

High Speed Britain

Scottish Inter-City Connectivity

July 2023

Scottish Inter-City Rail Taskforce Members

Our sincere thanks go out to all members of our Scottish Inter-City Taskforce, as well as to our Chair Alex Neil, for their highly valuable insight and recommendations regarding the future of the Scottish rail industry.

- Alex Neil, Scottish Inter-City Rail Taskforce
- Scott Prentice, ScotRail
- Sara Thiam, SCDI
- Liz McAreavey, Edinburgh Chamber of Commerce
- John McCormick, Scottish Association of Public Transport
- Willie Fraser, Jacobs
- Iain Docherty, University of Stirling
- Tom Wadsworth, Siemens/ High Speed Rail Group
- Hsham Rashid, Transport Scotland (Observer status)
- Angus Robertson, Network Rail (Observer status)

Foreword Alex Neil

Chair, Scottish Inter-City Rail Taskforce



Building a railway is a long-term project. New lines need to be sustained by multiple governments across several decades and succeed through any number of unknown unknowns. Investment plans must support a long-term strategic approach that delivers for both Scotland and the rest of the United Kingdom.

By some measures, rail plays a key role in supporting policy objectives in Scotland through decarbonisation, lowering pollution and building economic growth amongst communities.

Current investment plans are less promising however – HS2 has been repeatedly trimmed and delayed and although it may be a relatively young project, the opportunity is immense. Once complete, HS2 provides the starting point for developing a UK-wide high speed rail network. In turn, this network will drive modal shift, delivering significant carbon savings and free up airlines to focus on international routes, support the creation of more people-centred, healthier communities and reduce journey times.

With no sign of the investment needed in track and signalling over the lengthy connecting cross-border route however, journey times will be longer than necessary, and capacity will be limited, constraining passenger service timetables and making no space available for the substantial increase in rail freight now expected.

Yet seven years have already passed since governments in Edinburgh and Westminster committed to work toward rail journey times of less than 3 hours between the Scottish Central Belt and London. Since then, HS2's arrival at Euston has been delayed to the late 2030s and the spur to Leeds has been scrapped. The joint goal remains but one of the major levers to deliver it faces chronic uncertainty.

Our Taskforce argues that the opportunity remains and must be seized. Rail investment is a key way to make the country functionally smaller – reducing costs and logistical hurdles to the movement of goods and people, cutting the need for air travel and driving the accessibility of leisure travel. HS2 is a long-distance railway which can be spine for a new network that links every region and nation on the island of Great Britain, in a clean, efficient way.

Building a new physical connection between Scotland and London is a key starting point that rises above political imperatives. It will only happen if the constellation of local, regional and national entities can collaborate effectively. The three-hour journey is achievable but while it is not out of reach, the travelling public could be forgiven for seeing it drifting toward the horizon.

Now is the time for critical funding decisions to be made and a new approach is required as we move forward so that we, as a leading global power, are not left behind by a world coming together to reduce carbon emissions and reach net zero targets.

Both governments must now work together to capture this potential.

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Executive Summary



What role should rail play in supporting a net-zero, post-Covid economy? And where should investment be focused to achieve this? To answer these questions, the Scottish Inter-City Rail Taskforce considered four key issues which drive rail investment strategy:

- what is the wider policy context for rail?
- what investment is currently planned?
- what additional investment is required for rail to play its full part in transport sector decarbonisation? and
- how is investment being prioritised?

In other words, what do we want rail to do, how well are current investment plans delivering against this, where are there gaps and do we understand what these investments will achieve?

In the report that follows, we try to answer these questions and suggest where attention should now focus. Any immediate investment decisions need to support a long-term strategic approach to rail development that delivers for Scotland and the UK.

On the first question, we found an encouraging picture. The role that rail plays in supporting a suite of policy objectives in Scotland including decarbonisation, lowering pollution, building economic growth and placemaking is now well understood. Rail's strong environmental credentials and efficiency in transporting high volumes of people and goods, particularly between densely populated urban centres, make it a favoured choice against more polluting, more carbon-intensive journeys by air and road.

Moreover, as well as reducing CO₂ emissions, a modal shift from road to rail also supports the creation of more people-centred, healthier communities by helping to tackle the urban blight created through car-dominated planning.

These concerns are embedded in Scottish Government policy, which includes ambitious targets for carbon reduction. The 2045 target for achieving net zero carbon emissions was adopted in the October 2019 decision of the Scottish Government and, two years later, the changes in the transport sector needed to meet this target were set out. Transport Scotland's Decarbonisation report of 2021¹ pointed to modal shift as well as 'journey shortening' and 'journey avoidance' to achieve a 20% reduction in the number of car kilometres travelled across Scotland between 2019 and 2030. It also set out a target to shift 23% of freight goods from road to rail and ships over the same period.

At a UK level, long-standing commitments by governments in Westminster and Edinburgh to work towards achieving a sub-3hr rail journey between Scotland's Central Belt and London were followed up in 2021 by the Union Connectivity Review, chaired by Sir Peter Hendy. This recommended accelerating existing services over links connecting the new HS2 infrastructure between London and Crewe onwards to Scotland, Wales and Northern Ireland. The government's formal response is awaited.

¹ <https://www.transport.gov.scot/media/50354/decarbonising-the-scottish-transport-sector-summary-report-september-2021.pdf> see p79. There is also an interim target to reduce carbon emissions by 75% between 1990 and 2030.



Though some significant commitments have been made in recent years, not least the historic commitment to build the first long-distance rail route since Victorian times, there is no existing rail investment plan which delivers against either the Scotland or UK decarbonisation objectives.

Recent analysis suggests that the Department for Transport may have seriously under-estimated the carbon savings available.² This new work shows that, for travel between Glasgow and London, carbon emissions (CO₂e) per passenger are 304kg for the journey by air, 43.2kg by car, but only 4.9kg by rail. The rail carbon figure is around 20% of DfT's quoted estimate. The implication is that there is a clear opportunity to make a real difference that is being missed. DfT estimates had placed rail's carbon emission for this journey over five times higher.

The precise role rail can and should play in achieving net-zero remain to be set. For example; what level of modal shift from air and car to rail is desirable, necessary and feasible? And how much from the range-limited electric or hydrogen powered HGVs of the future to electrically powered railfreight?

Business case processes need to be updated to deliver against the transport sector decarbonisation aim. We urgently need to revisit our investment appraisal approach to answer such questions.

This shift in focus should help us to re-assess the pipeline of rail investment schemes and to guide decisions on how these are further developed. As things stand, there is a significant gap in the progress of key enabling schemes which have lain dormant for too long, leaving the existing programme of planned investment wanting.

On cross-border, HS2 provides the starting point for developing a UK-wide high speed rail network. But, while faster journeys on the planned new infrastructure between Crewe and London will be of benefit, Glasgow-London journey times will remain well shy of the 3-hour target that Westminster and Holyrood Ministers have agreed to work towards³.

With various parts of HS2 either postponed or cancelled and no sign of the investment needed in Network Rail track and signalling over the lengthy connecting cross-border route, journey times will be longer than necessary and capacity will be limited, constraining passenger service timetables and making no space available for the substantial increase in rail freight now expected.

Similarly, the Scottish Government's ambitious aim to reduce car vehicle kilometres by 20% by 2030 is yet to be followed up by the detailed actions needed to achieve make this possible. As we explore in the report, plans are available to upgrade the rail network, but critical funding decisions are required to progress them.

A new approach is required; one which updates business case methodologies to ensure investment delivers against net-zero targets as well as other Government policy aims and identifies the next steps in progressing the relevant policies and projects to deliver on net zero commitments.

² See David Shirres, DfT understates the benefits of modal shift", Modern Railways, pp62-63, June 2023

³ <https://www.gov.uk/government/news/three-hour-scotland-to-london-rail-journeys-on-track#:~:text=from%20when%20Phase%20one%20opens,route%20to%20Crewe%20in%202027>



Of course this is challenging, but we believe Government should take heart from the very significant rewards on offer from attracting greater rail usage. A glance at the Central Belt to London corridor for instance – Europe’s busiest and where only 40% of pre-Covid passengers chose rail over air – shows the huge gains that can be delivered if significant modal shift can be achieved. Across Europe, airlines and rail operators are collaborating to shift long-distance domestic travel from air to rail, delivering significant carbon savings and freeing up airlines to focus on the international routes for which they are best suited. The same energy and imagination is required in the UK, with an approach that puts in place all the necessary levers, including fixing the fares and taxation regime alongside infrastructure investment to incentivise rail travel. Similarly, there are significant opportunities to transform travel between Glasgow and Edinburgh, where, despite significant rail capacity, the majority of journeys are still made by car.

We are conscious that, at the same time as rail’s role as a critical long-term enabler of decarbonisation has solidified, it is experiencing a crisis of funding. In a few short years, as working-from-home has gone from being an emergency response to a global pandemic to an established way of working for a significant proportion of the UK workforce, rail commuting has fallen correspondingly, taking with it a significant slice of farebox revenue. Though leisure journeys have recovered strongly (and railfreight has continued to develop new flows and markets), this has created a funding gap: post-Covid, the rail system is delivering less revenue to Treasury. Governments and devolved transport authorities are left facing difficult decisions in maintaining and growing the rail sector in the short-term, an unenviable position that inevitably creates risk for the longer-term investment that decarbonisation commitments require.

Developing the long term investment programme needed requires new forms of collaboration. This is particularly true of Anglo-Scottish journeys, where the size of the decarbonisation prizes are biggest, and where investment decisions north and south of the border are co-dependent. Investment in upgrading Edinburgh and Glasgow termini to facilitate HS2 services, for instance, need to be matched by line-speed and capacity improvements in England.

Given the timescales involved in planning and delivering rail enhancements and the different and overlapping regional responsibilities this involves, a collaboration between UK, Scottish and devolved authorities in England will be required, extending over several parliamentary terms.

We hope that this report delivers fresh impetus for that work to recommence. We fully endorse agreements made by UK and Scottish ministers in 2016 to work towards a 3 hour rail journey once HS2 is complete and the recommendations of the Union Connectivity Review to accelerate journeys between the new HS2 infrastructure and the three devolved nations: these are key starting points.

In the following pages, we suggest where the areas of focus for this investment might be.

In **Part I**, we summarise relevant Scottish policy positions and consider changes in travel behaviour since the coronavirus pandemic. The climate emergency is identified as the key policy driver. We consider the priorities for rail in this changed circumstance, and how well progress is being made.

Part II covers cross-border movements to England. This is where, in addition to reducing road freight, more and better rail services can reduce the need for so many Glasgow/Edinburgh-London flights.

Part III addresses the challenges and opportunities for rail across Scotland as a whole. There is a technical annex that provides further background detail, including a set of tables showing rail’s competitive position in comparison with other transport modes in Scotland, route by route.



PART
01



01 Scottish Government plans and policy aims

Scotland is blessed with a comprehensive set of plans, including locations for land use and economic development. These plans and policies aim to reduce inequalities, deliver inclusive economic growth, improve health and wellbeing, and tackle the climate emergency, and these aims – together with providing safety and resilience – provide the policy framework for thinking on transport.

Helpfully, these ambitions are brought together in the second National Transport Strategy STPR2 (NTS2), published in December 2022.⁴

⁴ <https://www.transport.gov.scot/our-approach/strategy/strategic-transport-projects-review-2/>

Second National Transport Strategy STPR2 (NTS2)

(extracts from summary report, December 2022)

“The second National Transport Strategy (NTS2) is a strategy for change. It recognises the key role that transport has in reducing inequalities, delivering inclusive economic growth, improving our health and wellbeing, and tackling the climate emergency. At the heart of the Strategy is the recognition that we need to deliver a step-change in behaviour and provide attractive, affordable, accessible and sustainable travel options.”

“Reducing our carbon emissions to net zero by 2045, a key part of the Scottish Government’s policy to address the global climate emergency, will require significant changes to the transport choices we all make as well as the transport network and options that influence our decision making. Recognising this, the Scottish Government **has committed to reducing car kilometres by 20 per cent by 2030** and recently published the draft Route Map jointly with COSLA* which outlines the actions that will be taken to achieve this, acknowledging that technological advances will not be enough to achieve this on their own.”

“For passengers, rail is typically best suited to the higher volume ‘trunk’ element of city-to-city journey.. [..]. For freight, rail is often suited for longer distance bulk / intermodal freight. **Future passenger rail investment should therefore be targeted on the strongest city-to-city markets** as the routes where the greatest value from improvements will be realised, and freight investment on corridors from the Central Belt across the border and towards Aberdeen and Inverness.”

“**STPR2 recommends** a programme of enhancements, which would achieve improvements to journey times and increases in capacity and reliability for passenger and freight services. Additional freight enhancements to increase volumes carried would also be considered where these would lower operational costs and encourage a faster shift from road to rail.”

Note: emphasis added

* COSLA is the ‘voice of Local Government in Scotland’. The Route Map is out to public consultation - see <https://www.transport.gov.scot/publication/a-route-map-to-achieve-a-20-per-cent-reduction-in-car-kilometres-by-2030/>

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While rail already offers a carbon advantage over road use (car and lorry). Less energy is needed per passenger or freight tonne-km because of the combination of higher load factors and lower rolling resistance. A further reduction in fossil fuel use requires further extension of electrification across the rail network, for which Scotland has a clear programme.⁵

The extent of the electrified rail network in 2021 and as is planned for 2045 is shown below. Besides electrification, battery and hydrogen-based traction is also being considered.

⁵ <https://www.transport.gov.scot/media/50354/decarbonising-the-scottish-transport-sector-summary-report-september-2021.pdf>

Figure 1. Extent of rail electrification in Scotland 2020 (electrified routes shown in red)

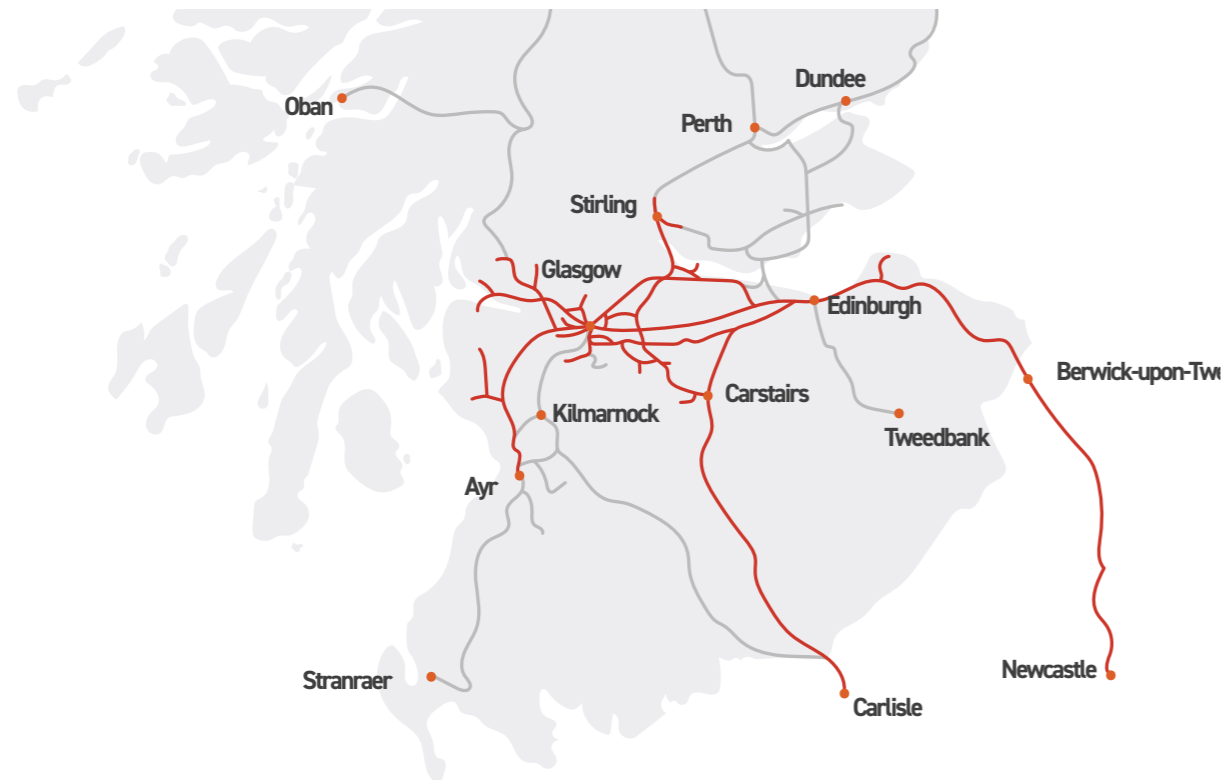
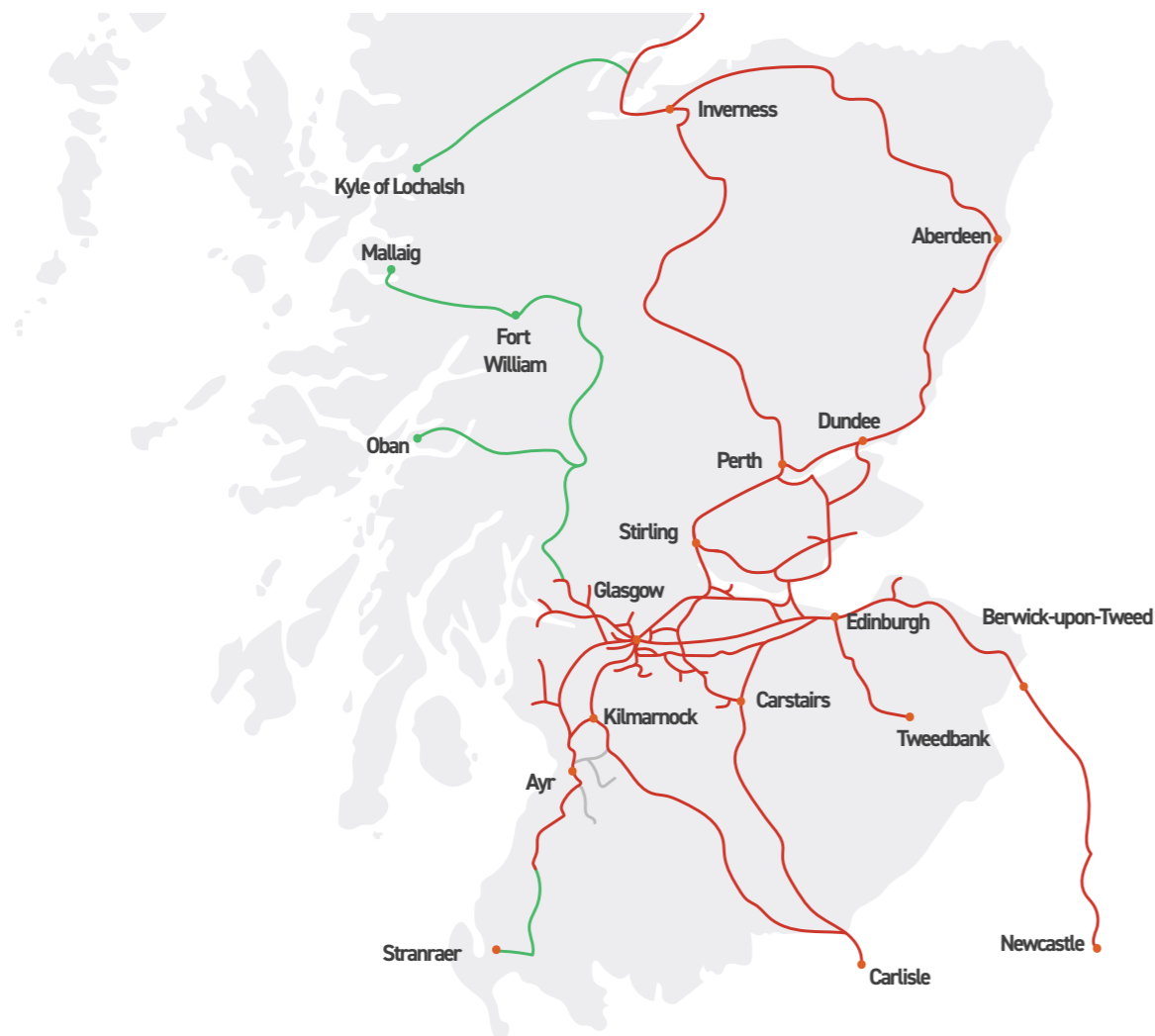


Figure 2. Planned electrified rail network in Scotland in 2045



What has changed since Covid-19?

