On the Move:

Investing in public transport to meet carbon targets and create jobs

Friends of the Earth Scotland

Commissioned by Friends of the Earth Scotland

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Commissioned by Friends of the Earth Scotland.
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Executive Summary

We are facing a climate emergency, with an urgent need to reduce carbon emissions this decade. The Scottish Government has set ambitious goals for traffic reduction and climate emissions reductions by 2030 but it now needs to deliver on those targets.

We estimate Scotland needs to shift around **6 billion car passenger kilometres a year by 2030 to public transport** (and walking and cycling) to meet its carbon targets. This will require **an average increase in bus and tram passenger km of around 80% and a more than doubling (110%) of rail passenger km in Scotland by 2030** compared to pre-Covid levels. Although this sounds ambitious, with the right investment and support significant increases can be achieved in a relatively short period of time.

We estimate that this will require **additional operating costs of around £1.6 billion a year by 2030**. These costs take no account of new revenue from the increase in public transport use, which would result from the service improvements and disincentives to driving, as there is a strong case to reduce fares to make public transport more cost competitive with driving.

We have used the Scottish Government's published cost figures for proposed bus, metro/mass transit and rail schemes from its Strategic Transport Projects Review. Although many of these schemes are still at an early stage and any costs are ballpark figures, they represent the schemes most likely to be taken forward to deliver improved public transport levels.

The additional capital investment is estimated at:

- **Around £1.4 billion (£0.8-1.9 billion) for bus schemes** and measures to integrate public transport up to 2030.
- **Around £8.9 billion (£7.7-10 billion) for mass transit/metro schemes** (a combination of bus, tram/metro, rail) up to 2035.
- **Around £10.3 billion (£8-12.5 billion) for rail schemes** up to 2035.
- The total average capital investment, annualized over 12 years, is around £1.7 billion a year.

We estimate the additional public transport investment would create:

- **Around 22,000 additional direct jobs** in bus, mass transit/metro and rail operation compared to around 24,000 existing jobs in public transport (i.e. almost one new job for every existing job).
- **Around 416,000 direct and indirect jobs** created through bus manufacture and construction of bus infrastructure, new mass transit/metro systems and rail infrastructure over 12 years (i.e. an average of around 35,000 jobs per year for 12 years).

The investment needed would more than pay for itself in benefits.

Numerous studies have shown that the return in terms of economic benefits from public transport investment outweighs the initial costs and provides high or very high value for money. The rail investment alone would yield economic benefits of around £20 – 30 billion while bus priority measures would generate economic benefits of around £2.5 – 5 billion.

To maximise the benefits of this investment and meet the 20% traffic reduction target, it is essential that measures are brought in to disincentivise traffic.

A national system of road pricing would not only constrain traffic and facilitate the shift to public transport, walking and cycling, it would also generate funds that could be used to fund investment in public transport infrastructure and services.

Behaviour change measures that reduce car traffic, including by shifting journeys to public transport, can reduce greenhouse emissions in Scotland by around 1.2 million tonnes by 2030. This is not only essential for meeting Scotland's carbon targets but has numerous positive benefits for economic prosperity, local communities, and health and wellbeing, and would help reduce inequalities.

Good public transport is not just a 'nice to have' but a climate imperative. Improving public transport service levels throughout Scotland will give people more freedom and choices and reduce their costs of travel.

It will simultaneously make people's lives better and greatly improve the places they live in.

1 Introduction

We are in a climate emergency, with an urgent need to reduce carbon emissions this decade. Transport in Scotland, as in the rest of the UK, is a major contributor to greenhouse gas emissions and the sector has failed to reduce emissions over the last 30 years, largely because of increased road traffic and aviation. The Scottish Government has recognized the problem and set ambitious carbon and car traffic reduction goals for 2030. However, it has not yet outlined how much additional public transport investment will be needed.

At the same time, public transport has suffered plummeting passenger numbers because of Covid. This has impacted fare revenue, making some services commercially unviable, while at the same time operators are faced with the rising cost of fuel and inflation.

Without continued government funding support there is likely to be widespread cuts in services, leaving many communities and individuals isolated.

This perfect storm for public transport comes at a time when we need to support existing public transport users, many of whom depend on public transport, and get more people out of cars and onto buses, trams, and trains (and walking and cycling). This is not only essential for the climate but has numerous positive benefits for economic prosperity, local communities and health and wellbeing, and would help reduce inequalities.

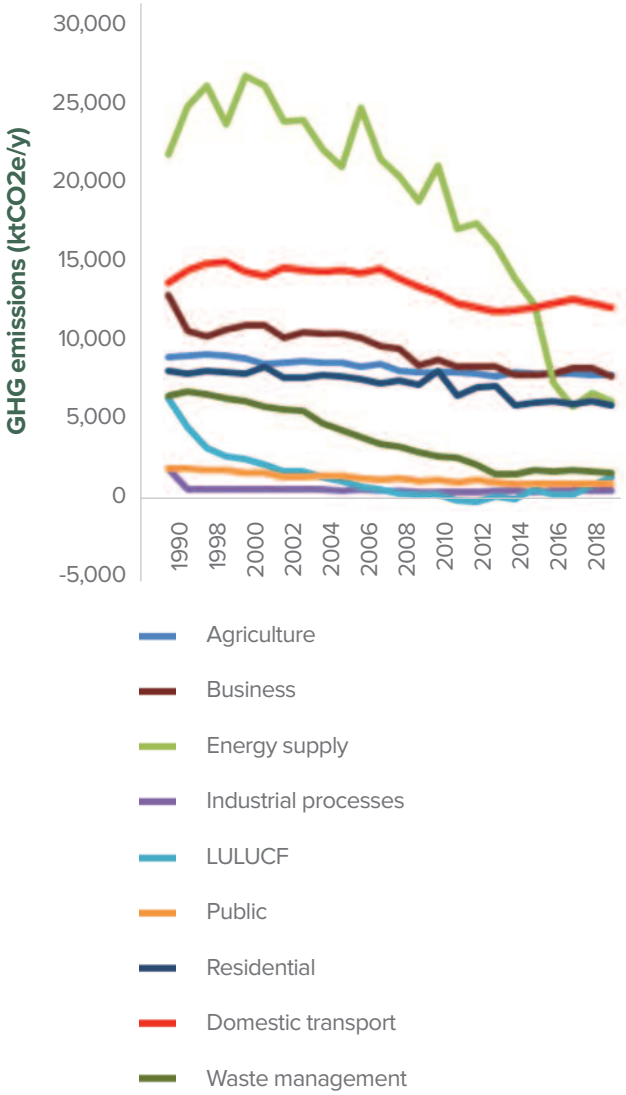
This report estimates the increase in public transport passenger distance and trips likely to be needed by 2030 to help meet Scotland's traffic reduction target, and high-level ballpark figures for the necessary investment and associated jobs. This complements and draws heavily on a similar report on the public transport investment needed in England outside London and Wales.[1] Both reports make the case for significant investment in public transport as part of a green and just transition that will meet climate targets and simultaneously create multiple economic, social, and environmental benefits.

2 The need for action

2.1 Transport is a problem sector

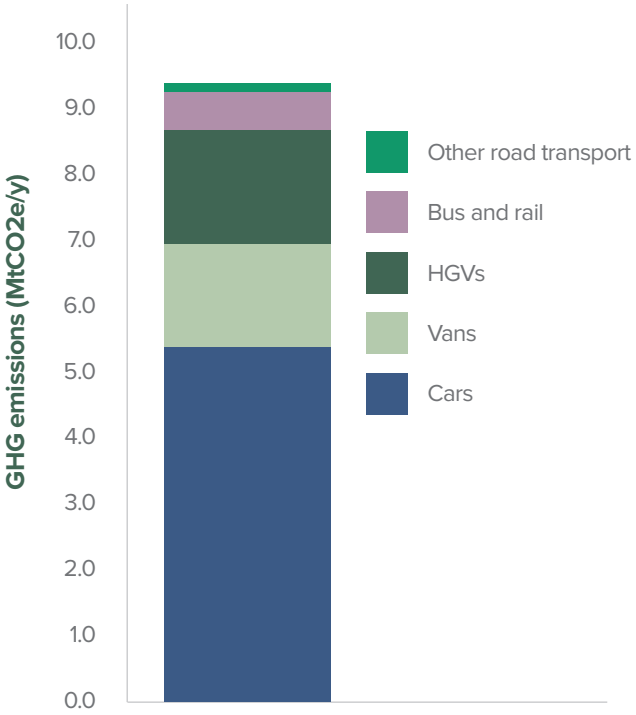
Transport was responsible for 29% of Scotland's total greenhouse gas emissions in 2019, the single biggest sectoral source of emissions.[2] Unlike other sectors, transport emissions have hardly changed since 1990, with domestic transport emissions only 2–3% lower in 2019 than 1990 levels (see **Figure 1**) while international transport emissions were over 40% higher.

Figure 1: **Greenhouse gas emissions in Scotland by sector 1990 – 2019**[3]



Car use was responsible for nearly two-fifths (38%) of total transport emissions (including international aviation and shipping) and nearly three-fifths (58%) of Scotland's Road transport emissions in 2019.[4] Public transport (bus and rail) was responsible for around 6% of road transport emissions (see **Figure 2**). Any improvements in car vehicle efficiency over time have been offset by increasing usage. Car mileage has grown by nearly a third (29%) since 1993, reaching a peak of over 36 billion vehicle km in 2019.[5] Although car mileage plummeted because of Covid, it has rebounded and in February 2023 total road vehicle traffic volumes across Britain were 96% of pre-Covid levels.[6]

Figure 2: **Greenhouse gas emissions from Scotland's road transport sector in 2019**[7]



2.2 Scotland's climate and traffic reduction targets

In 2019, the Scottish Government set ambitious carbon reduction targets to be net zero by 2045 (five years ahead of the UK Government) with an interim emission reduction target of 75% by 2030 relative to 1990 levels.[8] The transport sector has been assigned its own emissions target of a 56% reduction by 2030.[9]

Targets for 2030 are critical *"as the cumulative nature of CO_2 build up in the atmosphere makes early carbon reductions much more important in reducing the impacts of climate change than later emission reductions made in the 2030s and 2040s".*[10]

Transport Scotland commissioned research to understand the policy implications of these new emission targets. The resulting analysis by Element Energy demonstrated *"that major changes in the way people travel will be needed, alongside technology"* to avoid the worst impacts of climate change.[11] It showed that meeting carbon targets in Scotland would need both rapid introduction of low and zero emission technologies **and** a reduction in passenger, freight and vehicle kilometres achieved through modal shift and reduced travel demand.[12] This resulted in the Scottish Government commitment in their 2020 updated Climate Change Plan to reducing car kilometres by 20% by 2030 relative to 2019.[13] This will achieve a reduction in greenhouse emissions of around 1.2 million tonnes by 2030.[14] More details on the link between traffic reduction and carbon can be found in **Appendix 1**.

