transport for quality of life

TUC

Changing the world of work for good

Public transport fit for the climate emergency

More services, more jobs, less emissions

This report was researched and written by Lisa Hopkinson, with assistance from Ian Taylor. The opinions expressed in this report are those of the authors. Opinions and information provided in this proposal are on the basis of Transport for Quality of Life using due skill, care and diligence in the preparation of the same and no explicit warranty is provided as to their accuracy.

Transport for Quality of Life Ltd
Email: info@transportforqualityoflife.com
Contact for this project: Lisa Hopkinson lisa@transportforqualityoflife.com

Acknowledgements

Grateful thanks to union colleagues for their help with this report (names in alphabetical order):

TUC: Liz Blackshaw; Gareth Forest; Kamaljeet Gill (coordinating lead for this project); Sam Gurney; Helena Hammock; Anna Markova; Mika Minio-Paluello; Ceri Williams

Aslef: Dave Gould

RMT: James Croy, Sophie Ward

TSSA: Rob Jenks

Unite: Bobby Morton

And many thanks to the following for information and/or advice (in alphabetical order):

Andrew Allen (formerly Campaign for Better Transport); Professor Mark Barry (M&G Barry Consulting Ltd and Cardiff University); Jonathan Bray and Tom Ellerton (Urban Transport Group); Mal Drury-Rose (Liverpool City Region Combined Authority); Tom Forth: Open Innovations; Roger French OBE (formerly MD Brighton and Hove Bus and Coach Co, author of www.busandtrainuser.com); James Hammett (UK Trams); Daniel Hayes (Zemo Partnership); Geoff Hobbs (Transport for London); Stephen Joseph (Stephen Joseph Associates); David Powell (Liverpool City Region Combined Authority); Liam Robinson (Liverpool City Region Combined Authority); Trevor Rosenberg (London Travelwatch); Maggie Simpson (Rail Freight Group).

Congress House, Great Russell Street, London WC1B 3LS
020 7636 4030 www.tuc.org.uk

For more copies call 020 7467 1294 or email publications@tuc.org.uk
Please ask if you need an accessible format.

Published in April 2023
Cover image by John Lawson, Belhaven/Getty Images

Abbreviations

£bn: Billion pounds

£m: Million pounds

£bn/y: Billion pounds per year

£m/y: Million pounds per year

BCR: Benefit Cost Ratio (used to determine value for money)

BSIP: Bus Service Improvement Plan

GVA: Gross Value Added (the value of goods and services produced by an industry, sector or region)

Km: Kilometres

Km/y: Kilometres per year

LULUCF: Land use, land-use change and forestry

Pkm/y: Passenger kilometres per year (car passenger kilometres also includes car driver kilometres)

Contents

Foreword

Public transport has a vital role to play in decarbonising our economy and safeguarding a planet fit for our children and grandchildren to live in. Improving our public transport is not only about protecting our environment, it's also about the quality of life in communities all over England and Wales.

Decent public transport is essential for access to work across the economy, it also means that grandparents get to see their grandkids, and working parents get home earlier to spend time with their children, we call get to share in culture and entertainment. It means that teenagers can get to school and adult learners can access training that can transform lives. It means people on low incomes can visit town centre shops, and businesses can get the customers they need to reinvigorate local economies.

For too long, people have had to put up with inadequate services. All too often, buses are expensive and infrequent, with routes that get cut because the private providers are driven more by private profit than by a public service ethos. Train services are expensive and chaotic, with services frequently delayed – when they're not cancelled at short notice due to staffing levels cut to the bone and maintenance services outsourced and short-staffed. The transport workforce has suffered alongside passengers. Years of frozen pay and attacks on terms and conditions are a poor reward for those on the frontline during the pandemic.

Public transport fit for the climate emergency sets out a plan for the investment in public transport throughout England and Wales that has long been needed. From town and cities, to villages and rural communities, this plan would mean more services, new routes, cheaper fares and modern fleets of low emission vehicles. This radical transformation must be funded by central government and delivered by local and regional transport authorities. And we should all get a say on the transport needs where we live and how this investment is allocated. Passengers, local communities, and transport workers should all be consulted on public transport improvement plans where they live and work.

The investment proposed by this report would achieve the transition to low-carbon transport needed to honour our climate action agreements with the rest of the world. It would generate green and sustainable economic growth in regions across England and Wales. And it would directly create hundreds of thousands of jobs in the transport sector, plus many more in construction and manufacturing supply chains.

As well as cheaper, more extensive and reliable buses, trams and trains, we would have cleaner air to breath. And the roads would be less congested for all road users.

To make sure that every community benefits as fully as possible, with ongoing investment and the best value fares, our public transport should be publicly owned.

The climate emergency means we must act. But the benefits of affordable, reliable and extensive public transport are so great that we should want to anyway – for the lower cost of living and higher quality of life it will bring. This report lays out the blueprint for 21st century public transport, all that's left is to build it.

Paul Nowak, TUC general secretary

Executive summary

1. Transport is the 'problem sector' that has failed to reduce climate damaging emissions, due to our structural dependence on private vehicles, yet we have so far lacked an analysis and vision of what it will take to provide and fund public transport of a quality sufficient to break that dependence.
2. This report seeks to fill that gap for Wales and England not including London (London is excluded due to its unique features that require different consideration to other parts of England, whilst recognising that London's transport also needs improvement to meet the climate emergency). It provides an indicative assessment of the step-change in funding needed to provide sufficiently good public transport services that car users will shift to public transport on the scale scientists indicate is necessary to stabilise our climate at 1.5˚C.
3. The results show that Britain needs to place a value on public transport services similar to parts of Europe that achieve much higher levels of public transport use per capita.
4. To address the climate emergency, we need significant modal shift as well as a zero emission fleet. This report estimates that, across Wales and England (not including London) we need:
    a. **Over 47 billion car driver and car passenger kilometres per year to shift to public transport by 2030.**
    b. **Around 120% more bus/tram passenger kilometres and 80% more rail passenger kilometres than pre-Covid levels by 2030.**
    c. **Additional operating expenditure by 2030 of around £7.5bn per year for buses, £0.5bn per year for trams and £10.9bn per year for trains, to provide public transport services good enough to attract the necessary extra passengers.**
    d. **Additional capital expenditure of around £24bn by 2035 for schemes to speed buses past traffic jams and to make buses zero emission.**
    e. **Additional capital expenditure of around £5bn by 2035 to expand the light rail/tram network and around £89bn by 2035 to expand and electrify the rail network.**
    f. **An annualised total additional capital expenditure on buses, trams and rail of around £10bn a year up to 2035.**
5. In addition to giving us public transport fit to tackle the climate emergency these investments would bring major economic and social benefits:
    a. **Around 140,000 direct jobs in bus, tram and rail operation created by the uplift in public transport services (a new job for every two existing jobs).**
    b. **Around 620,000 jobs created through the proposed bus manufacture and construction of bus priority infrastructure up to 2035.**
    c. **Around 110,000 jobs associated with tram construction up to 2035.**

d. **Up to 1.8 million jobs supported indirectly in association with the additional rail investment up to 2035, although not all of these would be 'new' jobs.**

e. **This investment is estimated to be sufficient to deliver an increase in GDP in England (not including London) and in Wales of over £50bn a year through the agglomeration effects of the much improved and more rapid public transport connections. This is based on research that suggests if agglomeration benefits in the UK are as significant as in France, this would lead to an increase in GDP/capita of 7%[1].**

6. The split of these benefits and expenditure requirements has been calculated by nation and by region outside London as shown in the summary table below. Note that the allocation of rail capital costs by region/nation is indicative only due to a lack of a fully costed pipeline of rail schemes in the UK. The table shows that the increase of GDP generated across England and Wales far outstrips the increased transport expenditure.

Region/nation	Additional operating costs (£bn/y) (a)	Additional capital costs over 12 years (£bn/y)	Estimated increase in GDP (£bn/y)	Increase in GDP minus cost (£bn/y) (b)
North East	0.9	1.0	2.6	0.8
North West	2.5	1.0	10.7	7.2
Yorks & Humber	1.9	1.0	7.7	4.8
East Midlands	1.9	1.7	4.1	0.6
West Midlands	2.3	1.0	7.3	3.9
East of England	2.3	0.8	4.3	1.3
South East	3.6	0.9	9.8	5.3
South West	2.3	1.3	2.9	-0.7 (c)
Wales	1.1	1.3	2.6	0.1
Total	18.8	9.9	52.1	23.3

(a) All revenue costs draw on sources that pre-date Covid and do not take account of the escalating supply chain and operating costs and inflation.

(b) Monetised agglomeration benefits minus costs. Note this net figure does not include all types of other monetised benefits associated with investment in public transport such as economic benefits to non-urban areas, direct and indirect jobs from public transport investment, the value of carbon savings, the value of other environmental benefits, social benefits from better connectivity (linking friends and families, access to shops, facilities, leisure, green spaces), health system savings from more public transport and more active travel trip stages and increased tax revenue.

(c) Rural regions will have lower agglomeration benefits but there will be wider economic and social benefits not shown in this table that will mean that the benefits of investment for all areas, including the South West, will be very significant. For example, the GVA associated with rail investment in the SW is £25bn alone.

7. In the absence of a national light rail/tram investment plan or published pipeline of schemes, the figures above are calculated on the basis that only existing tram/light rail networks are expanded. However, new tram systems can be transformative for urban areas and should be seen as urban regeneration schemes as much as an essential part of an integrated transport system, because they enable major public realm improvements through reconfiguring streets and simultaneously replacing road space in favour of pedestrians and cyclists. As provision for a number of cities and large towns, particularly those in regions without existing networks, to develop tram systems we have estimated an indicative additional capital cost of £14.3bn. To meet both transport and climate goals, trams can enable high passenger flows along major road routes into cities, using space reallocated from cars rather than heavy rail capacity, which is crucial for accommodating additional rail passengers and freight.
8. The analysis in this report shows that a very significant increase in public transport investment is required to address the climate emergency. This investment will not only protect the climate, but also offers major economic and social benefits just as England and Wales try to recover from the coronavirus pandemic. Investment on the scale proposed would yield a very large benefit in the form of jobs and increased economic activity, much of it in areas in the most urgent need of economic recovery and 'levelling up'.
9. The investment needed would more than pay for itself in benefits. Reallocating funding from high-carbon projects (eg the £60bn roads programme), bringing rail and buses back into public ownership to avoid leakage of profits, and introduction of an Eco-Levy as a fair replacement for fuel duty can all help to fund these additional costs.
10. Public transport improvements on this scale would greatly expand travel horizons for millions of people, enabling greater access to work, education, training, services, shops and amenities, and to friends, family and leisure. **Better public transport does not just mean more trains and buses, it means better lives.**

At this moment when families are suffering severely from a cost-of-living crisis, investment in public transport would help cut households' costs and provide valuable new income opportunities from high quality job opportunities in an expanded green economy. In the wider context of a climate emergency the case for rapid expansion of transport investment is overwhelming.

Section 1: Introduction

Climate change, although dangerously advanced, remains a choice. Climate breakdown is not inevitable. We have the knowledge and the means to drastically cut greenhouse gas emissions and stabilise the climate at 1.5˚C. A world-class public transport system is also a choice and is within our reach. The current deregulated and fragmented system we have in Britain outside London is not inevitable. We have the knowledge and means to create a comprehensive, fully integrated, reliable and affordable public transport system fit to address the climate emergency. Other countries in Europe manage this and have public transport systems that serve their communities far better than ours.

Creating a world class public transport system is not only essential for enabling Britain to meet our climate commitments, it will also help support healthy, thriving communities and vibrant local economies. Yet despite general acknowledgement that more public transport is a vital part of tackling climate change, there is little analysis to show how much public transport is needed to meet carbon targets and what it will cost to deliver that.

This report looks at Wales and English regions not including London and provides some initial indicative estimates of the increase in public transport that is necessary to meet climate targets and associated levels of investment. It also provides estimates of the numbers of green jobs this would help create and summarises evidence of other social and economic benefits. London is excluded due to its unique features that require different consideration to other parts of England, whilst recognising that London's transport also needs improvement to meet the climate emergency.

Increased investment in public transport and a truly integrated transport network, resulting in better service levels and much wider coverage of the places people need to get to and from, will shift more journeys to public transport and thus reduce emissions from our excessive levels of car use.

This report also discusses some of the policy levers that are essential to generate a large-scale shift in travel from private cars to public transport within the short time window to prevent climate change reaching a tipping point. These complementary policy measures, including bringing public transport back into public ownership, would also increase the benefits and value of the capital and revenue investments that this report proposes.

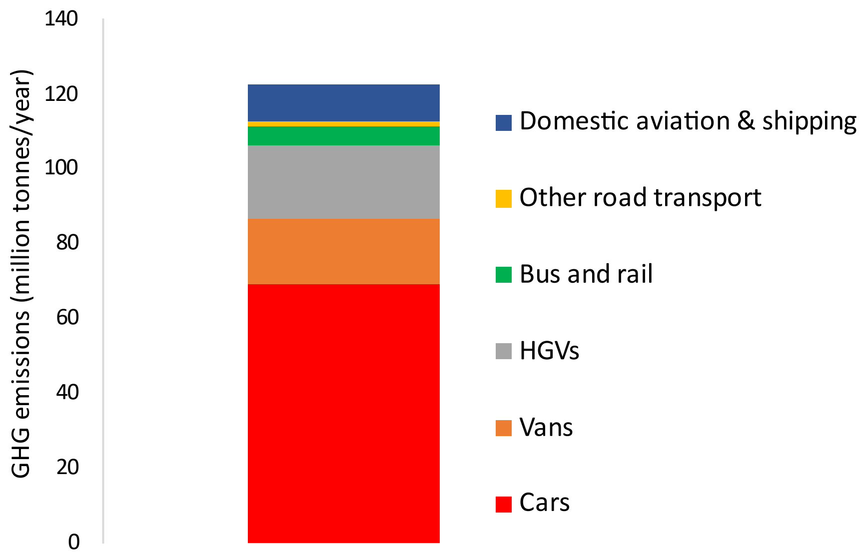
Section 2: The climate crisis and the need for action

The climate is in crisis. We are already experiencing damaging and deadly impacts from extreme weather events and rising sea levels. The summer 2022 heatwave in England and Wales alone was responsible for over 3,000 deaths[2]. Climate researchers warn that the next few years are critical because if emissions aren't rapidly reduced by 2030 it will make it impossible to limit warming later this century[3].

The costs of inaction on climate change are widely accepted to be much more than the costs of prevention. Unmitigated climate change would have catastrophic economic and fiscal consequences for the UK according to The Office of Budget Responsibility[4]. By contrast, while the expenditure required to get to net zero could be significant, it is not exceptional relative to the costs of other recent global emergencies, such as the financial crisis and the coronavirus pandemic. Moreover, it provides multiple other benefits that outweigh the up-front costs.

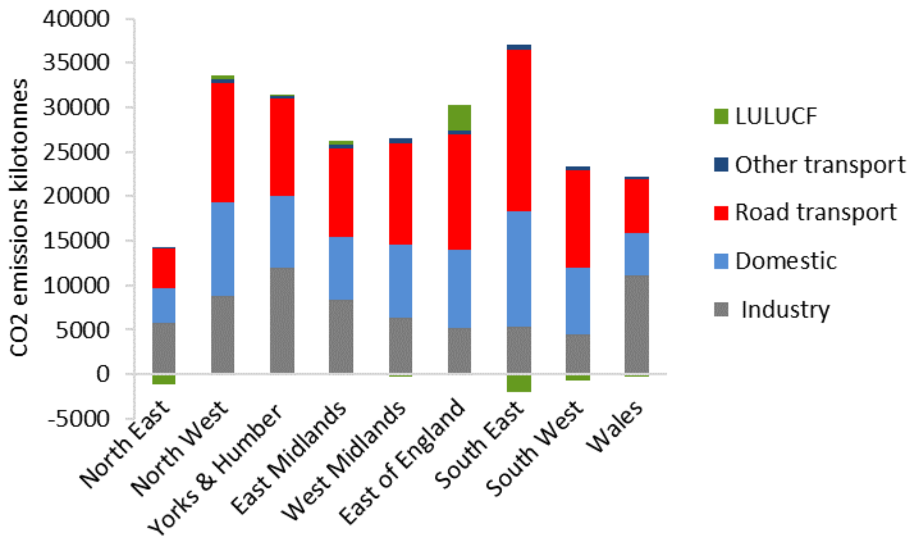
Transport is a problem sector: the single biggest contributor to the UK's greenhouse gas emissions and pre-covid was the only sector that had not achieved reductions from the 1990 baseline. In 2019, transport was responsible for over a quarter (27%) of the UK's domestic greenhouse gas emissions[5]. The majority of this (88%) was from road based private transport, with public transport (bus and train) contributing only around 4% of domestic transport emissions (see Figure 1).

Figure 1: Greenhouse gas (GHG) emissions from domestic transport in 2019[6]



Road transport is generally one of the main sources of carbon dioxide emissions when considered by regions and nations, ranging from 52% in the South East to 28% in Wales in 2019 (see Figure 2).

Figure 2: Breakdown of carbon dioxide (CO_2) emissions in Wales and English regions (not including London) in 2019[7]



Under the Paris Agreement, the UK is committed to reducing greenhouse gas emissions by 68% by 2030 (compared to 1990)[8]. Many climate scientists are calling for even faster and deeper cuts on the basis of the proximity to irreversible climate tipping points and global equity[9]. The UK's targets also ignore the large emissions associated with imported goods and place too much emphasis on the future removal of emissions by unproven technologies[10].

We cannot rely on electric vehicles alone to decarbonise transport. Even with the ban on the sales of new petrol and diesel cars and vans by 2030 and a Zero Emission Vehicle mandate, **most cars on the road will still be fossil fuelled in 2030**[11]. This is because new cars are only a small proportion (around 5% in 2021) of the total number of cars on the road and thus it will take many years at a feasible rate of 'churn' to replace all of the petrol and diesel vehicles. It is therefore essential that in addition to switching to electric vehicles we make deep cuts in car mileage by 2030.

The government's Transport Decarbonisation Plan recognises the importance of public transport and the complementary role it plays in achieving the necessary traffic reduction:

"Increasing car occupancy and encouraging public transport use are two measures that can immediately cut transport's carbon emissions"[12].

But government has failed to come up with a detailed plan on how to achieve the necessary cuts in transport emissions or provide any underlying data in support of the national carbon targets. There are no national targets for modal shift or traffic reduction. In July 2022, the High Court ruled that the government's Net Zero Strategy was in breach of the Climate Change Act by failing to produce detailed climate plans to meet carbon targets[13]. The government now has until March 2023 to come up with those detailed plans[14].

The Climate Change Committee's 2022 progress report warns that:

"Electric vehicles must not be the sole focus, with action also needed on demand and modal shift. The government has made the significant step of acknowledging the need to limit traffic growth and has provided significant funding to some key areas, but it has not set a specific

ambition or used all its available levers. It now needs to go further to set this aspect of the sectoral pathway in motion."[15]

Many of the sub national transport bodies also recognise that to decarbonise we need a significant shift away from car journeys.

"*Decarbonisation requires a step-change in the way we view and plan connectivity*"

England's Economic Heartland Transport Strategy[16].

With cuts to public transport funding (see Appendix 4 for details) the government are in danger of going backwards on transport decarbonisation.

The good news is that large scale modal shift from cars to public transport is possible if we put in place the policies, infrastructure and technology to enable changes to our lifestyles and behaviour. This will bring major benefits for health, the economy, social wellbeing and quality of life. Excellent and integrated public transport allows people to travel where and when they want and live a freer life, as well as reducing their travel costs.

There is huge potential for decarbonising the transport system by shifting more journeys from road to public transport, walking and cycling. While much of the focus on decarbonisation has been on electrifying cars, buses and trains (which is essential) there has been much less focus on the benefits of switching car journeys to more sustainable modes. Yet reducing car mileage by 4% would reduce emissions more than from electrifying the entire bus fleet[17].

As part of the levelling up agenda government has committed to deliver by 2030 local public transport connectivity across the country that is significantly closer to the standards of London[18]. Serious investment and supportive policies are needed now to get more people travelling by public transport to reduce private car travel and hence carbon emissions, support people during the cost-of-living crisis and bring widespread economic, social and environmental benefits. It is also necessary to build more climate resilience into the network to cope with growing numbers of extreme weather events.

To reduce car traffic by 2030 will require reliable, comprehensive and affordable public transport alternatives to be in place. The next section considers just how much car mileage we need to shift to public transport, and the necessary step-change in public transport provision to propel that shift.

Section 3: What increase in public transport is needed?

This section provides some indicative estimates for the increases in public transport (and reductions in car travel) needed at a regional and nation level to achieve our climate targets. Summaries by region and nation are provided in Appendix 1. A detailed methodology listing the assumptions and evidence used can be found in Appendix 2.

Existing levels of public transport and the potential for increase

Pre-Covid the passenger distance travelled by car far exceeded that travelled by public transport in every region and nation as Table 1 shows.

Table 1: Estimated passenger distance travelled by different modes in 2018/19 in Wales and English regions (not including London) (million passenger km, mpkm, rounded to nearest 10 million)[19]

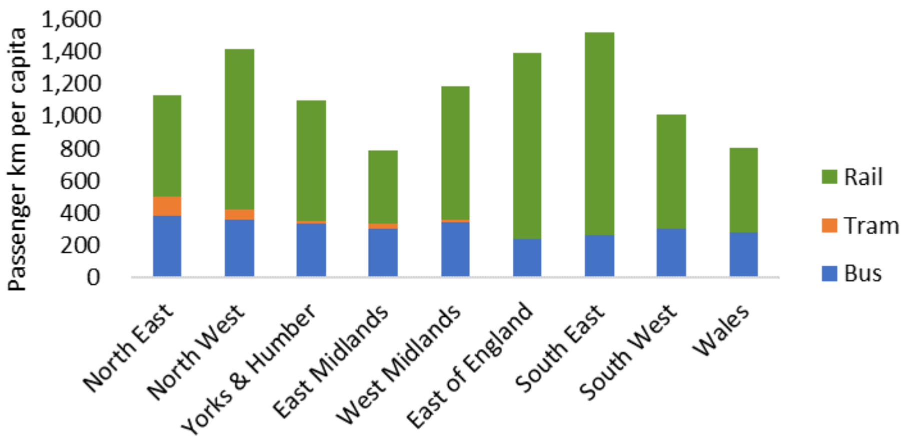
Region/nation	Passenger km travelled in 2018/19 mpkm/y (a)				
	Car (a)	Bus (b)	Light rail/tram	Train (b)	Total public transport
North East	25,200	1,010	320	1,670	3,000
North West	72,030	2,610	480	7,260	10,350
Yorks & Humber	55,170	1,830	80	4,120	6,020
East Midlands	56,520	1,470	120	2,210	3,800
West Midlands	63,010	2,020	90	4,870	6,980
East of England	72,370	1,500	No tram	7,140	8,630
South East	107,790	2,430	No tram	11,470	13,900
South West	70,590	1,700	No tram	3,960	5,660
Wales	37,260	900	No tram	1,640	2,520
Total	559,930	15,460	1,090	44,330	60,870

(a) 2019 figures. 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. We have used average car occupancy figures of 1.55 in 2019 to estimate car passenger km (see Appendix 2 for details).

(b) In the absence of regional statistics we have used passenger trips in 2018/19 multiplied by average regional trip distances in 2016/17 and 2017/18 from the National Travel Survey. Note the regional rail figures assume all journeys within the region and half the journeys to/from other regions to avoid double counting. We have adjusted the regional figures to bring the totals in line with DfT figures for total passenger bus km for England and Wales and ORR figures of total rail passenger km in Great Britain.

While some of the disparity in total public transport use between regions shown in Table 1 can be explained by differences in population, there is also a disparity in public transport use per head, particularly for rail, as shown in Figure 3 below (and Table 4.1 in Appendix 4). This shows that the rail passenger km per head in the South East is double that of Wales, the East Midlands and the North East. This partly reflects the proximity and radial links into London which means more rail commuters coming into London from the South East and East of England.

Figure 3: Public transport passenger km per capita in 2018/19 in Wales and English regions (not including London)



Yet public transport offers the best opportunity to reduce the distance travelled by cars (and lorries):

- A fully loaded bus can take 65 cars off the road.
- A full light rail/tram can take 90–150 cars off the road (varies with network).
- One passenger train can take 500 cars off the road.
- One freight train can take 76 lorries off the road.

while providing numerous other benefits:

- **Buses** are the best used form of public transport. Pre-covid nearly one billion journeys were made by bus in Britain and on average, one-quarter (25%) of the adult population use buses often (at least once a week). This increases to 54% amongst people that do not have personal car access[20]. It is the most-used public transport mode for people on lower incomes and is a lifeline for many. 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.
- **Light rail/trams** are an efficient, low carbon form of transport which provide predictable, regular and reliable journey times and service patterns combined with high passenger

carrying capacity[21]. As well as providing step-change transport improvements, they are a recognised catalyst for urban improvement that make the public realm hugely more attractive[22]. This means that light rail/trams should be seen as urban transformation and regeneration schemes that help stimulate local economies as well as being transport schemes. They have a proven record of attracting people out of cars. For example, 14% of all trips on the Midland Metro were previously undertaken by car, removing around 600,000 trips a year from the roads[23]. The rate of transfer from car to tram at peak times is typically around 27%[24].

Box 1: Definition of light rail/trams

"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." Department for Transport[25]

For the purposes of this report any reference to light rail/trams are for systems which predominantly reallocate space from roads rather than tram-train systems where trams run both on an urban tramway network and on main-line railways and where there may be potential conflict due to the need to expand heavy rail capacity significantly. Metro systems that run on dedicated light rail tracks (such as Tyne and Wear Metro, West Midlands Metro and Manchester Metrolink) are considered light rail. Metro systems that run on heavy rail (such as London underground or the proposed South Wales Metro) are considered more akin to rail.

- **Rail** is the backbone of the public transport system enabling large numbers of people to be moved efficiently in and out of congested urban areas and between cities and towns, as well as providing important links for rural residents to reach services and facilities. They offer the best opportunity to replace longer distance car trips. Rather than a cost to be borne, the rail network creates prosperity across all regions and nations as well as effectively cutting carbon and congestion. Although freight was outside the scope of this report rail also provides a low carbon way of transporting goods to market as the box below shows. Freight is a key part of an integrated transport system and it is important that there is also investment in the strategic rail freight network and potential rail freight lines are safeguarded for future use.

Box 2: The importance of rail freight for carbon targets

Although freight was not included within the scope of this project, shifting freight from road to rail is also essential for climate reasons.

Over a sixth (16%) of domestic transport's greenhouse gas emissions came from Heavy Goods Vehicles (HGVs or lorries) in 2019[26]. Transferring more freight to rail will help reduce carbon as every tonne moved by rail generates 76% less carbon than by road[27]. And because long-distance HGVs are not expected to be zero emission in any significant numbers by 2050, a much greater volume of freight will need to be moved by rail to meet net zero targets[28].

In 2019 9% of the UK's freight was moved by rail compared to 79% by road[29]. The Chartered Institute of Logistics and Transport (CILT) estimate that over a third (38%) of HGV tonne-kms would be suitable for rail, which combined with existing rail freight means that nearly a half of all UK tonne-kms could be moved by rail[30]. This means a more than trebling of rail freight in the UK to meet net zero ambitions[31]. Modal shift of trunk haulage from road to rail is a straightforward change in many supply chains according to CILT[32]. They estimate that "two-thirds reductions in the carbon footprint of a supply chain are achievable in a very short timescale". This would also help to alleviate the acute shortage of HGV drivers.

Moving more freight to rail would generate enormous benefits, including carbon reduction, reduced congestion, improved road safety, better road maintenance and wider economic and employment benefits. Currently rail freight generates economic benefits worth £2.45bn annually, including benefits to customers, reduced congestion, reduced carbon and improved safety[33]. A large proportion of these benefits accrue to communities in former industrial heartlands.

A study for the Rail Freight Group estimated that investment in the rail freight network of around £9–12bn in capital and £500m in revenue over ten years would save around 40% of the carbon from HGVs and would generate around £75–91bn in wider social and economic benefits[34]. These benefits would increase to £112–136bn with the introduction of distance-based road pricing for lorries, that would help to recoup the full cost of HGVs on society.

A separate study estimated electrification of around 700-800 miles would complete the core rail freight network and allow electric locos to be used across the system[35]. It is estimated that two million train miles a year could be converted to electric haulage if less than 50 miles were wired. Based on Network Rail's estimated costs for electrification (pro-rated and assuming the routes are twin track so 1km of route is equivalent to 2km of single track km) this would require around £224–322m to electrify 50 miles or £3.3-4.8bn to electrify 750 miles (2020 prices)[36]. Network Rail estimate an additional £3–4bn is needed for the electric freight rolling stock[37]. This would provide a significant return on investment (see Appendix 4 for more details).

