involved with decarbonising freight trains (see Chapter 5). The Taskforce made five strategic recommendations, including that the rail industry support the net zero 2050 target and the Government publish a long-term delivery plan for decarbonising the network.[17]

RIA Electrification Cost Challenge Report

10. In 2018, the RIA launched a new initiative to see how the costs of rail electrification schemes could be reduced. This initiative became known as the Electrification Cost Challenge. It brought together a number of contractors, consultants and suppliers of electrification infrastructure together with other stakeholders to investigate why costs were high and what could be done to reduce them.

11. Early input was presented to our predecessor Committee for its 2018 inquiry on 'Rail infrastructure investment'. The Committee's Report, published in June 2018, recommended that "the Department and Network Rail should engage with the RIA's Electrification Cost Challenge initiative, and together produce a report on cost effective electrification within 12 months."[18] The Department agreed to our recommendation to work with the RIA to produce a report.[19]

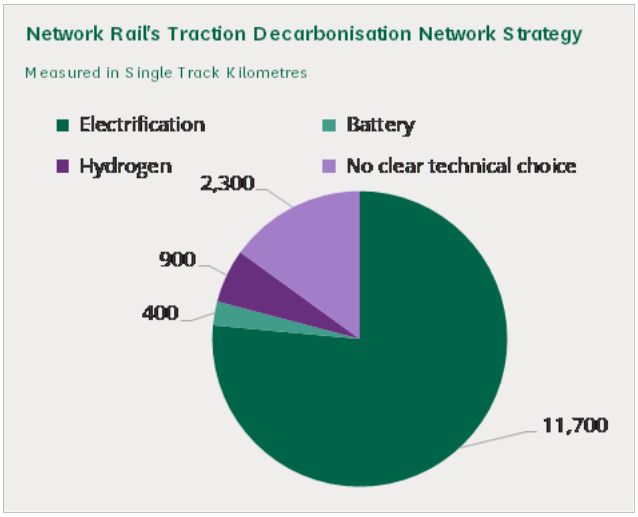
12. The RIA published the Electrification Cost Challenge Report in March 2019."[20] It stated that current electrification projects could be, and were being, delivered for between 33% to 50% of the costs of some recent projects. The RIA suggested that a simple electrification project should cost £750,000 to £1 million per single track kilometre (STK)[21] and more complex projects should not normally exceed £1.5m/STK. These were lower cost estimates than had been seen in practice with some electrification schemes, such as the Great Western Electrification Project.

Network Rail's Traction Decarbonisation Network Strategy

13. In September 2020, Network Rail published the Traction Decarbonisation Network Strategy (TDNS).[22] TDNS was produced by Network Rail in response to the Taskforce's recommendation that each key constituent of the industry, including Network Rail, should publish a long-term plan for rail decarbonisation in support of net zero carbon by 2050.[23] Network Rail examined the 15,400 STK of unelectrified track in Great Britain and assessed which decarbonised power source—electrification, battery or hydrogen—would be the most efficient replacement for diesel. The TDNS recommended 11,700 STK for electrification (76% of the available track), 900 STK for hydrogen (6%), 400 STK for battery (3%) and 2,300 STK for further analysis (15%) (Figure 1). We explore the balance of technologies in more detail in Chapters 3 and 4.

17 Ibid. p5
18 Transport Committee, Fourth Report of Session 2017–19, Rail infrastructure investment, HC 582 (para 45)
19 Transport Committee, Fourth Special report of Session 2017–19, Rail infrastructure investment, HC 582
20 Railway Industry Association, RIA Electrification Cost Challenge, March 2019, p3
21 m/STK Single track kilometre – the measure of electrification. Electrifying 1 km of two track railway is 2 STK.
22 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020
23 Ibid. p1

Figure 1: Balance of technologies in Network Rail's Traction Decarbonisation Network Strategy



Source: Network Rail, Traction Decarbonisation Network Strategy–Interim Programme Business Case, September 2020

14. Network Rail proposed different timelines for the delivery of the TDNS, ranging from 2040 to 2061.[24] Network Rail says it considered five different "pathways" to "highlight the key trade-offs which funders will need to consider depending on the extent and pace at which the [TDNS] could be delivered."[25] It said that commercial, financial, and management considerations would "determine an overall view of the feasibility of their implementation" and cost.[26] The Government would need to decide which timeline to adopt.

Government reports

15. The Department for Transport is expected to publish strategic reports that will influence the decarbonisation of the rail industry. The Transport Decarbonisation Plan ("Decarbonisation Plan") was initially expected in late 2020 but has been delayed as a result of the coronavirus pandemic. This is expected to respond to the recommendations made by Network Rail in the TDNS. In 'Setting the Challenge', the high-level consultation for the Decarbonisation Plan, the Department said it would "develop a decarbonisation programme for the rail network that will inform the deployment of electrification and new technologies over the next 30 years, building on the advice being prepared by Network Rail in the TDNS."[27]

16. The Williams Rail Review was established in September 2018 to examine the structure of the industry and the way passenger services are delivered. The White Paper arising from the review was initially expected in Autumn 2019 but has also been delayed because of the uncertainty caused by the coronavirus pandemic. Although the review is not primarily concerned with decarbonisation, it could influence the industry's plans to decarbonise the rail network through potential changes in rolling stock procurement processes or the organisation of research and development funding.

24 ibid. p96
25 ibid. p95
26 ibid. p95
27 Department for Transport, Decarbonising Transport: Setting the Challenge, March 2020, p27

Our inquiry

17. Our inquiry was originally launched by our predecessor Committee in April 2019. The Committee invited written evidence on the most effective way to decarbonise the rail network, including the development of alternatively fuelled rolling stock, the cost of alternatively fuelled rolling stock compared to electrification, and the accessibility of train carriages. A total of 39 submissions were received. No oral evidence was taken before the dissolution of Parliament. Our predecessor Committee visited rail manufacturers in Derby in July 2019 to learn about low carbon rail technology being developed by the industry[28] and also Warwickshire in September 2019 to observe Porterbrook's hydrogen train and Innovation Hub. Our predecessor Committee was also visited by One Nottingham Primary Parliament in July 2020, when the students explained what they would like to see in future train carriages."

18. We relaunched the inquiry in the new Parliament, in October 2020. We held two oral evidence sessions in November and December 2020 with train manufacturers, rail industry groups, freight representatives, Network Rail, the Rail Industry Decarbonisation Taskforce, and Chris Heaton-Harris MP, Minister for Rail and Rachel Maclean MP, Minister for Transport Decarbonisation, at the Department for Transport. We are grateful to all those who contributed written and oral evidence.

28 The Committee visited Loram, Porterbrook and Bombardier

2 Providing a long-term strategic plan

The need for long-term certainty

19. Decarbonising the rail network over the coming 20 to 30 years will require substantial and co-ordinated public and private investment in infrastructure and rolling stock, given that these assets will be used for potentially decades. Witnesses told us that the key obstacle to delivering a decarbonised railway was uncertainty. We heard that the Government should set a clear and consistent rail decarbonisation strategy for the next 30 years. The RDG said "what we need now is a clearer long-term plan that we can all align our efforts to."[29] Angel Trains, one of the UK's largest train leasing specialists argued that policy certainty was "essential"[30] and the RSSB called for the Government to "set the direction of the industry through clear and consistent policy."[31]

20. Rail industry witnesses told us that they needed long-term certainty to plan and invest in the people, infrastructure, and innovation required to decarbonise the network. The RIA told us that "providing we get a clear strategy […] the industry will swing in and invest in the people, plant and process that is needed"[32] The RDG and Alstom, a large rail manufacturing company, both emphasised that the wider UK supply chain also required certainty to invest in new technology, skills and products, and create highly skilled jobs.[33] We heard that changes to the rail network infrastructure needed to coincide with policies to support the introduction of new rolling stock. The RDG said:

> We need to make sure that we end up with a plan that aligns infrastructure change to rolling stock introduction, to skills and to the supply chain, to make sure that it is a holistic whole-industry change programme, which is what it would need to be effective.[34]

21. Angel Trains emphasised that long-term certainty was necessary given the long life-cycle of train carriages:

> Rolling stock investment decisions we make now will directly impact upon the industry's ability to meet [the UK's climate targets]. New trains, procured in recent years that are now coming on to the network, will also require major refurbishments and upgrades. To finance, deliver and enhance trains that are fit for the future, we need a long-term policy and funding framework, agreed by government and industry, which provides clarity of vision and deliverable timescales.[35]

22. Witnesses agreed that a long-term rail decarbonisation strategy may need to change as technologies, such as battery and hydrogen, mature, and perhaps other new ones are introduced.[36] We explore this in more detail in Chapter 4. Nevertheless, we heard that the need for flexibility at a later stage must be balanced against the need for a long-term

