



RAIL NEEDS ASSESSMENT FOR THE MIDLANDS AND THE NORTH

Final report

NATIONAL
INFRASTRUCTURE
COMMISSION

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The Commission

The Commission's remit

The Commission provides the government with impartial, expert advice on major long term infrastructure challenges. Its remit covers all sectors of economic infrastructure: energy, transport, water and wastewater (drainage and sewerage), waste, flood risk management and digital communications. While the Commission considers the potential interactions between its infrastructure recommendations and housing supply, housing itself is not in its remit. Also, out of the scope of the Commission are social infrastructure, such as schools, hospitals or prisons, agriculture, and land use.

The Commission's objectives are to support sustainable economic growth across all regions of the UK, improve competitiveness, and improve quality of life.

The Commission delivers the following core pieces of work:

- a National Infrastructure Assessment once in every Parliament, setting out the Commission's assessment of long term infrastructure needs with recommendations to the government
- specific studies on pressing infrastructure challenges as set by the government, considering the views of the Commission and stakeholders, including recommendations to government
- an Annual Monitoring Report, taking stock of the government's progress in areas where it has committed to taking forward recommendations of the Commission.

While the Commission is required to carry out its work in accordance with the remit and the terms of reference for specific studies, in all other respects the Commission has complete discretion to determine independently its work programme, methodologies and recommendations, as well as the content of its reports and public statements.

The Commission's binding fiscal remit requires it to demonstrate that all its recommendations for economic infrastructure are consistent with, and set out how they can be accommodated within, gross public investment in economic infrastructure of between 1.0 per cent and 1.2 per cent of GDP each year between 2020 and 2050. The Commission's reports must also include a transparent assessment of the impact on costs to businesses, consumers, government, public bodies and other end users of infrastructure that would arise from implementing the recommendations.

When making its recommendations, the Commission is required to consider both the role of the economic regulators in regulating infrastructure providers, and the government's legal obligations, such as carbon reduction targets or making assessments of environmental impacts. The Commission's remit letter also states that the Commission must ensure its recommendations do not reopen decision making processes where programmes and work have been decided by the government or will be decided in the immediate future.

The Commission's remit extends to economic infrastructure within the UK government's competence and will evolve in line with devolution settlements. This means the Commission has a role in relation to non-devolved UK government infrastructure responsibilities in Scotland, Wales and Northern Ireland (and all sectors in England).

The Infrastructure and Projects Authority (IPA), a separate body, is responsible for ensuring the long term planning carried out by the Commission is translated into successful project delivery, once the plans have been endorsed by government.

The Commission's members

Sir John Armitt CBE (Chair) published an independent review on long term infrastructure planning in the UK in September 2013, which resulted in the National Infrastructure Commission. Sir John is the Chair of National Express Group and the City & Guilds Group. He also sits on the boards of the Berkeley Group and Expo 2020.

Professor Sir Tim Besley CBE is School Professor of Economics and Political Science and W. Arthur Lewis Professor of Development Economics at the LSE. He served as an external member of the Bank of England Monetary Policy Committee from 2006 to 2009.

Neale Coleman CBE is a co-founder of Blackstock Partnership. He worked at the Greater London Authority from 2000-2015 leading the Mayor's work on London's Olympic bid, the delivery of the games, and their regeneration legacy. Neale has also served as Policy Director for the Labour Party.

Professor David Fisk CB is the Director of the Laing O'Rourke Centre for Systems Engineering and Innovation Research at Imperial College London. He has served as Chief Scientist across several government departments including those for environment and transport, and as a member of the Gas and Electricity Markets Authority.

Andy Green CBE holds several Chair, Non-Executive Director and advisory roles, linked by his passion for how technology transforms business and our daily lives. He chairs Lowell, a major European credit management company, and has served as Chair of the Digital Catapult, an initiative to help grow the UK's digital economy.

Professor Sadie Morgan OBE is a founding director of the Stirling Prize winning architectural practice dRMM. She is also Chair of the Independent Design Panel for High Speed Two and one of the Mayor of London's Design Advocates. She sits on the boards of the Major Projects Association and Homes England.

Julia Prescott holds several board and advisory roles. She is a co-founder and Chief Strategy Officer of Meridiam and sits on the Executive Committee of Meridiam SAS. She has been involved in long term infrastructure development and investment in the UK, Europe, North America and Africa. She is an Honorary Professor at the Bartlett School of Construction and Project Management, University College London. Since 2019 she has sat on the board of the Port of Tyne.

Bridget Rosewell CBE is a director, policy maker and economist. She served as Chief Economic Adviser to the Greater London Authority from 2002 to 2012 and worked extensively on infrastructure business cases. She has served as a Non-executive Director of Network Rail and Non-executive Chair of the Driver and Vehicle Standards Agency. She is currently Chair of the Atom Bank and the M6 Toll Road.

Foreword

The forthcoming Integrated Rail Plan takes place against the disrupting impact of the Covid-19 pandemic and a period of economic turbulence. Government will need to make crucial choices about rail investment in a climate of uncertainty. While old patterns of work and mobility may not return, our judgement is that it is unlikely that the current circumstances will put an end to the desire or need to travel within and between our towns and cities over the longer term.

Indeed, at this critical juncture, we must harness every benefit that infrastructure investment can bring. The government's Integrated Rail Plan represents a golden opportunity to bring clarity, stability and pragmatism to future rail planning. Strategic and long term investment in rail is necessary both to ensure passengers have a service fit for the long term, and as part of a wider economic strategy to rebalance regional growth and maintain national competitiveness.

The Plan also presents an opportunity to avoid the mistakes of the past. It is better to under promise and overdeliver than for rail schemes to be cancelled or cut back because costs have risen. The Integrated Rail Plan should provide a strong commitment to schemes that are sufficiently developed and costed. If more money becomes available, additional schemes or enhancements could be included as part of an adaptive approach.

We listened to more than 3,000 people in the Midlands and the North, with more than 21 hours of roundtables and 45 hours of virtual briefings from stakeholders, to inform our report, and while the railway needs to deliver what people care about, not everyone will be able to get the exact scheme they want or to the timescale they'd prefer. The Commission's assessment of rail needs in the Midlands and the North sets out a range of options to maximise and accelerate benefits for these communities.

The work for this report was undertaken at pace between July and November and has necessarily relied on the evidence that others have produced, so is a high level strategic analysis of options. The Commission team has worked enormously hard to pull together and analyse this evidence in quick time and all working at a distance through the pandemic. We are extremely grateful to them all and for the help of the work of secondees from Network Rail, Office of Rail and Road and the Department for Transport.

This report sets out three illustrative budget options and assesses the merits offered by various packages of interventions. Although it is for government to decide on the appropriate level of investment in rail, the evidence suggests that focusing on upgrades alone, the option with the lowest cost, would be insufficient to make real progress towards 'levelling up' our economic geography.

Even in the highest budget option we have considered, there is not enough money for every rail scheme proposed. Our analysis suggests that prioritising regional links, for example from Manchester to Liverpool and Leeds or Birmingham to Nottingham and Derby, has the potential to deliver the highest benefits for cities in the Midlands and the North.

While major projects will be vital to enhance connections between cities, where rail can be most effective, it could take many years for the economic impact of a large programme of rail investment to be fully felt. The Commission's findings should be considered alongside its previous recommendations for further devolution, to give local leaders the powers and funding they need to reshape transport within cities – strategies that could be realised much more quickly.

Our Victorian heritage once made the UK the envy of the world, but today our rail performance lags behind that of many of our European neighbours. Ultimately it will be for government to decide where public resources should be prioritised, but this report offers an evidence-based review of some of the options currently available and the choices that need to be made.

In turn, it is our hope that the government's forthcoming Integrated Rail Plan paves the way for a better-connected, more prosperous Britain, where economic success is shared more evenly across the country.



Sir John Armitt
Chair



Bridget Rosewell
Commissioner

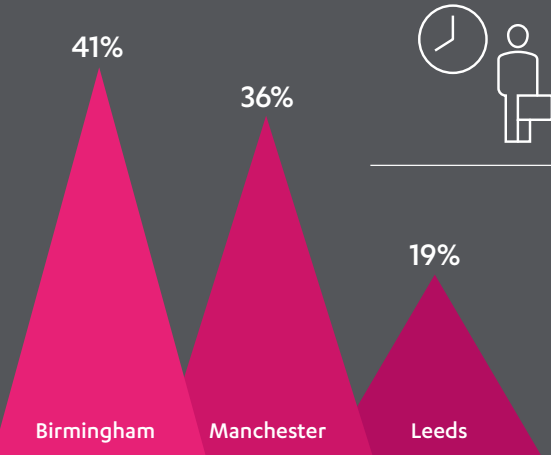


Andy Green
Commissioner

A REALISTIC PLAN AND AN ADAPTIVE APPROACH

Rail use is growing in the Midlands and the North

Increase in rail passenger arrivals during the AM peak, 2010 to 2019ⁱ



But rail services are lagging behind



Major rail projects have traditionally seen big increases in cost

1 in 3

major rail projects exceed their initial cost estimates by at least 50%ⁱⁱ



Government needs to take an adaptive approach, setting a stable core pipeline of investment, and taking decisions to enhance or add further schemes if:

- The core pipeline is on time and budget
- Costs and benefits of new schemes are more certain
- Other investments are being made, e.g. in skills, development and local transport.

Original government cost estimate for HS2 – equivalent to **£44.5bn**ⁱⁱⁱ

Current estimated total costs for HS2 **£80.7-87.7bn**^{iv}

A core pipeline of well developed, affordable investments

Options to enhance or add further schemes later

The Commission spoke to a wide range of people to inform this assessment:

Social research

3000 people



12 online focus groups



More than

21 HOURS of roundtables



2

calls for evidence



More than

45 HOURS of virtual briefings from stakeholders

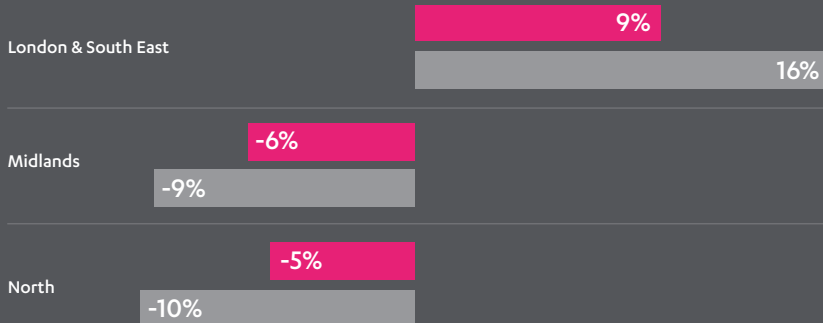
Rail is one of many factors that needs to be addressed to help 'level up' the Midlands and the North



Investment is needed in skills, as well as other areas such as urban transport and development

Skill level and earnings by region, 2019^v

- Percent of population with a degree or equivalent qualifications or above - percentage difference from the England average
- Hourly pay for all employees - percentage difference from the England average



Prioritising regional links is likely to deliver higher benefits for the Midlands and the North

Comparison of core packages against headline criteria^{vi}

Prioritising regional links (+25%)

Prioritising long distance links (+25%)

Productivity improvements (more capacity)



£30-51bn

£25-43bn

Connectivity improvements (faster journeys)



9-15%

10-11%

Connecting people to city services (retail, leisure etc)



£11-26bn

£10-22bn

A successful Integrated Rail Plan should:



Start with a realistic plan of core investments



Add further options subject to success



Be agreed with local stakeholders



Contribute to net zero and environmental net gain



Accelerate schemes and deliver benefits in the shorter term.