There are many examples from exemplar schemes in different areas which show that significant increases in public transport patronage can be achieved in relatively short periods. See box below.

Box 3: Upgrade of the West Coast Mainline benefits passengers and local economies[38]

The transformation of the West Coast Mainline in 2009 resulted in a doubling of passengers in 15 years. This £8.9bn (£12.4bn in 2021 prices) project resulted in significant benefits, according to evidence compiled by the Campaign for Better Transport. It increased capacity by up to three times on key routes, reduced journey times, reduced congestion, reduced carbon and supported local economies, including the regeneration of Runcorn Town Centre after numbers using its station doubled.

Need for modal shift

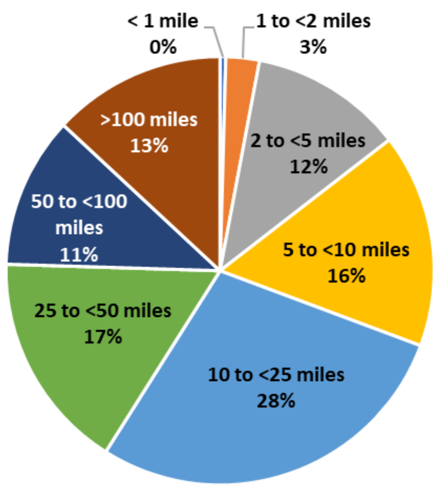
There is growing evidence that we need to reduce car mileage by at least 20% (and possibly by much more) by 2030 compared to 2019 levels[39,40,41]. This requirement for a minimum of 20% car mileage reduction is the basis for our analysis of the necessary increase in public transport.

Scotland and Wales have set traffic reduction targets and modal shift targets for public transport (sometimes combined with walking and cycling) but there are no such targets at a UK, England or English regional level despite growing recognition that radical change is needed.

"There is no doubt that mass transit solutions particularly in cities will need to be revolutionised."

Midlands Connect Strategic Transport Plan, 2022

Figure 4: Proportion of total miles travelled by car/van drivers in 2019 by average trip distance[42]



In reducing carbon, it is the mileage rather than the number of trips that is important: although the majority (57%) of car/van trips are less than five miles, these only account for 15% of the distance (see Figure 4). It is the car/van trips over 10 miles that account for the majority (69%) of the distance/carbon.

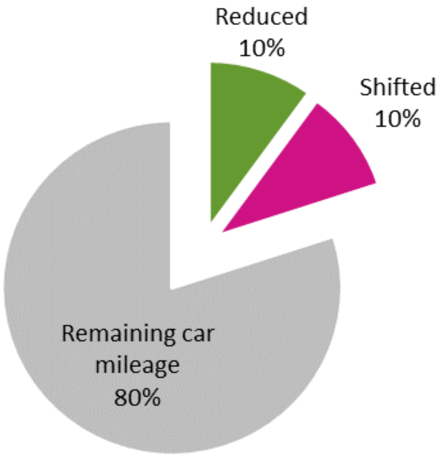
We have assumed that **10% of total car mileage will be reduced through measures such as working from home, use of remote technologies, destination shifting, better**

landuse planning, and more carsharing. As the methodology in Appendix 2 shows this is plausible given the higher levels of remote working since the pandemic. This 10% combined reduction is in the absence of any restraint measures or incentives, and additional reductions could be achieved through restraints on car travel (eg road pricing, reduction of parking provision, increased parking charges, traffic calming etc.).

We have assumed that another **10% of total car mileage (and associated passenger km) can be reduced by mode shift**. Note this is a minimum amount.

Generally, we assume that the shorter distance trips can be substituted by walking/cycling, the medium distance trips by bus/tram and the longer distance trips by rail. To account for the overlap between the different trip lengths per mode (eg a train trip could be as short as five miles or more than 25 miles) we assume a range of different car trip distances can be substituted by each public transport mode (eg we assume that buses/trams can substitute for car trips of 2–10 miles as a lower bound, and trips of 5–25 miles as an upper bound; and that rail can substitute for car trips of over 25 miles as a lower bound and trips of over 10 miles as an upper bound). This results in a range of 28%–45% of car driver/passenger km to be shifted to bus and tram, and 41%–69% of car driver/passenger km to be shifted to rail. We then scale up to account for forecast population in 2030 in each region and nation.

Figure 5: Reduction in car mileage needed by 2030 relative to 2019 to meet carbon targets



Of the 10% car mileage to be shifted, we assume:

- **28%-45% can be shifted to bus and tram**
- **41%-69% can be shifted to rail**

Estimates of future public transport levels needed

The average additional public transport passenger km that is needed by 2030 to meet carbon targets is shown in Table 2. This is based on a reduction of over 47 billion car driver/passenger km a year by 2030 in Wales and England (not including London). London is not included in the estimates for this report for methodological reasons (which makes direct comparison with Wales and the other English regions difficult) but the next section makes clear that additional public transport improvements and investment are also urgently needed in London.

Table 2: Average additional public transport passenger km required by 2030 to be climate emergency compliant, by nation and region (million passenger km (mpkm) rounded to nearest 10 million, % rounded to nearest 10%)

Region	Bus		Light rail/tram		Rail	
	Additional passenger km by 2030 (mpkm/y)	**% increase from 2019**	**Additional passenger km by 2030 (mpkm/y)**	**% increase from 2019**	**Additional passenger km by 2030 (mpkm/y)**	**% increase from 2019**
North East	750	70%	230	70%	1,470	90%
North West	2,440	90%	450	90%	4,480	60%
Yorkshire & Humber	2,090	110%	90	110%	3,330	80%
East Midlands	2,180	150%	180	150%	3,540	160%
West Midlands	2,510	120%	110	120%	4,070	80%
East of England	2,880	190%	0		4,620	70%
South East	4,260	180%	0		6,810	60%
South West	2,920	170%	0		4,510	110%
Wales	1,440	160%	0		2,180	130%
Total (average)	**21,460**	**120%**	**1,060**	**120%**	**35,000**	**80%**
Total (range) (a)	**16,660-26,250**		**830–1,300**		**26,710–43,280**	

(d) The ranges are based on the upper and lower bounds of modal shift as discussed in the methodology

Table 2 shows that the average increase in public transport passenger km is considerable in all regions, ranging from a 60% increase to a more than doubling (100%) or near trebling (190%) of passenger km in some regions by 2030. Viewed as an overall average across Wales and England (not including London) there needs to be an increase in bus passenger km of around 120%, an increase in light rail/tram passenger km of around 120% and an increase in train passenger km of around 80%. Combined, **public transport passenger km in Wales and England (not including London) needs to nearly double (90%) by 2030 on average**.

These increases may seem highly ambitious based on existing public transport provision and historic growth figures (though rail passenger trips have doubled in the past 20 years). However, these estimates should be regarded as an **absolute minimum** for the scale of increase needed and may be much higher if, say, the number of fossil-fuelled cars on the road by 2030 is higher than expected[43]. If this happens and we need to reduce car mileage by, say, 30% rather than 20% then the increases in public transport will need to be roughly double that shown in Table 2.

The table shows a rather striking difference between the percentage increases in different regions and nations. This is partly accounted for by very different levels of existing car passenger km and public transport passenger km in different places. For example, pre-Covid, the East of England had relatively high car passenger km and relatively low bus passenger km compared to other regions, which results in the highest percentage increase in bus passenger km. Similarly, the East Midlands had relatively high car passenger km and relatively low rail passenger km which results in a large percentage increase in rail passenger km.

Box 4: Comparison with other studies

The Confederation of Passenger Transport (CPT) have estimated that bus passenger km needs to increase by two-fifths (41%) by 2030 compared to 2019 levels to meet carbon targets[44]. Although this is lower than our estimates it also suggests a step change in patronage is needed.

By comparison to European countries the communities of Wales and England (not including London) are very poorly served by public transport. We present figures in Section 7.1 which highlight the disparity between the low levels of public transport usage in Britain and the significantly higher levels in comparable areas in Europe. The increases in Table 2 by 2030, though significant, would not even bring Britain's public transport levels of use outside London up to *current* levels in parts of Europe where the public transport systems are fully regulated and coordinated.

Future public transport levels needed in London

Although we have not included London in the estimates of additional public transport and investment levels due to the different carbon targets, transport system and funding arrangements which make direct comparison with other English regions difficult, this section highlights why London continues to need significant improvements and investment in public transport. Estimates of funding for London public transport could form the basis of a future piece of work.

The Mayor of London has set an ambitious target for London to be net zero carbon by 2030 (compared to the UK's target of 2050). This in turn will require more ambitious reductions in car mileage compared to other English regions, and "*action at a London-level in a timeframe that goes beyond that which is supported or funded at national-level.*" [45]

This goes well beyond the Mayor's Transport Strategy (which predated the net zero target), which aims for 80% of trips in London to be made by walking, cycling and public transport by 2041. The mode share of active and sustainable modes in London has increased gradually over time, to 67% in 2019/20[46]. This has been mostly driven by consistent growth in public transport use (primarily rail).

The possible pathways to achieving net zero in London have been analysed by Element Energy, who modelled four scenarios, representing different levels of ambition[47]. All of the scenarios require a reduction in car km by 2030. An **Accelerated Green** scenario would require a reduction in car vehicle km of 27% by 2030 relative to 2018 while a **No Constraints** scenario requires a reduction of 40%, far higher than the Mayor's Transport Strategy[48].

Element Energy advise that this reduction in car mileage will require a shift to public transport (and active and shared transport) and an improved public transport offering including extended bus, tram and rail networks, and improved frequency and capacity of existing services. While these measures are part of the Mayors Transport Strategy, they must be delivered much earlier in the **No Constraints** and **Accelerated Green** scenarios. The report noted that bus changes in particular can be delivered relatively quickly.

While the exact amount of public transport needed was not explicitly modelled the report provides some illustrative estimates of increases in bus vehicle km (note this is different to passenger km) of up to 4% by 2030 relative to 2018. In practice, there could be a greater increase in bus vehicle km depending on the share of travel shifted to different modes. London's bus vehicle km pre-Covid was almost as much as that in all of England's other metropolitan areas, so even a 4% increase is a significant increase (and greater than the increase in London's bus vehicle km since 2004/05)[49].

The urgency of a net zero 2030 target for London means substantial action must be taken in the next five years, otherwise more challenging action and investment will be needed in the mid-to-late 2020s to compensate for earlier under-delivery.

However current funding cuts threaten existing public transport services and the delivery of London's net zero targets. The devasting impact of the pandemic has meant that extraordinary government funding has been required to continue to operate services. While TfL has agreed an 18-month funding settlement with government, it still leaves a gap in TfL's budget of around £740m up to March 2024[50]. It is assumed this budget is based on the Mayor's Transport Strategy rather than the more challenging net zero strategy. Compared to other global cities like Paris and New York, TfL receives far less direct government funding: for example, TfL has to raise 72% of income from fares, compared to only 38% in New York or Paris[51].

Levelling down London is not the way to achieve levelling up in the rest of the country and without a London recovery there will be no national recovery. For example, for every £1 invested on the London Underground, 55p is paid to workforces outside of London, with TfL contracts contributing around £6.4bn to the economy overall[52].

Urgent funding is already needed to keep London's ageing transport network running safely and reliably. Additional funding is crucially important to restore and further increase public transport patronage levels in London. Because it is hard to get public transport patronage back once it is lost, the danger is that failing to properly fund London's transport system now will only end up costing more in the long run, and risks failing to meet carbon targets as well as resulting in higher congestion, worsening air quality and poorer health outcomes.

Section 4: What levels of additional investment are needed?

Achieving the uplift in public transport estimated in Table 2 for Wales and English regions (not including London) is going to need significant additional funding, which is exacerbated by the long-term under-funding from the UK government.

With a cost-of-living crisis, now is the time to be seriously investing in public transport to help cut people's costs, support access to jobs, training and education, and grow the green economy. With a climate emergency, it becomes an imperative. Additional investment now will enhance the capacity and performance of the network in future years. This will attract more passengers, increase the revenue from fares, and ultimately encourage more investment or further reduce fares, perpetuating a virtuous circle.

This programme of investment stretching into the medium-long term is in addition to a very urgent requirement for further short-term government support to halt a further decline in bus, light rail/tram and train patronage caused by the coronavirus pandemic (see Appendix 4 for more details).

Operating funding

The additional costs to run the extra bus, light rail/tram and rail services required to meet our carbon targets are shown in Table 3. The detailed assumptions and methodology for this are given in Appendix 2. Note that that all of our revenue costs draw on sources that pre-date Covid and do not take account of the escalating supply chain and operating costs and inflation.

Our calculations assume zero additional revenue from patronage uplift due to the increased public transport provision. This is because achieving the levels of mode shift to address climate targets is likely to require fare reductions to make public transport cost-competitive with private car use. This has to be applied to the existing public transport services, as well as the additional services, so in practice some of the present revenue would be lost. Fare reductions would not only assist with achieving climate targets but would have a valuable impact on the cost-of-living crisis, helping many families with the financial stress they are suffering due to the severe squeeze on their day-to-day expenditure.

Our calculations of operating costs could be reduced by a large amount (ie 50% or more) with different assumptions about fare income. But higher fares will militate against the necessary mode shift, so we have presented the full cost here on the basis that it is more likely to deliver the mode shift required to meet climate targets. One reason fares are so high in the UK is due to privatisation and profit leakage, so bringing public transport back into public ownership will also deliver operational cost savings.

Box 5: Need for fare reduction

To achieve the estimated increases in public transport patronage will almost certainly require a reduction in fares to make them more affordable and cost-competitive with car use. Currently there is a large discrepancy in costs caused by years of fuel duty freezes and above-inflation fare rises. The cost of bus and rail fares has risen faster than the cost of living since 2012 while the cost of motoring has fallen in real terms according to the RAC[53]. There are also existing regional inequalities in fares which for buses is a direct result of the deregulated and privatised bus network. For example, a single bus journey in some areas can cost four times the amount to cross London by bus[54]. Young people age 16–24 also face a "postcode lottery" in accessing free and discounted bus fares[55].

If fares aren't reduced then an alternative approach would be to introduce measures that dramatically increase motoring costs to make public transport cost-competitive with driving, an approach that would also generate a revenue stream to support public transport. This approach would require some sort of concession for low paid workers who rely on cars and have no alternatives but to drive (eg care workers, taxi drivers).

In practice, a combination of both fare reductions and increase in motoring costs is likely to be required which would benefit the majority of low-income workers who use public transport.

Note that our estimates of additional light rail/tram operating costs are based on expansion of light rail/tram networks only in regions with existing networks. If additional networks are provided in other regions this will mean the estimated bus costs will be reduced accordingly (as light rail/tram trips could replace some of the additional bus trips). Either way significant additional funding will be needed for buses to operate in all areas. Table 3 below shows our estimates for average additional operating costs (the full range is shown only for the total). See Appendix 2 for the methodology and assumptions.

Table 3: Estimates of average additional operating costs (£m/y) by 2030 (rounded to nearest £10m) (2020 prices) (% increase compared to estimated existing costs shown in parentheses, rounded to nearest 10%)

Region	Additional operating costs (£m/y) by 2030 (2020 prices)			
	Bus (a)	Light rail/tram	Rail	Total
North East	320 (100%)	100 (80%)	460 (90%)	870
North West	890 (130%)	190 (90%)	1,400 (60%)	2,480
Yorks & Humber	850 (160%)	40 (110%)	1,040 (80%)	1,930
East Midlands	690 (200%)	80 (160%)	1,100 (160%)	1,870

West Midlands	990 (170%)	50 (160%)	1,270 (80%)	2,310
East of England	840 (270%)	Not estimated	1,440 (70%)	2,280
South East	1,510 (240%)	Not estimated	2,120 (60%)	3,640
South West	930 (240%)	Not estimated	1,410 (110%)	2,330
Wales	460 (220%)	Not estimated	680 (130%)	1,140
Total **Total range**	**7,480 (190%)** **5,810–9,150 (150–230%)**	**450 (100%)** **350–550 (80–120%)**	**10,910 (80%)** **8,320–13,500 (60–100%)**	18,840 **14,480–23,190**

(a) Note that this is based on operating revenue rather than costs and assumes that some of the replacement capital costs for existing buses will be covered by operating revenue. This will underestimate the costs for regions such as Wales where buses operate at a loss.

Table 3 shows that total average additional operating costs by 2030 will be around £7.5bn a year for buses, £0.5bn a year for light rail/trams and £10.9bn a year for trains. For buses this would mean a more than doubling of pre-Covid support, although additional funding similar to the levels of Covid support (£7bn a year, see Appendix 4) and for rail this implies a doubling of pre-Covid levels of support although a similar level of funding to Covid support (£13bn a year, see Appendix 4). For bus, light rail/tram and train combined, **total additional operating costs in Wales and England (not including London) average around £19bn a year by 2030**.

Box 6: Comparison with other studies

Other studies have produced numbers in a similar ballpark. For example, the additional costs of providing a comprehensive bus service to all rural areas in England with services to every village ever hour is estimated to cost £2.7bn a year[56] (see Appendix 5 for more details and a breakdown by region).

Bus Service Improvement Plans (BSIPs) are costed plans for bus improvements prepared by local authorities and bus operators, which formed the basis for funding awards by government (see Appendix 4 for more details). The small number (16 out of 77) that provided a published breakdown of revenue/capital costs estimated that an additional £1.2bn of revenue funding to 2024/25 would be needed for a 5% increase in passenger numbers relative to 2018/19[57].

There will be significant operational efficiencies resulting from additional investment, but these are difficult to quantify and thus are not factored into the costs estimated above. For example, the proposed investment in bus priority measures (see following section) will mean more daily bus journeys can be added to a given route without increasing the vehicle requirement, while electrification of rail services provides significant reductions in operating costs. These are discussed further below.

Capital funding

Buses

We have considered how much investment in new bus infrastructure and vehicles is required to support the significant uplift in bus use estimated as necessary to meet our climate commitments (as shown in Table 2).

This estimate is based on the costs of expanding and electrifying the bus fleet by 2035 to accommodate the additional patronage, and investment in bus priority measures in each region or nation. Zero emission buses are essential for driving carbon and air pollution down.

Bus priority measures (measures to improve the reliability of bus journey times such as dedicated bus lanes or traffic light priority schemes) are absolutely essential to making buses a viable and attractive alternative transport choice for car users[58]. They make buses more reliable and reduce journey times so people are willing to shift their journeys from car to bus, thus reducing congestion and making the economics of running bus services more viable. They require political leadership to act for the benefit of the public good by reallocating road space for buses. But such measures do have public support: a 2022 survey for the Confederation of Passenger Transport (CPT) showed a majority (54%) of people surveyed in Great Britain outside London support bus priority measures while only 15% oppose them, with support even higher (62%) among businesses[59].

A detailed methodology and assumptions are shown in Appendix 2. Our indicative estimates of average additional bus capital costs are shown in Table 4 (the full range is shown only for the total) together with estimated wider economic benefits associated with bus priority measures.

Table 4: Estimated average additional capital investment needed for buses by 2035 (rounded to nearest £10m)

Region	Additional capital costs by 2035 (£m)			Estimated economic benefits (£m) (b)
	Additional buses and electrification (a)	Bus priority measures	Total	
North East	560	660	1,220	3,300
North West	1,410	2,350	3,770	11,770
Yorks & Humber	1,250	1,440	2,690	7,190
East Midlands	920	1,040	1,960	5,210

West Midlands	1,400	1,630	3,030	8,140
East of England	1,020	1,180	2,200	5,900
South East	1,910	2,060	3,970	10,310
South West	1,170	2,090	3,270	10,470
Wales	620 (c)	1,170	1,790	5,850
Total **(Total range)**	10,270 (8,790–11,740)	13,630	23,900 (22,420–25,370)	68,140

(a) Note that this assumes that some of the existing buses will be replaced by the operators covered by operating revenue, therefore for these buses the costs are the incremental cost of an electric bus versus a diesel bus. It also assumes that price parity of diesel and electric buses will be reached in 2030, so after then the total cost of the replacement buses will be covered by operating revenue. The costs include additional buses to cover the increase in passengers.
(b) Using the average investment for bus priority measures and assuming the economic return for each £1 spent on bus priority measures is £5 based on estimates for Greener Journeys[60]
(c) The costs for bus electrification are likely to be underestimated due to the methodology which assumes that some of the replacement costs of existing diesel buses will be funded through operating profits. However, compared with English regions bus operator profit levels in Wales are generally lower, so significantly more support than the figure shown is likely to be needed.

This shows that the additional total cost of electrifying the bus fleet including additional buses needed by 2035 is around £10bn while the costs of bus priority measures is another £14bn. **The total additional capital cost for bus improvements is approximately £24bn (with a range between £22.4 to £25.4bn). The estimated wider economic benefits (Gross Value Added or GVA), associated with the bus priority measures only, are around £68bn.**

Box 7: Comparison with other studies

Again, our figures are in the same ballpark as other estimates or scheme costs. For example, government funding for around 1,300 zero emission buses and associated infrastructure extrapolated to the remaining fleet in England (not including London) and in Wales would cost roughly £5.3bn[61]. The Scottish Government is investing £500m in bus priority measures[62]. Transport North East estimated £250m of funding was needed for bus priority measures along 17 corridors, including a Bus Rapid Transit scheme up to 2025[63]. Transport for Greater Manchester estimated £122m was needed for bus priority measures along three corridors up to 2025[64].

Light rail/trams

New light rail/tram systems require major investment but can be transformative for cities and regions. They should therefore be seen as urban regeneration schemes as much as an essential part of an integrated transport system because they enable major public realm improvements through reconfiguring streets and simultaneously replacing road space in favour of pedestrians and cyclists. The investment costs are generally more than offset over time by the economic and social benefits including greater reliability, comfort, accessibility, faster journey times and capacity[65].

In the absence of a national light rail/tram investment plan or published pipeline of schemes we have assumed that only existing light rail/tram networks get expanded. We have estimated a ballpark figure for the additional track length needed for the increased passenger km shown in Table 2 and used an indicative capital cost of £30m per km of track (see methodology in Appendix 2 for details). We have assumed delivery over a slightly longer time period up to 2035 due to the lead time needed to develop detailed costed schemes. Our estimated indicative capital costs are shown in Table 5 below. We were unable to find any estimates of economic benefits associated with light rail/tram investment.

Table 5: Estimated average additional capital investment needed for expansion of existing light rail/tram networks by 2035 (rounded to nearest £10m)

Region	Additional tram length by 2035 (km)	Additional capital costs by 2035 (£m)
North East	38	1,140
North West	67	2,020
Yorkshire & Humber	26	790
East Midlands	31	950
West Midlands	18	550
Total **(range)**	**181** **(141–222)**	**5,440** **(4,230–6,650)**

We estimate indicative **total funding of around £5.4bn for the five English regions with existing light rail/tram networks** would be needed to deliver an additional 181 km of track length (an increase of more than 60% compared to the existing light rail/tram track length in these five regions.)

Box 8: Comparison with UK government funding for light rail/trams

In recent years government funding has been awarded towards a £450m, 11 km extension of the West Midlands Metro from Wednesbury to Brierley Hill, as well as £200m of immediate funding for Leeds to plan and build a mass transit system[66]. Leeds is the largest city in Europe without a rapid transit system and has seen previous proposals turned down including a supertram estimated at £486m in 2005 (£694m in 2021 prices)[67]. The £200m funding provided to Leeds is insufficient to build the proposed system[68].

However, this investment does not address a much wider shortfall in funding for new networks. Britain lags well behind other countries. For example, there are only nine light rail/tram networks in Britain compared to nearly 50 in Germany and nearly 30 in France (see

Appendix 3). Yet dozens of cities and towns in England and Wales meet the UK government criterion that light rail/trams are suitable for medium sized cities and towns (200,000–600,000 population)[69].

As provision for a number of cities and large towns, particularly those in regions without existing networks, to develop light rail/tram systems we have estimated an indicative **additional capital cost of £14.3bn** as shown in the Box below, which would allow a near trebling of the light rail/tram network. Note we have not included these costs in the summary tables.

Box 9: Illustrative costs of further expansion of the light rail/tram network

To add a further 359 km of light rail/tram network to that shown in Table 5 so that the total network in England and Wales outside London matches the length of the existing French network of 827 km (see Appendix 3), and assuming a capital cost of £40m per km for new networks we estimate this would require **an additional £14.3bn capital cost**. This would enable a number of cities and large towns to develop a sizeable light rail/tram network (eg 20–30 km) or a large number of smaller networks depending on local need. While this would result in a near trebling of track length compared to the existing network (287 km) in Wales and England (not including London), this would still be much less than the existing track length in Germany (2,966 km) (see Appendix 3).

The actual costs would be highly dependent on local conditions, the type of system and the extent of the network. The costs could be reduced through efficiencies of scale across multiple schemes. This investment would not only deliver carbon savings and congestion relief but would provide transformational benefits to those cities and towns.

However, it is crucial that investment in light rail/trams is not at the expense of heavy rail and should complement rather than compete with the latter (since additional rail capacity will be needed to meet carbon goals). To achieve both transport and climate goals, trams can enable high passenger flows along major road routes into cities, using space reallocated from cars rather than heavy rail capacity, which is crucial for accommodating additional rail passengers and freight.

Heavy rail

The capital cost of heavy rail can vary greatly depending on local circumstances (for example, the need for tunnelling or bridges, design speed, line capacity, extent of electrification). We have therefore judged that our estimates for the capital funding needed for rail to accommodate the additional growth in passengers should be based on published figures, rather than on a more approximate methodology extrapolating from generalised costs.

There is no detailed national rail strategy (analogous to the Roads Investment Strategy) and with delays to the government's Rail Network Enhancements Pipeline (RNEP) (see Appendix 6) there is no updated comprehensive breakdown of a costed pipeline of priority rail schemes (other than those committed to in Network Rail's Delivery Plans for Control Period 6). Some regions have produced their own costed rail strategies, notably Transport for the North and Transport North East, but some English regions/sub national transport bodies have yet to produce a priority list of rail schemes, and are still some way from a costed list of rail schemes. The newly formed Great British Railways is developing a high-level, 30-year strategy, but many in the industry are calling for a detailed delivery plan[70].

We have summarised some published rail cost figures in Appendix 7. These include a high funding scenario in a study for the Rail Industry Association (RIA) which relates to major new projects. This estimates the UK's rail infrastructure needs funding of £20–23bn a year spending up to 2035[71].

In the absence of detailed costed figures by region we have used the RIA's estimates for the additional funding (ie the difference between the base scenario and high funding scenario) on the basis that these are likely to deliver the step-change in rail capacity needed. This level of funding is consistent with the National Infrastructure Commission's high scenario funding (+50%) for the Midlands and the North which would deliver multiple new regional and long-distance links[72].

Some highly illustrative figures for rail investment are shown in Table 6 using the additional funding for the RIA's high scenario (net of baseline) spend for the period 2023–2035 of £87.5bn for the UK. We have also included an additional amount of £31bn over the period 2020–2035 to take account of the shortfall between the RIA's assumed baseline spend (£13–15bn a year) and actual committed funding (average of around £12bn a year 2018/19 to 2020/21 for Great Britain[73]). A shortfall seems highly plausible given that the Northern Powerhouse Rail plans have a shortfall of around £14bn[74] and the delays to the rail pipeline are estimated to have resulted in at least £1bn of cuts to the rail enhancements budget to March 2024[75].

We have allocated the total figure derived from the above analysis to the UK nations and regions using weighting factors based on the population of England outside London and Wales and the percentage increase in rail passenger km needed by 2030 relative to 2019 as shown in Table 2. Thus, regions such as the East Midlands or Wales, needing a very high percentage increase in rail passenger km, will get proportionately more funding than a region such as the South East. Table 6 shows the results for Wales and England (not including London).

Other weighting factors could be applied (eg on a per capita basis or total rail passenger km per head) which would give different regional allocations. Note also that investment in one region may benefit other regions depending on the network. Any final allocation will depend on the costed schemes necessary to deliver the step-change in capacity and service levels that are required in a climate emergency. These need to be identified and developed in an updated and expanded pipeline of rail schemes as a matter of urgency.

We have assumed that this investment will need to be delivered over a slightly longer time period up to 2035 due to the lead time needed to develop detailed costed schemes. One of the issues will be whether there is the capacity to absorb this amount of spend as past under-investment will have led to a loss of skilled workers and supply chains in many areas. A key role of Great British Railways will be to scale up investment and the capacity to deliver schemes as quickly as possible to expand the rail network and improve services.