The Climate Change Committee's analysis suggests that this 20% car traffic reduction is equivalent to a 3% annual reduction a year to 2030.[15] While this is ambitious, annual reductions of this order have been seen previously in Scotland and other parts of the UK.[16]

This report uses the 20% reduction target for car traffic as the basis for estimating the increase in public transport needed by 2030, and 2019 or 2018/19 as the baseline year.

3 Scotland's existing public transport network and passenger levels pre-Covid

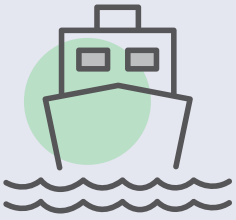
Scotland has an extensive bus service, the Edinburgh Tram, Glasgow Subway and has recently taken its train operation back into public service *(see box below)*.

Scotland's public transport network

Buses: Pre-Covid, 373 million journeys a year were made by bus in Scotland.[17] In 2019, one-quarter (25%) of the adult population used buses at least once a week, which rose to nearly two-fifths (39%) for people living in low-income households.[18] Despite declining bus passenger numbers over the last few decades, the number of bus journeys per capita was over 50% higher in Scotland in 2018/19 than for England outside London.[19] Since deregulation in the 1980s, most bus services in Scotland are operated on a commercial basis by private bus companies, with some non-commercial services subsidised by local authorities. There are three main operators, First, Stagecoach and publicly owned Lothian Buses (the main provider of bus services in Edinburgh and Midlothian), and dozens of smaller independent operators.

Trams/subway: Scotland has two tram/subway networks: the Glasgow subway built in 1894 and the Edinburgh Tram, which opened in 2014. Pre-Covid there were about 7 million tram trips per year on the Edinburgh tram and 13 million trips per year on the Glasgow subway.[20] The Glasgow Subway consists of a single orbital line of 10 km and is currently undergoing a £289 million upgrade with 17 new trains to be introduced in 2023. The Edinburgh tram has one line of 10 km from the City Centre to Edinburgh Airport with a 5 km line to Newhaven currently due to open in Spring 2023.[21] This will complete the originally envisaged phase 1a of the tram and is forecast to effectively double the passenger numbers from the current network in its opening year.[22] Both the Edinburgh Tram and the Glasgow Subway are publicly owned and operated.

Rail: Scotland has around 359 train stations and over 2,700 km of rail track.[23] Pre-Covid there were a total of around 102 million train trips within and to/from Scotland a year.[24] About 30% of adults in Scotland used the train at least once a month in 2019.[25] The majority of train services and train stations in Scotland (except Glasgow Central and Edinburgh Waverley) are run by ScotRail, though several other train companies operate services from England to Scotland.[26] Since April 2022, ScotRail has moved into public control and ownership.[27]



Ferries: There are over 60 scheduled ferry routes in Scotland, managed by a range of public and commercial operators. For the purpose of this report, we have not considered ferries because although they are an essential public transport service for island residents and visitors, they are not a direct substitute for cars.

Pre-Covid, the passenger distance travelled by car in Scotland far exceeded that travelled by public transport as shown in Table 1 (assumptions and data sources given in **Appendix 2**).

Table 1:
Estimated passenger distance travelled by different modes in Scotland in 2018/19 (million passenger kilometres or mpkm/capita rounded to nearest ten million)

Mode of travel	Passenger km (mpkm) (a)	Passenger km per capita (kpm per capita) (b)
Car	55,020	10,070
Bus	2,610	478
Tram/subway	100	20
Train	3,000	550
Total public transport	**5,710**	**1,050**

(a) A passenger km represents the transport of one passenger by bus, tram, train over one kilometre. For cars the passenger km refers to both drivers and any car passengers, so a car with one passenger driving, say 10 km, would be equivalent to 20 passenger km.

(b) Using mid 2019 population estimates.

This much higher car use is despite the fact that hundreds of thousands of households in Scotland do not have access to a car. In 2019, over a quarter (28%) of all households did not have access to a car, which increases to three-fifths (60%) for households on low income or nearly a half (47%) of households in Glasgow City.[29] Even in rural areas, a tenth of households do not have access to a car.[30] For all those without cars, public transport is a lifeline.

A 2016 report found that about 1 million people across Scotland lived in areas that are considered 'high risk' for transport poverty (when people don't have access to essential services or work because of a lack of affordable transport options). The risk of transport poverty was greatest in regions with (relatively) low income, high car availability and limited access to essential services by public transport.[31]

Public transport offers the best opportunity to reduce the distance travelled by cars:

- **A fully loaded bus can take 65 cars off the road**
- **A full Edinburgh tram can take 250 cars off the road**
- **A full Glasgow subway train can take 165 cars off the road**
- **A full passenger train can take 500 cars off the road**

It also provides numerous other benefits:

- **Buses** are the best used form of public transport in Scotland (in terms of number of trips). Buses are particularly important to younger people, older people and women[32] as well as for areas which are not served by the rail network, including much of rural Scotland. Additional bus services can be deployed relatively quickly and cheaply unlike light rail/trams and heavy rail which require longer lead times and more capital investment. Bus services are suitable for all areas.
- **Trams/light rail/subways** are an efficient, low carbon form of transport with high passenger capacity which provide predictable, regular and reliable journey times and service patterns.[33] New tram/light rail systems can be transformative for urban areas and enable major public realm improvements through reducing road space in favour of pedestrians and cyclists. They are a recognised catalyst for urban improvement and regeneration.[34] They have a proven record of attracting people out of cars. For example, the rate of transfer from car to tram at peak times is typically around 27%.[35]

Definition of light trail/trams

According to the UK Department for Transport: *"The term "light rail" covers a range of different systems, the most familiar being trams. In general, they are public transport systems which use rail-based technologies and typically operate in urban settings. The vehicles are usually lightweight, run on steel rails and are propelled by overhead electrical wires... Earlier guidance... stated that all 'tramway' systems were deemed to have a significant element of their operation in the highway. As a system is given increasing levels of separation from, and priority over, other traffic, it moves from being considered a tramway to being a light rail system."* [36]

Subways can be either light or heavy rail, depending on the vehicles used. Glasgow Subway is classed as a light metro system, which is somewhere in between light and heavy rail, but for the purposes of this report we have included it with light rail.

- **Rail** is the backbone of the public transport system, responsible for the highest passenger distance. It is the only public transport mode (along with coaches) that can substitute for long distance trips (>50 km). Rail services can deliver a substantial modal shift from cars and are essential for driving down transport carbon emissions. For example, when surveyed a year after the Borders Railway had opened, 57% of users said they would have previously made their journey by car.[37]

  On the Airdrie-Bathgate rail link, between Glasgow and Edinburgh, nearly a fifth (19%) of sampled rail users stated that in the absence of the recent rail improvement, they would travel by car, and a further 2% stated that they would use the car for part of their journey.[38] Rail has one of the lowest carbon footprints of any travel mode for long distance journeys. For example, taking the train from Glasgow to London emits around one third of the carbon per passenger km compared to driving an average petrol car and around a fifth of a large petrol car.[39]

As well as shifting more journeys from cars to public transport, Scotland also needs to decarbonise the bus fleet and electrify the remaining diesel rail network to meet its carbon targets:

- In 2021/22, Scotland had a fleet of around 3,700 public service buses as well as a larger fleet of private buses and coaches. Currently only around 16% of public service buses in Scotland are zero emission at point of use (mainly electric with a few hydrogen buses).[40]
- While the majority (76%) of Scotland's rail passenger journeys are on electric traction[41], it still lags behind other European countries. For example, as of early 2020 around 41% of Scotland's railway track was electrified while Switzerland has full electrification of its railway, Belgium 86% and Germany 60%.[42]

4 What increase in public transport is required to meet Scotland's traffic reduction and carbon goals by 2030?

In 2022, the Scottish Government published a draft route map of how the 20% car reduction target will be met.[43] This outlined a number of interventions to encourage modal shift including:

- **A Fair Fares Review to examine the affordability of public transport fares**
- **A Community Bus Fund**
- **Investment in the rail network**
- **A review of transport governance.**

However, the Climate Change Committee (CCC) has subsequently advised that this is not sufficient and a comprehensive delivery plan is needed, setting out measurable targets, milestones and allocated funding for interventions and delivered at pace and with ambition.[44] The CCC has recommended the detailed delivery plan *"should include both investment in more sustainable modes of travel and measures to reduce the attractiveness of driving."*

Despite the Scottish Government's laudable ambition and commitments for transport, progress on the ground for many proposed sustainable transport measures has been slow. According to analysis by Transform Scotland, 8 out of 10 major transport measures have shown little or no progress over three years with the risk that traffic reduction targets will be missed.[45]

While Scotland's transport vision is for an integrated network of public transport, active travel, and shared mobility, it is not clear how much of an increase in public transport is needed to achieve the necessary modal shift or approximately how much that will cost. It is clear that any change needs to be both transformational[46] and urgent, given the short timescales to 2030.

This report attempts to estimate the increase in public transport usage needed to meet Scotland's 20% traffic reduction goal by 2030.

In 2019, a total of nearly 37 billion kilometres were travelled by car in Scotland. To meet the traffic reduction target, Scotland needs to cut a total of over 7 billion kilometres being travelled by car per year (20%) by 2030, equivalent to over 11 billion passenger kilometres (assuming current average car occupancy of 1.5).

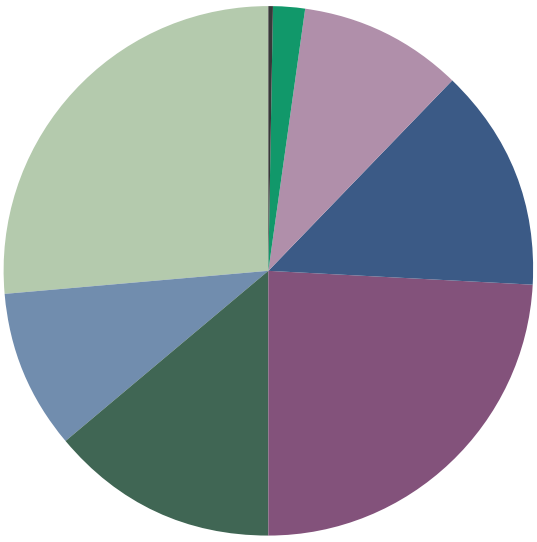
Using a similar methodology for a study estimating the increase in public transport needed in England outside London and Wales,[47] we have assumed that around 8–10% of car traffic can be reduced by 2030 relative to 2019 levels without modal shift. There is evidence from research for Transport Scotland that working from home can potentially reduce car and van mileage by around 5%.[48] We have assumed that reduced business travel (e.g. through use of videoconferencing), destination shifting (e.g. shorter journeys) and increased car occupancy (from 1.5 to 1.7) can reduce a further 3–5% of total car mileage. See **Table 2.2** in **Appendix 2** for details.