29 Q43 [Mark Gaynor]
30 Angel Trains (TFF0016)
31 RSSB (TFF006)
32 Q4 [David Clarke]
33 Q58 [Mark Gaynor], Alstom (TUF0008)
34 Q53 [Mark Gaynor]
35 Angel Trains (TFF0016)
36 Q27 [Mary Grant, Leo Murray, David Clarke]

strategy to provide clarity to the industry. The RIA said that "we do not have to set in stone the next 30 years; we just need to be confident about what the right first steps are that take us towards 2050."[37]

Building on the TDNS

23. As described in Chapter 1, Network Rail's TDNS sets out a long-term plan for the decarbonisation of the rail network, including mapping out recommended lines for electricity, hydrogen and battery power. The TDNS sets out five different timelines on which this can be achieved, ranging from 2040 to 2061. Several witnesses including Riding Sunbeams, Porterbrook the RIA and RDG, welcomed the plans set out in the TDNS and called for the Government to set out how it would be implemented.[38] The Department is expected to respond to Network Rail's proposals within its Decarbonisation Plan, expected this year.[39]

Uncertainty created by delays with the Rail Reform White Paper

24. Witnesses told us that the constant delays with the publication of the White Paper expected to arise from the Williams Rail Review was also creating uncertainty.[40] The White Paper is expected to set out significant changes to the structure of the rail industry, including how rolling stock is developed and procured and the funding of research and development within the industry. These changes will have an inevitable impact on plans to decarbonise the network.

25. Giving evidence in December 2020, Chris Heaton Harris MP, the Minister for Rail, told us that "the expected scale and pace of the railway decarbonisation will be set out in a plan going forward, which we will announce shortly."[41] He confirmed that it was still the Department's intention to remove *all* diesel-only trains from the network by 2040—not only passenger trains, as advocated by the Taskforce.[42]

26. **Transport is the largest source of carbon emissions in the UK, accounting for 27% of total emissions. If the UK is to meet its 2050 net zero carbon emissions target, a concerted effort will be needed to dramatically decarbonise the transport sector, particularly surface transport. This is a considerable challenge, and it offers the UK an opportunity to become a world leader in green transport and decarbonisation technology.**

27. **We welcome the Department for Transport's reaffirmation that it is committed to withdrawing all diesel-only trains by 2040—including freight trains. This will be a hugely important step in ensuring a greener, decarbonised rail network, which will be necessary for the Government to meet its legally binding net-zero target by 2050. However, it is difficult to understand how the current target framework fits together. The Taskforce and the Government have differing views on whether it is possible to remove all diesel-only trains from the network by 2040. While Scotland's**

37 Q6 [David Clarke]
38 Q45 [Mark Gaynor]
39 Department for Transport, Decarbonising Transport: Setting the Challenge, March 2020
40 Q40 [Mary Grant], Alstom (TUF0008) Rail Delivery Group (TFF0021)
41 Q126 [Chris Heaton-Harris MP]
42 Q147 [Chris Heaton-Harris MP]

target comes five years earlier, it includes the removal of all diesel passenger trains (including hybrids) but excludes freight. The industry needs the Government to clarify its expectations on decarbonisation.

28. **While we recognise the immediate challenges brought about by the coronavirus pandemic, we are concerned about the frequent delays to the publication of the Department's Transport Decarbonisation Plan and the Rail Reform White Paper based on the Williams Review. These delays have unfortunately compounded the difficulties for the rail industry to plan and invest in the development of a carbon-free railway.**

29. ***We recommend that the Department for Transport publishes a long-term strategy for decarbonising the rail network as a matter of priority. This should include a vision for what proportion of the future network will use electrification, battery and hydrogen. That strategy should be supported by appropriate costings, a credible delivery plan, and enabling targets and milestones. These targets and milestones should clarify how the 2040 and 2050 targets will fit together.***

30. **Dedicated investment over the long-term will be essential in order to meet the considerable challenge of decarbonising the rail network by 2050. There will be understandable pressures on public spending in the coming years as the country recovers from the pandemic. However, measures to decarbonise our transport sector ought to be considered a Government priority.**

31. ***We call on the Department to work closely with other Government departments, including the Treasury, to secure agreement for the levels of funding necessary to begin implementing a long-term decarbonisation programme of the rail network.***

3 Rolling programme of electrification

32. More than a third (38%) of the rail network in Great Britain is already electrified.[43] As highlighted in Chapter 1, four key reports relating to decarbonisation produced by key rail stakeholders in recent years, all concluded that electrification was currently the most effective way of decarbonising the rail network, supported by hydrogen and battery in certain circumstances.[44] In this Chapter, we explore the potential for further electrification of the network.

Advantages of electrification

33. Electrification is widely considered as the only current power source capable of decarbonising the whole rail network. It is a tried and tested technology, which is already in use on much of the British rail network and in many other countries. Electric trains are more environmentally friendly than diesel trains, producing less than half the carbon emissions of diesel trains. Furthermore, this carbon footprint will continue to decline as the National Grid uses more renewable sources.[45] Electrification also has the benefit of producing zero emissions at point of use, thus improving air quality in rail stations and cities. In comparison electric trains require less maintenance than diesel trains and are lighter, which reduces the need for track maintenance.

34. Importantly, electrification is currently the only technology that can deliver the energy demands of freight and high-speed services.[46] Siemens explained to us:

> Whilst a number of different technologies could be used to reduce the railway's carbon footprint, only electric and diesel traction can deliver a full range of requirements including high speed, long distance passenger travel and freight haulage.[47]

Despite rapid technological development, it remains unclear if battery and hydrogen will ever develop the capacity to provide the energy of freight and high-speed services.[48] We explore hydrogen and battery technology in more detail in Chapter 4.

Challenges of electrification

35. One of the main drawbacks of electrification relates to the high capital costs, caused in part by the need to install overhead power lines. The relatively high costs have been the key factor behind some troubled electrification projects in recent years. Most notably, the Great Western Electrification Project (GWEP), announced in 2009, was abandoned in 2017 before it could be fully completed. Other electrification projects, such as the Midland Main Line, north of Kettering, were also cancelled.[49] Although the Government

43 Office for Road and Rail, Rail Emissions and Rail Infrastructure and Assets 2019–20, November 2020,p1
44 Rail Industry Decarbonisation Taskforce, The Initial Report to the Minister, January 2019, Rail Industry Decarbonisation Taskforce, Final report to the Minister, June 2019, Railway Industry Association, RIA Electrification Cost Challenge, March 2019, Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020
45 Rail Industry Decarbonisation Taskforce, The Initial Report to the Minister, January 2019, p38
46 Rail Industry Decarbonisation Taskforce, The Initial Report to the Minister, January 2019
47 Siemens Mobility Limited (TFF0017)
48 Q10 [Leo Murray], Q11 [Leo Murray]
49 Railway Industry Association, RIA Electrification Cost Challenge, March 2019, p6

said the decision was taken because there were other ways of delivering improvements to these lines, the National Audit Office subsequently found that the projects were cancelled because they were deemed too expensive.[50]

36. More recent estimates, however, suggest that electrification could be delivered more cheaply than with previous projects such as GWEP. In the TDNS, Network Rail suggested that electrification would cost between £1m/STK to £2.5m/STK.[51] The RIA estimated a lower cost bracket of £750k to £1m/STK, with more complex projects not expected to normally exceed £1.5m/STK.[52] The GWEP, in contrast, cost between £2m and £2.5m/STK.[53]

37. The environmental credentials of rail electrification have also been questioned. For example, the installation of overhead wires requires significant volumes of steel, copper and concrete. All three materials have high levels of "embodied carbon", that is the carbon footprint of a material at all stages of production. According to the TDNS, a sample single track kilometre of electrification embodies around 680 tonnes of carbon.[54]

A rolling programme of electrification

38. In 2018 our predecessor Committee recommended that "Electrification should be delivered through a long-term rolling programme, in which the Department, Network Rail and the wider industry learn the lessons of earlier schemes and strive to reduce the costs."[55] This was supported by many witnesses to our current inquiry.

39. The RIA's Electrification Cost Challenge report described a "feast and famine" approach within Great Britain (outside of Scotland) to rail electrification, which had increased costs and made it difficult to maintain skills, expertise, and a supply chain. Riding Sunbeams told us:

> The fundamental reason why we have had such fluctuating costs for electrification in the UK is the feast or famine approach, which is not in the gift of the rail industry. They are decisions made by Government.[56]

40. As well as keeping costs lower, witnesses also told us that a long-term rolling programme of rail electrification could help to boost UK productivity.[57] For instance, it could create long-term and highly skilled jobs outside of London and the South East, helping to meet the Government's "levelling up" aspirations. The RIA said: "If we employ an apprentice tomorrow to start doing electrification or low-carbon rolling stock, they will have 30 years of work in front of them. That is a good thing."[58] The benefits of long-term highly skilled employment would not be limited to the engineers delivering electrification schemes but would also be spread amongst the wide supply chain.

