DELTIX
transport consulting

Rail for All – developing a vision for railway investment in Scotland

Final Report to John Finnie MSP, Scottish Green Party

November 2020

business • community • environment

CONTENTS

1. INTRODUCTION

1.1 John Finnie MSP commissioned Deltix Transport Consulting to produce a report which sets out an inspiring, credible and costed vision for the expansion and upgrade of the railway network in Scotland during the 2020-30 period, in response to the Climate Emergency – informing the discussion on the ongoing Strategic Transport Projects Review 2, and catalysing a modal shift from road to rail.

1.2 This is not an exhaustive study, and in the case of, for example, recommended station and route re-openings, detailed analysis will be needed on a case-by-case basis to establish feasibility and definitive costs. However the study argues strongly (see Section 3.4) that the Climate Emergency demands a significant move away from road-based transport to rail-based, to reduce both emissions and energy needs – so a streamlining of the currently complex and time-consuming appraisal process for rail projects is required. In the words of the Scottish Association for Public Transport, 'Scottish Transport Appraisal Guidance (STAG) needs to be amended to reflect climate change and other environmental priorities when assessing transport projects, rather than focusing on car journey time reductions which generate more journeys.'

1.3 The report has been researched and written by David Spaven of Deltix and by David Prescott (Deltix Associate) of AllanRail.

The Coronavirus pandemic

The current Coronavirus epidemic has generated major disruption to people's lives and livelihoods. Economic activity slowed down, with large numbers of people off work and some working from home, and as a result travel demand has diminished very considerably. The long-term impact of the Coronavirus pandemic on local, regional, national and international travel habits cannot be predicted with any confidence. There is enormous uncertainty about the levels of public investment which will be available for any new transport infrastructure investment. It is not at all clear where this will end, other than to conclude that the future is likely to be different to the past.

In this section we review **key transport impacts to date**, explore possible future transport trends and conclude with some thoughts on how to maintain the impetus of modal switch from road to rail, driven by the imperative of the Climate Emergency.

Following the introduction of lockdown, the virtually instantaneous and complete shutdown of city centre-based office employment, retail and leisure business had an immediate impact on travel, with a huge fall-off in all types of powered transport. Data from Transport Scotland https://www.transport.gov.scot/our-approach/statistics/#63626 showed that in the period 14th to 19th April, compared to pre-lockdown:

- concessionary bus journeys were down by 90%
- rail journeys by 95%
- ferry journeys by 95%
- plane journeys by 90%
- car journeys by 75%'

However, there was a major improvement in air quality in cities.

Since then the economy has gradually been released from lockdown, although Scottish offices and call centres currently remain closed other than for essential workers and work from home is the default position, so that the most recent data at the time of writing, for 31st August to 6th September shows:

- walking journeys down by 35% (compared to pre-lockdown)
- cycling journeys up by a reasonably constant 30%
- concessionary bus journeys down by 50%
- rail journeys down by 70%
- ferry journeys down by 50%
- air journeys down by 60%
- car journeys down by 10%.

These figures show **a consistent trend**: that public transport, which was demonised by the UK Government in the early days of the pandemic, largely due to remaining significant crowding on London Underground services, has been slow to recover, but cycling has boomed with the fall in road traffic – however, car use has returned towards the same levels as pre-lockdown, although not necessarily to the same pattern of flows. In practice, use of public transport is still – to some extent – being discouraged.

Transport Focus, the consumer watchdog, has been systematically monitoring the public's attitudes – and this has shown that the 'public transport is unsafe' message has stuck, especially as elements of it are still being promoted by operators and government. The public still see public transport as 'risky' only behind air travel in terms of risk.

It is probable that the Covid pandemic has accelerated trends that were already happening in terms of working from home and internet retailing vs High Streets. Looking at the wider economy, the following changes are suggested as a potential scenario:

- working from home will become normalised, although less so for younger and city dwellers – offices will remain an important part of economic activity, but on a more selective basis, with flexible hours
- video conferencing will remain a part of daily business life, but face-to-face meetings will return
- internet-based retailing will become entrenched at current levels, and with the investment that is being made this is likely to continue to grow
- city centre retailing and leisure will diminish
- small town, suburban and local retailing and leisure will increase
- there will be a small but significant dispersal of population away from cities as people start to base the location of their home on their lifestyle preferences – as opposed to the proximity to employment – but still able to offer access to places of employment
- international travel will only gradually recover
- the economy and GDP will be depressed for some time
- transport demand is likely to be lower than it was, – especially travel at peak times, which will reduce congestion and hence the pressure for major road upgrades**.** *This will have a wider beneficial effect, reducing transport emissions and transport energy demand.*

The **impact on future rail transport demand** is likely to be:

- reduced urban peaks, with a more even spread throughout the day – and longer trains to maintain social distancing
- longer-distance (including cross Border) services gradually returning to previous levels
- increased leisure travel on scenic routes from people taking 'staycations'
- while a solution (eg vaccination) may accelerate a return to public transport, including rail, growth back towards the pre-Covid levels of travel will be slow because of structural changes to employment and the economy
- physical methods of reducing infection risks and operating at lower load factors will need to be supported by stronger messaging, informative marketing and revised simple fare structures
- there will be demand for more rail freight in the small freight / parcels sector to deliver the requirements of internet retailing.

The consequences for future planning for **passenger rail** services are likely to be:

- urban services will operate at the same level all day, but with no additional peak services, reducing pressure on rolling stock and infrastructure provision
- load factors will remain low to help with social distancing
- the cost to the public purse of operating ScotRail is likely to increase

While one can conclude that the future is likely to be different to the past, most people will still be living in broadly the same places as now, they will need food and other goods, and employment will return – although possibly not to the same extent as in the past.

The working assumption of this project is that geographical travel patterns will remain broadly the same, but that the numbers travelling may not expand as they have been doing and may fall. However this does not lessen the need to address the Climate Emergency, so the core proposals of *Rail for All* remain relevant, with the variations being on the degrees of change.

In the short term there will be major challenges for public transport, both with managing social distancing and with travellers' perceptions of the desirability of travelling by public transport. The reduction in the number of travellers will stress passenger operators – road, rail, ferry and air – as income falls, but overheads remain substantially the same. Effectively, until a vaccine has been developed and the vaccination programme completed, there will be a need for public financial support to retain services and service frequencies.

Thereafter, as the 'New Normal' emerges, there may be a need to adjust service provision, but with the risk that reducing service quality reduces the attractiveness of public transport. One possible impact is that the vast improvement in air quality in cities as a result of the big reduction in traffic at the height of lockdown will show the way to electrifying city transport very quickly, not least for its health benefits.

All of this suggests that the climate change strategy of reducing private car use and increasing public transport use will be challenging and that it will be difficult to keep to the required trajectory to hit the climate change targets.

However, in contrast to these imponderables and constraints in the passenger transport sector, **rail freight** has been much less affected by Coronavirus. Freight train kilometres fell by 26% in April-June 2020 compared with the corresponding period last year,* with the biggest drop being within the construction sector, in response to the early lockdown – but this traffic is now returning as construction sites re-open. Given rail freight's resilience, there is considerable short, medium and long-term potential to substantially reduce carbon emissions by transferring more freight from road to rail.

There is capacity available in Scotland at terminals and within the rail haulier resources to provide more trains, which with the reduced passenger train service levels could be timetabled more efficiently. More Scottish Government investment in the established and well-understood mechanism of the Mode Switch Revenue Support (MSRS) grant to balance up the economics of rail and road transport (in recognition of the environmental and other benefits) would stimulate an early increase in rail freight *which can be delivered using existing processes and procedures, with no novel technology required*.

In this fashion it should be possible to both compensate for, and improve on, the short-term carbon increase which more car trips will generate – and help maintain the trajectory towards net-zero.

* Office of Road and Rail, as reported in *RAIL* 915, published on 7 October 2020

2. BACKGROUND / CONTEXTUAL ANALYSIS

2.1 The benefits of rail

Introduction:

In his foreword to the February 2019 Evidence Paper to the Williams Rail Review, Keith Williams summed up the reasons why we are rightly proud of our railways:

> They enable millions of people every day to get to school, college and work, visit family, meet clients, and access new places, and manufacturers to move everything from cars to concrete. Our railways do a huge amount for the country and are carrying vast numbers of passengers and goods every day.[1]

Railways – with their distinctive technical / operating characteristic of guided tracks of steel rail, on a segregated, signalled and very safe right-of-way – have high fixed costs, but are especially efficient when moving (a) large numbers of people into and around dense urban areas, and over medium to long distances at speed, and (b) freight in large quantities and/or over longer distances.

Scotland has a rail network of over 1,760 miles, serving the travelling public through 360 stations in every region of the country (of which 88 have opened since 1970). Around 100 million passenger journeys are made by rail in Scotland annually on inter-city,[1] regional and commuter services (see more facts and figures in Section 2.2).

The direct transport benefits which rail passengers derive from using the railway include speed, comfort, reliability, safety and value for money in the three core passenger markets: commuting, leisure, and business travel. But, as the Williams Rail Review emphasises, the railways system 'creates a range of economic and societal benefits that extend far beyond the direct benefit to its passengers and freight users.'

Environmental benefits:

The 'Climate Emergency' which we face has rightly focussed particular attention on rail's key capability to reduce CO2 emissions compared to road and air transport, both of which generate high 'external costs' not reflected in prices in the market place. In contrast to these competing modes of transport, rail – with its special technical / operating features – offers a range of 'external

[1] Within Scotland, the generic term 'inter-city' refers to express train services linking the seven designated cities of Aberdeen, Dundee, Edinburgh, Glasgow, Inverness, Perth and Stirling. Within the Central Belt these services are currently provided by electric multiple units (EMUs), between Edinburgh / Glasgow and Aberdeen/Inverness by InterCity 125 'High Speed Trains', and between Aberdeen and Inverness by a variety of types of train.

benefits' which can broadly be categorised as environmental, social and economic.

As the Williams Rail Review notes, rail 'provides the cleanest mode of transport for many types of local, regional and longer distance journey.' This is particularly the case where trains are electrically-powered, and it is widely agreed that that the current figure of 32% of the Scottish network being electrified[2] should be substantially increased, and complemented by the deployment of emerging battery and hydrogen technologies for lighter-trafficked rural routes.

It should be noted that most ScotRail, LNER and Avanti passengers in Scotland already travel in electric trains now that the majority of the Central Scotland network is electrified, together with the East Coast and West Coast Main Lines. It has been estimated that by the end of 2019, around 75% of all ScotRail passenger journeys were by electric traction.[3]

Rail is inherently energy-efficient – once a train has accelerated, it needs relatively little additional energy to maintain its speed and technology now allows energy to be captured when electric trains brake.[4] Rail therefore generates substantially less greenhouse gas emissions per journey than competing modes of transport – for passenger *and* freight traffic. For the inter-city journey from Edinburgh to London, for example, the air traveller generates almost five times the CO2 of a passenger on the electrically-hauled train service, while a car driver creates nearly four times as much.[5]

Rail freight generates as little as a quarter of the CO2 emissions per tonne-kilometre produced by road haulage, depending on the use of diesel or electric traction. Even where road legs are required at each end of a rail trunk haul, the complete intermodal transit (using electric rail traction) generates only a third of the CO2 produced by the throughout road haulage equivalent.[6]

Modal switch from road to rail therefore has to be at the heart of any robust policy for sustainable development.

Social benefits:

Car ownership has remained fairly stable over the last decade, with around 71% of households having access to at least one car[7]. The number of cars registered per 1,000 people (over 17) across Scotland is 557, but varies substantially from outer suburban / rural areas to cities: 808 in Renfrewshire, 748 in Stirling, and 691 in Aberdeenshire; but just 494 in Aberdeen, 454 in Dundee, 405 in Edinburgh and 385 in Glasgow (the lowest of any Local Authority area).

Alternatives to the car are therefore crucial for **social mobility and inclusion**, and the rail system provides high-quality access to education, employment and leisure opportunities, as demonstrated in the success of the Borders Railway to Midlothian, Galashiels and Tweedbank since its re-opening in 2015.

With its segregated and signalled right-of-way, rail – in terms of injuries and deaths per passenger mile – is **more than nine times safer than travelling by car**.[8] Over the decade 2009-19 there were no passenger or workforce fatalities resulting from a main-line train collision or derailment in Britain – despite passenger journeys and passenger miles rising by 40% and 36% respectively.[9]

Economic benefits:

Our rail system plays a key role in providing employment and facilitating long-term benefits to the Scottish economy. Illustrating the vital – but often unseen – role of rail freight, between 20% and 25% of Scotland's exports are forwarded by rail from the Coatbridge Freightliner Terminal.[10]

The rail sector generates a wide range of direct and indirect economic impacts including increased output, local regeneration (particularly around stations) and facilitation of the beneficial effects of 'agglomeration' (productivity improvements from firms being located closer to one another[11]).

It has been calculated that the 'Gross Added Value' of the Scottish rail sector is £668m a year and that the rail supply chain is responsible for around 12,800 employees in Scotland.[12]

Two specific benefits of rail relate to the industry's consequential impact on Scotland's road system – namely the **easing of road congestion in and around our cities** and the **reduction in trunk road maintenance costs** as a result of major freight flows being moved by train rather than Heavy Goods Vehicles.

2.2 Key rail facts and figures

Passenger rail:

Rail plays a vital role in Scotland's public transport, although it is not the leading mode in terms of usage. Of the 517 million public transport journeys made in 2018-19, 74% were by bus, 19% by rail, 5% by air and 2% by ferry. Two thirds of commuters said that they travelled to work by car or van in 2018, 12 per cent walked, 10 per cent went by bus, 5 per cent took a train and 3 per cent cycled.[13]

Over the last five years – pre-Coronavirus – there were increases in car, air and rail passenger numbers, while there was a fall in bus passengers. The biggest growth was experienced in the most unsustainable mode – air travel – but ScotRail patronage (journeys) grew faster than car kilometres, as shown in Table 1 below:[14]

Table 1: passenger transport trends

	2013-14	2018-19	Change over 1 year	Change over 5 years
Car Traffic (m/veh km) on all roads	33,811	36,413	0.6%	7.7%
ScotRail Passengers (millions)	86.3	97.8	0%	13.3%
Bus Passengers (millions)	421	380	-2.2%	-9.8%
Air Passengers (millions)	23.3	29.4	2.1%	26.2%

Rail freight:

The major trend in rail freight has been the decline of coal (due to its phasing out as a source pf power generation), with the consequent loss of business partly replaced by substantial growth in intermodal (container) transport in the domestic, Deep Sea and European markets. There are intermodal railheads in Aberdeen, Coatbridge, Grangemouth, Inverness and Mossend.

Statistics on rail freight in Scotland are incomplete within *Scottish Transport Statistics* 'due to difficulties obtaining updates to the data covering all the rail freight companies', but for the last year (2012) for which the Scottish Government published data on modal split, rail's share of freight moved

(tonne-kms) was 9%, with road haulage taking 42%, coastwise shipping 30%, pipeline 19% and inland waterway 1%.[15]

One billion net tonne-miles of product are shifted by rail annually in, to and from Scotland – on some 50 trains daily. And around 45% of these trains are already electrically-hauled, providing a very substantial carbon advantage over road haulage.[16] *Rail freight has also been much less affected by the Coronavirus than has passenger rail, as there were no direct constraints imposed by the lockdown or social distancing.*

2.3 Scottish Government and rail industry policies, programmes and plans

Scotland's Railways:

(See Appendix A1 for details)

The oldest of the current suite of rail policy documents, 'Scotland's Railways' was published in 2006, as a 'daughter' document to the first, and now superseded, National Transport Strategy (NTS). Scotland's Railways set the course for railway development within Scotland since its publication and continues to inform rail service development. It also has had a considerable influence on cross-Border services, reflecting rail devolution and the (then) recent transfer of power over internal rail policy to Scotland. It set out the implications for rail on the three NTS Strategic Outcomes:

- improving journey times and connections
- reducing emissions
- improving quality, accessibility and affordability.

. . . and should be seen in the context of the package of seven rail re-openings/new rail schemes which were in progress at the time as a result of the second Labour/LibDem coalition agreement.

With the publication of a new National Transport Strategy (NTS2) it is probably a reasonable assumption that Scotland's Railways will be updated to reflect the changed priorities in NTS2 and to incorporate STPR2 (see later).

Strategic Transport Projects Review (STPR):

STPR, published in 2008, was the major Scottish multi-modal transport planning study to take the NTS forward into delivery, using the three strategic outcomes as its principle focus. It was a considerable exercise, looking at long-distance corridors and key nodes across Scotland, but not local travel, other than where the latter occurs on the strategic network (defined as the railway and Trunk Road networks.

The final output was distilled down into 29 Proposed Projects, covering the road and rail networks, split into three tiers:

- maintaining and safely operating existing assets
- making better use of existing capacity
- targeted infrastructure enhancements.

As these covered both road and rail networks there were subtle differences between the approaches taken to the two modes. There were 16 projects

which were exclusively or partly rail projects, of which one – Project 21, Haymarket station – has been completely delivered, and anotherm – Project 15, Edinburgh-Glasgow Improvement Project – has been largely delivered. Elements of other projects have been partly delivered.

It is not clear that STPR is continuing to drive the strategic development of the Scottish rail network. The development which has been happening appears to be piecemeal and driven by the rail industry in response to the Network Rail-organised Route Utilisation Strategies and latterly its Scotland Route Plan priorities, rather than the wider strategic overview which STPR presented. This is evidenced by the lack of obvious progress on:

- Project 13, East of Scotland Rail Improvements, where the only work completed is extra east-end platforms at Waverley station
- Project 23, Rail Improvements between Aberdeen and the Central Belt, where very limited development work is taking place
- Project 24, West of Scotland Strategic Rail Enhancements, where any direction is now coming from the Glasgow Connectivity Commission
- Project 27, West Coast Mail Line Rail Freight Improvements, where only some minor freight upgrades were implemented at Mossend Yard, and potentially a longer loop will be provided at Carstairs
- Project 28, Inverkeithing to Halbeath Railway Line, where nothing has happened.

The partly-delivered projects, which could be described as 'work in progress', show variable progress:

- the re-instatement of the Almond (Dalmeny) chord removed from the Edinburgh - Glasgow Improvement Scheme (Project 15) is now being reconsidered
- Project 17, Highland Main Line Rail Improvements, will now be stalled until electrification is agreed, which will then define the infrastructure changes required to deliver faster (and more competitive) journey times
- Project 19, Rail Improvements between Aberdeen and Inverness, does not appear to be progressing to deliver the faster, hourly frequency end-to-end service required (but important work has been undertaken to double the track between Aberdeen and Inverurie and to enhance the crossing loops at Elgin and Forres)
- Project 20, Grangemouth Road and Rail Access Upgrades, is part complete, with electrification and some enhanced 'Loading Gauge' (height and weight) clearance for container wagons[17], but an essential element – the delivery of full-size train-handling capability within the

Port of Grangemouth is not happening (in spite of being a relatively low-cost option).

- Project 26, Rail Enhancements between Inverclyde, Ayrshire and Glasgow, has been partly delivered, but the infrastructure upgrades to enable half-hourly frequency to Wemyss Bay and Largs. and redoubling the remainder of Barrhead-Kilmarnock to better deliver services to the southwest, are not happening.

STPR2 is in progress and the indications are that it will be going back to a blank sheet with only committed schemes (A9 and A96 dualling) being carried forward.

National Transport Strategy 2 (NTS2) (Protecting our climate and improving lives) and Climate Emergency:

The completely new NTS2 was published in February 2020. It is the overarching policy setting document which all other future transport policies will need to take into account.

The strap line (*Protecting our climate and improving lives*) sets the agenda and represents the first tangible signs of the impact of the Climate Emergency on overarching transport policy.

It presents a vision for 'a sustainable, inclusive, safe and accessible transport system, helping to deliver a heathier, fairer and more prosperous Scotland' and sets out four priorities:

- reduces inequalities
- takes climate action
- helps deliver inclusive economic growth
- improves our health and well-being.

These are considerably different to the three priorities in the original NTS, expanding on the need to address climate change, but moving decisively away from transport specifics such as journey time reduction into wider policy outcomes.

It recognises that the cities have different needs to the rural areas. The economic growth aspects are more focused on productivity, and climate change features strongly, with the need to adapt to climate change and to improve air quality, especially particulates (most of which are produced by road vehicles).[18]

A strong policy statement – 'The Sustainable Travel Hierarchy – will be used to inform future transport decisions. It has walking and 'wheeling' (travelling by wheelchair and other wheeled walking aids) as the top priority, followed by cycling, public transport, taxis and shared transport (in that order), with private car at the bottom.

Additionally there is a 'The Sustainable Investment Hierarchy' which presents 'Reducing the need to travel unsustainably' as the first objective, followed by 'Maintaining and safely operating existing assets', and 'Making better use of existing capacity', with the least sustainable action being 'Targeted Infrastructure Improvements'.

These two policy statement will have a substantial impact on transport policy and decision-making and will require a complete overhaul and rethink of the transport appraisal processes.

Programme for Government 2019-20:

https://www.transport.gov.scot/news/programme-for-government-2019-20-protecting-scotland-s-future/

The 2019-20 Programme for Government, published in 2019 included this commitment as part of 'this embryonic Scottish Green Deal':
'reduce emissions from Scotland's railways to zero by 2035 through the continued electrification of the network, the procurement of battery-powered trains and exploration of the potential of hydrogen-powered trains in Scotland.' The 2020-21 Programme for Government places great emphasis on 'green jobs', which by implication suppprts electrification.