This leaves 10–12% of total car vehicle (and passenger) km which needs to be shifted to other modes by 2030 in order to meet the 20% traffic reduction target. Adjusting for population growth by 2030, we estimate that around 5.5 – 6.7 billion car passenger km per year need to be shifted to other travel modes by 2030 (see **Table 2.3** in **Appendix 2** for details).

To allocate this amount of car passenger km to different modes we have analysed which trips can be most easily substituted by public transport based on the breakdown of car mileage by trip length. We use the breakdown of car mileage rather than number of car trips as the former is better correlated with carbon emissions. For example, a single one-hundred mile car journey will have similar carbon emissions, all other things being equal, to a hundred one-mile car journeys.

Figure 3 shows the breakdown of car miles by trip length in England, in the absence of equivalent Scottish data. We assume that the pattern of trips in Scotland will be broadly similar.[49]

Figure 3: **Proportion of car miles by trip length in England in 2019** [50]



< 1 mile	0%
1 to < 2 miles	3%
2 to < 5 miles	12%
5 to < 10 miles	16%
10 to < 25 miles	28%
25 to < 50 miles	17%
50 to < 100 miles	11%
>100 miles	13%

Figure 3 shows that in 2019 car trips of 2–10 miles (around 3–16 km) were responsible for around 28% of total car mileage while car trips of over 25 miles (around 40 km) were responsible for around 41% of total car mileage.

Typically bus journeys in Scotland are medium distance (average around 12 km in 2019), and train journeys are longer distance (average around 28 km).[51] The average tram/subway distance is shorter than for buses (average 8 km for the Edinburgh tram and 3 km for the Glasgow subway)[52] but for simplification we have assumed that buses and trams can substitute for trips of similar length. Tram trip lengths are likely to increase in Edinburgh with the completion of the existing network.[53]

There is significant overlap between the different public transport modes as some bus journeys can be as long as 25 km and some train journeys can be as short as 5 km.[54] We have therefore assumed that bus/tram can substitute for car trips of 2–10 miles (3–16 km) as a lower bound and 5–25 miles (8 – 40 km) as an upper bound, and rail can substitute for car trips of >25 miles (>40 km) as a lower bound and >10 miles (>16 km) as an upper bound.

Of the car distance to be shifted to other modes, we have assumed bus/tram journeys will account for an average of 37% and train journeys for an average of 55% (see **Table 2.4** in **Appendix 2** for details). This is similar to the proportion of total passenger distance travelled by bus/tram and rail in Scotland in 2019.

For simplification we have ignored very short car trips (<2 miles) which can be shifted to walking and cycling, even though some of these journeys will also be taken by bus/tram. Some of the trips of 2–10 miles may also be substituted by walking and cycling. There will also be significant additional walking and cycling trips associated with increased public transport use, i.e. walking to a bus stop or cycling to a train station. This illustrates the importance of considering transport as an integrated network of walking, cycling and public transport.

By applying the percentages above to the total amount of car km to be shifted to other modes we get the results shown in the **Table 2** on the next page.

Table 2:
Additional public transport passenger km likely to be needed in Scotland by 2030 to meet traffic reduction target (billion pkm/y) (% increase rounded to nearest 10%)

	Bus	Tram/Subway	Train
Existing passenger km in 2019 (bpkm/y)	2.6	0.1	3.0
Average additional passenger km by 2030 (bpkm/y) (range in parentheses)	2.2 (1.5 – 2.9)	0.1 (<0.1 – 0.1)	3.4 (2.3 – 4.6)
Average total passenger km by 2030 (bpkm/y) (range in parentheses)	4.8 (4.1 – 5.5)	0.2 (0.2)	6.4 (5.3 – 7.6)
Average % increase by 2030 relative to 2019 (range in parentheses)	80% (60 – 110%)	80% (60 – 110%)	110% (80 – 150%)

We estimate Scotland needs an average increase in bus and tram passenger km of around 80% and a more than doubling (110%) of rail passenger km by 2030 relative to 2019 to meet the traffic reduction target. This does not include any additional rail passenger km due to a shift from aviation to meet carbon targets, which was outside the scope of this report.

However, if this is taken into account, the increase in rail passenger km is likely to be even higher.

Our estimate of additional public transport use needed is based on journeys that would otherwise have been made by car. We assume that this level of mode shift is needed to achieve carbon targets and **makes no allowance** for the propensity to change (e.g. they don't include passengers who previously walked/cycled or switched between different public transport modes). In other words, these are the journeys needed to accommodate the shift from cars and therefore represent a minimum increase. If mode shift on this scale is not achieved, there will need to be even greater reductions in car journeys or bigger cuts in carbon elsewhere in the economy.

A report for the Confederation of Passenger Transport (CPT) used a different methodology to estimate the total bus passenger km needed to meet net zero in Britain.[55] The CPT estimated that bus passenger km in Scotland would need to increase to a total of 4.1 billion passenger km by 2030, coincidentally, very similar to the lower bound of our bus estimates.

While these increases in public transport sound ambitious, there are many examples from schemes which show that, with the right investment and support, significant increases in use can be achieved in relatively short periods. For example:

- The Borders Railway, which (re)opened in 2015, had over a million passengers in its first year, exceeding forecasts.[56]
- Electrification of railway lines often result in an increase in passengers, something known as the 'sparks effect'.[57] This is partly due to faster and smoother services with electric trains which can operate at higher speeds than diesel trains. At Bathgate in West Lothian, the station was expanded and relocated at the time of electrification which allowed doubling of services from two to four trains per hour between Bathgate and Edinburgh. Passenger numbers increased by 87% from four years prior to electrification to four years post electrification, compared to a ScotRail-wide figure of 25% for the same 2010-2018 period.[58]
- Edinburgh Tram passenger numbers were over five million in its first year, exceeding forecasts.[59] Passenger numbers increased by over 80% in the four years up until Covid.

5 What levels of additional operating costs and capital investment are required?

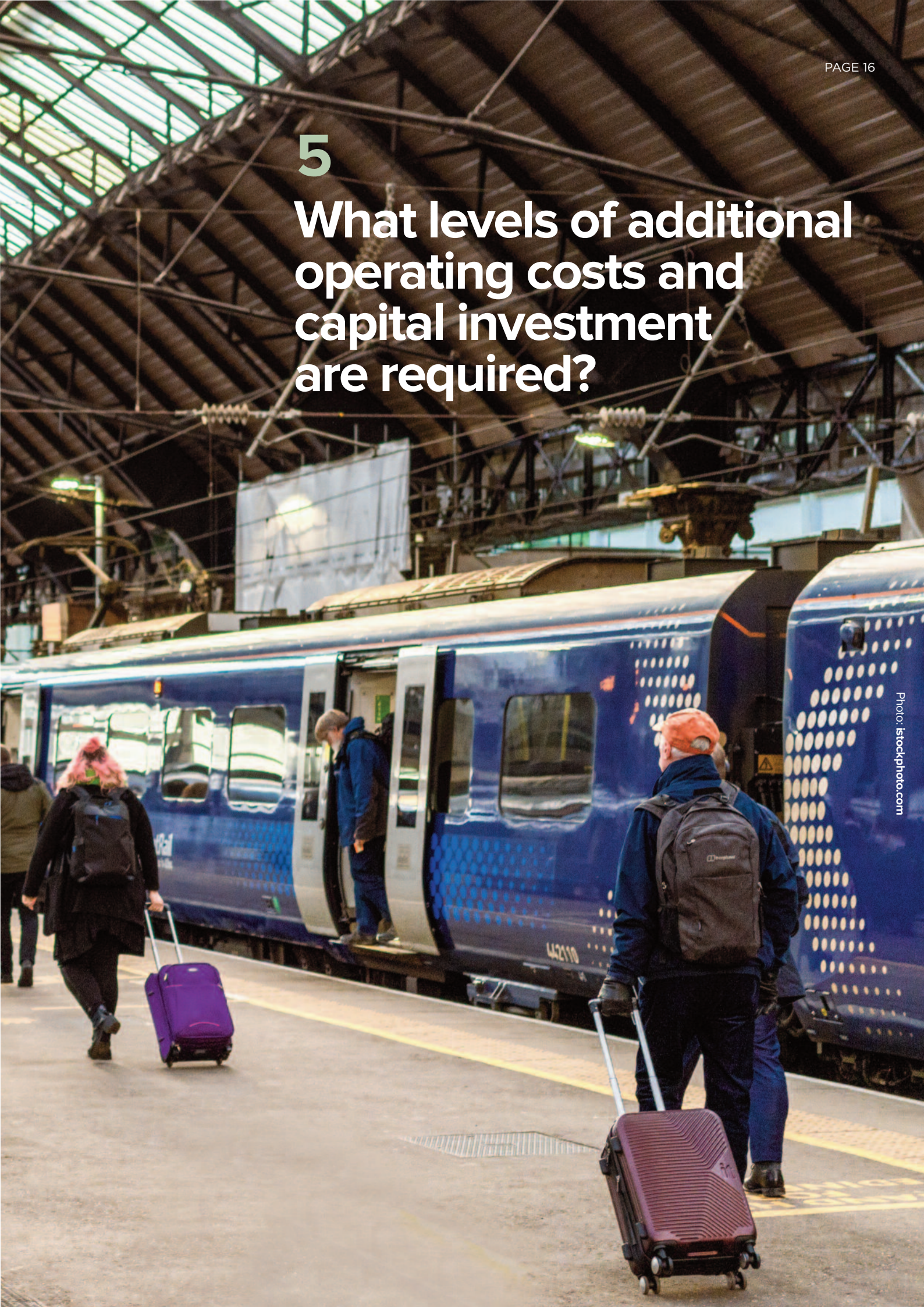


Photo: istockphoto.com

5.1 Need for fare reductions

Over the last 10 years, the cost of public transport fares has risen faster than the cost of living while the cost of motoring has fallen in real terms. Achieving the level of mode shift required is likely to need fare reductions to make public transport more cost competitive with private car use. This has to be applied to the existing public transport services as well as any additional services, so in practice some of the present revenue would also be lost. Fare reductions will also help with the cost-of-living crisis.