Sources:

- ⁱ Commission calculations using Department for Transport (2019), Rail Statistics, Table RAI0201, city centre peak passenger arrivals by rail on a typical autumn weekday
- ⁱⁱ Oxford Global Projects (2020), Rail Needs Assessment: Reference Class Forecast
- ⁱⁱⁱ Converted to 2019 prices. House of Commons Library (2019), High Speed 2: the business case, costs and spending
- ^{iv} Douglas Oakervee (2020), Oakervee Review of HS2
- ^v Qualification data from ONS Annual Population survey (2020). Earnings data from ONS Annual Survey of Hours and Earnings (2020). Both accessed from Nomisweb. London & South East includes London, the South East and the East of England, the North includes the North East, North West, and Yorkshire and the Humber, and the Midlands includes the East and West Midlands
- ^{vi} Figures are undiscounted. Undiscounted figures represent 60 years of benefits at a constant annual rate.

In brief

Rail has the potential to contribute to economic transformation in the Midlands and the North. But to give it the best chance of doing so, rail investment must be concentrated and at scale, and form part of a wider economic strategy including skills, development and urban transport. Government should use an adaptive approach and commit to an affordable, deliverable, fully costed pipeline of core investments to improve rail in the Midlands and the North. If further funding is available there could then be options to either enhance these schemes or add further schemes later.

To support government's decision, the Commission has developed a menu of options for a programme of rail investments in the Midlands and the North, using three different illustrative budget options (baseline, plus 25 per cent and plus 50 per cent):

- focussing on upgrades (baseline budget only)
- prioritising regional links
- prioritising long distance links.

The package focussing on upgrades is unlikely to be sufficient to support levelling up. Prioritising regional links appears to have the highest potential economic benefits overall for cities in the Midlands and the North and would improve many of the currently poorest services.

Even in the 'plus 50 per cent' budget, there is not enough money for all the proposed major rail schemes in the Midlands and the North, which total up to £185 billion.¹ While there is an argument for increasing the budget to plus 50 per cent, government would need to balance this against spend on other important aspects of economic infrastructure. The packages in the 'plus 50 per cent' budget have higher potential benefits, but higher risks. This level of investment would be a strategic bet.

As part of an adaptive approach, the government could sensibly begin by committing to a core set of programmes. If further funding is available, government could add additional schemes, or enhance existing schemes if:

- the core pipeline is delivering on time and to budget
- the costs and benefits of additional schemes are well developed
- complementary investments are being made that increase the likelihood of major rail investments delivering benefits.

Government should also consider ways of accelerating the benefits of the Plan to deliver benefits faster for passengers in the North and Midlands.

Executive summary

The Integrated Rail Plan for the Midlands and the North is an opportunity for government to bring clarity, stability and pragmatism to future rail planning, and avoid the mistakes of the past. Government should commit to a core pipeline of stable, affordable investments, as part of a wider economic strategy for levelling up. The Commission's analysis shows that prioritising regional links is likely to deliver the highest potential economic benefits to the Midlands and the North.

Rail has the potential to contribute to economic transformation in the Midlands and the North. To give rail the best chance of doing so, investment must be concentrated and at scale, and form part of a wider economic strategy including skills, development and urban transport. This includes giving city leaders the powers and funding to develop long term strategies for improving urban transport, which can bring benefits faster than major intercity rail.

To support government's decision, the Commission has developed a menu of options for a programme of rail investments in the Midlands and the North, using three different illustrative budget options (baseline, plus 25 per cent and plus 50 per cent):

- focussing on upgrades (baseline budget only)
- prioritising regional links
- prioritising long distance links.

The package focussing on upgrades is unlikely to be sufficient to support levelling up. Prioritising regional links appears to have the highest potential economic benefits overall for cities in the Midlands and the North.

Government should commit to an affordable, deliverable, fully costed pipeline of core investments to improve rail in the Midlands and the North. If further funding is available there could then be options to either enhance these schemes or add further schemes later if:

- it is clear the pipeline of core schemes is delivering on time and within the budget
- additional schemes or enhancements are sufficiently developed with robust cost ranges
- complementary investments are being made.

Government must also consider ways to ensure the Plan endures and accelerate the benefits to local communities and passengers in the North and Midlands.

Rail and economic outcomes in the Midlands and the North

Rail in the Midlands and the North needs improvement

The Midlands and the North are home to seven out of ten of England's largest cities, many of which are not far apart. In recent decades, cities such as Manchester and Leeds have experienced rapid population growth in their city centres, mainly driven by young professionals. Nevertheless, the Midlands and the North lag behind London and the South East in terms of productivity.

Improvements to rail services have long been proposed to support and boost economic growth in the Midlands and the North. The number of people commuting by rail into cities in the Midlands and the North was growing fast before Covid-19. Between 2010 and 2019, passenger arrivals by rail during the morning peak increased 36 per cent in Manchester, 41 per cent in Birmingham and 19 per cent in Leeds. However, capacity has not been able to keep up. Trains are often crowded, with peak morning trains operating over capacity in Manchester, Birmingham and Leeds in particular.

Despite the growth in the number of people commuting into city centres, rail journeys between major cities in the Midlands and the North can be slow, and the service unreliable. Trains between Reading and London run at almost double the speed of trains between Manchester and Leeds, which have an average speed of 48 miles per hour. These problems need to be addressed to enable growth in cities in the Midlands and the North and the surrounding towns.

The Commission's social research, based on a survey of 3,000 people in the Midlands and the North, showed that participants were doubtful that new lines would or could be delivered.

Rail can also improve economic outcomes

The government has made clear that the current position on regional economic disparities is not acceptable and that it has a strategic objective to level-up prosperity across the UK. The Integrated Rail Plan will need to set out a programme of rail investments that has the best chance of contributing to this strategic objective, within a budget that is affordable.

There is a strategic case for investing more in rail as a necessary part of a wider regional growth strategy. While infrastructure investment alone is not sufficient to change the UK's economic geography, rail can provide a significant contribution to any package of measures aiming to drive transformative change by improving connectivity between cities. Improving rail in the Midlands and the North will also improve the entire UK rail network.

Rail performs a unique function – it can move large numbers of people in and out of congested city centres, where there isn't enough space for everyone to use cars and air pollution is a concern. Rail also offers fast journeys between city centres. In dense, successful city centres, lack of rail capacity can be a constraint to further growth. Good rail connections into and between cities tend to be present in comparable groups of cities in other countries.² And none of England's economic comparators, with similar geography, have poor rail accessibility between cities.³

The government should focus rail investment on places where it can have the most impact, rather than spreading investment too thinly. Good rail connections can support economic growth by:

- **increasing the density of clusters of people and businesses**, which in turn increases the productivity of firms and workers and thereby supports growth

- **facilitating business between cities**, as faster, more frequent rail connections (improved ‘connectivity’) increase options for supply chains and markets for firms in each city, supporting the regions’ local industrial strategies
- **making places more attractive to live and work in**, by facilitating access to a wider range of places, businesses and services (‘amenities’)
- **acting as an anchor for commercial investment**, by signalling that an area is worth investing in.

The benefits of rail investment depend on certain assumptions

The benefits of rail, as of all long term investments, are not certain. The government will have to consider the following issues to decide whether investing in rail is a good idea, including:

- that the economy will remain focussed on city regions following the Covid-19 crisis or other shocks
- that other technologies, for example digital communication, do not replace rail
- that complementary policies in the Midlands and the North are delivered and work to raise productivity.

These judgements are all set out in more detail in chapter 2.

A core pipeline and an adaptive approach

Large scale rail investment has high costs, and the benefits for economic transformation are not certain, making it a strategic bet. Rail has the best chance of supporting economic transformation if complementary policies are in place. An adaptive approach can help reduce the risks of such a strategic bet, setting a stable core pipeline of investment but enabling further decisions to be made when costs and benefits are more certain.

The Plan should not overpromise

The Integrated Rail Plan presents an opportunity for this government to break the cycle of committing to major rail schemes, underestimating the costs and ultimately having to reopen plans or find additional funding. Rail has a history of overspends. For example, the cost of electrification of the Great Western railway grew by £2.4 billion between 2013 and 2016.⁴ As set out in the Oakervee Review, the total costs of HS2 were estimated at £80.7-87.7 billion, against a budget equivalent to £62.4 billion.⁵ This suggests that government should begin by focussing on a core set of investments and leaving some decisions on possible enhancements or additional schemes for later.

Making a long term plan and sticking to it are two different challenges. For the rail investments to be delivered to budget and on time, there need to be tight cost controls and rigorous governance. The Infrastructure and Projects Authority should assure and monitor the performance of the Plan at regular intervals to ensure it remains on track.

The Plan should maximise the benefits that rail can deliver

To give the Plan the best chance of supporting growth in the Midlands and the North, it must form part of a wider regional growth strategy, large parts of which should be delivered by and in city regions. To contribute successfully to a wider strategy of tackling regional variability, rail investment should focus on journeys both between cities and into city centres from their surrounding areas. Economic transformation in the Midlands and the North will only occur once the region's major cities become more productive. But successful cities can also improve the prospects for towns in the vicinity: most successful towns in England are close to successful cities.

Investing in complementary policies such as skills, urban transport, and devolving powers and budgets to locally accountable leaders could both deliver economic benefits to the Midlands and the North in the short to medium term and help maximise the benefits of rail investments in the longer term. The Commission has separately estimated that more than £40 billion is required between now and 2040 to fund major transit schemes in the fastest growing, most congested cities, as well as increased multi-year settlements for transport in all cities.⁶

An adaptive approach can address these challenges

The Integrated Rail Plan should adopt a long term, adaptive framework for planning. If the government wants to commit to higher levels of investment in rail it should initially set out a firm commitment to a pipeline of affordable core investments, with a clear funding profile and rigorous costings (using the upper end of cost ranges), that should not be reopened.

If further funding is available and can be committed, there could then be options to either enhance these schemes or add further schemes later, subject to certain conditions:

- it is clear the pipeline of core schemes is delivering on time and within the budget
- enhancements and new rail schemes are sufficiently developed with robust cost ranges
- complementary investments, for example in skills, development and urban transport, are being made that increase the likelihood of major rail investments contributing to transformation.

Assessing options for programmes of rail investment

It is for the government to decide how much investment in rail is affordable, given competing demands. While there is a strategic case for investing more in rail, the Commission's view is that this should not come at the expense of investment in other important and complementary aspects of economic infrastructure, including local urban transport projects.

The Commission has assessed the existing information on the capital costs of different proposed rail schemes and used this to develop potential options for packages of rail investments that fall within three illustrative budgets for rail spending in the Midlands and the North:

- **baseline (£86 billion)** – a fiscal envelope consistent with the rail spending in the Midlands and the North proposed in the National Infrastructure Assessment's fiscal remit table (in 2019/20 prices)⁷
- **plus 25 per cent (£108 billion)** – a fiscal envelope that assumes the money available for rail spending is 25 per cent higher than in the baseline scenario

- **plus 50 per cent (£129 billion)** – a fiscal envelope that assumes the money available for rail spending is 50 per cent higher than in the baseline scenario.

The ‘plus 50 per cent’ budget is still not enough to deliver all the proposed schemes in the Midlands and the North. The current total estimated capital cost of HS2, Northern Powerhouse Rail, the Transpennine Route Upgrade, Midlands Engine Rail and other interventions such as decarbonisation and digital signalling is in the region of £140-185 billion in 2019-20 prices between 2020 and 2045.⁸

These budgets include the costs of HS2, Phase 1 and 2a, as these phases are relevant to rail spending in the Midlands and the North. This is also in line with the Commission’s fiscal remit, which includes the expected cost of projects government has committed to taking forward. However, as Phases 1 and 2a were not in scope of the Assessment, their marginal benefits have not been evaluated as part of the Commission’s analysis. Therefore, to provide a fair comparison to the potential benefits of the packages, the costs of packages have been provided with Phases 1 and 2a excluded.