Rail electrification is a key theme of this *Rail for All* main report, and a review of the Scottish Government's views on rail decarbonisation – as part of their Scottish Green New Deal policy – was expected to be included at the time of writing *Rail for All*. However, the former was delayed by Covid-19 from the intended March publication date, and our main report is therefore based on the best information available at the time of writing – but a separate mini-report on 'Rail Decarbonisation' has been produced as a supplement to *Rail for All*, reviewing (and comparing with *Rail for All*) Transport Scotland's *Rail Services Decarbonisation Action Plan* ('Decarbonisation Plan') published on 28 July 2020 https://www.transport.gov.scot/media/47906/rail-services-decarbonisation-action-plan.pdf.

Electrification:

The assumption made in *Rail for All* is that the following routes will be electrified:

- Glasgow to East Kilbride, Barrhead, Kilmarnock and Barassie,
- Glasgow to Maryhill, Anniesland and Westerton,
- Dunblane to Perth, Dundee and Aberdeen
- Perth to Inverness
- Haymarket to Fife Circle (including Levenmouth), Dundee and Perth
- Edinburgh to Tweedbank
- Edinburgh South Suburban Line.

And that the following routes *may* be electrified:

- Aberdeen to Inverness
- Ayr to Girvan
- Kilmarnock to Dumfries and Gretna (-Carlisle)
- Inverness to Dingwall.

Network Rail are known to have been instructed by Transport Scotland to carry out design work on the Glasgow area routes and north of Dunblane.

Infrastructure Commission for Scotland:

The Infrastructure Commission for Scotland published its updates in 2019.[19] Not many specific projects are suggested, as the report is more concerned with wider underlying themes, mostly about reducing carbon – and a suggestion that journey time reduction may no longer be an appropriate measure of the value of a transport scheme.

Two railway projects are included: High Speed Rail and Aberdeen-Central Belt (STPR Project 23).

High Speed Rail

Two routes are under consideration:

- East Coast route between Edinburgh and Newcastle and
- West Coast route from Abington (south of Carstairs) to Glasgow – with a link to Edinburgh incorporating a new station in Livingston.

Early development work on the East Coast is being progressed to assess an East Linton to Prestonpans section as part of Network Rail's Southeast Scotland to England Project, which recognises the need for additional infrastructure on the ECML east of Edinburgh.

On the West Coast two new cross-Border stations are being considered at EuroCentral on the new line and in the Livingston area on existing tracks.

Aberdeen - Central Belt

The original STPR Project 23 concept of an incremental package of line speed, signalling and freight loop enhancements to deliver a journey time reduction of 20 minutes with more powerful rolling stock has not proved possible within the budget available (£200m Aberdeen City Deal funding)

Development work is now directed at signalling improvements between Dundee and Aberdeen, including freight/passenger loops, targeted line speed improvements and electrification and the project is now being taken forward by Network Rail under Transport Scotland's Rail Enhancements & Capital Investment Strategy, known as 'the Pipeline' (see later).

Scotland Route Study:

In parallel with Scottish Government policymaking – and responding to the latter as befits the key governmental role in funding the Scottish railway system – Network Rail published its Scotland Route Study in 2016, following extensive consultation with railway stakeholders. The aim of the study was to set the 'Specific Strategic Objectives' for Scotland's Railway and translate them into Conditional Outputs (shown to be affordable and offer value-for-money), which are the future service specifications to meet stakeholder aspirations in terms of connectivity and capacity. The remit was restricted to the existing rail network, with no proposals for additional routes or stations. The study looked at the various Scottish market segments, assessed the growth prospects and suggested train service requirements for 2043 across seven groupings of Scottish routes, which are set out in Section 3.1 and 3.2.

These projects are now starting to be developed by Network Rail through the Pipeline.

High Level Output Statement:

'The Scottish Ministers' High Level Output Specification for Control Period 6 (CP6)' (HLOS)[20] fulfils the requirements of the Railways Act 1993 and the Railways Act 2005, setting out what Scottish Ministers require the rail industry to achieve with regard to the rail network in Scotland during CP6 covering 1 April 2019 to 31 March 2024.

The Scottish Government's previous Key Strategic Outcomes for all transport modes (improved journey times and connections; reduced emissions; and

improved quality, accessibility and affordability) are reflected in its Strategic Priorities for rail, which are:

- improved services
- improved capacity
- improved value
- more effective integration
- increasing inclusive economic growth.

The HLOS notes that demand for rail is expected to grow in the coming years and Scottish Government priorities and investment activities in CP6 and beyond 'will look to support continued growth on the network in a way which best supports Scotland's communities and its economy.' The HLOS 'Requirements of the Scottish Ministers' relate to a variety of aspects of delivery by the rail system, including:

- network capacity / capability ([Footnote 2])
- availability of cross-Border routes
- improving journey times
- performance (' for the benefit of passengers and freight users')
- a rail freight growth target of 7.5%.

A key requirement relates to 'A greener Scotland', acknowledging that 'rail is already a low contributor of total transport emissions', but requiring rail investment strategies to become more sustainable, (a) to provide a contribution to overall emissions reductions and (b) to ensure enhanced network resilience from adaptation interventions.

Rail Enhancements & Capital Investment Strategy (the Pipeline Process):[21]

In a change from the previous approach, individual enhancements have not been specified in the HLOS, but will be developed through the new Rail Investment Strategy's Pipeline process. It sets the government's new approach to planning and funding rail projects and looks beyond the traditional five year railway industry planning cycle, taking a strategic approach to all rail capital

[2] ***Capacity*** bottlenecks are defined in this report as locations / corridors where the number of trains, length of trains or number of passengers moved are constrained by the current design of the physical infrastructure. ***Capability*** constraints are where the physical ability to deliver services at specific locations (or on specific corridors) is less than the railway is capable of delivering elsewhere, for example as a result of: lower axle loads; overbridges and tunnels too low for taller containers (inadequate Loading Gauge); or permitted line speeds being lower than the maximum design speed of the trains.

investments, with a particular focus on realising the opportunities that major renewals offer to enable the network to meet future requirements.

Working with the wider rail industry (including passenger and freight operators), Network Rail is planning how to meet future capacity needs for rail, creating a pipeline of future rail projects which are at different stages of development. Planning is informed not only by the Scotland Route Study and the rail industry's advice but also by the need to address the Scottish Ministers' wider social and economic aims.

Project promotors are required to use the Scottish Governments 'Scottish Transport Appraisal Guidance' (STAG) method of appraising transport schemes, Transport Scotland's 'Guidance on the Development of Business Cases' and Network Rail's Governance for Rail Investment Projects (GRIP) processes.

Scottish Planning Policy:

While the rail industry benefits from owning its route corridors and the supporting footprint of station areas and freight yards etc, the ability to cost-effectively upgrade and expand the network can often depend on adjacent land in disparate private and public ownership. Also, as rail demand grows, this needs to be recognised in planning the evolving urban form around the railway so that the railway can continue to perform its core transport function without causing undue nuisance to both existing and potentially new neighbours and without the risk of closure or curtailment of activity from new neighbouring land uses.

Existing 'Scottish Planning Policy' as laid down by the Scottish Government in 2014[22] provides some useful guidance to help protect the interests of rail during the preparation of local, regional and national development plans and in respect of specific planning applications for non-rail land uses on sites adjacent to existing or potential rail facilities, for example:

> 'Disused railway lines with a reasonable prospect of being reused as rail, tram, bus rapid transit or active travel routes should be safeguarded in development plans.' (Para 277)
>
> 'Where appropriate, development plans should also identify suitable locations for new or expanded rail freight interchanges to support increased movement of freight by rail. Facilities allowing the transfer of freight from road to rail or water should also be considered.' Para 288

Following the passage of The Planning (Scotland) *Act* 2019, revised planning guidance will be issued in due course. This will need to take account of the Climate Emergency and the associated enhanced role of the railway in Scotland's transport. It is understood that the rail freight industry has already

raised with Transport Scotland a number of areas where it feels that planning guidance should be strengthened to help modal shift of freight from road to rail.

2.4 Commentary on Scottish Government policies and programmes

Scottish Government policies have for decades favoured rail expansion – but not at the expense of road construction. However, the Climate Emergency has created a new context for policy-making, with over-arching policy aims which are less transport-specific. By way of example, reducing journey times has traditionally been a key aim of transport policies and is a central element of the 'business case' justification for constructing new roads – with often small benefits to individual motorists grossed up over a large body of motorists on key corridors. This may no longer be such a priority, with carbon reduction given greater importance, as suggested by the recent report of the Infrastructure Commission for Scotland.

Programmes of transport projects should reflect the laid-down policies, but even where they do – arguably as in the 2008 Strategic Transport Projects Review (STPR), with its relatively balanced mix of road and rail schemes – there is a tendency for *delivery* to be distorted by political considerations and traditional assumptions about linkage between new roads and economic development. A classic example is the Perth-Inverness corridor: STPR identified upgrading the railway as the third-top priority of 29 road and rail schemes across Scotland, and investment of between £200m and £450m was envisaged – to date, however, just £65m has been spent on rail enhancement, while A9 dualling (at an originally forecast cost in 2010 of £3,000 million) has made much faster progress, despite being lower in the list of STPR priorities. The A96 dualling is progressing despite not even making the final version of STPR, having been filtered out in the process as not offering sufficient value.

Inappropriate or inconsistent methods of project *appraisal* have facilitated this kind of distorted delivery. In response to the weak business case for A9 dualling Transport Scotland invented a new criterion – 'driver frustration' – which superficially strengthened the benefit to cost ratio. But arguably driver frustration is tangibly expressed in accident rates, reductions in which were already part of the business case for dualling – and much of the safety benefit has already been achieved through inexpensive and cost-effective Average Speed Cameras, in advance of most of the dualling.

It can therefore be concluded that STPR2's project list – and a 'cross-modal' approach to the appraisal of specific transport corridors – will be a key marker for the extent to which the Scottish Government is translating the Climate Emergency imperatives into a robust and sustainable programme for transport which will deliver the required decarbonisation now at the very heart of policy.

2.5 Scottish Green Party policies

Scottish Green Party policies strongly emphasise the development of rail services to reduce dependence on road transport, cutting environmental impacts (notably carbon) and improving social mobility. Key policy positions in the Holyrood 2016 manifesto included the following:[23]

Green MSPs will campaign to bring the railway back into public hands at the end of the current contract. Bringing railways back into public hands could reduce fares, improve links with other transport and ensure that the service is fully accessible to all. We support creating wi-fi and 3G coverage on all intercity public transport, including in stations. Reopening of old routes, such as to Methil and Leven, dualling the Highland mainline, and a switch from road freight to rail delivery will also be targets alongside securing faster journey times to London.

On international travel, the manifesto called for 'fast rail alternatives [to aviation] where possible', while on the domestic front:

All new road infrastructure should undergo a triple bottom line evaluation, ensuring that projects deliver tangible benefits to the economy and society and the environment is respected. Green MSPs would support any new infrastructure that meets these requirements.

The Scottish Green Party's Westminster 2019 manifesto featured 'A Scottish Green New Deal to tackle the Climate Emergency'. This would:

. . . redirect funding away from high-carbon transport infrastructure and to public transport, cycling and walking. It would see the existing programme of city and region deals, which deliver large-scale public investment but are largely focused on road infrastructure, replaced with green city and region deals, and a massive increase in investment in the strategic growth and decarbonisation of Scotland's railway network.

2.6 Lobby group campaigns

Scottish Association for Public Transport:

The Scottish Association for Public Transport (SAPT) was formed in 1962 (as the Scottish Railway Development Association) to campaign against the Beeching cuts. SAPT's response to the STPR2 Strategic Transport Projects Review, 'Recommendations for a Low Carbon Future' was published in 2019, with Section 1 citing four issues which have increased in significance since the last Strategic Transport Projects Review in 2008:

- **The Climate Emergency** declared by the First Minister in April 2019: 'SAPT recommends that priority should be given in STPR2 to public transport and active travel projects that will **cut emissions** and encourage modal shift away from cars.'
- **Health problems** due to particulates and NOx: 'STPR2 should focus investment in more urban electric trains, trams, metro and low-emission bus priority routes.'
- Fully switching to **electric road vehicles '**would need a 30% increase in electric power generation . . . This potential crisis in power generation can be avoided by prioritising in STPR2 projects that encourage greater use of efficient electric public transport'
- **Mitigating the results of climate change '**like rising sea level and flooding on infrastructure needs to be factored into the investment programme.'

SAPT concludes that 'the environmental benefits of investing in rail electrification are more predictable than for other transport modes. Rail electrification is a tried and tested technology which uses energy efficiently and reduces rail CO_2, NOx and particulate emissions. However rail's greatest environmental benefit will come from attracting modal shift from other more polluting forms of transport: car, lorry and plane.'

Section 2 of the SAPT submission argues that '**Scottish Transport Appraisal Guidance (STAG)** needs to be amended to reflect climate change and other environmental priorities when assessing transport projects, rather than focusing on car journey time reductions which generate more journeys.' SAPT say that STPR2 transport projects should be ranked based on their contribution to achieving the following objectives:

Factor A: Climate Change and Environmental Targets
Factor B: Connecting communities to employment
Factor C: Linking Cities
Factor D: Improving Rural and Tourist Transport
Factor E: Alleviating Transport Congestion.

Section 3 recommends rail projects for appraisal in STPR2. It notes that 'electrification of the complete ScotRail Inter7City network would cost £1.7 Billion over 15 years at a target cost of £1.5 Million per single track kilometre.

This compares with £6 Billion of spending (2010 prices) on just two road projects (A9 and A96) which will generate additional car traffic, and increase emissions and future power requirements.'

It is also argued that the Climate Emergency has implications for other policy areas: '**Planning and Land Use Regulations** should be updated to make it easier for planning authorities to reject developments that increase the need for unsustainable travel', and land should be safeguarded for STPR2 rail projects once agreed.

Seven 'Zero-Carbon Rail Projects' are presented in some detail, and are summarised as follows:

- Scottish InterCity Electrification
- Clyde Metro
- Edinburgh and Borders Rail Upgrades
- Fife Rail Connectivity
- Aberdeen CrossRail
- Rural Rail Upgrades
- Anglo-Scottish Rail.

Transform Scotland / 'Inter-City Express':

Transform Scotland, launched in 1997, is Scotland's 'alliance for sustainable transport', campaigning for walking, cycling and public transport to be 'the easiest and most affordable options for everyone'. It is a politically-independent charity, and its diverse membership brings together public, private and third sector organisations from across Scotland.

In its planned submission to Transport Scotland on the Strategic Transport Projects Review 2 process, Transform Scotland intends[24] to state that:

We believe that there is significant scope to connect more communities to the rail network. Since the Beeching era closures there have been significant changes in settlement patterns and travel habits which now leave many sizeable communities isolated from the rail network either through lack of a local station or a local rail line.

It should not be the role of local campaigners to lobby for the connection of communities to the rail network - it should be part of the strategic planning process for future transport needs. STPR2 presents the opportunity to make this a clear policy objective - expansion of the rail network should be a key element of planning for a shift to more sustainable transport modes.

Going forward rail planning should also consider light rail, either tram or tram-train, and ways to integrate this with the heavy rail network to ensure that all mainland

communities with a population in excess of 10,000 are served by rail. In city regions such as Edinburgh and Glasgow light rail schemes are already either planned or proposed but integration with the heavy rail network is not as yet an integral part of these schemes. Co-ordination is needed here and this will require Transport Scotland to work closely with the city regions on enhancements to the light and heavy rail networks and the integration of the two.

In parallel with the required modal shift from road to rail within Scotland will be the need to plan for and implement an increase in train services and train and network capacity to ensure that the additional passengers can be accommodated.

While Transform does not propose a list of individual rail re-opening schemes (for the reasons set out above), it does make one exception (a re-opened direct rail route from Edinburgh to Perth) as part of its **'Inter-City Express'** campaign, working together with other organisations to argue the case for 'a rail network fit for the 21st century'. The aim is to make rail travel between Scotland's seven cities quicker than by car, and to complete the electrification of the railways between the cities. There are five key strands to the Inter-City Express (ICE) campaign:

(i) **Double and electrify the Inverness to Perth 'Highland Main Line':** Two-thirds of this key 118-mile route is just single track – limiting capacity, slowing journey times and undermining reliability. ICE says that 'for rail to compete on this corridor a 'game changer' is required. That means creating an electrified and double-tracked railway – transforming rail's capacity and capability for passengers and freight.'

(ii) **Faster journeys and greater connectivity between Aberdeen and the Central Belt:** ICE advocates a package of measures to shift passenger and freight traffic off the A90, including: elimination of the single-track bottleneck between Montrose and Usan; extending overtaking loops for longer (and more cost-effective) freight trains; upgrading the route immediately south and east of Perth for higher speeds and greater capacity; and full electrification.

(iii) Time for a 21st century railway between Aberdeen and Inverness: Faced with the planned £3,000 million dualling of the parallel A96, ICE wants to see more, and longer, crossing loops on the line, to facilitate an hourly service frequency from Inverness to Aberdeen – taking two hours or less – and to increase capacity for the development of freight traffic.

(iv) Just 45 minutes from Perth to Edinburgh: The **reinstatement of a direct link from Perth to Edinburgh** – partly in tunnel to avoid the M90 and Glenfarg village – would slash the journey time by up to 35 minutes. The new route would be electrified and could accommodate faster Aberdeen to Edinburgh trains re-routed this way. The currently underutilised Perth station would be transformed into a new Inter-City hub.

(v) A new Inter-City rail hub at Perth: The new direct rail link from Perth to Edinburgh would slash journey times – *and* create a once-in-a-lifetime opportunity

to make Perth station the crossroads of the rail network north of the Central Belt. The vastly under-utilised station site at Perth could realise its untapped potential as a catalyst for urban regeneration, as well as transport connectivity.

Railfuture Scotland:

Railfuture Scotland – 'the independent campaign for a better passenger and freight rail network' – was originally launched in the 1970s as the Railway Development Association (Scotland).

In 2014 *Railfuture Scotland* published its proposals to expand Scotland's rail network, and these were re-launched (largely unchanged) in February 2020, as 'Railfuture's proposals for improvement to the infrastructure and operation of the rail network in Scotland' (see Appendices). The proposals are summarised below.

The proposals are stated to be designed – by increasing local accessibility to the rail network – to fulfil the three key Strategic Outcomes for transport in the first National Transport Strategy for Scotland in 2006, ie: (i) improve journey times and connections, (ii) reduce emissions, and (iii) improve quality, accessibility and affordability. The main elements of the Railfuture plan are:

(a) Proposals for service enhancements on existing rail lines

This sets out target service levels for different types of route, ranging from a 15-minute frequency for commuter / business services on journeys of up to 20 miles to a maximum 2-hourly interval on tourist routes.

(b) Proposals for improvements to existing rail lines

It is suggested that the electrification programme in the Strategic Transport Projects Review be accelerated and extended. Provision of modern signalling throughout the network is advocated 'to improve the frequency of services, to introduce new services or to efficiently recover from disruption/ perturbation'. The third element relates to track improvements to tackle capacity bottlenecks, including single-track sections and 'single-lead junctions' (where a double-track line has been reduced – generally in the 1970s and 80s, to reduce maintenance costs) to single-track where joining another double-track line.

(c) Proposals for new stations on existing rail lines

50 new stations throughout Scotland are suggested, with 'anticipated minimum annual usage' ranging from 2,166,700 at Glasgow Cross High Level (on the City Union Line in Glasgow) to 16,000 at Blackford (between Gleneagles and Dunblane). A subsequent list of a further 45 recommended re-openings includes two which have already re-opened – Edinburgh Gateway and Robroyston.

(d) Proposals for major line building / re-opening plus 'Short Feeder Lines'

Sixteen sections of railway longer than 10 miles are proposed for building / re-opening, while Railfuture propose 23 short feeder lines 'up to 10 miles (16km) in length on existing track, or on former track formation re-laid, or up to 5 miles (8km) of new track formation'.

Common campaigning themes:

The three rail / sustainable transport campaigns have different emphases, and not all go into the same level of detail (for example, on individual station re-opening schemes), but common themes relate to (i) electrification, (ii) other capacity / capability upgrades for key existing routes, and (iii) priorities for new route construction.

Over and above electrification, individual route projects which are common to all three campaigns (SAPT, Railfuture and Transform) are:

- Perth-Inverness (Highland Main Line) upgrading
- Aberdeen-Inverness upgrading.

Upgrade projects (for existing routes) which are advocated by at least two of the three campaigns are:

- extension of electrification (beyond the inter-city routes) to the Borders Railway and Ayr-Girvan
- Edinburgh/Glasgow- Aberdeen
- Borders Railway
- Glasgow-Barrhead-Kilmarnock-Dumfries-Carlisle.

New passenger rail routes which are advocated by at least two of the three campaigns are:

- Thornton-Levenmouth (now approved by Scottish Ministers)
- Dunfermline-Longannet-Alloa (of which Longannet-Alloa is being developed by NR at TS request)
- Dyce-Ellon
- Almond Chord (now subject to development by NR)
- Edinburgh South Suburban Line
- Tweedbank-Hawick
- (Edinburgh-) Cowdenbeath-Kinross-Bridge of Earn (-Perth).

2.7 Common themes / contrasts between the policies and programmes advocated by the Scottish Government / Scottish Green Party / rail campaign groups

There are some important *common themes* across these stakeholder groups, notably rail electrification (as part of a wider decarbonisation programme) – but unsurprisingly there is – to date – significant variation in the advocated extent and speed of implementation.

There are common aspirations for key individual route upgrades (not just electrification, but also other capacity / capability enhancements) – notably Perth-Inverness and Aberdeen-Inverness, but again there are major differences of view on the extent and speed of implementation, and on the prioritisation of rail investment ahead of roads.

There are inevitably significant *contrasts* between the Scottish Government position and that of the Scottish Green Party and rail campaign groups. Some of the latter have long and/or detailed 'wish lists' of projects (such as station and route re-openings), whereas the Scottish Government's new 'pipeline' approach means there is no list of committed rail enhancement projects (and extensions to the network – other than Levenmouth – are not identified). And while the Greens and campaigners argue for a substantial rebalancing of the transport budget away from roads and towards rail (and public transport generally), this is a choice which the Scottish Government has so far been unwilling to make.