A cross-party group of Scottish MSPs have recommended that the cost of bus and rail travel needs to be cut in real terms to respond to the cost-of-living crisis and provide affordable alternatives to car use.[60]

The NGO Transform Scotland has recommended flat-fare tickets that work across operator and modal boundaries, offering affordable tickets that integrate all public transport in their covered area.[61] Transform Scotland cites the example of the Austrian Klimaticket (Climate ticket) which costs €1,095 per year, €3 per day, and allows unlimited travel on all public transport in Austria. The Austrian government is providing financial support estimated at around €160 million (2022 figure).

Bus fares are already capped in London, Greater Manchester, West Yorkshire and Merseyside. In Greater Manchester, lower £2 bus fares have helped to increase bus patronage by 10% and attracted new users, some of whom are likely to have switched from cars.[62] The UK Government has also provided £135 million to fund a £2 fare cap on bus services in England from January – June 2023.[63]

In a report for the CPT, the costs of making buses cheaper were estimated as part of a package of measures to increase modal shift to buses to achieve net zero.[64] It was estimated that a £2 bus fare cap for single journeys in Scotland would cost around £78 million a year while free bus fares would cost around £480 million a year, delivering a 35% increase in passenger trips relative to 2018/19.[65]

Although a £2 bus fare cap has not been introduced in Scotland, the Scottish Government is currently undertaking a Fair Fares Review *(see Box below)*.

Fair Fares Review

The Scottish Government is currently undertaking a 'Fair Fares Review' to examine the range of discounts and concessionary schemes which are available on all modes including bus, rail and ferry across the whole of Scotland.[66] It is not clear when this will be published.

Scotland has already introduced a large number of concessionary fares including free bus fares for people aged over 60, disabled people, young people under 22, and 'Kids for a Quid' on rail.[67] In the first year of the free bus fare scheme, young people under 22 made over 50 million bus trips.[68]

In December 2022, the Scottish Government announced that it would provide £15 million for a six-month rail fare pilot, removing peak time rail fares as a way of making rail travel more affordable and attractive to travellers.[69]

It is worth noting that Scotland already has a model of making public transport cost equivalent to car travel in the form of a "Road Equivalent Tariff".[70] This ensures that the cost of travel from the mainland to the Western Isles by ferry does not exceed the cost of driving an equivalent distance.

In practice, a combination of both fare reductions and increase in motoring costs is likely to be required to make public transport more affordable and cost competitive with car use.

5.2 Operational (revenue) funding

We have made some ballpark estimates of the additional operating costs to run the extra bus, tram/subway and rail services needed to meet Scotland's traffic and carbon targets.

These should be seen as conservative estimates for two reasons. Firstly, they assume zero additional revenue from increased patronage uplift as discussed above in order to make fares more cost competitive. Secondly, the additional investment in public transport is likely to result in significant operational efficiencies, some of which are difficult to quantify. For example, investment in bus priority measures will mean faster journey times, so more daily bus journeys can be added to a route without increasing the number of vehicles. Completion of the Edinburgh Tram to Newhaven will result in incremental operating and maintenance costs costs per passenger which are much lower than existing costs, indicating the increased efficiencies with larger networks.[71]

However, we have assumed that additional costs for additional peak services, extending core hours and additional concessionary fares will be offset by lower operating costs. For example, an electric bus typically costs nearly 40% less to operate over its lifetime than a diesel one,[72] while electric trains are cheaper to operate and maintain than diesel ones.

Where possible we have tried to use the most recently available 2021/22 prices, but our costs do not take account of subsequent inflation and escalating supply chain costs.

Table 3 below shows our estimates of the average additional operating costs by 2030. See **Table 2.5** in **Appendix 2** for the methodology and assumptions used.

Table 3:
Estimates of average additional operating costs (£m/y) by 2030 (rounded to nearest £10m) (2021/22 prices) and % increase to costs in 2019 (rounded to nearest 10%)

Public transport mode	Average additional operating costs (£m/y) by 2030	% increase relative to 2019
Bus	600	80%
Tram (a)	40	70%
Rail	920	100%
Total	**1,550**	**90%**

(a) We have based future operating costs on tram rather than subway operating costs

Table 3 shows that the **additional** operating costs by 2030 are estimated to be around £1.6 billion a year which is nearly double (90%) the estimated costs in 2018/19.

Given that every £1 spent on bus operation is estimated to generate £2.50 – £3 in the wider economy,[73] the added costs are likely to be far outweighed by the benefits.

5.3 Capital funding

To achieve the necessary uplift in public transport passenger numbers and distance travelled will also require significant capital investment including:

- **Expanding the bus fleet:** From the current 3,700 public service bus fleet to an estimated 5,300 by 2030 to accommodate the additional service levels and passengers.[74] It is assumed that all replacement or new buses will be predominantly electric due to their much greater energy efficiency than alternative zero emission buses.[75]
- **Electrifying the bus fleet (and charging infrastructure):** It has been recommended that Scotland ends the sale of fossil fuel powered buses and coaches from 2025, in-line with the direction of the UK bus industry.[76] It is also recommended that by 2030 all buses manufactured prior to 2015 must be scrapped or repowered if Scotland is to meet its 2030 targets.[77] This would require around a half (54%) of Scotland's current public bus fleet to be replaced by 2030.[78]
- **Bus priority measures:** Interventions such as dedicated bus lanes or traffic light priority schemes which improve the speed and reliability of bus journey times are essential for making buses a viable and attractive alternative transport choice for car users. In a survey of bus users across 20 communities in Scotland, 83% of passengers valued bus reliability as their top consideration.[79]
- **New tram/light rail/metro schemes:** Although generally more capital intensive than bus improvements, they facilitate a shift from cars by offering greater reliability, comfort and faster journey times and capacity. The completion of the Edinburgh tram to Newhaven at a cost of £207 million was funded from reserves, but the longer term fare revenue is forecast to be able to fund the extension and provide additional income.[80]
- **Expanding rail capacity:** This will accommodate the large increase in passenger numbers required. The costs for any given scheme will vary greatly depending on local circumstances, and the need for tunnelling or bridges, ground conditions, line capacity etc. The voluntary organisation Rail Future Scotland has proposed a list of over 90 new train stations and over 20 new passenger and freight lines for Scotland.[81]
- **Electrifying the rail network:** The Scottish Government has a commitment to decarbonise rail transport by 2035 and a programme of interventions to achieve this.[82] Construction work on the rolling programme began in June 2022.[83]

The Scottish Government, unlike the UK Government, already has an up-to-date pipeline of strategic public transport projects developed as part of its second Strategic Transport Projects Review (STPR2) .[84] This review, published in December 2022, is designed to deliver the vision, priorities and outcomes set out in the second National Transport Strategy, and forms the basis for capital investment decisions over the next 20 years (excluding maintenance and renewal). 'Taking climate action' is one of five key objectives, along with addressing inequalities & accessibility; improving health & wellbeing; supporting sustainable and inclusive economic growth and improving safety & resilience.

Around two-fifths (17 out of 45) of the recommendations in the STPR2 relate to enhancing access to affordable public transport, decarbonising the bus and rail network, or strategic passenger rail. The remainder relate to active travel, behaviour change, safety and resilience on the Strategic Road Network and rail or road freight. A full list of schemes is shown in **Appendix 3**.

These schemes are the ones most likely to be taken forward to deliver improved public transport levels. Because the capital costs of schemes, particularly light and heavy rail, can vary greatly depending on local circumstances (e.g. the need for tunnelling or bridges, ground conditions, line capacity), we have used the Scottish Government's published ballpark costs for the STPR2 schemes rather than extrapolating from our passenger uplift figures and generalized costs.

Most of these schemes are at a very early stage, so do not have any estimates of associated passenger uplift. However, we assume that the public transport schemes recommended will deliver a step change in passenger capacity, provided that these schemes are delivered by 2035 at the latest (and the majority delivered in full or part by 2030). Under the current STPR2 schedule, some of these projects (e.g. the Clyde Metro) are assumed to take 30 years or so to develop, which would be far too late to meet carbon targets. Further work will be needed to establish the passenger uplift from these schemes, whether it will be sufficient to meet traffic and carbon reduction targets by 2030, and additional measures or schemes that will be provided if not.

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Buses

The Scottish Government has proposed four bus-related schemes in its STPR2. These are shown in **Table 4** below. They include a high-quality bus-based rapid transit system within the North East Region, centred on Aberdeen; bus priority measures; demand responsive transport and decarbonization of the bus network. In addition, there are a number of interventions proposed to improve integration of the network including ticketing and multi-modal hubs that are included here even though they will benefit all public transport modes.

Table 4:
Ballpark costs (£ million) for bus schemes from the STPR2[85]

Scheme No.	Recommendation	Lower cost (£m)	Upper cost (£m)
13	Aberdeen Rapid Transit (ART)	101	500
14	Provision of strategic bus priority measures (a)	501	1,000
20	Investment in demand responsive transport and mobility as a service	25	25
26	Decarbonisation of the bus network	51	100
18, 21, 22, 23	Support for integrated journeys (e.g. ticketing, interchange facilities, mobility hubs)	152	250
	Total	**830**	**1875**

(a) The Scottish Government has previously announced bus priority measures on Glasgow's motorways, with reallocation of road space on the M8 through Glasgow and the M77 and M80 approaches to Glasgow.[86] The STPR2 recommends further bus priority measures on the trunk road network, including improving access from the local road network and possible use of hard shoulders or variable speed limits. Other trunk roads under consideration include the M8 approach to Edinburgh and the A720 Edinburgh City Bypass.

Table 4 shows the **total ballpark capital costs of £0.8 – 1.9 billion** for the four bus schemes and various integrated transport measures in the STPR2. These costs are additional to any funding announced previously so it is assumed this does not include funding for the Scottish Ultra Low Emission Bus Scheme (SULEBS), an additional £120 million for electric buses up to 2025/26[87] or the £500 million already announced for bus priority measures.[88]

The estimated wider economic benefits associated with the bus priority measures alone is estimated at around £2.5 – 5 billion.[89]

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Tram/light rail/subway

New tram and mass transit networks centred on Glasgow and Edinburgh are recommended in the STPR2, though these are still at a very early design stage (see Box below). Both the Clyde Metro and Edinburgh and South East Scotland Mass Transit are recognised as national developments which would address connectivity and accessibility issues across their regions, and support disadvantaged communities currently not well served by public transport.