Evidence

The volume and complexity of data and the differing approaches across schemes means that completing the analytical programme of work has been challenging. The costs and benefits of many of the schemes in scope have changed during the Assessment, and the costs remain wide ranges. In part, this is because a significant number of schemes are still at a relatively early stage of development – some require refining of complex station or junction proposals, while others are still considering many possible options for routes and stations. The analysis informing this Assessment was finalised prior to the Spending Review and does not take into account any Spending Review announcements.

Government should ensure that costs and benefits continue to be refined as part of the Integrated Rail Plan to better develop the evidence base, if it is to avoid past pitfalls. This includes avoiding too early a judgment on realistic costs.

Options for programmes of rail investment

The Commission has developed five packages of rail investment in the Midlands and the North within the three illustrative budget options. The packages are designed to show the choices and trade-offs between strategic objectives. With the limited time available for the study, detailed options of schemes have not been examined in detail. Further planning and design work will be required as part of the Integrated Rail Plan process.

The packages are:

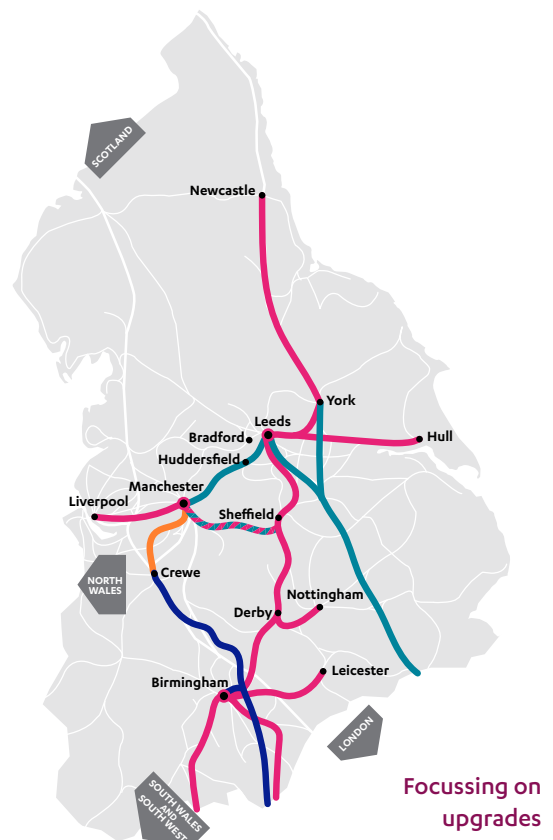
- **Focussing on upgrades:** by completing the western leg of HS2 Phase 2b and upgrading key existing lines, including the East Coast Main Line and Midland Main Line, in line with the **baseline budget** (capital costs estimated at £44 billion)⁹
- **Prioritising regional links:**
 - by delivering major upgrades (including some new line) on the Liverpool, Manchester, Leeds corridor, addressing congestion between Leeds and York and improving links to Bradford, a new high speed line from Birmingham to the East Midlands providing direct services to Nottingham, upgrades to the Midland Main Line and East Coast Main Line, improving links to Birmingham Airport and enhancements across the Midlands through the Midlands Rail Hub, in line with the **plus 25 per cent budget** (capital costs estimated at £69 billion); or

- by building new lines across the Liverpool, Manchester, Leeds corridor which also serve Bradford, increasing capacity between Leeds and Newcastle and upgrading the route from Manchester to Sheffield, delivering a new line into Leeds, providing improved journey times to/from Sheffield, and upgrades to the Erewash Valley route, as well as the Midland Main Line, building a new high speed line from Birmingham to the East Midlands, improving links to Birmingham Airport and enhancements across the Midlands through the Midlands Rail Hub, in line with the **plus 50 per cent budget** (capital costs estimated at £92 billion)
- **Prioritising long distance links:**
 - by focussing on delivering the full HS2 Phase 2b network to improve long distance connections, completing the Transpennine Route Upgrade between Leeds and Manchester, and Midlands Connect schemes that utilise the eastern leg of HS2, in line with the **plus 25 per cent budget** (capital costs estimated at £68 billion); or
 - by delivering the full HS2 Phase 2b network and the other schemes in the ‘plus 25 per cent’ package, as well as adding additional tracks to the Transpennine Route Upgrade between York and Manchester, upgrading connections and capacity from York to Newcastle, and Manchester to Liverpool, and building the Midlands Rail Hub to improve capacity into and across the Midlands, in line with the **plus 50 per cent budget** (capital costs at £90 billion)

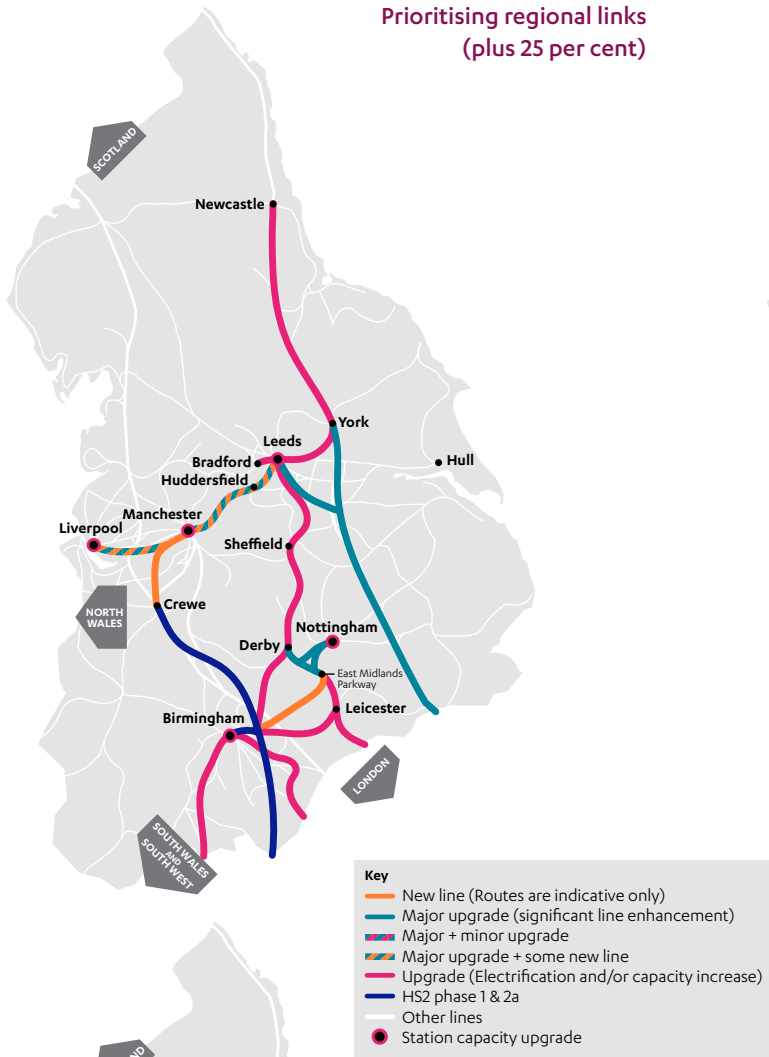
Across each of the packages, the Commission has included at least £15 billion for ongoing transformation programmes for decarbonisation and digital signalling, as well as ‘early wins’, as it is important that these are considered as part of the Plan, and funding for them included (see chapter 6). This could include schemes such as the Northern Powerhouse Rail proposal between Leeds and Hull, or other interventions complementary to planned works, where these have not been covered in a package.

Schemes across the various packages

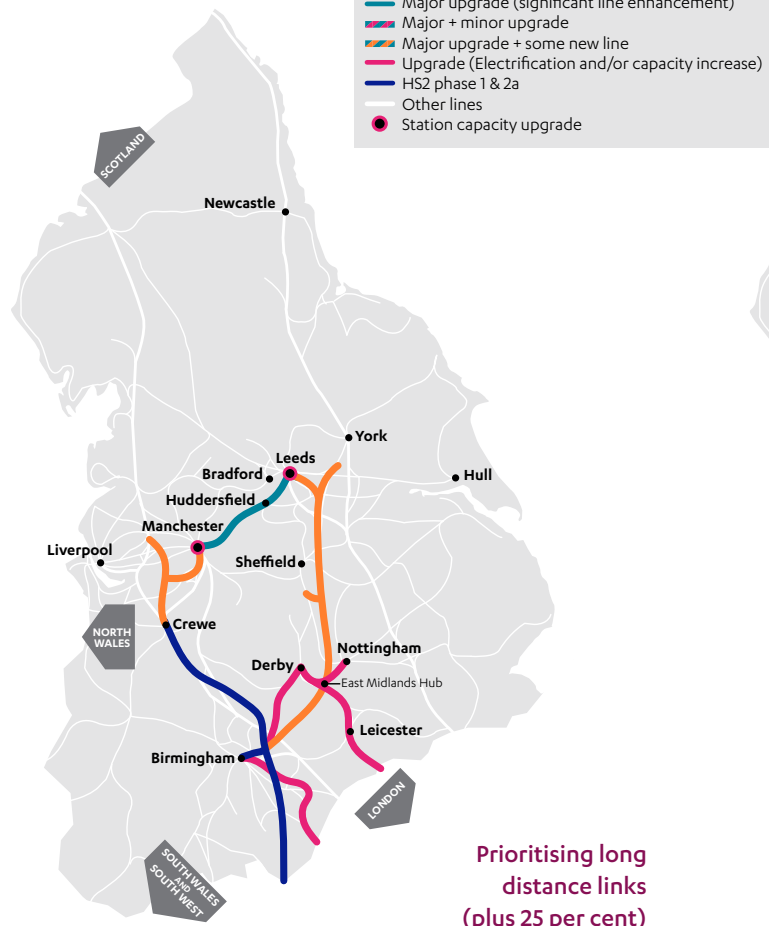
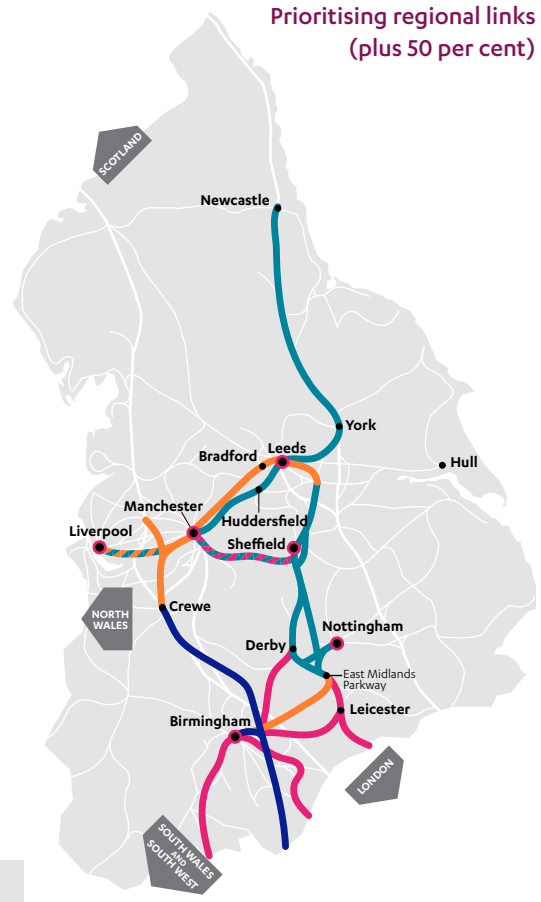
Infrastructure interventions are shown indicatively, not service origins or destinations. Not all stations shown. Full size versions of each map are found in the relevant annex.