While the electrification plan will further reduce carbon intensity, the nature of rail travel demand has changed since Covid-19. Five day-a-week commuting by rail has shrunk, but longer distance leisure travel has recovered well since Covid-19 restrictions were lifted. Once the period of industrial action and service cutbacks is over, rail passenger demand looks set to grow year-on-year, as it did for the 20 years that pre-dated the epidemic.

Research for Anglo-Scottish passenger operator LNER, which has led this pattern of demand recovery reports that⁶ :

27% say the pandemic and its side effects have motivated them to adopt more environmentally friendly travel (source: YouGov, 2020)

90% are confident face-to-face meetings will become the norm again (source: Prospectus Global, 2022).

Attitudes towards flying have changed too. Since the pandemic, LNER believes that travellers are more environmentally conscious and more likely to choose rail. LNER believes that it is now the main transport provider between Edinburgh and London with more than 50% of the market, whereas before Covid it only had 35% modal share.⁷ And it notes that 50% more passengers are travelling on Sundays than in pre-Covid times.

In summary, demand for commuter rail services has diminished and leaves a less certain need for additional peak rail capacity into city centres. Rail travel for other reasons has proved more resilient – for leisure in particular. Passenger miles travelled on Scotrail, dominated statistically at least by travel within the central belt, have fallen sharply from 0.5bn to 0.3bn between the last pre-Covid quarter (2019-20, Q3) and now (2022-23, Q3). This is much more than across Great Britain as whole (a decline from 10.8bn to 8bn passenger miles), with cross-border operator LNER, for example, only experiencing a decline from just 0.9bn to 0.8bn passenger miles.⁸

Rail freight demand has proved mainly to be more robust, with some new, long-distance services (e.g. Southampton-Mossend), logistics and other flows switching from road to rail.

⁶ Railway to Recovery: the future of business travel, LNER, Summer 2022

⁷ Source: On-track for continued growth (passengertransport.co.uk)

⁸ Source Table 5, Modern Railways., May 2023 based on ORR data.



The biggest carbon reduction prize?

“23% of freight goods moved by road must be shifted to rail and ships by 2030 (this is expected to be predominantly on longer routes)” – taken from Transport Scotland’s Decarbonisation report of 2021.

“When comparing today’s road and rail traffic, ..[it was].. concluded that a typical freight train produces 76% less CO₂ per tonne than the equivalent movement by road. By operating longer and heavier freight trains, rail freight operators are significantly improving productivity and growing the rail freight market. Analysis shows how these innovative services ease road congestion, as each train removes up to 129 HGVs from the road network, while further enhancing rail freight’s carbon and air quality performance.”

Source: Rail Partners report of March 2023, which includes independent analysis by Aether (an Air Quality and Climate Change Emissions Consultancy, University of Hull’s Logistics Institute, and Railfreight Consulting

For rail, there is both a shift in the demand pattern and greater uncertainty in forecasts. As a consequence, earlier rail investment business cases need to be re-visited and updated, and investment priorities will likely shift as a consequence, directed much more clearly towards addressing the climate emergency.

On balance, this is likely to lead to a need to increase the rate of capital spend on Scotland’s rail network. But there is also scope to re-balance service provision on the existing network given the shifts in demand since the Covid pandemic.

What progress has been made to date on transport decarbonisation?

Rail continues to improve and performs relatively well, with average emissions of 36.6 gCO₂e per passenger kilometre in 2018-2019. The 2017 carbon emissions of each mode in Scotland were summarised in a July decarbonisation 2020 report, as shown below.⁹ Overall, the report stated, transport accounts for 37% of Scotland’s greenhouse gas emissions – a higher proportion than for the UK as a whole, in part reflecting the dispersed geography and reliance on air and ferry services for some vital connections.

Notably, rail carbon emissions appear to be on a downward trajectory, and account for just 1.2% of all transport emissions in Scotland. The July 2020 report also pointed out that in the prior two years the number of ScotRail passengers carried on electrified services had increased by 23%, as a result of the electrification projects completed over this period.

The transport decarbonisation report came two years later and it was here that the Scottish Government adopted a proposed 20% reduction in car travel, to be achieved by 2030.¹⁰ This aim demands fresh thinking on rail. What can rail contribute towards this crucial part of the carbon road traffic reduction objective?

One implication is that rail needs to do more where car use is most intense – and that will be across the central belt which accounts for 70% of Scotland’s population. This is where the rail network is already close to being fully electrified.

“Transport’s contribution to net zero will only be delivered if decarbonisation and digitalisation are brought together to support a shift to more people using public and shared transport as well as the decarbonisation of private vehicles. Scotland can be a living lab for technology and data-led transport solutions, such as Mobility as a Service...”¹¹

Such an approach would need to sit alongside measures in longer distance sectors, to switch road freight to rail and to attract air passengers to switch to (improved) rail services.

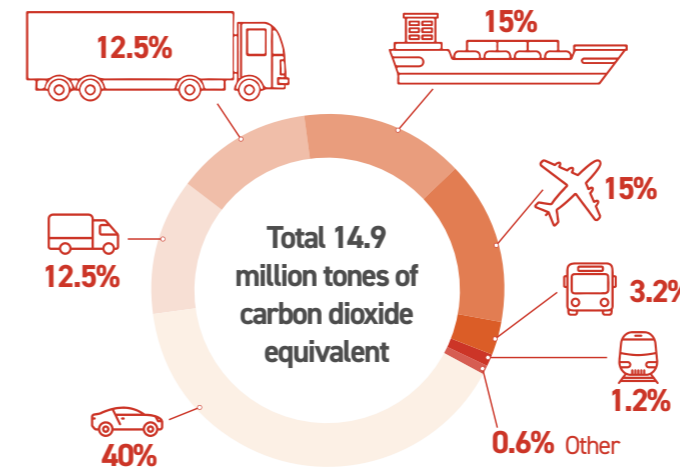


Figure 3. Breakdown of carbon dioxide emissions

The relatively benign contribution for rail was also noted in the rail services decarbonisation plan:

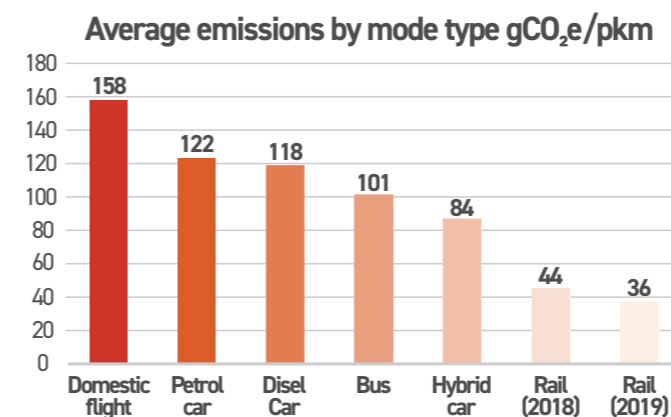


Figure 4. Average emissions by mode type (blue 2018, green 2019)

⁹ <https://www.transport.gov.scot/publication/rail-services-decarbonisation-action-plan/>

¹⁰ <https://www.transport.gov.scot/publication/decarbonising-the-scottish-transport-sector/>

¹¹ Blueprint 2030 - SCDI - SCDI



Summary

As for Scotland's progress against the net zero target for 2045, the Climate Change Committee (CCC) also reported in December 2022. It was highly critical of the rate of progress.

The report said¹²:

"Scotland's climate targets are in danger of becoming meaningless. The Scottish Government lacks a clear delivery plan and has not offered a coherent explanation for how its policies will achieve Scotland's bold emissions reduction targets".

These conclusions, the latest assessment of Scotland's progress by the Climate Change Committee, continue:

"In recent years, the Scottish Parliament has committed to extraordinary ambition to decarbonise its economy, with a welcome focus on a fair and just transition. That ambition should be applauded, but only if targets are achieved. The integrity of the Scottish climate framework is now at risk."

Scotland has an excellent set of plans in place that should lead to clarity of thinking on how to best develop the nation's rail system. Steady but slow progress continues to be made on rail electrification which must continue and accelerated as funds permit. But Covid-19 has had an impact, on health, well-being and the wider economy. Funding priorities have inevitably had to change, but better rail services and connectivity help these broader policy aims too. The investment case for rail may centre on the stark obligation of meeting climate change targets but it also embraces gains in air quality, health/well-being and economic performance.

There is no equivalent for the Scottish rail sector to the funding commitment made for the English North and Midlands in the £96bn Integrated Rail Plan of November 2021. Political discussion on transport policy currently centres in Scotland on timing of further dualling of the A9 Perth-Inverness road (with the A96 Aberdeen-Inverness also featuring)¹³ with no mention of rail.

A fresh narrative is needed to ensure rail plays its key part in creating the path to sustainability that the various national plans have so scrupulously identified. But this needs Government funding at a time when there are a host of other pressures on budgets, and the Scottish Parliament has no borrowing powers. So a targeted and prioritised approach is needed.

¹² Scottish Emission Targets & Progress in reducing emissions in Scotland – 2022 Report to Parliament - Climate Change Committee (theccc.org.uk) In response to the CCC's earlier report on progress in 2021, the Scottish Government responded in May 2022 as follows: (1) re-iterating its commitment to work to decarbonise scheduled flights within Scotland by 2040 and (2) stating that it is "focussing on supporting and facilitating greater use of rail where this is a viable alternative [and].....also continuing to work with the rail industry to reduce journey times, and have consistently supported high speed rail but not just [from London] to Birmingham, Manchester and Leeds. We know that to realise its full benefit for all of Britain, high speed rail infrastructure needs to be extended further and faster to reach Scotland."

¹³ These road schemes have safety benefits but also increase speeds and capacity. The Infrastructure Commission for Scotland report of January 2020 called for changes to the STAG appraisal methodology in favour of future-proofing existing road infrastructure making it safer, resilient and more reliable rather than increase road capacity (emphasis added).



PART
02



02 Cross-border connections

Scotland's second Strategic Transport Projects Review (STPR2) published in December 2022¹⁴ outlined the key advantages of investing in cross-border rail links. It said:

"Infrastructure upgrades to permit higher speeds on cross-Border routes would enable journey times to London and other key destinations to be more competitive with air travel. This improved connectivity would encourage a shift from air to rail on longer-distance travel and support Scotland's Net Zero emission commitments. These improvements would also release capacity for additional regional passenger and freight services."

Accordingly, the STPR2 report adds:

"STPR2 recommends that Transport Scotland continues to work closely with the UK Government to take forward a programme of infrastructure upgrades targeted at long-distance cross-Border routes. This is likely to include the...[.]...East Coast Main Line, West Coast Main Line (and) Glasgow and South Western Line (Glasgow to Carlisle via Dumfries)."

The Taskforce concurs with this conclusion and notes that the agreed target to work towards a 3-hour rail journey time Edinburgh/Glasgow-London has not been abandoned.

¹⁴ <https://www.transport.gov.scot/our-approach/strategy/strategic-transport-projects-review-2/>

The following chart shows the pattern of growth in the pre-Covid decade for cross-border rail demand Scotland-England by route)

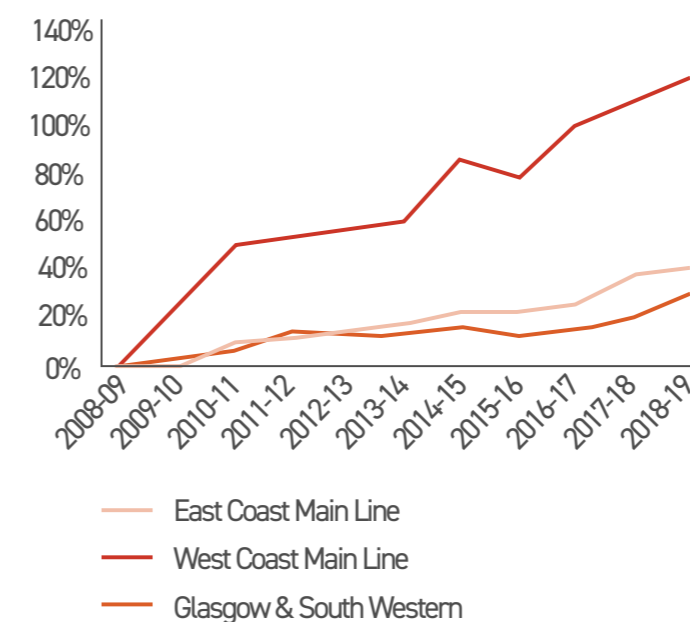


Figure 5. Network Rail Call for Evidence response, using MOIRAI data

The Hendy Review¹⁵ from which this chart is taken highlights both the prospects for air to rail demand shifts:

"Very large growth in rail freight is expected on the West Coast Main Line. Even in the central scenario, the number of services is set to more than double over the period....The 'high market growth, factors favouring rail over road' scenario is credible if government policy were implemented to encourage freight mode shift from road to rail."

Policy focus

Cross-border rail investment strategy needs to be focussed on the **twin decarbonisation goals** of more capacity to support freight flows transferred from road (especially over longer distances) and faster and more attractive services that will attract travellers from air (as well as road) travel. All rail services would (of course) use electric traction.

HGV emissions are much higher than those from cars, and suitable replacements for long-haul diesel goods vehicles – for instance, for a standard 44 tonne lorry – are yet to be found. In general, freight by rail travels on lines shared with passenger services, and travels at lower speeds, especially where significant gradients are involved.

The differential between freight and passenger train speeds reduces effective line capacity. Across the England-Scotland border, more rail capacity is needed.

The Taskforce believes that scenario is not just credible but inevitable. A typical freight train produces 76% less CO₂ per tonne than the equivalent movement by road...[and]... each train removes up to 129 HGVs from the road network.¹⁶

The rail investment needed would help both Scottish and UK Governments' objectives on carbon emissions, because they would bring about major reductions in air travel and major reductions in HGV mileage, and boost productivity across the British economy.

Earlier work by HS2 Ltd (with Transport Scotland, DfT and Network Rail), published in March 2016,¹⁷ reported on options to extend the benefits of the committed HS2 plans further northwards, with an ambition of achieving London-Glasgow/Edinburgh rail journey times of around 3 hours. Its conclusions have not been progressed since.

The emphasis now needs to change in any event. The Scottish Inter-City Rail Taskforce takes the view that the policy lens has shifted. Westminster and Holyrood Ministers need to recognise that there are now twin objectives that must be pursued to fulfil both Governments' climate change policies: to achieve a major switch from road haulage to railfreight as well as the transfer of passengers from flights to high-speed trains.

¹⁵ Union Connectivity Review, Figure 82

¹⁶ Freight expectations: How rail freight can support Britain's economy and environment

¹⁷ NES_Report.pdf (publishing.service.gov.uk)

Air to rail modal shift

The current plan for HS2's Anglo-Scottish services will reduce journey times – significantly so on the west coast route. This was identified in the Union Connectivity Review¹⁸ to be crucial to winning rail market share from air. Given the high volume of flights between Edinburgh/Glasgow and London (which, uniquely, provide travellers with six London airports to choose from), a modal shift in this travel market could make a significant contribution to meeting the challenge set by Transport Scotland's 2021 decarbonisation report. These city-city air flows form the single largest corridor of short-haul flights in Europe. They also dominate the UK domestic air market, as shown in an earlier HSRG report – see bar chart below.¹⁹

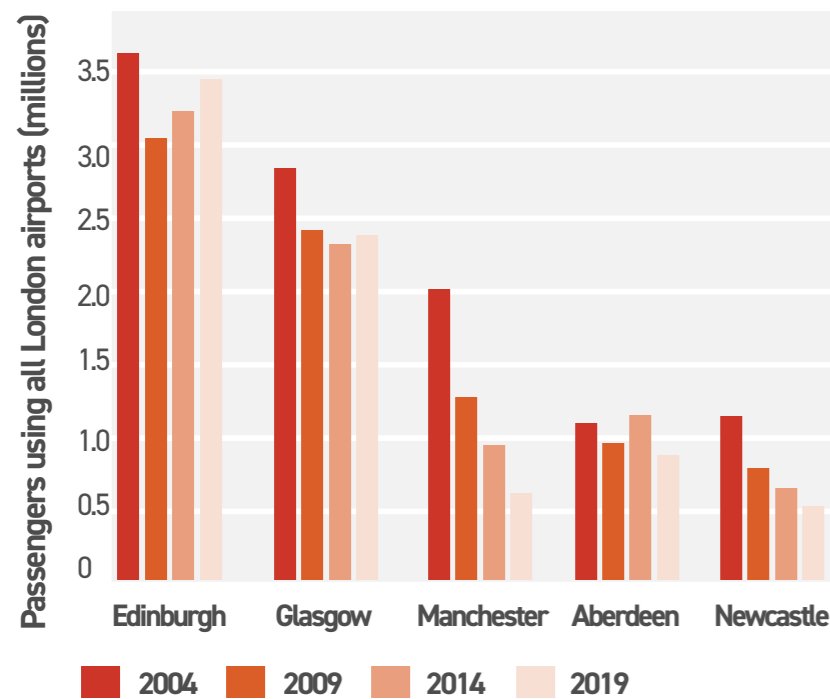


Figure 6: Time series for passengers, five busiest routes, for all London airports, 2004 to 2019
Source: CAA airport statistics, Greengauge 21 analysis

¹⁸ See November 2021 report: <https://www.gov.uk/government/publications/union-connectivity-review-final-report>
¹⁹ HSRG report of May 2022 on this subject: <https://www.rail-leaders.com/publications/how-to-win-air-travellers-to-rail/>
²⁰ Source: Union Connectivity Review final report p40

Anglo-Scottish air-rail market

To achieve this, rail services need to be attractive: it seems unlikely that governmental tax and rail fare policies currently don't encourage a change of consumer behaviour. But the carbon reduction prize comes from a reduction in flight provision which suggest a need for some liaison between the rail and aviation sectors.

On those routes where rail can provide a high-frequency (hourly or better) service with competitive centre to centre journey times (under 4 hours, preferably closer to 3h30 – so between London and Edinburgh (and post-HS2, Glasgow too) – air services could be cut back. Valuable Heathrow-Glasgow/Edinburgh slots, for example, could be switched to other Scottish Airports. Flights between Aberdeen and Inverness to Heathrow should be protected and even enhanced, while other airports such as Dundee could possibly see direct links to Heathrow added.

The significance of good connectivity to Heathrow for international trade will not be lost on forward-looking Scottish businesses, even as they seek to minimise their own air-miles, which increasingly from Glasgow and Edinburgh at least could be achieved through a switch to rail.

On the face of it, this is single biggest opportunity across Europe to achieve a large-scale carbon reduction without recourse to measures that seek to discourage passenger travel – that is without the attendant risk of adverse economic repercussions.

The UK Government's response to the Union Connectivity Review is still awaited 18 months after its publication. When it comes, it must provide a joined-up way forward to take forward its conclusions for cross-border freight and passenger travel.

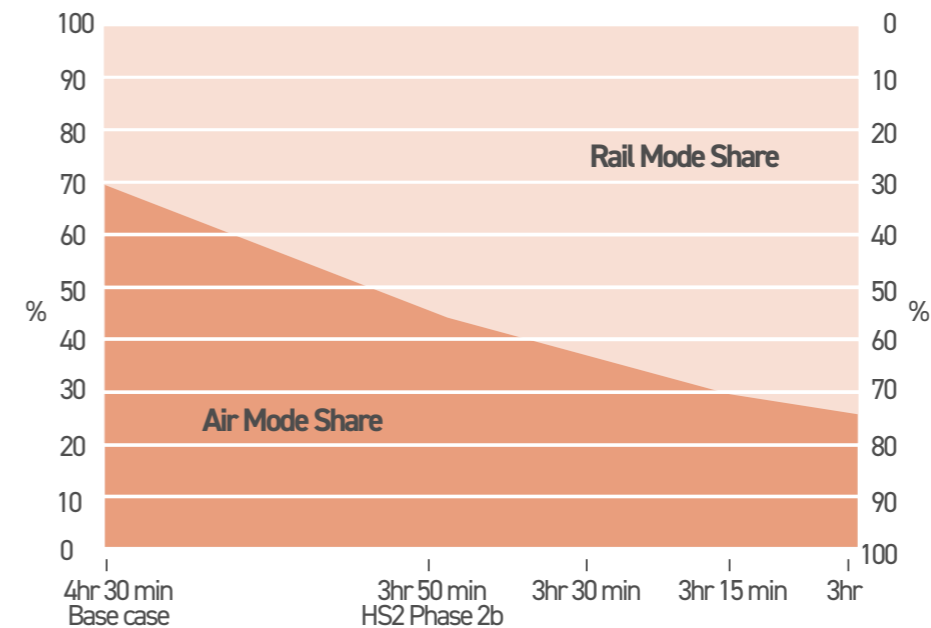


Figure 7. Anglo-Scottish air-rail market
Source: Union Connectivity Review final report p40

²¹ As they have been elsewhere (in France for example)

High Speed Two

The plan for HS2 had always been that services from Scotland would start when Phase 1 is complete into Euston.