Table 6: Illustrative estimates of additional rail investment needed by 2035 and associated GVA (£bn/y) [76] (investment per head in £/head rounded to nearest £100)

Region (a)	**Illustrative rail investment 2023-2035 (£bn)**	**Illustrative GVA 2023–2035 (£bn) (b)**	**Illustrative rail investment annualised over 12 years (£bn/y)**	**Illustrative rail investment per head 2023–2035 (£/head) (c)**
North East	9.3	19.3	0.8	3,500
North West	6.5	13.5	0.5	900
Yorkshire & Humber	8.6	17.7	0.7	1,600
East Midlands	17.0	35.2	1.4	3,500
West Midlands	8.8	18.3	0.7	1,500
East of England	6.8	14.2	0.6	1,100
South East	6.3	13.0	0.5	700
South West	11.5	25.0	1.0	2,100
Wales	14.1	29.2	1.2	4,500
Total	**89.4 (d)**	**185.4**	**7.5**	

(a) The total estimated from the RIA analysis and our additional uplift is allocated to regions based on a weighting derived from the % increase in rail passenger km from Table 2.
(b) We have used the RIA ratio of GVA to investment for the high scenario applied to our estimate of additional investment.
(c) Based on 2019 population.
(d) The larger total figure quoted in the text (£87.5bn + £31bn) is the UK total, which we have allocated to England (not including London) and Wales based on 2019 population.

Table 6 shows that **a total of around £89bn *additional* rail investment or £7.5bn a year is estimated to be needed up to 2035 in Wales and England (not including London)** (on top of the current baseline spend), but this will create over £185bn of GVA.

Total for buses, light rail/trams and rail

We have summarised the total capital investment for buses, light rail/trams and rail in Table 7 below.

Table 7: Estimates of total capital investment required by 2035 (£bn)

Region	Bus (£bn)	Light rail/tram (£bn)	Rail (£bn)	Total (£ billon)	Average annualised over 12 yrs (£bn/y)
North East	1.2	1.1	9.3	11.6	1.0
North West	3.8	2.0	6.5	12.3	1.0
Yorks & Humber	2.7	0.8	8.6	12.0	1.0
East Midlands	2.0	0.9	17.0	19.9	1.7
West Midlands	3.0	0.5	8.8	12.4	1.0
East of England	2.2	0.0	6.8	9.1	0.8
South East	4.0	0.0	6.3	10.2	0.9
South West	3.3	0.0	12.0	15.3	1.3
Wales	1.8	0.0	14.1	15.9	1.3
Total	**23.9**	**5.4**	**89.4**	**118.7**	**9.9**

This shows that **a total *additional* capital investment of around £119bn by 2035, or around £10bn a year for 12 years will be needed in Wales and England (not including London).** This is additional to any planned annual capital spend (ie net of any baseline expenditure).

Box 10: Comparison with other estimates

- National Infrastructure Commission estimates the capital costs of a transformational 20% uplift in peak transport capacity in 54 towns and cities in England is around £125bn (see Appendix 7, table 7.8)

Comparison with present levels of expenditure on infrastructure

- Current rail capital investment of around £11–12bn a year in the UK for the last three years (see Appendix 4).
- The cost of a single large road scheme (eg the £9bn Lower Thames Crossing or the £1.7bn A303 Stonehenge scheme).
- The current estimated cost of HS2 of between £72bn and £98bn

Comparison with other countries spending on infrastructure

- The German government has plans to spend €177.5bn (£150bn) on climate action and the transformation of the country's economy between 2023 and 2026[77], ie a total of £37.5bn a year

The funding for this can be provided in a number of ways, for example:

- Divert funding from high-carbon projects such as the £60bn planned expenditure on the Strategic Road Network over 10 years (2024/25 to 2034/35)[78] which will increase carbon emissions and ultimately add to congestion.
- Bring rail and buses back into public ownership to avoid leakage of profits to shareholders (see Section 7.1).
- Some form of road user charge such as an eco-levy linked to pollution as a replacement for fuel duty (See Section 7.3).
- A higher tax on polluting private jets could raise an estimated at £1.4bn a year[79].

The indicative levels of additional investment shown in Table 7 will not only help to level up the economy, but the environmental, social and economic benefits should far outweigh the initial costs, including the creation of thousands of new jobs. The wider economic benefits shown in Table 4 (bus capital investment) and Table 6 (rail capital investment) indicate that these far outweigh the upfront costs. Further estimates of some of the wider economic benefits of investment are given in Section 6.

Section 5: How many jobs will public transport fit for the climate emergency create?

Investment in public transport creates significant numbers of green jobs (direct and indirect) at a local and regional level:

- The £500m replacement of Merseyrail's fleet of trains and associated infrastructure works has generated several hundred direct jobs as a result of rolling stock design and manufacturing for 3–4 years across the supply chain[80]. Design, construction and project management of the infrastructure has employed another 200 people over 4–5 years, plus additional permanent jobs have been created in the Liverpool City Region Combined Authority, Merseyrail and manufacturing firm Stadler Rail[81]. An economic assessment undertaken in 2014 assessed that the improvements to the railway delivered by this programme would lead to the creation of 1,000 FTE jobs in the regional economy and a boost to economic output of £70m per year.
- Decarbonising the railway is estimated to create around 6,000 new jobs a year between 2024 and 2050, mostly outside London and the South East, and benefitting many suppliers[82]. The wider economic benefits of this employment is estimated at £2.2bn.
- The 31-mile Borders Railway in Scotland created 400 construction jobs over two years[83].
- Orders for zero emission buses from England and Ireland has generated 300 permanent jobs with Wrightbus in Northern Ireland[84.]
- The Salford Quays Metro extension in Manchester (cost £150m) created over 3,000 permanent jobs, stimulated £60m of investment by business and boosted the economy of Greater Manchester by £70m a year[85].

Public transport directly generates thousands of jobs in the sector. Pre-covid the bus, tram and rail industry in Britain employed over 670,000 people either directly (361,000) or through the supply chain (310,000) (see Appendix 4 for details).

Many of these public transport jobs are highly skilled. Productivity in each of the rail transport system and rail supply sectors is higher than the economy-wide average in every one of the UK's 12 regions and countries[86]. For example, the increase in productivity from the skilled jobs associated with rail electrification could be worth £3,900 per supported job per year[87].

Public transport jobs are spread evenly around the country and regions, and jobs can be created relatively quickly, particularly in the bus industry. It is important this pool of skilled, trained workers is maintained through a secure pipeline of investment.

Covid highlighted the importance of public transport for key workers, many of them low-paid, to access their workplaces. Bus, tram and train operators themselves are key workers, essential to keeping Britain moving.

We have estimated the number of jobs in each region and nation that would be created by the levels of investment in public transport that we have calculated as necessary to make public transport fit for the climate emergency (see Table 8). To do this we used documented factors for jobs per passenger or value of investment with a downward adjustment to allow for some efficiency increases/automation (see methodology in Appendix 2 for details). Average figures are shown with only the range given for the total.

This suggests that the uplift in public transport use and investment would create:

- Around 140,000 (109,00–174,000) additional direct jobs in bus, light rail/tram and rail operation, compared to around 360,000 existing jobs (a new job for every two existing jobs).
- Around 617,000 (589,000–645,000) direct/indirect jobs created through bus manufacture and construction of bus priority measures over 12 years.
- Around 109,000 (85,000–133,000) direct/indirect jobs created through light rail/tram construction over 12 years.
- Up to 1.8 million jobs supported directly/indirectly by the total rail capital investment up to 2035 (ie an average of around 140,000 jobs per year for 12 years), although not all of these would be 'new' jobs.

Box 11: Comparison with other figures

Our rail employment estimates are in a similar ballpark to those estimated in a report for the Rail Industry Association for their high investment scenario (which unlike our estimates include the baseline investment so are total rather than additional jobs)[88]. For the rail and rail supply sector employment was estimated to average 622,000 over the period 2025–29 while for the rail supply sector alone employment averages 494,000 a year. Although these jobs are expected to substitute for work elsewhere in the economy as the labour market would be close to full capacity at that time, because the jobs are higher productivity, the report considered that the UK economy would still benefit on a net basis. Based on these findings it was estimated that every additional £100m per annum spent by the UK government on rail infrastructure in the early-to-mid-2020s would support an additional 2,100 jobs (1,400 jobs in the rail supply sector and 700 in the wider economy due to induced effects)[89]. This analysis was based on an even distribution of investment across the English regions, but if the uplift were focussed on the northern English regions this would benefit those regions disproportionately, boosting the local average wage, and assisting with levelling up.

An evaluation of a £226m (£252m at 2021 prices) extension of the Nottingham tram which opened in 2015 was estimated to create an additional 100 direct jobs (and a further 130 through indirect and induced effects)[90]. Applying this ratio of direct jobs/investment to our estimates of capital investment results in a similar number of direct jobs to that shown in Table 8.

Table 8: Estimates of jobs created by public transport investment by region by 2035 (rounded to nearest 100)

Region	Average no. jobs created by investment					
	Bus operation (a)	Bus construction (b)	Tram operation (c)	Tram construction (d)	Rail operation (e)	Rail construction (f)
North East	3,100	31,100	600	22,700	1,300	186,000
North West	8,700	99,700	1,000	40,500	9,400	130,700
Yorks & Humber	8,400	68,300	300	15,800	6,200	171,400
East Midlands	6,800	49,800	600	18,900	4,800	340,000
West Midlands	9,700	77,100	200	10,900	9,100	177,000
East of England	8,200	56,000	0	0	9,600	137,200
South East	14,800	100,000	0	0	15,400	125,800
South West	9,100	87,100	0	0	5,800	241,100
Wales	4,000	48,000	0	0	4,600	282,200
Total	72,700 (54,500–89,000)	617,100 (589,000–645,000)	2,600 (2,000–3,200)	109,000 (84,800–133,200)	66,200 (50,600–81,900)	1,791,200

(a) Direct jobs in bus operation based on factor of bus operation jobs per million passengers
(b) Direct and indirect jobs in electric bus manufacture and construction of bus priority measures based on TUC factor per £1m investment
(c) Direct jobs in tram operation only based on factor of tram operation jobs per million passengers
(d) Direct and indirect jobs in tram construction based on TUC factor per £1m investment in expansion and upgrading of the rail network
(e) Direct jobs in rail operation/maintenance (Network Rail and rail operators) based on factor of rail operation jobs per million passengers
(f) Direct and indirect jobs in rail construction based on TUC factor per £1m investment in expansion and upgrading of the rail network

Section 6: Public transport and the green recovery

Public transport is a cornerstone of a green economy and is as essential to tackling climate change as ever. Covid has not changed that. We cannot meet climate targets without modal shift and that means better public transport but Covid means we are now starting from a worse position than before. The pandemic precipitated a fall in passengers that threatens the long-term viability of the public transport system, at a time when we need to revolutionise this vital service (see Appendix 4 for details).

"If you want to avoid congestion in the future, if you want to stick to your zero carbon, then you need to get people back on public transport."

Sir John Armitt, chair of the National Infrastructure Commission, May 2021[91].

However, instead of heeding this good advice and increasing investment, the government are making billions of pounds of cuts to public transport funding (see Appendix 4 for details). This short-sighted approach will make it more difficult to tackle the climate emergency and cost of living crisis. It has been suggested that it could take 12-24 months for post covid travel patterns to become clear and until that time government needs to continue to support the public transport sector[92].

Other countries in Europe have introduced innovative policies such as reduced fares to help people through the cost-of-living crisis and encourage them back onto public transport[93]. For example, in summer 2022 the German government introduced a discounted €9 nationwide travel pass to help offset rising fuel and living costs[94]. Spain has also slashed public transport fares on state owned transport and has made some train journeys free in response to rapidly rising energy costs and inflation, funded by a windfall tax on banks and energy firms[95].

As a result of these interventions in some European countries public transport usage bounced back strongly to levels that are higher than pre-Covid usage: in July 2022 public transport trips in France and Germany were 9% and 8% higher than pre-Covid levels, while in the UK they were 21% lower[96]. The increased number of trips in France and Germany was largely due to a surge in leisure travel, particularly at weekends, which suggests a need to redesign UK schedules for the changing work and leisure patterns post-Covid, ie a rebalancing of peak and off-peak services due to the large drop in commuter travel in the UK.

While government has belatedly announced a welcome £60m of funding for a £2 bus fare cap across England from January to March 2023[97] this comes at a time when many bus services are likely to be cut and is short term only. To get people back onto public transport will require sustained levels of increased support and investment.

But any additional investment is likely to be politically popular with wide support for better public transport. A 2022 survey found that two-thirds (65%) of adults in the UK would support encouraging more people to use public transport rather than driving a car to reduce the UK's carbon emissions[98]. A 2018 survey by the RAC found that 6 in 10 (60%) UK drivers would swap their cars for public transport if the services were better[99].

There are numerous studies and surveys showing why expenditure on public transport is an investment that reaps numerous dividends for communities and local economies.

Economic benefits

- The rail industry (transport system, supply sector, retail and induced impacts) is estimated to generate around £43bn of GVA a year[100]. Excluding retail and induced impacts this is greater than that generated by the legal sector, the transport machinery manufacturing sector, and the electricity and gas supply industry[101].
- The wider rail industry generated an estimated £14.1bn in tax revenue in 2019 (£9.6bn from the rail transport and supply industry) which would cover almost 80% total public expenditure on rail[102].
- For every £1 worth of work on the railway system itself, £2.50 of income was generated elsewhere in the economy[103].
- The economic return for each £1 spent on bus networks and services ranges from £2.50 to £3.80 for revenue expenditure and £5.00 and £6.80 for capital expenditure[104].
- The median benefit cost ratio of a sample of 150 small bus and rail schemes was 3.58 (ie the benefits were nearly four times the costs)[105].
- 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[106].

Box 12: Case Study: The value of bus priority measures in Greater Manchester[107, 108]

The Leigh-Salford-Manchester guided busway and Bus Rapid Transit (BRT) opened in 2016 at a total cost of £68m[109]. It significantly improved transport links between former coalfield towns such as Leigh, one of the largest towns in Britain without a railway station, to Manchester City Centre via Salford. A 2020 evaluation found that patronage growth had exceeded expectations with significantly more passengers in the first three years than forecast, rising from 2.2 million in 2016/17 to 3 million in 2018/19, a growth of 36% at a time of diminishing patronage across Greater Manchester[110]. There was evidence of high levels (25%) of modal shift from car and taxi to the guided busway, which was comparable with the Metro. It has increased access to employment with around 86,000 people benefitting from a reduction in door-to-door journeys by 5% or more. The busway is perceived to have stimulated the local economies and acted as a catalyst for regeneration in the outlying towns of Leigh, Atherton and Tyldesley in Wigan.

Box 13: Case Study: The value of light rail expansion in Nottingham[111]

A £226m, 17.5km extension of Nottingham's Express Transit which opened in 2015 is estimated to have generated the following benefits:

- Around 2,900 years of employment in the local economy and a further 1,600 years of employment in the regional economy during the four years of design and construction, generating around £108m and £61m of gross value added respectively
- Supply chain expenditures have generated around £140m of activity in the local economy and a further £77m in the regional economy
- Around 230 jobs as a result of operation of the new services, through additional drivers, control staff and so on, which will generate around £78m of gross value added in the local economy during the next decade.

Box 14: Case Study: The potential value of rail timetable improvements Paddington to Penzance[112]

It is estimated that investment of around £1.5bn to reduce journey times between Paddington and Penzance (a rail journey of over five hours) by 26 minutes would generate £7.2bn in GVA and £1.1bn in direct transport benefits over 60 years. Despite the large economic benefits, and the fact there has been no major timetable improvements for over 30 years this priority project for the South West region is still only rated at an early 'initiate' stage in the government's rail pipeline[113].

Social benefits

- A 10% improvement in local bus service connectivity is associated with a 3.6% reduction in deprivation[114].
- 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[115].
- An estimated 1 in 10 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[116].
- In 2020 one fifth of all households did not have access to a car, rising to 35% of households in the lowest income bracket[117].
- Households in the lowest income quintiles have the greatest dependency on bus for their travel with female heads of house, children, young and older people, BME and disabled people concentrated in this quintile[118].
- A survey of unemployed people found 57% did not have a full car or motorcycle driving licence and depend heavily on the bus for access to employment[119].
- 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[120]. 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[121].

Box 15: Case study: Regeneration through the Ebbw Vale line in South Wales[122]

The Ebbw Vale line in South Wales reopened to passengers in 2008 at a cost of £22.7bn. This was part of a wider Valley Rail Network linking Cardiff City Centre with communities in the Valleys and South Glamorgan / Vale of Glamorgan through a network of 81 stations, including a new station at Ebbw Vale Town[123,124]. According to a final evaluation report, the project has been highly successful delivering against its objectives[125]. It has generated around 77.5 million additional passenger kilometres per annum[126]. It removed around 14 million road kilometres annually, generating around £1m of gross economic benefits per annum, including reduced greenhouse gases and improved local air quality. Travel-to-work by rail grew by 300% in the Ebbw Vale – Rogerstone corridor between the 2001 and 2011 Census periods. It has had a transformative effect in terms of access to the jobs market, particularly in Cardiff, providing new employment and leisure opportunities for residents of the Ebbw Valley. It has facilitated economic development and regeneration within the Ebbw Valley, most significantly acting an enabler for development on the site of the former Ebbw Vale steelworks. The re-establishment of the line has also coincided with a range of town centre regeneration projects.

Our estimate of the wider productivity benefits of investment

Public transport can be instrumental in raising productivity levels through agglomeration (as more people gather in one place, typically a city centre, more jobs and firms cluster there, boosting both wages and economic productivity over time). For example, one study suggested the agglomeration-related productivity benefits of significant rail projects such as Crossrail could add 25% to the benefits of a project[127].

In theory, any improvement in transport that moves people more easily to a given place could promote agglomeration, but public transport is particularly effective because it moves people so efficiently. If workers can only get to an employment centre by car, eventually the roads will become congested and hinder growth. But if the employment centre is next to a train station, light rail stop or bus station then many more people will be able to access the area, which promotes clustering, and ultimately increases in productivity.

Conurbations, such as the Rhine-Ruhr in Germany and The Netherlands' Randstad, have higher productivity than their national economies due to strong agglomeration benefits. These benefits are derived from the higher densities of knowledge-based workers which in turn is helped by strong public transport links within these major urban areas, particularly between the cities and their hinterlands[128].

A 2014 US study found that a 10% increase in public transport service (by adding rail or bus seats or rail miles) was associated with an increase in wage increase per worker in the city centre equivalent to a 1–2% increase in Gross Metropolitan Product (GMP) per capita[129]. Scaled up by population the agglomeration benefits of public transport could be worth anywhere from $1.5m to $1.8bn (roughly £1.3m to £1.6bn) a year per city. The bigger the city, the bigger the agglomeration benefit of expanding public transport. Investment in light rail, reported to be instrumental in the relocation of the BBC, catalysed the successful regeneration of Salford Quays which became a key cluster for media and digital industries[130,131].

Evidence suggests that a key reason why UK cities are significantly less productive than similar-sized cities in Europe is due to the lack of good public transport[132]. The long public transport journey times into a given city centre reduces the effective size of that city, particularly at peak hours, sacrificing the agglomeration effects that would be expected given the size of the population. Making peak time public transport travel into city centres as reliable as off-peak travel would increase the effective population and hence productivity.

If agglomeration benefits in the UK are as significant as in France, researchers from Open Innovations estimate this would lead to an increase in GDP/capita of 7%[133,134].Using the analysis from Open Innovations we have provided some illustrative estimates of the additional GDP, shown in Table 9, based on the benefits of agglomeration from significantly improved public transport. We assume that the step change in public transport will make more and faster connections between key urban centres and between those centres and their hinterland 'catchments' of workers.

Table 9: Illustrative estimates of wider economic benefits (GDP) from public transport based on agglomeration effects (rounded to nearest £10m).

Region	GDP in 2019 (£m)[135] (a)	Additional GDP from improved public transport (£m) (b)
North East	65,096	2,600
North West	216,974	10,700
Yorkshire & Humber	148,523	7,700
East Midlands	131,220	4,130
West Midlands	164,568	7,290
East of England	191,781	4,300
South East	331,765	9,810
South West	166,455	2,950
Wales	79,252	2,590

Total	**1,495,634**	52,070

(a) According to ONS GVA is a good proxy for GDP but they use the term GDP within the statistical releases for ease of communication.

(b) We have assumed that the GDP for the population in urban conurbations in each region increases by around 7% (based on Open Innovations analysis), and for the population in cities and towns by a reduced amount of 5% (our assumption) using the Office for National Statistics' Rural Urban Classification[136]. This includes places like Bristol, Portsmouth, Luton, and Milton Keynes which are classed as cities and towns rather than conurbations but where benefits of reduced journey times into urban centres from improved public transport would be expected. For Wales we have used Nomis figures from the ONS to estimate the population in urban cities and towns.

This shows that **creating a world class public transport system in Wales and England (not including London) could deliver productivity benefits equivalent to over £50bn a year, more than the additional capital investment of £10bn a year and additional operational investment of £20bn a year.** This is on top of the many other economic, social and environmental benefits discussed earlier.

Section 7: Necessary conditions to maximise investment impact

There are a number of conditions that are either necessary or desirable to maximise the impact of any investment in public transport which are discussed below:

Changes to governance of public transport

To achieve a world class public transport system that is fit for the climate emergency we will need major changes to the way our public transport system is governed, moving from the current privatised, deregulated system to a full integrated, regulated system in public ownership.

The UK outside London is unique in Europe in having a deregulated system for its buses. This makes coordination of local buses outside of London impossible as individual bus operators, rather than local transport authorities, decide their own routes, timetables, tickets and standards, based primarily on criteria relating to profitability. Across England there are multiple bus operators with a confusing array of tickets, sparse or zero service coverage in some areas, expensive fares, and limited connectivity with each other or other transport services. Local authorities are no longer able to cross-subsidise socially valuable services from the most profitable routes and have to pay bus companies to fill in those gaps or cut services.

Across the UK, outside London, bus use has fallen dramatically between deregulation in 1986 and 2019 (see Figure 4.1 in Appendix 4) while bus fares have increased above inflation. In London, where Transport for London retained control of fares, routes and ticketing through franchising, passenger journeys have almost doubled over the same period.

Bus deregulation also undermines investment in light rail/trams, because it is hard for a transport authority to demonstrate a sound business case for a new light rail/tram route under circumstances when they lack powers to stop bus operators running competing services on the same corridor.

Since privatisation of rail services in 1993, train services do not coordinate with one another, let alone with buses. Before privatisation the British Railways Board showed that British railways were 40% more efficient than eight comparator railways in Europe, whereas by 2011 the McNulty report found that Britain's railways were 40% less efficient than the national railways of France, the Netherlands, Sweden and Switzerland[137]. Rail fares have rocketed, due to inadequate funding (as more of the costs are loaded onto passengers who pay 61% of costs compared to 32% just 10 years ago[138]), fragmented services and shareholder profits leaking out of the system. Over the last few years, a number of rail operators, LNER, Northern, TfW and Southeastern, have had their services brought back into public ownership.

Full integration of public transport – of all kinds – requires a 'guiding mind' to oversee the planning, management and delivery of public transport services across a whole town or city and its surrounding suburbs and villages[139]. This requires a fully regulated system so that decisions about where and when to run services are made on environmental, social and public interest criteria. A fully empowered guiding mind for public transport provision makes it possible to provide a comprehensive network of services, and to coordinate timetables and services across all public transport modes.

Although city regions were given the powers to regulate (franchise) their buses in 2017, the government requires authorities to follow a costly and lengthy process before it can introduce it[140]. Greater Manchester was the first city region to consult on a proposed bus franchising scheme and has overcome significant hurdles to finally bring its buses back under public control[141]. Franchising will enable Greater Manchester to provide coordinated, comprehensive bus-tram-train networks, with simple integrated ticketing, lower fares and more frequent services.

Box 16: Case Study: Benefits of bus franchising in Greater Manchester[142]

Assessment of the strategic, economic and financial case for franchising found there were large benefits compared to the alternative bus partnership approach or 'do minimum' case.

- **Strategic**: franchising was estimated to deliver more than the alternatives in terms of overall public transport demand and greater modal shift resulting in reduced congestion.
- **Financial**: while additional funding of £122m would be needed for the first 6 years, after that franchising was forecast to generate a surplus for the city region. Various funding mechanisms were considered to pay for these transition costs.
- **Economic**: as well as the immediate social, health and environmental benefits franchising was estimated to be hugely positive over the longer term with an estimated Net Present Value (NPV) (ie net of costs) over 30 years of £234m (mostly user benefits). It also had wider economic benefits, including agglomeration benefits, with the NPV of the wider economic benefits to Greater Manchester estimated at £508m.

Liverpool City Region has confirmed bus franchising as their preferred model and is currently proceeding with a full business case and public consultation[143]. The Welsh Government has also published a white paper on reforming the bus network which proposes to require bus franchising throughout Wales; permit local authorities to establish new municipal bus companies; and relax restrictions on existing municipal bus companies[144].

Public transport is a service. Any profits generated should be used to support more marginal services, to ensure that there is a comprehensive network. Removal of all dividend leakage to commercial shareholders and achieving the highest level of control by the guiding mind ultimately means running public transport services within public ownership, a long-established norm in many European towns and cities.

Pre-Covid around £2bn a year was paid out in public subsidies to private bus companies, and it is estimated that over a ten-year period around £2.8bn in profits were leaked out to British bus company shareholders[145]. By contrast the publicly owned bus companies' profits are reinvested or paid in dividends to their councils. According to research by RMT the three rolling stock companies (which own and lease the trains) paid out nearly £1bn in dividends in 2020/21 at taxpayers' expense[146]. It has been estimated that a publicly owned national rail system would save £1.2bn a year[147] (£1.4bn a year at 2021 prices).

Some places in Europe are creating new municipal bus companies. The small town of Dax in France (population 56,000) set up a municipal company to run its buses and raised additional funding of around €2m/year (total funding of around €5m/year) which enabled a complete redesign of the bus network, with new routes, higher frequencies and lower fares; construction of dedicated busways; a demand-responsive service to 18 rural settlements; a new bus/rail interchange; and new park and ride services[148]. By contrast, although some of the most effective and successful municipal bus services are run by local authorities in Britain, it remains illegal to for a local authority in England or Wales to set up a new one to achieve benefits similar to those in Dax. Despite the government's 2021 National Bus Strategy committing to a review on the ban of municipal bus companies[149], this has not progressed. By contrast, in 2022 Scotland gave local authorities back the powers to run their own bus services.

Britain's railways are undergoing major restructuring. The new public body Great British Railways will oversee rail transport from 2023. This is a missed opportunity to deliver an integrated and improved rail network in full public ownership as it leaves the provision of rail services with the private sector and relies upon multiple tiers of contractors and sub-contractors to deliver infrastructure works. Full public ownership of rail could provide a higher level of integration and could extend the cost savings and efficiencies achieved when Network Rail brought maintenance work in-house much further through the rail infrastructure supply chain.

There has been rail devolution of rail passenger services in Scotland, Wales and Merseyside. Devolved urban rail networks tend to have higher frequencies and much better off peak services[150]. In Scotland, more rail lines have opened over the last 15 years than the rest of the UK put together[151]. The ongoing reconfiguration of the railway under Great British Railways must strike an appropriate balance between national integration and enabling regional and national transport authorities to realise their ambitions for rail in their areas.

The universal, comprehensive public transport that we need to create to tackle the climate emergency will be like the public transport networks in the city regions of Munich, Vienna and Zurich. In these areas (which are 10–30 times bigger than the built-up areas of their main cities, and extend to surrounding towns and villages), public transport functions as a single system. Buses, light rail/trams and underground and suburban trains are coordinated by public transport governing bodies or Verkehrsverbünde (VV) to provide "one network, one timetable, one ticket". One of the strengths of this approach in the Zurich city region is that it enables services to run to clock-face timetables ('Taktfahrplan') with regular and efficient connections between buses and trains[152].

We have compared pre-Covid levels of public transport trips in the regions of England to places in Europe where the public transport systems are fully regulated and coordinated by VVs and largely in public ownership. Figure 6 indicates how residents in areas of England outside London are only able to make a small number of trips on public transport compared to the much higher levels of public transport use that are the norm for residents of European regions with similar population densities.