50 National Audit Office, Investigation into the Department for Transport's decision to cancel three rail electrification projects, March 2018
51 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p100
52 Railway Industry Association, RIA Electrification Cost Challenge, March 2019, p7
53 Campaign to Electrify Britain's Railway (TFF0012)
54 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p181
55 Transport Committee, Fourth Report of Session 2017–19, Rail infrastructure investment, HC 582 (para 45)
56 Q19 [David Clarke]
57 Hitachi Rail Ltd (TFF0036)
58 Q15 [David Clarke]

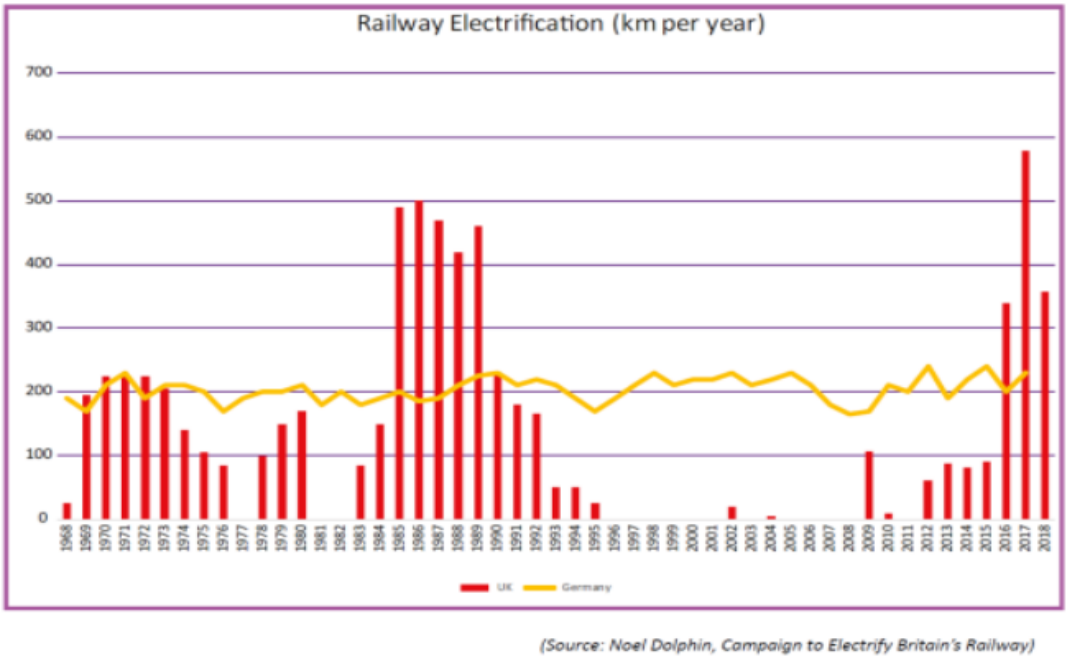
National and international comparison case studies

41. Some witnesses compared the "feast and famine" approach to electrification taken by successive UK governments to the more successful rolling programmes of rail electrification undertaken in other nations, such as Germany and by the Scottish Government.

Germany

42. Over the past 50 years Germany has had a consistent rolling programme of rail electrification, annually delivering about 200 km (125 miles). As of 2019, 61% of the German network was electrified, compared to 38% in Great Britain.[59] This is illustrated in Figure 2: the relatively steady line shows the amount of track electrified in Germany each year compared to the stark peaks and troughs in the UK.

Figure 2: Graph comparing electrification in the UK to Germany



Source: Campaign to Electrify Britain's Railway (TFF0012)

43. The costs of electrification in Germany are much lower than the UK. Germany is able to deliver electrification at £450,000/STK compared to the UK where, for example, the Great Western Electrification Project cost between £2m and £2.5m/STK.[60] The Campaign to Electrify Britain's Railways argued that the steady electrification programme in Germany has "allowed the industry to retain and develop a highly skilled workforce and perfect the plant and techniques, which are allowing German electrification projects to be delivered at substantially less cost than is experienced in the UK."[61]

59 Rail Tech, Electrification of cross-border tracks urgent for Germany, June 2020
60 Railway Industry Association, RIA Electrification Cost Challenge, March 2019, p25
61 Campaign to Electrify Britain's Railway (TFF0012),

44. In 2018 the German Government announced its intention to decarbonise the German railway by 2040, with 70% of all lines electrified by 2025. To achieve this Germany will have to double its rolling programme of electrification from 200 km (124 miles) of electrified track per year to 400 km (249 miles).[62]

Scotland

45. Since 2010, the Scottish Government has been electrifying its rail network though a rolling programme of electrification. During this period Scotland has invested around £1 billion in the electrification of 441 STK. As of early 2020 around 41% of Scotland's railway track was electrified, slightly higher than the total percentage of 38% for Great Britain as a whole.[63] As noted in Chapter 1, the Scottish Government has committed to decarbonising passenger rail services by 2035.[64]

46. The costs of electrifying the network in Scotland have been delivered within the target cost range identified by the RIA.[65] The RIA concluded that "through having a rolling programme of electrification Scotland is benefiting from learning and experience being passed from one project to the next."[66]

The need for immediate action

47. Witnesses emphasised that the electrification of the rail network needed to start as soon as possible. The decarbonisation of the rail network by 2050 is a large-scale infrastructure programme and Network Rail has forecast it would require the delivery of 355 STK of electrification per year from 2024 (that is, the start of Control Period 7).[67] The Taskforce said this was achievable but only if the delivery started soon.[68] Network Rail warned that if action was delayed it would become economically unaffordable and practically implausible to meet the Government's decarbonisation targets.[69]

48. The RIA told us that an electrification programme should have started "yesterday", warning that skills and experience may be lost if there was a delay.[70] This view was supported by Network Rail.[71] RIA also explained that the sooner that action was taken to decarbonise the rail network, the greater the reduction of cumulative carbon emissions: "If you save a tonne of carbon in 2020, that is 30 tonnes saved by 2050".[72]

62 Campaign to Electrify Britain's Railway (TFF0012), Electrification of cross-border tracks urgent for Germany, News article, Railtech.com, June 2020

63 "Ambitious plans to transform Scottish rail network unveiled" Scottish Government press release, June 2020

64 This target is five years ahead of the British Government's target to remove all diesel only trains by 2040. target covers freight trains, the Scottish target refers to passenger trains only.

65 A simple electrification project should cost £750k to £1m/STK and more complex projects should not normally exceed £1.5m/STK Railway Industry Association, RIA Electrification Cost Challenge, March 2019, p22

66 Ibid

67 Network Rail Control Periods are the five-year timespans into which Network Rail, the owner and operator of most of the rail infrastructure in Great Britain, works for financial and other planning purposes. The pathways set out in the interim TDNS assumed that a small number electrification projects would be able to commence before the end of Control Period 6, such as the Transpennine Route Upgrade.

68 Q86 [Malcolm Brown]

69 Q88 [Andrew Haines]

70 Q21 [David Clarke], Railway Industry Association, RIA Electrification Cost Challenge, March 2019, p17

71 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p34

72 Q2 [David Clarke]

When and how to start

49. Investment in the railway is traditionally structured around five-year funding cycles known as a control period. The next cycle—Control Period 7—begins in 2024. We heard evidence that the Department should not wait until 2024 to start implementing its rail decarbonisation programme.[73]

50. Witnesses advocated a rolling programme of electrification beginning with so-called "no regret schemes".[74] The Taskforce defines these as projects which have a strong economic case for electrification which will not change in the short to medium term. Typically these schemes are on the most intensively used parts of the rail network not currently electrified.[75] The business case for electrification on these intensively used lines is unlikely to diminish as alternative technology develops, because they are used so much that electrification will always be cost effective.[76] Network Rail told us that the Department should "crack on" with no-regret schemes.[77] Network Rail have sent a list of these schemes to the Department for consideration.