Following the Secretary of State for Transport's announcement on March 9th²², two parts of the HS2 programme have been put on a 2-year 'hold'. These are the Euston-Old Oak Common section (part of Phase 1) and the Phase 2a section of line between Handsacre junction (near Lichfield) and Crewe. Completion of Euston was already subject to a delay, and there is no settled date for its completion.

It subsequently emerged in mid-May that a previously unannounced further part of the Phase 1 scheme (Curdworth-Handascre, across Warwickshire) is also now subject to a 2-year delay.²³ This section of route will be used by London-Glasgow trains. In its absence, it is not possible to run HS2 services that serve Scotland.

The main length of Phase 1 between Old Oak Common (London) and Birmingham is now slated to be complete and ready for service between 2029 and 2033, with the delayed cross-Warwickshire part of the Phase 1 programme following presumably two years later, along with Phase 2a, which is said to have a completion timeline of 2030-2034. The Old Oak Common section has no set delivery date but will take longer to complete. While only formally delayed by two years, Euston works were running late in any event.

Plans for Anglo-Scottish HS2 services were also affected by the earlier abandonment of the 'Golborne spur' in the Government's adopted Integrated Rail Plan for the Northern and Midlands. This part of the HS2 Phase 2b plan provided a bypass to the two-track sections of railway between Crewe and Wigan. Without the Golborne spur, while it is possible to substitute a new faster HS2 service each hour for the existing Glasgow-London Pendolino train, a second hourly HS2 service, as provided for in the project business case, could not be accommodated.

Initially, HS2 will need to operate with Old Oak Common as a temporary terminus in west London. But HS2 Glasgow services will not be possible until the delayed cross-Warwickshire section of Phase 1 is complete to Handsacre Junction, and capacity northwards to Crewe over the West Coast Main Line will limit the number of HS2 services that can be run at that stage. Glasgow will be competing against Manchester and Liverpool as candidate early-years HS2 service destinations.

Delays and limitations on HS2 Glasgow services will be further constrained by the absence of additional capacity and power supply north of Crewe and no committed plan to rectify the situation.

Taken together, this amounts to a significant setback to achieving transport sector decarbonisation nationally: the impact of HS2 on Anglo-Scottish journeys will be blunted, and with it, the potential to encourage modal shift and significantly reduce CO2 emissions will be diminished.

While the overall delivery timescale for HS2 is now unclear, assuming that the intention remains to include Scottish services on HS2, as originally planned 13 years ago, then measures to accommodate them must be put in hand. At present there are no plans in place to make this possible.

The lack of a master-plan to implement HS2 is limiting the wider economic opportunity it brings to the UK as a whole. It should now also be recognised for the unique contribution it can make to reaching the carbon emission reduction targets that both the UK and Scottish Governments are committed. It uniquely offers the opportunity to bring about large-scale modal shift, achieved through the attraction of faster, more frequent services over longer distances and the additional (electrified) infrastructure to accommodate the shift.



²² The enforced delays to HS2 will increase its overall cost – see: The latest HS2 delays expose deeper problems with UK infrastructure planning | Institute for Government

²³ <https://www.building.co.uk/news/more-hs2-job-losses-loom-as-slowdown-on-route-out-of-birmingham-finalised/5123217.article>

High-speed Anglo-Scottish services

An hourly service from Glasgow could start prior to the completion of the new HS2 station at Euston, operating to/from Old Oak Common station in London, with onward connections provided by the new Elizabeth Line (Crossrail).²⁴ Indications are that effective (reliable) HS2 line capacity when operating on this pre-Euston basis would be six or perhaps eight trains per hour.²⁵ There would likely be competition for these early HS2 paths, which could be used instead to serve Liverpool or Manchester (as well as Birmingham) and not Scotland. But no other service destination from London would offer the same level of decarbonisation benefit as an accelerated hourly Glasgow service. And since Glasgow trains can also serve North West England destinations at (say) Preston and Carlisle the claim can be made that they offer the widest coverage of the possible HS2 services that run northwards beyond the English West Midlands.

When HS2 Phases 1 and 2a are complete, Glasgow-London journey times would shrink from today's typical 4h30 duration to around 3h45 minutes. As the Scottish Association for Transport has pointed out to the Taskforce, to this timing should be added longer connection times to most London destinations, compared with a service into Euston. Nonetheless, there is clearly a significant time saving on offer and for Scotland this would be a significant connectivity and decarbonisation gain.

This requires Scotland and in particular Glasgow Central station to be ready and able to accommodate the new high-speed services. And it would be desirable, under this revised phasing of HS2, for Glasgow Central to be able to accommodate a full length rather than a half-length HS2 from the outset. A half-length HS2 train would have less capacity than the longer Pendolino it would replace, but this would be inadequate and frustrate any ambition of attracting significant air passengers to high-speed rail.

Once HS2 Phase 2b is complete along with the route into London Euston, the business plan shows a second HS2 train each hour operating from Scotland (from both Glasgow and Edinburgh) to London Euston calling at Carlisle, Preston and Old Oak Common, as shown below. This would be the second of the two stages of HS2 service implementation.

This plan would now only be feasible if the Golborne spur component of Phase 2b is re-instated: otherwise there is insufficient line capacity over the Cheshire-Lancashire section of the West Coast Main Line. Along with Golborne link re-instatement, the capacity limitations between Wigan and Preston will also need to be addressed.²⁶



²⁴ although this requires the delayed cross-Warwickshire route to have been built and commissioned as noted

²⁵ Willian Barter, Modern Railways, May 2023 p46

²⁶ The Union Connectivity Review suggested that this part of HS2 (Phase 2b) should not be just re-instated but extended. This would help overcome the 2-track capacity constraint between Wigan and Preston. But given the new policy lens for the transport sector noted above, with the addition of a second objective of adding significantly to long distance rail freight capacity, consideration should also be given to the creation of a suitable diversionary freight route north of Golborne, because this may offer better value for money.

Full HS2 service plan ²⁷

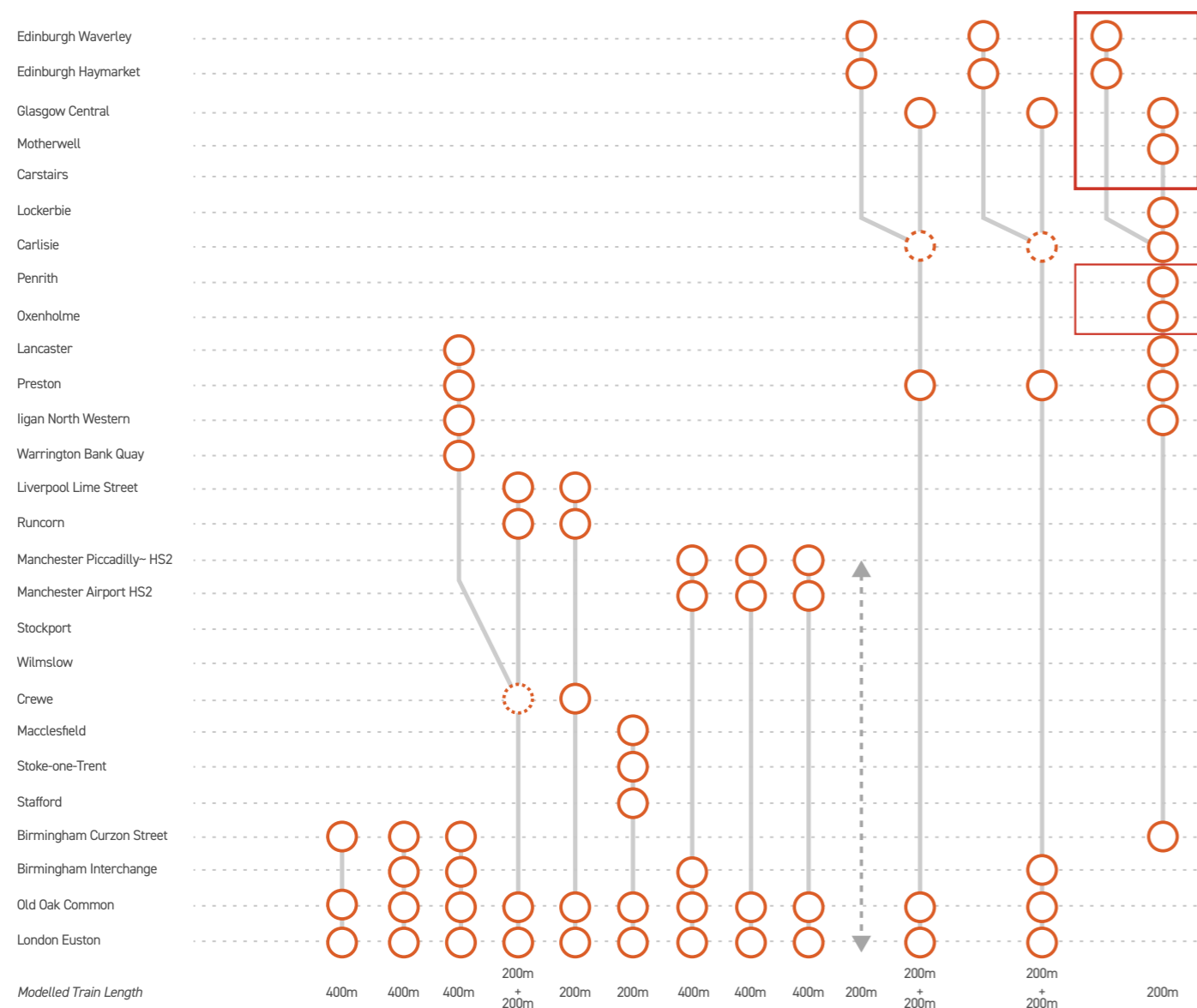


Figure 8. Full HS2 service plan

This plan shows 11 trains/hour into London Euston (others may be added by the planned HS2 Eastern Arm services not shown on the diagram).

For Scotland, the 2 trains hour for each of Glasgow Central and Edinburgh (Waverley and Haymarket), divide/join en route at Carlisle. There is also a Birmingham HS2 service (here the Scottish station calls appear in 'red boxes' and are assumed to be on an alternate hours basis).

Train lengths are shown, and it can be seen that all services in Scotland (north of Carlisle where the 400 metre long HS2 train splits into two) are assumed to be provided by 200m long trainsets: as noted, significantly shorter – and so with fewer seats – than today's cross-border Pendolino and Azuma trains.

Experienced rail operators have questioned the assumption of dividing and joining Glasgow/Edinburgh trains en route because:

1. this will extend journey times beyond those used in the HS2 business case – both for the division/joining operation and, for southbound trains, because the 'second half' train will need to arrive at the joining station (Carlisle) a suitable interval after the 'first half' train, which would need to await its arrival
2. the joining/dividing operation imparts a degree of added performance risk – there can be technical problems: in practice this can adversely affect on-time performance, which may be mitigated by adding 'performance allowances' into the timetable, but this would again lengthen journey times in practice
3. it can create north-bound passenger anxiety ("Am I in the right portion of the train?")
4. it reduces train capacity, since a 200m trainset is significantly shorter than today's Pendolino (west coast) and Azuma (east coast) trains.

On the other hand, this plan indicates that existing platforms at Scottish HS2-served stations will not need to be extended to accommodate the full HS2 design standard of 400m long trains. But in a situation where, as noted, the Scottish Government's climate emergency measures require a switch of travel mode to rail, it makes no sense to cut back on today's level of train seating provision – a Pendolino is 265m long – and so diminish the appeal of the HS2 services.

Given that these plans are nowhere near fixed, we have concluded it would be wise for Scotland to plan on full length 400m HS2 trains operating into Scottish termini from the outset. True, that cannot then deliver the suggested half hourly frequency for Glasgow and Edinburgh without consuming another train path into Euston. And it does raise a number of challenges at Glasgow and Edinburgh main line stations, where 400m long platforms are either not available (at Glasgow) or where there already are 400+m long platforms but insufficient capacity (Waverley). There are differing solutions for the two Scottish cities.

²⁷ Source: Full Business Case High Speed 2 Phase One, DfT, April 2020, p133



For Glasgow, the findings of a recent report by a dedicated Commission point the way.²⁸ The Glasgow Connectivity Commission looked at this problem and concluded (on pages 32-33) that, in preference to other sites (remote from existing rail termini that had been suggested previously):

“The Commission is of the view that there is only one credible option for a high speed rail terminal in Glasgow. This is to redesign Glasgow Central to accommodate HS2 trains. This would require at the very least the extension of the station over the River Clyde including the reinstatement of the former additional bridge and tracks over the river to the east of the station approach, and the creation of a new southern entrance and concourse roughly on the site of the former Bridge Street station.”

The advantages of such an approach, it said, included:

- significant regeneration potential to the south of the city centre
- the potential to create a bus station integrated with the new southern concourse of the station to provide an integrated transport hub for the south of the city.

These virtues play straight into wider Scottish Government policy objectives of reducing inequalities, delivering inclusive economic growth, improving health and wellbeing, and tackling the climate emergency noted earlier.

For Edinburgh, rail industry opinion is shifting towards providing the fastest cross-border connections over the east coast route, where journey times as low as 4 hours are already achievable (but not on an every-hour basis), and where there are prospects of this journey time being reduced further with investment in the East Coast Main Line (and potentially in future depending on the outcome of the HS2 Eastern Arm studies, with the additional facility to use HS2 to access London). But if HS2 use is preferred for London as well as Birmingham services from Edinburgh, this means that capacity issues on the western approaches to Waverley station would have to be addressed too.

Accommodating increased cross border rail traffic in Scotland

As of today, there are some investments proceeding designed to improve the capability of the Scottish part of the cross-border rail system. Journey time improvements can be had by removing low speed sections as well as by adding new high-speed lines. The scheme currently under way at Carstairs where the junction for the Edinburgh line joins the west coast route from Glasgow has track and signalling renewals being used as the base to create faster junction and non-stopping speeds, and adding increased freight loop capacity.

²⁸ see <https://www.glasgow.gov.uk/CHttpHandler.ashx?id=45064&p=0> The suggested scheme at Glasgow Central makes use of now disused bridge piers, and places a new deck across them into new long platforms on the east side of the existing station.

Photo: Greengauge 21



Carstairs

An overall development strategy is needed with a firm plan for west coast cross-border infrastructure and use²⁹ that will address the twin aims of the decarbonisation strategy when applied to rail, namely attract more freight from road and more passengers from car and (especially) air. This would likely entail:

1. specific measures to support a significant expansion of cross-border railfreight
2. further development of the Greater Glasgow and wider central belt rail network to support improved local rail services and their integration with Glasgow Metro plans, to reduce car-dependence for local and regional travel
3. the addition of HS2 services, on faster timings than today's Pendolinos, in order to make a progressive shift in air-rail market share.

All three measures will contribute towards the decarbonisation aim.

DfT/Network Rail/Scottish Government/HS2 Ltd together studied options for this route (and onwards across northern England to Crewe) in 2016 and identified options:

- a continuous cross-border high speed line, which could be capable of a 2hr30 journey time between Glasgow/Edinburgh and London, or
- a series of cut off options, or
- 'crawler lanes' – separate lines for freight trains ascending Beattock³¹ bank in either direction (in Scotland) and the approaches to Shap summit (in England) – see vertical profile below³⁰.

All of these options carry significant capital costs but each can bring journey time savings for high-speed trains and extra capacity to accommodate more freight services – and help address the problem of speed differentials (which are very significant between freight and passenger trains on the uphill sections at Beattock and Shap). None have been progressed past the feasibility stage. But they can no longer, surely be considered to be an optional 'nice to have'.

²⁹ there will also need to be a plan for the East Coast Main Line

³⁰ Source: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/506022/NES_Report.pdf

³¹ The G&SW route avoids a major summit as at Beattock.

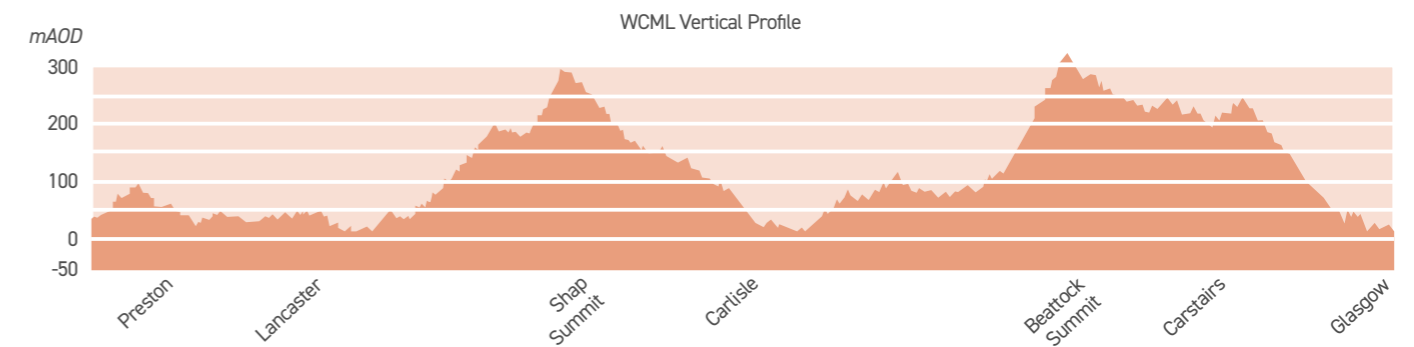


Figure 9. Vertical profile of the West Coast Mail Line

Note: Vertical scale is exaggerated for clarity. mAOD = Meters Above Ordance Datum.

In any event, given an objective centred on carbon reduction, the strategic choice isn't simply one of selecting the best options from these earlier studies. A strategic level review is needed and it should consider and agree:

- which schemes are worth proceeding with (either side of the border) to speed up HS2 (and other long distance passenger services) and add freight capacity - measured in terms of increasing rail market share and reducing carbon emissions
- whether to switch the focus of future Edinburgh-London services back to the East Coast Main Line (which is likely to trigger a question of the capacity for mixed local/long distance services on the East side of Edinburgh through rapidly growing East Lothian, as well as further south in- north east England)
- whether it makes sense to plan on accommodating freight on the Glasgow & South Western (G&SW) route via Dumfries, avoiding Beattock and the route through Lanarkshire. Of course having two parallel freight routes to the border would offer resilience, itself a likely

key factor in future decisions to switch from long haul HGVs to railfreight. There are also questions of which route to use for the faster premium logistics market by rail and whether using the East Coast Main Line for freight should be expanded (which has power supply, capacity implications)

- interfaces with the Clyde Metro concept which envisaged connecting the Cathcart Circle service into the Argyle Line which would take some pressure of train paths into Glasgow Central station. More generally, improved public transport connectivity between bus and rail away from Glasgow city centre on the eastern side of the Strathclyde conurbation could make a real impact on reducing carbon and improving air quality across an area of high car-dependency. Options need to be approached with an open mind: could tram-train have a role, or could, for example, RER type of services (where regional cities gain a rail-based network to serve the surrounding catchment) have applicability in Scotland, building on the limited existing cross-city rail services?³²

³² In France, as a key part of decarbonisation plans, a major programme has been announced by the Prime Minister Elizabeth Borne to bring RER-type services to France's regional cities – see <https://www.reuters.com/world/europe/france-plans-invest-100-billion-euros-rail-infrastructure-by-2040-2023-02-24/>

Glasgow & South Western (G&SW) for cross border freight?

Use of this line rather than the route through Beattock and Carstairs would need to include provision for cross-Glasgow freight flows to reach the major terminals at Mossend and Grangemouth. This may possibly be more easily achieved by using the 'Ayrshire lines' through Paisley Gilmour Street, with access via Mauchline - Newton-on-Ayr. This would avoid the single track sections on the more direct route north of Kilmarnock. Gauging work (for W9 or larger) has already been assessed, and prioritisation of the route for electrification would make sense.

This is maybe the best option to increase cross-border rail freight flows, and help free up what would then be a predominantly fast passenger route through Carstairs. G&SW route electrification would also bring benefits to passenger services Glasgow-Kilmarnock-Dumfries-Carlisle.

The best strategy here will only be found by a mix and match process, basing the selection on achievement of firmly committed Government policy goals.

An enhanced role for cross-border rail has a ripple effect for rail services within Scotland. More railfreight across the borders has implications for private sector freight terminal investment and offers the scope for new 'feeder' flows of railfreight within Scotland. More attractive long distance services from London to Glasgow Central and Edinburgh Waverley will likely also increase connectional journeys within Scotland, including by incoming tourists.