Figure 6: Comparison of public transport trips per capita and population density in nine English combined authorities and six European regions (VVs)[153]

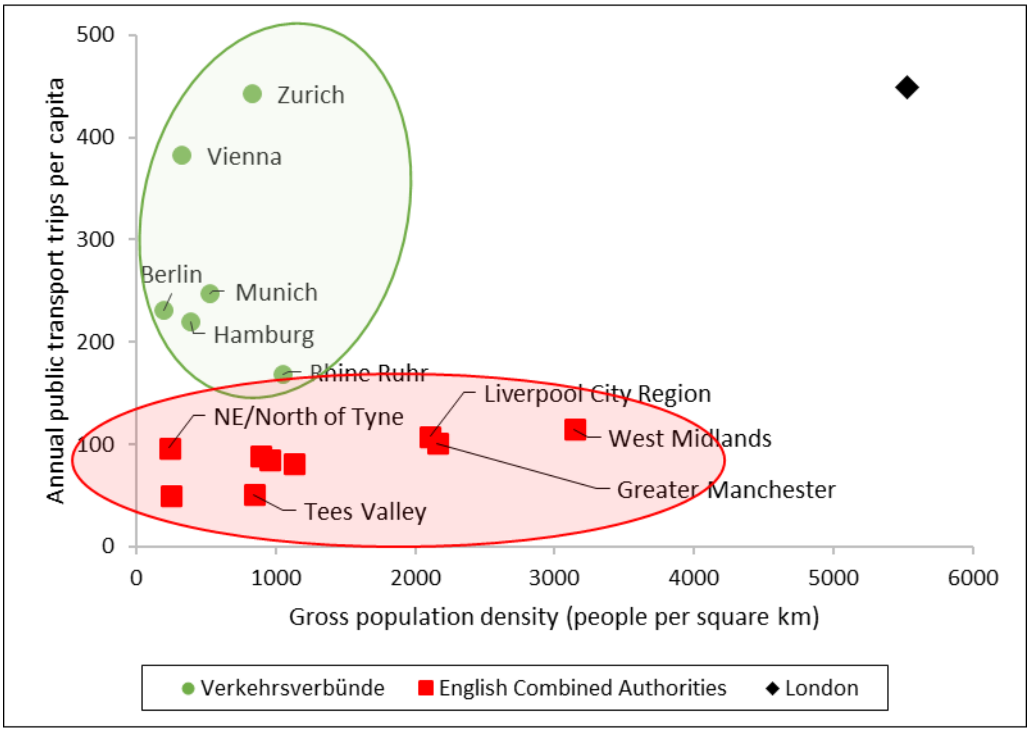


Table 10 shows our estimates of the number of additional public transport trips needed in different regions to match the European benchmarks (areas of similar population density) shown in Figure 5.

Table 10: Estimate of additional public transport (PT) trips in regions needed by 2030 to match European benchmarks (VVs) in areas of similar population density

Region	Population density per km^2	Total PT trips in 2018/19 (millions)	Total PT trips per head in 2018/19 (trips/y)	Additional new trips by 2030 if matched VV (m/y) (a)	% increase in PT trips
North East	309	220	83	549	250%
North West	517	549	75	1600	291%
Yorkshire & Humber	356	372	68	1235	332%
East Midlands	308	231	48	1232	533%

West Midlands	454	414	70	1367	330%
East of England	324	289	47	1558	539%
South East	479	548	60	2155	394%
South West	235	256	46	1446	564%
Wales	151	127	41	789	621%
Average of 6 VVs	387 (193–1054)		282		

(a) Accounting for population growth in each region

This shows that the scale of increase of public transport trips per head needed to match comparable regions in Europe is at least more than double, and in some regions over five or six times. The European model demonstrates what is possible with the right governance structures in place, proper integration of all transport modes and sustained levels of investment. To achieve something like this it will be necessary for all local bus, light rail/tram and rail services to be brought under the control and ownership of public bodies such as local authorities or Great British Railways, with, in the case of the devolved nations, the national transport authority also playing a key coordinating role.

Changes to the appraisal system

There will also need to be an overhaul of the transport appraisal system used by government to assess the business case and ultimately funding for new transport schemes. The current system is heavily biased against public transport schemes and towards road schemes. The high importance given to time savings of a few minutes for millions of motorists[154] combined with over-estimated forecasts of traffic growth[155], translate into enormous 'benefits' which generally account for the vast majority of predicted monetised benefits from road schemes. By contrast, the assigned 'cost' of carbon emissions is severely underestimated (even with recent increases) and costs of carbon emissions in future years are heavily discounted.

This bias towards time savings and the discounting of carbon impacts, means that environmentally damaging road projects that increase carbon emissions continue to get approved while public transport projects struggle to demonstrate a business case. Broader public policy goals achieved by public transport are also generally underestimated or ignored, so that investment in public transport to regenerate deprived areas is rare in the UK, unlike many European countries where social goals are given much higher priority[156].

Case studies of three alternative schemes in the North West: a tram extension to Lytham, a tram-train from Preston to Blackpool and the M6 Heysham Link Road, showed that the road scheme got a much higher Benefit Cost Ratio (>11) compared to the two tram schemes (2.1 and 0.7 respectively). Over 90% of the 'benefits' of the road scheme were due to notional time savings, which is hard for public transport investment to demonstrate, while the cost of increased CO_2 was put at less than 1% of the time saving benefits[157].

The current appraisal system has also been criticised as not fit for purpose for appraising rail investment due to the bias towards time savings, and its "silence" on the distribution of economic benefits and the value of economic regeneration[158]. Rail reopening schemes are also disadvantaged by the appraisal system as they must pass a high bar of financial sustainability with predicted revenue from fares underwritten by the scheme sponsor[159]. This reflects the wider government objective of increasing the proportion of railway costs borne directly by passengers.

The House of Commons Transport Committee have also noted that the decision-making process and system of scheme appraisal worked against regions outside London as the model had a bias towards schemes that have strong demand and/or potential to relieve congestion[160]. The Committee were not confident that government attempts to address this would make a real difference.

We need to replace the current appraisal system for England with a transparent and fit for purpose method to assess which schemes best meet carbon and other public policy goals such as levelling up[161]. For example, revisions to the Welsh Transport Appraisal Guidance, proposed at the time of writing, place less emphasis on the use of cost-benefit ratios, and more emphasis on well-being and wider social, economic, environmental and cultural factors[162].

Road user charging

While it is essential to provide the public transport alternatives that enable car users to shift from car travel, evidence suggests achieving the levels of mode shift that are required to tackle the climate emergency will require disincentives to driving, such as road user charges and controls on parking to drive behaviour change[163].

We suggest that the best way to constrain traffic sufficiently, to get the high levels of modal shift required as well as to generate new funds to invest in public transport infrastructure and radically improved levels of public transport services, is to introduce a national system of road user charging[164]. While low paid workers who rely on cars and have no alternatives but to drive (eg care workers, taxi drivers) may need some sort of concession, the majority of low paid workers will benefit from the reduction in public transport costs and increased services for getting to work and evidence shows there are generally more 'winners' than 'losers' from road user charging[165].

Surveys show that 49% of people support the idea of a 'pay as you drive' system with the main reason people opposed to it initially is because of the lack of alternatives to driving[166]. The same surveys show that 69% people would be more supportive if public transport was cheaper and better connected.

The present powers of local transport authorities to introduce road user charging schemes should also be used to the full, building on the existing examples of charging in London, Birmingham and Oxford and the national road user charging scheme must be designed to complement these and new local or regional schemes. Nottingham has also set an example with the introduction of a Workplace Parking Levy which has funded an extension to their tram, redevelopment of their train station and supports a popular bus network.

Road pricing is viewed by many observers as inevitable because the UK government needs to replace the loss of revenue from fuel duty as more people switch to electric vehicles. Without reform the burden of fuel duty will increasingly fall on those least able to afford electric cars/vans. And because the economic disbenefits of road traffic (carbon, air pollution, road casualties, noise etc) far outweigh the revenue generated from fuel duty and Vehicle Excise Duty, it is only fair to recoup some or all of these costs. This heavy burden of disbenefits is why some have suggested that it would be more correct to refer to road pricing as "a reduction in the "road use discount"[167].

The House of Commons Transport Committee has noted that a road pricing system would support increasing transport infrastructure investment and decarbonising transport and warned that if driving becomes cheaper, this will increase congestion, which will further undermine bus travel[168]. They call for radical reform to motoring taxation otherwise:

"The consequences for both public finances and congestion management are too severe for inaction."

The House of Commons Transport Committee

As of January 2023, the UK government had yet to respond to the Committee's report.

To overcome the political difficulty of bringing in road user charging schemes, it is sensible and probably necessary to adopt an approach that presents a 'benefits-and-charges packages', that put in place the alternatives to car travel and benefits such as lower public transport fares at an early stage, using funding from the revenue scheme and advance borrowing levered against future revenue from road pricing. Investing in public transport now to a level that provides good, reliable, convenient and affordable alternatives to car travel will enable political leaders to make the difficult choices on road user charging and show leadership, as well as providing civil society and unions with the political space to argue for change.

Section 8: Conclusions

For years, the British public have put up with declining or non-existent bus services, unreliable and overcrowded rail services, eye-watering rail fares and a fragmented and confusing public transport system. This was already the picture before the impacts of the Covid pandemic led to further service reductions. But public transport does not have to be like this. Poor and declining services are not an inevitability. Other countries in Europe have well integrated, cost effective, affordable and comprehensive services that serve their communities well. It is time to re-establish the importance of public transport as a public service, that provides access to health, education, jobs, family, opportunities and leisure, rather than as a purely commercial activity designed mainly to maximise profits. We need to help as many people as possible reach as many destinations as possible, as quickly as possible.

We need to shift millions of journeys and passenger km from cars to public transport if we are to have any hope of meeting our carbon targets by 2030. Transport has long lagged behind other sectors in terms of carbon reductions, but this needs to change. There needs to be traffic reduction and modal shift targets at a national and regional level.

- **This report estimates that, in order to address the climate emergency, we need to shift over 47 billion car driver/passenger kilometres a year to public transport by 2030 in England (not including London) and Wales.**
- **To shift this amount of car use to public transport requires an increase of around 120% in bus and light rail/tram passenger kilometres and around 80% in rail passenger kilometres compared to pre-Covid levels.**

There are many examples from exemplar schemes and local areas which show how with the right investment and support significant increases in patronage can be achieved in relatively short periods. Achieving this level of increase by 2030, although ambitious, would still leave Britain lagging *current* levels of per capita public transport use in parts of Europe where public transport operates as a truly integrated system.

- **To increase patronage to levels that are necessary to address the climate emergency would require additional operating expenditure estimated at around £7.5bn per year for buses, £0.5bn per year for light rail/trams and £10.9bn per year for trains by 2030.**

For buses and rail this would mean the additional bus and rail operating funding needed would be similar to Covid levels of support. These costs take no account of new revenue from the increase in patronage that will result from the service improvements. Revenue from fares could be used to defray some of the additional costs, but since a primary purpose of the investment is to achieve high levels of mode shift from private car use in order to meet climate change objectives, there is a strong case that fares should be reduced to make public transport cost-competitive with car use.

- **We estimate the additional capital investment in buses required to implement bus priority measures to make buses time-competitive with car use and make buses zero emission is around £24bn up to 2035.**
- **To bring rail and light rail/tram networks up to standards fit for the climate emergency will require capital expenditure to expand the network in the region of £5bn for light rail/trams and £89bn for rail up to 2035.**
- **The total capital investment, annualised over 12 years, is around £10bn a year**

These figures are approximations but give an indication of the scale of investment needed. The rail investment is partly based on industry figures which were also used to estimate that this would create over £185bn of GVA, indicating that the economic benefits are more than double the initial investment costs. Viewed another way, this could be taken as a measure of the economic damage our economy is suffering due to the failure to invest in fit-for-purpose public transport.

- **The number of direct jobs in bus, tram and rail operation created by the uplift in public transport use would be around 140,000 compared to around 360,000 existing jobs.**
- **There would be a further 617,000 direct/indirect jobs created through the proposed bus manufacture and construction of bus priority infrastructure and 109,000 direct/indirect jobs associated with light rail/tram construction.**
- **Up to 1.8 million jobs supported indirectly in association with the additional rail investment up to 2035, although not all of these would be 'new' jobs.**
- **This investment is estimated to be sufficient to deliver an increase in GDP in Wales and England (not including London) of over £50bn a year through the agglomeration effects of much improved and more rapid public transport connections.**

These estimates show that the investment needed to create this step-change improvement in public transport provision would more than pay for itself in benefits. This finding is in line with numerous previous studies that calculate investment in public transport infrastructure and services offers high value for money and the return in terms of economic benefits is more than the initial investment. And the economic benefit from agglomeration effects is just one of the many economic, social and environmental benefits resulting from a vastly improved public transport system and service.

In the absence of a national light rail/tram investment plan or published pipeline of schemes, the figures above are calculated on the basis that only existing tram/light rail networks are expanded. However, new tram systems can be transformative for urban areas and should be seen as urban regeneration schemes as much as an essential part of an integrated transport system, because they enable major public realm improvements through reconfiguring streets and simultaneously replacing road space in favour of pedestrians and cyclists. As provision for a number of cities and large towns, particularly those in regions without existing networks, **to develop tram systems we have estimated an indicative additional capital cost of £14.3bn**. To meet both transport and climate goals, trams can enable high passenger flows along major road routes into cities, using space reallocated from cars rather than heavy rail capacity, which is crucial for accommodating additional rail passengers and freight.

We need to refocus our investment away from ‘climate bads’, such as roads that increase traffic volumes and speeds and thus increase carbon emissions, and instead invest in ‘climate goods’, such as public transport and active transport. This is an investment that will not only help prevent catastrophic climate breakdown, and level up existing inequalities in public transport but will benefit generations to come.

There are a number of conditions that will maximise the benefits of this investment:

1. Regulate buses, enable local authorities to set up new municipal bus companies and ultimately bring all public transport back into public ownership.
2. Replace the current transport appraisal system, which has built-in biases in favour of damaging road schemes, with a method that fairly assesses investment against carbon and other public policy goals.
3. Introduce a national system of road pricing which will constrain car traffic and help propel the necessary shift to public transport, walking and cycling, and also generate funds that can be used to fund investment in public transport infrastructure and services.

Good public transport is not a nice-to-have, but a climate imperative. The climate emergency means that we need to make the right thing to do the easy thing to do. A transformational change in public transport is necessary to give more people more freedom and choices and reduce their costs of travel, a huge benefit at a time of severely stressed household budgets that would significantly alleviate the cost-of-living crisis for many families. It will simultaneously make many people’s lives better and greatly improve the places they live in by reducing traffic and enabling more of the public realm to be dedicated to people rather than to vehicles.

Appendix 1: Regional and national summaries

North East regional summary

What needs to change to reach carbon targets by 2030

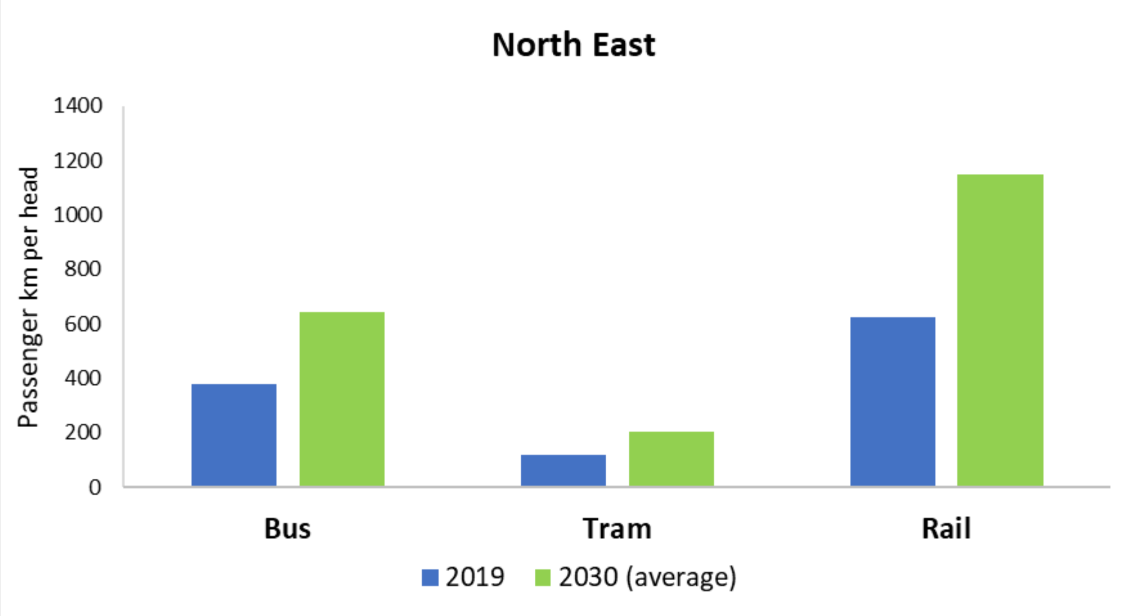
Table NE1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table NE1: Mode shift from car to public transport needed in the North East by 2030 (range for 2030 represent lower and upper bound estimates)

	2019	2030	% change needed
Car km travelled (billion km/year)	16.3	13.0	20% (a)
Car driver/passenger km travelled (billion pkm/year)	25.2	22.1 (b)	12%
Bus passenger km travelled (billion pkm/year)	1.0	1.7	73%
Light rail/tram passenger km travelled (billion pkm/year)	0.3	0.6	73%
Rail passenger km travelled (billion pkm/year)	1.7	3.1	88%
CO_2 from road transport (million tonnes/year)	4.4 (c)	2.4	45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy from 1.55 to 1.7
(c) 34% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure NE1: Public transport passenger km per head in the North East in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table NE2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the light rail/tram and rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK and any final allocation of funding by region will depend on further work to develop that pipeline.

Table NE2: Estimates of additional investment costs needed by 2030/35 in the North East to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Light rail/tram	Rail	Total
Operating costs (£bn/year)	0.3	0.1	0.5	0.9
Capital costs by 2035 (£bn)	1.2	(1.1)	(9.3)	11.6
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.1	(0.1)	(0.8)	1.0

What will this deliver by 2030/35?

- Vastly improved bus, tram and rail services and reduced fares.
- Better access to jobs, training, education, family, healthcare and leisure for 2.7 million people across the region, around 558,000 of whom don't have access to a car.

- A reduction of 1.4 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table NE1 from modal shift and 85% of the modal shift is to public transport).
- Around 3,000 additional jobs (operation and maintenance) in the bus industry and a further 31,000 in construction/manufacture of bus infrastructure and electric buses
- Around 600 additional jobs in the light rail/tram industry (operation and maintenance only) and 23,000 in construction over 12 years.
- Around 1,000 additional jobs in the rail industry (operation and maintenance only) and 186,000 in construction over 12 years.
- Around £660m of bus priority measures and an additional 700–1,000 electric buses (as well as the incremental costs of replacing existing diesel buses with electric).
- An additional 30–50 km expansion of the existing light rail/tram network. Although this funding does not cover delivery of new light rail/tram networks elsewhere in the region we have provided illustrative costs for new networks in the main report.
- All of the schemes in the North East Rail and Metro plan (planned for delivery over 2023-2035, estimated capital cost of £3.2bn and operating costs of £120m) including restoring the Leamside line to create a parallel rail route (estimated capital cost >£1000m) and electrification of rail lines.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every journey on the North East Metro and local rail generates £8.50 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £2.6bn a year.

North West regional summary

What needs to change to reach carbon targets by 2030?

Table NW1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table NW1: Mode shift from car to public transport needed in the North West by 2030

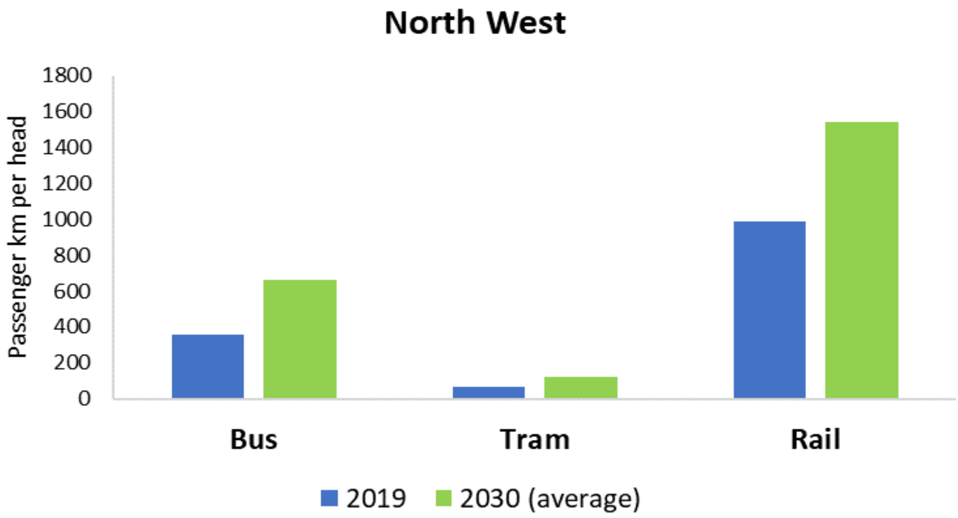
	2019	2030	% change needed
Car km travelled (billion km/year)	46.5	37.2	↓ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	72.0	63.2	↓ 12%
Bus passenger km travelled (billion pkm/year)	2.6	5.1	↑ 94%
Light rail/tram passenger km travelled (billion pkm/year)	0.5	0.9	↑ 94%
Rail passenger km travelled (billion pkm/year)	7.3	11.7	↑ 62%
CO_2 from road transport (million tonnes/year)	13.4 (c)	7.4	↓ 45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel

(b) Assumes increase in average car occupancy from 1.55 to 1.7

(c) 40% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure NW1: Public transport passenger km per head in the North West in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table NW2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the light rail/tram and rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK and any final allocation of funding by region will depend on further work to develop that pipeline.

Table NW2: Estimates of additional investment costs needed by 2030/35 in the North West to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Light rail/tram	Rail	Total
Operating costs (£bn/year)	0.9	0.2	1.4	2.5
Capital costs by 2035 (£bn)	3.8	(2.0)	(6.5)	12.3
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.3	(0.2)	(0.5)	1.0

What will this deliver by 2030/35?

- Vastly improved bus, tram and rail services and reduced fares
- Better access to jobs, training, education, family, healthcare and leisure for 7.3. million people across the region, around 1.5 million of whom don't have access to a car.
- A reduction of 4 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table NW1 from modal shift and 85% of the modal shift is to public transport).

- Around 9,000 additional jobs (operation and maintenance) in the bus industry and a further 100,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 1,000 additional jobs in the light rail/tram industry (operation and maintenance only) and 41,000 jobs in construction over 12 years.
- Around 9,000 additional jobs in the rail industry (operation and maintenance only) and 131,000 in construction over 12 years.
- Around £2.3bn of bus priority measures and an additional 1,900–2,800 electric buses (as well as the incremental costs of replacing existing diesel buses with electric).
- An additional 50-80 km expansion of the existing light rail/tram network. Although this funding does not cover delivery of new light rail/tram networks elsewhere in the region we have provided illustrative costs for new networks in the main report.
- All or part funding for North West rail schemes in the government's RNEP pipeline, eg Cumbrian Coast Capacity/Energy Coast Rail Upgrade; Cross Manchester Capacity and Performance (Castlefield Corridor); Wigan-Bolton electrification.
- All or part funding for schemes in Option 3 of the Northern Powerhouse Rail plan eg new lines on the route between Liverpool, Manchester and Leeds.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £10.7bn a year.

Yorkshire & Humber regional summary

What needs to change to reach carbon targets by 2030?

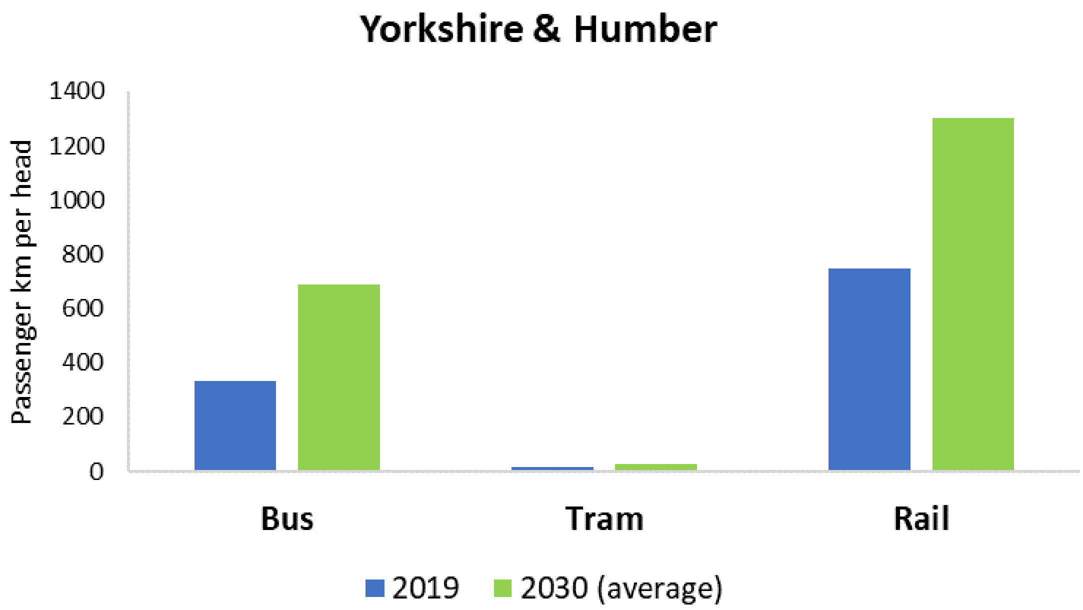
Table YH1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table YH1: Mode shift from car to public transport needed in Yorkshire & Humber by 2030

	2019	2030	% change needed
Car km travelled (billion km/year)	35.6	28.5	↓ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	55.2	48.4 (b)	↓ 12%
Bus passenger km travelled (billion pkm/year)	1.8	3.9	↑ 114%
Light rail/tram passenger km travelled (billion pkm/year)	0.1	0.2	↑ 114%
Rail passenger km travelled (billion pkm/year)	4.1	7.4	↑ 81%
CO_2 from road transport (million tonnes/year)	10.9 (c)	6.0	↓ 45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy from 1.55 to 1.7
(c) 35% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure YH1: Public transport passenger km per head in Yorkshire & Humber in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table YH2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the light rail/tram and rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK and any final allocation of funding by region will depend on further work to develop that pipeline.

Table YH2: Estimates of additional investment costs needed by 2030/35 in Yorkshire & Humber to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Light rail/tram	Rail	Total
Operating costs (£bn/year)	0.9	<0.1	1.0	1.9
Capital costs by 2035 (£bn)	2.7	(0.8)	(8.6)	12.0
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.2	(<0.1)	(0.7)	1.0

What will this deliver by 2030/35?

- vastly improved bus, tram and rail services and reduced fares
- Better access to jobs, training, education, family, healthcare and leisure for 5.5 million people across the region, around 1.2 million of whom don't have access to a car.

- A reduction of 3 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table YH1 from modal shift and 85% of the modal shift is to public transport).
- Around 8,000 additional jobs (operation and maintenance) in the bus industry and a further 68,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 300 additional jobs in the light rail/tram industry (operation and maintenance only) and 15,000 in construction over 12 years.
- Around 6,000 additional jobs in the rail industry (operation and maintenance only) and 171,000 in construction over 12 years.
- Around £1,400m of bus priority measures and an additional 1,700–2,600 electric buses (as well as the incremental costs of replacing the existing diesel buses with electric).
- An additional 20–30 km expansion of the existing light rail/tram network. Although this funding does not cover delivery of new light rail/tram networks elsewhere in the region we have provided illustrative costs for new networks in the main report.
- All or part funding for rail schemes in the government's RNEP pipeline, eg Skipton Colne.
- All or part funding for schemes in Option 3 of the Northern Powerhouse Rail plan, eg new lines on the route between Liverpool, Manchester and Leeds, which would also serve Bradford; increases capacity between Leeds and Newcastle; upgrades to the Erewash Valley route between Nottingham and Sheffield; upgrades to the Midland Main Line.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £7.7bn a year.

East Midlands regional summary

What needs to change to reach carbon targets by 2030?