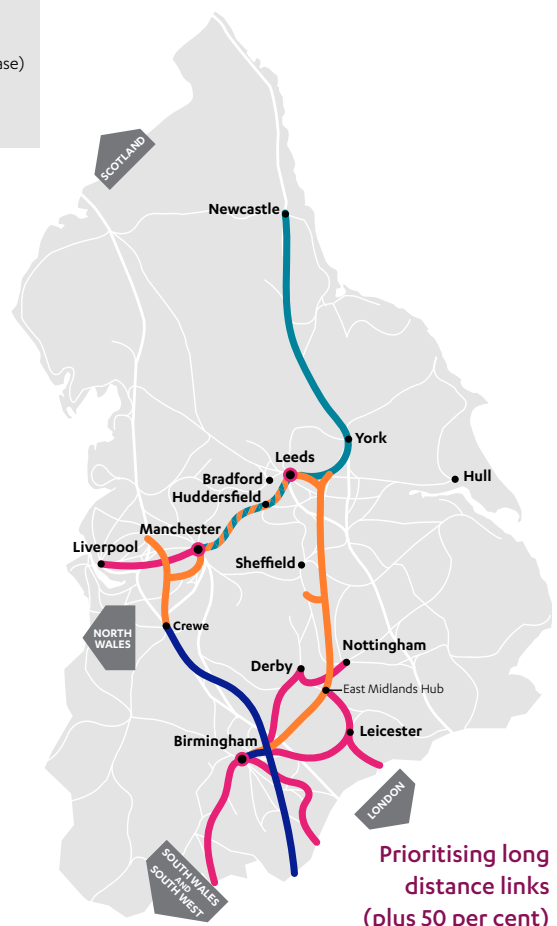
Prioritising regional links
(plus 25 per cent)



Prioritising regional links
(plus 50 per cent)



Prioritising long
distance links
(plus 25 per cent)



Prioritising long
distance links
(plus 50 per cent)

Benefits of packages

The Commission has assessed the benefits of the five packages for economic growth and competitiveness, and for sustainability and quality of life. The Commission used a multi-criteria approach, which was set out in detail in the interim report. Figure 0.1 sets out the headline assessment of the benefits and impacts of the packages that the Commission has quantified, alongside a central estimate for costs (see chapter 4).¹⁰ The government's budget for the Integrated Rail Plan will need to reflect the range of potential costs.

Figure 0.1: Headline benefits and impacts across packages¹¹

Package	Economic growth and competitiveness		Sustainability and quality of life	
	Improvements to connectivity from faster journeys	Improvements to productivity in city centres, undiscounted	Benefits from connecting people to city services, undiscounted	Environmental impact (combined quantified partial valuation of the loss of natural capital and monetised lifecycle carbon impact)
Focus on upgrades	7%-9%	£18-30bn	£7-15bn	£0.3 to £0.2bn
Plus 25 per cent				
Regional links	9%-15%	£30-51bn	£11-26bn	£0.7 to £0.5bn
Long distance links	10%-11%	£25-43bn	£10-22bn	£0.7 to £0.5bn
Plus 50 per cent				
Regional links	11%-19%	£41-71bn	£16-38bn	£1bn to £0.8bn
Long distance links	11%-12%	£33-58bn	£13-31bn	£1bn to £0.7bn

As shown in figure 0.1, the packages prioritising regional links are likely to provide the highest combined benefits. At the 'plus 25 per cent' budget, the package prioritising regional links has the highest potential improvements for productivity overall in cities in the Midlands and the North, and may also provide higher trade benefits to businesses from faster and more frequent connections between cities (potentially up to a 15 per cent improvement compared to 11 per cent for the 'plus 25 per cent' package prioritising long distance links). At the 'plus 50 per cent' budget, the package prioritising regional links has the highest potential benefits of all the packages, both in terms of productivity and trade benefits.

The Commission has also considered the potential benefits of the packages for unlocking investment in land around stations, and the potential impact on freight. These are set out in annexes A-C.

The Commission has also looked at the impact of each of the packages on:

- connectivity with Scotland
- connectivity with the rest of the world (via airports)
- disruption.

All these are covered in more detail in chapter 5.

In this Assessment, the Commission has considered how best to deliver the government's commitment to improve rail connectivity in the North and Midlands, rather than whether to do it at all. The Commission's methodology therefore assesses which rail interventions deliver the most potential benefits within a given budget, rather than producing a traditional Benefit Cost Ratio. The numbers in figure 0.1 would only form one part of a traditional Benefit Cost Ratio and should therefore not be interpreted as such. However, with some assumptions, the Commission's analysis suggests the benefits meet or outweigh the costs of the packages.¹² The value for money case is covered in more detail in the modelling annex, published alongside this report. Critically, the Commission's methodology is intended to guide judgements on which rail investments are most likely to deliver economic transformation as part of a wider strategy – it is the cumulative effects of such a strategy, not the direct impact of rail investment alone, that can deliver significant benefits to the Midlands and the North.

Comparison of packages

The significant increase in the cost of many rail schemes since the National Infrastructure Assessment was published two years ago means that the level of funding set out in that Assessment only provides enough funding for upgrades and some new lines, as demonstrated in the package focussing on upgrades. The package focussing on upgrades is unlikely to meet the strategic objective of levelling up in the North and the Midlands.

Although the option focussing on upgrades provides some improvement to the speed and frequency of trains between cities and capacity into city centres, and has the lowest environmental impact, the benefits it delivers are not at scale and would be less likely to trigger long term economic transformation than other packages.

The packages prioritising regional links are more likely to bring higher benefits, overall, to cities in the Midlands and the North and to support the strategic objective of levelling up, because they:

- improve the quality of regional, largely east to west rail links between cities within the Midlands and the North, which are generally inferior to longer distance rail links
- focus on schemes that can provide the biggest potential improvements in productivity across the Midlands and the North
- deliver greater improvements to connectivity for several key cities, including Nottingham, Coventry, Derby, Manchester and Liverpool, while also providing significant improvements to a range of smaller places, such as Crewe, Doncaster, Huddersfield and Warrington, and potentially Hull under the electrification programme
- address the biggest problems of existing poor capacity and connectivity, with significant further capacity added to Birmingham, Manchester and around Leeds, particularly on the route to York, and improved connectivity between and within the West and East Midlands, for example improving journey times between Birmingham and Nottingham
- focus improvements on the journeys that people are most likely to take – into cities from the surrounding area, rather than into London (for example, in 2018-19, 60 per cent of rail journeys in Yorkshire and the Humber were between places in the region, while only 10 per cent were to London).

As part of an adaptive approach, the government could sensibly begin by committing to a core set of programmes. Some elements of the major rail projects proposed for the Midlands and the North, including the Transpennine Route Upgrade, Midland Main Line electrification and some Midlands Engine Rail schemes, present opportunities for earlier delivery as work is underway already, or because they are independent of other major schemes.

There is a strategic case for increasing the budget to ‘plus 50 per cent’. However, this high level of investment would be a strategic bet and comes with higher risks. The costs and benefits of all the necessary schemes are not sufficiently well articulated for the Commission to take a firm view on this. If more funding were available, there are options to either enhance these schemes or add further schemes later, under an adaptive approach as set out above.

The Commission has had to develop packages on the basis of existing proposals, which do not necessarily fit within the Commission’s preferred adaptive approach, so it is not possible to set out exactly which additional schemes should be considered under an adaptive framework. However, if the pipeline of investments was based on the Commission’s ‘plus 25 per cent’ package prioritising regional links or something similar, further schemes or enhancements under a ‘plus 50 per cent’ budget could include:

- a phased approach to the remaining sections of the eastern leg of HS2 Phase 2b from the East Midlands to Leeds
- prioritising improved connectivity between Sheffield and Leeds – as set out in the ‘plus 50 per cent’ package prioritising regional links
- improved connectivity between Sheffield and Manchester
- a new line from Manchester to Leeds via Bradford, building on the partial new line option in the ‘plus 25 per cent’ package.¹³

While the Commission’s analysis suggests that the highest local economic benefits are likely to be delivered by initially prioritising regional links, this does not rule out the further development of options such as the HS2 Phase 2b eastern leg that also have strategic value. There is the possibility of approaching the eastern leg in phases to deliver benefits earlier, starting with a high speed line between the West and East Midlands to significantly enhance capacity and connectivity between these two areas. These schemes should continue to be developed so decisions can be made on the best possible evidence.

It is important that whichever schemes are included in the Integrated Rail Plan, the Commission’s design principles are used to ensure that schemes including stations are well designed and contribute to climate, people, places and value.

Areas of further work

Given the short timeframe for the Assessment, the Commission has had to focus on the strategic case for investment. The Commission has not undertaken the type of detailed railway planning that a project of this scale will need. Government, along with Network Rail and regional transport bodies, will need to ensure that this detailed work is undertaken for the Plan to be a success, both to ensure schemes are sufficiently developed and plan for their effective delivery. In particular, government will need to ensure it has properly considered and planned for the integration of different schemes, both with one another and with the existing rail network.

Further work will also be needed to ensure that the Plan is able to also deliver on long term priorities, such as decarbonisation, and to maximise opportunities for development and regeneration. The latter will be particularly important if government chooses to make changes to the current investment plans. Even the core set of schemes will require further work and refinement as they go through the consents process, but it is important that this is given sufficient focus. More detail on the areas where additional work required is set out in chapter 4.

Long term commitments and shorter term wins

Whichever package of rail schemes the government chooses in the Integrated Rail Plan, the benefits from many of the schemes will likely not be seen until the 2030s or 2040s on current plans. Government should systematically look at how to accelerate the delivery of these schemes, and ensure the Plan delivers benefits in the short to medium term. Steps should be taken to reduce the risk of the core interventions in the Plan needing to be reopened, or replaced in future.

Ensuring the Plan endures

Long term transport plans have sometimes been subject to delay due to disagreement and appeals. There are steps government can take to ensure the plan endures:

- Agreeing the Plan with local stakeholders will ensure it reflects local priorities and reduce the risk of the Plan being disputed. Government may also wish to consider strengthening regional transport bodies, and their remits, to ensure that they can most effectively work alongside government and Network Rail to enable a coordinated and prioritised approach to rail investment.
- Ensuring plans contribute to net zero and net environmental gain is important for its own sake but will also avoid the risks of plans being delayed at a later stage due to controversy around the potential environment impact. Decisions on the Integrated Rail Plan should be consistent with the government's legislative commitment to reaching net zero and transport decarbonisation plans and the Integrated Rail Plan should set out a strategic approach to minimising, and where necessary mitigating, impacts on the local environment and natural capital, adopting a 'net gain' approach.

Accelerating schemes and delivering benefits in the shorter term

As set out above, some elements of the major rail projects proposed for the Midlands and the North present opportunities for earlier delivery as work is underway already, or because they are independent of other major schemes. There are also some other schemes, including upgrades on the East and West Coast Main Lines, that need to be progressed earlier in the timeframe to allow other schemes to advance. Government should also ensure necessary upgrades to the conventional network are completed in time to enable the integration of new, faster rail lines like the HS2 Phase 2b western leg.

The Commission has also identified several potential 'early wins' that could help deliver benefits for passengers in the North and Midlands within the next decade. These include smaller scale interventions including station improvements to improve passenger experience and enable longer trains and increase capacity, and digital signalling to increase reliability and capacity across the network.

The government is undertaking a programme of work to speed up the delivery of major infrastructure projects. The lessons learnt should be applied to the schemes in the Integrated Rail Plan. From the Commission's perspective there are several non-infrastructure issues that government should address to help accelerate delivery of major new rail schemes and upgrades, and which would also limit further escalation of rail costs. These include:

- the process for acquiring the necessary consents
- the existing regulatory framework
- certainty for the supply chain
- the approach to upgrading existing lines.