Three or four cross-border freight paths/hour along with two HS2 services per hour plus the hourly Birmingham to alternatively Glasgow and Edinburgh HS2 service (as well as other existing flows) could be a suitable bench-mark to use,

allowing a significant increase in rail use and a significant decrease in flights, car trips and HGV flows. The HS2 services, it should be assumed, will operate to and from an expanded Glasgow Central station and at least the services to London are likely to be high-capacity (400m in length).³³

There is another factor: the original HS2 Phase 2b scheme provided an east-to-north connection from the Manchester-Crewe high-speed line – which is still to proceed³⁴ – to the high-speed line via the Golborne spur northwards. Removal of this connection reduces the efficacy of HS2 to Scotland and indeed reduces the value that could be gained from HS2 related works further north, since the possibility of direct Glasgow-Manchester high-speed services has been removed. The Golborne spur (or an extended version, or in combination with a revised freight route) needs to be re-instated in HS2 plans.

³³ It remains unclear in whether there is any point in trying to design for a possible future HS2 train build, designed to fit the larger European rolling stock gauge. Better perhaps to equip Glasgow Central to provide easy access to the unified train fleet that is actually being built, designed for standard GB gauge clearances.

³⁴ But it has not yet started its Parliamentary Bill hearing process and was also delayed in the UK Government's announcement on March 9th, 2023

Reaching other English destinations (and the continent) by HS2 from Scotland

HS2 trains from Scotland might ultimately call at Carlisle (for destinations across Cumbria and Northumbria); Preston –with connections to Blackpool, Liverpool and Manchester; Crewe –Derby, Chester, and Wales, and possibly Birmingham Interchange but then only Old Oak Common (for Elizabeth Line destinations which include Heathrow terminals) before Euston in central London.

So, while there are plenty of feasible onward connections, much of England is hard to access from an HS2 train from Scotland, including most of Eastern England, East Anglia, South West England and South East England south of the Thames. No major cities are picked up by HS2 services directly en route to London.

Anglo-Scottish rail demand – as forecast by HS2 Ltd demand models - is certainly not restricted to flows to/from London, even though this is where air traffic volumes are highest. Mid 2030s forecasts of daily numbers of trips (both directions) to England and Wales are summarised by region below.³⁵

³⁵ chart source: see report as in reference 18

Forecast rail flows, Scotland-English regions, mid 2030s

There is no user-friendly connection from HS2 at Euston to St Pancras International for trains to Europe (Paris, Brussels and Amsterdam, with more destinations expected to be added over the next few years) – although perhaps the delay to Euston works completion can be used to introduce one). Scottish travellers can however, of course, use the East Coast Main Line services to reach Kings Cross which adjoins St Pancras International and this is a convenient transfer for onward travel to Europe by high-speed train.

With a clear plan forward for accommodating HS2 services from Glasgow eight to ten years hence, as set out here, the opportunity should be taking to start to 'build the market', perhaps with a speed-up of selected Glasgow-London Pendolino services which might stop at Carlisle and Preston only.

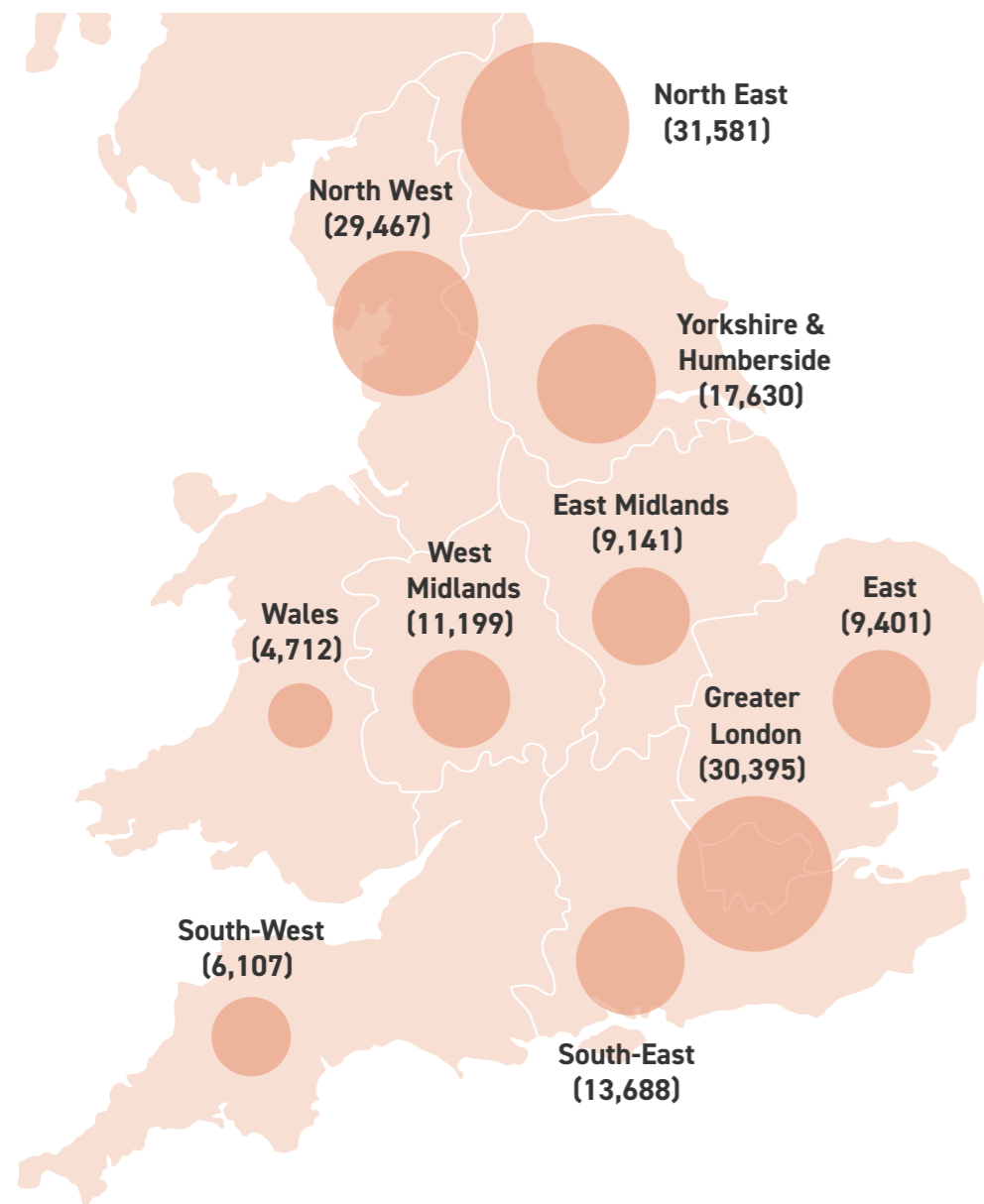


Figure 10. Mid 2030s demand forecasts
daily numbers of trips (both directions) between Scotland and English regions and Wales

Source: <https://www.transport.gov.scot/projects/high-speed-rail/project-details/>

East Coast corridor

The East Coast Main Line provides good connections to North East England, Yorkshire and East Anglia as well as London and train services to mainland Europe. Since longer 9-coach LNER trains cannot be accommodated in Glasgow Queen Street station, it may be worth seeking to re-instate some LNER service extensions to/from Glasgow Central, since the city will remain better connected to these places if trains are provided via Edinburgh and the east coast, and since it is now evident that Plymouth-Leeds-Edinburgh Cross Country services will not have alternate hour extensions to Glasgow Central in the re-instated 2023 timetable plan.³⁶

Separately, Scotland along with regional and city authorities on the eastern side of England await with interest the findings of the promised study of the HS2's Eastern Arm, one part of which (in effect from Birmingham to Nottingham) remained in the Government's Integrated Rail Plan (IRP) while the section northwards to Leeds and Yorkshire remained under consideration in a planned new study of options. This study may lead to new opportunities to connect Scotland with key cities in the English north and midlands (and Edinburgh to Heathrow Airport via Old Oak Common) as well as London.

In any event, the IRP commits Government to upgrades in England to improve the East Coast Main Line and its services which would benefit Scotland.

More generally, the rail network offers resilience through its two main cross-border routes, the east and west coast main lines, both of which can and do offer services to both Edinburgh and Glasgow. It is important that these duplicate capabilities remain, especially in the context of the climate emergency, with its increased risk of infrastructure damage caused by more extreme weather events and the risk of coastal cliff erosion which might affect the East Coast Main Line north of Berwick upon Tweed.

Looking ahead, as regards international connectivity, current plans will mean that the west coast route will offer good access to Heathrow Airport (direct, fast Elizabeth Line services to each of the airport's terminals from Old Oak Common) while the east coast will continue to offer ready access to the Eurostar and other services to Mainland Europe. This serves to underline why the two main Scottish cities should be provided with London services over each of the east and west coast routes.³⁷

³⁶ One alternative would be portion working with divide/join LNER operations at Waverley, with one portion of the London-Edinburgh train proceeding to Glasgow Queen Street and another portion progressing, say, to Dundee and Aberdeen. But such operations add to the pressures on the network and to its western approaches and may depend on investment in junctions and signalling at Waverley and its surrounds.

³⁷ As noted adding an Edinburgh-HS2 service via the west coast route to London is apparently infeasible without the now missing Golborne link, and this precludes an HS2 service linking Edinburgh and Heathrow via Old Oak Common. But if HS2 service plans are not finalised, and it would be worth examining the viability of an Edinburgh-Carlisle-Crewe-Birmingham (Curzon Street, reverse)-Old Oak-Euston service, avoiding adding another path into Euston by incorporating a planned Birmingham-Euston service.



Connections between HS2 and HS1

The provision of a user-friendly transit connection between HS2 Euston and St Pancras/Kings Cross that would provide the missing HS2-HS1 connection as well as connectivity from Glasgow passengers to the useful Thameslink network would overcome several of the connectivity limitations noted here.

Conclusions: Cross-border rail development

The West Coast Main Line, northward through Lancashire and Cumbria and across south west Scotland is the main cross-border freight route and the planned host for HS2 services. It cries out for a cross-border development strategy. Evidence to date suggest that this route, despite serving critical areas of North West England will not be prioritised for investment by Transport for the North³⁸. This is a challenge for DfT in partnership with Transport Scotland/the Scottish Government, to take up, working together, as has been done before, and of course with Network Rail/GBRTT/HS2 Ltd.

The choices ahead centre on providing more capacity, better differentiated capacity (with fast passenger services separated from increased railfreight volumes), and speed improvements. The Scottish part of the strategy, which would include consideration of an expanded role for the G&SW route³⁹, should be called for and commissioned by Transport Scotland. It should provide for an acceleration of HS2 and other cross-border passenger services and for a substantial increase in freight capacity. This is consistent with the conclusion section of the STRP2 which:

“recommends that Transport Scotland continues to work closely with the UK Government to take forward a programme of on-line and off-line infrastructure upgrades targeted at longer-distance cross-border routes. These would reduce long-distance passenger service journey times and increase capacity and reliability for regional passenger and freight services.”⁴⁰

Given the major change in transport and travel behaviour the Scottish Government is seeking, developing and putting this strategy in place cannot be delayed any further.⁴¹ A very significant part of Scotland's carbon emissions stem from long distance movements across the English border. Scotland-London alone accounts for 57% of UK domestic air travel, or around 9,500 passengers/day.⁴²

We know that travellers will switch when there is a fast rail alternative. Using HS1, Eurostar has removed the equivalent of 60,000 flights a year between the UK and Europe.⁴³ The Union Connectivity Review suggested that HS2 together with complementary investment (our emphasis) could allow rail to win 75% of cross-border air travel.⁴⁴

And while decarbonisation may be the driver of change, there are significant economic benefits to be had too: cross border transport is critical to Scottish exports (with over 90% of tonnage being shipped through ports in South/East England), to expanding the business catchments of Glasgow and Edinburgh; and to inward tourism.

³⁸ for whom the NPR project Liverpool-Manchester-Bradford-Leeds remains a priority

³⁹ South of the border, there may be a parallel need to develop the Settle & Carlisle line as a primary freight route

⁴⁰ <https://www.transport.gov.scot/publication/final-technical-report-december-2022-stpr2/> - see p124

⁴¹ While scheme feasibility studies were carried out by early 2019 – with the results summarised above – the Scottish Government commitment has not proceeded to examine costs and benefits to prepare the necessary business cases, and neither has the equivalent work south of the border progressed. The SCDI called for the Scottish business cases to be in its first phase of STRP2, to try to get this work back on track – see:

Strategic-Transport-Projects-Review-2-SCDI-RESPONSE.pdf

⁴² <https://www.rail-leaders.com/publications/how-to-win-air-travellers-to-rail/>

⁴³ <https://twitter.com/hs2ltd/status/1363830349189496837?lang=ar-x-fm>

⁴⁴ <https://www.gov.uk/government/publications/union-connectivity-review-final-report>

The drive towards a more sustainable cross-border transport system, with a further shift away from air travel and from freight being shipped by HGVs, has wider implications for transport arrangements within Scotland:

1. it creates the opportunity for selected HS2 services to operate onwards directly to Stirling/Perth/Inverness and to Dundee/Aberdeen. There is no reason why HS2 services should not operate this way, just as selected LNER Kings Cross trains do today since they would provide the fastest connections from the key cities north of the central belt with England and London. Indeed, once the timetable for the west coast is fully restored, there would be value in looking at introducing a direct London (Euston)-Stirling-Perth-Inverness service to help build the rail market. Direct air services to key London airports (and especially Heathrow) from locations such as Inverness and Aberdeen (and possible new destinations such as Dundee) should remain and be improved because, unlike those from Edinburgh/Glasgow (which should be cut back), they will retain a significant journey time advantage over surface transport

2. the proposed west coast strategy begs the question of the future use of the G&SW route between Glasgow and Carlisle via Kilmarnock and Dumfries. This is likely to see an increased role as a key corridor for railfreight. This may involve doubling the single track section of route between Kilmarnock and Barrhead and investment to provide the necessary capacity across the south side of central Glasgow; it will also prompt gauge clearance and prioritisation within Scotland's electrification plans, and lead in turn to an opportunity to accelerate passenger services between Glasgow, Kilmarnock, Dumfries and Carlisle
3. the planned HS2 services from Glasgow Central ten years or so hence, would benefit from access across as wide a part of Scotland as feasible. Arrangements to provide HS2 services with de-conflicted access to Glasgow Central could be used also to accommodate connecting Scotrail services from Glasgow Central services to the north/east via Cumbernauld.



LNER service to London, Aberdeen, March 2023

Photo: Charlie MacDonald

These wider HS2 access developments in Scotland need to be paralleled by a complementary strategy south of the border, where the same twin modal shift policy imperatives will apply, and where the withdrawal of the Golborne link from HS2 plans which damages Scotland's connectivity needs to be rectified as a matter of some urgency.

More generally, the damage to achieving the Scottish (and therefore UK) carbon reduction targets caused by delays to HS2 are clear. A revised, coherent delivery plan for HS2 that provides a new high-speed line between London Euston and Wigan (Golborne) as planned and provided for in the Government's Integrated Rail Plan is needed. HS2 and associated route development north of Crewe is not a 'nice to have' but an essential and very significant part of any carbon reduction plan.

Earlier joint studies have shown that sections of new high-speed line between Gretna and Lockerbie, over some parts of the section between Carlisle and Shap and between Lancaster and the southern end of the Lune gorge could together speed up HS2 Scottish services by nearly 30 minutes. This would be a significant step towards the 3 hour target of the two Governments noted earlier and which is acknowledged in the recent transport strategy (STPR-2). The new infrastructure needed could help add capacity for additional freight services too, critical to achieving net zero.

Scotland, meantime, needs to prepare for 400m full-length HS2 services at Glasgow Central – Transport Scotland has carried out the necessary studies – and it will find the conclusions of the Glasgow Connectivity Commission of help in achieving this.

On the East Coast, consideration will need to be given to 4-tracking⁴⁵ the approaches to Edinburgh Waverley through East Lothian where housing growth is substantial (and where developer contributions should be sought). A Transport Scotland Feasibility study as shown this could be built as the first phase of a 45 minute high speed route between Edinburgh and Newcastle. This study⁴⁶ has also not progressed beyond the feasibility stage.

⁴⁵ Which may not be adjacent to the existing line

⁴⁶ <https://www.transport.gov.scot/projects/high-speed-rail/project-details/#42615>



PART
03



03 Improving Rail Connectivity in and beyond the Central Belt

There are of course already plans to improve Scotland's rail network, and these are increasingly focused on helping to achieve the transport sector decarbonisation target.⁴⁷ Not all of the funding needed is in place, however. Rail will have to fight its corner for scarce Government resources. It should be given priority by the Scottish Government, because:

- the economy needs the stimulus that rail service improvement will bring
- the decarbonisation commitment – as we have seen – will simply not be met unless there is a step change in transport policy with rail making a greater contribution. As a July 2022 report on Scottish cities suggested⁴⁸, Scotland's pathway to Net Zero rests on radical change in transport demand in the 2020s. The report suggests that equitable reduction in car use in Scottish cities requires treating sustainable transport as a "public good", embedding the goal of reducing car use across all Government strategies.

Appraisal of investments may need to switch to more of a cost-effective/goals-achievement measure than benefit cost ratio – both here and on cross-border investment options. While it lacked an emphasis on contribution to carbon emissions reduction, the approach adopted by the National Infrastructure Commission in setting out the Rail Needs for the North and Midlands in England is an interesting example of an influential analysis that eschewed the use of benefit-cost ratios.⁴⁹

⁴⁷ The STRP2 report suggests for rail improvements within Scotland: "Future passenger rail investment should ... be targeted on the strongest city-to-city markets, as these are the routes where the greatest value from improvements would be realised." This may be so in a conventional project appraisal sense, and the importance of reducing longer distance travel by car should not be overlooked, but the majority of car trips are undertaken in the central belt.

⁴⁸<https://www.ippr.org/research/publications/fairly-reducing-car-use-in-scottish-cities>

⁴⁹<https://nic.org.uk/studies-reports/rail-needs-assessment-for-the-midlands-and-the-north/>



Delivering transformational change

The aims of reducing inequality and achieving inclusive economic growth call out for a visible delivery programme of rail-led connectivity improvements, creating accessibility that meets Government's key social & economic policy remit and can win for Scotland a claim to be regarded internationally as place for new investment, and a place that will attract businesses that can see the nation is intent on a progressive, sustainable development path.

An example of a sector that can benefit specifically from rail investment that leads to better rail services is tourism. Research by Visit Scotland in February 2020, suggested that tourism would be "influenced by the values of a younger generation, with their greater awareness of sustainability issues." It continued:

*"younger-generation visitors are increasingly aware of the environmental costs of their travel. Rail travel is increasing in popularity as an alternative to short-haul flights. Indeed, it is establishing itself as a fashionable and responsible tourism experience."*⁵⁰

For visitors, the Scottish rail system may well be regarded as appealing and even fairly comprehensive, but also in need of being joined up with other modes (ferry and bus/coach in particular) for travel connections it doesn't provide, and to reach places beyond those that lie within train station catchments.

Just as with regular rail users, it would help hugely if (electrified) rail can be positioned as the 'green core' of a joined-up national transport system. This could point towards 'Swiss-style' connecting timetables set on a repeat hourly (or 2-hourly etc) pattern⁵¹, so that transfers between modes can be readily achieved. This is transformational, and can change public perceptions of living without the car.

The need for integrated public transport systems in the Greater Glasgow, Edinburgh and Aberdeen areas has been recognised⁵². But this need is just the same for the rest of the country: rail isn't the right solution for every journey, and we need a joined up alternative to car use, especially for travel beyond the immediate locality. ScotRail has in the past considered the adoption of regular cyclic rail timetables and found a need to reduce the number of services operated each day significantly, which would be unacceptable, unless there was very substantial investment in infrastructure.

Such a development philosophy can also give a different, more valuable, approach to prioritisation of investments and help foster appreciation of the seriousness of Government's policy position and appreciation for its serious intention to create a viable alternative to car use: more inclusive and a necessary step if car use is to be reduced, breaking a long term multi-decade trend.

But adopting 'connectional timetables' as a policy direction should be reflected in investment prioritisation, although it has to be recognised that while the direction of travel could be set, it will take several decades to achieve. A good first step would be a fares system set nationally on an easy-to-use multi-modal basis, with obligations on all public transport operators to join an 'inter-connecting Scotland' programme, again recognising that change takes time. There will be consequential investment by the private sector in the digital space, with a choice of new ways to offer assistance and guidance when travelling sustainably, provided all public transport businesses offer open access to real time data sources.