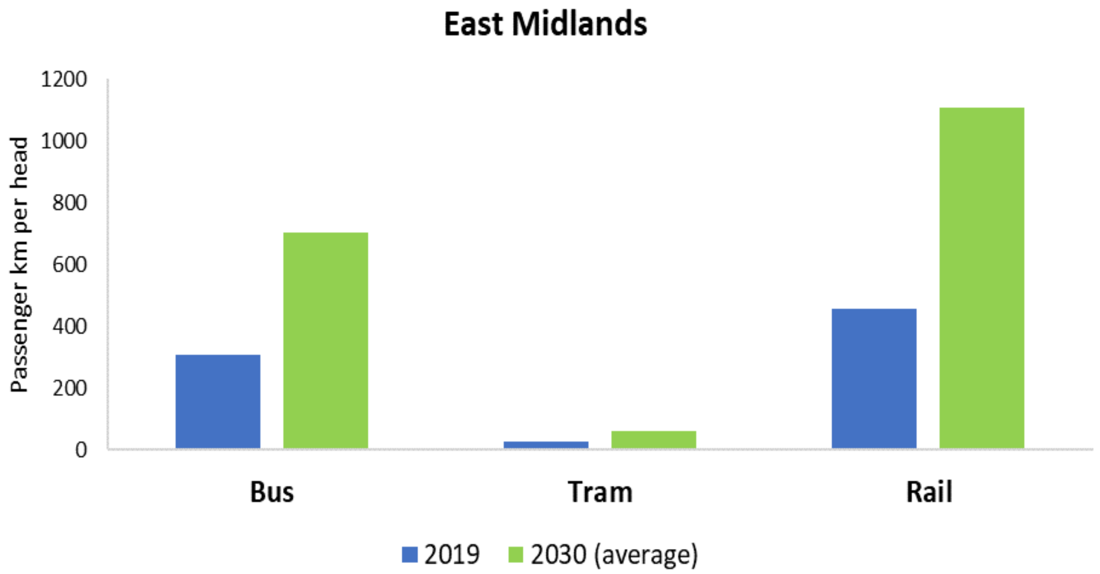
Table EM1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table EM1: Mode shift from car to public transport needed in the East Midlands by 2030

	2019	2030	% change needed
Car km travelled (billion km/year)	36.5	29.2	⬇ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	56.5	49.6 (b)	⬇ 12%
Bus passenger km travelled (billion pkm/year)	1.5	3.7	⬆ 148%
Light rail/tram passenger km travelled (billion pkm/year)	0.1	0.3	⬆ 148%
Rail passenger km travelled (billion pkm/year)	2.2	5.7	⬆ 160%
CO_2 from road transport (million tonnes/year)	9.9 (c)	5.5	⬇ 45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy from 1.55 to 1.7
(c) 38% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure EM1: Public transport passenger km per head in the East Midlands in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table EM2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the light rail/tram and rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK and any final allocation of funding by region will depend on further work to develop that pipeline.

Table EM2: Estimates of additional investment costs needed by 2030/35 in the East Midlands to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Light rail/tram	Rail	Total
Operating costs (£bn/year)	0.7	<0.1	1.1	1.9
Capital costs by 2035 (£bn)	2.0	(1.0)	(17.0)	19.9
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.2	(<0.1)	(1.4)	1.7

What will this deliver by 2030/35?

- Vastly improved bus, tram and rail services and reduced fares.
- Better access to jobs, training, education, family, healthcare and leisure for 4.8 million people across the region, around one million of whom don't have access to a car.

- A reduction of 3.1 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table EM1 from modal shift and 85% of the modal shift is to public transport).
- Around 7,000 additional jobs (operation and maintenance) in the bus industry and a further 50,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 600 additional jobs in the light rail/tram industry (operation and maintenance only) and 19,000 in construction over 12 years.
- Around 5,000 additional jobs in the rail industry (operation and maintenance only) and 340,000 in construction over 12 years.
- Around £1bn of bus priority measures and an additional 1,400–2,100 electric buses (as well as the incremental costs of replacing the existing diesel buses with electric).
- An additional 25–40 km expansion of the existing light rail/tram network. Although this funding does not cover delivery of new light rail/tram networks elsewhere in the region we have provided illustrative costs for new networks in the main report.
- All or part funding for East Midlands rail schemes in the government's RNEP pipeline, eg Robin Hood Line, Syston to Trent Gauge enhancement, electrification of the Midlands Main Line.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £4.1bn a year.

West Midlands regional summary

What needs to change to reach carbon targets by 2030?

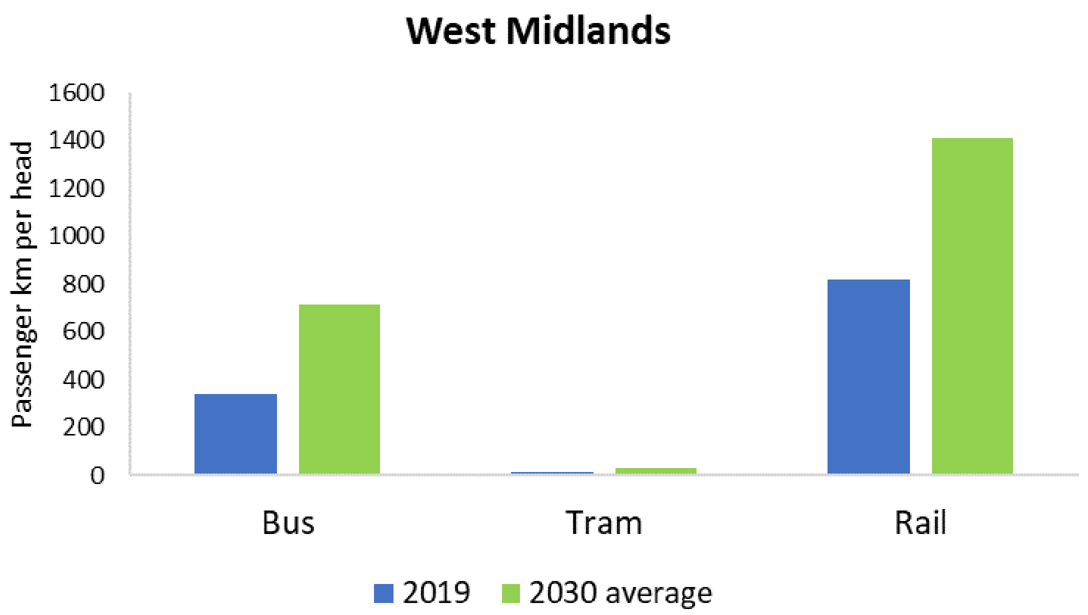
Table WM1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table WM1: Mode shift from car to public transport needed in the West Midlands by 2030

	2019	2030	% change needed
Car km travelled (billion km/year)	43.2	34.6	20% (a)
Car driver/passenger km travelled (billion pkm/year)	67.0	58.5 (b)	12%
Bus passenger km travelled (billion pkm/year)	2.0	4.5	124%
Light rail/tram passenger km travelled (billion pkm/year)	0.1	0.2	124%
Rail passenger km travelled (billion pkm/year)	4.9	8.9	83%
CO_2 from road transport (million tonnes/year)	11.5 (c)	6.3	45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy from 1.55 to 1.7
(c) 44% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure WM1: Public transport passenger km per head in the West Midlands in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table WM2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the light rail/tram and rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK and any final allocation of funding by region will depend on further work to develop that pipeline.

Table WM2: Estimates of additional investment costs needed by 2030/35 in the West Midlands to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Light rail/tram	Rail	Total
Operating costs (£bn/year)	1.0	<0.1	1.3	2.3
Capital costs by 2035 (£bn)	3.0	(0.5)	(8.8)	12.4
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.3	(<0.1)	(0.7)	1.0

What will this deliver by 2030/35?

- Vastly improved bus, tram and rail services and reduced fares.
- Better access to jobs, training, education, family, healthcare and leisure for 5.9 million people across the region, around 1.2 million of whom don't have access to a car.
- A reduction of 3.5 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table WM1 from modal shift and 85% of the modal shift is to public transport).
- Around 10,000 additional jobs (operation and maintenance) in the bus industry and a further 77,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 200 additional jobs in the light rail/tram industry (operation and maintenance only) and 11,000 in construction over 12 years.
- Around 9,000 additional jobs in the rail industry (operation and maintenance only) and 177,000 in construction over 12 years.
- Around £1.6bn of bus priority measures and an additional 2,000-3,000 electric buses (as well as the incremental costs of replacing the existing diesel buses with electric).
- An additional 15-20 km expansion of the existing light rail/tram network. Although this funding does not cover delivery of new light rail/tram networks elsewhere in the region we have provided illustrative costs for new networks in the main report
- All or part funding for West Midlands rail schemes in the government's RNEP pipeline, eg:
  - Leamington to Coventry Capacity Enhancement (Birmingham Connectivity); Solihull Corridor Capacity; Birmingham Moor Street capacity; West Midlands Train Lengthening.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £7.3bn a year.

East of England regional summary

What needs to change to reach carbon targets by 2030?

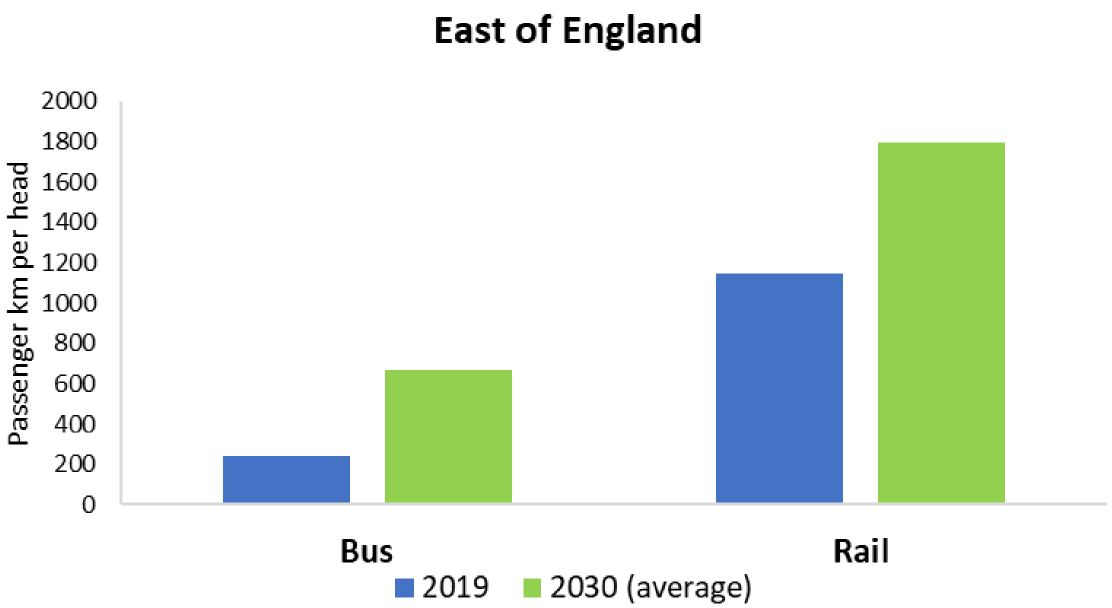
Table EE1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table EE1: Mode shift from car to public transport needed in the East of England by 2030

	2019	2030	% change needed
Car km travelled (billion km/year)	46.7	37.4	⬇ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	72.4	63.5 (b)	⬇ 12%
Bus passenger km travelled (billion pkm/year)	1.5	4.4	⬆ 193%
Rail passenger km travelled (billion pkm/year)	7.1	11.8	⬆ 65%
CO_2 from road transport (million tonnes/year)	13.0 (c)	7.2	⬇ 45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy from 1.55 to 1.7
(c) 43% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure EE1: Public transport passenger km per head in the East of England in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table EE2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK. Although the Table does not cover delivery of new light rail/tram networks we have provided illustrative costs for new networks in the main report. Any final allocation of funding for light/heavy rail by region will depend on further work to develop that pipeline.

Table EE2: Estimates of additional investment costs needed by 2030/35 in the East of England to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Rail	Total
Operating costs (£bn/year)	0.8	1.4	2.3
Capital costs by 2035 (£bn)	2.2	(6.8)	9.1
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.2	(0.6)	0.8

What will this deliver by 2030/35?

- Vastly improved bus and rail services and reduced fares.
- Better access to jobs, training, education, family, healthcare and leisure for 6.2 million people across the region, around 1.3 million of whom don't have access to a car.

- A reduction of 4.0 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table EE1 from modal shift and 85% of the modal shift is to public transport).
- Around 8,000 additional jobs (operation and maintenance) in the bus industry and a further 56,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 10,000 additional jobs in the rail industry (operation and maintenance only) and 137,000 in construction over 12 years.
- Around £1.2bn of bus priority measures and an additional 3,600-4,500 electric buses (as well as the incremental costs of replacing the existing diesel buses with electric).
- All or part funding for East England rail schemes in the government's RNEP pipeline, eg Ely area capacity improvement; Haughley Junction, Suffolk.
- As provision for a number of cities and large towns, particularly those in regions without existing networks, to develop tram systems we have estimated an indicative additional capital cost of £14bn for England (not including London) and Wales.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £4.3bn a year.

South East regional summary

What needs to change to reach carbon targets by 2030?

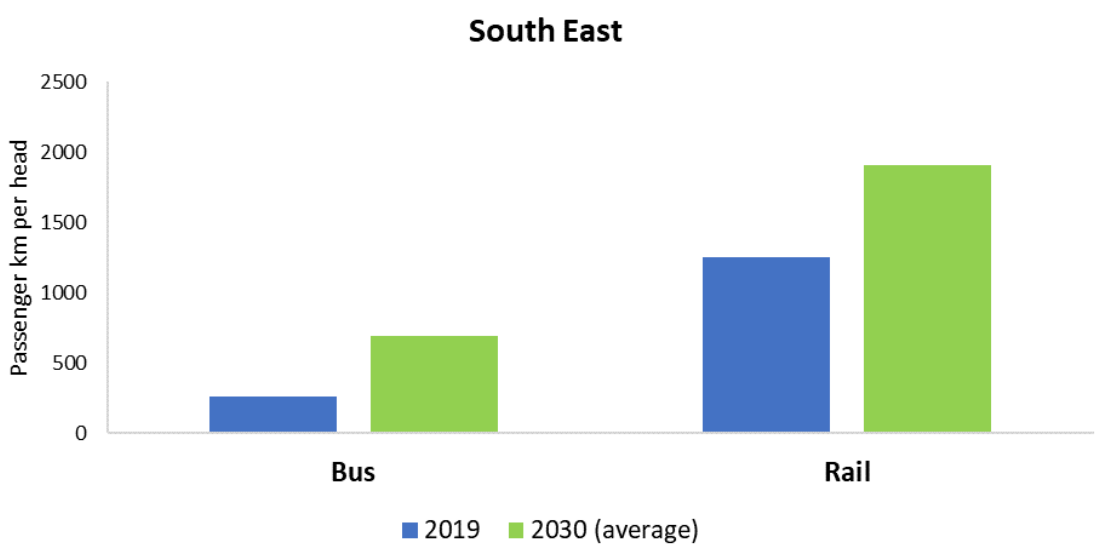
Table SE1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table SE1: Mode shift from car to public transport needed in the South East by 2030

	2019	2030	% change needed
Car km travelled (billion km/year)	69.5	55.6	↓ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	107.8	94.6 (b)	↓ 12%
Bus passenger km travelled (billion pkm/year)	2.4	6.7	↑ 175%
Rail passenger km travelled (billion pkm/year)	11.5	18.3	↑ 59%
CO_2 from road transport (million tonnes/year)	18.1 (c)	9.9	↓ 45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy from 1.55 to 1.7
(c) 52% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure SE1: Public transport passenger km per head in the South East in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table SE2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK. Although the Table does not cover delivery of new light rail/tram networks we have provided illustrative costs for new networks in the main report. Any final allocation of funding for light/heavy rail by region will depend on further work to develop that pipeline.

Table SE2: Estimates of additional investment costs needed by 2030/35 in the South East to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Rail	Total
Operating costs (£bn/year)	1.5	2.1	3.6
Capital costs by 2035 (£bn)	4.0	(6.3)[a]	10.2
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.3	(0.6)	0.9

(a) Illustrative estimates only

What will this deliver by 2030/35?

- Vastly improved bus and rail services and reduced fares.
- Better access to jobs, training, education, family, healthcare and leisure for 9.1 million people across the region, around 1.9 million of whom don't have access to a car.
- A reduction of 5.9 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table SE1 from modal shift and 85% of the modal shift is to public transport).
- Around 15,000 additional jobs (operation and maintenance) in the bus industry and a further 100,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 15,000 additional jobs in the rail industry (operation and maintenance only) and 126,000 in construction over 12 years.
- Around £2bn of bus priority measures and an additional 2,900–4,500 electric buses (as well as the incremental costs of replacing the existing diesel buses with electric).
- All or part funding for South East rail schemes in the government's RNEP pipeline, eg Reading Independent Feeder (Power Supply); South East (Sussex and East London Line) Traffic Management Scheme; Brighton Mainline; Woking capacity enhancement; Oxford Corridor Capacity Phase 2; Chiltern Train Lengthening; SE Franchise Stations Congestion Relief – Lewisham.

- As provision for a number of cities and large towns, particularly those in regions without existing networks, to develop tram systems we have estimated an indicative additional capital cost of £14bn for England (not including London) and Wales.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £9.8bn a year.

South West regional summary

What needs to change to reach carbon targets by 2030?

Table SW1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table SW1: Mode shift from car to public transport needed in the South West by 2030

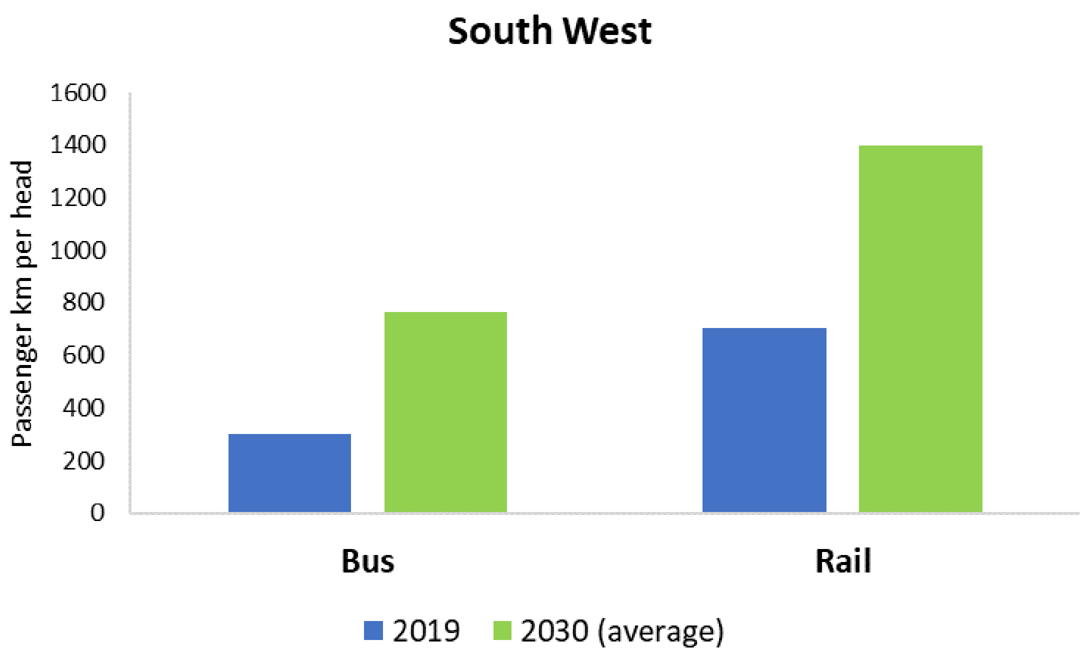
	2019	2030	% change needed
Car km travelled (billion km/year)	45.5	36.4	↓ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	70.6	61.9 (b)	↓ 12%
Bus passenger km travelled (billion pkm/year)	1.7	4.6	↑ 163%
Rail passenger km travelled (billion pkm/year)	4.0	8.5	↑ 114%
CO_2 from road transport (million tonnes/year)	11.0 (c)	6.1	↓ 45%

(a) Assumes half of this reduction will come from modal shift, half from reduced travel

(b) Assumes increase in average car occupancy from 1.55 to 1.7

(c) 49% total regional CO_2 emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure SW1: Public transport passenger km per head in the South West in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table SW2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK. Although the Table does not cover delivery of new light rail/tram networks we have provided illustrative costs for new networks in the main report. Any final allocation of funding for light/heavy rail by region will depend on further work to develop that pipeline.

Table SW2: Estimates of additional investment costs needed by 2030/35 in the South West to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030/35	Bus	Rail	Total
Operating costs (£bn/year)	0.9	1.4	2.3
Capital costs by 2035 (£bn)	3.3	(12.0)[a]	15.3
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.3	1.0	1.3

(a) Illustrative estimates only

What will this deliver by 2030/35?

- Vastly improved bus and rail services and reduced fares.

- Better access to jobs, training, education, family, healthcare and leisure for 5.6 million people across the region, around 1.2 million of whom don't have access to a car.
- A reduction of 3.9 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table SW1 from modal shift and 85% of the modal shift is to public transport).
- Around 9,000 additional jobs (operation and maintenance) in the bus industry and a further 87,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 6,000 additional jobs in the rail industry (operation and maintenance only) and 241,000 in construction over 12 years.
- Around £2bn of bus priority measures and an additional 1,800–2,700 electric buses (as well as the incremental costs of replacing the existing diesel buses with electric).
- All or part funding for South West rail schemes in the government's RNEP pipeline, eg:
  - South West Rail Resilience Programme – Parsons Tunnel to Teignmouth resilience
  - South West Rail Resilience Programme – Central Tunnels Section Resilience
  - Bathampton to Bradford Junction W8 Gauge (Dundas Aqueduct)
- As provision for a number of cities and large towns, particularly those in regions without existing networks, to develop tram systems we have estimated an indicative additional capital cost of £14bn for England (not including London) and Wales.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £2.9bn a year.

Wales national summary

What needs to change to reach carbon targets by 2030?

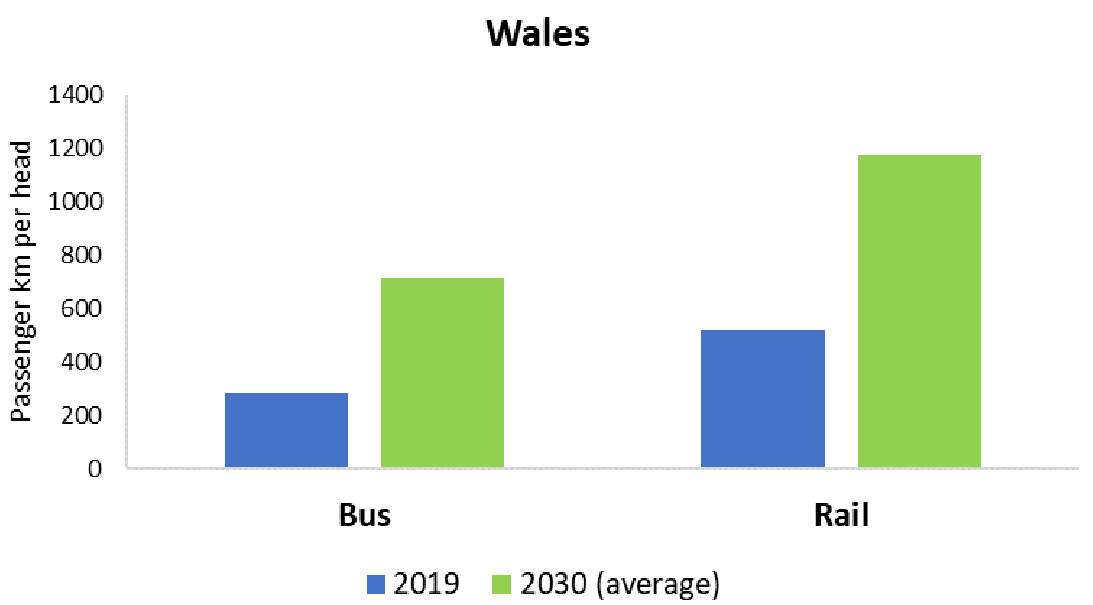
Table W1 below shows the estimated reduction in car and car driver/passenger km (pkm) needed by 2030, relative to 2019, to meet carbon targets and the associated increase in public transport passenger km needed. We have estimated a lower and upper bound for the public transport figures, represented by averages in the table. The assumptions and methodology used can be found in the main report. Figure NE1 shows the total public transport passenger km *per head* in 2019 and 2030.

Table W1: Mode shift from car to public transport needed in Wales by 2030

	2019	2030	% change needed
Car km travelled (billion km/year)	25.1	20.1	⬇ 20% (a)
Car driver/passenger km travelled (billion pkm/year)	39.0	34.2 (b)	⬇ 12%
Bus passenger km travelled (billion pkm/year)	0.9	2.3	⬆ 124%
Rail passenger km travelled (billion pkm/year)	1.6	3.8	⬆ 133%
CO_2 from road transport (million tonnes/year)	6.1 (c)	3.3	⬇ 45%

(a) Half of this reduction will come from modal shift, half from reduced travel
(b) Assumes increase in average car occupancy
(c) 28% regional total emissions (UK local authority and regional greenhouse gas emissions national statistics)

Figure W1: Public transport passenger km per head in Wales in 2019 and estimates for average increase needed by 2030



What will this cost to deliver?

Table W2 below shows our estimates of the *additional* investment costs needed by 2030/35 to meet carbon targets (on top of current baseline spend). Note the rail capital costs in parentheses are indicative only due to the lack of a fully costed pipeline of schemes for the UK. Although the Table does not cover delivery of new light rail/tram networks we have provided illustrative costs for new networks in the main report. Any final allocation of funding for light/heavy rail by region will depend on further work to develop that pipeline.

Table W2: Estimates of additional investment costs needed by 2030/35 in Wales to meet carbon targets (average, rounded to nearest £100m)

Estimated additional costs by 2030	Bus	Rail	Total
Operating costs (£bn/year)	0.5	0.7	1.1
Capital costs by 2035 (£bn)	1.8 (a)	(14.0)	15.9
Annual capital costs over 12 years (2023/2035) (£bn/year)	0.1	(1.2)	1.3

(a) The costs for bus electrification are likely to be underestimated due to the methodology which assumes that some of the replacement costs of existing diesel buses will be funded through operating profits. However, compared with English regions bus operator profit levels in Wales are generally lower, so significantly more support than the figure shown is likely to be needed.

What will this deliver by 2030/35?

- Vastly improved bus and rail services and reduced fares.
- Better access to jobs, training, education, family, healthcare and leisure for 3.1 million people across the region, around 659,000 of whom don't have access to a car.
- A reduction of 2 billion car km/y with benefits for congestion, road safety, air quality and noise (assumes half of the reduction in Table W1 from modal shift and 85% of the modal shift is to public transport).
- Around 4,000 additional jobs (operation and maintenance) in the bus industry and a further 48,000 in construction/manufacture of bus infrastructure and electric buses.
- Around 5,000 additional jobs in the rail industry (operation and maintenance only) and 282,000 jobs in rail construction over 12 years.
- Around £1.2bn of bus priority measures and an additional 900–1,400 electric buses (as well as covering the incremental costs of replacing the existing diesel buses with electric).
- Welsh Government aspirations for the North Wales and South Wales main lines.
- All or part funding for Welsh rail schemes in the government's RNEP pipeline, eg: Cardiff Central Station; North Wales journey time improvement (Wrexham -Bidston

and N Wales ML); South Wales journey time improvement (Swansea to Cardiff); Severn Tunnel Junction to Cardiff relief lines upgrade; GWML Freight Corridor /Gauge clearance Didcot – Bristol/Cardiff.

- 'Metro-isation' of Wales urban and suburban rail networks to provide high grade 'rapid transit' travel options at 'turn-up-and-go' service frequencies.
- As provision for a number of cities and large towns, particularly those in regions without existing networks, to develop tram systems we have estimated an indicative additional capital cost of £14bn for England (not including London) and Wales.

What are the wider benefits?

- Every £1 spent on bus operation generates £2.50–£3 in the wider economy.
- Every £1 spent on bus infrastructure generates £5–£6.80 in the wider economy.
- Every £1 invested in rail generates £2.50 in the wider economy.
- Productivity benefits estimated from the benefits of reducing public transport journey times into urban centres, thus increasing the effective size of the urban area, of £2.6bn a year.

Appendix 2: Assumptions and methodology

Estimating levels of public transport needed to meet carbon targets

Methodology

- We assume that car km travelled in each region has to be reduced by 20% by 2030 relative to 2019 levels to meet carbon targets.
- We assume that half of this reduction (10% of total) can be reduced by measures such as remote working, car sharing etc and the other half (10% total) has to be shifted to other modes.
- We take the car km travelled in each region in 2019 and use car occupancy figures to estimate the car passenger km travelled in 2019.
- We assume that 28–45% of this distance (equivalent to car journeys of 2–10 or 5–25 miles) can be shifted to bus/tram and 41-69% (equivalent to car journeys of >25 or > 10 miles) can be shifted to rail. Note there is overlap between the different modes.
- We apply an uplift to the increase based on 2030 forecast population levels to account for growth in population.
- We compare the 2019 public transport passenger km to the 2030 forecast to estimate the overall % increase needed.