The Department's approach

51. Given the cancellation of previous electrification projects, the economic pressures caused by the coronavirus pandemic, and the devastating impact of the pandemic on the rail sector and passenger numbers, we wanted to explore how committed the Department was to rail electrification. The Minister for Rail said that the Government was "very committed" to electrification and it was his ambition "to do a lot more electrification."[78] He believed that the Treasury was likewise committed to electrification.[79] He explained that electrification was a "key part of decarbonisation of our transport network. Decarbonisation is a Government priority to which the whole of Government is fully signed up."[80]

52. Regarding costs, the Minister told us that since the cancellation of the final stages of GWEP in 2017 the industry had "learned many lessons", including how to "programme better."[81] He said that Network Rail had been implementing these lessons, with the result that recent projects had been delivered on time and to budget.[82] He agreed with Network Rail's price costing range of £1 million to £2.5 million/STK, rather than the RIA's lower cost estimates of £750,000 to £1.5 million.

53. The Minister for Rail was clear about the scale of challenge required to electrify the British rail network: "This is quite a big ambition and the pipeline is probably 30 years-worth of work to get to that end point."[83] We asked if there was a potential for new electrification projects to begin before the start of the next control period in 2024. Philip

73 Q9 [David Clarke]
74 Q61 [Paul Smart]
75 Rail Industry Decarbonisation Taskforce (TFU0015)
76 Q89 [Andrew Kluth]
77 Q88 [Andrew Haines, Helen McAllister]
78 Q134 [Chris Heaton Harris MP], Q132 [Chris Heaton Harris MP]
79 Q136 [Chris Heaton Harris MP]
80 ibid.
81 Q140 [Chris Heaton Harris MP]
82 ibid.
83 ibid.

Luxford, Director for One Railway and Security, Department for Transport, said "maybe."[84] Mr Luxford told us that the Government's ability to start electrification quickly would depend on which projects were prioritised. He said that some projects had already been scoped as part of previous electrification schemes. He explained that if these projects were chosen, rather than ones which were still to be designed, then there could be "shovels in the ground as opposed to just design work" before the end of this control period in 2024.[85]

54. **Decarbonisation of the rail network over the next generation will require moving from diesel traction to cleaner technologies, such as electrification, battery, and hydrogen. We agree with the Department and industry experts that electrification is the only immediately viable decarbonisation option for most of the network, not least because the alternatives are not suitable for freight and high-speed services due to their high energy demands.**

55. **Rail electrification projects within Great Britain have historically been costly. The Department and Network Rail have said that lessons have been learned from previous projects. The importance of this cannot be overstated. The mistakes that unnecessarily increased the cost of previous schemes should not be repeated.**

56. **We understand that rail electrification project costs are monitored by the Department and Network Rail as part of the Rail Network Enhancements Pipeline process. Any overspend would be flagged by that process. The financial failures of previous electrification programmes caused work to cease. It is vital that the future electrification programmes are subject to a new cost discipline, with robust and rigorous financial controls that enable electrification to be successfully delivered to budget.**

57. ***We recommend that the Department implements an enhanced financial mechanism beyond that contained in the Rail Network Enhancement Pipeline process. That enhanced financial mechanism must be designed to ensure that strict transparency and adherence to cost discipline are maintained in any electrification programme.***

58. **As recommended by our predecessor Committee in 2018, the best way to deliver efficient and cost-effective electrification is to establish a rolling programme of electrification over the next 30 years. A rolling programme of electrification should also support the delivery of the Government's "green industrial revolution" and "levelling up" economic disparities between the regions. The task of decarbonisation belongs to successive governments, but this administration must take the first steps towards meeting the 2050 "net zero" target.**

59. ***We recommend that the Department commits to a 30-year rolling programme of electrification projects and sets this out in its long-term rail decarbonisation strategy.***

60. **The scale of change required to meet the 2040 and 2050 rail decarbonisation targets is considerable. We believe it would be beneficial to start the electrification programme as soon as possible, rather than wait for the start of the next control period in 2024. This would also enable the industry to retain the workforce skills and experience it has developed through recent electrification schemes.**

84 Q150 [Philip Luxford]
85 Ibid.

61. Some 30% of the electrified railway in the UK uses third rail rather than overheard systems, where the electricity is supplied through a conductor placed alongside or between the rails of a railway track. Electrification via a third rail is most commonly found in London and the south-east. Third-rail systems were installed from the 1920s onwards. The last length of third rail was installed to Weymouth in the 1980s. We understand that Network Rail is working with the Office of Rail and Road on a project on the Merseyrail network to explore whether further sections of electrification can be delivered using a third-rail infill. Electrification of the third rail could help train operators in the south-east to deliver further decarbonisation of the network without the need for costly overhead electrification or delays from the advances in battery or hydrogen technology. ***We recommend that Network Rail and the ORR continue to explore the potential for an extension in third-rail electrification capability and that the Department, as the overall sponsor of rail decarbonisation, proactively monitors this development in the event that Network Rail and the Office of Rail and Road are unable to reach an agreement on whether to proceed with further third-rail electrification projects."***

62. ***In responding to this Report, if not earlier, the Department should publish the list of "no regret" electrification schemes identified by Network Rail and confirm which schemes they intend to deliver as a priority, the costs of doing so, and the timeframes.***

4 Alternative decarbonisation technologies

63. Network Rail's TDNS recommended that hydrogen powered trains would be suitable for 6% (900 STK) of the unelectrified network, battery power for 3% (400 STK) and 15% (2,300 STK) for further analysis. In this Chapter we examine in more detail the scope for hydrogen and battery powered trains.

Hydrogen

64. Hydrogen is an emerging technology being developed as a zero-carbon power source for use on the rail network, as well as the wider economy. In September 2020, the world's first hydrogen passenger service train was introduced by Alstom in Austria, on four routes in Lower Austria, Vienna and Styria.[86] Within the UK, Porterbrook and the University of Birmingham have developed the HydroFLEX train but it has not yet been introduced into passenger service. Our predecessor Committee visited Porterbrook to observe the HydroFLEX train in September 2019.

Advantages of hydrogen fuel

65. A key benefit of hydrogen fuel is that it is zero-emission at the point of use, given that hydrogen combines with oxygen to produce electricity, heat and water.[87] It is quiet and, unlike electrification, it does not require extensive trackside infrastructure.[88]

66. The Government is keen to encourage the development of hydrogen as an energy source more generally. In November 2020 the Government published *The Ten Point Plan for a Green Industrial Revolution*[89] which set out aspirations to cut emissions in different areas of the economy and secure long-term growth for the whole country. One of the ten points is to drive the growth of low carbon hydrogen, including an ambition to develop five gigawatts of low carbon hydrogen production capacity by 2030, the equivalent of a power station's output.[90] The Ten Point Plan also states that the Government will publish a Hydrogen Strategy in 2021. In September 2020, Julian Critchlow, Director General, Energy Transformation and Clean Growth, told the Environmental Audit Committee that hydrogen will have a big role in decarbonising Transport.[91] He said the strategy will contain the "detailed and specific policy levers" required to make the UK "a world-leading hydrogen market."[92]

Challenges of hydrogen fuel

67. There are limitations with hydrogen technology in its current state of development. Most notably, hydrogen is not capable of delivering the power required by freight and

86 Austria's ÖBB completes three-month hydrogen train passenger trials, railway Technology, December 2020
87 Fuel Cell Basics, Fuel Cell & Hydrogen Energy Association
88 Angel Trains (TFF0028), Alstom UK (TFF0024), Rail Delivery Group (TFF0021), West Yorkshire Combined Authority (TFF0020)
89 HM Government, The Ten Point Plan for a Green Industrial Revolution, November 2020
90 Ibid. p10
91 Q39 [Leo Murray]
92 Environmental Audit Committee, Oral evidence: One-off session with the Secretary of State for BEIS, HC 755 Q40 [Julian Critchlow]

high-speed train services because of their high energy demand.[93] Although hydrogen capability is expected to develop over the next 30 years, many witnesses considered it highly unlikely that the capacity would ever develop sufficiently to power freight and high-speed services.[94] The RSSB told us:

> Hydrogen has an energy density limitation, which means you cannot generate the power you need to move a freight train at the speeds required across a mixed-use network, or drive trains very fast. That will probably always be the case.[95]

68. Although hydrogen does not require extensive overhead wires like electrification, the use of hydrogen on the rail network would also require the development of its own supporting infrastructure and a supply chain which the UK does not currently have and would require significant levels of investment.[96]

69. The production of hydrogen has also been criticised for its environmental impact. Although hydrogen production is widespread, no low-carbon production methods are commonplace due to the high costs involved.[97] Currently only 4% of the worlds' hydrogen supply is produced "greenly" using the process of electrolysis; the rest is generated by heavy industry using coal or natural gas.[98] Moreover, the production and use of green hydrogen consumes around three times more energy than conventional electric trains, because a greater amount of energy currently is required for the electrolysis and compression process.[99] Hydrogen trains also require batteries to store residual energy and so suffer from some of the same drawbacks we cover in paragraphs 74 to 76 in respect of battery powered trains.[100]