Positioning rail as the 'green core' of a joined-up national transport system is transformational. It gives a refreshed purpose to rail investment, for which plans are available, but funding has not yet been forthcoming at the pace needed.

⁵⁰ Visit Scotland, Insight Department - Trends 2020 - Travelling Towards Transformational Tourism, published in February 2020

⁵¹ Now being adopted in Germany too, but with a several decades implementation timescale. It is recognised that a similar timescale would apply in Scotland.

⁵² see STRP2

The plans are available

Scotland's Railway Strategic Plan, published in April 2021⁵³, sets out how journeys by train can be accelerated and extra capacity created to accommodate more rail freight. It included a strategy to develop a number of activities and schemes, including:

- a rolling programme electrification
- the Highland Main Line improvements
- new freight terminals
- Edinburgh, Perth and Inverness station masterplans
- freight gauge enhancements
- step-free accessibility across the network for passengers.

There is no need to change this agenda, but it will be necessary to see how investments can incorporate the wider connectivity aim, for instance when looking at step-free access arrangements, anticipating the connecting timetables concept. Indeed this seems to be the obvious next step onwards from the plans set out in the second Strategic Transport Projects Review (STPR2)⁵⁴, which under the heading "enhancing access to affordable public transport" provides for:

a set of **city region rail (and bus)** developments:

- Clyde Metro
- Edinburgh & South East Scotland Mass Transit
- Aberdeen Rapid Transit

a set of **rail corridor improvements**:

- Highland Main Line rail corridor enhancements
- Perth-Dundee-Aberdeen rail corridor enhancements
- Edinburgh/Glasgow-Perth/Dundee rail corridor enhancements

and, of great relevance to the **transformational connectivity** agenda:

- infrastructure to provide access for all at rail stations
- improved public transport passenger interchange facilities
- framework for the delivery of mobility hubs
- smart integrated public transport ticketing.

And there is more under the heading "**decarbonising transport**":

- decarbonisation of the rail network
- behavioural change and modal shift for freight.

This implies a comprehensive development programme which this report fully endorses. Our observation is that to secure the public sector funding this programme merits and needs, it should be presented through the lens of Scottish people and Scottish businesses, who may need support and encouragement to make the serious changes of travel behaviour that are being sought.

STPR2 is a pragmatic, transformational, programme to make that possible and allow Scotland to thrive. It needs now to be brought out into the fresh light of day.

Rail electrification

Scotland's railway is a decarbonisation success story, with around 76% of passenger and 45% of freight journeys already on electric traction. The 2020 plan envisages an average electrification rate of 130 single track kilometres/year. By 2045, only the routes to Wick/Thurso north of Tain, Dingwall-Kyle of Lochalsh, Helensburgh-Mallaig/Oban and Girvan-Stranraer would likely remain unelectrified.

The vision is for Scotland to have the best air quality in Europe with a transport system contributing to make this happen.⁵⁵ It is intended that the routes from Glasgow and Edinburgh to Aberdeen and Inverness would be fully electrified by 2035 (with Aberdeen-Elgin-Inverness electrification added by 2045).

Early candidates ahead for electrification also include the route to East Kilbride/Barrhead and onwards to Kilmarnock (the G&SW route discussed earlier for railfreight expansion. Design and development work is also under way for the route from Dunblane to Perth and Haymarket to Dalmeny/Fife.

⁵³ The Railway Strategic Plan followed the Sustainability Development Strategy of 2019 and the subsequent Network Rail Environmental Sustainability Strategy of 2020.

⁵⁴ see reference 2

⁵⁵ Rail Decarbonisation plan – see reference 4

Improving the key Intercity routes

The key routes we considered are:

- Glasgow-Stirling-Perth-Inverness/Dundee-Aberdeen
- Edinburgh-Perth-Inverness
- Edinburgh-Dundee-Aberdeen

Electrification of the Edinburgh-Aberdeen line is likely itself to lead to journey time savings of 10-20 minutes. Improvements between Dundee and Aberdeen and the facility for a fast service to overtake a semi-fast train at Dundee are key components in this scheme. The faster Aberdeen-Edinburgh service frequency would be hourly.

While the first Strategic Transport Project Review included consideration of a new rail alignments in Fife northwards from Inverkeithing, the second plan published at the end of 2022 does not.

In its absence, it may be worth considering if the use of tilt technology on the Aberdeen to Edinburgh route would be worthwhile. The Pendolino fleet (Avanti West Coast) will start to become free from 2033, as HS2 opens progressively. There is an established maintenance base with a skilled workforce for maintaining these trains at Polmadie, Glasgow. With no other candidate use, lease rental could be at an attractive price. Journey time savings over non-tilting trains could be expected to be at the 20% time saving level (on top of any savings achievable from eliminating very slow speed sections of alignment noted above). Network Rail in Scotland is fully experienced in the type of infrastructure changes needed (signal siting, application of the Tilt Authorisation and Speed Supervision System, (abbreviated as TASS) and gauging work, for example) following the successful application of this technology between Gretna, Carstairs and Glasgow/Edinburgh.

The High Speed Rail Group has always supported the creation of a whole of Great Britain network of high-speed rail services. Where new high-speed lines can also deliver valued network capacity gains, they should be progressed – and this rationale applies within Scotland, just as much as (say) across northern England. With consideration of the opportunity – and need – to grow railfreight in Scotland, the Scottish Government needs to look at this possibility again.

Freight flows northwards from the central belt are expected to treble in volume from today's five/day. So a combination of removing low speed sections of route, using the extra acceleration/deceleration capability of electric traction and providing extra line capacity where feasible is likely. Works on the Highland Main Line (Perth-Inverness) are unlikely to reduce journey times, but resilience, better service reliability and capacity will all be improved. Reducing Inverness-Edinburgh/Glasgow journey times is more likely to rely on initiatives south of Perth.

To the south of the central belt, the most important connection is to Kilmarnock and Dumfries⁵⁶ and this has a potentially crucial role to play in adding capacity for cross-border flows. But this, along with route electrification and track re-doubling, should allow a significant acceleration of Dumfries-Glasgow timings which currently are around 1h45 and with daytime service gaps of as much as 3 hours.

⁵⁶ Ayr is served by the existing, high frequency, electrified Strathclyde regional service network

Attracting more travellers on to rail

Masterplans are the way forward for all key stations, intended to maximise the scope for onward travel by active modes' (walk, cycle) as well as bus and other forms of public transport.

Rail fare levels are inevitably a factor. The Scottish Government is piloting reductions at peak times, to help stimulate office workers back to pre-Covid 19 commuting patterns. But Scotland, with such broad tourism and outdoor leisure appeal may also follow the several successful European examples, which have been designed to increase leisure travel by rail, an already strong market for rail.⁵⁷ A key learning from this experience, as countries have emerged from Covid-19 lockdowns, is that people were most attracted by fares offers to travel on already (relatively) successful services, and at busy times of day. So to be successful, plans would have to be developed to increase the capacity of the more popular trains in the leisure market. This in turn, has an operating cost implication, but there is no doubt that this should be explored.

⁵⁷ As in Germany's deep discount KlimaTicket, for example which "allows you to use all scheduled services (public and private rail, city and public transport) in a specific area for a year: regional, cross-regional and nationwide. See <https://www.klimaticket.at/en/#was-ist-das-klimaticket>

Freight

In 2019, road goods vehicle carbon emissions were on an upward trend and accounted for fully one-quarter of all road transport emissions, and were well over five times that of the aviation sector (which was on a downward trend).⁵⁸

Given the need to find alternatives to the use of roads and HGVs for longer distance freight hauls, Scotland's rail network could see a resurgence of demand for additional freight capacity. The significant gradients on many of Scotland's railways, the move towards electrification and the greater traction power that will bring will be key factors in a successful response.

Network Rail, the Scottish Government and the rail freight industry have previously launched (in 2018) an (at the time) ambitious plan to grow railfreight on the Scottish rail network at an annual rate of 7.5%. This was part of the High Level Output Specification, which set out available funding for the years 2019-24.

Scotland has led the way in establishing regular supermarket distribution traffic to regional centres using rail rather than road. This could be expanded to more destinations; after all it is a market that is unlikely to diminish in scale. The circular economy concept could be helped by freight capacity, and waste flows to recycling centres and land-fill sites might be a future market in Scotland as they already are in England. Historically, rail has played an important role in supporting the off-shore sector and if this proves capable of being revived with, for instance, success in carbon capture storage, then the rail network is likely to be called upon again to help in supply of pipes and other equipment.

The attraction of rail to business customers under pressure to reduce their own carbon foot-prints would no doubt be attracted by the increasing universality of electric traction across Scotland's rail network, and equally, by the need to escape from high-carbon HGV-based freight, logistics and distribution movements.

There are opportunities for rail to win further traffic from road in the timber, bottled water and whisky sectors for example. But with little domestic manufacturing (which generate flows of steel, finished products, and 'just-in-time' movements in supply chains) it is mainly freight to/from ports that is likely to be the largest growth sector – and at present, to a significant extent, that means cross-border flows to/from SE England ports.

There is also a great opportunity for rail to win what was once known as 'parcels' but which is now seen as a fast expanding premium logistics sector.⁵⁹ This can apply to conventional speed rail too, but for now, HSRG has been exploring this in relation to HS1 and HS2 and finding a great deal of market appetite.⁶⁰

But as noted above, the opportunity (or need, given the decarbonisation target) arises most strongly on the cross border routes. Here, at least a further 40 freight trains would need to operate on Scotland-England routes each day if modal-shift targets are to be met⁶¹. This means increasing fast hourly freight paths from 2/hour (in each direction) at present to 3 or 4 paths/hour. Extra cross-border freight by rail will lead to a requirement for additional private sector investment in railfreight terminal capacity and, in turn, to the opportunity to expand railfreight services across Scotland.

Responsibility for the implementation and design of regional KlimaTickets lies with the respective federal state.

⁵⁸Source: 2019 Scottish Transport Statistics (as supplied by the Scottish Association for Public Transport)

⁵⁹as noted in STRP2

⁶⁰ See <https://www.railfreight.com/railfreight/2023/02/16/moving-uks-logistics-market-to-high-speed-rail/>

⁶¹ Element Energy on behalf of the Scottish Government, 2019



Strengthening strategic connections

Here we refer again to the STRP-2 report which identified the need for:

- improved access to Stranraer and the ports at Cairnryan (to which Northern Ireland ferries have been transferred and for which a war-time rail connection has since been abandoned but could be re-instated)
- major station masterplans and railfreight terminals
- High Speed and cross-Border rail enhancements.

These may all be usefully progressed, but for the first one to prove worthwhile, an approach to switching freight via Cairnryan to a multi-modal system that avoids the need for lengthy HGV haulage in Scotland might be necessary to make a suitable investment case (there are few 'foot passengers' by ferry) based on carbon reduction.

Longer term ambitions, longer term needs

There is no shortage of measures that can support steady growth in rail use across Scotland. The question is: will these improvements, planned over the next 20 years or so, be sufficient to enable the Scottish Government to meet its climate change goals and obligations and to support a resurgence in the Scottish economy? Schemes which require finding new alignments are not as readily addressed as those which 'bolt on' improvements to existing lines, usually done at times of unavoidable renewals activity. But should more ambitious plans be considered too?

A prospective scheme to shorten rail journey times between the Forth and Tay estuaries, for example, was included in STRP1 but dropped from STRP2. Such a scheme could have been included (but wasn't) under the Strengthening strategic connections heading. A lower cost alternative with a much reduced capital funding element has been identified here, which is use of proven tilting technology which reduce journey times by a round 20%. A proper examination of the options and the impact on network capacity for railfreight and the carbon and economic value of shrinking rail journey times northwards from Edinburgh would need to be assessed, and new infrastructure should not be excluded from the option-set.

Another driver of more radical approaches might be the need to take 'adaptive measures' in response to the climate emergency. This might be the case with the East Coast Main Line which runs in effect along the cliff tops between Berwick and Burnmouth, for example. The situation is monitored closely by Network Rail, but there are unlikely to be any easy fixes if there is a deterioration. At such time, thought would need to be given to a new alignment, and with this would come the opportunity to look at a more direct inland route that might, as a by-product, shorten East Coast Main Line journey times, with a new alignment possibly built to higher design speeds.

But there is also a case for examining where the topography and construction techniques of the 19th century have created routes which could be made much shorter as well as more resilient to climate change. This would require a review of network short-comings and an identification of prospective time savings and the wider benefits in terms of modal switches away from high-carbon travel modes. As was the case with HS2, there is unlikely to be a business case for such development unless besides quicker journey times (inducing modal transfer) there is an increase in network capacity too. Especially if the 'short circuited' line has a residual use-value, this may well be the case.

Conclusions

The cross-border challenge is this:

1. ensuring resilient connections from Scotland to key destinations in England including access to the Channel Tunnel
2. achieving decarbonisation through radical change in the air/rail market
3. transferring the bulk of cross border freight currently using HGVs to rail

This requires a different approach than was adopted in earlier joint Government-led studies of speeding up London-Scotland rail journey times, as the value of modal shift / the decarbonisation benefits at a transport sector level are much higher priority today. It has to focus on the end-to-end timetable and enabling high levels of on-time performance given the mix of freight and passenger services to be accommodated. And the choices to examine will also differ. For example; it will be necessary to examine use of the Settle & Carlisle and the Glasgow and South-West lines for freight trains, alongside a range of measures to improve passenger train speeds over the existing West Coast Mainline via Lancaster.

Our recommendation on HS2 is that both governments commission and work with HS2 Ltd and Network Rail to identify phased interventions, justified on their decarbonisation benefits, to improve cross-border rail journey times between London and Glasgow/Edinburgh to close to 3 hours, and enable an average of up to 4 freight services an hour to operate on cross-border routes throughout each week.

Within Scotland, once the post-Covid demand pattern recovers and settles down, the aim has to be to accommodate many more passenger journeys than the network did in 2019. This means more intensive use of the existing network, and thinking carefully about the role of each particular corridor, while accommodating where relevant additional freight flows too. An aim should be to spread the end-user benefits of HSR as widely as possible through excellent station interchanges and clever service planning.

Ensuring the lines to/from Glasgow/Edinburgh to Aberdeen/Inverness can handle both improved passenger services and more and larger freight traffic is fundamentally important. Electrification as per plan should proceed, but with a recognition that train lengths and frequencies will increase over time in response to passenger and freight modal shift from road to rail.



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1. Introduction

This technical annex supports the activity and report of the Scottish Inter-City Rail Taskforce, chaired by Alex Neil. It was prepared by independent transport consultant, David Thrower, and has been reviewed and edited by HSRG.

2. Environmental Policy Objectives

Across a range of issues, Scotland has in place a number of well-established policies that support and imply the need for greater use of public transport.

Transport and Net Zero - Scotland's Climate Change Plan 2018-2032

The Scottish Government set ambitious and legally-binding targets to end Scotland's contribution to climate change in February 2018. It commits Scotland to reducing emissions by 75% by 2030, and to Net Zero by 2045.

Although a progressive transition to the use of electric cars and light goods vehicles is under way, it remains likely that many petrol and diesel powered private cars and vans will remain in use well into the 2030s. There is also little prospect at present of any early transition away from diesel for HGV traffic.

Air travel, although flight volumes reduced during the pandemic, remains a key part of Scotland's transport system, although again with only modest progress towards decarbonisation.

For transport, the Scottish Climate Change Plan includes:

- measures to encourage mode-shift, including reducing car kilometres by 20% by 2030
- phasing out the need for new petrol and diesel cars and vans by 2030
- working to phase out new petrol and diesel light commercial vehicles by 2025
- establishing (with Scottish Enterprise) a Zero Emission Heavy Duty Vehicle Programme for HGVs
- for aviation, decarbonising scheduled flights within Scotland by 2040

- creation of the world's first zero emission aviation region, jointly with Highlands and Islands Airports
- taking action on public transport provision and active travel.

Securing A Green Recovery

An update to the Scotland Climate Change Plan, Securing a Green Recovery on a Path to Net Zero - Climate Change Plan 2018-32, was published by the Scottish Government in December 2020, at the end of the first year of COVID. For transport, the Update stated:

"(Transport) continues to be Scotland's biggest emitting sector, accounting for 35.6% of emissions in 2018. Additionally, the technological solutions in certain modes, such as aviation, maritime and heavy goods vehicles, are (only) in the early stages of development."

"NTS2 (the National Transport Strategy 2) sets out our vision for transport, and is clear about the need to reduce unsustainable travel.....Cars currently account for almost 40% of transport emissions, and therefore the predominance of car use cannot be overlooked.....The Scottish Government will not build infrastructure to cater for forecasts of unconstrained increases in traffic volumes.....We will continue to promote active travel and a shift to more sustainable modes"

"We also want to move freight from road to rail where possible.....In addition, there is increasing interest in the potential to bolster the use of 'light' or 'express' freight by rail. We will work to maximise all opportunities for rail freight"

It is estimated that 37% of Scotland's carbon emissions - over one-third - come from transport, but only just over 1% of these are from rail. For public transport and active travel, the Scottish Government's Climate Change Plan states the intention to decarbonise most of Scotland's rail services by 2035. This will mean a programme of rolling stock replacement. It is current policy that Scotland would not accept any "cascaded" (second-hand) trains, either diesel or electric, from elsewhere in the UK.

The adverse impact of vehicle exhaust emissions will diminish as cars themselves progressively move towards electric traction. However, even electric cars generate potentially-toxic particulates from braking and tyres (non-exhaust emissions, or NEEs), so modal switching from road to rail will have an indefinite air quality payback.

For air travel, although the sector is making significant efforts to reduce emissions per passenger, flying is still a major source of emissions, and will likely remain so.

3. Economic Policy

Scotland's Demographics

According to Scottish Government data published in 2021, Scotland's population stands at 5.46m, a marked increase from 5,062,000 in 2001, mainly due to increases in inward net migration. According to a 2022 report by National Records of Scotland, the population is expected to increase until about mid-2028, peaking at 5.48m, and is then projected to fall to 5.39m by 2045.

The four largest cities, based upon National Records of Scotland definitions, are Glasgow (599,650) - although the Glasgow commuter zone ("Greater Glasgow") is much larger - Edinburgh (464,990), Aberdeen (196,670) and Dundee (147,710). National Records of Scotland cites Greater Glasgow as having a population in 2020 of 1,028,000, about 20% of the national total.

In its May 2022 response to the Climate Change Committee's annual progress report of 2021, the Scottish Government:

- re-iterated its commitment to work to decarbonise scheduled flights within Scotland by 2040
- stated that it is "focussing on supporting and facilitating greater use of rail where this is a viable alternative (and).....are also continuing to work with the rail industry to reduce journey times, and have consistently supported high speed rail but not just [from London] to Birmingham, Manchester and Leeds. We know that to realise its full benefit for all of Britain, high speed rail infrastructure needs to be extended further and faster to reach Scotland" and added that:
- *"We continue to support and promote our Caledonian Sleeper rail services that connect Scotland with London and offer an alternative to air."*

The ability of rail to attract passengers from the key air routes between Scotland and the five London airports will pivotally depend upon achieving significant journey time reductions on the WCML and ECML (see journey time comparisons in section 8 below).

Data for 2021 shows that the population of the large cities has continued to grow, while more-remote areas have declined, with 2020 data confirming that 71% - almost three out of four - of Scotland's residents now live in large-urban and other urban areas: about 70% of the total population live in the Central Belt. However, according to an NRS report of July 2022, Scotland's largest cities saw their populations fall during the pandemic, reversing this trend.

According to the Scottish Government State of the Economy report, May 2022, for the first quarter of 2022:

- there were 2,682,000 people in employment, a rate of 75.6% (up 1.3% since pre COVID)
- there were 88,000 people unemployed, a rate of 3.2%, down 1.2% over the previous year
- there were 749,000 people economically-inactive (a rate of 21.9%, down 0.3%)
- the claimant count fell 47% from its August 2020 (pandemic) peak, but still remained 5.5% higher than the February 2020 pre-pandemic level.

City Economies

According to Scotland's Labour Market - People, Places and Regions, 2021,

the highest unemployment rates were in North Ayrshire (5.8%), North Lanarkshire (5.7%) and Glasgow City (5.6%).

In terms of a standard productivity measure – GDP per worker – the UK-wide Cities Outlook 2020 placed Edinburgh 8th, but Dundee just 59th in a list of 63 cities. For percentages of residents with higher qualifications, Edinburgh came 3rd. On a measure of residents with no formal qualifications placed Glasgow 53rd.