Proposed new tram/metro and mass transit networks in Scotland

Clyde Metro[90]

This project would connect Glasgow with Renfrewshire to the west, linking transport hubs (Glasgow Central and Queen Street railway stations, Glasgow Airport and suburban interchanges) with key facilities such as hospitals, schools, employment centres and leisure/sports facilities and connect "unserved or underserved areas". This scheme would complement the service provided by traditional railways and use a mixture of light and heavy metro, some converted from traditional railway lines. It would provide a step-change in public transport capacity and be expected to encourage significant modal shift from car to public transport. There are suggestions it could have a bigger footprint than Manchester's current Metrolink (currently over 100 km of track) and could extend as far as East Kilbride and Newton Mearns.[91]

Edinburgh and South East Scotland Mass Transit (ESES MT)[92]

This proposal consists of a mixture of potential tram extensions together with Bus Rapid Transit and bus priority measures, and a series of mobility hubs. The tram could potentially expand west to Newbridge, north to Granton and east to Musselburgh and Dalkeith. The Bus Rapid Transit and Bus Priority Measures could extend to Fife, West Lothian, East Lothian and as far south as Tweedbank in the Scottish Borders.

Both of these schemes have thus far been planned with very long timelines and are not projected to impact reduction of car km or emissions for 2030. However, the pace of delivery can and must be increased.

Note that the completion of the £207 million Edinburgh tram to Newhaven, due to open in Spring 2023, will effectively double the existing passenger trips in its opening year, and by 2032 the total number of trips on the whole network are forecast to more than double to nearly 22 million per year.[93] Because the average trip length is also likely to increase due to the additional line, the total additional tram passenger km by 2030 is likely to meet some of the required uplift in **Table 2** (as only a proportion of these passengers would have previously driven). The ongoing £288 million modernisation of the Glasgow Subway is also expected to result in more frequent services and more passengers.[94] Any increase in passenger km from the two proposed mass transit schemes would therefore be additional to this and contribute to the overall uplift in public transport needed.

The Clyde Metro and Edinburgh and South East Scotland Mass Transit (ESES MT) would both provide a step-change in accessibility and modal shift. Although they have significant light rail/metro elements, they are essentially mixed multi-modal schemes with heavy rail extensions, in the case of the Clyde Metro, and bus priority/Bus Rapid Transit, in the case of the Edinburgh scheme. The ballpark costs, as given in the STPR2, are shown in **Table 5**. We have assumed delivery over a slightly longer period up to 2035 due to the lead times needed to develop detailed costed schemes, though each can be delivered in stages. The actual costs will be highly dependent on local conditions, the type of system and the extent of the network.

Table 5:
Ballpark capital costs (£ billion) for Mass Transit/Metro schemes from the STPR2[95]

Scheme No.	Recommendation	Lower cost (£b)	Upper cost (£)
11	Clyde Metro (a)	~2.5 (b)	~5 (b)
12	ESES Mass Transit (c)	~>5 (d)	~>5 (d)
	Total	**~7.5 (e)**	**~10 (e)**

(a) Conceptual drawings suggest around 240 km of light Metro and heavy rail conversion sections, and around 60 km of heavy rail extension
(b) Ballpark costs for the whole scheme including heavy rail conversion and extension from STPR2[96]
(c) Conceptual drawings suggest around 20 km of tram extension, and around 100 km of Bus Rapid Transit/Bus priority measures
(d) Ballpark costs for the whole scheme including BRT/Bus Priority from STPR2[97]
(e) Includes costs for bus and heavy rail conversion/extension.

Table 5 shows the total **ballpark capital costs for the two schemes is around £7.5 – 10 billion** or £0.6 – 0.8 billion a year over 12 years. Combined, they have the potential to increase the tram/light rail/Metro track length by approximately 260 km, compared to the existing tram/subway network (including the Edinburgh Newhaven line) of around 29 km.

As multi-modal schemes, they can deliver some of the necessary modal shift to bus and heavy rail as well as tram/light rail. There is no data on the additional passengers they would support but schemes of this scale would be transformative. If we conservatively estimate that every kilometre of the proposed multi-modal network (BRT/tram/Metro/heavy rail) supports around 0.6 million passenger journeys a year,[98] with an average trip length of 10 km (similar to the Manchester Metro), this will mean an additional 2.5 billion passenger km a year by 2035. This is a significant proportion of the total 5.8 billion passenger km a year needed by 2030 shown in **Table 3**. These figures are highly speculative but give an indication of the scale of investment likely to be needed.

Rail

There are seven passenger rail schemes in the STPR2, including several rail corridor enhancements, high speed rail, as well as improvements of rail stations and electrification of the rail network. There are no details of delivery dates, but it is assumed that the majority of these can be delivered by 2035 given sufficient impetus and priority. The ballpark costs of the rail schemes are shown in **Table 6**.

Table 6:
Ballpark costs (£billion) for passenger rail schemes from STPR2[99]

Scheme No.	Recommendation	Lower cost (£b)	Upper cost (£b)
15	Highland Main Line rail corridor enhancements	0.1	0.5
16	Perth-Dundee-Aberdeen rail corridor enhancements	0.1	0.5
17	Edinburgh/Glasgow-Perth/Dundee rail corridor enhancements	0.1	0.5
19	Infrastructure to provide access for all at railway stations	0.1	0.5
25	Decarbonisation of the rail network (a)	2.5	5
43	Major station masterplans	0.1	0.5
45	High speed and cross-border rail enhancements	5	5
	Total	**8**	**12.5**

(a) (a) Costs are based on the estimated costs per km of single-track rail electrification from UK research and the total length of Scotland's rail network (1,616 single track km) that requires to be electrified .[100]

Table 6 shows total ballpark **costs of around £8 – 12.5 billion** for the seven passenger rail scheme recommendations, or an additional £0.6 – 1 billion a year over 12 years (on top of the current baseline spend). Using figures from a study for the Rail Industry Association (RIA) this is likely to **create around £20 – 30 billion in economic benefits in the form of Gross Value Added (GVA)**.[101] This includes the economic benefits from the rail sector directly, as well as the knock-on effects of wage-funded spending and purchase of business supplies.

While there are no estimates for the uplift in passenger numbers associated with these schemes, they should deliver a step change in rail capacity and electrification. It is likely that a more than doubling of rail passenger km will need investment of this scale.

6 How many jobs could this investment create?

Photo: istockphoto.com

Investment in public transport can create thousands of green jobs in Scotland as part of a green growth strategy.

- Investment in buses that are electric and zero emission at point of use can support jobs at Scottish bus manufacturer Alexander Dennis Ltd (ADL), which had over 1,800 employees in 2021 and was investing heavily in hydrogen and electric vehicles.[102] Investment in 117 ZEV buses elsewhere in Britain is estimated to create hundreds of new high skilled jobs.[103]
- The Edinburgh to Newhaven tram is estimated to have created several hundred jobs during the construction phase, including jobs in the local economy, and an additional 78 jobs once operational.[104] It also supports the bringing forward of employment related development in the Leith Waterfront area.
- Decarbonising the railway in Scotland is estimated to create around 630 new jobs a year between 2024 and 2050, and would benefit many suppliers.[105] The wider economic benefit of the total UK employment, pro-rated for Scotland, is estimated at around £230 million.[106]
- Construction of the 31-mile Borders Railway in Scotland, which opened in 2015, created 400 jobs over two years.[107] At the peak of construction there were 1,000 workers on site.

Public transport already generates thousands of jobs in the sector. Pre-Covid we estimate the bus, tram/metro and rail industry in Scotland employed nearly 70,000 people, either directly (24,000) or through the rail supply chain (46,000) (see **Appendix 4** for details).

Many of these public transport jobs are highly skilled and it is important that this pool of skilled, trained workers is maintained through a secure pipeline of investment. These jobs are spread across Scotland, and new jobs can be created relatively quickly, particularly through increased bus services, and targeted in deprived areas.

We have estimated the number of jobs that would be created by the levels of investment shown in **Tables 4 – 6**. We have used documented factors for jobs per passenger or jobs per value of investment, with a downward adjustment to allow for efficiency/ automation. The results are shown in **Table 7**.

Table 7 shows that the additional public transport investment would create:

- Around 22,000 additional direct jobs in bus, mass transit/metro and rail operation compared to around 24,000 existing jobs (i.e. a new job for every existing job)
- Around 416,000 direct/indirect jobs in bus manufacture and construction of bus infrastructure, new mass transit/metro systems and rail infrastructure over 12 years (i.e. an average of around 35,000 jobs per year for 12 years). Though not all of these will be new jobs.

These additional jobs can help meet the UK Government's target to create 2 million green jobs by 2030.[108] They can also help the Scottish Government with the just transition needed for the shrinking numbers of jobs in high carbon sectors, particularly given the existing skills shortages within the public transport sector.[109]

Table 7: Estimates of average number of jobs created by the public transport investment in Scotland by 2035 (rounded to nearest 100)

Public transport mode	Operation (a)	Construction (b)
Bus	7,600	34,800
Mass Transit/Metro	400	175,300 (c)
Rail	14,400	205,400
Total	**22,400**	**415,500**

(a) These figures are based on the passenger uplift in Table 2

(b) These figures are based on the investment levels in Tables 4 – 6 which are not linked to any particular increase in passenger numbers or distance and are independent of the operational estimates

(c) This also includes jobs associated with the bus priority measures and rail expansion in the two mass transit/Metro schemes in Table 5.