Table 2.1: Assumptions and evidence for estimating levels of public transport needed

Assumption	Evidence
A minimum 20% reduction in car km by 2030 compared to 2019 levels is needed to meet carbon targets	Evidence for the Scottish Government target of 20% reduction in total car mileage by 2030, relative to 2019[169]
	The Centre for Research into Energy Demand Solutions (CREDS) estimates that a 30–50% reduction in total car mileage is needed by 2030, relative to 2020[170]
	Green Alliance estimates that a 20–30% reduction in total car mileage is needed by 2030, relative to 2019[171].
10% of total mileage reduction can be achieved by measures such as remote working (commuter and business travel) and more carsharing	Evidence in summer and Autumn 2021 that car traffic was down 10% from pre-pandemic levels despite the economy recovering to previous levels, suggesting a decoupling of economic growth and travel[172].
	A longitudinal study of over 1,700 people suggests that even if people currently working from home go back to work half time, this will lead to a 16%

	reduction in car commuting compared to pre-Covid levels[173]. This is equivalent to an overall reduction in mileage of 4%[174]
	A review for the Scottish Government suggested there could be a 5% reduction in car and van mileage as a result of home working[175].
	An IPSOS Mori survey found that projected demand for business travel is likely to be lower than pre-pandemic levels[176]. Based on these results, assuming a net 14% of companies making fewer business trips translates into a 14% reduction in business travel miles, this could cut overall car mileage by 2%. With rising fuel prices and policy incentives to reduce business travel it is likely business travel could be cut further.
	The Climate Change Committee conservatively estimate there is scope to increase average car occupancy from 1.55 today to up to 1.7 by 2030. Assuming 50% of those additional car passengers previously drove, this would be equivalent to a reduction in mileage of around 3%.
To reduce carbon, it is the mileage rather than the number of trips that it is important	National Travel Survey statistics show that although the majority (57%) car/van trips are less than 5 miles, these only account for 15% of the distance. It is the longer car/van trips that account for the majority of the carbon
10% of car km and associated passenger car km needs to be shifted to other modes	Use average car occupancy of 1.55 to estimate passenger car km in 2019 which increases to 1.7 by 2030
Another 10% total car mileage reduction and associated car passenger km can be allocated between different modes based on an assumed average trip distance for each mode	National Travel Survey statistics (NTS0308) of average distance travelled by car per person (pre-Covid) in terms of the individual trip distances and average distance travelled. This shows car/van trips of <5 miles (8km) account for 15% (cumulative) distance, trips of 5–25 miles (8–40km) account for 44% distance; and trips>25 miles (40km) account for 41% distance[177].
The shorter distance trips (<5 miles) can be substituted by walking/cycling, the medium distance trips (5–25 miles) by bus/tram and the longer distance trips (>25 miles) by rail	Pre covid most (45%) bus trips were 2–5 miles (3–8km) length, over a third (36%) were 5–25 miles (8–40km)[178]. Similarly, the average tram trip in England outside London was around 9km in 2018/19[179]. With a greater rural bus network and a more integrated transport system it should be possible to shift a much greater proportion of medium distance car journeys to bus and tram. There are already many longer distance bus routes including the Trawscymru T1 bus between

	Aberystwyth and Camarthen (46 miles or 73km) or the 680 between Newcastle and Carlisle (60 miles or 97km) and the potential for more with improved bus priority routes. The average train trip in 2018 was 28 miles (45 km)[180].
Bus/tram trips can substitute for car trips of 2–10 miles (28% of car distance) as a lower bound and trips of 5–25 miles (45% of car distance) as an upper bound.	There will be overlap between the difference trip lengths per mode. Many train trips will be less than 25 miles and many bus/tram trips will be less than 5 miles
Trains can substitute for car trips of >25 miles (41% of car distance) as a lower bound, and trips of >10 miles (69% of car distance) as an upper bound.	As above. 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 and will reduce car mileage by more than 10%.

Table 2.2: Inputs for estimating levels of public transport needed

Input	Source
Existing car km by region (2018/19)	Dft Table TRA8905a
Average car occupancy of 1.55 in 2019	National Travel Survey Table NTS0905
Existing car passenger km by region (2018/19)	Above combined with average car occupancy of 1.55
Existing bus passenger km and trips by region (2018/19)	Bus passenger trips DfT Table BUS0108 combined with average bus trip length for 2016/17 and 2017/18 from NTS Tables 9903 and 9904
Existing tram passenger km, trips and trip distance by region (2018/19)	DfT tables LRT0103, LRT0101 and LRT0107a
Existing rail passenger km and trips by region (2018/19)	ORR tables of regional passenger journeys by region – using journeys within region and half the journeys to/from other regions to avoid double counting, combined with average rail trip length figures from the National Travel Survey as for buses
Population figures 2018 and 2030	ONS population figures and forecasts
Tram track length in England outside London	Figures from UK Tram

Caveats and simplifications

- We assume that this level of mode shift is necessary to achieve carbon targets and make no allowance for the propensity to change. If not achieved the amount of car km that needs to be reduced will have to increase.
- We assume this 10% car reduction can be achieved in each region and that the 10% reduction is uniformly spread across England. In reality, the growth in car mileage has not been uniform across regions over the last 10 years (2010 to 2019) ranging from 9% in the South East to 23% in Yorkshire and Humber.
- We assume that there is no additional driving as a result of increased public transport use (eg people driving to a rail station to take the train).
- We have not made any allowance for destination shifting, eg the use of public transport may encourage people to make shorter trips than they would do if using a car.

Estimating additional investment levels needed

Methodology

- We use the additional public transport figures for 2030 to estimate additional operating costs for bus, tram and rail using an average cost/revenue factor per trip or passenger km in regions in England outside London obtained from national statistics.
- We use average revenue per journey instead of costs for bus/rail to include a margin for renewal/replacement by the operators.
- For buses we assume additional uplift factors to account for additional services, operating hours, and concessionary passengers.
- For bus capital costs we assume all buses will need to be zero emission by 2035 and assume costs for electric buses and bus charging infrastructure.
- We assume the rate of increases in buses for each region is half the rate of the increase in passengers (ie a 100% increase in passengers will need a 50% increase in buses). In addition, each region will need an extra 8% of buses up to 2030 to bring the average age in line with London (ie an uplift of 1% per year in replacement rate to 8% per year). The additional costs are the full costs of these additional 1%/y plus the other new buses.
- We assume that 7% of buses a year will be replaced by the operators (covered by the revenue cost factor above) and the additional costs are the incremental costs for a new electric vs a diesel bus.
- We estimate additional infrastructure costs for bus priority schemes using the costs for the North East region (from the North East and Tees Valley Bus Service Improvement Plans) for five years up to 2025 as a benchmark, extrapolated over 12 years to 2035. The remaining regions' costs were pro-rated based on the North East's costs and the relative length of urban A/B road length relative to the North East.

- For light rail/tram we assume a factor of million passenger km per km of track based on existing regional figures with an added 50% increase to account for greater efficiency by 2030.
- For rail we use published figures to estimate additional capital costs.

Estimating investment levels needed – bus (operating and capital costs)

Table 2.3: Assumptions used to estimate additional costs for buses

Assumption	Value	Source	Note
Operating costs			
Cost of bus journey/passenger (£/journey) (a)	1.80	DfT bus statistics[181]	Used revenue per journey instead of cost per journey[182] to include margin for bus replacement. 2018/19 values at 2020/21 prices.
Uplift factor for additional services at peak hours (b)	1.25		For additional services at peak times, assuming 50% passengers at peak hours and 50% buses at peak don't have enough capacity
Uplift factor for expansion of services €	1.1		For additional services running buses outside core hours (eg late at night)
Bus capital costs			
Buses replaced by operators through operating revenue	7%/y	DfT bus statistics[183]	Assume outside London and in Wales replacement rate is ~7% (ie 15 years to replace all buses) (d)
Additional buses needing to be replaced to bring regions bus average age in line with London	8%/y	As above	Assume London bus replacement rate is ~8%/y (ie 12 years to replace all buses)
Uplift in annual replacement rate to bring average age of buses in England outside London in line with London	1%/y		ie 8% (8x1%) total by 2030
Additional buses needed for increase	50% of the estimated		A 31% increase in passenger levels in London over 10 years

in patronage (additional to those above)	increase in passenger numbers		2004/05 to 2014/15 was met by a 20% increase in buses. However, it is assumed that outside London occupancy levels are much lower.
Cost of electric double decker	£400,000		
Cost of diesel double decker bus	£300,000		
Cost of electric single-decker bus	£350,000	Zemo Partnership[184]	
Cost of diesel single-decker bus	£190,000	Zemo Partnership	
Cost parity of electric and diesel buses	2030	BloombergNEF[185]	
Incremental cost of replacing diesel with electric bus	£130,000		Assumes half new buses double-decker
Additional full cost of new electric bus	£350,000		Assumes half new buses double-decker
Additional buses needed for extra services (e)	10–20%		
Cost of depot charging infrastructure	£40,000 per bus	Zemo Partnership[186]	Assume 80% buses charged at depot and 20% have additional fast charging
Cost of fast charging infrastructure	£60,000 per bus	Zemo Partnership	
Bus infrastructure costs			
Cost of proposed bus priority measures in the North East over 5 years	£275m	NECA and Tees Valley BSIPs	
Length of regional urban A and B roads	Varies	DfT statistics[187]	Bus priority measures are generally on principal urban A/B roads

(a) For simplification and in absence of detailed figures assume costs per journey are the same across regions

(b) Assume that some of the increased patronage can be accommodated by the existing bus fleet (due to existing low capacity off peak) but that additional buses will be needed for peak times.

(c) For extending core hours (to run services at weekends and late at night) and for additional concessionary fares (accounted for 11% of revenue in 2018/19 in England outside London). Although these costs may not be realised in practice if the routes become more commercially viable with more passengers – assume that any increase in revenue will be offset by a reduction in fares.
(d) Based on average age of the fleet in 2020/21 in London was 6.4 years, in England outside London 9.5 years and Wales 9.7 years.
(e) An increase in bus service levels does not necessarily imply a proportionate increase in the size of the bus fleet as some buses can be run more efficiently. For example, services at night, and more bus priority measures can facilitate the increased frequency of bus services.

Caveats and simplifications

- We don't make any allowance for the additional fare revenue when estimating additional operating costs as we assume that this will balance out any fare reductions.
- We assume the operating costs per passenger will stay the same whereas they are likely to come down due to efficiencies (eg increased occupancy levels).
- We don't make any allowance for the recent increase in energy/material costs or high levels of inflation this year.

Estimating investment levels needed – light rail/tram and rail (operating costs).

Methodology

- We estimate additional light rail/tram and rail operating costs using the additional light rail/tram and rail pkm estimates and an average cost factor for light rail/tram and rail journeys per pkm.
- As for bus costs we use average revenue per journey to include a margin for new trams/rolling stock and doubled for trams to take account of the fact that the revenue typically only covers half the costs.
- For rail costs we use average revenue per passenger km and doubled to take account of the fact that fare revenue is half the operating costs.

Table 2.4: Assumptions used to estimate tram and rail operating costs

Assumption	Value	Source	Notes
Average cost per light rail/tram passenger km (£/pkm)	Ranges from £0.32-£0.40	DfT Light Rail and Tram statistics[188]	Based on a doubling of revenue per passenger journey in 2018/19 at 2020/21 prices (a)
Average revenue per franchised rail passenger km in 2018/19 (£/pkm)	£0.16	ORR Table 1210[189]	Based on revenue per passenger km in 2018/19 at Nov 2020 prices

Average cost per franchised rail passenger km in 2018/19 (£/pkm)	£0.32	ORR	UK Rail Industry Financial Information 2018/19 – which shows that fare revenue is half the operating costs once Network Rail costs taken into account

(a) Cost figures aren't available but assume that fare income covers half the operating costs (the case for Tyne and Wear Metro in 2020/21 according to the NERMS)

(b) Note this includes all rail journeys in GB including London. No regional breakdowns available.

Caveats and simplifications

- This assumes that all tram networks costs are twice the revenue per passenger whereas some networks will have revenues approaching or even exceeding costs.
- We don't make any allowance for the additional fare revenue when estimating additional operating costs as we assume that this will balance out any fare reductions.
- We don't make any allowance for the recent increase in energy/material costs or high levels of inflation this year.

Estimating investment levels needed – light rail/tram and rail (capital costs)

Methodology

- For light rail/tram we assume a factor of million passenger km per km of track based on existing regional figures for 2019 with an added 50% increase in passenger km to account for greater efficiency by 2030
- We used average costs per km of £40m/km for new networks based on the costs of past projects (see Table 3.3 in Appendix 3) with a reduction to £30m/km for expansion of existing networks
- For rail investment we used the RIA high scenario costs (see Appendix 4) net of baseline costs to estimate additional spend needed for the UK for the period 2023–2035.
- We added in an uplift over the same period to take account of the shortfall between the RIA's assumed baseline spend (£13–15bn a year) and actual committed funding (average of around £12bn a year 2018/19 to 2020/21).
- We allocated this UK total to Wales and England (not including London) based on 2019 population, and applied a weighting based on the percentage increase in rail passenger km needed by 2030 relative to 2019 as shown in Table 2 to allocate to regions and nations.

Estimating jobs associated with additional investment levels

Methodology

- We use the additional passengers and investment costs estimated above and apply the adjusted job multiplier factors shown in Table 5 below to estimate additional jobs created.
- A 5% adjustment to the original factors was applied to take account of increased efficiency and automation.

Table 2.5: Factors used to estimate jobs

Assumption	Adjusted value	Original value	Source	Notes
Bus operator employment (direct jobs per million passengers)	24.3	25.6	DfT BUS statistics[190]	
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[191]
Rail operator employment (direct/indirect jobs per million passengers)	130.2	137	Williams Rail Review	
Bus priority measures (direct/indirect jobs per £1m investment)	31.0	32.6	TUC report[192]	Factor for cycle route construction
Electric bus manufacture (direct/indirect jobs per £1m investment)	19.0	19.99	TUC report	For manufacture in UK only.
Rail construction employment (direct/indirect jobs per £1m investment)	20.0	21.09	TUC report	Also used for tram construction

Appendix 3: Light rail/trams

Currently England outside London has only six light rail/tram networks (shown in Table 3.1 below) serving a combined population of around eight million people. In 2018/19, there were 124 million passenger journeys combined on these networks. All UK light rail/trams are publicly owned.

Table 3.1: Light rail/tram networks in England outside London

	Nottingham Express Transit	West Midlands Metro	Sheffield Supertram	Tyne and Wear Metro	Manchester Metrolink	Blackpool Tramway
Population served ('000)	331	2,928	685	1,136	2,822	138
Year of opening	2004	1999	1994	1980	1992	1885
Length of track (km)	32	22	34.6	77.2	103	17.7
No. Lines	2	1 (2)	4	2.0	8	1.0
No. stations	50	28 (41)	50	60	99	61
Passengers 2018/19 (millions)	18.8	8.3	11.9	36.4	43.7	5.2

There is a huge disparity between the UK and European countries in terms of light rail provision, as shown in Table 3.2. For example, there are only nine light rail/tram networks in Britain compared to nearly 50 in Germany and nearly 30 in France.

Table 3.2: Light rail/tram networks in the UK compared to Europe[193]

Country or region	No. cities with Light rail/trams	Length of light rail/tram network (km)	Number of passengers (million passengers per year)
Britain	9	356	196
Germany	49	2966	2908
France	28	827	1104
Baltic/Nordic region	12	482	375
Benelux	10	645	700

Poland	15	979	1051
South Eastern Europe	29	992	1277
Central Europe	23	1240	2188
Western Mediterranean	29	809	623

Table 3.3 below shows that even relatively small towns in Europe have comprehensive light rail/tram networks. For example, Jena in Germany (pop 110, 000) has a tram with five lines, 14 km of track and over 40 stations.

Table 3.3: Examples of tram networks in Europe

	Jena, Germany	Aubagne, France	Tours, France	Becanson, France	Brest, France	Utrecht, Netherlands
Pop served ('000)	110	47	136	115	139	359
Year of opening	1901	2014	2014	2014	2012	1983
Length of track (km)	13.6	1	14.3	14.5	1	38.5
No. Lines	5	7			28	3
No. stations	>40		29	31		43

Table 3.4 shows some typical costs of new light rail/tram infrastructure. Note that the costs per kilometre tend to be cheaper in France as the publicly owned utility companies have to move any utilities at their own cost[194].

Table 3.4: Typical costs of new light rail/tram infrastructure

Light rail/tram	Infrastructure	Capital cost (2021 prices in parentheses)	Unit cost (2021 prices)
Besancon, France[195]	14.5km new tram	€254m (2014 prices) (£351m)	£24m/km (a)
Tours, France[196]	14.3km new tram	€433m (2014 prices) (£599)	£42m/km (a)
West Midlands Metro	11km extension	£450m (2018 prices) (£474m)	£43m/km
Manchester Metro	6.4 km extension (Eccles Line)	£160m (1999 prices) (£248m)	£39m/km
Edinburgh tram	14 km new tram	£776m (2014 prices) (£866m)	£62/km

Tyne and Wear Metro[197]	46 new trains	£362m (2020 prices) (£371m)	£8.0/train
West Midlands Metro[198]	21 new trains	£83m (2019 prices) (£86m)	£4.1/train

(a) Based on a 2014 exchange rate of £1:€1.2411 and adjusted for inflation

Appendix 4: The current situation and impact of Covid

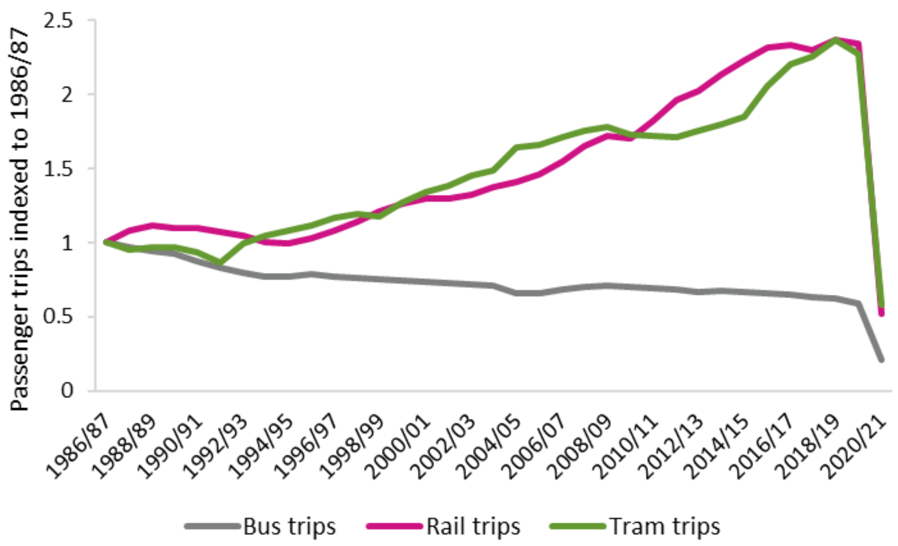
Passenger levels

Before the pandemic bus journeys had been in decline for many years, with the situation worsening outside London after deregulation in 1985/6 (see Figure 4.1). Covid exacerbated this decline with passenger trips more than halving from 2.1 billion in 2018/19 to 0.7 billion in 2020/21 (in England outside London). By March 2022 post covid bus trips were still 69% of pre-pandemic levels[199]. However, some regions (the South East and South West) and some districts saw an increase in bus passengers pre-Covid, indicating that with the right conditions and investment declining bus patronage is not inevitable[200].

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 Britain almost doubled (>80% growth) between 2000 and 2019 reaching 1.7 billion in 2019, followed by a dramatic fall in 2020/21 due to Covid. In March 2022 passenger trips were 80% of pre-pandemic levels and there is still significant uncertainty around future growth. And rail network capacity limitations means that rail cannot accommodate significant future growth in passengers without major investment; certain rail corridors are already at or approaching capacity.

The situation is similar to rail for tram journeys in England outside London, as Figure 1 shows, with significant growth (70%) in the 20 years leading up to the pandemic, reaching 0.1 billion journeys in 2019/20 (in England outside London) followed by a cliff edge fall in 2020/21 to 0.03 billion.

Figure 4.1: Annual passenger journeys on buses (England outside London), rail (Great Britain) and trams/light rail (England outside London) from 1986/87 to 2020/21 indexed to 1986/87[201]



Yet even pre-Covid, the share of total trips or distance travelled by public transport was small compared to private cars and vans. In 2019, cars and vans accounted for three fifths (61%) of passenger trips and 85% of all passenger miles in the UK[202].

Table 4.1 shows the number of public transport trips per head in 2018/19 while Table 4.2 shows the estimated car and public transport passenger km per head in the same year. This shows the large disparities between the regions, particularly for rail trips and passenger km.

Table 4.1: Public transport passenger trips per head in Wales and English regions (not including London) in 2018/19

Region	Passenger transport trips per head per year		
	Bus	**Tram (a)**	**Rail**
North East	64.8	13.7	4.1
North West	52.5	6.7	15.3
Yorkshire & Humber	55.0	2.2	10.3
East Midlands	39.3	3.9	4.5
West Midlands	54.6	1.4	13.2
East England	28.2	0	17.5
South East	38.1	0	20.8
South West	38.8	0	6.5
Wales	32.1	0	8.1

(a) Note this is different to the figures presented in DfT Table LRT0103 which expressed tram trips per capita for the area the tram serves whereas this is the number of tram trips per head for the whole region.

Table 4.2: Car/driver passenger km per head and public transport passenger km per head in Wales and English regions (not including London) in 2018/19

Region	Passenger km per head (pkm/cap/y)			
	Car driver/passenger	**Bus**	**Tram**	**Rail**
North East	9,437	380	120	583
North West	9,812	358	66	923
Yorkshire & Humber	10,025	334	15	695
East Midlands	11,687	306	25	425
West Midlands	10,618	342	15	764

East England	11,606	242	0	1,066
South East	11,741	266	0	1,164
South West	12,550	304	0	655
Wales	11,818	287	0	433

Funding

Funding is in crisis. The rapid decline in bus, tram and train passengers due to Covid has led to a loss of revenue for the operators, threatening their financial viability and leading to emergency spending by government to maintain service levels[203],[204]. It is estimated that without this funding buses would have been less frequent and more expensive, with an even higher loss of passengers[205].

The fear is that unless measures are taken to get overall public transport patronage back to its pre-Covid level this will lead to a vicious cycle where falling passenger numbers lead to higher fares and cuts in services, which in turn leads to falling numbers. Without serious investment, services deteriorate to a point where they are unattractive to customers. This inevitably leads to more people opting to travel by car, adding to congestion, carbon emissions and other harmful impacts of road travel. Many people may not be able to travel at all because they don't have any alternative means of travel, reducing people's access to education, employment, training, social and healthcare options.

A report for the Urban Transport Group warns that "*the impact of reduced services and increased fares on bus patronage could be as big as the impact of the pandemic itself.*"[206] They suggest that light rail operation will be under similar pressure. It could take 12-24 months for post covid travel patterns to become clear. Until that time, they argue that government needs to continue to support the public transport sector. They estimate the necessary support for buses is around £635m outside London, less than the average annual support over the last two years. Doubling this funding could return bus patronage to close to its pre-pandemic levels[207].

Total public expenditure on rail in 2020/21 was around £24bn in England (£12.8bn revenue) and £0.9bn (£0.6bn revenue) in Wales[208]. The equivalent funding on local public transport (buses and trams) was around £7bn (99% revenue) in England and around £70m (£40m revenue) in Wales. Note this represented a significant increase in revenue spending compared to the previous year due to Covid. See Table 4.3 for a detailed breakdown from 2018/19 to 2020/21.

Table 4.3: Total public expenditure on public transport in England and Wales from 2018/19 to 2020/21[209]

Country and transport sub-sector	Total public expenditure (£m outturn prices) (a)		
	2018/19	2019/20	2020/21
England			
Rail capital	10,835	10,736	11,310

Rail current	5,155	5,291	12,842
Local public transport capital	116	114	73
Local public transport current	1,950	1,869	6,901
Wales			
Rail capital	257	268	327
Rail current	325	415	562
Local public transport capital	12	19	33
Local public transport current	34	36	40

(a) Includes central government, local government and public corporation expenditure

Although the government provided significant emergency Covid funding to keep public transport services going during the pandemic, they have also significantly cut back on previous commitments. For example, funding for Bus Service Improvement Plans (BSIP) was more than halved from £3bn to £1.4bn in early 2022210. This is despite the fact that the total cost of delivering all the BSIPs was estimated by the Confederation of Passenger Transport (CPT) as at least £7bn211. Only 31 out of 77 BSIPs submitted were eventually funded, meaning that many places will be unable to even restore pre-Covid passenger levels let alone transform their services in line with the government's national bus strategy, Bus Back Better.

The Rail Industry Association highlighted in October 2021 that there has also been at least £1bn cut from the rail budget due to delays to the Rail Network Enhancement Pipeline (RNEP) (See Appendix 6) as the government's planned investments will not be delivered by March 2024, when the current five-year funding period ends212. In December 2021 rail operators were told by government to cut hundreds of millions of pounds from their operating budget[213.] Network Rail are also pressing ahead with £100m cuts in maintenance staff, despite warnings from the TUC that this would compromise passenger safety[214.]

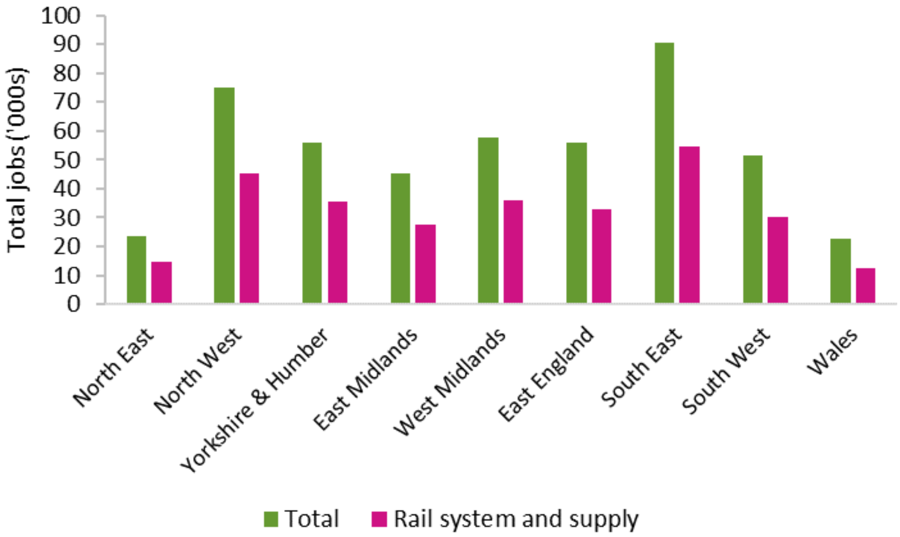
Employment

Pre-Covid there were approximately 118,000 people employed by local bus operators (platform, maintenance and administrative staff)[215]. Though updated figures are lacking a 2010 study suggested that the bus and coach supply chain employed between 50,000-110,000 people[216]. Reflecting falling passenger numbers there was a 12% reduction in the numbers directly employed compared to 2008/09[217].

Although there are no statistics on the number of people employed in light rail operation and maintenance, we estimate that pre-Covid there were around 3,800 people employed directly by the nine tram networks in Britain. We were unable to find any figures on the numbers employed through the supply chain.

Estimates of the number of people employed in the rail industry pre-Covid range from approximately 240,000 people directly employed[218] to around 440,000 (including the rail supply sector) or 710,000 (including station retail and induced demand)[219]. A regional breakdown is shown below.

Figure 4.2: Estimates of jobs in the rail sector (rail transport system and supply sector) in 2019 by region[220]



Appendix 5: The costs of providing a bus to 'Every Village Every Hour' by region

A 2021 report, *Every Village Every Hour* for CPRE, estimated the additional costs of providing a comprehensive bus service to rural areas in England with services to every village ever hour would cost £2.7bn a year[221]. This would be transformational for rural England and would cover the travel of around 24 million people. To tackle inequality and social exclusion, the report estimated the costs of charging a £1 flat fare, would cost £3bn per year over present expenditure. This includes allowance for the additional passengers attracted by lower fares. The report also estimated the costs of providing the same comprehensive service with free fares would be £3.5bn per year. This is proportionally a relatively small increase compared with the costs with current commercially set fares, because even on 'commercial' services in many rural areas approximately half or more of the bus operating costs are met from public funds. To enable this to happen would require services to be regulated to ensure an integrated approach to network planning, timetabling and ticketing.