The Knight Frank January 2022 UK Cities Report listed the following UK Top Ten regional cities in terms of their transport connectivity, based on an exploration of the demography of each city using defined travel-times:

- 1 Manchester
- 2 Birmingham
- 3 Leeds
- 4 Coventry
- 5 Leicester
- 6 Glasgow**
- 7 Liverpool
- 8 Bristol
- 9 Preston
- 10 Edinburgh**

Cities Outlook 2020 placed Dundee 58th out of 63 as a city with the lowest business start-up rate. The same report placed Edinburgh second out of 63 for highest private-sector jobs growth, but Dundee 59th out of 63 for its ratio of private-sector to public-sector jobs.

The Centre for Cities has reported estimated GVA per worker for 63 UK cities, including four in Scotland. Because of the temporary economic effects of the pandemic, we use their 2019 Report here:

- Aberdeen £62,200
- Dundee £53,500
- Edinburgh £68,200
- Glasgow £47,200
- **(GB average £57,600).**

For proportions of residents with high-level qualifications, the same 2019 report noted the following:

- Aberdeen 51.7%
- Dundee 38.4%
- Edinburgh 58.7%
- Glasgow 47.4%
- **(UK average 38.4%).**

Cities Outlook 2019 also identified, based upon the most recent data than available (2013), that Dundee had, out of a list of 64 UK cities and major towns, the 63rd-lowest Business Stock index (a score of 209.5, when the UK average was 344.9. Aberdeen had a score of 390.1, fifth out of 64. The two cities are served by the same inter-city rail routes, to Edinburgh and to Perth, Stirling and Glasgow.

A May 2020 report, High Speed Rail and Scotland, published by Greengauge 21, emphasised the opportunities for creating much stronger economic links between city-pairs such as Glasgow-Manchester or Edinburgh-Newcastle. It also re-presented its much earlier conclusion in 2009 that extension of HS2 to Scotland from Manchester/Crewe dramatically improved the 2009 Benefit-Cost Ratio of HS2, from 2.9 to 1 up to 7.6 to 1.

Higher Education

There are 14 universities in Scotland, the majority in or close to the major cities.

In 2022, there were 180,170 Scottish-domiciled students, and some 34,520 rest-of-UK-domiciled students at Scottish universities. In addition, there were 20,550 EU-domiciled students, and a further 47,630 non-EU overseas domiciled students. Student concessionary travel makes this an important market for rail.

Tourism

The future of tourism trends in Scotland was set out in a report by Visit Scotland, Insight Department - Trends 2020 - Travelling Towards Transformational Tourism, published in February 2020 at the outbreak of the pandemic. The report looked ahead to the factors that would influence tourism over the (then) next decade. The future tourism industry was seen as being influenced by the values of a younger generation, with their greater awareness of sustainability issues. The report particularly noted that younger-generation visitors are increasingly aware of the environmental costs of their travel. The report commented:

"Rail travel is increasing in popularity as an alternative to short-haul flights. Indeed, it is establishing itself as a fashionable and responsible tourism experience".

Countering Peripherality

The issue of regional peripherality affects many communities in Scotland. The rail journey time from Inverness to Edinburgh is 3hrs 30mins, and of course there are many communities a substantial distance (and travel time) beyond Inverness: Durness, Helmsdale, Thurso, Ullapool, Wick...the western and northern isles.

Upgrading long secondary lines within Scotland, such as the West Highland, Kyle and Wick routes, could help to reduce the disadvantages of peripherality. Currently timings are slowed by the need for train-staff control at minor crossings, among other issues.



The Far North line

Photo: Greengauge 21

4. Rail Policy

Scotland's Railway Strategic Plan, 2021

Scotland's Railway Strategic Plan, published in April 2021, sets out clearly a vision of how journey times could be improved, and equally important, how more freight paths could be delivered on the nation's network.

The key stakeholders in the 2021 Plan include train operators ScotRail, LNER, Avanti West Coast, First TransPennine Express, Serco Caledonian Sleeper, Arriva CrossCountry, LNER/East Coast Trains Ltd, charter operators, and rail freight operators including Direct Rail Services, GB Railfreight, DB Cargo, Colas Rail, Freightliner and Rail Operations Group. The Plan was also formulated with the co-operation of the UK Government, HS2 Ltd, the Office of Rail and Road and user representative groups.

The Strategic Plan followed the Sustainability Development Strategy of 2019 and the subsequent Network Rail Environmental Sustainability Strategy of 2020. The latter Strategy pledged to continue to contribute towards a sustainable society and to create a legacy for future generations, working with local suppliers to encourage and promote the use of rail as a new method of transporting people and freight.

The Plan included a strategy to develop a number of activities and schemes, including for:

- the Highland Main Line
- freight terminals and other facilities
- Edinburgh, Perth and Inverness station masterplans
- a rolling programme of decarbonisation, including electrification
- freight gauge enhancements
- step-free accessibility across the network for passengers.

Rail and the Second Strategic Transport Projects Review

Transport Scotland commissioned in 2019 the second Strategic Transport Projects Review (STPR2), to help deliver priorities and outcomes set out in the National Transport Strategy. The outcome of the Review, produced by consultants Jacobs and AECOM, was published in December 2022, and included 45 recommendations. Its principal findings relevant to rail included:

Enhancing access to affordable public transport:

- Clyde Metro
- Edinburgh & South East Scotland Mass Transition
- Aberdeen Rapid Transit
- Highland Main Line rail corridor enhancements
- Perth-Dundee-Aberdeen rail corridor enhancements
- Edinburgh/Glasgow-Perth/Dundee rail corridor enhancements
- infrastructure to provide access for all at rail stations
- improved public transport passenger interchange facilities
- framework for the delivery of mobility hubs
- smart integrated public transport ticketing

Decarbonising transport:

- decarbonisation of the rail network
- behavioural change and modal shift for freight

Strengthening strategic connections:

- sustainable access to Grangemouth investment zone
- access to Stranraer and the ports at Cairnryan
- major station masterplans
- railfreight terminals and facilities
- High Speed and cross-Border rail enhancements.

Seventeen out of the forty-five recommendations therefore relate directly or, in a few cases, indirectly to the rail network.

For High Speed Rail, STPR2 stated:

"Infrastructure upgrades to permit higher speeds on cross-Border routes would enable journey times to London and other key destinations to be more competitive with air travel. This improved connectivity would encourage a shift from air to rail on longer-distance travel and support Scotland's Net Zero emission commitments. These improvements would also release capacity for additional regional passenger and freight services."

"STPR2 recommends that Transport Scotland continues to work closely with the UK Government to take forward a programme of infrastructure upgrades targeted at long-distance cross-Border routes. This is likely to include the.....East Coast Main Line, West Coast Main Line (and) Glasgow and South Western Line (Glasgow to Carlisle via Dumfries)."

STPR2 further stated that:

"Future passenger rail investment should therefore be targeted on the strongest city-to-city markets, as these are the routes where the greatest value from improvements would be realised."

For railfreight, STPR2 stated this:

"Freight investment should be targeted on corridors from the Central Belt towards Aberdeen, Inverness and cross-Border routes. STPR2 recommends a programme of strategic rail enhancements to improve journey-times and increase capacity and reliability for passenger and freight services."

"For the Highland Main Line, these would include new and longer passing loops with more flexibility and permissible speed increases. Both the Perth-Dundee-Aberdeen and Edinburgh/Glasgow-Perth Dundee improvement programmes would include junction upgrades and permissible speed increases. Opportunities would be taken to increase gauge clearance to permit taller and wider (freight) trains".

For railfreight terminals and facilities, STPR2 recommended that:

"Transport Scotland supports industry partners in carrying out an updated market study for railfreight growth (including).....a review of railfreight terminals and hubs to confirm how to meet long-term requirements to shift freight from road to rail."

Union Connectivity Review

The 2021 Union Connectivity Review stated that:

"Devolution has been good for transport where delivery has been devolved"

but also noted that there has been:

"....a lack of attention to connectivity between the nations of the United Kingdom, that the Government's policies to build back better and for levelling up entail making different, wider, strategic cases for transport investment."

The Review highlighted the opportunity to create a strategic transport network for the whole United Kingdom. Specifically, the Review included several concerns in relation to the economic and social needs of Scotland:

- investing in the West Coast Main Line north of Crewe to properly use HS2 and its faster journey times and capacity (our emphasis) to serve connectivity between Scotland and England better
- conducting an assessment of the East Coast rail and road corridor to determine appropriate investments for better connectivity between Scotland and England
- securing better connectivity for freight across the UK with ports, and freeports as they are established (see below).

The Review particularly identifies the capacity of the West Coast and East Coast Main Lines, notably for bulk freight, as a key issue that requires addressing, as part of economic connectivity and sustainability.

Scottish Policy On Expanding Railfreight

Transport Scotland set out its policy on railfreight in March 2016, in Delivering the Goods - Scotland's Rail Freight Strategy. The Strategy stated:

"The Scottish Government's High Level Output Specification for Scotland's railways for the period 2019-2024 will include a specific output on the availability (including resilience) of cross border routes for freight".

The Strategy also identified the need to ensure that:

"that Network Rail is properly incentivised to proactively support the growth of freight traffic on the network, both local and cross-border."

Freight policy in Scotland was again further set out in 2017 in Transport Scotland's Delivering Your Goods - Benefits of Using Rail Freight. This stated that:

"Making use of rail can improve the quality of your logistics chain - in terms of cost, reliability and environmental performance.....Scotland and Great Britain have a strong competitive rail freight market.....The increased confidence in rail is demonstrated by growing use of rail for time-sensitive deliveries.....Transport Scotland has policy responsibilities for rail freight, including its promotion. Whilst the vast majority of rail freight activities are undertaken on a strictly commercial basis, without subsidy or Government support, in some cases grant aid may be needed to tip the commercial balance from road to rail."

The Report of the Second Strategic Transport Projects Review (STPR2) in turn stated that:

*"A significant amount of freight needs to shift from road to rail or water, and the overall distance travelled reduced. **This is necessary if Scotland is to meet its Net Zero carbon emission targets, (emphasis added) as these cannot be achieved by changes in technology alone.**"*

"(The Review) recommends the Scottish Government brings together public and private sector organisations to develop a Net Zero freight and logistics network for Scotland that would encourage the switch to more sustainable and efficient freight transport."

Network Rail, the Scottish Government and the rail freight industry have previously launched (in 2018) an ambitious plan to grow railfreight on the Scottish rail network at an annual rate of 7.5%. This was part of the High Level Output Specification, which set out available funding for the years 2019-24.

In July 2022, the Great British Railways Transition Team (GBRTT) called for evidence to assist it in designing and delivering rail freight growth target options.

The GBRTT has stated that:

- one tonne of freight transported by rail produces 76% less carbon emissions than one tonne transported by road, and produces significantly lower NOx and particulate emissions than road freight per tonne delivered
- one freight train can deliver the equivalent load of 76 HGVs, and rail freight generates £2.45 billion in economic benefits to UK plc annually.

The GBRTT noted that commentators believe that to meet the legislative Net Zero targets, a larger volume of freight will need to move by rail as long-distance HGVs are not expected to be electrically powered in any significant numbers by 2050.

This has an important implication for making available and exploiting rail capacity to maximise the contribution rail freight can make to achieving Net Zero. That, in turn, may have implications for accelerating the planning and construction of High Speed Rail and other capacity expansion projects, segregating fast passenger services from freight on the rail network. Fewer lorries on Scotland's roads would also significantly reduce the nation's highway maintenance bill.

5. Strategic Risks for Scotland's Environmental Policies

There are a number of major emerging risks to the agreed Government policies and aspirations set out in the previous sections.

Missing Net Zero Targets

The first and most critical, in terms of importance and timescale, is Net Zero, and the risk that the 2030 and 2045 targets will not be met unless there is significant long-term development of the rail network, notably higher-speed and more-attractive rail passenger services to encourage a switch from car and form air travel, and route capacity that can cater for a significant switch of long-distance HGV bulk freight to rail.

The December 2022 Climate Change Committee report noted these concerns:

- progress in EV deployment to date in Scotland is slightly behind the UK overall, and sales are behind the Committee's assumptions
- there are concerns including charging experience and inconsistent charging provision, and price-disparities between home-charging and public-charging.

The July 2022 report by the Institute for Public Policy Research, Fairly Reducing Car Use In Scottish Cities, has warned that Scotland's pathway to Net Zero rests on radical change in transport demand in the 2020s. Its principal findings for equitably reducing car use in Scottish cities included treating sustainable transport as a "public good", and embedding the goal of reducing car use across all Government strategies. Recommendations include:

- affordable, convenient and comprehensive public transport is at the heart of a fairer, greener transport system (and) reducing car use.....is contingent on viable public transport options
- all parts of Scotland's public sector must align behind achieving the goal of reduced car use and.....(improving) opportunities for those on low incomes.

The March 2021 report by the Just Transition Commission, A National Mission for a Fairer, Greener Scotland, states that:

*"there is a real opportunity to build a transport system that improves our health and wellbeing as a nation.....The Net Zero transition presents an opportunity to do things differently. **The priority we have given to car users for many decades will need to shift to other modes of transportation (emphasis added). Tough decisions on infrastructure.....will be needed if we are to meet Scotland's ambition to reduce car miles travelled by 20% by 2030.**"*

There is already, in addition to climate change concerns, a problem in urban parts of Scotland with poor air quality. According to the Centre for Cities report, Cities Outlook 2020, poor air quality is blighting Scottish cities. Out of a list of the UK's 63 cities and major towns, for PM2.5 emissions per 10,000 population:

- Aberdeen was 51st worst
- Dundee was 57th worst
- Glasgow was 59th worst
- Edinburgh was 62nd worst.

For NO emissions, transport was found to be the most major source but not the only source. At a national (UK) level, road transport accounts for no less than 34% of all NO emissions. For NO emissions per 10,000 population (out of 63):

- Aberdeen was 10th worst (in other words, fairly good)
- Edinburgh was 34th worst (midway)
- Glasgow was 49th worst (serious cause for concern)
- Dundee was 50th worst (ditto).

A study report from consultants ElementEnergy in 2021, Decarbonising the Scottish Transport Sector, reported that:

- only limited progress has been made to date in reducing emissions from the Scottish transport system, **as improvements in vehicle efficiency have been largely offset by increasing demand** (emphasis added). As a result, domestic transport emissions have only fallen by 2%-3% since 1990, whilst Scottish international transport emissions have increased by over 40%
- although Scotland's economy-wide emissions targets are a 75% reduction by 2030, a 90% reduction by 2040 and Net Zero by 2045 (from a 1990 base), analysis by the Scottish Government has assigned the transport sector an emissions envelope of a 56% reduction by 2030, a 70% reduction by 2040 and Net Zero by 2045.....meeting the 2030 target is the most challenging because of the short time-frames involved.
- a pathway which relies only on the introduction of zero-emission vehicles will fail to meet the emissions target, and that **major changes in the way people travel will be needed** (emphasis added).

Failure to Cut HGV Emissions

As already noted, a major benefit of creating new high/higher speed passenger routes, for example, is that the release of existing line capacity for freight traffic.

This could help meet the major challenge of reducing road emissions from HGVs. The road freight sector is almost entirely diesel-powered at present, and although the diesel engines involved meet higher standards of emissions than in the past, they still contribute a major part of overall transport emissions. Transport Scotland recently reported that HGVs account for 6% of all traffic on Scotland's roads. As these vehicles are large and heavy, and universally diesel-powered, emissions are proportionately greater and accounted in 2018, pre-COVID, for 12.6% (one-eighth) of all transport emissions, and at that point representing a 4.3% increase over 1990.

The December 2022 Climate Change Committee report noted that HGV (and van) kilometres rebounded quickly following the lifting of pandemic restrictions. The Committee note that the kilometres travelled by HGVs in Scotland grew by 9% between 2020-21. The Climate Change Committee target benchmark is 2.4 billion kilometres, but the most recent level is already 2.5 billion kilometres.

Scottish Transport Statistics (supplied to this Report by the Scottish Association for Public Transport) noted that, whilst **overall** total emissions fell between 2014-19, **transport** emissions rose, and in the case of HGVs and LGVs, rose sharply:

	(2014)	(2019)	(% change over 5yrs)
Total emissions (mtCO2)	53.68	47.78	-11%
Total road transport emissions	13.57	13.95	+2.8%
HGVs and LGVs	3.16	3.43	+8.5%
Aviation	0.72	0.64	-11.2%

It is noteworthy that for 2019, HGV and LGV emissions accounted for fully one-quarter of all road transport emissions, and were well over five times that of the aviation sector. Yet this appears to have attracted surprisingly little attention, perhaps because there is no technical fix on the horizon, at least for HGVs, and probably for LGVs out on all-day delivery rounds.

According to a recent report by truck manufacturer Volvo, each alternative power-source for HGVs – synthetic diesel, hydro-treated vegetable oil, electro-fuels, hydrogen, liquefied natural gas, bio-LNG and dimethyl-ether (DME) – will either have only a very limited effect in emission terms or cost more per vehicle in capital terms, or reduce payloads, or all three. Battery HGVs are widely seen as impractical for long-haul bulk freight, due to high capital cost, the charging infrastructure needed, battery weights and sheer range limitations.

In October 2020, Volvo reported growing interest in powering HGVs with liquefied natural gas (LNG). However, we understand that Volvo only claim a 10-20% reduction for tailpipe emissions, and acknowledge that supply infrastructure for what is still a fossil fuel remains very limited and would require major investment. LNG also requires energy to produce it (this was before the very steep climb in energy prices in 2022), and Volvo concede that the additional tanks needed for storing it onboard vehicles would reduce their payload.

This points towards a looming crisis in managing-down HGV emissions, with no obvious solution.

The December 2022 Climate Change Committee report notes that:

“Technology development and commercialisation for zero-emission HGVs is still at an early stage” and, under “risks”:

“Decarbonisation of the fleet will depend on UK-wide markets, which are expected to expand through ongoing UK demonstrations and as a result of UK Government phase-out dates.”

The Climate Change Committee has, however, acknowledged the need to secure, where possible – such as on long-haul bulk loads – a degree of modal shift to rail. The Committee states its concerns as follows:

“Both the Scottish and UK Governments have pledged to explore opportunities for logistics and efficiency improvements and increased use of railfreight.....So far, this area has received little attention from both Governments and concrete policy is lacking. It is important that the opportunities to manage demand in the freight sector are not overlooked amid the priority to deliver the 20% car demand reduction target.”

Although the overall impact on emissions would still be moderate, the challenge of meeting Net Zero is such that any measure to transfer long-distance HGV freight to a less-polluting mode looks very worthwhile and needs to be urgently pursued.

An obvious possibility is therefore the sharply-increased use of railfreight, if route-capacity can be secured. The potential for synergy would apply particularly on the long-haul routes between Scotland and the North West of England, the

Midlands, London and the Channel Tunnel, and routes towards the major East Coast and South Coast ports such as Felixstowe and Southampton. The UK Government, in its 2016 report Rail Freight Strategy “Moving Britain Ahead” claimed that switching every tonne of freight from HGV to rail reduced that load's emissions by 76%.

The need to assist air sector emissions reduction

Scotland's geography means that air travel will always play a vital part in connectivity policies. But for air travel, emission reduction targets are also looking challenging, as technical progress in delivering major reductions in aviation is even less certain than the situation with diesel-powered HGV road transport.

It is the stated aim of Transport Scotland to reduce the environmental impact of aviation in line with the Scottish Government's commitment to be a Net Zero nation by 2045, just over two decades from now. The Scottish Government is working with the UK Government to ensure that there is an ambitious approach to international aviation emissions.

It will always be unavoidable that Scotland will depend on aviation for links to (most) outlying islands, as well as to mainland Europe and elsewhere. Clearly there is a major opportunity to reduce emissions from internal flights on the trunk domestic air corridor between Scotland and England. But progress to date appears to lack momentum, and thus represents a rising threat to the legally-binding Net Zero policy. The Climate Change Committee report of December 2022 states that:

“There has been minimal progress (emphasis added) in the last year in developing policies to reduce emissions from aviation in Scotland.....The Scottish Government is yet to publish a strategy for aviation decarbonisation or commit to using its powers to reduce demand growth for aviation.”

This doubtless reflects technical realities. The availability of zero-emission, or even only low-emission, aircraft still appears to be years, maybe decades away. Even the use of sustainable aviation fuel for conventional aircraft appears problematical due to cost, though the Scottish Government is exploring options to incentivise its use.