7 Wider benefits of public transport investment

The Scottish Government has outlined the wider benefits that a 20% reduction in car traffic will generate.[110] These include reducing inequalities; helping deliver inclusive economic prosperity; and improving health and wellbeing. Investing in public transport offers significant economic, social, and environmental benefits, for example:

7.1 Economic benefits

- The rail industry estimates that the rail sector in Scotland generated over £3.2 billion in GVA and £1 billion in taxes for the UK Government in 2019.[111]
- Every £1 spent on the Newhaven tram line is estimated to generate £1.40 in direct benefits plus wider benefits including increasing the attractiveness of major development sites and supporting higher density development.[112]
- The £353 million Borders Railway helped the local tourist economy. In the first seven months of 2016, it was reported that there was an increase in overall visits to Midlothian and Borders tourist attractions of 4% and 7% compared to the same period in the previous year.[113] Two years after it had opened around 25% of visitors surveyed using the train said they would not have made the trip if it had not been for the rail line.[114]
- Public transport offers opportunities for lowering travel costs and reducing the UK's reliance on oil in the context of the current cost of living crisis.[115]

7.2 Social benefits

- A 10% improvement in local bus service connectivity is associated with a 3.6% reduction in deprivation.[116]
- Public transport is vital for many people to access employment, education or training. It is the only way that many employers can get the employees they need to the workplace with over 2.5 million regular bus commuters pre-Covid.[117]
- An estimated one in ten bus commuters would be forced to look for another job or give up work altogether if they could no longer travel to work by bus.[118]
- A 2003 report identified that two out of five job seekers could not get a job due to a lack of transport, 31% of people without cars could not access a hospital, 16% of households without cars found it difficult to access a supermarket, and 6% of 16- to 18-year-olds turned down training or further education because of travel costs.[119] Given the extent of bus cuts these percentages are likely to be even higher now.
- Public transport provides additional health benefits since people often walk or cycle to access it. According to the National Institute for Health and Care Research, use of public transport is associated with a lower BMI in adults, and switching from private car to public transport for school journeys has been associated with lower percentage body fat in children.[120]

7.3 Environmental benefits

- Cutting car traffic by 20% by 2030 will reduce carbon emissions by about 1.2 million tonnes per year[121] and will help Scotland achieve its legally binding carbon goals.
- Cutting car traffic will help reduce air pollution, particularly if the bus and rail network are electrified. Transport is Scotland's primary source of air pollution, which leads to an estimated 2,500 premature deaths in Scotland every year.[122]

8

What other measures are needed to meet traffic and carbon goals by 2030?

There are a number of other measures needed to meet traffic reduction goals by 2030 and maximise the impact of any investment in public transport (and active travel).

8.1 Disincentives to car travel

As well as measures to make public transport more affordable and attractive, achieving the levels of mode shift estimated in this report will require demand management measures which disincentivize driving. In order to decarbonize Scotland's transport sector, Element Energy have recommended a policy of road user charging to mitigate the increases in vehicle demand caused by the decreasing cost of electric fuels, and car taxation to ensure the cost competitiveness of public transport.[123]

The draft routemap to 20% traffic reduction published by the Scottish Government identified several 'push' measures to disincentivize car travel such as a Workplace Parking Levy and interventions on car parking.[124] They have proposed developing a new Car Demand Management Framework by 2025.

The Climate Change Committee has subsequently advised that this is too late and recommend that the Scottish Government develop *"a comprehensive Car Demand Management Framework as soon as possible."*[125]

There is support from different sectors in Scotland for a national system of road pricing:

- The majority (63%) of Scotland's Climate Assembly members have supported a recommendation to 'phase in increased road taxes for private car use and use the revenue to subsidise public transport'.[126]
- Local councils have called for national road pricing to be introduced.[127]
- Business organisations have suggested that a national (UK) road charging scheme to replace fuel duty and vehicle excise duty would be more likely to be seen as fair by businesses than local measures.[128]

The Scottish Government has identified the current UK approach to motoring taxation as a *"significant barrier to the decarbonisation of the transport sector"*.[129] The UK Government has frozen the rate of fuel duty each year since 2010, meaning the cost of driving has fallen in real terms.

National road pricing is now widely viewed as inevitable to replace the loss of revenue from fuel duty as more people switch to electric vehicles.[130] Without reform the burden of fuel duty will increasingly fall on those least able to afford electric cars/vans. The latter will make up an increasing majority of fuel duty payers, while richer electric vehicle owners will pay less tax. Without reform, fuel duty will become increasingly regressive.

The need to design a fair national road pricing scheme is essential for reducing emissions and emergent inequalities.

In a comprehensive review of traffic demand management measures Edinburgh Napier University concluded that the most effective schemes are part of a package of measures, including public transport improvements.[131] To overcome the political barriers of introducing road user charging any revenue generated should be ringfenced and reinvested in public transport to provide a viable alternative to driving. The House of Commons Transport Committee has called for radical reform to motoring taxation and have suggested that the revenue would support transport investment and decarbonisation.[132]

While reforms to taxation is a reserved matter requiring legal consent from the UK Government, further delay in introducing a national road charging scheme to replace fuel duty and VED by the UK Government risks severe consequences for UK public finances as well as risks to the Scottish traffic reduction and carbon targets. The two governments need to work closely to come to an agreement and introduce a national road pricing system without further delay.

8.2 **Changes to governance**

Although Scotrail has been taken back into public ownership, the bus system in Scotland is still largely unregulated. This makes coordination of local buses difficult as local operators, rather than local transport authorities, decide their own routes, tickets and standards based largely on profitability. This results in multiple tickets, limited or zero service coverage in some areas, expensive fares and limited connectivity with other public transport services.

Full integration of public transport requires a 'guiding mind' to oversee the planning, management and delivery of public transport services across Scotland's councils and regions. This requires a fully regulated system so that a comprehensive and coordinated network of services can be provided.

Secondary legislation to enable bus regulation or franchising is due to be introduced in Scotland before the end of 2023.[133] However, even when these powers are introduced it will require significant financial and capacity support to councils to enable them to franchise their buses. For example, Glasgow City Council has taken the first steps to explore public control for buses and has estimated that it needs up to £15 million and seven years to set up a franchising model.[134]

The Scottish Government is also planning to use powers in the Transport (Scotland) Act 2019 to enable local authorities to set up their own municipal bus services, similar to the award-winning Lothian Buses in Edinburgh. However, this will also require funding support. Glasgow has estimated it will cost a further £200 million to set up its own bus company.[135]

Additional capital and revenue funding is likely to be required from the Scottish Government or Transport Scotland to support changes to bus governance. However, as the business case prepared for Greater Manchester bus franchising has shown, this can bring immediate social, health and environmental benefits as well as wider economic benefits, which far outweigh the transition costs.[136]

Given the long lead-time for making these changes the process needs to be expedited in order to achieve these benefits by 2030.

9 Conclusions

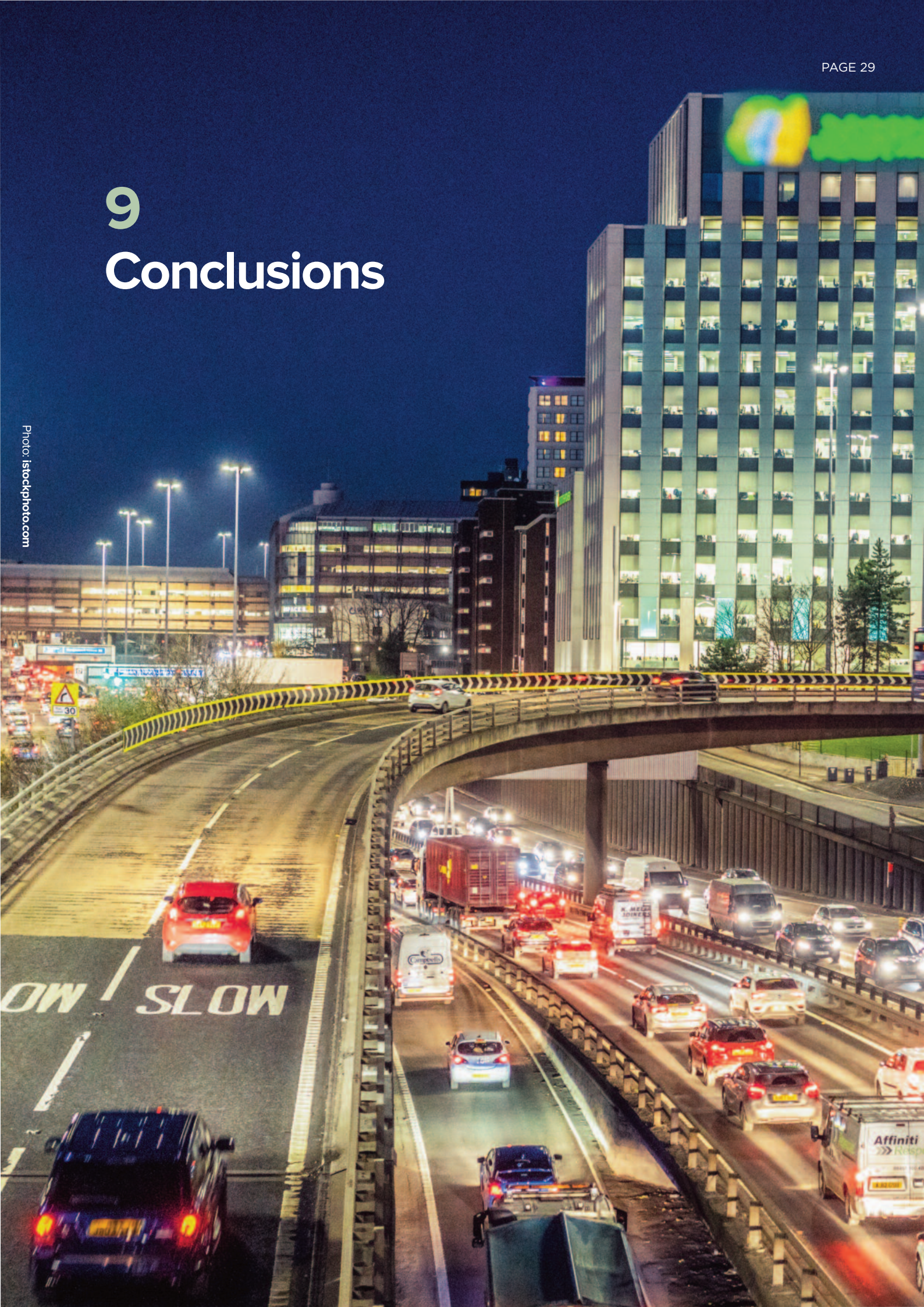

Photo: **istockphoto.com**

The Scottish Government has set ambitious goals for traffic reduction and climate by 2030 but now needs to deliver on those targets. The Climate Change Committee has advised that they require both measures that support and improve alternatives to car travel and interventions that discourage car use and these are urgently required. Car travel has rebounded to levels close to pre-Covid, while Scotland needs to be reducing car mileage by around 3% a year to meet the target.

We estimate Scotland needs to shift around 6 billion car passenger km a year by 2030 to public transport (and walking and cycling) to meet its carbon targets. This will require an average increase in bus and tram passenger km of around 80% and a more than doubling (110%) of rail passenger km in Scotland by 2030 compared to pre-Covid levels.

There are many examples which show that with the right investment and support, significant increases in public transport use can be achieved in relatively short periods.