70. Giving evidence, the Minister for Transport Decarbonisation said that "hydrogen [will play] a massive role in the decarbonisation of transport".[101] She said that the Government was currently working on the practical challenges of producing and commercialising green hydrogen.[102]

Battery power

71. Battery-powered trains are "electric multiple units and locomotives which carry batteries in order to provide traction power for in-service use."[103] Battery technology is already successfully being used on some parts of the rail network. For example, Vivarail have developed an operational battery train with a range of 60 or more miles between charges and the accompanying charging system.[104] Hitachi Rail and Great Western

93 Q88 [Helen McAllister], Q105 [Andrew Kluth]
94 Q89 [Helen McAllister], Q106 [Andrew Kluth]
95 Q111 [Andrew Kluth]
96 Aldersgate Group (TFF0011), Alstom Transport UK Limited (TFF0024), Anglo American (TFF0025), Eversholt Rail Limited (TFF0014)
97 Commons Library, Climate change solutions: The role of technology, June 2020
98 Committee on Climate Change, Hydrogen in a low-carbon economy, November 2018
99 Bombardier Transportation UK (TFF0033)
100 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020
101 Q129 [Rachel Maclean]
102 Ibid.
103 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p69
104 Vivarail launches fast charge system for the Class 230 battery trains – the UK's only battery train with a range of 60 miles between charges, Vivarail.co.uk, 18 March 2018

Railway have announced that services between London Paddington and Penzance will be partly powered by battery—this will be the first long distance service in the UK to use battery power.[105]

Advantages of battery power

72. Similar to hydrogen trains, battery technology is zero emission at the point of use, it can travel on the network without a "contact system" (which eliminates the need for the overhead wires required by electrification) and it is quiet. Battery technology is also a natural complement to electrification—for instance, batteries can easily be incorporated on electric trains and they can charge from the existing electricity infrastructure.[106] Batteries also have the added benefit that they can be used to reduce peak electricity load and can work during a power outage.[107]

Challenges of battery power

73. Similar to hydrogen, we were told that battery technology is not currently capable of delivering the required energy for freight and high-speed services. Angel Trains explained:

> At this stage, battery-only trains are not a viable replacement for diesel or electric trains. Based on the current technology available, they would require batteries of 40 times the physical volume of the diesel to provide the same amount of energy.[108]

74. Batteries also have a significant "embodied carbon value", meaning lots of carbon is emitted during their production. They are typically made with chemicals from minerals found in Asia, South America and Africa. The extraction of these minerals through mining is often very labour-intensive and requires significant amounts of heavy machinery. Poor working practices have also been reported in some mines, including low pay, long hours, and child labour.[109] The minerals are then shipped to the manufacturer, where they are combined through a high energy process and are then shipped to suppliers.[110]

75. In addition, the disposal of batteries is a high energy process and recycling is complex.[111] Current battery life typically ranges from five to 15 years whereas the lifetime of a train can be 30 to 40 years.[112] This means that, over the lifetime of a train, the embodied carbon in producing and recycling the battery has to be accounted for several times over.

76. No domestic battery manufacturers are currently based in the UK.[113] The UK's withdrawal from the European Union may also have an impact—under the EU-UK Trade

105 Plan for UK long-distance battery-powered trains, BBC.co.uk, 15 December 2020
106 Q11 [Leo Murray], Q14 [Leo Murray]
107 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p 70
108 Angel Trains (TFF0028)
109 Amit Katwala, The spiralling environmental cost of our lithium battery addiction, August 2018, Forbes, Manufacturers Are Struggling To Supply Electric Vehicles With Batteries, March 2020
110 Air Quality News, The politics of making an electric vehicle battery, May 2020, Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, p180
111 Institute for Energy Research, The Afterlife of Electric Vehicles: Battery Recycling and Repurposing, May 2019
112 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020
113 Yun Zhang et al. A SWOT Analysis of the UK EV Battery Supply Chain, November 2020

and Cooperation Agreement, rules of origin requirements mean that batteries will need to be sourced from the EU or UK from 2027 to benefit from tariff-free trade between the EU and UK.[114]

77. We questioned the Department about the potential use of battery-powered trains. The Minister for Transport Decarbonisation recognised the ethical concerns about the production of batteries in some other countries and explained that the Government aimed to develop a domestic battery industry:

> The Government set up the Faraday Institution, which is funded with about £374 million. They are developing our own skill set in battery technology […] We are committed to investing in the UK to have a supply of batteries that is ethical, renewable, and sustainable. We are working on sustainability and recycling technology for batteries. I am confident that this industry will develop very quickly. We want to have a "gigafactory" in the UK as well.[115]

78. **We believe that battery and hydrogen technology should play an important part in decarbonising the rail network and should feature prominently in the Department's long-term decarbonisation rail strategy. New technology should be embraced although we recognise that at present both battery and hydrogen have limitations in that neither can deliver the energy demands required for high-speed rail and freight services.**

79. ***The Department must make the case within Government to ensure that hydrogen trains are fully incorporated within the forthcoming national Hydrogen Strategy. This will help ensure the roll out of this new technology is properly co-ordinated and supported by appropriate infrastructure.***

80. ***In its response to this Report, the Department should provide more information on how it intends, working with other Government departments, to support the growth of a domestic battery industry to ensure this form of technology can be utilised on the railway.***

Enabling flexibility for technological advances

81. Some witnesses highlighted the risks of Network Rail and others being too definite about the future power requirements of the rail network, given the likelihood of technological advances during the long implementation timeframe. Alstom told us:

> The TDNS sets out to forecast, based on the technology base of today, the end state for the decarbonised UK rail network. Whilst we fully accept the risks of basing forecasts on assumed technological advances, we would be concerned that a strategy set today, based on technologies known today, extending to beyond 2050 risks stifling any further innovation. It could be a mistake to focus on the current limitations of alternative technologies, rather than their future horizons.[116]

114 Letter from Rebecca Pow MP, Parliamentary Under-Secretary of State at the Department for Environment, Food and Rural Affairs, to Sir William Cash MP

115 Q153 [Rachel Maclean]

116 Alstom Transport UK Limited [TFU0008]

82. Arriva Trains UK drew a comparison between the development of hydrogen and battery technology and the development of the offshore wind industry. It highlighted that, between 2010 and 2020, the offshore wind industry focused on the development of the supply chain, innovation, financing and skills development. By 2020, offshore wind was one of the lowest cost options for new power in the UK and cheaper than nuclear power. Arriva suggested that, through proper investment, battery and hydrogen technology could develop at the same pace.[117]

83. Other witnesses, however, were concerned that waiting for battery and hydrogen technology to develop until it was viable for wider use on the railway could hinder the challenge of fully decarbonising the rail network and meeting the 2050 net-zero target.[118] While Network Rail was supportive of incorporating hydrogen and battery-powered trains onto the network, "it does [not] take away the need for electrification in the intervening period; otherwise, you are dependent, frankly, on speculation that somehow technology is bound to emerge when there is no pathway to that at this stage."[119] Riding Sunbeams said there is "an enormous amount of uncertainty around the future capability of hydrogen to deliver substantial emissions reductions."[120]

84. Network Rail recognised that battery and hydrogen technology were rapidly developing and could have an impact on the economic and technological assumptions underpinning the TDNS, and thus potentially change the optimum balance of decarbonisation technologies.[121] Network Rail's proposed approach was to focus first on the so-called 'no-regret' electrification schemes on the more intensively used parts of the network (see paragraph 50). This could allow time for further developments in battery and hydrogen technology to potentially change the business case behind the balance of technologies and encourage greater utilisation of these alternative technologies. Network Rail proposed that the technological assumptions built into TDNS would be refreshed on a "five yearly basis to factor in any future changes in technology."[122] The RIA agreed that this was a sensible strategy:

> If we are setting out a 30-year programme, and we crack on for the first 15 or 20 years electrifying the core bits of the network and rolling out low-carbon rolling stock, we will know a lot more about the technology when we are deciding about the last 10 years. I could entirely see that there would be more hydrogen and battery in the last 10 years displacing some electrification, but it is not going to displace electrification in its entirety.[123]

This view was also supported by other witnesses, including the Taskforce.[124]

85. On the other hand, the train manufacturer Alstom, which had developed hydrogen trains, asserted that reviewing the assumptions every five years was not frequent enough:

117 Arriva UK Trains [TFF0030]
118 Q88 [Andrew Haines], Q89 [Helen McAllister], Q26 [Mary Grant]
119 Q110 [Andrew Haines]
120 Q10 [Leo Murray]
121 Q110 [Andrew Haines]
122 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020
123 Q11 [David Clarke]
124 Q87 [Malcolm Brown]