1. Background

The government asked the Commission to carry out an assessment of rail needs in the Midlands and the North of England, to inform the development of the government's Integrated Rail Plan.

In July, the Commission published an interim report, which covered rail and economic outcomes, the Commission's methodology, and set out a series of questions for stakeholders.

The Commission conducted an extensive stakeholder engagement process as part of this Assessment, including social research, a call for evidence and several virtual briefings.

Background to the Assessment

Following the Oakervee review of HS2 in February 2020, the government announced its intention to draw up an Integrated Rail Plan for the North and the Midlands which will identify the most effective scoping, phasing and sequencing of relevant investments and how to integrate HS2, Northern Powerhouse Rail, Midlands Rail Hub and other proposed rail investments. This plan will be informed by the Commission's independent assessment of the rail needs of the Midlands and the North.

The Infrastructure and Projects Authority is conducting a review of the lessons learned from HS2 Phases 1 and 2a on the supply chain and costs for the delivery of the rest of the project, which will also feed into the government's Plan.

The Commission has previously recommended investing in better rail in the North, particularly in *High Speed North*, the Commission's report on strategic improvements to transport connectivity in the North. However, before this Assessment the Commission has not previously considered HS2, as its remit excludes decisions that have already been made and spending that has already been committed, unless specifically requested to do so by government.

Interim report

In July, the Commission published an interim report, which covered rail and economic outcomes (which is summarised in chapter 2), the Commission's methodology (which is summarised in chapter 4) and set out a series of questions for stakeholders. Responses to the questions are covered in box 1.1.

Box 1.1: Responses to interim report questions

The interim report set out questions for stakeholders on the proposed methodology for assessing the costs and benefits of different rail investment packages. The Commission held two roundtables with key stakeholders including government, transport bodies, rail interest groups and rail providers, as well as receiving 35 written responses to the questions.

Feedback was generally supportive of the methodological approach, although there was some concern that the approach may not capture potential transformational impacts from rail investments, particularly land values. The Commission's methodology is intended to assess which rail investments are most likely to lead to transformational change but does not directly capture all the benefits that would arise from transformational change. The Commission's methodology is covered in more detail in chapter 4.

Other key themes in the responses included:

- the need for Assessment to consider the 'last mile' of journeys and integration with local transport, which was particularly raised by local government respondents
- concern that small or underdeveloped schemes would be out of scope, meaning that proposals of significant local importance would not be included
- some opposition to the proposed approach to freight, particularly not assessing it under economic growth and not considering projected increases in rail freight volumes
- that a degree of uncertainty can be mitigated by government by setting out a clear long term pipeline of schemes
- a desire for greater clarity on the definitions being used for criteria, particularly amenity benefits and land values, and how different criteria will be measured and weighted against one another
- the need to take greater notice of demand forecasting in the analysis
- concern about the granularity of natural capital assessment tools.

Chapters 2 and 3 cover the need for the Integrated Rail Plan to avoid providing additional spending for rail at the expense of local transport. The interim report also stated that the Commission would not consider local (rather than strategic) rail schemes, and the Commission has followed this approach in the packages that have been developed for this assessment. Separately, some smaller schemes have been considered under 'quick wins' which can be delivered in the short term and may help to enable larger schemes to deliver benefits. Larger, strategic projects cannot be delivered to this timescale.

The Commission's approach to freight is discussed further in box 5.4 and chapter 3 sets out the need for government to commit to a core long term pipeline of investment within an adaptive approach. The Commission has also published a modelling annex, which sets out more detail on the methodology, including the criteria used, alongside this report.¹⁴

The final Assessment

The Commission's final Assessment sets out:

- key considerations for a successful Integrated Rail Plan
- an analysis of five options for programmes of rail investment, within three illustrative budgets
- options for accelerating the benefits of long term rail investments and identifying 'early wins'.

While the Commission's work on this Assessment has been informed by engagement with central government departments, as well as the Infrastructure and Projects Authority, the Commission's conclusions have been reached independently. These conclusions represent the Commission's judgement, informed by the evidence provided by stakeholders and its own analysis. The analysis informing this Assessment was finalised prior to the Spending Review and does not take into account any Spending Review announcements.

Stakeholder engagement

The Commission conducted an extensive stakeholder engagement process as part of this Assessment, including:

- a Call for Evidence, asking for evidence on the benefits and drawbacks of different schemes
- Interim Report questions on the methodology for assessing cost and benefits, as set out in box 1.1
- social research on the views and perceptions of rail of people in the Midlands and the North
- roundtable and briefing sessions with a range of expert stakeholders from local government, the rail industry, businesses, academia, environmental groups and other sectors.

Due to the ongoing Covid-19 crisis, this engagement has taken place virtually. The potential impact of Covid-19 on rail demand is discussed in chapter 2.

Responses to the Call for Evidence covered a wide range of different issues, proposals and potential investments across the Midlands and North in detail; a report summarising the key themes from those responses is being published alongside this report, as well as a summary of responses to the interim report questions.

A summary of the key themes from the Commission's social research is included in chapter 2.

2. Rail and economic outcomes in the Midlands and the North

Despite being home to seven out of ten of England's largest cities¹⁵ – many of which are not far apart – economic outcomes in the Midlands and the North of England are lagging behind those in the South of England. There is also a considerable difference between journey speeds in the Midlands and the North, and similar journeys in other countries and the South.

Rail cannot singlehandedly achieve the government's objective of levelling up the UK. But it can improve productivity in dense city centres and deliver benefits to businesses from faster and more frequent connections between cities. The Integrated Rail Plan must address the existing issues in the Midlands and the North and focus on improving rail connections into dense city regions and between cities in the Midlands and the North, to have the best chance of supporting economic growth.

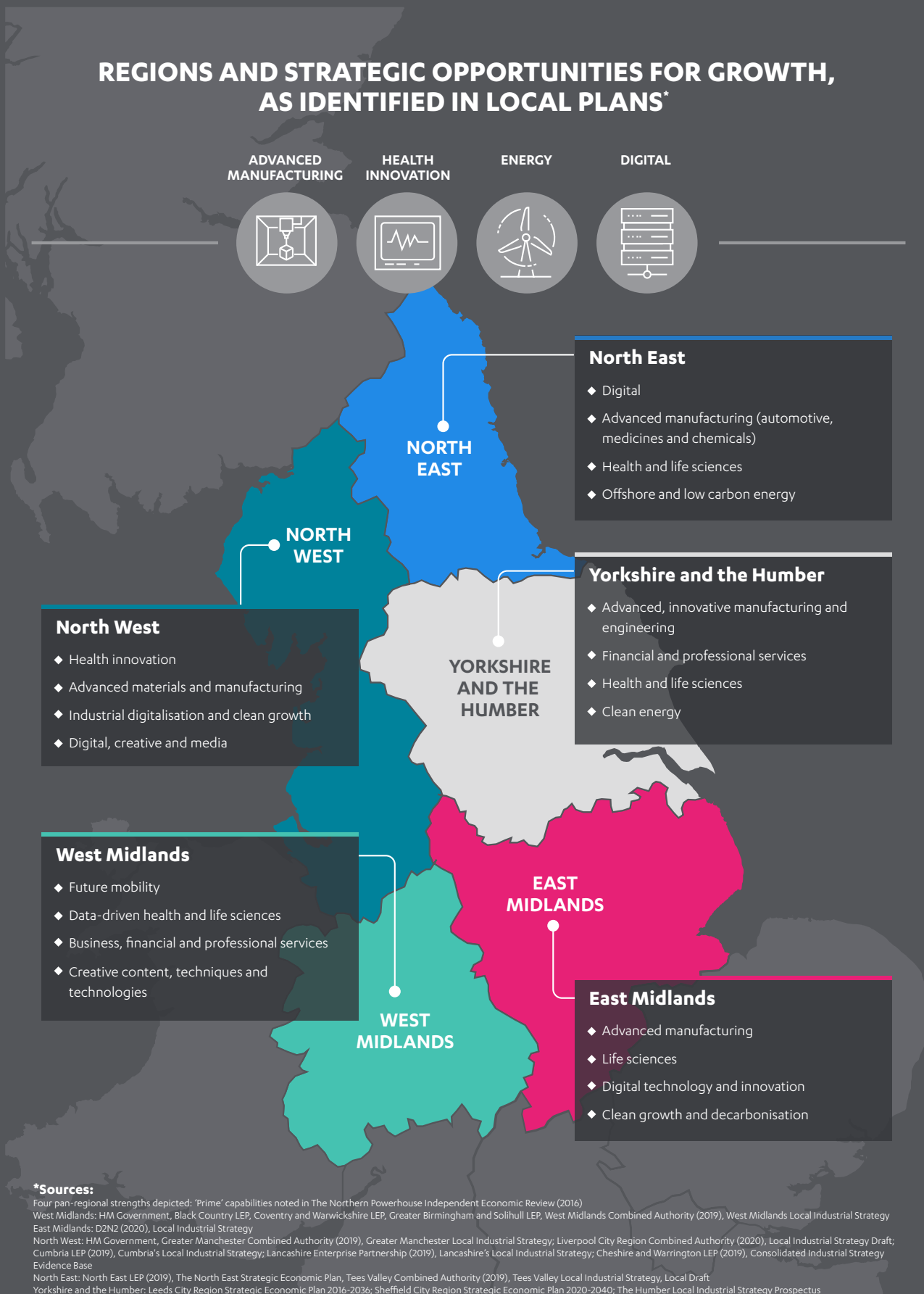
The Midlands and the North

The Midlands and the North are home to seven out of ten of England's largest cities, many of which are relatively close together.¹⁶ In recent decades cities such as Manchester and Leeds have experienced rapid population growth in their city centres, mainly driven by young professionals. This has led to city centre populations doubling in size between 2002 and 2015, and they have continued to grow since.¹⁷

But economic outcomes in the Midlands and the North of England are lagging behind those in the South of England. Although cities such as Manchester and Birmingham are projected to see high employment growth and high congestion,¹⁸ productivity in cities in the North and the Midlands is still below the national average (although London and the South East are the only regions with above average productivity)¹⁹ and some smaller cities and towns, particularly those on the coast,²⁰ have lagged behind. While other countries face persistent regional economic variation, the extent of regional variation within England appears to be unusually high compared to other countries.²¹

Each of the regions has different economic strengths and opportunities they wish to unlock to improve economic outcomes in the region; see figure 2.1. Many of these are high skilled, knowledge based sectors which particularly benefit from improvements to productivity in cities.²² The businesses and supply chains in these sectors will also gain benefits from increased connectivity.²³ The Commission's methodology assesses the potential benefits of a menu of options of rail investments in these areas and so packages that perform better against these criteria should support the regions' economic strengths and opportunities.