Using the CPRE methodology we have estimated the costs to provide a comprehensive bus service to every village in England, seven days a week. Note that our total figures are slightly lower than the original report due to the use of revised population figures.

Table 5.1: Regional breakdown of costs of providing a comprehensive bus service to every village in England

Region	Costs (£m)
North East	£106
North West	£169
Yorks & Humber	£124
East Midlands	£251
West Midlands	£178
East of England	£378
South East	£437
South West	£404

Appendix 6: Rail Network Enhancements Pipeline (RNEP) pipeline schemes by region

To receive government funding a rail scheme needs to move through the Rail Network Enhancements Pipeline (RNEP) a government list of planned railway projects[222]. DfT's last release of the RNEP was in October 2019, despite pledging to update it annually. The RIA's Rail Enhancements Clock, which records the amount of time since the government last updated its RNEP, reached three years in October 2022[223]. The £10.4bn funding envelope for rail enhancements agreed with Network Rail in 2019 for its 6th Control Period (2019-2024) was cut by £1bn in the 2020 Spending Review[224].

There are five stages in the RNEP: determine (initiate), develop, design, deliver and deploy. According to the 2019 RNEP there were 58 schemes: 23 with a decision to initiate (stage 1), 22 schemes with a decision to develop (stage 2) and only 13 schemes with a decision to design (stage 3) across the 4 Network Rail regions in England and Wales (see Appendix 6 for a regional breakdown)[225]. A scheme will not proceed to delivery until it has received a 'Decision to Deliver' (Stage 4). While some of the schemes in the pipeline are being delivered through other government funding pots (eg reopening of the Portishead Rail Line through Transforming Cities Fund) there are still no details about some of the schemes that are in the design stage (eg the Trans-Pennine Route Upgrade) and there are concerns that some of the schemes in the development stage may not go ahead. In the three years to October 2022 one third of the 58 schemes had not progressed[226].

Note that the Network Rail region's do not map onto the English regions and therefore the allocation of schemes to each region is approximate. Also, many schemes will affect regions well beyond the boundary of the geographical region, so although London schemes are not included here, they will also benefit train travel to/from the regions. The last column is our assessment of the current status of the funding for the project.

Table 6.1: 2019 RNEP pipeline of projects loosely organised by region in England (not including London) and in Wales

Approx. Region (a)	Network Rail region	Name of scheme	RNEP stage	Status
NW	Eastern	Transpennine Route Upgrade	Design	Funded (b)
NE	Eastern	Middlesbrough Station Capacity	Develop	Funded £35m (c)

NE	Eastern	Northumberland Line: passenger service reintroduction	Develop	Part funded (d)
NW	North West & Central	Cumbrian Coast Capacity / Energy Coast Rail Upgrade	Develop	No decision Unclear(e)
NW	North West & Central	Cross-Manchester Capacity and Performance (Castlefield Corridor)	Initiate	Unclear (f)
NW	North West & Central	Wigan-Bolton electrification	Initiate	Funded £78m (g)
YH	Eastern	Harrogate station franchise capacity	Design	Funded £9.8m (h)
YH & EM/NW	North West and Central	Hope Valley Capacity	Design	Funded £137m (i)
YH	Eastern	Leeds Station Capacity	Initiate	Funded £161m (j)
YH	Eastern	Skipton Colne	Initiate	Unfunded (k)
EM	Eastern	Robin Hood Line	Develop	Commitment to funding (l)
EM	Eastern	Syston to Trent Gauge enhancement	Initiate	Unclear
WM	North West & Central	Leamington to Coventry Capacity Enhancement (Birmingham Connectivity)	Develop	Unclear
WM	North West & Central	Solihull Corridor Capacity	Develop	Unclear
WM	Eastern	Birmingham Moor Street capacity	Initiate	Unfunded. £950m (m)
WM	North West & Central	Dudley Port Capacity	Initiate	Unclear
WM	North West & Central	West Midlands Train Lengthening	Initiate	Unclear
EE	Eastern	St Albans Station Capacity	Design	Funded £5.7m (n)
EE	Eastern	Cambridge South	Develop	Funded £184m (o)
EE	Eastern	Ely area capacity improvement	Develop	Unfunded (p)

EE	Eastern	Haughley Junction, Suffolk	Develop	Unfunded (q)
EE & others	Eastern	East Coast Digital Programme	Develop	Funded £1billon (r)
SE	North West and Central	East West Rail Phase 2	Design	Funded (s)
SE	Wales and Western	Reading Independent Feeder (Power Supply)	Design	Unclear
SE & London	Southern	Feltham Resignalling Enhancement	Design	Funded £31m (t)
SE & London	Southern	South East (Sussex and East London Line) Traffic Management Scheme	Design	Unclear
SE	Southern	Brighton Mainline	Develop	Unfunded (u)
SE	Southern	Woking capacity enhancement	Develop	Unclear
SE	Wales & Western	Oxford Corridor Capacity Phase 2	Develop	Pending approval (v)
SE	North West & Central	Chiltern Train Lengthening	Initiate	Unclear
SE	Southern	SE Franchise Stations Congestion Relief – Lewisham	Initiate	Unclear
SW	Wales and Western	Bristol East Junction	Design	Funded £132m (w)
SW	Wales and Western	Metro West (Portishead element only)	Design	Funded (x)
SW	Wales and Western	South West Rail Resilience Programme – Parsons Tunnel North Resilience	Design	Funded (y)
SW	Wales & Western	South West Rail Resilience Programme – Parsons Tunnel to Teignmouth resilience	Develop	Unfunded (z)
SW	Wales & Western	South West Rail Resilience Programme – Central Tunnels Section Resilience	Develop	Unclear

SW	Wales & Western	Bathampton to Bradford Junction W8 Gauge (Dundas Aqueduct)	Initiate	Unclear
SW	Wales & Western	London Paddington	Initiate	Funded £1m (aa)
SW & Wales	Wales & Western	GWML Freight Corridor /Gauge clearance – Didcot – Bristol/Cardiff	Develop	Unclear (bb)
SW & Wales	Wales & Western	Severn Tunnel Junction to Cardiff relief lines upgrade	Initiate	Unclear (cc)
Wales	Wales & Western	Cardiff Central Station	Initiate	Funding not committed (dd)
Wales	Wales & Western	North Wales journey time improvement (Wrexham – Bidston and N Wales ML)	Initiate	Unfunded (ee)
Wales	Wales & Western	South Wales journey time improvement (Swansea to Cardiff)	Initiate	unclear

(a) Our allocation
(b) In July 2020, the government announced £959m of additional funding though there are concerns about further cost increases and delays https://www.newcivilengineer.com/latest/transpennine-route-upgrade-budget-soars-to-11-5bn-and-could-rise-again-20-07-2022/
(c) https://teesvalley-ca.gov.uk/tees-valley-mayor-launches-35million-station-transformation-to-deliver-more-trains-to-boro/
(d) https://www.railfuture.org.uk/The-Northumberland-Line
(e) https://cdn.networkrail.co.uk/wp-content/uploads/2019/11/Cumbrian-Coast-Study-2019.pdf
(f) https://www.networkrail.co.uk/wp-content/uploads/2021/02/Castlefield-Corridor-Congested-Infrastructure-Capacity-Enhancement-Plan-26-February-2021.pdf
(g) https://www.networkrailmediacentre.co.uk/news/powering-ahead-bridge-upgrade-for-wigan-to-bolton-electrification
(h) https://www.harrogateadvertiser.co.uk/news/politics/inside-track-the-long-journey-to-new-ps9-million-harrogate-york-rail-improvements-3050443
(i) https://www.modernrailways.com/article/hope-valley-upgrade-third-express-path-hour
(j) https://www.railway-technology.com/projects/leeds-integrated-station
(k) https://www.lancashiretelegraph.co.uk/news/19842927.colne-skipton-call-county-council-help-fund-rail-study/
(l) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1062157/integrated-rail-plan-for-the-north-and-midlands-web-version.pdf
(m) https://www.birminghammail.co.uk/news/midlands-news/new-street-at-full-capacity-23331962
(n) https://www.therailwayhub.co.uk/45442/thameslink-completes-5-7m-upgrade-of-st-albans-city-station/
(o) https://www.networkrail.co.uk/running-the-railway/our-routes/anglia/improving-the-railway-in-anglia/cambridge-south-station/
(p) https://www.networkrail.co.uk/running-the-railway/our-routes/anglia/improving-the-railway-in-anglia/ely-area-capacity-enhancement/
(q) https://www.eadt.co.uk/news/local-council/new-delay-for-haughley-junction-in-suffolk-8963554

(r) https://www.gov.uk/government/speeches/transport-update-investment-in-the-east-coast-digital-programme

(s) https://www.orr.gov.uk/sites/default/files/2021-09/2021-07-20-east-west-rail-phase-2-letter-from-dft.pdf

(t) https://www.gov.uk/government/news/state-of-the-art-31-million-feltham-station-update-complete

(u) https://www.networkrail.co.uk/running-the-railway/our-routes/sussex/upgrading-the-brighton-main-line/

(v) https://www.networkrail.co.uk/running-the-railway/our-routes/western/oxfordshire/oxford-corridor-phase-2/

(w) https://www.networkrailmediacentre.co.uk/news/major-track-upgrade-completed-at-bristol-east-junction

(x) https://travelwest.info/projects/portishead-rail-line-metrowest-phase-1

(y) https://www.networkrail.co.uk/running-the-railway/our-routes/western/south-west-rail-resilience-programme/parsons-tunnel-north-portal/

(z) https://www.networkrail.co.uk/running-the-railway/our-routes/western/south-west-rail-resilience-programme/parsons-tunnel-to-teignmouth-resilience-project/

(aa) https://www.networkrailmediacentre.co.uk/news/network-rail-sets-out-gbp-1million-plan-to-improve-station-facilities

(bb) https://www.modernrailways.com/article/nr-enhancements-disarray

(cc) https://www.business-live.co.uk/economic-development/plans-passenger-trains-run-relief-20942923

(dd) https://tfw.wales/projects/cardiff-central-enhancements

(ee) https://news.tfw.wales/blog/connecting-north-and-south-wales

Appendix 7: Summaries of published studies on rail and other public transport capital costs

Table 7.1: Summary of published costs on rail

Item	Unit	Cost (£bn)	Benefit (£bn)	Source
UK rail infrastructure 2020–24 (high scenario)	Average cost/benefit per year	19.4	37.6	Rail Industry Association[227]
UK rail infrastructure 2025–29 (high scenario)	Average cost/benefit per year	23.1	42.3	As above
Rail electrification for the UK	Total capital cost/net present value	36–47	-3.7 to 1.6	Network Rail[228]
Rail electrification for the UK	Total benefits		4.4	Rail Delivery Group[229]
Regional rail – transforming a local rail network	Present Value of costs (a)/net present value	1.2	2.4	Urban Transport Group[230]
33 rail reopening schemes with 72 stations (28 rail reopening schemes with 65 stations excluding London and Scotland)	Total capital costs/benefits	4.8–6.4 (4.3–5.8)	0.2–0.3 (0.1–0.2)	Campaign for Better Transport[231]

(a) After revenue deducted, discounted over 60 years

Rail investment (Railway Industry Association)

A report for the Railway Industry Association (RIA) used two rail investment forecast scenarios to estimate the economic benefits and jobs associated with the rail industry[232]. The scenarios comprised: (1) a baseline scenario based on National Infrastructure Commission's projections for rail spend[233] and (2) a high scenario 50% higher than the baseline. The baseline scenario assumes NIC figures for investment in HS2, Crossrail 2, Northern Powerhouse Rail and capital spend by Network Rail together with additional figures for local public transport spend. The high scenario is assumed to relate to major new projects and was considered at the top end of the range[234]. The table below shows the results for the two scenarios up to 2029 for total infrastructure spend as well as the associated GVA.

Table 7.2: Projections for rail infrastructure spending up to 2029 and associated GVAs (all values at 2019 prices).

Projections	Scenario	Year		
		2019	2020–2024	2025–2029
Total rail infrastructure spending (£bn/y)	Base	9.6	12.9	15.4
	High	9.6	19.4	23.1
Total GVA (£bn/y)	Base	30.0	32.9	36.7
	High	30.0	37.6	42.3

We assume that the higher levels of rail investment are likely to be needed to accommodate the additional passengers needed in every region. Based on this, it is possible that the total rail investment needed for the UK will average £19.4bn a year until 2024, rising to £23.1bn for the following five years to 2029. However, this is estimated to generate GVA that is nearly double the investment value: £37.6bn a year up to 2024 rising to £42.3bn a year up to 2029. Note that public capital expenditure on railways in England in 2018/19 was nearly £11bn and around £260m in Wales[235].

Regional rail investment (Urban Transport Group)

A 2017 report for the Urban Transport Group (UTG) looked at the transformational effect of investment in regional rail[236]. This looked at four scenarios based on real life examples:

1. New passenger service on an existing freight line (based on the proposed reintroduction of passenger traffic to the Ashington Blyth and Tyne line in South East Northumberland).
2. Whole route upgrade (based on the Leeds-Harrogate-York line).
3. Linking 2 radial routes into a city to create cross city and longer distance routes (based on the northern hub in Manchester).
4. Transform entire local rail network (based on the valley lines in South Wales).

The table below shows the estimated costs and benefits of the scenarios and associated uplift in rail passenger journeys. All four scenarios showed very high value for money. With a long-term commitment to investment the study suggested it should be possible to reduce operating costs and raise demand and move closer to a breakeven point, rather than relying on subsidy. There are also operational savings, for example scenario 2 has a reduction in operating costs of 15% per vehicle as a result of electrification.

Table 7.3: Costs and benefits of four regional rail scenarios

Scenario	Present Value of Costs (£m) (a)	Prevent Value of benefits (£m) (b)	Net Present Value (£m) (b)	Benefit Cost Ratio	Additional trips (m/y)
1	99	233	134	2.4	0.4
2	198	812	614	4.1	2.5
3	260	933	673	3.6	2.3
4	1202	3608	2406	3.0	3.6

(a) Includes operating and capital costs, discounted over 60 years, after passenger revenue deducted from costs
(b) Discounted over 60 years

The table shows that all four schemes have very high benefit cost ratios and result in additional passenger trips of between 400,000 and 3.6 million a year.

Reopening of railway stations and lines (Campaign for Better Transport)

A 2017 report for the Campaign for Better Transport looked at the costs and benefits of reopening railway stations and lines across the country[237]. It used social, economic and environmental factors to assess the case for over 224 potential rail reopening projects. The study first assessed the viability of the schemes and then rated them against three themes and nine criteria to identify 33 schemes of the highest priority across the UK. The table below shows the estimated costs of the 28 priority schemes in England (not including London) and in Wales are around £4.3–5.8bn. If all 28 schemes were implemented this would represent over 310 miles of reinstated passenger service miles and 65 new stations.

Table 7.4: Priority schemes, miles, stations and costs by region (excluding London and Scotland)

Region	No. schemes	No. Stations	Miles of track	Estimated cost (£m) (2017 prices)
North East	3	13	47	477–716
North West	3	5	21	458–504
Yorks & Humber	2	4	25	225–418
East Midlands	3	8	49	309–406
West Midlands	4	13	40	360–668
East of England	3	5	52	1,540–1,630
South East	2	5	14	290–501

South West	4	7	47	529–777
Wales	4	5	16	144–267
Total	28	65	311	4,270–5,787

The Campaign for Better Transport also estimated that reopening of 33 priority rail lines across Britain and associated stations could create up to 6,500 jobs (1,645 direct jobs, 3,000 in the supply chain and 2,000 in construction)[238].

Rail electrification[239] (Network Rail and the Rail Delivery Group)

Network Rail estimates the majority (around two thirds) of rail carbon emissions come from traction, largely diesel. Currently only about 38% of the UK's rail network is electrified. There is great regional inequality with lines in the South East, routes to/from London and between Edinburgh and Glasgow mostly electrified. The UK also lags behind other European countries: Switzerland has full electrification of its railway, Belgium 86% and Germany 60%.

The National Audit Office have recommended that there needs to be sustained investment in rail electrification over the next few decades[240]. Network Rail estimates that this will require £36bn to £47bn (2020 prices) in capital costs (infrastructure and rolling stock) depending on the pathway[241]. Network Rail's most ambitious pathway would make it possible to remove all diesel-only passenger trains by 2040. While this level of investment is significant there are strong strategic and economic rationales for such investment including[242].

- £12bn to £17bn (2020 prices) in operating cost savings over a 90-year appraisal period
- improvements to reliability and resilience
- faster journeys
- reduced maintenance costs
- improvements to air quality
- safety improvements for users (compared to road)
- creation of skilled jobs and
- levelling up of the economy.

Even with very high capital investment levels, there is a return on investment, with operational cost savings, increased revenue and lower greenhouse gas emissions. The Net Present Value (NPV) ranges from -£3.7bn to £1.6bn (2010 PV) for a 90-year appraisal period[243]. Because greenhouse gas reduction forms around 40% of the benefits and the NPV is sensitive to changes in the value of carbon removal these benefits have almost certainly increased in the two years this analysis was published[244].

As well as reducing carbon emissions and improving air quality (particularly in large stations) electrification also increases patronage, through both supply (faster journeys allow more services) and demand (newly electrified passenger railway lines often show what is known as a 'sparks effect' where improved passenger experience leads to increased patronage[245]).

There are efficiency benefits from a lengthy programme of decarbonisation which can reduce costs, as seen in a number of major European countries[246]. Scotland also has a long-term rolling programme of electrification to 2045 laid out in Transport Scotland's Decarbonisation Action Plan[247].

The Rail Delivery Group has also looked at the wider benefits of rail electrification[248]. They estimate this will deliver economic benefits from employment of £2.2bn, avoid 33 million tonnes of carbon emissions by 2050, provide air quality improvements valued at a further £2.2bn and provide around 6,000 jobs - with opportunities to level-up and enhance the diversity of the rail workforce.

Based on the geographical location of infrastructure works and rolling stock manufacturing/assembly plants their analysis provides a geographical distribution of jobs as shown in the table below. Because rail electrification requires a highly specialised workforce having a long-term programme of investment means that these jobs are retained, making training worthwhile[249]. Table 8 shows a regional breakdown.

Table 7.5: Estimates of additional jobs created by rail electrification[250]

Region	No. additional jobs
North East	470
North West	580
Yorks & Humber	870
East Midlands	940
West Midlands	350
East of England	200
South East	420
South West	830
Wales	610
Total (a)	5,270

(a) Scotland and London make up the balance to 5,930

Local public transport (National Infrastructure Commission)

The NIC's 2018 Infrastructure Assessment also makes a strong call for better public transport in towns and cities. "More investment in public transport, alongside the promotion of safe cycling and walking, is the only way that cities can increase their infrastructure capacity to support growth."[251]

The NIC recommends increased funding for all cities with a population over about 100,000 to reflect the higher infrastructure needs of denser urban areas [this broadly matches the definition of 'primary urban areas'].

"Local transport authorities outside London should have stable, devolved infrastructure budgets, as Highways England and Network Rail have. The devolved budget should comprise of five-year settlements, with fixed annual budgets set at least two years before the start of the five-year period. This budget should be sufficient to cover all maintenance, small to medium enhancement projects and programmes to deploy or pilot new smart infrastructure technologies."

The table below shows the NIC's expected average annual expenditure on transport up to 2035.

Table 7.6: NIC's average annual expenditure on local public transport based on the government's fiscal remit[252]

Average annual expenditure (£m, 2018/19 prices)	Year		
	2020–2025	2025–2030	2030–2035
Devolved cities	3,300	3,600	4,600
Urban Major Projects	500	400	2,400
Non-urban local transport	2,700	2,900	3,400
Total (a)	6,500	6,900	10,400

(a) Assume this is all local public transport, as separate categories for rail and road

Based on this it would appear that average annual investment in local public transport outside London should be of the order of £6.5bn a year up to 2025, rising to £6.9bn a year for the following five years.

Transforming peak hour transport capacity in cities and towns (NIC)

A 2018 report for the NIC provides order of magnitude estimates of increases in peak hour transport network capacity to the centre of towns and cities in England[253]. The five scenarios considered include a combination of interventions across all modes and range from incremental change (5% uplift) to transformational change (20% uplift). It also includes a 10% uplift scenario with a focus on bus capacity (in which buses contributed between 50–80% of the capacity uplift).

For example, for a generic large city a 10% uplift in peak hour capacity would imply:

- 13 additional road lanes (unlikely to be possible) or
- 150 additional rail carriages (two carriages to every train or an additional 30 trains in peak hour) or
- 27 new trams (>80% uplift in frequency) or
- 93 new buses (>30% uplift in frequency).

The report looked at 20 case studies of towns and cities in England and extrapolated the results to a further 34 towns/cities. The figure below shows the pre-Covid morning peak capacity utilisation by different modes in the core 20 cities (the greyed-out area represents the theoretical capacity).

Figure 7.1 Morning peak capacity utilisation across city centre cordon – case study cities

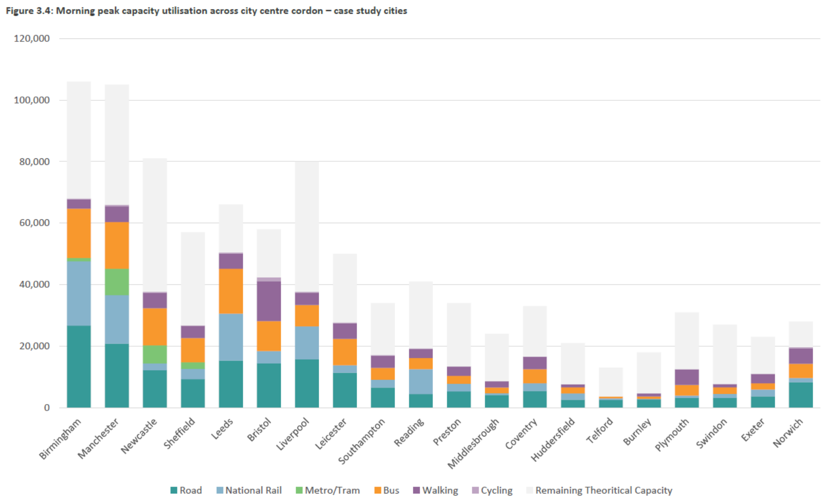


Table 7.7: Capital cost estimates of a 5% uplift, a bus-focussed 10% uplift and 20% uplift in peak hour capacity in a generic small, medium and large city[254]

Generic city size	**Capital cost (£m) (2018 prices)**		
	5% uplift	**10% bus focussed uplift**	**20% uplift**
Large	348	2,131	5,898
Medium	143	638	1825
Small	137	203	778

Table 7.7 shows that for a small city costs range from around £140m to £780m; for a medium city £140m to £1.8bn; and for a large city £350m to £5.9bn.

Note the cost estimates for this study are intended to be used in aggregate rather than on a city-by-city basis to provide a more representative figure. The report notes that costs do not have a linear relationship to the increase in capacity with the more transformational changes having a significant impact on cost. It also notes the costs for a given city and scenario range from -45 to +307%. The Table below shows the capital costs for selected scenarios in generic large, medium and small cities.

Note that peak hour capacity does not easily translate to total passenger numbers or trips and the study doesn't provide any figures on the expected increase in passengers/trips. We have assumed that the increased uplift required to meet the climate emergency is more than incremental (5%) and may even be transformational (20%). However, we have taken the 10% bus focussed capacity costs as a starting point.

The table below shows the estimates by region based on the 54 towns and cities considered in the report.

Table 7.8: Capital cost estimates of a 5% uplift, a bus-focussed 10% uplift and 20% uplift in peak hour capacity by region

Region	Capital cost (£m) (2018 prices)		
	5% uplift	10% bus focussed uplift	20% uplift
North East (a)	624	3,172	9,178
North West (b)	1,721	7,643	22,627
Yorkshire & Humber (c)	1,870	8,412	27,057
East Midlands (d)	1,120	5,024	15,878
West Midlands (e)	954	4,054	12,485
East England (f)	875	1,552	6,460
South East (g)	2,044	7,233	20,947
South West (h)	1,131	3,452	11,142
Total	10,339	40,542	125,774

(a) Newcastle; Middlesbrough; Sunderland
(b) Manchester; Liverpool; Preston; Wigan; Birkenhead; Burnley; Blackpool; Warrington; Blackburn
(c) Sheffield; Leeds; Huddersfield; Bradford; Wakefield; Doncaster; Hull; Barnsley; York
(d) Leicester; Nottingham; Derby; Mansfield; Northampton
(e) Birmingham; Coventry; Telford; Stoke
(f) Norwich; Southend; Peterborough; Ipswich; Cambridge
(g) Southampton; Reading; Portsmouth; Brighton; Chatham; Milton Keynes; Luton; Aldershot; Basildon; Oxford; Slough; Crawley
(h) Bristol; Plymouth; Swindon; Exeter; Bournemouth; Gloucester; Birmingham; Coventry; Telford; Stoke

Endnotes

[1] Forth T (2019) Birmingham is a small city. Web article, Tom Forth website,14/01/19.
[2] Office for National Statistics and UK Health Security Agency (2022) Excess mortality during heat-periods: 1 June to 31 August 2022. 07/10/22.
[3] McGrath M (2022) Climate change: IPCC scientists say it's 'now or never' to limit warming. BBC News Report, 04/04/22.
[4] Office of Budget Responsibility (2021) 2021 Fiscal Risks Report. October 2021
[5] Domestic transport emitted 122.3 million tonnes greenhouse gases (by source) in 2019. As well as domestic transport emissions there were additional emissions (36.8 million tonnes) from international shipping and aviation. BEIS (2022) Final UK greenhouse gas emissions national statistics: 1990 to 2020. February 2022.
[6] Ibid
[7] Department for Business, Energy & Industrial Strategy (2021) UK local authority and regional carbon dioxide emissions national statistics: 2005-2019
[8] Department for Business, Energy & Industrial Strategy (2020) UK sets ambitious new climate target ahead of UN Summit. Press Release, 03/12/20.
[9] Anderson K, Broderick J and Stoddard I (2020) A factor of two: how the mitigation plans of 'climate progressive' nations fall far short of Paris-compliant pathways, Climate Policy, Volume 20, 2020 - Issue 10. https://doi.org/10.1080/14693062.2020.1728209
[10] Oldridge S and King J (2022) Net Zero – The Ambition Gap. Will the UK net zero strategy keep 1.5 alive? Report by Zero Hour. August 2022.
[11] Transport for Quality of Life (2022) The Last Chance Saloon: We need to cut car mileage by at least 20% Radical 2-pager.
[12] Department for Transport (2021) Decarbonising Transport.
[13] Friends of the Earth (2022) Government's Climate Strategy deemed "unlawful" in historic ruling. Press release, 18/07/22.
[14] Friends of the Earth (2022) Government not appealing ruing that Net Zero Strategy is unlawful. Press Release,
[15] Climate Change Committee (2022) 2022 Progress Report to Parliament. June 2022.
[16] England's Economic Heartland (2021) Connecting People, Transforming Journeys. Transport Strategy https://eeh-prod-media.s3.amazonaws.com/documents/Connecting_People_Transforming_Journeys_av.pdf
[17] Assuming car emissions are roughly proportional to mileage. Car emissions in 2020 were 60.8 million tonnes, bus emissions were 2.3 million tonnes, equivalent to 3.8% of car emissions.
[18] Department for Levelling Up, Housing and Communities (2022) Levelling Up the United Kingdom White Paper. February 2022.
[19] DfT (2022) Transport Statistics: Table TRA8905a (car km); Table BUS0108 (Bus passenger journeys); Table LRT0103 (tram pkm) and ORR Regional Passenger journeys combined with National Travel Survey Tables NTS0903 and NTS0904
[20] Chatterjee K *et al.* (2019) Access to Transport and Life Opportunities. A NATCE Social Research report for the DfT. August 2019.
[21] Public transport systems which use rail-based technologies. 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. DfT (2019) Light Rail (and other rapid transit solutions) A

Call for Evidence on the opportunities available to introduce new Light Rail Systems or other rapid transit solutions into towns and cities in England. February 2019
[22] Ibid.
[23] Urban Transport Group (2020). Light rail briefing note
[24] Light Rail (UK) (2020) Leigh Guide Busway Upgrade. October 2020.
[25] DfT (2019) Light Rail (and other rapid transit solutions) A Call for Evidence on the opportunities available to introduce new Light Rail Systems or other rapid transit solutions into towns and cities in England. February 2019.
[26] Equivalent to 19.7 million tonnes greenhouse gas emissions by source in 2019 (18.6 Mt in 2020). BEIS (2021) Final UK greenhouse gas emissions national statistics 1990-2020.
[27] Department for Transport (2016) Rail Freight Strategy. September 2016
[28] Chartered Institute of Transport and Logistics (2021) Decarbonising Logistics and Transport Route to Net Zero – COP26 Discussion Papers
[29] In 2019 17 billion tonne kilometres of freight was moved by rail, 154 billion tonne kilometres by road and 25 billion tonne kilometres by water. ORR (2021) Table 1350: Rail freight market share, Great Britain, annual data, January 1998 to December 2020.
[30] Chartered Institute of Transport and Logistics (2021) Decarbonising Logistics and Transport Route to Net Zero – COP26 Discussion Papers
[31] Great British Railways Transition Team (2022) Future guiding mind for rail seeks views on how to grow freight to reduce road congestion and carbon emissions. News release, 05/07/22.
[32] Chartered Institute of Transport and Logistics (2021) Decarbonising Logistics and Transport Route to Net Zero – COP26 Discussion Papers.
[33] Deloitte (2021) The role and value of rail freight in the UK Report for the Rail Delivery Group, April 2021.
[34] Stephen Joseph Associates (2019) What level of ambition is achievable and worthwhile for rail freight? Report for Rail Freight Group, July 2019.
[35] Chartered Institute of Transport and Logistics (2021) Decarbonising Logistics and Transport Route to Net Zero - COP26 Discussion Papers.
[36] Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020. We have pro-rated the total infrastructure costs of £18-26bn to electrify 13,000 STKs.
[37] Ibid.
[38] CBT (undated) Transformation of the West Coast Mainline.
[39] The Scottish Government have a target of a 20% reduction in total car mileage by 2030, relative to 2019, supported by detailed analysis of the carbon pathways to meet carbon targets. Element Energy (2021) Decarbonising the Scottish Transport Sector. Report for the Scottish Government.
[40] Analysis by 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. CREDS (2021) The role of energy demand reduction in achieving net zero. October 2021 and additional data from Personal Communication with Dr Christian Brand.
[41] Analysis by Green Alliance estimates that a 20-27% reduction in total car mileage is needed by 2030, relative to 2019. Bennett H and Brandmayr C (2021) Not going the extra mile: driving less to tackle climate change. Report for Green Alliance. 08/12/21
[42] DfT (2021) National Travel Survey Tables NTS9903 and NTS9904.
[43] This depends on the number of new electric cars bought each year (which depends on both the proportion of new cars that are electric and the number of new cars sold) and the number of petrol/diesel cars that are replaced. In an economic downturn people are less likely to buy new electric cars and scrap their old petrol/diesel ones.