> [We] recommend a route by route evaluation of the most suitable traction technology as has been made by the TDNS, but crucially it should be based on the development state and economics of technologies available at the time each route is to be addressed, not just as they are today."[125]

86. We asked the Department how a long-term rail decarbonisation strategy would be flexible enough to adapt to new technological developments and innovations. The Minister for Rail was not specific but said he was keen to support a flexible approach by "opening up opportunities for companies".[126]

87. **Although the rail industry requires a long-term strategy for decarbonising the rail network, it is important that the strategy is sufficiently flexible to incorporate alternative technologies, such as hydrogen and battery, and other new technologies that might be developed. When and if it is demonstrated that clean, green and cost-effective alternatives to electrification can deliver the energy required by freight and high-speed passenger services, they should be introduced to decarbonise the rail network.**

88. ***The long-term rail decarbonisation strategy must explain the process by which the development of alternative technologies will be reviewed and how such technologies can be incorporated into the network strategy, if they reach the necessary level of development.***

125 Alstom Transport UK Limited [TFU0008]
126 Q152 [Chris Heaton-Harris]

5 Decarbonising rail freight

89. Currently rail freight is almost entirely operated by diesel traction, with less than 10% of journeys powered through electric traction.[127] As described in Chapter 1, the Department's challenge to remove all diesel-only trains from the track by 2040 included freight trains. Freight trains pose particular challenges for decarbonisation, as highlighted by the Taskforce and others.[128] The average freight train carries a cargo load equivalent to 76 heavy goods vehicles (HGV), which demands a high energy power source to move the trains.[129]

Fuel options for freight trains

90. At present the energy demands of rail freight mean that electrification is the only viable option for decarbonisation. This was the view expressed by Network Rail, the Taskforce and by many of our witnesses, including the RFG.[130] The Taskforce said:

> Electrification is key. We are looking at different technical solutions, but the physics of simply having enough grunt in a locomotive to pull what we need to pull and do it efficiently mean that right now electrification and, unfortunately, diesel engines are the best way of doing that.[131]

Risks of moving freight from rail to road

91. Even with its current reliance on diesel traction, rail freight is a much more environmentally friendly transport mode compared to road freight.[132] On average, rail freight produces 76% less carbon than the equivalent journey by road and produces less air pollution. The Rail Freight Group (RFG) and RDG emphasised that modal shift from road to rail freight would be necessary to help the UK achieve its 2050 "net-zero" target. RSSB said that "rail freight should be a key element of any decarbonisation pathway for freight transport."[133] Furthermore, shifting freight from road to rail would also reduce road congestion and improve air quality.[134]

92. Riding Sunbeams explained the scale of the benefit that could be achieved through modal shift from road to rail freight: "if we were able to shift 10% of HGV traffic from roads today to rail freight, the emission savings from that would be equivalent to all the emissions from the entire rail sector today."[135]

93. We were told that the rail freight industry is a "high-volume, low-margin business" and that "getting it fractionally wrong can be quite risky."[136] Witnesses warned that any decarbonisation solutions for rail freight should be carefully analysed from the commercial

127 Rail Freight Group (TFF0010)
128 Ibid
129 Rail freight, Network Rail
130 Network Rail, Traction Decarbonisation Network Strategy – Interim Programme Business Case, September 2020, Rail Freight Group (TFF0010), Rail Industry Decarbonisation Taskforce, Final report to the Minister, June 2019
131 Q112 [Malcom Brown]
132 Rail Freight Group (TFF0010),
133 Decarbonisation and Air Quality Improvement: a Roadmap for the Rail Freight Industry, RSSB, August 2020
134 Arriva UK Trains [TFF0030]
135 Q38 [Leo Murray]
136 Q58 [Paul Smart]

perspective to minimise the risk of a counterproductive modal shift to road freight, which could have the adverse effect of increasing overall carbon emissions.[137] Paul Smart, an advisor to the rail freight industry, said:

> The mission is to decarbonise the UK economy, or decarbonise the freight economy, not specifically just to decarbonise railways. That is important to keep in mind. I would look for mechanisms that protect what we do against inadvertent modal shift, because the timing of implementing something on rail phases differently from implementing something on road.[138]

This was supported by Network Rail, which emphasised the importance of examining "decarbonisation of surface transport and freight overall rather than just decarbonisation of rail freight."[139]

94. In April 2019 the National Infrastructure Commission (NIC) published 'Better Delivery: The Challenge for Freight'. The report considered solutions to freight's contribution to carbon emissions and congestion and recommended that:

> Road and rail freight should have a common, single target to decarbonise fully by 2050. No part of the freight system should be indirectly subsidised by being allowed to emit carbon when other parts are decarbonising.[140]

95. The Minister for Transport Decarbonisation told us that the Government was aware of the connection between the decarbonisation of road and rail freight. She said "the broader point is that we need to decarbonise road freight as well."[141] The Minister referred specifically to the Department's Mode Shift Revenue Support Scheme (MSRS), which aims to encourage modal shift from road to rail freight.[142] In 2019–20, the Government spent £17.5 million on the MSRS.[143] The Minister for Rail also supported greater modal shift from road to rail freight:

> I think [rail freight] has a really vibrant future. […] the rail freight industry results in about 7 million fewer lorry journeys each year. That is a number that we would very much like to see go up because it is good for overall carbon emissions.[144]

96. The Department intends to soon publish a new cross-modal freight strategy.[145] This was due to be published in late 2020 but was delayed because of the coronavirus pandemic.

97. **Encouraging modal shift from road to rail freight will be an essential part of ensuring the transport sector contributes to the net zero 2050 target. It is therefore crucial that any action taken to decarbonise the rail network does not have the adverse effect of distorting the competitiveness of the rail freight market and pushing freight on to the road. The risk of adverse outcomes highlights the need for the Government to produce its national freight strategy.**

137 RSSB (TFF006), Rail Delivery Group (TFF0021)
138 Q62 [Paul Smart]
139 Q112 [Helen McAllister]
140 Better Delivery: the challenge for freight, National Infrastructure Committee, April 2019
141 Q154 [Rachel Maclean]
142 Ibid.
143 Department for Transport, Review of Revenue Support Freight Grant Schemes Final Report, February 2020
144 Q154 [Chris Heaton-Harris]
145 Department for Transport, Decarbonising Transport: Setting the Challenge, March 2020, p45

98. ***As part of its upcoming cross modal freight strategy, the Department should ensure there is a single cross-modal freight decarbonisation target including both rail and road freight.***

6 Research and development funding

99. The Government has a target for total research and development investment to reach 2.4% of GDP by 2027. In 2018, total expenditure on R&D was £37.1 billion—the equivalent of 1.7% of GDP.[146] The Minister for Transport Decarbonisation told us that:

> The overall R&D spend that we are putting in as a Government to transport, and the economy generally, will be ramping up massively. We have seen that with announcements from the Prime Minister, we have seen it go further in the 10-point plan, and rail will be part of that—it absolutely has to.[147]

100. The Department provides various sources of funding to encourage innovation in the rail sector. The main funding stream is RSSB's Research and Innovation Fund, which received £100 million between 2014 and 2020 (£80 million from the Department and £20 million from Network Rail).[148] In addition, the Department supports Innovate UK (the Government's innovation agency) in running a series of competitions (named First of a Kind, FOAK) open to innovators "developing cutting-edge technology focused on making rail journeys faster, cleaner and greener."[149] In 2020 £9.4 million of funding was made available through the FOAK competition[150] Furthermore, in the 2020 March Budget the Chancellor announced £30 million of funding towards the establishment of "The Global Centre of Rail Excellence in Neath Port Talbot."[151] The centre is designed to showcase Wales as a hub for research and development and leading low-carbon rail technology.[152]

101. Many witnesses, including Merseytravel, the RFG and RDG, told us that the delivery of a decarbonised rail network was dependent on increased R&D funding from Government and industry.[153] The Taskforce report stated that the R&D funding available for the rail sector was small compared to the automotive and aerospace sectors. Angel Trains told us that "the funding allocation [for the rail industry] must at least match, if not exceed, the levels of support offered to the aviation and automotive sectors"[154]

102. **We welcome Government funding to support the establishment of the Global Centre of Rail Excellence, which is a positive step in decarbonising the rail network. However, we heard evidence that the amount of research and development funding provided by Government for innovation in the rail sector compares unfavourably to other transport sectors. This will need to change if the rail sector is to meet the considerable challenge of decarbonising by 2050. R&D funding can help to catalyse the development of new technologies and support smaller businesses and local economies.**