3. OVERVIEW OF CURRENT NETWORK

3.1 Capacity bottlenecks

Capacity bottlenecks identified by the Scotland Route Study include the following (with Network Rail's proposed high-level interventions added). Given the nature of the railway there are also capability implications arising from the bottlenecks.

• **Edinburgh Waverley and Haymarket to Glasgow Queen Street (High Level) and Fife:** lack of capacity for additional train services to the west of Edinburgh.
Proposals include: new 'Almond Chord'[25], new Inverkeithing–Cowdenbeath cut-off line[26] (formerly STPR Project 28), electrification of the Fife network, and passenger capacity enhancement at Edinburgh Waverley.

• **Edinburgh Waverley and Anglo-Scottish Routes from Slateford to Berwick-upon-Tweed:** lack of capacity for additional train services to the west of Edinburgh.
Proposals include: including four-tracking of the East Coast Main Line (ECML) in East Lothian

• **Glasgow Central High Level to Carlisle via WCML, Carstairs to Slateford (for South Suburban Line) and Haymarket:** lack of capacity for additional train services, especially freight and local services.
Proposals include: a range of capacity enhancements south from Glasgow, including possible grade-separation of junctions along the WCML, electrification of remaining diesel suburban routes, four-tracking of the WCML south of Carstairs.

• **Glasgow Queen Street High Level to Aberdeen / Inverness:** some capacity constraints and some locations are not delivering the required capability.
Proposals include: grade-separation of the key Greenhill Upper Junction near Falkirk, electrification through to Aberdeen and Inverness, and removal of key capacity / capability constraints from Dundee to Aberdeen and Perth to Inverness.[27]

• **Strathclyde commuter network:** generally a lack of capacity to carry the expected demand for more and longer trains.
Proposals include: enhancement of Glasgow Central Low Level station and four-tracking from Partick to Hyndland[28]

• **Aberdeen to Inverness:** lack of capacity for the required train service, and extended journey times.
Proposals include: higher speeds, 'dynamic loops'[29] and station enhancements.

• **Far North Line (Inverness to Caithness):** lack of capacity for more trains (especially at the south end) and extended journey times.
Proposals include: capability upgrades, primarily on the commuter section between Inverness and Invergordon (with subsequent government / industry documents advocating capacity enhancements, including a new crossing loop between Inverness and Muir of Ord[30]).

3.2 Capability constraints

Some of the capability constraints on the Scottish rail network are included in the outcomes coming forward through the Scotland Route Study and the Pipeline process. Others have been distilled for *Rail for All* from the current service outputs when compared with 'Scotland's Railways' aspirations.

Key identified capability shortfalls when compared with the requirements of Scotland's Railways or the Scotland Route Study are:

- journey times from all Scottish cities to London and principal cities in the north and midlands of England
- journey times on inter-city routes: Glasgow/Edinburgh-Perth/Dundee/Aberdeen/Inverness, and Aberdeen-Inverness
- inadequate frequencies on inter-city routes: Aberdeen-Inverness (less than hourly)
- journey times on rural routes: Glasgow to Oban and Fort William, Glasgow to Dumfries and Stranraer, and between Inverness and Caithness
- freight Loading Gaugeand train length limitations for intermodal (container) traffic on cross-Border routes and to Aberdeen, Inverness and Fort William – preventing cost effective, largely commercial, rail freight operation
- lack of route capacity for slower-running freight traffic, exacerbated by more and faster passenger trains, on all routes.

Rail for All has identified additional shortfalls from analysis of the National Transport Strategy 2 (NTS2), the Strategic Transport Projects Review 2 (STPR2) currently in progress, and other transport reports such as the 'Connecting Glasgow', 'South West Scotland Transport Study - Initial Appraisal - Case for Change' and 'Borders Transport Corridors Study Pre-Appraisal' studies which have been published in recent years:

- links from the area of Scotland south and west of Glasgow to the area east and north of Glasgow, and to Edinburgh, including across Glasgow and directly from southwest Scotland to Edinburgh
- lack of connectivity from the east and north to Cairn Ryan / Port Ryan for Northern Ireland ferries
- insufficient passenger-carrying capacity on many urban routes to cope with major mode shift to rail
- unattractive services marked by inadequate frequencies on a number of suburban routes – our assessment is that in the densely populated Central Belt suburban routes should not operate at less than a half

hourly frequency. The following do not meet this threshold: Edinburgh-North Berwick, Dundee-Carnoustie, Glasgow–Largs/ Wemyss Bay/Girvan (where services are only hourly), and Cumnock Valley stations (approximately two hourly).

- on rural and other secondary routes we suggest that the minimum frequency should generally be hourly if possible (although not on the Kyle or Fort William lines) – this compares for example with the current two-hourly frequency from Dumfries to Glasgow, four per day from Fort William to Glasgow, and eight daily from Inverness to Tain
- decarbonisation of travel including rail travel – but the biggest contribution that rail can make is through mode switch to enable people and freight to use less carbon-intensive and energy-intensive forms of transport
- a shift from road to rail for appropriate freight flows – in order, *at the very minimum*, to meet the HLOS 7.5% growth target for 2019-24, and ideally to achieve significantly higher growth in line with the aspirations of Transport Scotland's 2016 rail freight strategy document, 'Delivering the Goods'[31]

3.3 Review of rail re-openings in Scotland

In a reversal of the 1950s / 60s trend for rail closures – the last of the Beeching and 'post-Beeching' cuts in Scotland had been implemented by the early 1970s – no fewer than 88 passenger stations have opened / re-opened north of the Border since 1970. Fifty-one of these were on existing passenger service routes, while 37 were on routes opened / re-opened to passenger traffic having previously been abandoned or carrying only freight traffic.

Passenger services have been introduced on 18 new routes, some of these being cross-country links with no intermediate stations but providing connectivity between existing lines (such as Ladybank to Perth via Newburgh in 1975, cutting the rail journey distance from Edinburgh to Perth).

Forty six of the new stations are in the (largely electrified) Strathclyde commuter network, with the remainder predominantly in the Edinburgh commuting catchment (27) and the Highlands (9).

How and why has this happened? By the mid-1980s concerns about the environment, road congestion, and changing patterns of urban development were leading to growing pressure for rail re-openings. This has been a gradual and un-coordinated process, with Railfuture noting that 'There has been no central government or rail industry plan to achieve this but progress has come usually as a result of local or regional initiatives by rail managers, local authorities and rail campaigners.'[32] However, due credit should go the devolved government in Scotland where the rail network has benefitted from 'a much more determined, pro-active and independent transport role', including funding contributions to station re-opening projects.

Station re-opening costs:

One of the factors which facilitated the surge of re-openings in the pre-privatisation British Rail era – between 1984 and 1994 new stations opened every year in Scotland – was the relatively low cost of opening. The example of Falls of Cruachan is cited as demonstrating the cost-effectiveness of the state-owned railway, costing just £10,000 for a simple, single-platform station in 1988. By extreme contrast, the Edinburgh Gateway two-platform interchange with the city's tram line cost £40m in 2016. The two cases are not of course directly comparable, but are illustrative of a pronounced trend since the rail system was privatised in the mid to late 1990s.

Unpublished research[33] shows that the cost of new stations doubled post-privatisation and doubled again in the 2000s. Since then, over the decade to 2017, new station costs did not just double, but trebled to the current £8m-£10m price tag for an average two-platform station – with no apparent change

in the size / quality of station and facilities provided for the rail traveller. The research paper concludes:

> *There is does not appear to be an obvious reason why such a basic and simple structure as a station should have suffered such major cost inflation over the privatised railway era. This should be of major concern to those directly involved in the railway industry, who should be concerned about extending the reach and relevance of the railway. But it is also critically important for those who have wider interests in enabling communities to benefit from access to the rail network and all the social and economic opportunities that such access brings. There is a need for an urgent review of the costs of new stations, and the changes over time, to show what is driving the costs up to the present unaffordable levels – and more crucially how to reverse the cost inflation.*

Patronage trends:

Data provided by the Office of Rail and Road[34] shows that for the 62 stations opened prior to the year 1999-2000, all but six experienced growth between 1999-2000 and 2018-19 – indeed overall patronage at the 62 grew by 153% over the 19 years. Of the 26 stations opened since 1990-2000, all but six have seen patronage growth between the first full year of opening and 2018-19 – and there have been spectacular examples, such as Howwood in Renfrewshire which saw 346% growth in a period of 17 years. Housing developments (in some cases facilitated by the new stations), rail service upgrades (including electrification) and road congestion have played a part in the growth trends. In the small number of cases where patronage has declined, this is often explained by the loss of a key traffic generator or rail quality of service problems on specific routes.

A failure of forecasting:

At the 2017 launch of the *Expanding the Railways* guide, published by the Campaign for Better Transport in partnership with Railfuture, the rail industry's *Passenger Demand Forecasting Handbook* was criticised 'for always under-predicting demand so new facilities such as the Borders Railway are built with inadequate facilities'.[35] In fairness, some station openings have not initially met the forecast level of patronage, but there has been evidence for more than 30 years that most new stations have performed much better than forecast.

An early and spectacular example was the Edinburgh-Bathgate line re-opened in 1986, where 'passenger journeys of 264,000 per annum were predicted, but by 1989 usage had already exceeded 1,000,000'. The Hamilton to Larkhall line re-opened in 2005, 'and by 2008 trains were carrying around 40% more passengers than predicted'.[36] The Stirling-Alloa railway which re-opened in 2008 quickly delivered 180% more passengers than forecast, while the apotheosis of forecasting failure came in the first year of the Borders Railway

(opened in 2015) when the three stations within the Borders – Stow, Galashiels and Tweedbank – saw, respectively, 313%, 330% and 681% more passengers than forecast![37]

3.4 Government and rail industry processes

The challenge:

The delivery of railway projects which will reduce transport-generated carbon emissions is an important part of the response to climate change. However the current, time-honoured appraisal and project development processes are no longer fit for purpose. The Airdrie to Bathgate railway project took only seven years (2003-2010) from inception to completion, but regrettably this was the exception over decades of rail re-openings since privatisation. Generally, railway re-opening projects have taken significantly more than ten years to complete and even the relatively simple Edinburgh to Glasgow electrification project took eleven years (2007-2018) to complete.

The evidence suggests that it is the appraisal, design and approvals processes which take the majority of the time, rather than the construction. This is particularly true with plans for new stations.

Consequently it is suggested that the appraisal, initial design and approvals processes need to be streamlined to deliver the required changes – and especially to avoid an unsustainable peak in workload for the contracting industry in the 2030–35 period.

For rail there are early opportunities to provide solutions for reducing transport-produced carbon, creating alternative low-carbon travel options for some communities through re-opening or building completely new stations on existing railways – as these are likely to be amongst the lowest-carbon solutions for travel needs. However, experience suggests that these projects have extremely long gestation periods.

In addition there is the challenge of modelling changes in rail services, where the current rail industry-based models, which work for incremental service changes may be less representative of future scenarios. Transport models are predominately road-based, with public transport tending to be an 'add-on', and do not have a good track record in predicting the likely impact of adding a new range of travel opportunities to a place which has not benefited from them for a generation or more.

This problem with modelling in not just of academic interest, as these models are a significant part of the decision-making process, and may well result in viable projects not being built or being built with inadequate capacity / capability, as happened with the Borders Railway.

Models all rely on past experience and interpolating it forward to a specified future. This is likely to be a problem over the next two decades as decarbonisation – as well as rail electrification – will result in a switch to electric vehicles. This will reduce the

income from fuel duty and could well result in a move to road pricing, which could result in a whole new set of price signals to motorists, with consequential changes in driver behaviour.

The future of transport appraisal and associated modelling will need to move away from the traditional measures of money and time saved which are used in the quantification of value to a 'carbon-saved' model. This will be a fundamental change, and may take time to perfect. But as there is very little time available and while early appraisals under such a new regime are likely to be relatively unsophisticated, that will come with time and experience.

Scottish Transport Appraisal Guidance (STAG):

The STAG appraisal process is extremely detailed, complex, time-consuming and costly. STAG, which is at the heart of all Transport Scotland (TS) decision-making, is fundamentally a sound intellectual process and has many positive points, including a strong focus on qualitative outcomes rather than just quantitative ones (those that can be monetised by use of the government approved 'Green Book' data). However its application depends on the views of the TS decision-makers.

TS's application of the process is pedantic, leading to major additional appraisal costs, as in the case of the Levenmouth scheme, which took many years of study to reach a Ministerial decision. But in the context of the Climate Emergency, where time is now critical, if the 2045 net-zero target and the interim targets are to be achieved it is clear that the time to get simple proposals through the STAG process has to be significantly reduced.

Moreover with NTS2 now setting different high-level targets and priorities and establishing a new hierarchy of modes based on emissions, the whole basis of STAG decision-making and prioritisation will need to be reconsidered to reflect this new, over-riding decarbonisation requirement.

It is suggested that this reassessment of STAG and the wider decision-making framework is a multi-stage process, with immediate unilateral changes to slim down the initial 'Case for Change' process and to focus on developing outcomes, using a single-stage appraisal – rather than the current two-stage – for the deliverables. This would help early delivery in response to the new NTS2 policy, especially where changes build on the efficient use of existing infrastructure.

In parallel, a more formal review of STAG should take place, with consultation across the transport industry, but time-limited – leading to much quicker appraisal, and thus delivery, of projects.

This is particularly important since delivering results to meet the Climate Emergency requirements needs strong input from all communities, in effect to be bottom-up, so

that there is local buy-in to proposed outcomes. This is very challenging with the current STAG process.

With the new NTS2 hierarchy there should probably be a much more generic process to identify the problems / need / opportunities and to be able to focus on where in the hierarchy the solution lies. If rail offers a solution it should quickly move into the development phase.

Governance for Rail Investment Projects (GRIP):

In parallel with the urgent update of STAG, Network Rail's GRIP process will need to under-go a similar streamlining to reduce the duplication inherent in the process and thus the length of time, resources and cost to develop projects. This should release resources for project delivery. It will be important to adopt a rigorously proportionate process, so that the GRIP costs and timescales for smaller projects are not inflated. Network Rail's move to a fully devolved organisation should facilitate such a change.

Scottish Government Business Case Process:

The two processes (STAG and GRIP) come together in the government's Business Case Process, which again will need streamlining to achieve delivery of the emissions targets in the 2019 Climate Change Act. The current process requires a lot of revisiting the previous Business Case stage, using more detail as it becomes available.

With the Climate Emergency and the mandatory carbon reduction targets, the Business Case process had to become much more focussed on the absolute reduction of carbon from the transport system and, in parallel, an assessment of the changes in energy consumption. There is an equally big challenge to provide sufficient renewable electricity to not only replace the remaining fossil-fuel-generated electricity (mostly gas) and the small remaining contribution from nuclear power, but also to replace the oil fuel used directly in transport.

Approvals:

It is vital that the major policy decisions, such as rail electrification, are made very soon, so that the design and delivery process can start. For cost efficiency this needs to be based on a long-term view of the network requirements to avoid abortive expenditure, as has happened to recently completed projects – usually as a result of late changes (such as the removal of the Greenhill Junction grade separation and the Almond Chord from EGIP, both of which are now being reconsidered and if built will result in new overhead line equipment being removed). This design work needs to start immediately if the 2035 target for rail decarbonisation is to be achieved cost-

effectively, especially recognising the age and replacement profile of the existing rolling stock.

Integral to achieving the 2035 target is the ability of Network Rail to start the design work and to secure the land and powers necessary to deliver the works without undue costs or risks of delays to the programme. However, combined with this, there needs to be a clear view of the nature of the post-electrification railway, including all the 'minor' changes such as track realignment, upgrading junctions, additional double-track sections and extending loop lines.

There also needs to be a cross-linkage with utilities providers and their Regulators to ensure that utility diversions do not add undue costs or delays to projects, such as altering bridges to permit the overhead wires to pass underneath. Furthermore the electricity network operators will need to be fully aligned with the rail industry players to ensure an adequate traction power supply through new feeder stations at the right times.

A Task Force is needed:

The scale and urgency of the rail contribution to the nation's decarbonisation challenge suggests that a small multi-agency and multi-disciplinary Task Force needs to be created and empowered to press forward with delivering not only the large schemes, such as electrification and route modernisation, but also the smaller incremental schemes which will impact on local connectivity, often in much shorter timescales. The delivery of early successes, starting to move towards the targets, will demonstrate commitment and provide early experience of revised forms of appraisal. Examples of early successes could include:

- provision of additional stations on existing routes
- opening existing freight-only lines for passenger trains, where there is sufficient demand to justify passenger train services (the UK Government is adopting this approach)
- initiating the national Rolling Programme of rail electrification
- small-scale electrification to eliminate pockets of diesel working in generally electrically-operated areas, including possible use of electric / battery bi-mode trains, as an early transition towards full route electrification
- development and introduction of self-powered non-carbon rural trains
- provision of large numbers of low-cost all-day electrical 'trickle' charge points at railway station car parks to stimulate connected all-electric travel using car to the station and train to the destination.
- development of walking and cycling plans for all stations (recognising that the two modes often have different infrastructure requirements), including

provision for electric bikes, with the objective of widening access to train services.

The implications of the Stonehaven accident

The tragic accident between Carmont and Stonehaven in August 2020 is likely to result in a significant re-think in the management of railway infrastructure in this new era of climate change -induced weather events.

Whilst it will be well into 2021 before the Railway Accident Investigation Board (RAIB) publishes its detailed and in-depth report into this accident and its causes, enough information has been released by RAIB for the immediate causes to be broadly understood. An interim report 'Resilience of rail infrastructure - Interim report to the Secretary of State for Transport following the derailment at Carmont, near Stonehaven' has also been prepared published by Network Rail.

The root cause of the derailment was some 50mm (2 inches) of rain which fell in the morning before the crash, washing out rock fill around a drain that had been installed in 2010. The drainage had been inspected by Network Rail in May this year, and the earthworks around the line were inspected in June.

The circumstances are very specific to the site, but Network Rail has examined 584 sites across Britain considered at similar risk to the line at Stonehaven, with only about 1% requiring intervention (although these included some busy main lines).

The report stated: 'Climate change is often viewed as a future problem. However, it is already causing more frequent and more severe extreme weather events and we are experiencing its impacts', adding that 'There will be occasions when additional speed restrictions will be required on particular lines if heavy rainfall is judged to present a heightened risk to earthwork stability.' A key conclusion was that that strengthened procedures could lead to more line closures in bad weather, pending safety inspections.

Network Rail's Chief Executive, Andrew Haines, said: 'Earthworks and drainage infrastructure – some of which are more than 150 years old – prove to be a real challenge as the country experiences more heavy rainfall and flooding.'

Landslips have already become a cause for concern, with RAIB publishing 'Report 08/2014 Class investigation into landslips affecting Network Rail infrastructure between June 2012 and February 2013'. https://www.gov.uk/raib-reports/class-investigation-into-landslips-affecting-network-rail-infrastructure-between-june-2012-and-february-2013

Experience from the past 25 years shows that major accidents such as happened at Stonehaven lead to significant new interventions to improve safety on a changing railway: Southall (1997) and then Ladbroke Grove (1999) resulted in the requirement to fit the Train Protection & Warning System (TPWS) throughout the network in a very short timescale; Hatfield (2000) resulted in major changes to maintenance procedures and costs and contributed to the demise of Railtrack; and Potters Bar (2002) resulted in maintenance being taken 'In house' by Network Rail (which had replaced Railtrack).

A key point to be taken in the context of *Rail for All* is that more money is likely to be diverted into managing the impacts of climate change on the infrastructure. This may divert funds from other projects which offer expansion of the network – unless of course there were to be a significant shift away from investment in road building, freeing up more funds for rail infrastructure.

3.5 Identification of key network gaps

New passenger stations on the existing network:

Railfuture Scotland's list of 50 top-priority stations for re-opening on the existing network (plus its supplementary list of a further 45) provides a useful starting point. Our initial appraisal of these suggests that the 23 listed below are 'possible' (some only in the longer term). Others might have to be rejected due to constraints such as: impacts on line capacity; proximity to existing stations; and limited population catchments. For only a minority of these places are population statistics available (as the latter involve different boundaries and/or location names), but for those where data is available these range from 840 (Blackford) to 3,040 (Winchburgh).

- Abernethy
- Altonhill
- Auchenback
- Balloch (Inverness)
- Blackford
- Blindwells
- Dalcross
- Dundee Airport
- Dunragit
- Eastriggs
- Ecclefechan
- Errol
- Evanton
- Finnieston
- Halkirk
- Hurlford
- Kinloss
- Mossend
- Newburgh
- Ravenscraig
- Thornhill
- West Paisley
- Winchburgh

Passenger stations on new passenger routes:

Transform Scotland's suggestion that all towns over 10,000 population should have a rail service provides a useful starting point. This would bring the following towns on to the network (in descending order of population):

- Methil, Leven and Buckhaven (in process)
- Peterhead
- Grangemouth
- St Andrews
- Erskine
- Penicuik
- Broxburn
- Bo'ness (already served by 'heritage' railway)
- Forfar
- Hawick
- Fraserburgh
- Westhill, north west of Aberdeen
- Ellon.

If re-opened wholly or largely along former railway alignments, the following lines would be involved:

- Thornton-Levenmouth
- Aberdeen-Fraserburgh / Peterhead
- Leuchars-St Andrews
- upgrading of existing Bo'ness & Kinneil Railway
- Perth-Forfar-Laurencekirk 'Strathmore Route'
- Tweedbank-Melrose-St Boswells-Hawick.