[44] WPI Economics (2022) The decarbonisation dividend. The economic, environmental and social benefits of more bus and coach journeys. Report for the Confederation of Passenger Transport. July 2022.
[45] Element Energy (2022) Analysis of a Net Zero 2030 Target for Greater London, Report for Greater London Authority. Report for Greater London Authority, 18/01/22.
[46] Transport for London (2021) Travel in London Report 14. December 2021.
[47] Element Energy (2022) Analysis of a Net Zero 2030 Target for Greater London, Report for Greater London Authority. Report for Greater London Authority, 18/01/22.
[48] A 14% reduction in vehicle km by 2041 relative to 2015. Transport for London (2019) M77 Mode Share Targets. Written Statement for the London Plan Examination in Public – Matter 77.
[49] In 2018/19 there were 476 million bus vehicle km in London compared to 485 million bus vehicle km in English Metropolitan areas. In 2004/05 there were 461 million bus vehicle km in London. Department for Transport (2021) Bus Statistics. Table BUS0203: Vehicle kilometres on local bus services by metropolitan area status and country: Great Britain, annual from 1970.
[50] Transport for London (2022) TfL Statement – update on government funding settlement. Press release, 30/08/22.
[51] Mayor of London (2021) Mayor warns tube line could shut if ministers fail to fund TfL. Press release, 30/11/21.
[52] Mayor of London (2021) Mayor says budget shows government is 'taking London for granted. Press Release, 27/10/21.
[53] RAC Transport Price Index https://www.racfoundation.org/data/cost-of-transport-index
[54] Pidd H (2019) Massively Unfair' Gulf in Bus Fares Between London and Rest of England. Article in The Guardian, 05/05/19.
[55] Collings S, Chatterjee K and Cope A (2022) Fair Bus Fares for Young People. A report by UWE Bristol and Sustrans. July 2022.
[56] Taylor, I (2021) Every Village Every Hour. Transport for Quality of Life report for CPRE.
[57] Authors own estimates.
[58] UTG (2014) Bus priority in practice.
[59] Passenger Transport (2022) Majority of public back bus priority measures. News article in *Passenger Transport Magazine*, 24/03/22.
[60] KPMG (2020) Maximising the Benefit of Local Bus Journeys. Report for Greener Journeys, July 2020.
[61] In 2021/22 the government's Zero Emission Bus Regional Areas (ZEBRA) scheme awarded £269m for 1,278 zero emission buses and associated infrastructure. This represents roughly 5% of the current fleet in England (not including London) and in Wales. Based on this it would cost roughly £5.3bn to electrify the remaining fleet in England (not including London) and Wales. DfT (2022) Zero Emission Bus Regional Areas (ZEBRA) scheme
[62] Transport Scotland (2020) £500 million for bus priority infrastructure. News item, 09/11/20.
[63] Transport North East (2021) North East Bus Service Improvement Plan. October 2021.
[64] TFGM (2021) Greater Manchester BSIP. October 2021.
[65] Urban Transport Group. Light rail briefing note.
[66] DfT (2021) Integrated rail plan for North and Midlands. 18/11/21.
[67] BBC (2005) Tram plans reach end of the line. News item, 03/11/05.
[68] Rose M and Hyomes C (2021) Leeds metro. Article on Rail Future website, 16/11/21.
[69] DfT (2019) Light Rail (and other rapid transit solutions) A Call for Evidence on the opportunities available to introduce new Light Rail Systems or other rapid transit solutions into towns and cities in England. February 2019.
[70] Great British Rail (2022) Whole Industry Strategic Plan. Call for Evidence Response Report. June 2022.

[71] Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.
[72] For example the NIC high scenario funding would deliver the following: wholly new Northern Powerhouse Rail lines on the route between Liverpool, Manchester and Leeds, which would also serve Bradford; increases capacity between Leeds and Newcastle; upgrades the Hope Valley route from Manchester and Sheffield; delivers a new line into Leeds off the existing network north of Sheffield and a new high speed line from Birmingham to the East Midlands providing direct services to Nottingham; upgrades the Erewash Valley route between Nottingham and Sheffield; upgrades the Midland Main Line. NIC (2020) Rail Needs Assessment for the Midlands and the North. November 2020.
[73] Department for Transport (2022) Table TSGB1302: UK Public Expenditure on Transport by Country and Spending Authority: from 2005/06
[74] This is the difference between Transport for the North's Northern Powerhouse Rail (NPR) Option 1, selected by government in its Integrated Plan for the North and Midlands, and the NPR Option 3.
[75] Quote from Darren Caplan, CE of RIA. Rail Magazine (2022) Thousand days since RNEP. Article, 22/07/22.
[76] Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.
[77] Kurmayer N J (2022) Germany's €177bn climate budget to focus on building retrofit. Article on Edie.net. 01/08/22.
[78] Office of Rail and Road (2019) RIS2 Efficiency Review: ORR's advice on Highways England's Draft Strategic Business Plan for the Second Road Investment Strategy. 11/03/19.
[79] Campaign for Better Transport (2022) Charity calls for private jet super tax on super rich. Media release, 30/12/22.
[80] Robinson L (2022) Personal Communication by email with Liverpool City Region Combined Authority's Transport Team, 30/11/22.
[81] Ibid.
[82] Rail Delivery Group (2021) Catalysing a green recovery. Creating jobs by building Britain's net zero railway. Analysis by Oxera, IPEX and the National Skills Academy for Rail (NSAR). October 2021.
[83] Rebirth of the Waverley Route' Butlin, Ashley (January 2014). The Railway Magazine. p. 15. Secondary reference in CBT (2019) The case for expanding the rail network.
[84] Wright (2021) A bus maker to create up to 300 jobs! Web article, 17/08/21.
[85] Urban Transport Group (2022) Briefing on Light Rail. 06/09/22.
[86] Nationally, across the rail and supply sectors together, the average GVA of £62,000 per job was 38% above the average across activities of all kinds. Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.
[87] Rail Delivery Group (2021) Catalysing a green recovery. Creating jobs by building Britain's net zero railway. October 2021.
[88] Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.
[89] Ibid.
[90] Nottingham Business School (2016) NET Phase Two Local Economic Evaluation. Report 2: Impact Evaluation Findings. Report by the Economic Strategy Research Bureau (ESRB), Nottingham Business School for Tramlink Nottingham.
[91] Comments by Sir John Armitt, Chair of NIC. Islam F (2022) 'Keep spending on transport ready for return to work', says adviser. Article for BBC, 13/05/21
[92] Steer (2022) Continuing COVID Funding Support for Urban Public Transport. Report for Urban Transport Group. February 2022.

[93] Luman R (2022) European public transport recovers, but commuting has changed. Article for ING, 15/07/22.
[94] The German Way & More (2022) About Germany's 9-Euro Monthly Public Transport Ticket. Web article, 17/09/22.
[95] Frost S (2022) Spain: Short and medium distance trains will be free this autumn, thanks to a windfall tax. Article in Euronews, 19/07/22.
[96] Ibid
[97] Department for Transport (2022) £2 bus fare cap across England to save passengers money. News release, 03/09/22.
[98] IPSOS (2022) New survey shows public back action to encourage cycling and public transport but remain attached to their cars. Article on website. 04/04/22.
[99] RAC (2018) Six in 10 drivers 'would switch to public transport' article on website. 20/09/18.
[100] Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.
[101] Ibid.
[102] Ibid.
[103] Ibid.
[104] KPMG (2020) Maximising the Benefit of Local Bus Journeys. Report for Greener Journeys. July 2020.
[105] Jacobs Consultancy (2011) Value for Money and Appraisal of Small Scale Public Transport Schemes. Study for the Public Transport Executive Group (pteg). July 2011.
[106] Climate Change Committee (2022) 2022 Progress Report to Parliament. June 2022.
[107] Peat C (2016) Busway begins. Article on bus and coach buyer website, 05/04/16.
[108] TfGM (2020) Cross City Bus Package and Busway Programme. Monitoring and Evaluation Early Findings Report. July 2020.
[109] Peat C (2016) Busway begins. Article on bus and coach buyer website, 05/04/16.
[110] TfGM (2020) Cross City Bus Package and Busway Programme. Monitoring and Evaluation Early Findings Report. July 2020.
[111] Nottingham Business School (2016) NET Phase Two Local Economic Evaluation. Report 2: Impact Evaluation Findings. Report by the Economic Strategy Research Bureau (ESRB), Nottingham Business School for Tramlink Nottingham.
[112] Peninsula Rail Task Force (2016) Closing the Gap. November 2016.
[113] DfT (2019) RNEP Rail Network Enhancements Pipeline. Autumn 2019 Schemes Update. October 2019.
[114] Greener Journeys (2016) The value of bus to society.
[115] UTG (2014) Bus priority in practice.
[116] Steer (2022) Continuing COVID Funding Support for Urban Public Transport. Report for Urban Transport Group. February 2022.
[117] Department for Transport (2021) National Travel Survey. Table NTS0703.
[118] Steer (2022) Continuing COVID Funding Support for Urban Public Transport. Report for Urban Transport Group. February 2022.
[119] Johnson D and Mackie P (2014) Buses and the Economy II: Task 4 Report: Bus Use Amongst the Unemployed, Institute for Transport Studies.
[120] Lucas K et al (2019) Inequalities in Mobility and Access in the UK Transport System. Institute of Transport Studies, University of Leeds report for Government Office of Science and Foresight f 2003 Social Exclusion Unit Report.
[121] See original studies at National Institute for Health and Care Research (undated) Enabling active travel and public transport. Webpage.

[122] Peter Brett Associates, Beaufort Research, and Loxley Consultancy. (2018). Evaluation of the Valleys Rail Strengthening: Final Report. Cardiff: Welsh Government. GSR report number 04/2018

[123] Peter Brett Associates, Beaufort Research, and Loxley Consultancy. (2018). Evaluation of the Valleys Rail Strengthening: Final Report. Cardiff: Welsh Government. GSR report number 04/2018

[124] Network Rail (undated) Transforming the Ebbw Vale Line. Webpage.

[125] Peter Brett Associates, Beaufort Research, and Loxley Consultancy. (2018). Evaluation of the Valleys Rail Strengthening: Final Report. Cardiff: Welsh Government. GSR report number 04/2018

[126] Ibid

[127] Graham D J (2007) Agglomeration, Productivity and Transport Investment. Journal of Transport Economics and Policy, Vol. 41, No. 3, pp. 317-343

[128] Swinney P (2016) Building the Northern Powerhouse. Lessons from the Rhine-Ruhr and Randstad. Report for Centre for Cities.

[129] Chatman D and Nolan R (2014) Transit Service, Physical Agglomeration and Productivity in US Metropolitan Areas. Urban Studies. Vol 51, No. 5, pp. 917–937.

[130] Knowles R and Binder A (2017) MediaCityUK at Salford Quays: A sustainable, transit oriented development. Manchester Geographies essay published by the Manchester Geographical Society.

[131] Knowles R and Ferbrache F (2014) An investigation into the economic impact on cities of investment in light rail. Report for UK Tram.

[132] Forth T (2021) Birmingham isn't a big city at peak times. How poor public transport explains the UK's productivity puzzle. Article in City Monitor, 31/01/19, updated 29/07/21.

[133] Forth T (2019) Birmingham is a small city. Web article, Tom Forth website,14/01/19.

[134] Forth T (2019) "Birmingham isn't a big city at peak times": How poor public transport explains UK's productivity puzzle. Article for City Monitor, 31/01/19.

[135] Office for National Statistics (2022) Regional gross domestic product (GDP): all International Territorial Level (ITL) regions.

[136] Office of National Statistics (ONS) (2011) Rural/urban classifications.

[137] McNulty R (2011) Realising the potential of GB rail. Independent report for Department for Transport and Office of Road and Rail. 19/05/11.

[138] RMT (2021) Written Evidence from the National Union of Rail, Maritime and Transport Workers (RMT) to an enquiry into green jobs by the House of Commons Environmental Audit Committee (EAC)

[139] Sloman L and Hopkinson L (2018) Transforming Public transport. Briefing for Friends of the Earth. January 2019.

[140] The present rules for shifting to bus franchising oblige local authorities to invest significant upfront funding and resources. For example, Liverpool City Region spent over £700,000 for a draft assessment of options with additional resources required for a final assessment, plus an independent audit and consultation. Taylor I and Hopkinson L (2020) Making transport fit for the climate emergency. Activists Briefing for Friends of the Earth. Appendix 4 on Bus Franchising.

[141] Including two consultations, legal challenges and hundreds of thousands of pounds developing the business case. GMCA (2022) Greater Manchester Bus Franchising Update. May 2022. The first bus franchising contracts are expected to begin operation from September 2023 as the first part of a three-stage rollout of reregulation.

[142] Greater Manchester Combined Authority (2019) Bus Franchising in Greater Manchester Assessment.

[143] Liverpool City Region (2022) Liverpool City Region bus revolution moves another step closer. Press Release,04/03/22.

[144] Minnis A (2022) Plans for bus reform in Wales. Saved by the Bill or knock-out blow? Article for Senedd Cymru/Welsh Parliament, 07/10/22.
[145] Taylor I and Sloman L (2016) Building a world class bus system for Britain. Report by Transport for Quality of Life for The Foundation for Integrated Transport and Unite, May 2016.
[146] RMT (2021) Railway rolling stock fat cats paid out £1bn dividends during pandemic year. RMT News Release, 07/10/21.
[147] Taylor I and Sloman L (2012) Rebuilding Rail. Report for Aslef, RMT, Unite and TSSA. June 2012.
[148] Ibid.
[149] Department for Transport (2021) Bus Back Better. National Bus Strategy for England. May 2021.
[150] Bray J (2018) Rail Cities UK – Our Vision for Their Future. Report for Urban Transport Group.
[151] Systra (2017) The Transformational Benefits of Investing in Regional Rail. Report for Urban Transport Group.
[152] Sloman L and Tyler J (2019) Public Transport Everywhere with a National Timetable. Transport for Quality of Life Radical 2-Pager No. 6.
[153] 2016/17 data for combined authorities and 2015 data for VVs. Original figure from Sloman L and Hopkinson L (2018) Transforming Public Transport. Briefing for Friends of the Earth
[154] Metz D. (2008) The Myth of Travel Time Saving Transport Reviews 28, 3, pp.321-336; Metz D. (2014) Travel demand: the basics. Local Transport Today, 643, March/April 2014;
[155] Marsden G. et al. (2018) All Change? The future of travel demand and the implications for policy and planning. May 2018. The First Report of the Commission on Travel Demand; and Goodwin P. (2018) How should we use the road traffic forecasts in practice? Local Transport Today, 12 October 2018.
[156] Hickman R. (2015) The problematic application of CBA in transport appraisal. Presentation, Sintropher final workshop, Brussels, 2015.
[157] The three projects were specifically (1): Tram Extension to Lytham; (2): Tram-Train Preston-Blackpool; (3): M6 Heysham Link Road. Hickman R. (2015) The problematic application of CBA in transport appraisal. Presentation, Sintropher final workshop, Brussels, 2015.
[158] Metz D (2022) New thinking on rail appraisal should extend across the modes. Article in LTT. January 2022.
[159] Campaign for Better Transport (2019) The Case for Expanding the Rail Network. January 2019.
[160] House of Commons Transport Committee (2018) Rail infrastructure investment. Fourth Report of Session 2017–19. 19/06/18.
[161] An example of a more transparent approach is multi-criteria analysis used by Transport for London. See Hopkinson L and Sloman L (2019) Getting the Department for Transport on the right track. Transport for Quality of Life Briefing for Friends of the Earth, May 2019.
[162] Welsh Government (2022) Welsh transport appraisal guidance (WelTAG) 2022. Consultation, August 2022.
[163] Rasmussen et al (2022) Carrot or Stick? – Traffic Policy Instruments to Influence Sustainable Transport Behaviour. Danish Journal of Transportation Research – Dansk Tidsskrift for Transportforskning Vol 4. (2022) 16-30.
[164] Sloman L and Hopkinson L (2019) An Eco Levy for driving: cut carbon, clean up toxic air, and make our towns and cities liveable. Transport for Quality of Life Briefing for Friends of the Earth, November 2019.
[165] Ibid.
[166] Campaign for Better Transport (2022) Pay-as-you-drive: The British public's views on vehicle taxation reform. September 2022.
[167] Barry M (2022) Submission to Senedd Climate Change Committee, May 2022.
[168] House of Commons Transport Committee (2022) Road Pricing Report. Feb 2022.

[169] Element Energy (2021) Decarbonising the Scottish Transport Sector. Report for the Scottish Government.
[170] CREDS (2021) The role of energy demand reduction in achieving net zero. October 2021 and additional data from Personal Communication with Dr Christian Brand.
[171] Bennett H and Brandmayr C (2021) Not going the extra mile: driving less to tackle climate change. Report for Green Alliance. 08/12/21.
[172] Anable, J., Brown, L., Docherty, I. and Marsden, G. 2022. Less is more: Changing travel in a post-pandemic society. Centre for Research into Energy Demand Solutions. Oxford, UK. ISBN: 978-1-913299-15-6
[173] Ibid.
[174] Based on the fact that commuting in 2018 and 2019 was around 24–25% of car traffic. NTS0409b Average distance travelled by purpose and main mode: England, from 2002.
[175] Based on the assumption that 37% of survey respondents who expected to work from home more often in the future worked from home 50% of the time. Stantec (2021) Home working socio-economic analysis research findings. 2021. Report for Transport Scotland. Reference in evidence review.
[176] A survey of 465 decision makers for domestic business travel in the UK on the impact of the pandemic on business travel. Lowe G (2018) Business Travel during Covid 19: A survey of UK businesses. An IPSO Mori survey for DfT. August 2021.
[177] This distribution was similar in 2020 during Covid with less than 2 percentage points difference in cumulative percentage.
[178] DfT (2021) National Travel Survey Table NTS0308b: Average distance travelled by trip length and mode: England, from 2002.
[179] DfT (2022) Light Rail and Tram Statistics. Table LRT0107: Average length of journey in kilometres on light rail and trams by system: England – annual from 2011/12.
[180] DfT (2021) National Travel Survey Table NTS0308b: Average distance travelled by trip length and mode: England, from 2002.
[181] DfT (2022) Bus statistics. Table BUS0402a
[182] For comparison average cost per journey was 160p/journey in England outside London in 2018/19 (2020/21 prices).
[183] DfT (2022) Bus statistics. Table BUS0611. Age distributon of the bus fleet used as Public Service Vehicles by metropolitan area status and country, local bus operators only: Great Britain, 2020/21
[184] Zemo Partnership (undated) Ultra low emission bus scheme.
[185] BloombergNEF (2018) Electric Buses in Cities: Driving Towards Cleaner Air and Lower CO2. Report for C40 Cities. April 2018.
[186] Personal Communication with Zemo Partnership.
[187] DfT (2022) Road Length Statistics. Table RDL0201. Road length (kilometres) by road type, region and country in Great Britain.
[188] Estimated using DfT statistics for revenue from passengers and fares divided by the number of passengers for each tram network. DfT (2022) Light rail and tram statistics. Tables LRT0101, LRT0301, LRT0302,
[189]. ORR (2022) Table 1210 Revenue per passenger km and passenger journey.
[190] DfT (2022) Bus Statistics. Tables BUS0701 and BUS0101.
[191] Based on KAM (Manchester) ~800 employees and 43.7m passengers, NET (Nottingham) ~ 300 employees and 18.8m passengers (passenger figures pre covid).
[192] Minio-Paluello M and Markova A (2020) Can an infrastructure stimulus replace UK jobs wiped out by COVID19 crisis? Report for the TUC, June 2020.
[193] Hammett J (2021) A Light Rail Strategy for the UK. A Look Inside. Presentation by UK Tram at the UK Light Rail Summit, Edinburgh, 23/09/21.

[194] Hammond J (2022) Personal Communication by videocall with Managing Director of UK Tram, August 2022.
[195] Barrow K (2014) Low-cost light rail: what can we learn from Besançon? Article in Rail Journal, 02/09/14.
[196] Ibid.
[197] Nexus (undated) New train fleet. Webpage.
[198] West Midlands Combined Authority (2019) West Midlands Metro orders 21 new trams for rapidly expanding network. News release, 09/10/19.
[199] For year ending March 2022. Department for Transport (2022) Quarterly Bus Statistics. 28/06/22.
[200] Notably Brighton, Bristol, Southampton and Reading. A number of factors contributing to this successs include a buoyant economy, good bus company management, effective partnership with the local authority, simple fares, constrained parking, and extensive bus priority measures. Steer (2022) Continuing COVID Funding Support for Urban Public Transport. Report for Urban Transport Group. February 2022.
[201] Department for Transport (DfT) (2022) Transport Statistics Tables BUS0108 and LTR0101 and ORR Table 1210
[202] NTS0303 and TSGB0101. Note that the distance statistic includes taxis.
[203] In 2020/21, government funding for the operation of the railway increased by £10.4bn to £16.9bn. ORR (2021) Rail industry finance (UK) 2020-21. 30/11/21
[204] Around £2bn has been provided to support local bus and tram services in England outside London during Covid through the Covid Bus Services Support Grant (CBSSG). A history of the various tranches of funding can be found in Steer (2022) Continuing COVID Funding Support for Urban Public Transport. Report for Urban Transport Group. February 2022.
[205] Ibid.
[206] Ibid
[207] Ibid
[208] Department for Transport (2022) Transport Expenditure. Table TSGB1302: UK Public Expenditure on Transport by Country and Spending Authority: from 2005/06
[209] Ibid.
[210] Huseyin D (2022) LTA chiefs told BSIP funding will be more than halved to £1.4bn. Article in LTT, 31/01/22.
[211] CPT (2021) Analysis reveals billions of pounds shortfall in National Bus Strategy plans. News article, 25/11/21.
[212] Railway Industry Association (2021) RIA asks government to publish Rail Network Enhancements Pipeline urgently, as two year milestone is passed. News release, 21/10/21.
[213] Topham G (2021) 'Back to the bad old days': swingeing rail cuts set alarm bells ringing. Article in The Guardian, 05/12/21.
[214] Topham G (2022) Network Rail's proposed cuts put passengers at risk, say unions. Article in The Guardian, 04/05/22.
[215] Department for Transport (2022) Bus Statistics: Table BUS0107. Figures for 2018/19
[216] Ekosgen (2010). Employment in sustainable transport. Report for PTEG, the Campaign for Better Transport, Sustrans. June 2010.
[217] Department for Transport (2022) Bus Statistics. Table BUS0701 Staff employed by local bus operators1, 2: Great Britain, annual from 2004/05
[218] 68% in infrastructure, 25% as train operators, and the remainder on rolling stock, freight operation and other. Williams Rail Review (2019). The rail sector in numbers. March 2019.
[219] Includes 123,400 in rail system, 317,000 in rail supply, 22,400 in station retail and support and 247,200 in induced impacts. Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.

[220] Ibid.
[221] Taylor I (2021) Every Village Every Hour. Transport for Quality of Life report for CPRE.
[222] It should be noted that these stages do not and need not directly align with the Governance for Railway Investment Projects (GRIP) stages used by Network Rail. DfT (2018) Rail Network Enhancements Pipeline A New Approach for Rail Enhancements. March 2018.
[223] Rail Industry Association (2019) RIA launches 'Rail Enhancements Clock', showing the days since the government said it would publish its list of upgrade projects. Website checked December 2022.
[224] Ford R (2020) NR enhancements in disarray. Article in Modern Railways 24/12/20
[225] Eastern, North West & Central, Southern and Wales & Western. Note Scotland's railway is now under public ownership after being nationalised in April 2022.
[226] Hakimian R (2022) One third of rail schemes in enhancements pipeline have not progressed. New Civil Engineer, 21/10/22.
[227] Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021.
[228] Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020.
[229] Rail Delivery Group (2021) Catalysing a green recovery: Creating jobs by building Britain's net zero railway. October 2020.
[230] Systra (2017) The transformational benefits of investment in regional rail. Report for Urban Transport Group. 01/10/17.
[231] Campaign for Better Transport (2019) The case for expanding the rail network. Report for RMT. January 2019.
[232] Oxford Economics (2021) The economic contribution of UK rail. Report for the Rail Industry Association. September 2021
[233] which in turn are on the Fiscal Remit, the government's long term funding guideline for public capital expenditure. National Infrastructure Commission (2018) National Infrastructure Assessment. July 2018.
[234] It is consistent with the NIC Rail Needs Assessment for the Midlands and the North which assumed 3 scenarios: a baseline, 25% uplift and 50% uplift.
[235] DfT (2022) Transport Expenditure. Table TSGB1302. Outturn prices for 2018/19 includes capital and operating costs.
[236] Systra (2017) The transformational benefits of investment in regional rail Report for Urban Transport Group.
[237] Campaign for Better Transport (2019) The case for expanding the rail network. Report for RMT.
[238] Ibid
[239] Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020.
[240] National Audit Office (2021) A Financial Review of the Rail Industry. SESSION 2019–2021, 26 APRIL 2021, HC 1373
[241] it is anticipated this would be spread over a number of funding Control Periods, frontloaded with an initial cost outlay. The UK has around 15,400 single track km (STK) of unelectrified railway track. The capital costs of electrification are around 1m-£2.5m/STK (2020 prices) which are based on historical outturn figures. Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020.
[242] Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020.
[243] Ibid.

[244] The original analysis was based on previous BEIS carbon values which more than doubled when updated in Sep 2021

[245] Transport Scotland (2020) Rail Services Decarbonisation Action Plan July 2020.

[246] Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020

[247] Although there are no costs given. Transport Scotland (2020) Rail Services Decarbonisation Action Plan July 2020.

[248] Rail Delivery Group (2021) Catalysing a green recovery. October 2021.

[249] Network Rail (2020) Traction Decarbonisation Network Strategy. Interim Programme Business Case. July 2020.

[250] Rail Delivery Group (2021) Catalysing a green recovery: Creating jobs by building Britain's net zero railway. October 2021.

[251] National Infrastructure Commission (2018) National Infrastructure Assessment. July 2018.

[252] Ibid. Table 7.1

[253] Steer Davis Gleave (2018) Urban Transport Analysis: Capacity and Cost. Report for NIC. July 2018.

[254] Ibid