According to the Climate Change Committee, in 2021 air transport movements were up 12% from 2020 and stood at 0.26 million per year. The Committee's benchmark is 0.25 million. The Committee report also noted that the Scottish Government has committed to reviewing Air Passenger Duty, ahead of the devolved-replacement Air Departure Tax. The Committee urges the Scottish Government to use ADT as a way of reducing demand for flights. The Committee concluded that "Risks remain on the demand side (and) there are significant risks for.....the aviation sector, with insufficient detail on plans being made.....to make a complete judgement on progress.". It also notes that the roll-out of technologies will require high levels of international co-operation and that this is a (further) considerable risk.

High Speed Rail, using established and proven off-the-shelf technology, can clearly assist the air sector - an important part of the Scottish economy - in securing reduced emissions from domestic air travel, most notably on the Glasgow-London and the Edinburgh-London corridors, by offering a sustainable alternative. Indeed, even using the existing 100-125mph East Coast Main line, during 2022 the new open-access rail operator Lumo has offered a viable alternative to domestic air travel, using new trains on a limited-stop timetable. It is understood that LNER and Lumo combined carried two-thirds of all Edinburgh-London travellers during August 2022. Lumo claims that their passengers generate 41 times fewer emissions than air passengers.

The critical threshold between air travel and rail travel is about three to four hours, which makes the Glasgow/Edinburgh to London/South East England travel market particularly suitable for modal switch to rail. Evidence from mainland Europe demonstrates that when High Speed Rail is offered as an alternative to short-haul air travel, significant numbers of passengers will switch mode. The May 2020 report by Greengauge 21, High Speed Rail and Scotland, quoted that as many as 60% of HSR passengers had switched from air on the Madrid-Barcelona AVE rail route and 49% on Eurostar between London and Bruxelles/Paris/Lille.

Failure to Reduce Car Use

Achieving the Scottish Government's 20% reduction target for car traffic looks increasingly out of reach. While most car trips are surprisingly short, and longer distance car travel less common, the smaller number of long distance car trips still account for a significant proportion of car-miles and of carbon emissions. And over these longer distance journeys, the convenience factor of car use ('on my doorstep') has diminished relevance compared with other factors affecting modal choice.

There is still a major opportunity for high-speed (150-250 mile/h) or higher-speed (100-125mph) rail, to make a significant contribution to addressing this carbon reduction risk, although it may be too late to help achieve more than a modest part of the 2030 target of a 20% reduction in car use, which would likely have to rely on a much more generous incentive package to trains and public transport rather than private cars. Attracting car users to high(er) speed rail would be for travel between the major cities and towns of Scotland, and between Scotland and England via the West Coast and East Coast corridors. This would also assist the Scottish Government in meeting emission-reduction targets, and help cut non-exhaust emissions, congestion and accidents.

Transport Scotland data for 2018-19, immediately prior to COVID, confirmed that of the 2.99m vehicles on Scotland's roads, a 12% **increase** over 2008, some 83% were cars. The COVID-19 crisis in 2020-22 interrupted normal traffic trends, but Transport Scotland had noted that prior to 2020 overall traffic volumes on major roads in Scotland had been broadly increasing over the past three decades. Pre-pandemic, volumes had reached new highs in 2019, with traffic volumes on major roads no less than 46% higher than in 1995. Transport Scotland recently noted that cars account for 72% of the total volume of traffic on Scottish roads, with LGVs a further 19% and HGVs 6%.

Five local authority areas (Glasgow, North Lanarkshire, Edinburgh, Fife and Aberdeenshire) account for fully 26% of all traffic on Scotland's road network, suggesting that action needs to particularly focus upon these areas. The percentage of Scotland's population with a current driving licence has also been climbing, from 68% in 2009 to 71% by 2019, before COVID disrupted testing.

Research commissioned by Transport Scotland from consultants Element Energy concluded that vehicle technology alone cannot deliver the 2045 emissions target, and that **there will need to be a reduction in the use of private vehicles** (emphasis added) as well as the progressive adoption of lower-emission battery power-packs.

The Climate Change Committee report concluded:

*"Given the short timescales to 2030, it is important to begin implementing schemes (to reduce car use by 20%) with urgency.....Prior to the pandemic, car demand in Scotland had been steadily increasing. A paradigm shift will be required to reverse this - and quickly - if the Scottish Government is to deliver on its commitment to reduce car demand by 20% by 2030.....It is our assessment that delivering a 20% reduction is likely to require both **measures that support and improve alternatives to car travel** (emphasis added) and **interventions that discourage use.**"*

These considerations are in addition to providing good-quality public transport for the non-car-owning market. The 2019 Scottish Household Survey confirms that 28% of households have no access to a car, making public transport availability essential.

Slow Recovery of Rail Passenger Patronage

A further threat to Government policy objectives is the depressed level of rail use (across the entire UK, Scotland not excluded) due to the 2020-22 COVID pandemic and its effects upon work-patterns and commuting in particular.

Recovery from these depressed levels have been hindered by the 2022-23 industrial dispute. For services in Scotland for the financial year 2021-22 (i.e. up to March 31st, 2022):

- ScotRail journeys were only 46.7m, compared with 97.8m in 2018-19, the last full pre-COVID financial year, a 52% drop
- Caledonian Sleeper journeys were 0.2m, compared with 0.3m, showing good recovery
- Avanti West Coast journeys (overall, not just Scotland) were 21.6m, compared with 39.5m
- TransPennine Express journey volumes were likewise at 16.2m, compared with 29.2m
- London & North Eastern Railway journeys (again, UK-wide) were 17.7m, compared with 22.3m, showing a stronger recovery than other operators. New ECML operator Lumo added a further 0.3m ECML journeys in its first period of operation
- CrossCountry journeys (all-UK) were 20.5m, compared with 40.6m in 2018-19.

For UK-wide rail use, more recent data is available. The latest-available (third-quarter 2022) Office of Road and Rail data for rail use levels, published in December 2022, reported that total UK passenger journeys were now back to 80.3% of pre-pandemic (2019) equivalent-period levels (the third-2022 quarter included the first 5 strike days). Passenger kilometres remain more depressed, at 77.4% of the third quarter of 2019. Passenger revenues were only back to 71%, indicating still-depressed peak period/premium fare commuting and heightened off-peak/cut-price sales. Season tickets now account for only 13% of journeys.

The depressed levels of rail service levels (with the notable exception of LNER) is a cause of concern, as it has significantly-widened the gap between total passenger revenue and total passenger costs.

6. Developing Scotland's Rail Network

But the Scottish Government's six-month peak-fare-abolition experiment, whilst falling far short of Germany's 49-euro Klimaticket, will help aid recovery.

There are plans in existence for the development of all of Scotland's rail network by the relevant authorities. In this chapter we highlight the challenges ahead.

High Speed 2

The construction of HS2 from London to Manchester/East Midlands was re-confirmed by the UK Government in the 2022 Autumn Statement, only for the decision to be taken to slow down delivery of two key elements of the project in March 2023. It would appear that the needs of Scotland are being under-valued in the planning of HS2.

HS2 Phase 1 is now under construction between Central London, Birmingham city centre and to location near Lichfield where a connection to the West Coast Main Line with a junction being built at Handsacre. Phase 2a, onwards to Crewe, has received the UK Parliament's approval and Royal Assent, but is subject to a 2-year enforced delay, and only some preliminary works have been carried out. Euston has no revised opening date, but it will not be available for the limited frequency service start-up, which will be from Old Oak Common in west London. Phase 2b, from Crewe to Manchester city centre, is still intended, but is on hold, part of the 2-year delay. The cross-Midland stage which is part of the Eastern arm is still at the re-formulation stage, given the options that exist for connections further north. As of March 2023, the terms of reference for the study of those options, 15 months after it was announced, have not been published.

Implications for Scotland from HS2 decisions in England

With devolution of transport responsibilities, it remains important to have regard to Scottish interests arising from decisions being made for the railway south of the border in England. There are five areas of importance for a Scottish perspective:

- the March 2023 delay to key HS2 construction phases
- HS2 northwards from Crewe including a reinstatement of the Golborne Link
- wider access from Scottish HS2 services to English destinations and to Eurostar
- the east coast corridor
- connections between HS2 and HS1.

March 2023 delay to key HS2 construction phases

While the March 2023 changes to HS2 is acknowledged to increase capital costs, there should be an increase in funding to Scotland through the Barnett consequential formula. Decoupling phase 1 and Phase 2a timescales means there will be a period (possibly 2 years long) when Glasgow-London HS2 services will need to negotiate a constrained 2-track section of the West Coast Main Line south of Stafford rather than operate over the new Phase 2a high-speed route. The delay imposed to Euston HS2 works means that initially services from Scotland will need to terminate at Old Oak Common where turn-round capacity is limited and connection times to central London will be increased.

HS2 northwards from Crewe

Following the Oakervee Review into HS2 published in February 2022¹, the decision was taken to proceed with HS2, but the Government's Integrated Rail Plan (for the English Midlands and North) while committing to take forward the Phase 2b Crewe-Manchester section of HS2 dropped the so-called Golborne link, which is the next section of HS2 northwards from Crewe, bypassing Warrington. This would be subject to further study of the options available.²

Optimistically, these options could include the Golborne link extended north of Wigan, re-joining the West Coast Main line where it has 4 tracks nearer to the southern approaches to Preston.³ The case for extending the Golborne link in this way is based on network capacity concerns:

*"[The] Wigan to Preston section is 16 miles (26km) long. Just north of Wigan, the line goes from four-track to two-track for approximately 8 miles (13km), then reverts to four-track for the remaining distance to Preston. This stretch of track handles a high concentration of intercity, regional services and freight trains, making the two-track stretch of the line a major bottleneck on capacity and a significant risk to timetable resilience."*⁴

It is not clear that there are any other suitable alignments for this connection, and it would seem unlikely at this time that DfT would opt for a variant which adds to HS2's capital cost, which is what an extended Golborne scheme would do. Another option might be a so-called 'strategic alternative' (which is code for an upgrade instead to the existing line through Warrington).

The big problem from a Scottish perspective is that the route north of Crewe is a section of the West Coast Main Line that has only two tracks.

It is a bottleneck today, before HS2 services (or any additional freight services) are added to this part of the rail network. But this bottleneck doesn't affect HS2 services other than those headed for Scotland (Liverpool trains diverge south of Warrington). It is an Anglo-Scottish high-speed service problem, where lengthy operation over existing tracks is impacted by an estimated 10-12 minutes because of the loss of the Pendolino tilt capability.

The best way to accommodate HS2 services in Glasgow was set out in that city's Connectivity Commission report.⁵

"Although European loading gauge high speed trains will be limited to the new HS2 infrastructure itself, from day one of operation, 'classic compatible' trains will run north from London over HS2 and then on the existing West Coast Main Line to Glasgow. These trains are 400m long, and there is no existing station in Glasgow that is able to accommodate them. Some form of strategic intervention is therefore required to make Glasgow ready for HS2, and to capture its benefits from the beginning.

The Commission is of the view that there is only one credible option for a high-speed rail terminal in Glasgow. This is to redesign Glasgow Central to accommodate HS2 trains. This would require at the very least the extension of the station over the River Clyde including the reinstatement of the former additional bridge and tracks over the river to the east of the station approach, and the creation of a new southern entrance and concourse roughly on the site of the former Bridge Street station."

Source: Glasgow Connectivity Commission

¹<https://www.gov.uk/government/publications/oakervee-review-of-hs2>

²See <https://www.gov.uk/government/news/government-takes-action-to-ensure-scotland-receives-best-possible-hs2-service-as-of-june-2022> It is evident that longer and therefore more expensive solutions, were they to be preferred, could only be adopted at the expense of some other part of the Integrated Rail Plan: "Government commits to finding the best solution to take HS2 trains to Scotland as it confirms its intention to remove Golborne Link from HS2 Bill. Government will explore alternatives that deliver similar benefits, within the £96 billion envelope of the Integrated Rail Plan." The Golborne Link was included in the IRP funding envelope. A longer version as suggested in the Union Connectivity Review would break the IRP budget.

³as advocated in the Union Connectivity Review

⁴see p17 in https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/506022/NES_Report.pdf

⁵CHttpHandler.ashx (glasgow.gov.uk)

West Coast Corridor and the Golborne Link

The fully-planned section of HS2 northwards from North Cheshire to Wigan, termed the "Golborne Link" (or Spur), which would have bypassed the congested two-track section of the WCML between Winsford (north of Crewe) through Warrington to Golborne (south of Wigan), was cancelled without replacement, and without prior consultation of the Scottish Government, by the UK Government in Summer 2022.

There is now therefore no clear timescale, nor indeed selected route, for planning any extension of HS2 northwards over any part of the 243-mile length of the Crewe-Carlisle-Scotland section of the WCML. The quoted justification used by the UK Government for the cancellation of the Golborne Link was the earlier publication of the Union Connectivity Review. In June 2022, the UK Government stated in a Department for Transport Written Statement to Parliament, 6th June 2022, that:

"[The Union Connectivity Review] set out that the Golborne Link would not resolve all the rail capacity constraints on the WCML between Crewe and Preston. [It] recommended that the Government should reduce journey times and increase rail capacity between England and Scotland by upgrading the WCML north of Crewe and by doing more work on options for alternative [more] northerly connections between HS2 and the WCML.....Removing the [Golborne] Link [from the HS2 Phase 2b Bill] is about ensuring we've left no stone unturned when it comes to working with our Scottish counterparts to find a solution that will best serve the great people of Scotland."

However, the Golborne Link alignment was arrived at originally after a thorough review of alternatives by HS2 Ltd. It is not necessary to cancel a scheme such as this while reviewing it: the scheme could have been "put on ice" pending the review.

The Union Connectivity Review actually states that:

"The Golborne Link does not resolve all of the identified issues.....The emerging evidence suggests that an alternative connection (from HS2) to the WCML, for example at some point south of Preston, could offer more benefits and an opportunity to reduce journey times by two to three minutes more than the Golborne Link more work is required to better understand the case for and against such options. These benefits could also include additional operational flexibility when timing freight services and less disruption to the WCML than major upgrades, as most construction could take place away from the railway. (again, our underlining)" – see Union Connectivity Review report, p41).

In other words, the Union Connectivity Review suggests that consideration should be given to **extending the Golborne link** further north. At no point did it suggest it might be better to drop it, nor does it suggest instead upgrading the West Coast Main Line through Warrington. Since the Union Connectivity Review, in January 2023 Transport for the North (of England) launched a Freight and Logistics Strategy that specifically identified the West Coast Main Line north of Golborne as one of four key bottlenecks.

Subsequently, the UK Government stated in the HS2 Phase 2b Western Leg Crewe-Manchester, Supplement to the Update on the Strategic Outline Business Case that it:

"will work with Network Rail and HS2 Ltd and engage with the Scottish Government to ensure the best evidence is gathered to investigate and consider appropriate options for future Union connectivity. Exploring these opportunities.....is key to the Government's commitment to explore alternatives that deliver similar benefits to the Golborne Link....."

While this all refers to infrastructure in northern England, it is of significant consequence to Scotland's transport connectivity. Since the cancellation, there has been no further announcement to commission the necessary studies for the promised "further review".

East Coast Corridor and the UK Government's Integrated Rail Plan

Part of the concern over Scotland's high speed rail services is bound-up with the outcome of the Integrated Rail Plan, published in November 2021 by the UK Government. The Plan covered routes lying wholly within England but its contents have implications for Scotland. On the East Coast corridor, the Plan stated:

"We will build HS2 from the West Midlands to East Midlands Parkway, about six miles south-west of Nottingham.....From here, HS2 trains will continue directly to Nottingham, Derby, Chesterfield and Sheffield on the upgraded and electrified Midland Main Line.....We will look at the most effective way to run HS2 trains to Leeds....."

This final point referred to a "£100m study". On 19th January, UK Rail Minister Huw Merriman stated that an update on the study would be published "very shortly"; as of mid-March, the details are awaited.

The Integrated Rail Plan referred to earlier HS2 plans to:

"continue on high speed line to a new station at Leeds, with a spur to the East Coast Main Line to serve York, Darlington, Durham and Newcastle."

The report did not mention Scotland in this explanation, and indeed the Plan's Map 5 of the HS2 East Core Network shows all HS2 services north of York terminating at Newcastle.

The Integrated Rail Plan went on to promise:

"An ambitious package of further investment on the East Coast Main Line from London to Leeds and the North East.....We will ensure digital signalling is delivered and also upgrade the power supply to allow longer and more frequent trains, increase maximum speeds up to 140mph in some places, improve the capacity of stations and remove bottlenecks such as flat junctions."

The Plan claimed that:

"London to Newcastle and Edinburgh could be 25mins faster than now "

This would be on existing tracks; the feasibility has been questioned by industry observers. As with the west coast, there is likely to be a critical capacity issue to address, and increasing speed differentials makes such a need all the more pressing. This is why separate high-speed lines (or, potentially separated freight lines) make good sense.

No element of the Plan, other than power upgrades, delivers improvements through Northumbria, between Newcastle and Berwick, that would benefit Scotland. The Integrated Rail Plan, with its deferral of HS2 north of the East Midlands pending further studies, is regarded as a set-back even though it is clear there are some troubling aspects of the original Eastern arm plan.

The development of the Integrated Rail Plan therefore has not addressed congestion on the ECML north of Northallerton, and does not take sufficient account of the differing speeds of the fastest passenger trains from Scotland to York and London and the semi-fast passenger services that are needed to serve the key intermediate centres such as Berwick, Durham and Newark. It could result in a "knife-edge" timetable, where the fastest trains can only overtake semi-fast services at stations, thus requiring very high levels of punctuality throughout the ECML that may prove hard to deliver in practice.

South of the Border, the possibility of extending HS2 eastwards from East Midlands Parkway through Nottingham to Newark and then northwards with new high-speed rail infrastructure bypassing Doncaster to just south of York, as suggested in 2022 by Greengauge 21, could be advantageous to the connectivity of Edinburgh and the East Coast of Scotland. It would allow a speed-up of Edinburgh-London trains and provide the extra capacity needed south of York.

The Need For Anglo-Scottish High Speed Rail

For Scotland-England passenger and freight services to grow, there is the need for additional rail capacity on the northern sections (north of the reach of HS2) on the WCML and ECML corridors, in the absence of plans for any extension of HS2 to the Scottish Border.

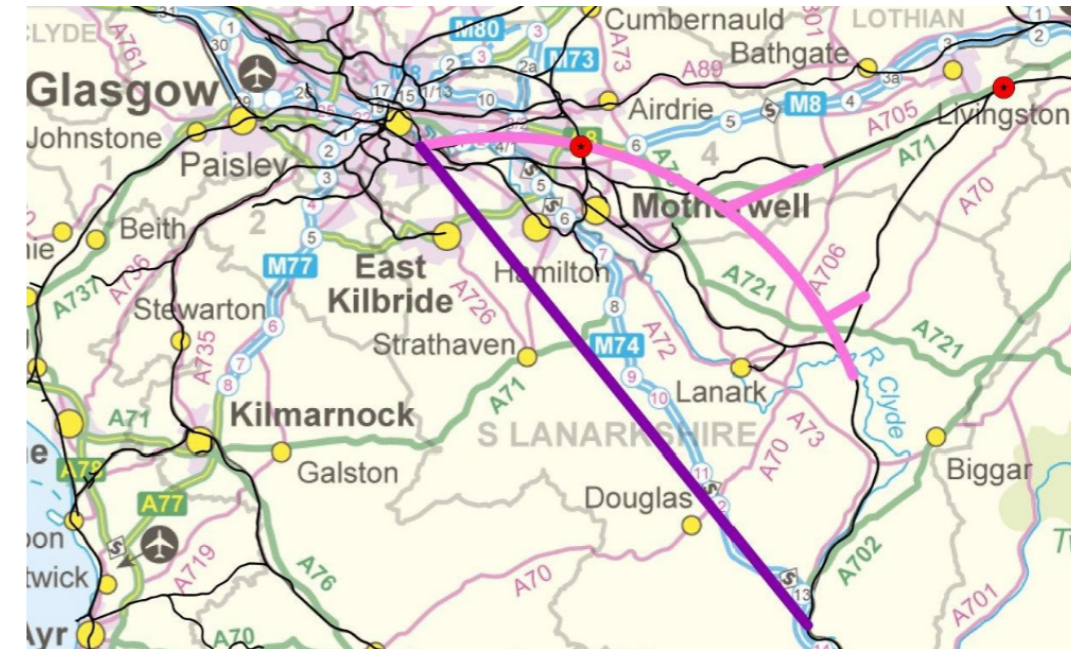
To achieve significant modal switching from air on the ECML, rail's present travel times, such as 4hrs 30mins for Edinburgh-Kings Cross (with one daily service timed at just 4 hours), will need to be reduced to at most 3hrs 30mins to be strongly competitive. Meanwhile, the ECML Lumo service with an average timing of 4hrs 27mins has achieved remarkable early success in abstracting air passengers to rail, partly through low price offerings on a low-cost airline book-ahead model.