Towns over 10,000 population involving a requirement for largely new alignments are as follows:

- possible Tram extension from Edinburgh Airport to Broxburn
- possible TramTrain route to Erskine
- possible TramTrain route to Penicuik
- possible TramTrain route to Westhill.

Additionally, there is potential for passenger services to resume on certain routes which currently handle only freight traffic – improving connectivity and also serving settlements which would not justify building a completely new railway:

- Alloa-Clackmannan-Kincardine-Longannet-Culross-Valleyfield-Cairneyhill-Dunfermline
- TramTrain services on Edinburgh South Suburban Line through Gorgie, Craiglockhart, Morningside, Newington, Craigmillar etc.

New freight railheads on the existing network:

Key gaps in the network for intermodal (container) trains which link multi-user railheads with distribution hubs, East Coast ports and Deep Sea ports in England include:

- Dundee
- Speyside (Elgin / Keith)
- Bathgate.

In addition, there is scope to provide direct ('private siding') rail connections to major traffic generators, notably within the whisky sector – such as Cameron Bridge in Fife (the largest grain distillery in Europe) and Cambus / Blackgrange near Alloa (the largest bonded warehouse site in Europe) – and in the timber processing sector at board, paper and saw mills.

4. A COSTED, PRIORITISED PROGRAMME

4.1 Introduction

This chapter sets out (in Sections 4.2 to 4.10) a prioritised programme in the various passenger sub-sectors (and rail freight), and then provides a summary of the indicative costs of the programme in Section 4.11.

4.2 Inter-city services

This section examines the existing inter-city rail network and proposes changes to improve its capacity and capability to provide a cost-effective transport network suitable for the post Climate Emergency environment when carbon-based travel will be virtually eliminated. It does not propose new network links to places not currently on the rail network (see Sections 4.2 and 4.3 on regional / rural and conurbation / commuter routes) but does suggest an entirely new inter-city link from Edinburgh to Fife to reduce journey time and increase capacity between Edinburgh and Kirkcaldy, Perth, Inverness, Dundee and Aberdeen).

Introduction:

The inter-city network in Scotland provides links between the seven designated cities, Aberdeen, Dundee, Edinburgh, Glasgow, Inverness, Perth and Stirling. The services between Edinburgh and Glasgow and between Stirling and both cities have been subject to a major upgrade with full electrification, new electric trains, more capacity and shorter journey times. Because the longer-distance service to Aberdeen and Inverness share parts of the routes, these will be considered in route sections.

General observations:

The Scottish Government has announced plans to decarbonise the rail network which imply the full electrification of the inter-city network linking all seven cities. This needs to happen by 2030,as opposed to 2035, to enable the replacement of the by-then over-50 year old diesel HSTs with modern high-performance electric trains. This has been assumed as the base case in *Rail for All*. (Please refer to the separate mini-report on 'Rail Decarbonisation' produced as a supplement to *Rail for All*).

A consequence of this decision is that ideally all infrastructure and signalling upgrades on routes to be electrified should be completed before the electrification works are required, to avoid abortive costs which would arise from altering an already electrified railway.

The four keys to achieving faster rail journey times are:

- to raise line speeds, which is likely to require the removal of level crossings on safety grounds on higher-speed sections of line

- to provide high-acceleration trains capable of exploiting line speeds
- to reduce the incidence of conflicts at junctions
- to reduce both the number and length of single-track sections, particularly between Perth and Inverness and between Aberdeen and Inverness.

It is important to note that the low-speed sections of a route take a disproportionately large amount of journey time, for example lifting a 20 mph speed limit to 40 mph over a mile (such as on the southern approaches to Perth) will reduce the running time by 1½ minutes, whereas raising a mile from 100 mph to 125 mph will only save 7 seconds (therefore to deliver the 1½ minutes time saving would require the upgrade of 12 miles of railway).

Furthermore, the quicker a train can pass through a junction, the greater the capacity which will be available for other trains, and there will be less impact in 'perturbed' working (when trains are not running in their planned paths) – in short, improving speeds at slow-running junction and station areas is disproportionately beneficial to the operation of the railway.

The specification for the future inter-city trains should be for 125mph capable, high-acceleration light-weight electric multiple units (EMUs) to deliver as short as possible journey times whilst retaining the connectivity of intermediate stations.

Glasgow-Stirling-Perth–Dundee:

This route section is already relatively fast and has been electrified as far as Stirling and Dunblane, (41% of the route). The route is shared with the main Edinburgh-Glasgow service, and Edinburgh to Dunblane and Glasgow to Alloa local services. There are several critical junctions between Glasgow and Stirling, and a slow section between Greenhill Junction (on the Edinburgh-Glasgow main line) and Larbert.

The grade separation of Greenhill Junctions was originally part of the Edinburgh Glasgow Improvement scheme ('EGIP') but was removed to reduce costs. It should be reinstated, but also with solutions to resolve the congested Greenhill Lower Junction to Carmuirs West Junction section of the route – where there is also a strong claim for a new station to serve the Bonnybridge area.

Perth area resignalling is planned for this Control Period (so before 2024) and should be designed to deliver the highest possible running speeds with modern trains. It is a precursor to electrification.

This leaves a single-track section over the Tay Viaduct which is challenging to remove, but the impact can be reduced by extending the double track section through Perth station to the west end of the viaduct and by substantially raising the speeds through the single to double track junction at Barnhill at the east end.

There are considerable lengths of 90 mph and 100 mph track which should be increased to potentially 125mph running, and a number of level crossings that should be replaced to both facilitate the higher speed running, but also improve reliability and reduce risk. The potential overall time saving is 5-10 minutes.

Summary of problems:

- conflicts at junctions associated with the Edinburgh-Glasgow route and local services in the Greenhill-Larbert area, with possible provision for a station to serve the Bonnybridge area
- sections of very slow running (notably in the Perth station area)
- single-track section east of Perth
- over long stretches of line, speeds are lower than the rolling stock capability
- level crossings which restrict line speeds and carry safety and reliability risks, and which are best closed or removed (and typically replaced by overbridges) for resilient higher-speed railway operation.

Summary of suggested interventions:

- grade separation, extra capacity, higher speeds and segregation at Greenhill Upper and Lower Junctions and Carmuirs West Junction
- remodelling of tracks in the Perth area for higher-speed operation
- minimising the impact of the single-track Tay Viaduct at Perth
- line speed improvements between Larbert and Dundee up to 125mph (including level crossing closures).

Edinburgh-Perth/Dundee:

This section is the slowest and most complex part of the of the Scottish inter-city network. It was built in the Victorian era, (in part linked to the construction of the Forth and Tay Bridges) and was then 'rationalised' in the 1960s and 70s following the construction of the Forth and Tay Road Bridges.

The route shares the Edinburgh-Glasgow route going *west* out of Edinburgh (note that Dundee and Aberdeen are geographically *east* of Edinburgh) before going over the Forth Bridge at Queensferry, which is the natural crossing place of the Forth using bridges, as it is the firth's narrowest point.

The route through Fife is highly curved, with speeds as low as 30mph and very little mileage above 85mph – even where differential speeds apply, permitting 'High Speed' (in practice, most passenger) trains to operate above the universal line speed. Target line speeds from Kirkcaldy northwards (see box below) should be 100 to 125 mph, with limited slow-speed sections. The southern half of the inter-city route

through Fife is shared with the half-hourly 'Fife Circle' local services to and from Edinburgh, adding four local trains per hour over the Forth Bridge.

Perth is served by a 15-mile single-track route (with no crossing loop) from Ladybank via Newburgh, effectively requiring Edinburgh-Perth (and Inverness) trains to run double the 30-mile distance of the former direct Glenfarg route (and at relatively low speed) since the closure of that route in 1970 to facilitate the construction of the M90 motorway.

Summary of problems:

- extended travel distance and journey times as a result of the need to go west (ie in the wrong direction) for destinations which are east of Edinburgh
- congestion in the Waverley and Haymarket station areas
- conflicts at junctions associated with the Edinburgh-Glasgow route, coupled with sharing the route and the Forth Bridge with Fife local services
- numerous sections of very slow running (particularly in the Forth Bridge-Kirkcaldy area and in North Fife on routes both to Perth and Dundee, including the Tay Bridge)
- over long distances, line speeds are lower than the rolling stock capability
- speed-constraining alignments in the Ladybank area and between Leuchars and the Tay Bridge
- a number of level crossings
- single-track from Ladybank to Perth
- a 'virtual' single-track over the central/north part of the Tay Bridge (only one train permitted at any one time) is a significant constraint on the timetable and capacity.

<u>In short, this section of the Scottish inter-city network is not fit for purpose, and we propose a range of interventions, including the following 'game-changer':</u>

A Firth of Forth Tunnel to transform east coast transport

The first Edinburgh to Aberdeen railway route used train ferries to cross the Forth (Granton to Burntisland) and Tay, running in almost a straight line to Dundee. The Tay was successfully bridged in 1887 and in 1890 the Forth Bridge, was constructed, greatly reducing the Edinburgh to Dundee and Aberdeen journey times. The Forth Bridge at Queensferry, the lowest bridging point, was built using the new technology of the day - good quality steel.

The current network focuses all trains linking Edinburgh to the rest of Scotland through Haymarket, creating a significant bottleneck, which is now close to capacity. Moreover, trains between Edinburgh and Dundee and Aberdeen make a considerable detour to the west to reach destinations which are geographically east of Edinburgh (23¾ miles Waverley to Kinghorn via the Forth Bridge compared with 9 miles straight line). As the railway between the Forth Bridge and Kinghorn is also relatively slow-speed, this translates into a considerable time penalty.

The future?

Using modern technology we suggest that two 9-mile, single-bore, rail tunnels are driven under the Firth of Forth from Abbeyhill to Seafield, between Kinghorn and Kirkcaldy, passing under Leith. These would be connected to the east end of Waverley station using the former Abbeyhill loop off the East Coast Main Line east of Calton Tunnel, with the railway burrowing underground below Leith (served by an underground station) then the Firth of Forth, returning to the surface near Seafield.

It should be noted that there has been a long history of boring under the Forth for coal mining, and railwaytunnels much longer than this have become relatively common in mainland Europe. The very recently opened Ceneri Base tunnel in Switzerland, which at 9.6 miles is virtually the same length, had a quoted cost of €3.6b. There are several other sub-Alpine tunnels of recent construction.

The Öresund or Øresund Bridge between Denmark and Sweden includes both a 5-mile (8km) bridge and the 2½ mile (4km) immersed-tube Drogden Tunnel over a similar distance and incorporates a dual-carriageway road as well as a double-track railway.

The Lower Thames Crossing will provide two 2.6mile (4km) road tunnels under the Thames, with each being the third largest bored tunnels in the world, all part of a 14.3 mile new dual-carriageway road. The budget cost for the whole scheme is £5.3b to £6.8b. The Crossrail tunnels in London are each 13 miles long and the London Tideway tunnel will be 25 miles under the Thames.

As part of the under-Forth scheme, a double-ended underground station could be provided in Leith, with the south end at the Foot of Leith Walk and the north end near the Waterfront. An indicative first estimate of the cost of the under-Forth project is £4bn-£6bn, including the station at Leith, based on the out-turn costs of recent tunnelling projects.

A big package of benefits

A cross-Forth Tunnel changes the whole relationship of Edinburgh to east Fife, the east coast, and Central Highlands, offering very considerable social, economic and transport benefits:

- 25 minutes journey time reduction between Edinburgh and east Fife, Dundee, Perth, Aberdeen and Inverness
- Kirkcaldy, Glenrothes, Levenmouth, north and east Fife (120,000 people), Perth and Dundee would become within a one-hour travel time of central Edinburgh
- more trains for Central Belt routes west of Edinburgh and / or the West Coast Main Line south to Carlisle as a result of fewer Forth Bridge trains on the western approaches to Edinburgh
- creates more line capacity for more trains to serve west Fife (Dunfermline) and Alloa)
- more capacity at Waverley station (west end) as a consequence of running some services through the station to serve Leith, which would enable new train services to use the west-end bay platforms and would reduce platform-end conflicts between arriving and departing trains
- a freight chord to the East Coast Main Line at Craigentinny, providing a much faster route for freight (especially heavy axle load trains) between Fife (and north thereof) and the ECML – saving time, resources and congestion on routes in Edinburgh / over the Forth Bridge / through Stirling

Linking up Leith

The tunnel facilitates a station at Leith connecting c.50, 000 people in a densely populated area, to the wider Scottish economy. Leith is an area with substantial and sustainable growth potential with much former industrial land available for development, both housing and employment, eg the recently announced Film Studio. The Benefits include:

- greatly improved connectivity of Leith and north Edinburgh for both residents and businesses
- reduces the number of passengers from north Edinburgh requiring to interchange at Waverley station

Comparing the Forth Tunnel with a suggested new line between Cowdenbeath and Perth

A cross-Forth Tunnel offers significant advantages over the alternative proposal to speed trains from Edinburgh to the north, which would effectively rebuild, in modern form, the 22-mile route from Cowdenbeath via Glenfarg to Bridge of Earn (on the current Ladybank-Perth route).

Both the Forth Tunnel and the Glenfarg line would reduce journey times from Edinburgh to Perth and Inverness by around the same extent (c.25 minutes), but only the tunnel reduces journey times to east Fife, Dundee and Aberdeen.

Summary of other interventions to complement the cross-Forth Tunnel

- significant line speed improvement from north of Kirkcaldy to the Tay Bridge, including new alignments in places, such as Ladybank and between Leuchars and the Tay Bridge
- redoubling (partial or all) of the Ladybank-Perth route, with line speed improvements
- Tay Bridge replacement structure (bridge or tunnel) to improve train speed and weight capability.

Dundee–Aberdeen:

The approach to Dundee station from the north is through the 600m Dock Street (cut and cover) tunnel which is curved and restricted to 15mph. If this could be raised to the 40mph which applies to the rest of the tracks in the station area, then in excess of a minute's running time would be saved.

Beside the Firth of Tay, east of Dundee, there is a 15-mile flat, racing (100mph) section – the longest flat section on the entire London-Aberdeen journey.

The route section north of Arbroath is characterised by miles of gently curving track through the undulating coastal countryside, with a number of substantial viaducts. Line speeds are generally below 100mph (only two sections at this speed), but there are long sections where differential speeds apply, permitting 'High Speed' (in practice, most passenger) trains to operate above the universal line speed.

There is a short (2 mile) but slow single-track section between Usan and Montrose, which restricts the timetable for both passenger and freight traffic.

Signalling is largely still the traditional manual type, restricting capacity. This should be replaced in conjunction with electrification, at which time any signalling constraints on capacity and journey times can be removed as relatively low-cost, marginal additions to the electrification scheme.

Initial railway industry analysis to assess the best expenditure for the £200m Aberdeen City Deal funding to improve journey times on this corridor appears to have rejected doubling the Usan single track. The focus is on incremental improvement along the route.

If the Usan alterations are deemed poor use of funds there appears to be little prospect of delivering any other major changes on this section – the curving nature

of the route would require a completely new alignment, with the associated costs, but the speed uplift would generally only be from 80/90 mph to 125mph, saving 10/12 seconds a mile. Therefore rebuilding 40 miles of railway (other than in the immediate station areas) would yield a journey time saving of only 6 to 8 minutes in return for expenditure of potentially £2,000 million.

It is likely that the higher acceleration capability of new electric inter-city units will make 2 or 3 minutes difference on the existing route, which with minor incremental upgrades could deliver half the journey time benefits of a new line, with a fraction of the capital and environmental costs.

Summary of problems:

- single-track section from Usan to Montrose
- long stretches where line speeds are lower than the rolling stock capability
- a number of level crossings which restrict line speeds and carry safety and reliability risks, especially on potentially high-speed sections
- locations with very slow-speed running caused by the nature of the infrastructure
- no opportunities for slower trains (eg freight) to be overtaken by fast trains (a problem which will increase when line speeds increase and faster-acceleration passenger rolling stock is introduced).

Summary of suggested interventions:

- incremental line speed improvements, ideally including Dock Street tunnel
- removal of level crossings
- remodelling the track at Arbroath and Montrose to provide efficient 'turn-back' facilities for local services
- long loops to enable slower freight trains to be overtaken.

Perth-Inverness, known as the Highland Main Line (HML):

Two-thirds of this route is single-track, with three double-track sections (one at each end, and one in the middle), crossing loops at all stations, except Newtonmore, and extra loops at the north end. The timetable is constrained by the limited number of locations where trains travelling in opposite directions can cross each other. The timetable for freight trains is further constrained by many of the loops being too short for optimum-length freight operation.

The challenge with single-track lines is integration between the train performance and the crossing points, because speeding up a train without changing the crossing points only results in trains having to wait longer at crossing points.

The electrification of the HML will potentially bring substantial journey time savings, both through the superior speeds up the steep gradients to the two summits of Druimuachdar (1,484 ft above sea level, and the highest point on the British rail network) and Slochd (1,315 ft, and the second-highest point on the network), and through higher acceleration away from the stops and speed restrictions along the route.

For single-track lines to work with the minimum constraint arising from crossings, sections of double track, called dynamic loops, should be used. Unlike the typical 'static' crossing loop, they allow trains to cross at speed – and are typically five or six miles long, with high-speed entry and exit points. They also provide flexibility for minor timetable variations, and reduce or eliminate the reactionary delay which is inherent on single-track lines where one late-running train impacts on one in the opposite direction – which can in turn set up a chain reaction of delay to subsequent trains. Because the key line-capacity factor is time spent on the double-track section, creating dynamic loops on sections with stations increases the effective length of the double track by the station 'stop time'.

The design of the HML cannot be finalised until the performance of new electric EMUs has been fully modelled and the broad timetable plan has been fixed. However it is anticipated that at least one new dynamic loop will be required somewhere north of Aviemore, with potentially one to encompass both Kingussie and Newtonmore stations, and one at the south end of the HML in the Ballinluig area. Extension of the existing double-track sections is potentially required at both the extreme north and south ends and potentially northwards from Dalwhinnie on the central double-track section.

Some of the existing short loops may require extension, both to smooth the crossing of trains and to facilitate the operation of longer freight trains (currently intermodal trains are restricted to 20 containers rather than the 28 which the locomotive can haul). The new double-track sections (and dynamic loops) would add approximately 30 miles of double track (a further 25% of the route) – still leaving 42% as single track, but making a substantial difference to capacity and journey times (and deliverable within the electrification timescale).

Expenditure will also be required on removing some of the line's speed restrictions with the objective – apart from clearly challenging places such as on the approaches to, and through, Killiecrankie Tunnel – of achieving a minimum of 75mph throughout, and up to 100/110mph on the straightest sections. There are speed restrictions for heavy axle-load trains which further reduce capacity on the single-track sections.

A reasonable target time for the 118miles between Perth and Inverness, with four calls, is 1 hour 40 minutes – an average speed of 71mph.

Summary of problems:

- the mix of single-track and double-track sections, and crossing loops of varied length, inhibits changes to the timetable
- over long distances line speeds are lower than the rolling stock capability (but faster running would then impact on the train crossing pattern on the single-track sections)
- a small number of level crossings which restrict line speeds and carry safety and reliability risks, and which are best removed for resilient higher-speed railway operation
- loops that are too short for modern freight train operation.

The key problem:

A long, single-track line of this nature has to be considered as one train / infrastructure system, and has to be designed as such, ensuring that the crossing locations are optimised for the highest possible train operation speeds, which will be a function of new high-performance electric trains, longer electric freight trains and higher speed infrastructure.

Summary of suggested Interventions:

- three new dynamic loops: two of which are substantially extended existing static loops ('Carrbridge' and 'Newtonmore/Kingussie'), and one an entirely new loop ('Ballinluig') – with locations to be precisely defined when timetable and new rolling stock performance details are known
- extension of existing double-track sections (north from Stanley, north from Dalwhinnie, and south from Culloden) – and as a result of the above, approximately 30 miles would be doubled which represents a further 25% of the route, such that more than half of it would be double-track compared to the current one third
- improved and lengthened static loops at stations and intermediate points
- raised line speeds: focusing on currently slower speed limits (for freight and passenger trains), but with a 100/110mph target top speed.

Aberdeen–Inverness:

The Aberdeen-Inverness route is largely rural in character, and until 20 years ago effectively had no suburban operation into the city of Aberdeen and the large, expanding newly-designated city of Inverness. It was single-track with a short (5½ mile) double-track section (Insch–Kennethmont), two of the crossing loops were not located in the stations (Keith and Forres), which is not efficient, and there were some very long single-track sections (notably 18 miles from Keith to Elgin), a number of which still operated using the Victorian system of physical exchange of tokens to permit the passage of the trains.

Line speeds are generally slow by inter-city standard, with a maximum speed of 75mph and many miles of the route at 60mph. There are a considerable number of level crossings.

Phase 1 of the Aberdeen-Inverness upgrade project has now removed the old token signalling, improved loops at the west end, and redoubled all but three quarters of a mile of the route between Aberdeen and Dyce to facilitate a full suburban service at the east end. Kintore station is being built and Dalcross is in the planning phase.

However the route still cannot support a regular hourly frequency timetable, and Phase 2 is required to deliver this. Phase 2 has not been fully defined but must include some double-track between Inverness and Nairn, as this single-track section is too long to enable the operation of trains on a 30-minute frequency (there is pressure to develop a local service linking Elgin, Forres, Nairn and Inverness). New dynamic loops are required, as well as a general raising of line speeds to 100 mph. A target end-to-end journey time with eight calls should be under one hour 45 minutes, (average speed 62mph).

Summary of problems:

- the mix of single–track and double-track sections, and crossing loops of varied length, inhibits changes to the timetable
- over long distances, line speeds lower than the rolling stock capability (but faster running would then impact on the train crossing pattern on the single track)
- a number of level crossings which restrict line speeds and carry safety and reliability risks, and are best removed for resilient higher-speed railway operation.
- loops too short for modern freight train operation.