We estimate that this will require additional operating expenditure of around £1.6 billion a year by 2030. These costs take no account of new revenue from the increase in public transport use, resulting from the service improvements and disincentives to driving, as there is a strong case to reduce fares to make public transport more cost competitive with driving.

We have used the Scottish Government's published figures for proposed bus, metro/mass transit and rail schemes from the SPTR2 published in December 2022. Although many of these schemes are still at an early stage and any costs are ballpark figures, they represent the schemes most likely to be taken forward to deliver improved public transport levels.

- The additional capital investment in bus schemes and measures to integrate public transport is estimated at around £0.8 – 1.9 billion (average £1.4 billion) up to 2030.
- The additional capital investment in mass transit/metro schemes (a combination of bus, tram/metro, rail) is estimated at around £7.7 – 10 billion up to 2035.
- The additional capital investment in rail schemes is estimated at around £8 – 12.5 billion up to 2035.
- The total average capital investment, annualized over 12 years, is around £1.7 billion a year.

While there are no figures on how much passenger uplift these schemes would deliver they are likely to deliver step-change improvements in service levels and capacity, and would not only reduce carbon, air pollution and noise, but would reduce transport poverty and regenerate many areas.

The additional public transport investment would also create:

- Around 22,000 additional direct jobs in bus, mass transit/metro and rail operation compared to around 24,000 existing jobs (i.e. a new job for every existing job).
- Around 416,000 direct/indirect jobs created through bus manufacture and construction of bus infrastructure, new mass transit/metro systems and rail infrastructure over 12 years (i.e. an average of around 35,000 jobs per year for 12 years).

These estimates show that the investment needed would more than pay for itself in benefits. Numerous studies have shown that the return in terms of economic benefits from public transport investment generally outweighs the initial costs and provides high or very high value for money. The rail investment alone would yield economic benefits of around £20 – 30 billion while the bus priority measures would generate economic benefits of around £2.5 – 5 billion.

To maximise the benefits of this investment, as well as meet the 20% traffic reduction target it is essential that measures are brought in to disincentivise traffic. A national system of road pricing would not only constrain traffic and facilitate the shift to public transport, walking and cycling, it would also generate funds that can be used to fund investment in public transport infrastructure and services.

Behaviour change measures that reduce car traffic, including shifting journeys to public transport, can reduce greenhouse emissions in Scotland by around 1.2 million tonnes by 2030. This is not only essential for meeting Scotland's carbon targets but has numerous positive benefits for economic prosperity, local communities and health and wellbeing and would help reduce inequalities.

Good public transport is not just a 'nice to have' but a climate imperative. Improving public transport service levels up throughout Scotland and will give people more freedom and choices and reduce their costs of travel. It will simultaneously make people's lives better and greatly improve the places they live in.

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Appendix 1

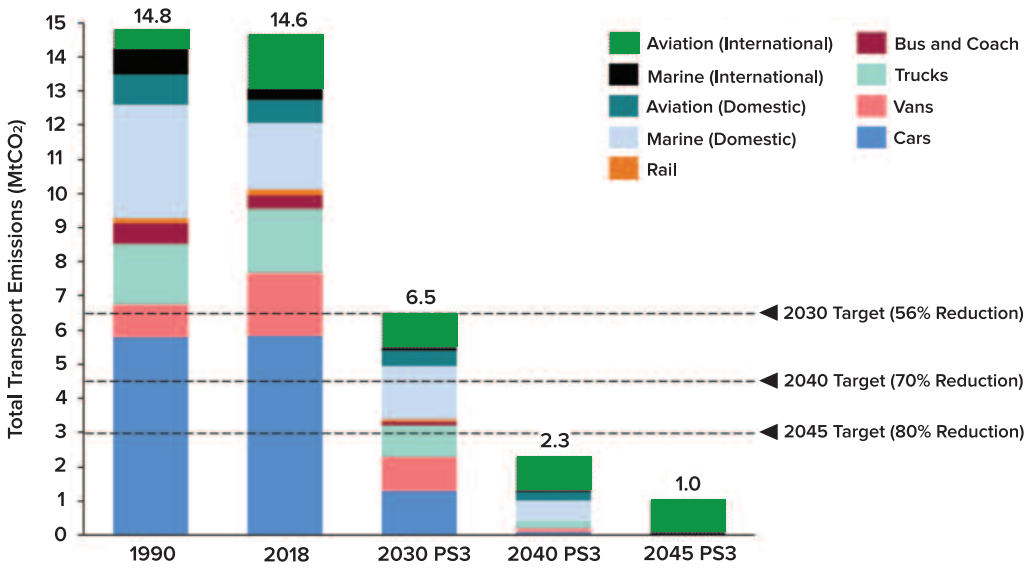
Link between traffic reduction and carbon targets

The Climate Change (Emissions Reduction Targets) (Scotland) Act 2019 commits to achieving a 75% reduction in greenhouse gas emissions, relative to 1990, by 2030, and net-zero by 2045.[137] Analysis conducted by the Scottish Government using the TIMES model has assigned the transport sector its own emissions target of a 56% reduction by 2030.[138] Note the Climate Change Committee has also assigned the UK transport sector a lower reduction target relative to 1990 than the economy as a whole.[139]

Given the fact that transport emissions levels in Scotland (and the UK) in 2018 and 2019 were very similar to 1990 levels, the **absolute** emission reductions by 2030 relative to 2018 and 2019 will be greater for transport than for other sectors.

The largest proportion of the reduction in transport emissions up to 2030 will need to come from cars (see **Figure 1.1**) where there are better developed technology options than other forms of transport.

Figure 1.1: **Summary of modelled reductions in transport emissions by Element Energy necessary to meet 56% reduction target by 2030 relative to 1990**[140]



For example, cars in Scotland were responsible for greenhouse gas emissions of around 5.8 million tonnes ($MtCO_2e$) in 2018 and will need to reduce emissions to around 1.3 $MtCO_2e$ in 2030. This is equivalent to a 78% reduction relative to 2018.[141] The majority of the reduction is expected to be through technology change (e.g. electrification of the fleet), with around 1.2 Mt CO_2e reduction through behaviour change.[142]

Electric cars have much lower carbon emissions than petrol and diesel cars (even taking into account the power for the electricity and embodied energy).[143] However, even with a ban on the sale of new petrol and diesel cars by 2030 and a Zero Emission Vehicle (ZEV) mandate, the UK Government expects only 55 – 60% of new cars to be battery electric by 2030.[144] Because new cars are a small proportion of the cars on the road and the average age of a car at scrappage is 14 years (with some considerably older),[145] the majority of cars on the road in the UK and Scotland are still expected to be fossil-fuelled in 2030. The impact of electric cars on carbon emissions will therefore not be fully felt until the next decade, and additional measures, such as traffic reduction, will be needed before then.

Element Energy's modelling for the Scottish Government also assumes that the sale of plug-in hybrid cars and vans, which are not much better than fossil fuel vehicles for emissions, will also be phased out in 2030, five years ahead of the UK commitment, and that there will be a reduction in the sale of large cars, including SUVs, from 60% of new car sales in 2021 to 40% in 2030.[146] Even with these measures it is expected that there will continue to be significant emissions from the car fleet in Scotland throughout the 2030s.[147]

There is other evidence from UK analyses that we cannot meet 2030 carbon targets through technology alone, and that we also need to reduce car traffic. For example:

- The Centre for Research into Energy Demand Solutions (CREDS), a consortium of universities, estimates that a 30 – 50% reduction in total car mileage is needed by 2030, relative to 2020.[148]
- Green Alliance estimates that a 20 – 27% reduction in total car mileage is needed by 2030, relative to 2019.[149]
- Analysis by the RAC suggests that meeting carbon targets by 2030 without reducing driven miles was "mathematically" possible[150] but would require big changes in other areas which "looks like a monumentally steep challenge, like climbing Everest on a bad day".[151]

The UK Government's Transport Decarbonisation Plan (TDP)[152] looks increasingly out of step with this growing body of evidence. The TDP states:

"It's not about stopping people doing things: it's about doing the same things differently. We will still fly on holiday, but in more efficient aircraft, using sustainable fuel. We will still drive on improved roads, but increasingly in zero emission cars."

There are clear differences in the conclusions by the Scottish Government and the UK Government on the need for behaviour change, which is seen as a necessary part of reducing emissions and a positive step in improving transport equity in Scotland. Element Energy studied the TDP to understand how the two reports came to such different conclusions and their analysis suggests it is because very different levels of emission reductions will be achieved in each case in 2030.

"The TDP scenarios deliver between a 5% and 40% reduction in domestic and international transport emissions between 1990 and 2030, with a central scenario at 20%. Our analysis of the TDP suggests that the policies actually committed to in the TDP are likely to deliver towards the bottom end of this [reduction] spectrum."[153]

By contrast the measures recommended by Element Energy for the Scottish Government (including the 20% traffic reduction by 2030) are designed to deliver a 56% reduction in domestic and international transport emissions between 1990 and 2030, requiring much greater ambition in technology and behavioural change policy.

Other analysis suggests that the upper emissions band of the TDP carbon reduction trajectory is based on higher car traffic mileage and lower electric vehicle uptake than the Climate Change Committee for their 6th Carbon Budget, raising questions as to how the TDP upper emissions trajectory can be aligned with Net Zero.[154]

Note that if the rate of battery electric car uptake in Scotland is slower than assumed then the level of traffic reduction will need to be higher and vice versa. Or if looking at the transport budget as a whole, if any of the other necessary measures (e.g. reduction in aviation or shipping emissions) are slower than planned, again there will need to be more ambition in other parts of the transport budget. The transport sector has just seven years left to significantly reduce its emissions. There are no longer any sectors of the economy that can deliver bigger emissions reductions so that the transport sector can deliver less.

Appendix 2

Methodology and assumptions

Table 2.1: Assumptions used to estimate passenger km travelled by different public transport modes in 2018/19

Mode	Source of passenger km data
Car	Car vehicle km from DfT Table TRA8905a for 2019, with average car occupancy figures of 1.5 in 2019[156]
Bus	DfT Table BUS03a_km for 2018/19[157]
Tram/subway	Edinburgh tram and Glasgow subway figures from DfT Table LRT0103 or 2018/19[158]
Train	ORR figures for passenger trips in 2018/19[159] multiplied by average rail trip distance in Scotland from the Scottish Transport and Travel survey for 2019.[160] We use all journeys within Scotland and half the journeys to/from Scotland to avoid double counting. We have adjusted the figures to bring the total for Scotland, Wales and England in line with ORR figures of total rail passenger km in Great Britain. Scotland had an unusually high proportion (>90%) of rail trips within Scotland compared to English regions (18% – 71%) in 2018/19. This may partly explain why the average rail trip distance in Scotland (28 km) is lower than English regions, though there may be methodological differences between the English National Travel Survey and the Scottish Transport and Travel Survey.