103. ***We recommend that the Department's long-term rail decarbonisation strategy sets out how research and development will be supported and properly funded in order to deliver the scale of change required to decarbonise the rail network.***

146 Research and development spending, House of Commons Library, June 2020
147 Q133 [Rachel Maclean]
148 Rail Industry Decarbonisation Taskforce, The Initial Report to the Minister, January 2019
149 GOV.UK, First of a Kind 2020 launches to find this century's Brunel, January 2020
150 GOV.UK, SBRI rail demonstrations: first of a kind 2020, January 2020. Riding Sunbeams and G-Volution have received funding though the FOAK competitions.
151 Budget Speech 2021, HM Treasury, March 2021
152 Budget boost for major valleys rail test centre warmly welcomed, Neath Port Talbot Council, March 2021
153 Rail industry Association (TFF0031), Angel Trains (TFF0016), Rail Delivery Group (TFF0021), Merseytravel (TFF0013), Campaign to Electrify Britain's Railway (TFF0012), Rail Freight Group (TFF0010)
154 Angel Trains (TFF0016)

Chapter 7: Making trains fully accessible

104. Although the main focus of our inquiry was the decarbonisation of trains, our terms of reference also considered how to make trains fit for the future from an accessibility perspective. In 2011 Parliament passed legislation which set a deadline of 31 December 2019 by which it would be unlawful for a passenger rail train to be used in service unless it was accessible for people with reduced mobility.[155] Rail owners and operators therefore had ten years to prepare for the deadline.[156]

105. Several train operating companies missed the 2019 deadline, including Eurostar, Arriva Rail London, Abellio Scotrail, Great Western Railway, Chiltern Railways and South Eastern.[157] The Minister for Rail gave a one-month dispensation to the companies that missed the deadline, giving them until 31 January 2020 to comply. In a letter to the industry group RDG, the Minister wrote:

> Owners and operators have had 10 years to prepare for the 31 December 2019 deadline. It is deeply frustrating that disabled passengers will still be waiting into 2020 to see accessibility improvements to some services […] The Government's position is unequivocal. The industry must urgently address the issue of providing accessible rail carriages and replacement bus and coach services. Delivering an accessible service for every passenger on every rail journey is essential to creating an inclusive and accessible railway. It must not be delayed any longer."[158]

106. The Minister gave further dispensations to Abellio Greater Anglia[159] and Northern Trains Limited[160] on 30 September 2020 and 27 November 2020 respectively. These dispensations gave these companies until 31 May 2021 to meet the legal requirements. Under the terms of the dispensation, these companies are required to report monthly to the Secretary of State providing an "update on passenger satisfaction with the vehicles and progress to remove the units from the timetable."[161]

155 Regulation 45 of the Railways (Interoperability) Regulations 2011, SI 3066/2011

156 Department for Transport, Compliance with rail accessibility requirements, January 2020

157 The Railways (Interoperability) Regulations 2011 – Class 373 e300 Eurostar – 2020 accessibility deadline, Department for Transport, December 2019, The Railways (Interoperability) Regulations 2011 – Class 317/7 and 317/8 Arriva Rail London - 2020 accessibility deadline, Department for Transport, December 2019, The Railways (Interoperability) Regulations 2011 – Abellio Scotrail HST sets - 2020 accessibility deadline, Department for Transport, December 2019, The Railways (Interoperability) Regulations 2011 – Great Western Railway Class 143 - 2020 accessibility deadline, Department for Transport, December 2019, The Railways (Interoperability) Regulations 2011 – Chiltern Railways Mark 3 – 2020 accessibility deadline, Department for Transport, December 2019, The Railways (Interoperability) Regulations 2011 – Class 466 2020 accessibility deadline, Department for Transport, December 2019

158 Compliance with rail accessibility requirements for 1 January 2020, Department for Transport, January 2020

159 The Railways (Interoperability) Regulations 2011 – Class 317/7 Abellio Greater Anglia – 2020 accessibility deadline, Department for Transport, September 2020

160 The Railways (Interoperability) Regulations 2011 – Class 153 Northern Trains Limited – 2020 accessibility, Department for Transport, November 2020

161 Ibid. The Railways (Interoperability) Regulations 2011 – Class 317/7 Abellio Greater Anglia – 2020 accessibility deadline, Department for Transport, September 2020

107. Giving evidence to us on 9 December 2020, the Minister for Rail said:

> There are still some trains that are not compliant. I am the Minister that has to sign off any extensions to that, and the train operating companies and rolling stock companies know my view on whether I am going to sign off things in the future.[162]

108. The day after speaking to us, the Minister provided a further dispensation to Transport for Wales[163] and a week later to East Midland Railway.[164] These dispensations have the same deadline and monthly reporting requirements as those given to Abellio Greater Anglia and Northern Trains Limited. As a result, there are currently at least four operators who are still not compliant with the legal accessibility requirements.[165]

109. **Public transport must be accessible to all. It is unacceptable that several train companies have consistently failed to meet targets to make their trains fully accessible, despite having had 11 years to do so. In our view, the Department's response of extending the legal deadline and requiring monthly progress reporting does not treat this matter with the seriousness that it deserves.**

110. ***The Department must set out how it will ensure that train operators meet the legal requirement to make their trains fully accessible and what sanctions will be used if some train operators once again fail to meet the deadline. We will monitor this situation closely.***

162 Q160 [Chris Heaton-Harris]

163 The Railways (Interoperability) Regulations 2011 – Class 153 Transport for Wales Rail Services - 2020 accessibility deadline, Department for Transport, December 2020

164 The Railways (Interoperability) Regulations 2011 – Class 153 EMR – 2020 accessibility deadline, Department for Transport, December 2020

165 Transport for Wales, East Midland Railway, Abellio Greater Anglia and Northern Rail Limited

Conclusions and recommendations

Providing a long-term strategic plan

1. Transport is the largest source of carbon emissions in the UK, accounting for 27% of total emissions. If the UK is to meet its 2050 net zero carbon emissions target, a concerted effort will be needed to dramatically decarbonise the transport sector, particularly surface transport. This is a considerable challenge, and it offers the UK an opportunity to become a world leader in green transport and decarbonisation technology. (Paragraph 26)

2. We welcome the Department for Transport's reaffirmation that it is committed to withdrawing all diesel-only trains by 2040—including freight trains. This will be a hugely important step in ensuring a greener, decarbonised rail network, which will be necessary for the Government to meet its legally binding net-zero target by 2050. However, it is difficult to understand how the current target framework fits together. The Taskforce and the Government have differing views on whether it is possible to remove all diesel-only trains from the network by 2040. While Scotland's target comes five years earlier, it includes the removal of all diesel passenger trains (including hybrids) but excludes freight. The industry needs the Government to clarify its expectations on decarbonisation. (Paragraph 27)

3. While we recognise the immediate challenges brought about by the coronavirus pandemic, we are concerned about the frequent delays to the publication of the Department's Transport Decarbonisation Plan and the Rail Reform White Paper based on the Williams Review. These delays have unfortunately compounded the difficulties for the rail industry to plan and invest in the development of a carbon-free railway. (Paragraph 28)

4. *We recommend that the Department for Transport publishes a long-term strategy for decarbonising the rail network as a matter of priority. This should include a vision for what proportion of the future network will use electrification, battery and hydrogen. That strategy should be supported by appropriate costings, a credible delivery plan, and enabling targets and milestones. These targets and milestones should clarify how the 2040 and 2050 targets will fit together.* (Paragraph 29)

5. Dedicated investment over the long-term will be essential in order to meet the considerable challenge of decarbonising the rail network by 2050. There will be understandable pressures on public spending in the coming years as the country recovers from the pandemic. However, measures to decarbonise our transport sector ought to be considered a Government priority. (Paragraph 30)

6. *We call on the Department to work closely with other Government departments, including the Treasury, to secure agreement for the levels of funding necessary to begin implementing a long-term decarbonisation programme of the rail network.* (Paragraph 31)

Rolling programme of electrification

7. Decarbonisation of the rail network over the next generation will require moving from diesel traction to cleaner technologies, such as electrification, battery, and hydrogen. We agree with the Department and industry experts that electrification is the only immediately viable decarbonisation option for most of the network, not least because the alternatives are not suitable for freight and high-speed services due to their high energy demands. (Paragraph 54)

8. Rail electrification projects within Great Britain have historically been costly. The Department and Network Rail have said that lessons have been learned from previous projects. The importance of this cannot be overstated. The mistakes that unnecessarily increased the cost of previous schemes should not be repeated. (Paragraph 55)