The key problem:

A long single-track line of this nature has to be considered as one train/infrastructure system, and has to be designed as such, ensuring that the crossing locations are optimised for the highest possible train operation speeds, which will be a function of new high-performance electric trains, longer electric freight trains and higher speed infrastructure.

Summary of suggested interventions:

- line speeds raised to 100mph, plus a focus on lower-speed sections
- electrification
- new dynamic loops or existing loops extended (eg Nairn-Inverness, Elgin, Huntly), increasing double track by 20 miles – a further 18.5% of the route

- improved and lengthened station and static loops (eg Keith)
- removal of level crossings.

Cross-Border inter-city Routes:

The two major cross-border trunk routes – the East and West Coast Main Lines – are vital sustainable transport links for passengers and freight to England and beyond. They are funded within Scotland by the Scottish Government, but predominantly used by passenger train operators specified by the UK Government and by privately-owned freight train operators.

Transport Scotland and Network Rail are already undertaking considerable analysis of the demands being placed on these routes and the potential solutions.

East Coast Main Line (ECML)*:*

The ECML has a relatively high speed capability from Edinburgh through east Lothian, up to 125mph, but south of Dunbar the route is much slower, winding through the eastern Border hills.

The ECML also provides a local route out of Edinburgh serving East Lothian (ScotRail services to Dunbar and North Berwick) and the tracks are shared as far as Portobello Junction with ScotRail services to Tweedbank. Until recently the principal freight traffic had been generated by Dunbar cement works, but with the growing importance of east coast ports there are now two daily intermodal trains linking Teesport with Mossend. The speed differential between these trains (maximum 75 mph) and the four long-distance passengers train running every hour (maximum 125 mph) is restricting the growth of freight. There is also limited capacity on the current infrastructure for additional ScotRail trains to North Berwick and Dunbar (both currently on a frequency of just hourly for much of the day).

With increases in both long distance and local services there is considerable congestion on the eastern approaches to Edinburgh from Portobello Junction to Waverley station.

There are a range of high level proposals to add an additional two tracks between various points in East Lothian, some as dedicated high-speed lines (ie over 125mph). There are also clear requirements for long freight loops to permit the lengthy intermodal trains required for economic operation (potentially up to 775m) to be overtaken by the fast passenger trains.

Summary of problems:

- very capacity-restricted eastern approaches to Waverley station

- no overtaking facilities for slower-running freight trains on what is a relatively high-speed route
- no overtaking facilities for stopping local passenger trains on the high-speed western part of the route
- slow line speeds over the Dunbar-Berwick section of the route
- single-track section from Drem to North Berwick which may restrict the timetable options
- two level crossings which restrict line speeds and carry safety and reliability risks, and are best removed for resilient higher-speed railway operation.

Summary of suggested interventions:

- urgent provision of long overtaking loops for freight operation in each direction towards the Berwick end of the route
- urgent provision of a short section of four-track railway to permit more ScotRail services to operate to East Lothian
- provision of a flexible four-track eastern approach to Edinburgh Waverley station, including through the Calton Tunnels
- grade separation of Portobello Junction to reduce congestion where the ECML and trains from Tweedbank and the new Millerhill train maintenance depot converge

West Coast Main Line (WCML):

Heading out of Glasgow, the WCML is a reatively slow-speed railway until it reaches the limit of the suburban network at Carstairs, where it becomes a high-speed mixed traffic railway with a considerable volume of intermodal freight traffic.

The route climbs to a summit at Beattock (1,016ft), with the steeper approach in the northbound direction. The route is almost continuously curved and requires the use of tilting trains to achieve the higher speeds required to be competitive with air and road transport. When these are replaced by HS2's new high-speed trains, journey times along the northern part of the London to Glasgow route will, ironically, lengthen, because the HS2 trains will not be able to tilt like the existing Pendolino trains and thus will be slower on the curved northern part of the WCML

Most of the loops are now too short for modern intermodal trains and a lack of freight capacity is hindering growth, with many freight trains still diesel-hauled because of a lack of electrification of key freight routes in England. Electrically-hauled freight – with its better operating performance – could ease the capacity challenge.

The major challenge on this route is traffic segregation to permit the higher speed long-distance trains to operate to their maximum capability, whilst still allowing for the reliable operation of Glasgow area suburban services and efficient freight services.

Summary of problems:

- congestion and numerous junctions between Carstairs and Glasgow Central
- limited overtaking facilities for stopping local passenger trains in this area
- limited overtaking facilities for slower-running freight trains on what is a relatively high-speed route, especially for modern longer freight trains
- level crossings which restrict line speeds and carry safety and reliability risks, and are best removed for resilient higher-speed railway operation.

Summary of suggested interventions:

- high-speed bypass line from south of Carstairs to west of Rutherglen
- high-speed chord and link towards Edinburgh using the existing line via Shotts
- provision of a central Scotland Park-and-Ride hub station accessible from the motorway network
- selective fast cut-offs to reduce the number of slower-speed sections for passenger trains and leaving the existing route for freight operation
- provide long freight running lines to allow overtaking by passenger trains, whilst not stopping the freight trains.

4.3 Regional services

Suburban routes – introduction:

As a general point, with noted exceptions, services are now operating on an, at least, half-hourly frequency, which suggests that future capacity growth is likely to be best catered for by lengthening trains to 8 or 9 car lengths. A planned programme to lengthen platforms at key stations on a route by route basis will need to be devised, with the use of Selective Door Operation (SDO), which permits trains longer than the platforms to call by preventing doors off the platform from opening.

Glasgow / West of Scotland:

Connecting Glasgow is a report published in 2019, by the independent Glasgow Connectivity Commission – chaired by Professor David Begg – which was established by Glasgow City Council in 2017. The strategic outcomes proposed for much of the extensive inner-Glasgow suburban network has been considered in *Connecting Glasgow,* which focuses on the future nature of the network at a high level. These are considered in more detail in Section 4.4. However *Connecting Glasgow* does not consider the current railway and the problems inherent in the reliable operation of the network. These problems need resolution, regardless of the future methods of operation.

The Glasgow North electric services were formerly one of the most punctual of the whole ScotRail operation, but due to the introduction of new services, notably Larkhall and Airdrie–Bathgate, and general increases in service (from two an hour to four an hour in some cases), the infrastructure is working at capacity for much of the day. Consequently there is considerable import of delay from elsewhere, which has a 'ripple effect' across the network.

There should be no place for single-lead junctions (junctions which incorporate a short stretch of single track) and single-track lines in an intensively-used urban network, especially where there are 'flat' (at grade) junctions which require both careful planning and focused operation to secure high-performing services.

The suburban network also offers rail-ship connections to Dunoon, Rothesay and Arran through Gourock, Wemyss Bay and Ardrossan Harbour respectively. However, the ferry-connecting train services are not treated as distinct, but are integral parts of the suburban service, with its associated multiple-stopping patterns.

To the east of Glasgow, suburban services blend from serving Glasgow to serving Edinburgh, providing a wide range of stopping services serving both cities. These services have the scope to grow faster than those to the west of Glasgow, which are ultimately constrained for further urban development by the Firth of Clyde and Argyllshire mountains barriers.

Many towns to the south of the Clyde and west of Glasgow do not have direct rail services to Edinburgh, relying on connections.

Summary of problems:

- congestion and numerous junctions between Carstairs and Glasgow Central
- single-track branches which restrict the timetable options and amplify late running
- single-lead junctions which restrict the timetable options and amplify late running
- a very intensively used Partick-Hyndland section, common to all routes west of Glasgow Central and Queen Street low-level stations
- poor direct links to Edinburgh from everywhere south-west of Glasgow.

Summary of suggested interventions:

- redoubling of single-track lines for performance reasons: Milngavie and Balloch branches, Helensburgh-Craigendoran (including Craigendoran Junction), Paisley Canal (eastern section), Larkhall, Lanark, Wishaw connecting line, Cowlairs chord, Sighthill West and Cowlairs South Junctions.
- replacement of single-lead junctions with double-track junctions at Bellgrove, Westerton, Haughhead Junction (Hamilton), Lanark Junction
- grade separation of Hyndland East Jn in order to remove conflicts between trains in opposite directions at Scotland's busiest flat junction
- turnback facilities at Hyndland, with a third platform
- grade separation outside Glasgow Central station to enable Ayr trains to run through to Edinburgh without conflicting movements on the level
- restore double track (using the parallel former Hunterston freight line) between Ardrossan South Beach and Hunterston (enabling the provision of a half-hourly service to Largs and the scope to create bespoke limited-stop trains connecting with the Arran ferry)
- upgrade the Wemyss Bay branch to operate half-hourly throughout the day, with limited-stop trains connecting with the Rothesay ferry
- platform lengthening as demand rises.

Edinburgh / East of Scotland:

The East of Scotland suburban network south of the Forth is limited to the Edinburgh ends of the various Edinburgh-Glasgow suburban services (see Glasgow above) and three services to the east: North Berwick, Dunbar and Borders. As these routes

operate wholly or partly along the ECML they are included in the ECML interventions. Some others are included in the TramTrain section.

There are sections of single track which limit service flexibility and also impact on performance, most notably on the Borders Railway.

Summary of problems:

- very capacity-restricted eastern approaches to Waverley station
- no facilities for overtaking stopping local passenger trains on the high-speed Edinburgh end of the ECML
- single-track section to North Berwick which may restrict the timetable options
- single-track sections on the Borders Railway which are too long and terminate in the wrong places for routine, reliable operation and which inhibit flexibility in planning and operation.

Summary of suggested Interventions:

- double the Borders Railway at least as far south as the Esk Viaduct (between Shawfair and Eskbank stations), through Gorebridge station, and north from Galabank Junction just north of Stow station
- double the North Berwick branch and Drem Junction
- platform lengthening at intermediate stations served by North Berwick trains.

Fife:

The suburban services in Fife are part of the 'Greater Edinburgh' network, but the Fife operation has distinctive characteristics. It remains a diesel-operated service – at four trains per hour. It is one of the most intensive diesel services left in Scotland – and should be an early candidate for electrification as the inter-city route to Aberdeen and Inverness is electrified through Fife.

Summary of suggested intervention:

- use of the new Forth Tunnel to reduce travel time to Kirkcaldy and East Fife
- extra services to Dunfermline, West Fife and Alloa, using capacity released by Forth Tunnel
- platform lengthening.

Glasgow-Kilmarnock-Dumfries–Carlisle:

The Glasgow and South Western (GSW) secondary main line from Glasgow to Carlisle via Kilmarnock and Dumfries does not fall easily into any wider Scottish route

category. The northern section from Glasgow to Kilmarnock is essentially part of the West of Scotland suburban network, which could be considered to extend along the Cumnock Valley. Beyond there, the route is through a sparsely-populated rural area to Dumfries, 82 miles from Glasgow – but Dumfries is a substantial town with 34,000 people and in the top 25 highest-populated towns in Scotland. The remainder of the route to Carlisle has a more intensive service with the stations at Annan and Gretna being akin to the smaller intermediate stations on the Aberdeen-Inverness route.

The development of the route needs to reflect that split function, with bespoke 'rural trains' certainly not suited for the Glasgow-Kilmarnock section, and the multiple suburban stops impacting on the journey time from Dumfries to Glasgow, which at around 1 hour 45 minutes (46 mph) is not competitive. Maximum line speeds are in the 70mph to 80 mph range. Furthermore there are communities south of Kilmarnock who wish to be linked into the wider network but which presently do not have stations, such as Mauchline, Cumnock and Thornhill.

A further complication is that the line is used occasionally as a diversionary route for the WCML, although its use is limited by a restricted Loading Gauge capability to accommodate tall containers, and by the standard half-hourly suburban service timetable which results in the Barrhead-Kilmarnock (largely single-track) section being effectively at full capacity.

Traffic densities south of Kilmarnock may be too low for electrification to be cost-effective, other than as a diversionary route. This may change if electrification costs fall as a result of efficiencies resulting from the experience in the rest of Scotland. The route signalling is a mixture of Victorian and early modern.

Summary of problems:

- single-track sections on the busy Glasgow-Kilmarnock part of the route which prevent more services being operated, restrict the timetable options, and amplify late running
- poor journey times for longer distance travel
- poor direct links to Edinburgh from everywhere southwest of Glasgow
- route not capable of offering significant extra capacity for WCML diversions
- poor service frequency for developing commuter travel into Glasgow.

Summary of suggested interventions:

- line speed improvement to secure 100mph running
- redoubling of Barrhead-Lugton and Stewarton-Kilmarnock
- resignalling to provide capacity for WCML diversionary purposes

- efficient turnback in the New Cumnock / Sanquhar area to terminate Glasgow-Kilmarnock services extended beyond Kilmarnock to increase frequency and reduce calls in longer-distance trains.

4.4 Rural Routes

The rural routes are characterised by their length (all more than 35 miles), by their single-track operation with crossing loops, and by their traffic levels – with modest service frequencies and relatively small numbers of passengers (except in summer). Signalling is generally with the now exclusively Scottish 'Radio Electric Token Block' (RETB) system, which whilst very cost-effective was specified for much lower levels of train service than are now being operated and which in some cases is inhibiting the development of business.

Consequently the focus is more on a rolling stock solution than an infrastructure solution. The design of the rolling stock can, in part, compensate for the short-comings of the infrastructure, especially through lower weight and faster acceleration and braking characteristics, so rolling stock capability will inform the infrastructure proposals. In effect the rural routes need to be considered as a single system solution, with the rolling stock designed to cater for the infrastructure constraints, but – where cost-effective – the infrastructure is modified to capture the benefits arising from the new rolling stock.

Summary of problems (all routes unless otherwise noted):

- long single-track sections
- generally short crossing loops
- poor journey times for longer-distance travel
- poor capability for heavy axle-load freight
- numerous level crossings.

Rural Rolling Stock Replacement

Background:

Rural routes were traditionally operated by cascaded vehicles from other busier routes which were replaced by more modern rolling stock. The Class 156 and Class 158 diesel multiple units (DMUs) introduced in the late 1980s represented a different approach, with new rolling stock, offering lower running costs. However these trains are multi-functional (operating on both rural and commuter routes) and have only partially been re-configured for the needs of scenic rural routes.

The 156s used on the Stranraer and West Highland lines and the 158s on the Far North and Kyle lines are now 30 years old and are probably entering the last decade of their lives.

Replacement will need to be considered by the operator who replaces Abellio in 2022 at the end of the current franchise. Decarbonisation of rail is now starting to gather momentum and is likely to result in pressure to replace the current rolling stock with a design of train which does not use oil as a base energy source.

Power Source:

These rural lines are unlikely to be fitted with conventional electrification equipment over significant lengths because the route distances are too great in relation to the number of trains for it to be cost-effective. Therefore independent power sources are required. Batteries may not be satisfactory because the distances run are considerable, but recharging capability and battery range are improving all the time, driven by automotive requirements. Hydrogen, generated from local green electricity – potentially from wind farms when their generating capacity is in excess of the capability of the grid – is also a potential power source. Depending on the development of technology, small-scale electrification of route sections such as Ayr to Girvan and Inverness to Dingwall may offer opportunities to use battery trains / EMUs.

Design Specification:

The DMU replacement requirement generates the opportunity to create a fleet of self-powered multiple-units (possibly using hydrogen, but also possibly using batteries with suitable charging arrangements along the routes) which are specifically designed to serve rural routes. Whilst this spec is being driven by the requirements of Scottish long-distance rural routes, it should also be relevant for similar routes in Wales and parts of England, and possibly Ireland.

It would be desirable if they could also be equipped with a pantograph and transformers to collect electricity from the railway overhead lines where it is available, to reduce energy consumption and increase range.

Design features should include:

- comfortable seats: suitable for four+ hour journeys
- sufficient luggage space (close to the seats) for the needs to tourists/visitors, many of whom will be staying for some time and, especially if camping, will have considerable equipment
- capable of supporting a catering option
- sufficient space for cycles – touring and mountain bikes – plus surf boards
- possible space for parcels (including parcels carried in standard cages / trolleys)
- wide and high-top windows to give scenic views, including if possible to the front and rear of the train (as was the case with 1950s/60s ‘first generation’

DMUs) – and no blind spots due to over-wide 'deadlights' (the areas without windows) as in the Pendolino trains

- easy access/egress for passengers, especially people with disabilities / infirmity and those with luggage – also minimising station 'dwell time'
- high acceleration capability at all speeds to reduce the impact of station stops and local speed restrictions on journey times
- light weight with low un-sprung weight (the weight of the wheels, axles and other equipment which directly impacts on the track, and not through the suspension system) so that they can operate at higher speeds than conventional trains over the same tracks
- top speed at least 75mph, but ideally 90mph
- good standard braking capability, to permit higher speeds with existing signalling, and highly energy-efficient to reduce the size of the fuel store required, including low energy consumption 'hotel power' (for heating, lighting and air conditioning) – possibly including solar panels to minimise external energy requirements – and regenerative braking to recharge the batteries whilst braking or running downhill
- Track Brakes (electro-magnetic brakes such as fitted to trams, which do not rely on the friction between the wheel and the rail) or equivalent for emergency use to reduce risk of running into land slips, fallen trees and also large animals (especially deer, which are natural hazards on the long-distance Scottish rural routes)
- robust design so that the train is less likely to be immobilised as a consequence of striking a deer or running over debris
- capable of operating in deep snow and over flooded tracks
- suitable for survival in possible extreme weather stranding events – so minimal energy use / heat loss is a requirement.

Possible infrastructure Interventions

Inverness-Thurso / Wick (Far North Line):

This route has been the subject of a significant multi-stakeholder Far North Line Review Group investigation which is coming forward with proposals for change. These include reassessing the use and purpose of the railway, especially at the south end with the growth of Inverness as a city and its reach out into the surrounding areas, creating a new Inverness travel zone.

Summary of suggested interventions:

- significant improvements to capacity and line speed (including through points at crossing loops) at the south end, through the provision of modern colour-light signalling and additional crossing loops.
- line speed improvements, especially for freight trains which have numerous speed restrictions over structures and sections of track.

Kyle of Lochalsh:

This service shares the Far North Line between Inverness and Dingwall. It is a low-speed route providing some vital links, but also serving a strong tourist market, which is important to the local economy. The journey times are not competitive with road for local travel.

Summary of suggested interventions:

- higher running speeds for passenger services which reduce journey times and also resource costs, because the trains can be used more intensively and more services operated at only marginally increased cost
- additional facilities for charter and potentially freight trains(sufficient suitable paths, which might require more loops, longer loops, infrastructure upgrades to reduce journey times and run-round and train servicing facilities at terminals).

(Glasgow)–Craigendoran Junction-Oban / Fort William and Mallaig (West Highland Line):

This route is also the subject of a multi-stakeholder Review Group investigation.Capacity is becoming limited at the south end and line speeds are relatively low, especially for locomotive-hauled trains (charters, freight and sleepers). The loops are too short for modern freight train working and the very slow speeds on some sections result in poor economics for rail freight in an area where roads are also of relatively poorer quality than much of Scotland.

To deliver lower road use as required by National Transport Strategy 2, journey times need to be reduced and the frequency of the service increased to encourage modal switch to rail.

Summary of suggested interventions:

- more loops at the south end and the provision of modern colour-light signalling as least as far as Crianlarich (inclusive)
- raising of general line speeds to 75mph
- removal, as far as practical, of lower speed restrictions

- longer loops to facilitate freight operation
- improved facilities for charter train operation (sufficient suitable paths, which might require more loops, longer loops, infrastructure upgrades to reduce journey times and run round and train servicing facilities at terminals)

Girvan–Stranraer:

Ayr to Girvan is the final extent of the west of Scotland suburban network and it is assumed that electrification extends from Ayr to Girvan to improve the connectivity of this area of south Ayrshire. This leaves Girvan to Stranraer as a lightly-used inland route, with no significantly sized communities in the forty miles of remote countryside through which it passes. The key transport destination in the Stranraer area is the ferry ports of Cairn Ryan and Port Ryan, which regrettably are not served by rail. The only significant settlement between Stranraer and Girvan (and not on the railway), is Ballantrae on the coast, which has a population of fewer than 1,000 people.

The route is completely un-modernised, still using traditional physical tokens as the method of signalling, low line speeds and no ability to carry large containers or heavy axle-load wagons and locomotives.

The strategic direction of this route is unclear, with the UK Government examining the option of a bridge or tunnel between this area and Northern Ireland. The provision of a fixed link would require a massive investment in new road and rail infrastructure, with 70 miles of new M77 from Kilmarnock and a completely new A75 to a similar standard from the Gretna/Lockerbie of a similar length. As the fixed link is being considered in the new context of Climate Emergency it should include a railway, which will, in turn require upgraded railway links in Scotland.

This generates uncertainty about the future use and operational needs of the existing railway, which suggests that this route is unlikely to be considered for major changes in the near future. Consequently the proposed interventions are shorter-term in nature.

Summary of suggested interventions:

- replace the Victorian signalling with a modern system
- relocate Stranraer station at a public transport hub to better serve the community
- either a small fleet of battery fitted EMUs to provide through services between Stranraer and Glasgow, or, operate an hourly Girvan-Stranraer service using new ‘rural trains’ which would require a south-facing bay platform at Girvan to facilitate cross platform interchange

- open simple ‘Beauly-style’ halts at selected locations, possibly Pinwherry, Glenluce and Dunragit.

4.5 TramTrains for conurbation / commuter services

Introduction:

TramTrains are an innovative concept, taking a conventional tram designed to run on streets but technically modified to be able to operate safely on Network Rail's tracks. The concept was launched in Germany, with Karlsruhe in 2002 and Kassel in 2006. There has been a UK trial extension of the Sheffield Supertram which is now fully operational serving Rotherham. Thus they can be considered a mature technology and several UK cities are considering use of TramTrains.