Table 2.2: Assumptions used to estimate potential reduction in car mileage to meet traffic and carbon targets

Assumption	Source	Notes
A minimum 20% reduction in car km by 2030 compared to 2019 levels is needed to meet carbon targets	Scottish Government target[161]	
8 – 10% of total car mileage can be reduced by 2030 through avoiding travel (e.g. working from home, use of remote technologies, destination shifting, better land use planning etc.) and more carsharing. *(10% lower bound, 8% upper bound)*	WfH could result in a 5% reduction in car and van mileage.[162] Demand for business travel is likely to be lower post pandemic.[163] The Climate Change Committee estimate average car occupancy could increase to 1.7 by 2030.	Authors own estimates of 2% reduction based on survey results. Authors own estimates of 3% reduction assuming 50% of those additional car passengers previously drove
The balance of total car mileage (10 – 12%) and associated passenger km needs to be shifted to other modes to achieve a total reduction in car mileage of 20%. *(10% lower bound, 12% upper bound)*		

Table 2.3: Estimates of car passenger km that needs to be shifted to other modes by 2030

Car vehicle and passenger km	Value (lower bound)	Value (upper bound)	Source/Assumption
Car km in 2019 (billion vehicle km)	36.7	36.7	DfT Traffic Statistics
Car km to be shifted by 2030 (billion vehicle km)	3.7	4.4	Assume 8 – 10% can be avoided leaving a balance of 10 – 12% to be shifted to other modes
Equivalent car passenger km to be shifted by 2030 (billion pkm/y)	5.5	6.6	Assume average car occupancy of 1.5[165]
Car passenger km to be shifted by 2030 adjusted for population growth (billion pkm/y)	5.5	6.7	Assume 1% growth by 2030 relative to 2019[166]

Table 2.4: Upper and lower bound scenarios for bus/tram and rail

Scenario	Substitute for car trip length (a)	% car distance (b)
Bus/tram lower bound	2 – 10 miles (ca. 3 – 16 km)	28%
Bus/tram upper bound	5 – 25 miles (ca. 8 – 40 km)	45%
Bus/tram average		36.5%
Rail lower bound	>25 miles (ca. 40 km)	41%
Rail upper bound	>10 miles (ca. 16 km)	69%
Rail average		55%

(a) Based on average trip lengths for bus and rail from the Scottish Transport and Travel survey 2019 and for tram/subway from DfT Light Rail and Tram Statistics. Note that the lower bound for buses/trams has to be matched by the upper bound for trains and vice versa. If both lower bound ranges are assumed this will not reduce car mileage sufficiently while if both upper bound ranges are assumed this involves some double counting.

(b) This represents the % of total car distance. These percentages are applied to the 10-12% of car mileage to be shifted to other modes. Based on the English National Travel Survey data for 2019 (in the absence of similar data for Scotland but it is assumed that travel patterns will be similar).[167]

Table 2.5: Assumptions used to estimate additional operating costs for buses, trams and trains

Assumption	Value	Source	Note
Cost of bus journey/passenger (£/journey)	1.92	DfT bus statistics[168]	2018/19 values at 2021/22 prices
Cost of tram journey/passenger km (£/passenger km) (b)	0.43	Assumed operating costs from Edinburgh Tram Annual Accounts 2019[169] combined with DfT Tram statistics	These costs are likely to come down with increasing passengers when the Newhaven line opens
Cost of rail journey/passenger km (£/passenger km)	0.27	Approximate operating costs per passenger km in 2018/19 from Abellio Scotrail Annual accounts[170] plus Scotrail passenger km in 2018/19.[171]	Operating costs were prorated for 12 months as the annual accounts covered 15 months from January 2018-March 2019

Table 2.6: Factors used to estimate additional employment

Assumption	Adjusted value (a)	Original value	Source	Notes
Bus operator employment (direct jobs per million passengers)	24.3	25.6	DfT BUS statistics[172]	
Tram operator employment (direct jobs per million passengers)	20.8	21.9	DfT light rail statistics, UK Tram and online search	Average of numbers employed by tram operators and passenger numbers[173]
Rail operator employment (direct/indirect jobs per million passengers)	130.2	137	Williams Rail Review[174]	
Bus priority measures (direct/indirect jobs per £1M investment)	31.0	32.6	TUC report[175]	Factor for cycle route construction
Electric bus manufacture (direct/indirect jobs per £1M investment)	19.0	19.99	TUC report (as above)	For manufacture in UK only
Rail construction employment (direct/indirect jobs per £1M investment)	20.0	21.09	TUC report (as above)	Also used for tram construction

(a) A 5% adjustment to the original factors was applied to take account of increased efficiency and automation.

Appendix 3

Strategic Transport Projects Review 2 Recommendations[176]

No.	STPR2 Recommendation
Improving active travel infrastructure	
1	Connected neighbourhoods
2	Active freeways and cycle parking hubs
3	Village-town active travel connections
4	Connecting towns by active travel
5	Long-distance active travel network
Influencing travel choices and behaviour	
6	Behavioural change initiatives
7	Changing road user behaviour
8	Increasing active travel to school
9	Improving access to bikes
10	Expansion of 20mph limits and zones
Enhancing access to affordable public transport	
11	Clyde Metro
12	Edinburgh and South East Scotland Mass Transit
13	Aberdeen Rapid Transit
14	Provision of strategic bus priority measures
15	Highland Main Line rail corridor enhancements
16	Perth-Dundee-Aberdeen rail corridor enhancements
17	Edinburgh/Glasgow-Perth/Dundee rail corridor enhancements
18	Supporting integrated journeys at ferry terminals
19	Infrastructure to provide access for all at railway stations
20	Investment in Demand Responsive Transport and Mobility as a Service
21	Improved public transport passenger interchange facilities
22	Framework for the delivery of mobility hubs
23	Smart, integrated public transport ticketing

No.	STPR2 Recommendation
Decarbonising transport	
24	Ferry vessel renewal and replacement, and progressive decarbonisation
25	Decarbonisation of the rail network
26	Decarbonisation of the bus network
27	Behavioural change and modal shift for freight
28	Zero emission vehicles and infrastructure transition
Increasing safety and resilience on the strategic transport network	
29	Access to Argyll (A83)
30	Trunk road and motorway safety improvements to progress towards 'Vision Zero'
31	Trunk road and motorway climate change adaptation and resilience
32	Trunk road and motorway renewal for reliability, resilience and safety
33	Future Intelligent Transport Systems
34	Traffic Scotland System renewal
35	Intelligent Transport System renewal and replacement
36	Strategy for improving rest and welfare facilities for hauliers
37	Improving active travel on trunk roads through communities
38	Speed Management Plan
Strengthening strategic connections	
39	Sustainable access to Grangemouth Investment Zone
40	Access to Stranraer and the ports at Cairnryan
41	Potential Sound of Harris, Sound of Barra fixed link and fixed link between Mull and Scottish mainland
42	Investment in port infrastructure to support vessel renewal and replacement, and progressive decarbonisation
43	Major station masterplans
44	Rail freight terminals and facilities
45	High speed and cross-border rail enhancements

Appendix 4

Public transport passenger levels and employment

Passenger levels

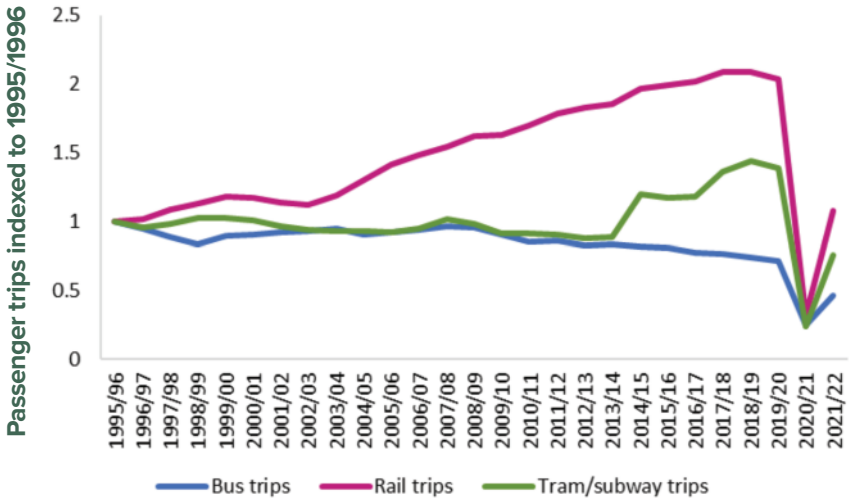
Prior to Covid, bus trips in Scotland had been generally in long term decline though passenger numbers had increased over the period 1998 – 2008 before the recession. Covid has exacerbated this decline with passenger trips falling by two-thirds from 373 million in 2018/19 to 125 million in 2020/21.[177]

Tram trips on the Glasgow subway had stayed relatively constant since the 1990s, while trips on the Edinburgh tram, which opened in 2014, increased rapidly prior to Covid. In 2018/19 the combined number of passenger trips on the subway and tram was 20.6 million which fell to 3.4 million in 2020/21.[178]

Unlike buses, passenger growth in the rail sector over the past few decades has been significant. The number of people travelling on the rail network in Scotland grew by nearly 80% between 2000/01 and 2018/19, reaching 101.9 million passenger journeys in 2018/19 and falling to 15.6 million in 2020/21.[179]

While passenger numbers on buses, trams and rail partially recovered in 2021/22 they are still far less than half of pre-Covid levels.

Figure 4.1:
Bus, tram/subway and train passenger trips in Scotland from 1995/96 to 2021/22 indexed to 1995/96.



Employment

Pre-Covid there were approximately 13,000 people employed by local bus operators (platform, maintenance and administrative staff) in Scotland.[180] Reflecting falling passenger numbers there was a 15% reduction in the numbers directly employed compared to 2008/09 and employment fell to around 11,000 in 2020/21.

Although there are no statistics on the number of people employed in light rail operation and maintenance, we estimate that Edinburgh Trams employs around 200 people[181] and the Glasgow Subway around 245 people.[182] We were unable to find any figures on the numbers employed through the supply chain.

It is estimated by the rail industry that over 36,000 people were employed in the rail sector and rail supply industry in Scotland pre-Covid (10,500 of which are direct jobs) which rises to over 56,000 when induced impacts are taken into account.[183]

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