Figure 2.1: Regions in the Midlands and the North – economic strengths and strategic opportunities



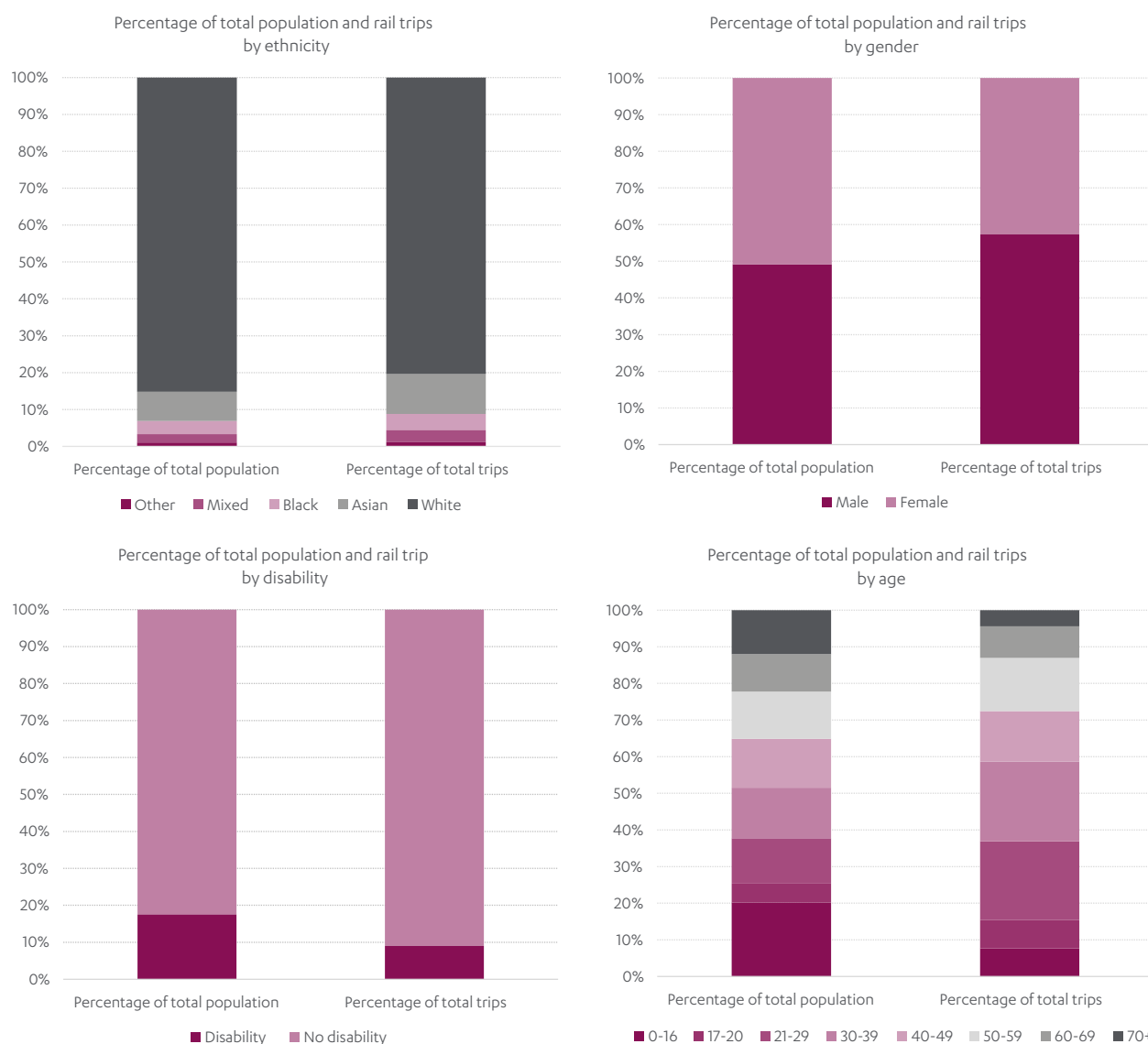
Only ten per cent of journey miles are made by rail.²⁴ However, the benefits of rail investment do not just fall to those who use the railway. Rail investment also brings benefits to the cities it connects and the towns nearby.

Who uses the railway in the Midlands and the North?

As well as testing the public's preferences for rail investment, the social research undertaken by the Commission to inform the assessment also provided a picture of rail use in the Midlands and the North. The research found that only a minority of people use rail as their main mode of transport, frequent rail users are more likely to earn higher incomes and work in managerial and professional occupations, rail use is more common among those living in urban areas, and rail use is higher amongst the working age population, with younger people more likely to use the train. This is consistent with the analysis in the Commission's interim July report.

These characteristics are aligned with the characteristics of rail users across England. Other characteristics of rail users across England are set out in figure 2.2.

Figure 2.2: Railway use in England²⁵



Who will share the wider benefits of rail investment in the Midlands and the North?

The economic benefits of rail tend to fall primarily to cities, which generally have a more diverse ethnic makeup than rural areas.²⁶

The population of cities also tends to be younger – the population in major cities in the Midlands and the North is younger on average than the population as a whole.²⁷ Figure 2.3 sets out distributional data about the people who live in and around key cities in the Midlands and the North.

Figure 2.3: Distributional data for travel to work areas (TTWA) in the Midlands and the North²⁸

% of TTWA Population	Age					Ethnicity					Disability	
	0 to 19	20 to 29	30 to 44	45 to 64	65+	White	Mixed	Asian	Black	Other	Disability	No Disability
Manchester	25%	14%	21%	25%	15%	85%	2%	10%	2%	1%	19%	81%
Liverpool	23%	15%	19%	26%	17%	94%	2%	3%	1%	1%	23%	77%
Birmingham	26%	14%	20%	24%	17%	74%	3%	17%	5%	1%	19%	81%
Leeds	26%	15%	21%	24%	15%	79%	2%	15%	2%	1%	17%	83%
Nottingham	23%	14%	19%	26%	19%	89%	3%	5%	2%	1%	19%	81%
Sheffield	23%	14%	19%	25%	18%	89%	2%	5%	2%	1%	20%	80%
Newcastle	23%	14%	19%	27%	18%	95%	1%	3%	1%	0%	22%	78%

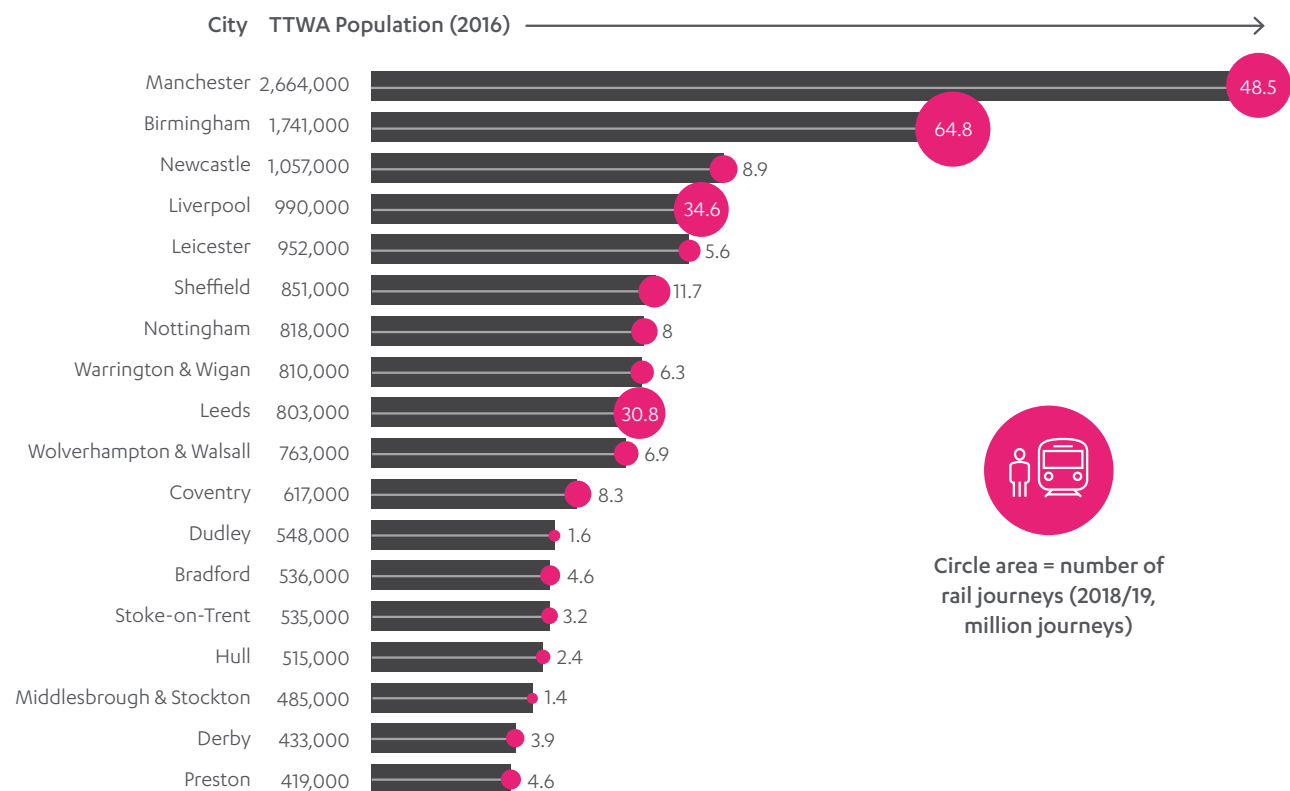
Rail in the Midlands and the North needs improvement

Major cities in the Midlands and the North are experiencing capacity issues

Alongside the growth in city centre living, many large cities in the Midlands and the North were experiencing very high volumes of rail journeys in and out of city centres before the Covid-19 pandemic see figure 2.4. And this number appeared to be growing – between 2010 and 2019, passenger arrivals by rail during the morning peak increased 36 per cent in Manchester, 41 per cent in Birmingham and 19 per cent in Leeds.²⁹

Some of these cities, such as Manchester, Birmingham and Leeds, have had commuting capacity issues for several years, with peak morning trains operating with 2.6, 4.6 and 2.1 per cent of standard class passengers in excess of capacity in 2018. This has also become more of an issue in Nottingham in recent years.³⁰

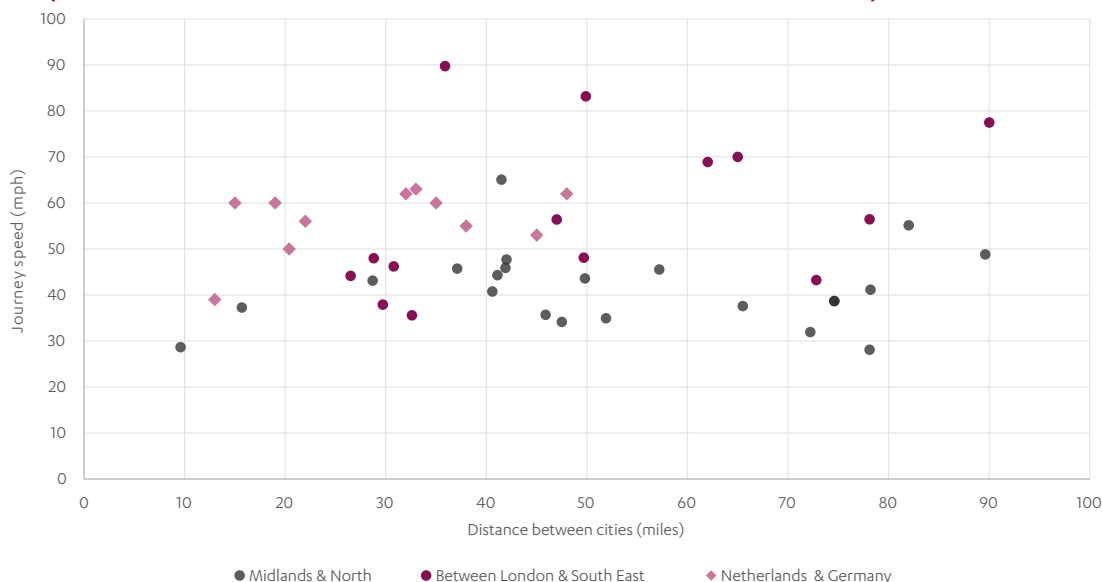
There are also congestion issues on the rail network. One of the benefits of HS2 is that it would free up train paths and platforms on the heavily congested East and West Coast Main Lines and the Midland Main Line.³¹

Figure 2.4: Rail journeys in cities in the Midlands and the North

Rail journeys data represents the number of people travelling to and from city centre stations in each highlighted Travel to Work area, not including interchanges (2018/19, million passengers; ORR, 2020)

Rail services in the Midlands and the North can be slower than those in the South and other comparable countries

Rail journeys between major cities in the Midlands and the North also tend to be slower than those in London and the South East, and in regions with high productivity in other countries, particularly for shorter distances (see figure 2.5).