The benefit that they bring is being able to use existing and often under-utilised Network Rail tracks in the suburbs and possibly from country hinterlands, but to then – through 'street running' – penetrate city centres or reach other major employment, housing or retail locations centres which are not close to existing railways.

They have higher acceleration and braking capability than conventional heavy rail trains, and station / stop dwell times are shorter, enabling them to share the same tracks as faster long-distance trains. They may require rail electrification, but can also operate on battery power on city streets (as in the town of Nordhausen in Germany), thereby removing the need for overhead wires. Generally the street running voltage is 750dc. Operation at heavy rail standard 25kv ac requires a heavy transformer and it is unlikely that a TramTrain will be as cost-effective as dual voltage and battery. The specific configuration for each system will emerge from the detailed development work.

Major research is now underway in Coventry to find lower-cost methods of providing on-street tram infrastructure, with both lighter vehicles and no requirement for the relocation of under-street utilities before the tracks are laid, thus reducing disruption, timescaes and costs associated with new on-street tram routes. This could considerably reduce the costs of running TramTrains into Scottish cities.

Four Scottish cities are considered as offering the potential for TramTrains to improve public transport provision relatively quickly: Glasgow, Edinburgh, Aberdeen and Dundee.

Glasgow:

Connecting Glasgow covers all the strategic transport issues which the city region faces. Included is a recommendation to convert the Cathcart Circle / Newton / Neilston heavy rail lines currently operated by ScotRail to a Metro

operation, with extensions to Castlemilk and Newton Mearns. We suggest that St Enoch / Argyle Street is used as a city centre terminal (but the site urgently needs to be protected from inappropriate development) and that TramTrains are used, to enable the continued use of Network Rail tracks for conventional passenger and freight services. TramTrains would remove existing local passenger trains and movements from Glasgow Central, freeing up capacity for longer-distance traffic.

Connecting Glasgow advocates a Metro network which includes not only the routes above but also a wider network based on currently out-of-use Victorian rail track beds stretching to the east, west and north of the city centre. Instead, use of TramTrains on the shorter services would still leave the important city centre tracks available for longer-distance ScotRail trains.

The use of the 'City Union Line' – a freight-only route crossing the Clyde east of Glasgow Central – would permit the Paisley Canal services to be diverted into the new Argyle Street high-level terminus, releasing capacity on the Ayrshire and Inverclyde lines for longer-distance services.

Reopening the former Glasgow & South Western Railway 'Strathbungo Link'- under the M74 and over the West Coast Main Line wouldconnect the new Argyle Street station with the East Kilbride and Barrhead / Kilmarnock lines. The use of Argyle Street High Level station would increase cross-city connectivity – with a new linked Metro route to run east and north to Bellgrove, up to Springburn and onwards to Anniesland using existing heavy-rail lines. Grade separation at Cowlairs (across the Edinburgh-Glasgow main line) would increase capacity on these critical longer-distance routes.

Edinburgh:

It is proposed that the Edinburgh South Suburban line ('the Sub') which bypasses the city centre to the south – from Newcraighall in the east to Slateford in the west – should form the core part of a new TramTrain route running from Musselburgh station via Newcraighall to west of Haymarket and then on the existing Tramline 1 (from Newhaven and Leith in 2021) to Edinburgh Park and Edinburgh Airport. This could also link to the existing Tram route through Haymarket and Princes Street, while a TramTrain branch from the Sub could connect to the Royal Infirmary of Edinburgh and Midlothian beyond.

Another possible TramTrain route would be from Haymarket to Heriot-Watt University using the existing railway via Slateford, Kingsknowe, Wester Hailes and Currie (providing interchange between TramTrain and ScotRail services). This route could also loop back to Edinburgh Park to give the university campus much-enhanced connectivity.

Dundee:

The core route is proposed to replace the existing ScotRail Abroath-Dundee local train service. Here the shorter time-penalty that a TramTrain incurs for stops would allow additional calls to be made at two of the existing, poorly-served stations – Golf Street and Balmossie. On-street running would start at the docks area to the east of the city centre.

A potential city centre loop would return to the current main-line station and then follow use the Dundee-Perth railway, calling at the Airport and a new Dundee West station before climbing up to Ninewells Hospital and Technology Park.

A further TramTrain route could link St Andrews to Dundee via Leuchars with an additional call at Wormit, with possible on-street running to Newport and/or Tayport.

Aberdeen:

There are two corridors on which TramTrain could operate, which if realised would create a convenient cross-city transit line.

The initial north TramTrain route would start with a branch from Aberdeen Airport to Dyce station, and then make use of the largely redoubled Dyce-Aberdeen line, with some new intermediate calls, including the new Aberdeen Exhibition and Conference Centre.

To avoid the short section of single track on the northern approach to Aberdeen station, it is proposed that the TramTrain runs along the freight-only Waterloo branch and/or the A96, to the east end of the city centre, then along Union Street, past the main-line station to College Street, to regain the former Ballater branch line at Duthie Park. From here it would use the former, and largely unobstructed, rail route to Banchory or possibly beyond.

This core network could provide the base from which a new loop to serve Westhill could be built. It is also potentially a solution to providing rail services to Ellon, Peterhead and Fraserburgh, using vehicles suitably internally-configured for longer-distance running.

4.6 Proposed new passenger stations on the existing passenger rail network

Opening new passenger stations on the existing rail network is – other things being equal – simpler and cheaper than building entirely new routes with new stations. Settlement population – and hence potential rail demand – is clearly a key factor, but cannot be the sole guide to feasibility, as a variety of constraints may come into play, such as: impacts on line capacity; proximity to existing stations; road access and availability of land for car parking; the quantity and quality of any existing road-rail interchange facilities in the area, etc.

To the 23 places recommended (in Section 3.5 above) from within the Railfuture lists, it is suggested that Bonnybridge (population 25,660) should be added, with the proviso that accommodating a new station on the busy Stirling/Falkirk-Glasgow railway may be problematic. A further potential station is at Beattock on the West Coast Main Line, as a railhead for Moffat (population 2,510).

4.7 Proposed new passenger stations on the existing rail freight network

There is potential for passenger services to resume on two routes which currently handle only freight traffic – improving connectivity and also serving settlements which would not justify building a completely new railway:

- Alloa-Clackmannan-Kincardine-Longannet-Culross-Valleyfield-Cairneyhill-Dunfermline
- TramTrain services on the Edinburgh South Suburban Line through Gorgie, Craiglockhart, Morningside, Newington, Craigmillar etc.

4.8 New destinations served by proposed new passenger routes (heavy rail and TramTrain)

Transform Scotland's suggestion that all towns over 10,000 population should have a rail service is endorsed, with just two exceptions: (i) Grangemouth, where the existing freight railway and potential passenger station are not well located in relation to the town's population, and (ii) Bo'ness, which is the terminus of a popular heritage railway, with engineering and operational constraints on a 'public transport' service. However, both could be served by an integrated ScotRail coach link to Linlithgow (five miles from Bo'ness) feeding into train services to Edinburgh (and Glasgow) as per the concept outlined in Section 4.9 below. Aside from these two, the 10,000 criterion would bring the following towns on to the network (in descending order of population):

- Methil, Leven and Buckhaven (in process)
- Peterhead
- St Andrews (possible heavy rail or TramTrain)
- Erskine (possible TramTrain)

- Penicuik (possible TramTrain)
- Broxburn (possible TramTrain)
- Forfar (possible TramTrain, from Dundee)
- Hawick
- Fraserburgh
- Westhill, north west of Aberdeen (possible TramTrain)
- Ellon.

To this list it is suggested that the following be added as proposed new termini on new routes to selected settlements of under 10,000 population (in descending order of population):

- Haddington
- Banchory (possible TramTrain)
- Strathaven.

For those routes re-opened wholly or largely along former railway alignments, the following lines would be involved:

- Aberdeen-Banchory
- (Aberdeen-) Dyce-Ellon-Fraserburgh
- Aberdeen-Dyce-) Ellon-Peterhead (via Cruden Bay)
- Larkhall-Strathaven
- Leuchars-St Andrews
- Longniddry-Haddington
- Thornton-Levenmouth
- Tweedbank-Hawick.

For those re-opened on new alignments (typically for TramTrain operation) the following routes would be involved:

- Aberdeen-Westhill
- Dundee-Forfar
- Edinburgh-Penicuik
- Edinburgh Airport-Broxburn (Edinburgh Tram extension)
- Elderslie-Kilmacolm
- Glasgow Airport-Erskine (extension of proposed Metro).

The above heavy rail / TramTrain routes could also serve intermediate stations at the following key locations (in descending order of population):

- Loanhead & Bilston
- Peterculter
- Stonehouse
- Kingswells
- Kirkliston
- Mintlaw
- Melrose
- Newmachar
- Ratho
- St Boswells and Newtown St Boswells.

Local environmental factors:

It should be noted that in the case of proposed re-openings along former railway alignments, there will be some instances where local objections will arise, for example where – as in a number of locations along the Borders Railway – central and local government failed to protect the old railway solum from breaches by housing, industry, roads etc. However, these were all satisfactorily resolved on the Borders Railway.

In other cases, eg Aberdeen-Fraserburgh and Aberdeen-Banchory, the (predominantly single-track) solum has been converted into a walking route / cycle path, and new routes for the latter would be required – this was done satisfactorily in the case of a section of the Borders Railway through Galashiels and over much of the re-opened Airdrie-Bathgate route. Where a formerly double-track route is involved, and the new railway were to be single-track only (this might be the case between Longniddry and Haddington, for example) then there would normally be sufficient room to accommodate both railway and the (suitably fenced) walking route / cycle path on the old solum – as was done in the case of the 'Black Path' over the Red Bridge across the River Tweed immediately west of Tweedbank station on the Borders Railway.

For new lines on largely new alignments, the route can be defined to avoid local environmental problems, most readily on rural sections of TramTrain operation, where its curvature and gradient capabilities provide greater choice of routes than in the case of heavy rail. Street running of TramTrains in urban areas will inevitably – as in the case of the Edinburgh Trams – involve some objections to loss of car parking and/or road space, but as the Edinburgh example has demonstrated, these can be managed to create satisfactory

outcomes both locally and city-wide, with the new quiet and clean transport enhancing the local environment and increasing the attraction of the corridor for shopping by tram, bus, bike and foot.

4.9 An integrated ScotRail coach service for locations outwith the new rail network

Introduction:

Railways generally need large concentrated volumes of passenger traffic to operate efficiently, taking advantage of their segregated, signalled and guided steel tracks – which are expensive to maintain and operate. It is therefore inevitable that some towns distant from the rail network (and whose population would justify a passenger station if located on an existing rail route) cannot cost-effectively be reconnected to the railway.

However, there is an opportunity to fully integrate such locations to the rail network – with connecting buses / coaches and through ticketing to provide a high quality of service, as applies in Switzerland. At a few designated locations on these routes 'virtual stations' would be created, with waiting facilities, help points and customer information. Such arrangements could in some cases be a first stage before longer-term consideration of rail reconnection.

Corridors where rail – at least in the medium-term – may not be cost-effective, but where an integrated bus /coach network could transform the quality of public transport are considered region-by-region below. Careful consideration would be required to resolve any tensions between bus routings for local needs and bus routings for rail connectional purposes, as in some cases these will diverge.

South West Scotland:

Re-opening the Dumfries-Stranraer railway (with an extension to Cairnryan / Port Ryan) has been suggested in connection with a proposed bridge / tunnel to Northern Ireland. The rail option is being examined – as part of SW Scotland STAG work. –But the intermediate communities are too small to fit this study's base criterion (10,000 population) for new stations on new routes: Castle Douglas, Dalbeattie, Kirkcudbright and Newton Stewart are all around 4,000 population, and an expensive c. 65-mile through railway (partially on a new alignment to meet modern needs) would be required.

There are potential opportunities for rail freight from the ports at Cairnryan / Port Ryan (via the Stranraer railhead), but long-haul freight trains to English markets and supply areas can already operate via Ayr, Kilmarnock and Dumfries to the West Coast Main Line at Carlisle (as they did for 27 years before freight services were withdrawn in 1992). There are extensive forests in

South West Scotland and timber is considered to be a priority potential traffic by the rail freight sector in Scotland; but while the former Dumfries-Stranraer line ran through or close to these harvesting areas, a more cost-effective option would be to use potential railheads in the Dumfries area and on the existing Stranraer-Ayr railway.

It is therefore suggested that as part of a pan-Scotland ScotRail integrated coach network, the following new coach service should be introduced: Lockerbie (train connection from Edinburgh and the south), Lochmaben, Dumfries (train connection from Glasgow), Dalbeattie, Castle Douglas, Kirkcudbright, Gatehouse of Fleet, Creetown, Newton Stewart, (Cairnryan, Port Ryan as required to meet ships), and Stranraer.

South East Scotland:

A possible rail link from Hawick to Carlisle is being examined as part of SE Scotland STAG work. However, over the former rail distance of 45 miles from Hawick to Carlisle the largest settlement along the former Waverley Route within Scotland (Newcastleton) has a population of under 1,000, and the largest within England (Longtown) has a population of 3,000.. A possible alternative route via Langholm (population 2,160) would involve steeper gradients, and substantial dislocation in Langholm itself.

The former railway alignment (including a branch to Kielder) does however run through the heart of major timber harvesting areas in the Kershope, Kielder, Newcastleton and Wauchope forests. It is possible that the combination of rail freight (including possible Ministry of Defence rail movements to and from the Otterburn range) and inter-regional passenger trains from Edinburgh via the Borders to Carlisle, Manchester etc could together make the case for a railway re-opening in the long-term, but at this stage it is suggested that as part of a pan-Scotland ScotRail integrated coach network, the following new coach service should be introduced: Galashiels and Selkirk *(until the line is rebuilt to Hawick*), Hawick, Langholm, Longtown, and Carlisle (replicating the existing 'Rail Link' service, but with through ticketing and other 'railway' facilities such as use of Railcards.

SE Scotland STAG work is also examining options to link to the East Coast Main Line, but the only significant places between St Boswells (on a reinstated railway to Hawick) and Berwick are Kelso (population 7,200) and Coldstream (population 1,930). A rail option would be to re-open from St Boswells to Kelso only, or in the longer term through to Berwick (creating a strategic diversionary route and a Borders link to the closest north east England city at Newcastle).

In the meantime is suggested that the following new integrated coach service should be introduced: (Galashiels, Tweedbank and Melrose *(until the line is*

rebuilt to Hawick), Newton St Boswells, St Boswells, Kelso, Coldstream, and Berwick. The existing 'Rail Link' bus service from Galashiels to Berwick via Earlston and Duns should also be incorporated in the pan-Scotland ScotRail integrated coach network.

Central Scotland:

While Grangemouth and Bo'ness are two of the ten largest towns in Scotland without a regular train service, at Grangemouth the existing freight railway and potential passenger station are not well located in relation to the town's population, and at Bo'ness reintroducing a public transport operation on such a popular 'heritage railway' as the Bo'ness & Kinneil could be problematic, not just in terms of almost complete reconstruction of the branch itself to create the necessary capacity and capability, but also the configuration of the junction at Manuel on the Edinburgh-Glasgow main line (requiring reversal prior to joining the main line) and the constraints of main-line capacity.

Instead it is suggested that the following new integrated coach service should be introduced: Falkirk Grahamston, Grangemouth, Bo'ness, and Linlithgow.

A similar service could be introduced between Callander, Doune and Dunblane.

Fife:

An integrated coach service should link the planned new station at Levenmouth with the string of small towns in the East Neuk of Fife – Largo, Elie, St Monans, Pittenweem, Anstruther, Crail and Kingsbarns – with St Andrews (and onwards to Leuchars, until the Leuchars-St Andrews railway is rebuilt).

In the absence of a railway from Cowdenbeath via Kinross and Bridge of Earn to Perth, an integrated coach service could link Inverkeithing station, Halbeath Park & Ride, Kinross, Milnathort, Glenfarg, Bridge of Earn, and Perth.

Perth & Kinross / Angus:

The existing Crieff-Dunblane-Stirling bus service could become an integrated ScotRail coach service routed via Gleneagles station, connecting with the enhanced train services to Stirling, Glasgow, Dundee and the north.

Within Angus there are two potential integrated coach routes: Blairgowrie, Coupar Angus, and Dundee; and Montrose, Brechin, Forfar, and Dundee (with a connecting link from Kirriemuir at Forfar) – and ultimately TramTrain from Forfar to Dundee.

North East:

Core integrated coach routes could link the following: Inverurie with Old Meldrum, Fyvie, Turriff, MacDuff and Banff; Macduff, Banff, Portsoy, Cullen, Portknockie, Findochty, Portgordon and Buckie with Elgin; and Buckie and Portgordon with Keith. Other routes could link Lossiemouth with Elgin, and Elgin, Llanbryde and Fochabers with Keith.

Highlands:

The basis for an integrated coach link between Oban, Ballachulish, Fort William, Fort Augustus, Drumnadrochit and Inverness already exists in the form of Citylink services (but without through rail ticketing), although services can be sparse at certain times and days. This is also the case between Dingwall, Strathpeffer and Ullapool.

4.10 Freight modal shift

Introduction:

Rail's inherent technical attributes – its segregated, signalled and guided steel tracks – allow big trainloads of freight to be moved safely and sustainably, with minimal disturbance of everyday life. Railways have high fixed costs, but are especially efficient when moving freight in large quantities and/or over longer distances. Intermodal (container) trains travel at speeds of up to 75mph and are most competitive with road haulage over lengthy hauls such as from Central Scotland to Deep Sea ports and the major national distribution centres in England. In the case of heavy, bulk traffics, rail can be competitive over short distances: such as the 70-mile train haul of cement from Dunbar to Uddingston, near Motherwell.

At present, rail freight has a relatively modest share (around 10%) of the general freight market, where road haulage offers highly cost-effective services but imposes significantly more externalities on society in terms of carbon, other environmental impacts, public safety etc, the costs of which are borne by society as a whole.

There are substantial opportunities for 'big wins' shifting freight from road to rail, but these will require not just innovation and resources from the rail freight industry but also a major shift in the emphasis of transport infrastructure investment and support by the Scottish Government.

Indicative costs for the freight programme are included in Section 4.11 below.

Contribution to climate change objectives:

A low-carbon economy is central to the Scottish Government's aims, and in April 2019 the First Minister announced a 'Climate Emergency'.[38] But there is still a relatively low level of awareness of the important contribution rail freight can make – in both the short and long term – to delivering policy objectives, for example through cutting CO2 emissions by up to 76 per cent compared to road haulage, even where road collection and delivery legs are required at either end of the rail trunk haul.[3] Switching freight from road to rail can offer a 'quick win', as it involves doing the same activity for less carbon, rather than having to doing things completely differently (as is often the climate change prescription in other sectors).

Contribution to the Scottish economy:

Rail freight has long played a central role in Scotland's exporting economy, particularly in the movement south of spirits – for domestic, mainland

European and Deep Sea markets – from hub container railheads at Coatbridge, Grangemouth and Mossend. Following the end of the Rosyth-Zeebrugge freight ferry service, two container trains daily link Mossend with the fast-expanding Teesport, providing vital links to mainland Europe.

The retail transport sector has successfully moved into using rail to convey supermarket supplies in containers from the West Midlands of England to the Central Belt, and from the latter to Aberdeen and Inverness. In the reverse direction finished timber products are moved from the Highlands for distribution in England. And traditional bulk commodities by rail continue to efficiently service the Scottish economy – and keep heavy lorries off the roads, with big safety and road maintenance benefits – through trainloads of alumina, cement, calcium carbonate, china clay, coal, oil and steel.

Rail provides timetabled reliability, avoiding 100% dependence on road haulage and its vulnerability to road congestion, lorry driver shortages and future energy constraints. But the much bigger role which freight trains could play in a sustainable low-carbon economy is fundamentally dependent on the quantity and quality of available infrastructure.

Current rail infrastructure:

The Scottish Government and the UK Government – through Network Rail – have invested in enhancement of the rail network, both on cross-Border and internal Scottish routes, including electrification of the important Grangemouth branch. The **capability** of the East Coast Main Line (ECML) through Berwick and Edinburgh has been upgraded so that the highest British domestic clearance (height and width) for international containers through overbridges and tunnels is available for rail transits. However, a lack of overtaking loops for long freight trains means that 'paths' for 775-metre services between the ever expanding number of passenger trains are very limited, extending rail freight journey times on both the East Coast and West Coast Main Lines.

West Coast Main Line (WCML) freight is largely electrically hauled and a rolling programme of electrification of other key routes would further contribute to climate change objectives, but this needs to be co-ordinated across Britain to ensure that the complete routes are electrified, unlocking private sector investment in new locomotives. The Scottish Government also needs to start work now with the Department for Transport to avoid capacity challenges for Anglo-Scottish freight once HS2 passenger trains are operating on the northern sections of the East Coast and West Coast Main Lines.

The Scottish Government – unlike the UK Government – has retained the vital Freight Facilities Grant (FFG) to support the development of **terminals**, including a new railhead for Highland Spring at Blackford (currently under

construction), which will handle two daily trains of bottled water to southern markets. But there are major gaps in the terminal network, as we shall see.

The Scottish rail network as a whole remains a patchwork of different clearances, involving complex permutations of wagon and container types. There are relatively few constraints on the cross-Border routes into the Central Belt, although diversionary routes are limited. However there are particular constraints on rail conveyance of international high-capacity containers and wider refrigerated containers for chilled / frozen food on the routes from Aberdeen / Inverness to the Central Belt. In contrast, thanks to long-standing Government road investment, road hauliers can send the biggest containers on a standard tractor & trailer unit anywhere on the upgraded trunk road network.