9. We understand that rail electrification project costs are monitored by the Department and Network Rail as part of the Rail Network Enhancements Pipeline process. Any overspend would be flagged by that process. The financial failures of previous electrification programmes caused work to cease. It is vital that the future electrification programmes are subject to a new cost discipline, with robust and rigorous financial controls that enable electrification to be successfully delivered to budget. (Paragraph 56)

10. *We recommend that the Department implements an enhanced financial mechanism beyond that contained in the Rail Network Enhancement Pipeline process. That enhanced financial mechanism must be designed to ensure that strict transparency and adherence to cost discipline are maintained in any electrification programme.* (Paragraph 57)

11. As recommended by our predecessor Committee in 2018, the best way to deliver efficient and cost-effective electrification is to establish a rolling programme of electrification over the next 30 years. A rolling programme of electrification should also support the delivery of the Government's "green industrial revolution" and "levelling up" economic disparities between the regions. The task of decarbonisation belongs to successive governments, but this administration must take the first steps towards meeting the 2050 "net zero" target. (Paragraph 58)

12. *We recommend that the Department commits to a 30-year rolling programme of electrification projects and sets this out in its long-term rail decarbonisation strategy.* (Paragraph 59)

13. The scale of change required to meet the 2040 and 2050 rail decarbonisation targets is considerable. We believe it would be beneficial to start the electrification programme as soon as possible, rather than wait for the start of the next control period in 2024. This would also enable the industry to retain the workforce skills and experience it has developed through recent electrification schemes. (Paragraph 60)

14. *We recommend that Network Rail and the ORR continue to explore the potential for an extension in third-rail electrification capability and that the Department, as the overall sponsor of rail decarbonisation, proactively monitors this development in*

the event that Network Rail and the Office of Rail and Road are unable to reach an agreement on whether to proceed with further third-rail electrification projects." (Paragraph 61)

15. *In responding to this Report, if not earlier, the Department should publish the list of "no regret" electrification schemes identified by Network Rail and confirm which schemes they intend to deliver as a priority, the costs of doing so, and the timeframes.* (Paragraph 62)

Alternative decarbonisation technologies

16. We believe that battery and hydrogen technology should play an important part in decarbonising the rail network and should feature prominently in the Department's long-term decarbonisation rail strategy. New technology should be embraced although we recognise that at present both battery and hydrogen have limitations in that neither can deliver the energy demands required for high-speed rail and freight services.(Paragraph 78)

17. *The Department must make the case within Government to ensure that hydrogen trains are fully incorporated within the forthcoming national Hydrogen Strategy. This will help ensure the roll out of this new technology is properly co-ordinated and supported by appropriate infrastructure.*(Paragraph 79)

18. *In its response to this Report, the Department should provide more information on how it intends, working with other Government departments, to support the growth of a domestic battery industry to ensure this form of technology can be utilised on the railway.* (Paragraph 80)

19. Although the rail industry requires a long-term strategy for decarbonising the rail network, it is important that the strategy is sufficiently flexible to incorporate alternative technologies, such as hydrogen and battery, and other new technologies that might be developed. When and if it is demonstrated that clean, green and cost-effective alternatives to electrification can deliver the energy required by freight and high-speed passenger services, they should be introduced to decarbonise the rail network.(Paragraph 87)

20. *The long-term rail decarbonisation strategy must explain the process by which the development of alternative technologies will be reviewed and how such technologies can be incorporated into the network strategy, if they reach the necessary level of development.*(Paragraph 88)

Decarbonising rail freight

21. Encouraging modal shift from road to rail freight will be an essential part of ensuring the transport sector contributes to the net zero 2050 target. It is therefore crucial that any action taken to decarbonise the rail network does not have the adverse effect of distorting the competitiveness of the rail freight market and pushing freight on to the road. The risk of adverse outcomes highlights the need for the Government to produce its national freight strategy. (Paragraph 97)

22. *As part of its upcoming cross modal freight strategy, the Department should ensure there is a single cross-modal freight decarbonisation target including both rail and road freight.* (Paragraph 98)

Research and development funding

23. We welcome Government funding to support the establishment of the Global Centre of Rail Excellence, which is a positive step in decarbonising the rail network. However, we heard evidence that the amount of research and development funding provided by Government for innovation in the rail sector compares unfavourably to other transport sectors. This will need to change if the rail sector is to meet the considerable challenge of decarbonising by 2050. R&D funding can help to catalyse the development of new technologies and support smaller businesses and local economies. (Paragraph 102)

24. *We recommend that the Department's long-term rail decarbonisation strategy sets out how research and development will be supported and properly funded in order to deliver the scale of change required to decarbonise the rail network.*(Paragraph 103)

Making trains fully accessible

25. Public transport must be accessible to all. It is unacceptable that several train companies have consistently failed to meet targets to make their trains fully accessible, despite having had 11 years to do so. In our view, the Department's response of extending the legal deadline and requiring monthly progress reporting does not treat this matter with the seriousness that it deserves. (Paragraph 109)

26. *The Department must set out how it will ensure that train operators meet the legal requirement to make their trains fully accessible and what sanctions will be used if some train operators once again fail to meet the deadline. We will monitor this situation closely.* (Paragraph 110)

Formal minutes

Tuesday 16 March 2021

Members present:

Huw Merriman, in the Chair

Mr Ben Bradshaw	Karl McCartney
Ruth Cadbury	Grahame Morris
Lilian Greenwood	Gavin Newlands
Simon Jupp	Greg Smith
Robert Largan	

Draft Report (*Trains fit for the future?*), proposed by the Chair, brought up and read.

Ordered, That the draft Report be read a second time, paragraph by paragraph.

Paragraphs 1 to 110 read and agreed to.

Summary agreed to.

Resolved, That the Report be the Sixth Report of the Committee to the House.

Ordered, That the Chair make the Report to the House.

Ordered, That embargoed copies of the Report be made available, in accordance with the provisions of Standing Order No. 134.

[Adjourned till tomorrow at 9.30 am

Witnesses

The following witnesses gave evidence. Transcripts can be viewed on the inquiry publications page of the Committee's website.

Wednesday 11 November 2020

David Clarke, Technical Director, Railway Industry Association; **Mary Grant**, Chief Executive Officer, Porterbrook; **Leo Murray**, Innovation and Communications Director, Riding Sunbeams — Q1–41

Mark Gaynor, Head of Railway Planning, Rail Delivery Group; **Paul Smart**; **Chris Smith**, Managing Director, G-volution Ltd — Q42–83

Wednesday 9 December 2020

Andrew Haines, Chief Executive, Network Rail; **Helen McAllister**, Strategy and Planning Director, Network Rail; **Malcolm Brown**, Chair, Rail Industry Decarbonisation Taskforce; **Andrew Kluth**, Lead Carbon Specialist, Rail Industry Decarbonisation Taskforce — Q84–122

Chris Heaton-Harris MP, Minister of State, Department for Transport; **Rachel Maclean MP**, Parliamentary Under-Secretary of State, Department for Transport; **Philip Luxford**, Director of One Railway and Security, Department for Transport — Q123–167

Published written evidence

The following written evidence was received and can be viewed on the inquiry publications page of the Committee's website.

TFU numbers are generated by the evidence processing system and so may not be complete.

1 Department for Transport (TFU0011)

2 Dundas, Mr David (TFU0004)

3 G-volution Ltd (TFU0002)

4 GB Railfreight (TFU0012)

5 Icomera AB (TFU0009)

6 Miller, J (TFU0007)

7 Network Rail (TFU0014)

8 Porterbrook (TFU0001)

9 Rail Industry Decarbonisation Taskforce (TFU0015)

10 Alstom (TFU0008)

11 Rock Rail (TFU0005)

12 Shirres, David (Editor, Rail Engineer) (TFU0006)

13 Railway Industry Association) (TFU0013)

14 Transport Focus (TFU0010)

15 Waxwing Engineering Ltd (TFU0003)

List of Reports from the Committee during the current Parliament

All publications from the Committee are available on the publications page of the Committee's website.

Session 2019–21

Number	Title	Reference
1st	Appointment of the Chair of the Civil Aviation Authority	HC 354
2nd	The impact of the coronavirus pandemic on the aviation sector	HC 268
3rd	E-scooters: pavement nuisance or transport innovation?	HC 255
4th	Road safety: young and novice drivers	HC 169
5th	The impact of the coronavirus pandemic on the aviation sector: Interim report	HC 1257
1st Special Report	Pavement parking: Government Response to the Committee's Thirteenth Report of Session 2017–19	HC 158
2nd Special Report	The impact of the coronavirus pandemic on the aviation sector: Government and Civil Aviation Authority Responses to the Committee's Second Report	HC 745
3rd Special Report	E-scooters: pavement nuisance or transport innovation?: Government Response to Committee's Third Report of Session 2019–21	HC 1085