Figure 2.5: Rail journey speeds versus distance between cities: Key cities in the Midlands and the North, compared to London and the South East, and the Netherlands and Germany 2019³²

Furthermore, some train services in the North and the Midlands can be unreliable, with services including Northern, CrossCountry, TransPennine Express and Hull Trains performing worse than the national average for trains arriving on time in 2019-20.³³ The issues with rail in the Midlands and the North were covered in more detail in the Commission's interim report.³⁴

The public see room for improvement in rail, but are doubtful that it can or will be delivered

The Commission carried out social research to support this Assessment, which aimed to understand what rail users value about the railways, identify barriers to using rail among non-users, establish public priorities for future investment and explore what might encourage rail use. The social research comprised:

- a quantitative survey of a representative sample of 3,000 adults in the North and the Midlands, including around 2,000 rail users, and around 1,000 people who had not used the railway in the last 12 months
- twelve online focus groups to understand the thoughts underpinning the survey responses.

The key findings from the social research included the following:

- **Participants in focus groups were doubtful that new lines would or could be delivered:** Participants in the focus groups favoured rail investments which felt tangible, including increased capacity and reliability, but not new lines, because they were sceptical about whether these would or could be delivered.
- **Participants prioritised the minimisation of disruption for improvement works over completing work quickly:** While minimising disruption did not score highly in priorities for improvement, the possibility of work taking place at night was well-received, with many saying that there are few night trains in the regions. There was also widespread cynicism that rail improvement works are ever completed on time, leading to participants being sceptical about delivery schedules.
- **People use rail when it is convenient, and services are direct:** The quantitative survey revealed rail users choose rail because of its speed and convenience and are more likely to live and/or work within walking distance of a railway station. Conversely, non-users do not use rail because it does not offer a simple route and is considered slow and inconvenient compared to other forms of transport.
- **Participants did not prioritise further increases in train speed:** In the quantitative survey 'faster trains' ranked eighth out of a list of 12 priorities for improvement. Rail users consider trains to be a fast means to travel and they do not prioritise increasing the speed of future journeys.
- **Participants favoured increased rail capacity:** All survey respondents expressed an overall preference for increased capacity (which they likely understood as reduced crowding and more available seats) and reliability on the rail network, well ahead of other areas for investment.
- **Participants struggled to see the connection between rail and economic growth:** Arguments related to 'boosting local economies' were generally met with confusion by participants.

The Integrated Rail Plan must improve services for rail passengers in the Midlands and the North

Improvements to rail services in the Midlands and the North are needed to accommodate long term growth in the number of people commuting by rail. While providing additional rail capacity would reduce crowding on trains in the short term, existing crowding demonstrates that increased capacity would be valuable (people are already willing to board crowded trains for these journeys) and likely to be filled over time. Although this means crowding is likely to increase again in the long term, without additional capacity being used the economic benefits of rail investment will not be delivered.

Rail can improve economic outcomes

The Integrated Rail Plan is intended to support the government's strategic objective of 'levelling up' by contributing to economic growth in the North and the Midlands.

The Commission's recent discussion paper *Growth across regions* sets out three different pathways by which infrastructure investment can help to achieve economic outcomes in different regions:

- **universal provision** – setting common/minimum standards for infrastructure services where appropriate to reduce differences in access and opportunity across the UK
- **addressing constraints to growth** – enabling future growth in congested places by investing in capacity upgrades, with the expectation that this will also benefit surrounding areas
- **contributing to transformation** – prioritising infrastructure investment alongside wider policies to increase growth in low productivity places.³⁵

The most appropriate pathway and type of infrastructure measures will vary according to the characteristics and strategic needs of different places. Providing faster or more frequent journeys is the clearest way rail investment can address constraints to growth. However, with the right package of complementary investments rail can also contribute to transformation. This pathway has the biggest impact on growth where it is effective but is also the highest risk strategy.

Rail can contribute to improving economic outcomes by:

- increasing the density of clusters of people and businesses,³⁶ which can increase the productivity of existing firms and workers in cities, improve the environment for innovation and make cities more attractive for businesses and workers to locate in
- facilitating 'trade' between cities by providing faster, more frequent rail connections to businesses, enabling them to source a wider range and better quality of inputs to their supply chains, and increasing the size of the market any one business can access, allowing successful firms to grow, and encouraging workers to specialise and upskill³⁷
- making places more attractive to live and work in
- encouraging commercial investment by signalling that an area is worth investing in.

These benefits tend to arise from rail investment that supports transporting people into dense city regions and providing high speed rail links between cities, where rail can be faster or more convenient than cars for many people.

Good rail connections into and between cities tend to be present in comparable groups of cities in other countries. While cities in the Midlands and the North have below average productivity, strong regional centres in other countries, such as the Randstad in the Netherlands and the Rhine-Ruhr region in Germany, have productivity above their national averages.³⁸ This is driven in part by strongly performing cities within those regions, but those cities are also well-connected by rail links which tend to be faster and, crucially, more frequent than those between Northern cities in the UK (see figure 2.5).³⁹ None of England's economic comparators, with similar geography, have poor rail accessibility between cities.⁴⁰

To contribute successfully to a wider strategy of tackling regional variability, rail investment should focus on journeys both between cities and into city centres from their surrounding areas. Although major rail interventions can most successfully support big cities, successful cities can improve the prospects for towns in the vicinity: most successful towns in England are close to successful cities.^{41,42}

Rail improvements for big cities can benefit cities and towns nearby – for example, improving links between Manchester and Leeds will also improve connectivity for places like Huddersfield and Bradford, and places like Solihull will benefit from better services to and from nearby Birmingham.

Rail alone may not be enough to deliver economic transformation

Rail investment alone is unlikely to be enough to transform the economic outcomes of a region, city or a town. Large scale rail investment is a strategic bet. However, there are things that can be done to increase the likelihood of rail investment contributing to economic transformation. More concentrated interventions have a better chance of supporting economic transformation than a series of small changes. And a wider set of complementary policies are also needed to address other issues, such as skills and urban transport, that are necessary for economic transformation.

As part of a combination with other policies, rail is much more likely to contribute to the type of non-linear benefits that true transformational change can bring. It is difficult to quantify these benefits, or the tipping point at which they will occur. But delivering the right set of interventions together, rather than in isolation, should increase the chance of these non-linear benefits occurring.

Investment needs to be at scale

Where rail can support growth, the direct benefits are modest compared to the size of local economies. Investment must be concentrated and at scale for it to have the best chance of contributing to growth in cities.⁴³

Enabling places with low productivity to 'catch up' with more successful places requires a step change in growth that outpaces the more successful places for a sustained period, which is very hard to achieve. But, according to the Industrial Strategy Council, "the evidence also clearly suggests that reversing the cycle of stagnation is possible provided policy measures are large-scale, well-directed and long-lived."⁴⁴

The analysis shows that under all the packages Birmingham, Manchester and Leeds are generally the largest beneficiaries. This is consistent with the Commission's view that levelling up and increasing economic growth in regions requires economic growth in the major cities. While the relationship is complex there is a strong linkage between highly performing major cities and highly performing regions.

Rail needs to be combined with other policies

Regional disparities are caused by many interrelated issues, including skills, that would need to be addressed to achieve economic transformation. Other factors, such as the availability of good housing, schools, urban transport, city services such as shops and hospitals, low crime rates and good governance also affect outcomes, such as where people choose to live.

Other measures that support growth can increase the likelihood of rail investment delivering the intended benefits, and rail investment can in turn encourage other investment and contribute to the success of these other measures, contributing to a positive cycle. Therefore, it is vital that when and where rail investment happens it is coordinated with, and enables, local plans to address other issues and support growth, in order to maximise the benefits of the rail investment.

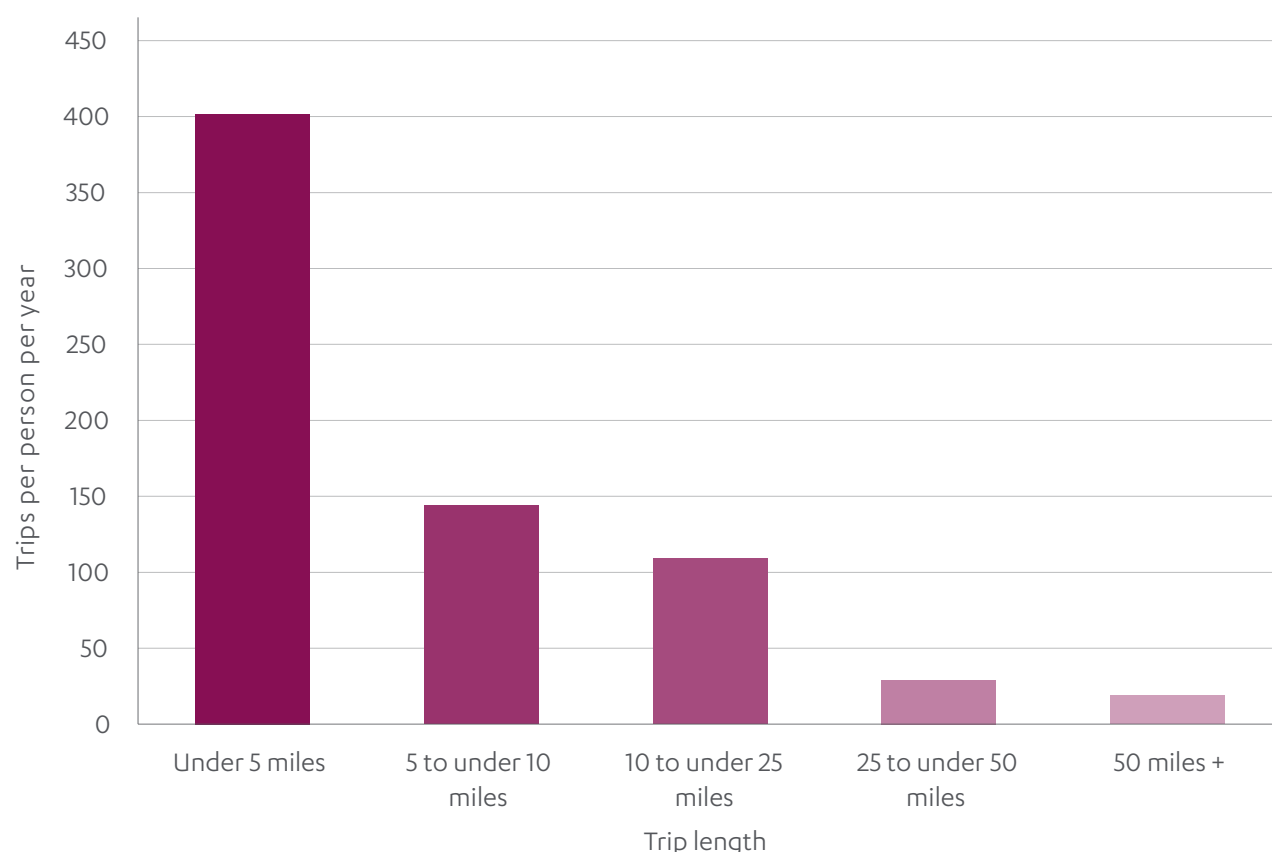
Figure 2.6: Skill level and earning potential for London and the South East, the Midlands and the North, 2019⁴⁵



Urban transport is particularly important, as urban transport networks underpin commuter journeys that create deep labour markets and enable people to access cultural and leisure activities. Most journeys are short, relying predominantly on urban transport networks (see figure 2.7). Infrastructure to support public transport in growing and congested cities offers some of the highest returns for transport investment.⁴⁶

For example, West Yorkshire Combined Authority is developing mass transit options for the Leeds City Region, which is often characterised as the largest metropolitan area in Europe without any form of light rail or underground rail network.⁴⁷ Delivering a mass transit system for Leeds could likely be done sooner than the current lead-in times for major rail projects and could enable passengers to see improvements faster.⁴⁸ Box 3.1 covers urban transport strategies.