Rail freight in Scotland is also constrained by **capacity** bottlenecks. Perhaps the worst example is between Perth and Inverness, where the largely single-track Highland Main Line constrains the daily Mossend-Inverness container train for Tesco / Stobart to just 20 containers due to the short length of crossing loops – yet the train locomotive could haul 28 containers, a 40% increase in productivity. This significantly hinders rail's competitivity with road hauliers who enjoy the benefits of an entirely dual-lane or dual-carriageway A9. And with the progress of the A9 full-dualling scheme, there are worries that freight will shift from rail to road – the opposite of stated government policy outcomes.

Current approaches to evaluation and prioritisation of transport infrastructure investment:

The Perth-Inverness corridor provides a good illustration of flaws in the current evaluation and prioritisation of transport infrastructure investment, to the disadvantage of rail freight.

In 2008 the Scottish Government's 'Strategic Transport Projects Review' (STPR) identified upgrading the Highland Main Line (HML) as the third-top priority among 29 road and rail schemes across Scotland. Investment of between £200m and £450m was envisaged, including 'additional loops, dynamic loops or lengthening of double track sections'– designed to benefit both passenger and freight traffic. The outcomes would include that 'the freight improvements would make it considerably more attractive for freight hauliers to move containers and other goods by rail, by reducing journey times'.

Twelve years later, work has just been completed on a drastically scaled-down rail infrastructure programme, with £65m invested in track and signalling upgrades, entirely driven by the hourly-frequency passenger service timetable, with very little benefit to rail freight. Train lengths – a crucial competitive factor – remain significantly constrained by the short crossing loops.

In the meantime, some years after STPR was completed, a political decision was taken to bring forward the dualling of the A9 between Perth and Inverness, at a 2010 cost of £3,000m (potentially around £5,000m now), despite this not having a proven business case and being a lower priority in STPR than the HML upgrade. At no stage did the Scottish Government undertake a 'cross-modal' appraisal of the best mix of road and rail upgrades for the corridor – to meet policy aims and provide best value for the taxpayer. Their post-decision Business Case had to invent a new benefit of 'driver frustration' and to put a cost to that to secure a positive benefit-to-cost ratio.

A new approach to evaluation and prioritisation of transport infrastructure investment across Scotland is long overdue, and this should be reflected in the forthcoming Strategic Transport Projects Review 2 process. This also needs to be linked with stronger guidance in Scottish Planning Policy to ensure that the land needs of rail freight are suitably protected in the interests of strategic – and sustainable – development.

Potential 'big wins' in shifting freight from road to rail:

In response to the target of 7.5% growth in rail freight between 2019 and 2024, set by the Scottish Government in 2017[39], the rail freight industry published its 'Industry Growth Plan for Rail Freight'[40] in 2019.

The plan identified a range of key potential traffics which, 'with the right conditions, are ideal partners for rail freight', but also noted that, 'without collaboration and finding innovative solutions, modal shift will be difficult to achieve in some markets'. Key sectors are:

- intermodal (including chilled and frozen produce)
- forest products (including logs and the output of board, paper and saw mills)
- whisky / spirits (including bulk and bottled spirit, and barley / wheat)
- bulk cement / aggregates
- bulk waste
- express freight.

As there a range of variable factors which will influence the extent of modal switch (industry innovation, partnership between the private and public sectors, Government infrastructure investment etc) the Growth Plan does not seek to quantify the potential tonnage involved. However, based on 'information gleaned from Industry and rail freight industry interviews and research into Scottish markets', and industry workshops held with potential freight users in Coatbridge, Aberdeen, Inverness and Kirkcaldy, the plan sets

out the 'known potential growth' in terms of trains along key corridors during CP6 (2019-24):

- Central Scotland Terminals (CST) to the West Coast Main Line: 4 trains a day in each direction (actual in 2019 was up to 27 trains a day in each direction)
- East Coast Main Line to the south: 4 trains a day in each direction (actual up to 10)
- CST to the East Coast Main Line: 3 trains a day in each direction (actual up to 19)
- CST to Inverness: 4 trains a day in each direction (actual up to 4)
- CST to Aberdeen: 4 trains a day in each direction (actual up to 3)
- Aberdeen to Inverness: 3 trains a day in each direction (actual zero)
- CST to West Highland Line (WHL): 1 train a day in each direction (actual up to 2)
- CST to Ayrshire: 1 train a day in each direction (actual up to 3)
- Ayrshire to WCML via Dumfries: 1 train a day in each direction (actual up to 2)
- Inverness to Far North: 1 train a day in each direction (actual up to 2).

A range of constraints on realising this short to medium term growth are listed for each corridor in the Growth Plan. North of the Central Belt, a common factor is lack of route capacity (except the WHL, where modest potential is identified) and capability (notably 'loading gauge' for intermodal traffic). Within the Central Belt and through Edinburgh to the ECML, while loading gauge is generally adequate there are capacity and capability problems, including the short, but critical, non-electrified Edinburgh South Suburban Line.

Making it happen:

The Growth Plan identifies four 'headline objectives' as follows:

1. Encouraging Customer Confidence
2. Developing Growth
3. Doing Things Differently
4. Simpler Solutions

These are all valuable aims, but the Industry Growth Plan – being led by Network Rail, who are funded by the Scottish Government – is inevitably non-political. It notes that one of the constraints on rail winning a share of the 1.5m tonnes of bulk spirit moved annually by road from North of Scotland distilleries to maturation sites and blending plants in the Central Belt is 'A9 doubling –

road even more attractive'. This is fair comment, but the clear political issue is the relative balance between A9 and Highland Main Line investment by the Scottish Government. As the current 'balance' is undermining rail's competitivity (for example through constraining freight train lengths) then that has to be addressed urgently if this key corridor is to play its part in addressing the Climate Emergency. And the big prize is to shift to rail a significant share of the 50,000 long-distance whisky lorry trips on the A9 annually.

Electrification:

With current technology rail freight offers the only way to cost-effectively electrify long-distance heavy freight haulage with battery and hydrogen technology both requiring significant payload reductions for heavy goods vehicles to achieve the required range whilst hauling heavy freight

The Scottish Government has been very active in electrifying the Scottish rail network, mainly focussed on passenger routes, but including the marginal add-on to serve the key Grangemouth hub which is served by a freight-only line. The main drivers of future electrification will be the replacement of the ageing diesel HST passenger trains, which will need replacement by 2030. This will drive electrification from the Central Belt to Perth, Dundee, Aberdeen and Inverness, the routes on which there are already notable existing rail freight flows and potentially substantially more. The Industry Growth Plan, as we have seen, suggests a potential doubling or more of the number of freight trains to Aberdeen and Inverness by 2024.

Electric freight haulage offers considerable benefits in that the trains will accelerate faster, and run at higher speeds (up to the line speeds) – allowing better utilisation of rolling stock – and heavier and longer trains can be operated. These inherent benefits from electric traction bring cost efficiencies as well as easing the timetabling of freight trains amongst the passenger services.

In addition the need to rebuild over-line structures to facilitate the provision of the overhead electrical equipment will ease some of the constraints on hauling bigger containers on the routes to Aberdeen and Inverness. However as the efficient electrification programme currently being developed is intended to reduce the number of structures that will need to be altered and to reduce the degree of alteration for electrification purposes there will need to be strong interworking between the electrification project and a parallel freight Loading Gauge clearance project to secure best value.

Traction power feeders also need to be specified to be able to provide sufficient power for the operation of heavy freight trains.

Route infrastructure needs:

- Central Belt to Aberdeen and Inverness route investment to give W12 clearance (the maximum GB domestic gauge clearance) and full electric freight train capability
- ECML & WCML investment to give full 775m freight train length capability at W12 and electric traction (including the South Suburban Line in Edinburgh)
- investment in resilience, with more routes (eg Glasgow- Stewarton-Kilmarnock-Dumfries-Carlisle and Aberdeen-Inverness) made available for freight traffic to provide alternative routing options (with appropriate gauge clearance) in the event of planned or unplanned disruption.

Locomotive needs:

- provision of 'off-wire' capability in freight depots for electrically-hauled trains (this would be facilitated by support funding for new bi- or tri-mode electric locos).

Terminal needs:

- investment in strategically-placed multi-user intermodal hubs – eg Dundee, Speyside (Elgin / Keith) and Bathgate – to fill key gaps in the network for container trains linking to distribution centres and East Coast and Deep Sea ports in England
- investment in strategic direct rail connections ('private sidings') to major traffic generators, as is happening at Blackford with Highland Spring
- new private sidings within the whisky sector – at locations adjacent to the railway such as Cameron Bridge in Fife (the largest grain distillery in Europe), Cambus / Blackgrange near Alloa (the largest bonded warehouse site in Europe), and grain distilleries at Girvan and Invergordon.
- forest products: handling/loading facilities at Barrhill, Crianlarich, Kinbrace (Flow Country) and Rannoch for round wood; Barony, Cowie, Dalcross, and Lockerbie for processing plants.

Investment and financial support:

- continued support for Freight Facilities Grants, with revised terms, recognising that most traffic is now carried on multi-user intermodal trains and this in turn presents difficulty in securing sufficient longer-term commitment to rail

- continue and expand the scope of the Mode Shift Revenue Support grant scheme to £5m pa (from the current £400k pa)
- provision of a small 'start-up' mixed wagon fleet to enable market testing / introduction to happen.
- continued investment in small freight efficiency schemes either free-standing or as part of wider schemes to improve rail freight efficiency so enabling the commercial operation of existing and new services
- pump-priming: provide additional financial support over and above MSRS and FFG to aid the introduction of trial multi-user freight trains on new routes and to support the introduction of additional trains on existing routes (see box below).

Stakeholder buy-in:

Rail freight growth could be significantly boosted by a Scottish Government (Minister) led programme to engage the key senior decision-makers in the key companies in ectors where rail freight can make a contribution to the Climate Emergency delivery programme through modal switch from road haulage.

There are relatively few companies within each of the sectors where rail freight can contribute significantly to climate change objectives through mode shift, but they are generally large businesses. The task is to win 'the hearts and minds' of the key influencers to steer company policy towards freight modal switch as part of their corporate contribution to the environment and tackling the Climate Emergency. An encouraging example is provided by Tarmac, the international construction materials business – and a major rail customer through their Dunbar cement works – whose senior management have worked collaboratively with the wider rail freight sector in Scotland to help produce the Industry Growth Plan and to promote modal switch more widely.

Pump Priming

Rail freight is generally a commercial activity, with government support limited to FFG and MSRS grants

Both grants are intended to enable rail freight to compete with road haulage where there are wider environmental benefits. These grants should continue and the scope of MSRS should be expanded to increase the number of routes on which support funding is paid. This will result in more traffic switching from road to rail, with carbon, environmental and road safety benefits at a small additional cost.

Margins in the haulage industry, including rail freight, are low, which makes new investment in expanding services (locomotives, wagons and drivers) difficult to justify. For rail freight, virtually all of the costs are incurred up-front as soon as a train starts operating, but the income only arrives after shippers put traffic onto the train, which will only reach break-even with a load factor of around 75% or more.

Therefore the big challenge for rail freight operators is building up business after a train service starts operating, first to achieve break-even and then to deliver a profit to cover the losses during the start-up and traffic build-up periods.

In these circumstances there is a case for providing 'start-up'pump-priming support payments to reduce the financial risk to the rail freight operator during this early stage. This would apply to both the operation of new service routes and the provision of additional services on existing routes to grow capacity. Grants would be (a) time-limited, with the train thereafter operating commercially, and (b) fixed to ensure sufficient incentive exists to encourage the train operator to develop their business as quickly as possible.

Such a grant is likely to speed up and encourage the provision of more freight train capacity and services. Examples could include a new regular intermodal service from Elgin / Keith to the Central Belt for the whisky and food sectors, and an additional daily Mossend- Inverness train as the existing train is running at capacity. (The addition of a new train service will result in initial operating losses until the traffic volumes have grown sufficiently to put both trains in a financially sustainable position.)

4.11 Programme costs and benefits

The costs that have been prepared for this programme – as set out in Table 2 below for passenger / shared passenger & freight enhancements – are at an indicative and high level. They are directly related to the interventions suggested in this report, with the unit cost based on published out-turn prices over the past ten years. However, to reflect the degree of uncertainty all figures (except those which are freight-specific) have been rounded to half billion £s. Significant elements of the passenger-related programme will also offer shared benefits with freight, eg through electrification.

Costs have been prepared for six types of output:

- new stations
- new routes
- route upgrades
- electrification
- TramTrain specific
- major specific infrastructure (Forth Tunnel and Tay Bridge).

Costs have only been put forward for the major infrastructure interventions proposed here and do not include any rolling stock costs (based on the assumption that leasing will still be the preferred method of funding trains) or general renewals, station and passenger-train depot improvement projects.

It should be noted the short-term costs and some of the medium-term costs for passenger / shared passenger & freight enhancements in Table 2 below are already implicit in announced Scottish Government policy. However, that is not the case for freight (see Table 3) where new investment commitments are required to allow rail freight to play a much-enhanced part in tackling the Climate Emergency.

It is suggested that the programme is planned to be completed over twenty years, which will greatly contribute to the 90% target set in the Climate Change (Emissions Reductions Targets) Scotland 2019 Act for 2040. Twenty years is not long for a major infrastructure programme but it is most of the remaining time to the 2045 Net Zero target set by the Act, so is a reasonable compromise, with challenging targets to deliver the required outcomes.

Table 2: Suggested costs of prioritised programme (£ million)

(Each cost figure in the Short / Medium / Long-term columns refers to the total spend across the seven / six-year periods involved.)

	Short Term 2020 - 2027	Medium Term 2027 - 2034	Long Term 2034 - 2040	Total £ million
New stations	£500			£500
New routes	£500	£2,000	£500	£3,000
Route upgrades Scotland	£500	£2,500	£1,000	£4,000
Route Upgrades Cross border	£500	£1,000	£2,000	£3,500
Electrification	£1,000	£1,500		£2,500
TramTrain		£1,000	£500	£1,500
Forth Tunnel		£2,000	£3,000	£5,000
Tay Bridge			£1,000	£1,000
Passenger / shared passenger & freight TOTAL	**£3,000**	**£10,000**	**£8,000**	**£21,000**
Additional freight-specific TOTAL	***£200***	**£320**	**£120**	***£640***

Freight interventions for railheads / siding connections will be eligible for the existing Freight Facilities Grant scheme which provides for up to 75% of the capital cost of such schemes. Therefore, allowing for private sector investment of at least 25%, *the cost to the Scottish Government of the freight-specific terminals elements (railheads and sidings) would be significantly less than shown in Table 3 below.*

Table 3: Suggested costs of key freight-specific elements (£ million)

(Each cost figure in the Short / Medium / Long-term columns refers to the total spend across the seven / six-year periods involved.)

	Short Term 2020 - 2027	Medium Term 2027 - 2034	Long Term 2034 - 2040	Total £ million
Route freight upgrades eg loading gauge	*£100*	*£300*	*£100*	*£500*
New / upgraded intermodal railheads	*£40*			*£40*
New direct siding connections to key whisky sites	£30			£30
New railheads / direct siding connection to forest products sites	£20			£20
New railheads / direct siding connection for other sectors	*£10*	£20	£20	£50
Additional freight-specific TOTAL	***£200***	**£320**	**£120**	***£640***

Mode Shift Revenue Support Grant – which monetises the environmental benefits of flow-specific rail freight operation compared to road haulage – has

in recent years totalled only £400,000 pa in Scotland. It is suggested that to kick-start modal switch through a new pump-priming approach, MSRS should be increased to £5m pa in the Short Term, ie to 2027. After 2027 the suggested prior network enhancements and terminal / private siding investments – and the associated improvements in rail freight efficiency (longer trains, bigger containers, reduced unit costs at terminals, and reduction / elimination of road feeders) – may enable this sum to be reduced.

Programme:

The suggested timescales are largely driven by the time taken to develop new proposals. Project development and approvals are the aspects which drive both cost and delays, and need streamlining in light of the climate change emergency target years.

The Short Term outcomes are relatively simple (in engineering terms), works for which there are already plans and which are of a type that have been routinely delivered over the past two decades: in effect, a ramping-up of current delivery capability. These are the 'low-hanging fruits' which will quickly deliver both improvements for passengers and cuts in emissions with relatively little difficulty, but the biggest impacts will come in the medium to long term.

However, in the case of rail freight much of the benefit can be delivered in the short to medium term, as some important upgades – such as extending freight loops or dealing with the most restricted structures to improve Loading Gauge – involve simple engineering and in most cases do not require time-consuming planning approvals (being contained within the railway footprint).

The Medium Term outcomes are designed to complete electrification, continue with the major works or projects which are still largely based on the existing railway network, but also to integrate with other developments such as the delivery of HS2 in England. The 'new' long-term interventions of TramTrain and the first new estuary crossing – the Forth Tunnel – are to be physically started at this time, although development work will need to begin within the short-term timescale. Many of the major interventions will require Transport and Works Orders (TWO) to secure the powers for their delivery – which can take a considerable time.

The longer-term timescale projects will see the completion of the medium-term works, with the replacement Tay Bridge being the last of this programme of major projects.

General cost environment:

The delivery of works of this scale is a challenge for the current rail industry structure as well as for the contracting base, but is well below the expenditure levels envisaged for HS2. It will be important to establish a Rolling Programme of Scottish-based design and delivery capability to secure lower costs. The objective should be to build a Scottish based railway supply industry, as there will be pressure due to the vast sums being spent on HS2 – currently around £100 billion in the same timescale – and on other projects across the UK.

The route upgrades on the East and West Coast Main lines, costing £3,500 million, are components of a UK-wide High Speed network and funding should be shared with the UK government.

A move to a fully vertically-integrated railway would help to substantially reduce costs and most critically reduce the time taken to design and develop both the whole programme and individual projects.

Consequently it is strongly recommended that the railway industry in Scotland is re-integrated with ScotRail and Network Rail (Scotland) becoming one publically-owned company, with high level oversight by Transport Scotland.

This will reduce costs by reducing overlapping work between ScotRail and Network Rail staff, but more critically it will enable the work to be developed under a 'Single Guiding Mind' and so speed up decision-making and project design. It would also remove the cost of the compensation paid by Network Rail to train operators when lines are shut for engineering works (known as Schedule 4 payments from the standard Track Access Contracts between Network Rail and Train Operating Companies and Freight Operating Companies).

There are potentially many other benefits from vertical integration on a 'one operator' network as exists in Scotland, improving timetabling, reducing operating costs and removing many of the inherent and unnecessary complexities of the current rail industry structure.

Cross-Border, charter and freight operations would be able to continue in a similar fashion as now, with an external Regulator overseeing these bi-lateral contracts between other operators and the vertically-integrated ScotRail, but with a streamlined approach from all parties.

The proposed railway business structure in Scotland:

What is proposed is a return broadly to the very successful ScotRail organisation which existed prior to privatisation. Here there were four local Business Managers: ScotRail Express, Glasgow area local services, Edinburgh area local services, Rural Routes. Each one had a complete view of what was happening in their area, from marketing and fares through timetabling to track and signalling renewals and enhancements. A technical oversight remained at ScotRail HQ to provide support and to ensure that decisions were taken in the best interests of ScotRail as a whole.

This organisation was fast-moving, with low management overheads and short chains of command.

As well as facilitating the ambitious climate change driven programme, an organisational structure of this nature will yield considerable economies in the operation of the Scottish rail network and services, both directly as a result of lower management overheads and indirectly as a result of faster, more responsive and better decision-making.

Deliverability:

There is nothing in any of these *Rail for All* programme proposals which relies of new or untried technologies or processes, so delivery is not anticipated to carry undue risk or be an exceptional challenge. Deliverability will be improved by commissioning long-term programmes and building an established construction industry which is not subject to the inefficiencies of 'stop-start' investment which characterises UK infrastructure investment.

Benefits:

The proposed interventions have been developed in the context of the Climate Emergency and the climate change legislation and targets as approved by the Scottish Parliament. *The timescale for delivery of these targets does not allow for a debate about what to do – it is too late for that. There has to be a mobilisation of effort to deliver what is urgently needed.*

There are several broad objectives driving the choice of interventions proposed:

- move to an electrified transport system on the assumption that electricity generation will be substantially decarbonised

- to provide for the lowest electric energy options for transport, as the transfer from oil-powered to electric-powered transport will require a very substantial increase in green electricity generation capacity
- to improve connectivity for smaller communities so that they can fully participate in the societal and economic benefits which are provided by the cities in this era of every greater specialisation and thus concentration on fewer centres of excellence
- to capitalise on the capabilities of each of Scotland's individual cities and enable them to function as part of a single international economic and social unit.

Specifically these objectives translate into the following operational aims:

- full electrification of the rail network
- improved rail journey times to enable low-energy rail travel to become the dominant mode for longer-distance journeys, both within Scotland and to the rest of England
- to reduce road vehicle trunk freight traffic by increasing the rail network's capability to carry freight
- to provide connectivity to the national rail network for all communities of more than 5,000 people, or where this is not possible at realistic cost (both financial and environmental) to provide integrated coach routes as part of the national strategic network.

Most of the planned interventions bring multiple benefits. All the proposed interventions should being carbon, air quality, noise and safety benefits, as they will not only reduc these outputs on the current railway, but will also provide the capacity, capability and journey time reduction benefits to attract people from car travel. The increased connectivity provided by additional stations, extra routes, improved city transits and integrated coach operations will provide much greater opportunities to choose public transport.

Certain interventions have very strong social and environmental benefits, such as the Forth Tunnel with its station in Leith, completely changing the connectivity of East Fife and Leith, and generating benefits as far north as Dundee (as well as transport advantages stretching as far as north as Aberden and Inverness).

The very substantial journey time reductions will improve the inter-connectivity of the key Scottish cities and economic centres, thus enabling most of the Scottish population to join in the success of the key cities.