On the WCML, current Anglo-Scottish rail timings are even worse. Present Glasgow-London schedules are about 4hrs 40mins, with multiple intermediate stops. This is uncompetitive with the flight alternative. The present 2023 timing is only 20mins faster than that offered in May 1974 (then, with only one intermediate stop, but without the savings of the 1997-2008 route modernisation programme or the use of the tilt technology in the Pendolino fleet which typically raises speeds through curves by around +20 mile/h).

The opening of HS2 as far north as Crewe, by around 2035, will offer the opportunity to accelerate Glasgow-London schedules.

Earlier work by Transport Scotland examined the feasibility of new high-speed rail infrastructure across Lanarkshire. ⁶This could bypass the series of nine flat junctions (where rail line cross each other, and inevitably on a busy part of the network cause delays and the need for low speed running) between Carstairs and Glasgow Central.

Two schemes were developed earlier, and they are shown in indicative outline below. Neither have progressed past initial feasibility stage. The purple line shows an indication of the longer of the two routes, broadly following the M74 corridor south to Abingdon; the shorter option (in pink) also offers a high-speed connection towards Edinburgh and could serve a new interchange station at Eurocentral Business Park in north Lanarkshire. Besides having an interchange with the Strathclyde rail network, this could offer a 'park and ride' facility over a wide part of the central belt. It could also be adapted to provide a north facing junction and spur to join the existing line that bypasses Glasgow and proceeds via Cumbernauld to Stirling and Perth, a route northwards used in earlier years for direct services from Euston to Perth and the Highlands – or such services could use the existing line and call at Motherwell, which would be bypassed by HS2 trains into Glasgow, creating additional capacity if the new high-speed line is built. ⁷



Source: Transport Scotland; routes shown are indicative only

Either of these lines would bring some journey time savings for HS2 trains and would release some additional capacity on existing lines for local passenger and for freight expansion. Either option would need to be complemented by work on the route into Glasgow Central station through Rutherglen to ensure that conflicting train movements could be minimised through grade separation of Rutherglen junction.

The alternative to building either of these two Scottish sections of high-speed line would be to commission further upgrades to improve line speeds and increase capacity. These may prove disruptive and consideration will need to be given to diversionary routes while the work is being carried out. With this approach, it would seem likely that Motherwell could be developed as a key rail/bus hub station.

To the south (from Carstairs or Abingdon, depending on which new alignment was selected⁸), the West Coast Main Line would be re-joined, a lengthy double track railway across the border to Carlisle. Neither of these schemes has been progressed past feasibility stage.

⁶ <https://www.transport.gov.scot/projects/high-speed-rail/project-details/>

⁷ The Royal Highlander used this route, running non-stop overnight between Carlisle and Perth into the 1960s. There is currently an open access application to introduce a Stirling-Euston train service using this line.

⁸ The joint DfT/Network Rail/HS2 Ltd/Transport Scotland study that looked into achieving a 3 hour London-Glasgow/Edinburgh journey time (source paragraph 3.3.42, see ref 12 below) observed that: "between Abingdon and Carstairs, higher speeds are possible and there is no significant capacity constraint", which might suggest the shorter (Carstairs) new alignment would be preferable, but no doubt there are other considerations.

Additional Passenger Capacity within Scotland

As detailed earlier, although there are plans to operate HS2 services to both Glasgow and Edinburgh, there are no plans to extend the HS2 infrastructure through North West England to Scotland.

Outside the Central Belt, although there are a number of other good existing rail links between the eight cities of Scotland – Glasgow, Edinburgh, Stirling, Perth, Dunfermline, Dundee, Aberdeen and Inverness. As previously detailed, many of these links struggle to offer journey times that can compete effectively with parallel car travel.

This means that the rail network, despite the efforts by ScotRail to offer fast and convenient services, struggles to offer the journey-times to would-be users might be expect in the 21st century. The lack of route-capacity of the inter-city network north of the Central Belt has three key adverse consequences.

First, for passenger traffic, there is **no opportunity for offering fast city-to-city service timings**.

The size of the market offered by, for example, Edinburgh, Dundee, Montrose and Aberdeen would suggest that a fast service (on existing tracks), taking about two hours, would be very attractive and appropriate. But there are other important locations on the route that also merit good rail services, even if “semi-fast” rather than “non-stop”. And there are many more smaller locations that also need serving.

Instead of being able to offer a logical three-tier service - very fast, semi-fast and stopping - the timetable is forced to become an uneasy two-tier compromise, “semi-fast” and “most-but-not-all-stops”, with the faster trains being slowed-down by too many stops and the smallest stations having very few services. This serves to frustrate the ability to grow traffic at intermediate stations.

Another consequence is the **inability to offer easy-to-remember “clockface” standard-interval local timetables**, as offered on so many rail routes in Europe (and over many routes in England). Because capacity at certain locations in Scotland is at such a premium, it becomes difficult to do this, and an important selling-point for rail – departures at memorable times, with standardised stopping patterns – is often unachievable.

The third unwanted effect, of particular importance where there are frequent fast passenger services, is that **it becomes difficult to accommodate new railfreight flows**. This is already very much the case on the Edinburgh-Newcastle route, where there are already four inter-city passenger operators. Freight, with its lower speeds and slower acceleration, either has to be slotted-in with difficulty between passenger service (and frequently side-lined in time-wasting loops to let passenger trains pass), or it has to operate at night, where it interferes with track maintenance.

The only solution to these problems is to segregate traffics by their average speeds. This has been the approach taken in parts of the UK where there is quadruple track (there is virtually no quadruple track anywhere in Scotland, other than the inner southern approaches to Glasgow Central and Edinburgh Waverley). Freight services can still to some extent share tracks with stopping passenger services, but the fastest passenger trains, and even some semi-fast services, ideally require separation from these slower flows.

The construction of new high-speed tracks for faster passenger services, or the quadrupling of sections of existing routes, will make greater segregation possible. It also offers the opportunity for significantly faster non-stop schedules between major traffic centres, and if wholly-new high speed tracks are provided, speeds of the fastest services can be raised from 60-110mph to 150mph+.

Time-savings from the construction of new high speed lines can be dramatic. Initial studies already undertaken on behalf of Transport Scotland, of a new high speed route between Edinburgh and Newcastle, demonstrated that travel times could be cut from a current best non-stop time of 82mins to around 45-50mins. In England HS2 route will cut London-Crewe from about 1hr 40mins to under an hour and London-Birmingham by HS2 will be cut from about 80mins to 52mins.

Releasing Capacity for additional Railfreight

The Rail Freight Group reports that bulk railfreight emits only 25% of the CO₂e (gases with global warming potential) of road freight for the equivalent journey, and so moving medium/long distance bulk freight to rail would save 75% of medium/long distance HGV emissions. The group claims that modal shift of only 10% of HGV traffic to railfreight would reduce as much annual CO₂e as the entire rail industry contributes – in other words, completely neutralise it. But this requires early investment in rail; leaving it until later will only make achieving the 2050 UK targets (2045 in Scotland) that much harder.

As a backdrop, UK-wide railfreight forecasting work was undertaken by MDS Transmodal in early 2019. It therefore pre-dated both the 2020-22 pandemic and the recession. The study assessed its findings against four potential scenarios:

- factors which favour rail relative to road, with low market growth
- factors that favour rail relative to road, with high market growth
- factors which disfavour rail relative to road, with low market growth
- factors which disfavour rail relative to road, with high market growth

The study reported that for 2033-34, rail freight tonnages UK-wide were expected to grow as follows (main commodities only, rounded to nearest million tonnes per annum):

- for port-based intermodal, growing from 16m tonnes pa in 2016-17 to between 26m tonnes and up to 48m tonnes by 2033-34
- for domestic intermodal, growth from 2m tonnes in 2016-17 to between 3m and up to 18m tonnes by 2033-34
- for construction materials, growth from 24m tonnes in 2016-17 to between 23m tonnes (a slight decline) or up to 51m tonnes by 2033-34.

In the forecasts to 2043-44, rail freight tonnages were expected to grow as follows (again, main commodities only, rounded):

- for ports intermodal, major growth from 16m tonnes in 2016-17 to up to 61m tonnes, a massive increase
- for domestic intermodal, major growth from 2m tonnes in 2016-17 to up to 28m tonnes, again a massive increase.

The range of these forecasts is considerable, unsurprisingly given the various “known unknowns” and the lengthy horizons involved, but there is clearly the anticipation of major growth in port intermodal, domestic intermodal and construction materials.

The 2021 study by Element Energy on behalf of the Scottish Government demonstrated that at least a further 40 freight trains would need to operate on Scotland-England routes each day if modal-shift targets were to be met.

The key long-haul commodities that could switch to rail are consumer goods in containers. Other key targets could include construction materials, fuels, timber and mails/parcels. New operator, Varamis Rail, is proposing to work with the parcels sector to carry Anglo-Scottish parcels traffic, part of a sector which has expanded significantly since the start of COVID.

One key to making freight more efficient through enabling longer trains, and reducing its own traction emissions to zero, is further electrification, which will obviously have a synergistic benefit to faster passenger services and the possibility of operating 100mph-125mph electric passenger services over existing routes if the route-capacity can absorb this. Electrification of more of the Scottish (and English) rail network will therefore assist phasing-out of elderly diesels locomotives wherever possible.

It is also likely that there will be particular interest in the rail network's future potential for serving the two Scottish Green Freeports (free economic zones), that at Inverness & Cromarty Firth Green Freeport and at Forth Green Freeport, including facilities in Leith, announced in mid-January 2023. The rail industry has confirmed that locations at both Freeports are served by existing or dormant rail freight infrastructure.

The choice of Inverness & Cromarty Firth may mean that greater priority will need to be given to increasing railfreight capacity on the Highland Main Line, where single track sections with short passing-loops are already a problem.

Proposals for wholly-new sections of high (or higher) speed line in Scotland could be expected to gain very significantly from lessons learned during the planning of HS2 in England, avoiding unnecessary expense by much better planning at the early "concept" stage and thereby reducing drawing-up detailed designs for routes that later prove sub-optimal in their benefits or unacceptable in their local environmental impacts. Cost effectiveness measures could include:

- avoiding over-specification of speeds. The trunk HS2 route has been designed to take up to 18 trains per hour, at a very high design speed of up to 225mph (360kph). High speed rail in Scotland could be more economically designed for a maximum of 150-175mph, giving much greater flexibility on route selection
- avoiding the use of EU design standards, which are not needed given there is no through-running capability between HS2 and HS1; and avoiding the need for HS2-specific platforms. There is also little point in assuming that future HSR train specifications will be for double-decker trains – which will be incompatible with structure gauges whenever HS trains reach the existing rail network.
- avoiding the use of expensive solutions to mitigate noise impacts (which are minimal compared with (say) motorways) such as depressing route elevation below ground level and the use of unnecessary lengths of tunnelling.

7. Route-level and multi-modal assessments

Across Scotland's rail network there are plans, kept up to date by Network Rail, that set out what can be achieved at reasonable cost given known operator and stakeholder ambitions. We do not seek to replicate or summarise these plans here, which would be inappropriate. But along selected corridors we note, where applicable, particular opportunities that arise in pursuit of the wider policy goals noted above.

West Coast Corridor, Glasgow/Edinburgh-Carlisle

As an interim pre-HS2 measure, a new Glasgow-Preston-London 125mph service on the existing West Coast Main Line, taking perhaps 4hrs 15mins-4hrs 20mins and aimed as a sustainable alternative to Glasgow-London flights. Such a service would be the WCML equivalent of the successful new open-access Lumo service on the ECML. It would signal what lies ahead when HS2 services start and help build rail's share of the market.

The introduction of HS2 passenger services to Scotland from the early 2030s can be expected to aggravate existing route-capacity problems north of Crewe, to the particular detriment of the need to grow railfreight, and the plans and solutions that Transport Scotland and Network Rail have developed to tackle this challenge are available and require development to the next stage of refinement.

Glasgow-Edinburgh and Glasgow-Stirling-Perth

Along these corridors, electrification has been completed over all four routes to Edinburgh and is programmed for the route to Aberdeen 'by 2035'. With the start of HS2 services from Glasgow Central, there will be places to the east and north of Glasgow from which people will likely wish to access the new faster rail services to London, people who would otherwise take a flight alternative, or make lengthy car journeys. New service connections from places that currently only have connections into Glasgow Queen Street would be needed.

Providing such access to Glasgow Central from places to the east/north of Glasgow could not be justified solely by possible high-speed rail feeder traffic, of course. But direct and convenient access onwards to services to Paisley and Ayrshire communities by a single interchange from faster services from routes from Stirling and Perth, for instance, could improve the overall rail offer across the central belt.

Such options would add to existing network pressures on the approaches to Glasgow Central from the east. But this part of the rail network needs to be enhanced to accommodate HS2 services into Glasgow. These new feeder service possibilities should be considered when it comes to assessing options to create conflict-free routes for HS2 services into Glasgow Central.

Highland Main Line

As Anglo-Scottish HS2 services start, and especially if infrastructure improvements are made between Glasgow and the border, the possibility would also arise of creating a limited number of new fast Anglo-Scottish services (perhaps once/twice daily) to Birmingham and London from Inverness and Perth.

Multi-modal measures (1)

Using ScotRail and Network Rail's existing plans as a baseline, the possible adoption of Swiss-style connected timetables, operating across the public transport modes needs to at least to be considered. This could usefully include, for current longer-distance rail services, a detailed review of the radial bus networks surrounding every Scottish station served by main-line services, to see if there are network gaps that could be filled with commercial or subsidised services, and whether site-specific interchanges could be improved. Better inter-modal connectivity would be the aim, to provide more viable alternatives to car use.

Bus (postbus) – rail connections (at Tain), 2016

Photo: Greengauge 21



'Avanti West Coast has recently introduced live electronic bus departure screens in WCML booking-halls, for example. Through ticketing between bus and rail at least, if not necessarily the full 'Mobility as a Service' model could be a feature. This is territory where investment in digital technologies would be of significance.

Overall this may be the single policy most likely to support the reduction in car travel that the net zero commitment demands.

Multi-modal measures (2)

Cross-border rail is already eating into air market share, especially between Edinburgh and London, the UK's busiest air market. The same will happen when Glasgow gains its HS2 services in the 2030s.

The opportunity to make better use of airport slots arises. Instead of concentrating on Edinburgh/Glasgow-London, air services between the more northerly airports (Inverness, Aberdeen and Dundee) should be able to secure their connections to the key international gateways, including in particular Heathrow. And Edinburgh/Glasgow airports should be able to concentrate on better flight connections to the Scottish islands, and to Ireland and to those EU cities where surface connections cannot compete.

Overall, this approach can be used to reduce unwanted aircraft miles. But more generally, it should prompt the requirement to achieve even closer connections between the rail and the air network: that's a simple by-product of trying to facilitate the development of a pattern of flights for which there is no good rail alternative, recognising the need to avoid lengthy car trips to airports wherever possible.

Scotland is well-placed on air-rail connections, and has a new station opening in 2023 to serve Inverness airport.

8. Current Rail Journey Times Compared With Other Modes (Tables 1-7)

The following tables set out current average speeds for Scotland's longer-distance rail routes. Timings are an average of a basket of five services. Rail mileages are taken from rail timetables. Car and bus times are taken from Rome2rio website and are approximate.

For each table we highlight – for each origin-destination pair – the fastest way (mode) to travel (highlighted in green) between city centres, and summarise the comparative speed advantage.

Table 1 Northwards from Glasgow

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)
Glasgow-Stirling	29	34min	51	32min	44min
Glasgow-Perth	62	59min	63	1h02min	1h45m
Glasgow-Inverness	118	2h20min	51	2h09min	2h52min
Perth-Dundee	21	22min	57	26min	35min
Dundee-Aberdeen	71	1h14min	58	1h08min	1h20min
Glasgow-Aberdeen	154	2h42min	57	2h28min	3h10min

Travelling northwards from Glasgow, rail is the fastest mode as far as Stirling, Perth and Dundee, but for longer distance journeys to Inverness and Aberdeen, car is quicker.

Table 2 Glasgow-Edinburgh corridor

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)
Glasgow-Edinburgh	47	50min	56	53	1h18

Note: train time shown fastest route (via Falkirk High). Rail journey times via Airdrie, Bathgate 1h18; via Shotts 1h24; via Carstairs 1h23 (Scotrail) 1h10 Cross Country.

There are four railways between the two cities and the times shown are for Scotrail services on the quickest route via Falkirk. Travel by car is very slightly slower; by bus, a lot slower.

Table 3 Northwards from Edinburgh

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)
Edinburgh-Stirling	36	51min	42	49min	1h31min
Edinburgh-(Ladybank)-Perth	57	1h32min	37	51min	1h28min
Edinburgh-(Stirling)-Perth	70	1h19min	53	51min	1h37min
Edinburgh-Inverness	175	3h38min	48	2h55min	3h50min
Edinburgh-Dunfermline	17	33min	31	26min	42min
Glasgow-Aberdeen Edinburgh-Dundee	59	1h10min	51	51min	1h35min
Edinburgh-Aberdeen	130	2h24min	54	2h13min	3h00min
Aberdeen-Inverness	108	2h23min	54	2h09min	n/a
Dundee-Aberdeen	71	1h10min	51	1h08min	1h20min

In every case, northward travel from Edinburgh is quicker by car. For travel from Edinburgh to Perth and Inverness, bus is almost as quick as rail.

Table 4 Southwards from Glasgow/Edinburgh (West Coast Main Line)

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)	Air/flight (were applicable)
Glasgow-Carlisle	115	1h13min	95	1h39min	2h05min	
Glasgow-London	401	4h43min	85	6h38	7h50	3h04min
Glasgow-Manchester (Oxford Road)	223	3h26min	69	3h36min	5h00min	4h11min
Edinburgh-Birmingham	309	4h14min	72	4h59min	9h15min	3h06min

Travel southwards from Glasgow by train over the West Coast Main line, cross-border to London, Manchester and Birmingham is faster than by car, often by a substantial margin. It is also faster than a flight to Manchester (but not to London or Birmingham).

Table 5 Southwards from Edinburgh (East Coast Main Line)

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)	Air/flight (were applicable)
Edinburgh-Newcastle	125	1h26min	87	2h13min	2h45min	
Edinburgh-London	393	4h17min	92	6h51min	8h57min	3h24min (Heathrow)
Edinburgh-Bristol	429	6h41min	64	6h17min	10h20min	
Edinburgh-Birmingham	296	5h03min	59	4h59min	9h15min	3h06min

Travel from Edinburgh to Newcastle and to London is much faster by train than by car, although flying via Heathrow for London is faster. Travel by car is quicker than train to Bristol and slightly quicker to Birmingham, however, reflecting the slow journey times by train over the cross-country route via Leeds, Sheffield and Derby. To Birmingham, it is quicker to fly, but also nearly an hour faster by train if the journey is made via the West Coast Main Line (i.e. via Preston rather than York).

Table 6 South West from Glasgow

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)
Glasgow-Dumfries-Carlisle	115	2h29min	46	1h39min	2h05min
Glasgow-Stranraer	101	2h29min (change at Ayr)	41	1h43min	2h35min
Glasgow-Cairnryan	-	n/a	-	1h34min	2h10min

Table 7 To the Highlands and Islands

Route	Distance (miles)	Train journey time (hours and minutes)	Train average speed (mile/h)	Car journey time (hours and minutes)	Bus journey time (hours and minutes)
Glasgow-Oban	101	3h09min	32	1h57min	3h02min
Glasgow-Fort William	123	3h46min	33	2h11min	3h11min
Inverness-Kyle of Lochalsh	82	2h28min	31	1h33min	2h06min
Inverness-Wick	161	4h22min	37	2h11min	2h57min

Travel to southwest Scotland from Glasgow is generally quicker by car. And for the highlands, islands, and the far north as well, car is always quicker than train. Indeed here, in every case, bus is quicker than train too, and by some margin on the far north line to Wick and Thurso.

Overall

In summary, rail is the fastest way to travel northwards from Glasgow as far as Stirling and Perth and westwards to Edinburgh. But longer distance journeys, to Aberdeen and Inverness are slower by train than by car.

But journeys from Edinburgh northwards across the Firth (and Tay) and even to Stirling are always quicker by car (although sometimes only by a narrow margin).

Train journey southwards from Glasgow over the West Coast Main Line and from Edinburgh over the East Coast Main Line are quicker than the alternatives, except where there is an airline service on offer, or to less accessible English regions.

Train travel over other lines – to southwest Scotland, and to the Highlands and the far north can be made more quickly by car – and in general, by bus too.