The reduced journey times to London and the north and midlands of England should continue the reduction in the number of short-distance domestic flights, as well as attracting people from cars, which has already occurred on

the Edinburgh / Glasgow to Manchester and Leeds routes, making considerable savings in carbon, as well as releasing capacity at the Scottish airports to enable them to provide essential international air links without requiring further expansion of runway capacity.

The costs table for the programme demonstrate the feasibility, importance – and relatively modest cost – of 'quick wins' through investment in freight modal switch from road haulage to rail. And this can provide a disproportionate benefit in terms of maintaining the trajectory towards a net-zero carbon economy.

As a comprensive passenger and freight package, *Rail for All* – with its low-risk but transformational investment – puts the railway at the heart of a civilised transport system, designed to meet the enormous challenge the Climate Emergency poses for Scotland.

Appendices

A1 Scotland's Railways – Details

Found here with together with other rail specific strategy publications:
https://www.transport.gov.scot/public-transport/rail/rail-policy-and-strategy/#45406
It set out the implications for rail on the three NTS Strategic Outcomes:

- Improving Journey Times and connections
- Reducing emissions
- Improving quality, accessibility and affordability

It should be seen in the context of the package of seven rail re-openings/new rail schemes that were in progress as a result of the second Labour/LibDem coalition agreement.

It set out the "Challenges ahead" with a perceptive view of its expectations of what the rail industry needed to do including, delivering innovative rail solutions, minimising the impact on the environment and making rail the environmentally preferred mode and a real alternative to car and air travel, reducing the time required to develop and deliver projects and deliver the projects on time and on budget. It would be fair to say that some of these expectations have been realised and some have not.

Chapter 7 sought to relate the Strategic Outcomes to projects and proposals that were already in the railway development process.

Chapter 8 was the Implementation Plan with detailed proposals setting the direction for railway development over the following two decades. It is a fair summary to say that most of the short term proposals have been delivered as have many of the medium term (defined as 2009-14) proposals.

A2 Strategic Transport Projects Review (STPR)

https://www.transport.gov.scot/publication/strategic-transport-projects-review-final-report/

The final STPR output was distilled down into 29 Proposed Projects, covering the road and rail networks, split into three tiers:

- Maintaining and safely operating existing assets
- Making better use of existing capacity
- Targeted infrastructure enhancements

As these covered both road and rail networks there are subtle differences between the approaches taken to the two modes.

The following were of relevance to the rail operation, green - largely complete, yellow - partly delivered or on-going, red - not real progress:

- 2 Maintenance and safe operation of the rail network - delivered by ongoing funding on Network Rail through the five year Control Periods
- 3 Electrification of the strategic rail network - ongoing
- 7 Reconfiguration of the National Timetable - ongoing
- 10 Integrated ticketing - ongoing, but slowly
- 12 Rail system enhancements - ongoing through the regular Network Rail/Transport Scotland assessment, management and upgrade of the network
- 13 East of Scotland Rail improvements - nothing significant apart from Shotts electrification, which is part of Project 3
- 15 Edinburgh - Glasgow Rail Improvements - partly completed - Almond chord outstanding
- 17 Highland Main Line Improvements - limited Phase 1 works complete
- 19 Rail Improvements between Aberdeen and Inverness - east end complete, west end partly complete, no work in the middle
- 20 Grangemouth road and rail access improvements - largely complete
- 21 Upgrade Edinburgh Haymarket - complete as defined
- 23 Rail improvements between Aberdeen and Central Belt - no progress
- 24 West of Scotland Strategic Rail Enhancements - no progress
- 26 Rail Enhancements between Inverclyde, Ayrshire and Glasgow - some progress, still Kilmarnock/Wemyss Bay lines to do
- 27 West Coast Main Line Freight Enhancements - little progress
- 28 Inverkeithing to Halbeath railway line - no progress

Project 8 - Park & Ride and Park & Choose specifically excluded any rail based schemes and is entirely road orientated.

A3 National Transport Strategy 2 (NTS2) (Protecting our climate and improving lives) and Climate Emergency Declaration

https://www.transport.gov.scot/our-approach/national-transport-strategy/
The completely new NTS2 was published on 5 February 2020. It is the overarching policy setting document to which all other future transport policies will need to take account. The strap line (Protecting our climate and improving lives) sets the agenda and represents the first tangible signs of the impact of the Climate Emergency on overarching transport policy.

The VISION is for "a sustainable, inclusive, safe and accessible transport system, helping to deliver a heathier, fairer and more prosperous Scotland. It sets out four priorities:

Reduces inequalities:

- Will provide fair access to services we need
- Will be easy to use for all
- Will be affordable for all

Takes climate action:

- Will help deliver our net-zero target
- Will adapt to the effects of climate change
- Will promote greener, cleaner choices

Helps deliver inclusive economic growth:

- Will get people and goods where they need to get to
- Will be reliable, efficient and high quality
- Will use beneficial innovation

Improves our health and well being:

- Will be safe and secure for all
- Will enable us to make healthy travel choices
- Will help make our communities great places to live

There is no weighting applied to these four Priorities, but do recognise the need to address climate change.

It recognises that the cities have different needs to the rural areas. The economic growth aspects are more focused on productivity measured in GDP per hour worked, labour markets and connectivity.

Climate change features strongly with the need to adapt to climate change the need to improve air quality, especially particulates, most of which is produced by road vehicles. It also references the decline in bus use.

Reference is made to the importance of transport to employment, work skills, exporting and Tourism, with changing habits such as the move towards digital shopping, with all its ramifications.

What emerges is "The Sustainable Travel Hierarchy" which presented as an inverted pyramid with the least sustainable travel at the bottom point. Walking and Wheeling (use of walking aids) is at the top, followed by Cycling, Public Transport, Taxis and shared transport with private car at the bottom. This hierarchy will be used to inform future transport decisions.

It is followed by "The Sustainable Investment Hierarchy" which has "Reducing the need to travel unsustainably" at the top followed by "Maintaining and safely operating existing assets", "Making better use of existing capacity" with the least sustainable action being "Targeted Infrastructure Improvements". The final part expands on the four priorities with a lot more general detail both in terms of transport but also wider policy issues.

A4 Electrification / Decarbonisation

The Scottish Government in its September 2019 Programme for Government had made reference to 'decarbonising Scotland's railways by 2035'. This was expanded in the detail to 'reduce emissions from Scotland's railways to zero by 2035 through the continued electrification of the network, the procurement of battery-powered trains and exploration of the potential of hydrogen-powered trains in Scotland'

There were clear indications that Transport Scotland would publish further details in March 2020, but the Covid-19 pandemic had prevented this happening.

A5 Infrastructure Commission for Scotland

https://www.gov.scot/publications/infrastructure-investment-plan-2015-programme-pipeline-update-september-2019/

The Infrastructure Commission for Scotland published its updates on 1st November 2019. It includes tables on the major transport projects that are in the early stages of planning (There are other tables that deal with projects in delivery or complete.)Two railway projects are included: High Speed Rail and the Aberdeen - Central Belt (STPR project 23)

High Speed Rail:

Two routes have been considered the East Coast route between Edinburgh and Newcastle where a halving of the journey time to 45 minutes is considered possible and a West Coast route from Abington (south of Carstairs) to Glasgow.

An initial benchmarking exercise is under way on the East Coast to assess an East Linton to Prestonpans section as part of Network Rail's Southeast Scotland to England Project, which recognises the need for additional infrastructure on the ECML east of Edinburgh.

On the West Coast two new cross-border stations are being considered at Eurocentral on the proposed new line and in the Livingston area on existing tracks.

Aberdeen - Central Belt

Aberdeen City Deal funding to £200m is available for this project. The proposal was an incremental package of line speed, signalling and freight loop enhancements to deliver journey time reduction of 20 minutes with more powerful rolling stock. This has not proved possible within this budget. Removal of the single track Usan - Montrose section is not seen as a good value option.

The work is now directed at signalling improvements between Dundee and Aberdeen, which will include freight/passenger loops, targeted line speed improvements and facilitate the decarbonisation of the network. The project is now moving into delivery.

Appendix A6

Glasgow

The next ten years offers a real opportunity to restructure Glasgow's rail network and deliver early results in the drive to meet the 2035 net zero targets as well as eliminating diesel trains from the city's rail network because the bulk of the current rolling stock is already 30 years old and will require replacing before 2035.

Connecting Glasgow, the Glasgow Connectivity Commission's Report on strategic transport issues across the city region made a number of important rail proposals.[41] The headline-catching recommendation was for a new 'South Growth Corridor Metro' line linking the currently major non-rail served locations of Glasgow Airport, Renfrew, Braehead, Queen Elizabeth University Hospital, to the city centre, called the "". The first part of this is a now being actively developed to provide a link between Paisley Gilmour Street station and Glasgow Airport.

The use of Metro-type (light rail) trains allows steeper gradients to be climbed and sharper curves negotiated than with traditional 'heavy rail' operation – thereby offering greater flexibility in choosing route options.

Connecting Glasgow also proposes conversion of the Cathcart Circle / Newton / Neilston heavy rail lines currently operated by ScotRail to a Metro operation, with extensions to Castlemilk and Newton Mearns. It is suggested that St Enoch / Argyle Street is used as a city centre terminal and that TramTrains are used. This would remove existing heavy rail trains and movements on these services from Glasgow Central, freeing up capacity for longer-distance traffic. Planning for this change needs to start now, as a significant proportion of the existing Glasgow suburban train fleet is electric multiple units (EMUs) already around 30 years old, needing replacement in the next decade. This represents a once-in-a-generation minimum-cost opportunity to alter the character of the Glasgow area rail network.

Connecting Glasgow advocates a Metro network which includes not only the routes above but also a wider network based on currently out-of-use Victorian rail track beds stretching to the east, west and north of the city centre. The report also proposes a new under-city tunnel to provide both cross-city links and to reduce pressure on the two existing terminal stations, Queen Street and Central. However this was extensively tested during STPR in 2007/8 and the depth required (due to the river and the Subway) and the steep hills, particularly on the north side, would make this a much longer tunnel than *Connecting Glasgow* suggests. Whilst the concept has merit the execution is challenging and may not deliver what is desired.

This network is based on a range of different operational approaches – from (i) operating on the current Network Rail infrastructure, to (ii) new dedicated and segregated infrastructure, (iii and on-street running. The report indicates that the Metro network may not need to be of one standard but could be two or more discrete routes operating with the appropriate technology for the corridors involved.

The detail of the development of this network will need to be decided in a dedicated authority. It is recommended that a new 'Glasgow City Region

Development Agency' is established, for which primary legislation would be required.

This strategic approach is going to take many years to develop and the large new infrastructure interventions are not likely to start to contribute to the area's transport needs until into the mid/late 2030s.

With this in mind *Rail for All* proposes that the early interventions should be around the discrete and relatively simple tasks of converting and extending the South Glasgow electric network, using tried and tested approaches. Scotland has a good record of developing and delivering new heavy rail infrastructure and services, and we should build on that solid base.

Our proposal is to convert the existing Cathcart / Neilson / Newton routes to a dedicated rail Metro operation, which will be needed to provide the future capacity required, but will also allow considerable improvements in service frequency on all legs – but only when the terminal capacity is available in Glasgow city centre. A new overground terminal station should be developed at Argyle Street station, with a shared terminal building and the new station on a high level above the car park at the rear of the St Enoch centre. It would link into the revived, upgraded and electrified City Union line (which connects the main line from Paisley etc. to the commuter routes running east from Queen Street Low Level and High Street stations. The use of the City Union Line would permit the Paisley Canal services to be diverted into the new Argyle Street high-level terminus, releasing capacity on the Ayrshire and Inverclyde lines for longer-distance services

The only other significant infrastructure works required would be to reopen the former Glasgow & South Western Railway 'Strathbungo Link' – connecting the City Union line with the East Kilbride and Barrhead / Kilmarnock lines – on a largely protected alignment under the M74 and over the West Coast Main Line. Use of the Strathbungo Link would permit the complete diversion of the Barrhead local services and the East Kilbride (via Giffnock) services to the Metro operation, using the new high-level Argyle Street station.
The most challenging part of such a proposal would be the linking of the Strathbungo line to the east side of the Cathcart Circle near Pollokshields East station, where the two routes are at different levels. This is not essential, particularly at the first phase if it is accepted that Metro trains using the east side of the Circle still operate into and out of Glasgow Central station. Neither is it significantly different in scale and challenge from any other recent major road or rail transport scheme.

With the re-construction of a short curve beside Williamwood Golf Course linking the Glasgow - Neilston line into the East Kilbride branch (the alignment

remains largely free of obstruction) additional services could be operated to Busby and East Kilbride and improving connectivity through south Glasgow.

Whilst Metro type trains will appear similar to conventional trains to the users, with the main differences being technical. Another option is to use TramTrains. These are essentially tram-type vehicles adapted to operate on heavy rail infrastructure, so they can run on the segregated heavy railway then divert off onto street running. The system is well established on the continent and is being successfully trialled in Sheffield.

The proposed new routes to Newton Mearns and Castlemilk are potentially more suited to TramTrain operation, with, as far as possible, segregated off-street running. TramTrain may also offer greater penetration of East Kilbride beyond the existing station, including the possibility re-instating a former rail link to Hamilton and Motherwell along the dual-carriageway A725 corridor. Other possible extensions to the network would run east and north using the City Union line to Bellgrove, up to Springburn and onwards to Anniesland using existing heavy-rail lines. Grade separation at Bellgrove (across the Glasgow Queen St Low Level line to Airdrie) and Cowlairs (across the Edinburgh-Glasgow (E&G) main line) would increase capacity on these two longer-distance routes (which could be by TramTrain using street running under the E&G), whilst the new linked Metro route would increase cross-city connectivity.

Edinburgh

It is proposed that the Edinburgh South Suburban line which bypasses the city centre to the south, from Newcraighall in the east to Slateford in the west could form the core part of a new TramTrain route running from Musselburgh via Newcraighall to Haymarket and then on the existing Tramline 1 (from Newhaven and Leith – in 2021) to Edinburgh Park and Edinburgh Airport. Much of this is existing rail infrastructure, or on the Newcraighall to Musselburgh section former rail infrastructure with some on / off street running. New infrastructure would be required to the west of Haymarket to cross the Edinburgh - Carstairs and Edinburgh - Glasgow and Fife main lines. The link to Tramline 1 would be west of Haymarket, where the proposed tram line to Granton would have branched off to the north.

An additional route is possible to Heriot-Watt University (via Currie) which would enable the token ScotRail calls at Slateford, Kingsknowe and Wester Hailes to be removed, speeding up longer-distance Regional journeys, developing Currie as the interchange point between the TramTrain and the Regional services. This route could also loop back to Edinburgh Park to give the university campus much-enhanced connectivity.

Dundee

There is the potential to replace the existing ScotRail Dundee-Arbroath local train service with a TramTrain option. The shorter time-penalty that a TramTrain incurs for extra calls would allow additional stops to be made at two of the existing, poorly-served stations – Golf Street and Balmossie – with the TramTrain from Arbroath leaving the main line in the docks (to begin street-running), thereby freeing up capacity in the constrained east end of Dundee station for long-distance trains.

The route through Dundee city centre would be subject to 'option development', but it should pass close to the current main-line station and ultimately follow the railway corridor to call at the Airport and a new Dundee West station before climbing up to Ninewells Hospital and Technology Park – again with a route selected through option development and stakeholder input.

A separate TramTrain route could link St Andrews to Dundee via Leuchars with an additional call at Wormit. Any operation to Newport and/or Tayport would require a large degree of on-street running which is unlikely to be affordable, given the relatively modest population which would be served.

Dundee City centre to Ninewells would be expected to operate at a minimum 10 minute frequency, with the possibility of through running from both the Arbroath and St Andrews legs, plus a shorter-distance city centre shuttle.

Aberdeen

There are two corridors on which TramTrain could operate, which if realised would create a convenient cross-city transit line.

It is proposed that a branch from Aberdeen Airport serving Dyce station, for interchange with the longer distance services to Inverurie and Inverness, then making use of the largely redoubled Dyce-Aberdeen line, with a small number of intermediate calls, including for new Aberdeen Exhibition and Conference Centre.

The Network Rail line from north of Aberdeen is single track for the last ¾ mile before Aberdeen station, but to avoid this it is proposed that the TramTrain operates either:

- along the freight-only Waterloo branch with a stop at Kittybrewster to serve the University area, it would then move to on-street running along Beach Boulevard and Union Street, giving strong city centre penetration, or,

- via the A96 (largely dual-carriageway) to the east end of the city centre, then join the proposed route on Union Street.

The tram route would then cross the railway, turn south along College Street to regain the former Ballater branch at Duthie Park where it would use the former and largely unobstructed rail route to Banchory or possibly beyond. The detailed routing between College Street and Duthie Park would be subject to option evaluation, but is likely to include shared use on Network Rail's infrastructure and on-street running.

This option would also potentially a solution to providing rail services to Ellon, Peterhead and Fraserburgh, although the vehicles would need to be suitably internally configured for such longer-distance operations.

Endnotes

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/782063/role-of-railway-evidence-paper-rail-review.pdf

[2] https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition-pdf-only/

[3] https://infrastructurecommission.scot/storage/247/FullReport_200120a.pdf

[4] https://www.raildeliverygroup.com/component/arkhive/?task=file.download&id=469776117

[5] https://energysavingtrust.org.uk/blog/planes-trains-and-automobiles-%E2%80%93-carbon-emissions-compared-between-london-and-edinburgh

[6] http://www.ukraildev.net/wp-content/uploads/2016/11/The-Value-and-Importance-of-rail-Freight-summary-report.pdf

[7] https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition-pdf-only/

[8] https://www.oxera.com/wp-content/uploads/2018/07/The-economic-contribution-of-rail-in-Scotland.pdf.pdf

[9] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/782063/role-of-railway-evidence-paper-rail-review.pdf

[10] https://www.transport.gov.scot/media/33630/transport-scotland-rail-freight-guide-web.pdf

[11] https://www.oxera.com/wp-content/uploads/2018/07/The-economic-contribution-of-rail-in-Scotland.pdf.pdf

[12] https://www.oxera.com/wp-content/uploads/2018/07/The-economic-contribution-of-rail-in-Scotland.pdf.pdf

[13] https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition/summary-transport-statistics/

[14] https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition-pdf-only/

[15] https://www.transport.gov.scot/publication/scottish-transport-statistics-no-38-2019-edition/summary-transport-statistics/

[16] Figures supplied by Network Rail at the 2020 Rail Freight Group Scottish Conference held in Bellshill.

[17] The freight loading gauge defines the maximum height and width for wagons and containers on specific routes to ensure that they can pass safely through tunnels, under bridges and keep clear of structures *(modified from Wikipedia)*

[18] With a large proportion from tyre and brake wear, see: https://ec.europa.eu/transport/road_safety/sites/roadsafety/files/pdf/projects_sources/particulates_d16_final_report.pdf 2nd para numbered page 6

[19] https://infrastructurecommission.scot/storage/247/FullReport_200120a.pdf

[20] https://www.transport.gov.scot/media/39496/high-level-output-specification-hlos-for-control-period-6-final.pdf

[21] https://www.transport.gov.scot/publication/rail-enhancements-capital-investment-strategy/

[22] https://www.gov.scot/publications/scottish-planning-policy/

[23] https://greens.scot/scotland-can/connect-people

[24] Informal advice to the consultants in 2020

[25] The Almond Chord was a planned cut-off line from the Winchburgh Junction to Dalmeny line onto the Edinburgh to Fife line just north of Edinburgh airport. It was designed to transfer trains from the Falkirk route onto the Fife route to balance the occupation through the congested Haymarket and Princes Street Gardens area, to reduce conflicts at Newbridge Junction and to serve Edinburgh Gateway station.

[26] A short stretch of new railway beside the M90 to enable InterCity trains to bypass slow sections of railway in Fife and to create a 'Dunfermline' circle for short peak workings over the Forth Bridge (STPR Project 28 Inverkeithing to Halbeath Railway Line)

[27] The key capacity constraints are the various single-track sections on the Highland Main Line (Perth to Inverness) and on the Perth to Aberdeen line at Perth, over the Tay east of Perth, and between Usan and Montrose over the Esk. (STPR Projects 17 (HML improvements) and 23 (Rail Improvements between Aberdeen and the Central Belt))

[28] The two lines through central Glasgow (via Queen St and Central) converge at Partick, and at Hyndland the two lines to Dalmuir via Yoker and via Westerton diverge, making Partick-Hyndland the most intensively-used section of the Scottish rail network (as well as being occupied by two busy stations at Partick and Hyndland)

[29] Dynamic Loops are long crossing loops (effectively sections of double track) on otherwise single-track railways designed to enable trains in opposite directions to cross at line speed, reducing the inherent extra time if trains have to stop to cross each other and also improving performance by reducing the interaction between trains

[30] https://www.transport.gov.scot/public-transport/rail/far-north-line-review-group/

[31] https://www.transport.gov.scot/publication/delivering-the-goods-scotlands-rail-freight-strategy/

[32] *Britain's Growing Railway*, Railfuture (2017)

[33] Private research by David Prescott of Allan Rail Ltd (2017)

[34] Data from ORR's Estimates of Station Usage, collected over a long time period. https://dataportal.orr.gov.uk/statistics/usage/estimates-of-station-usage/

[35] *Britain's Growing Railway*, Railfuture (2017)

[36] *Britain's Growing Railway*, Railfuture (2017)

[37] Spaven, D, *Waverley Route: the battle for the Borders Railway* (third edition), Stenlake Publishing (2017)

[38] https://www.bbc.co.uk/news/uk-scotland-scotland-politics-48077802

[39] https://www.transport.gov.scot/media/39496/high-level-output-specification-hlos-for-control-period-6-final.pdf

[40] https://www.networkrail.co.uk/industry-and-commercial/rail-freight/freight-growth

[41] Connecting Glasgow https://www.glasgow.gov.uk/connectivitycommission