Figure 2.7: Average number of trips per person per year by trip length, 2019⁴⁹



Rail can also be an anchor for investment

Rail, particularly in and around new railway stations, can also act as an anchor investment, signalling to the market that the location is worth investing in because other people or businesses are also likely to move there. This helps to solve coordination problems where the value of private sector investment depends on other investors making similar choices.⁵⁰

New and major redevelopments of stations are the most visible sign of this and can help to create further development opportunities where land in city centres is scarce and expensive. Development plans are already in place for new HS2 stations. For example, the Curzon HS2: Masterplan for Growth is aiming not only to increase commercial floor space in the centre of Birmingham but also to add 4,000 new homes, and the plan claims that it will increase Birmingham's GVA by £1.4 billion per year.⁵¹

Not only does this provide an example of rail's ability to act as an anchor, it also shows that the signal provided by stable future commitments can enable benefits to be delivered well in advance of rail investments themselves coming online. By providing an anchor, rail can help to enable the broader set of policies needed to create the potential for transformational change.

The benefits of rail investment depend on certain assumptions

In order to think that investing in rail is a good idea, government will need to consider that the current evidence supports the following assumptions remaining true:

- **The economy will remain focussed on cities** – Rail is predominantly effective for transporting large numbers of people into and between dense city centres. Nowhere outside of cities and their surrounding areas has the high densities of people using rail that would justify its high costs. Since the 1990s cities have grown as centres of employment and entertainment, making rail more important. This is likely to continue if the following hold true:
 - Covid-19 or other shocks do not cause people to abandon cities over the long term
 - there continue to be benefits to many UK businesses from being located close to other businesses, which is particularly important in highly skilled services, which the UK currently specialises in, but less important in other areas such as agriculture
 - that people continue to go to cities for leisure, retail and entertainment.
- **Other technologies will not replace rail** – Technologies usually go out of use because they are replaced by something better. Government would need to consider that rail will not be replaced either because digital connectivity replaces face to face communication or because alternative transport technologies offer a cheaper and more convenient way to move into and between dense city centres.
- **Complementary policies in the North and the Midlands work** – Rail is necessary but not sufficient to deliver economic transformation. It needs to form part of a wider economic strategy for levelling up the Midlands and the North. Government would need to consider that the wider economic strategy will work for rail investment to deliver the intended benefits. Rail use will also be higher if the economic strategy works, as people in the highest income band are the biggest users of rail,⁵² and because rail is a complement to highly skilled industries, as it provides specialist services with a wider potential market and employment pool.
- **The economy does not stagnate** – Government would need to consider that the economy will grow on a national level over the coming decades. Rail use will grow if the economy does well, for the same reasons set out above.
- **The working age population does not fall** – The last 20 years have seen large increases in the UK's working age population, partly due to immigration; however, EU exit and low birth rates mean this trend may not continue. Since rail is mainly used for commuting to work,⁵³ a fall in working age population could also lead to a fall in peak rail use and undermine the case for additional capacity.

3. A core pipeline and an adaptive approach

The Integrated Rail Plan is an opportunity for government to bring clarity, stability, and pragmatism to future rail planning. But that doesn't mean committing to every major project – it is also an opportunity for this government to break the cycle of committing to major rail schemes, underestimating the costs and ultimately having to reopen plans or find additional funding. The Plan also needs to form part of a wider economic strategy.

The Integrated Rail Plan must be well costed to provide greater certainty and avoid overspends. If the Plan is to have the best chance of delivering economic transformation, investments must be concentrated and at scale in the places where they are most valuable and form part of a wider economic strategy.

Government should commit to a core pipeline of rail investments that align with its strategic objectives. If further funding is available and can be committed, government could add further schemes or enhancements that build on this core pipeline to deliver the strategic objectives. Further enhancements or additional schemes should only be delivered where:

- it is clear the pipeline of core schemes is delivering on time and to budget
- complementary investments are being made that increase the likelihood of rail investments contributing to transformation
- they are sufficiently developed with robust cost ranges.

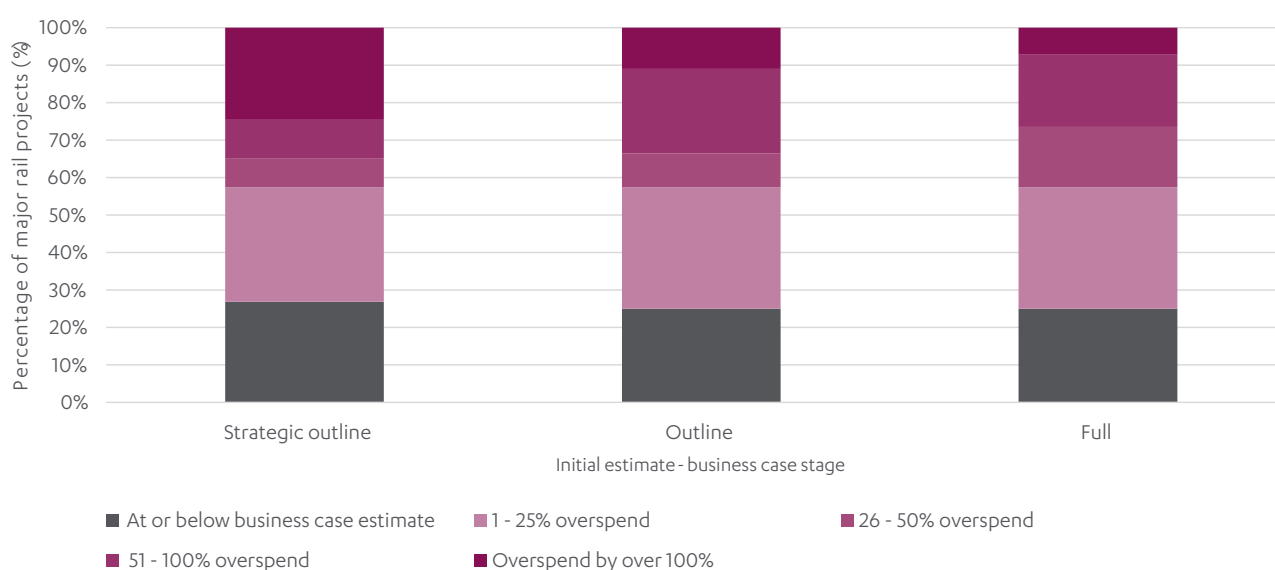
The Plan should not overpromise

There is a long history of overspends and cost increases on major rail projects.⁵⁴ The cost of electrification of the Great Western railway grew by £2.4 billion between 2013 and 2016.⁵⁵ Costs for the West Coast Main Line upgrade rose by £7.8 billion.⁵⁶ The central section of the Elizabeth line was initially planned to open in December 2018, but this has since been delayed to 2022, and the project could cost £1.1 billion more than the financing package (of £17.6 billion) agreed in December 2018.⁵⁷ As set out in the Oakervee Review, the total costs of HS2 were estimated at £80.7-87.7 billion, against a budget equivalent to £62.4 billion.⁵⁸ Cost increases and overspends can lead to schemes being revised or descope because costs have increased and plans are no longer affordable within the funding available.

Cost overruns are driven by several factors, including underestimation of the cost and quantity of materials required and changes in standards or scope during construction, planning and design. However, cost estimates for projects continue to insufficiently consider these possibilities, in part down to optimism.

It is standard in the rail industry to have a 64-66 per cent uplift applied to the 'base' cost estimate when a single option is selected. Research carried out for the Commission suggests that, for certain projects, a significantly higher uplift to the base cost estimate may be more appropriate.⁵⁹ Given this uncertainty about costs, the Commission has included potential cost ranges for each package.

Figure 3.1: Outturn costs of major rail projects compared to cost estimates at different business case stages⁶⁰



It is better that government promises less and eventually delivers more, than that places in the Midlands and the North are promised projects that eventually have to be cut, delayed or significantly descoped due to cost overruns. The government should develop realistic costings in the Plan, considering the potential for current costs and lead times to be underestimated and having regard to findings from the Infrastructure and Projects Authority. This may mean more time is needed to develop the Plan, but this will cause less delay in the long term and provide greater certainty and stability for stakeholders.

While better cost estimation would help reduce the likelihood of overspends, it is also important that projects stick to budget during construction. If one project runs over budget, then others in the pipeline may no longer be affordable. Government therefore needs to ensure that the right processes are in place to manage costs and that difficult decisions about scope are made to avoid cost increases.

There is also a clear tendency for the timescale for schemes to be underestimated as well as costs. On average, construction schedules for rail projects have ended up being between a quarter and a third longer than predicted, although the overrun distribution differs quite a lot between project types.⁶¹

The Plan should maximise the benefits that rail can deliver

As set out in chapter 2, rail can contribute to economic outcomes, but rail alone is not necessarily enough to deliver economic transformation. To give the best chance of delivering economic transformation rail investment should be concentrated and at scale, and form part of a wider economic strategy.

Investment should be at scale

As set out in the previous chapter, rail investments have the best chance of contributing to economic outcomes if they are at scale. Practically, this means:

- investment should be targeted at places where rail is most valuable, for example where there are already capacity constraints – rail capacity will be most in demand where there are already economic opportunities in the cities that people want to access, and this may be where complementary factors are already in place
- rail investment should be focussed at scale on specific places – if investment is spread thinly between different places the benefits, if they are achieved, will likely be smaller.

The Plan should form part of a wider economic strategy including local transport

As set out in the previous chapter, to have the best chance of realising their benefits rail interventions should form part of a wider economic strategy.

The Plan should form part of a comprehensive strategy to make cities attractive places to live, work and invest in, alongside other factors including skilled employment, urban transport, good governance and local decision making, which should include local strategies (see box 3.1).⁶² To be successful, the strategy will need to be comprehensive and recognise the scale of the regional variation challenge and its self-reinforcing nature.

Box 3.1: The Integrated Rail Plan and urban transport strategies

In the *National Infrastructure Assessment*, the Commission recommended that urban authorities should be given the powers and funding they need to pursue ambitious integrated strategies for transport, employment and housing. These strategies should enable cities to make the most of national rail schemes, such as those in the Integrated Rail Plan, ensuring they are integrated with local transport networks, and support housing and employment. As part of that recommendation, the Commission advised that £43 billion of additional investment should be made available between now and 2040 for major urban transport projects in the fastest growing, most congested cities, which could cover interventions such as delivering a mass transit for Leeds.

Both HS2 and Northern Powerhouse Rail will interact with existing local transport strategies along their routes. Examples of these include:

- the Sheffield City Region Transport Strategy⁶³
- West Midlands Combined Authority's Movement for Growth strategy⁶⁴
- West Yorkshire Combined Authority's Transport Strategy 2040⁶⁵

- Greater Manchester Combined Authority's Transport Strategy 2040.⁶⁶

Local transport plans in Liverpool, Tees Valley, Derby and Cheshire East are also all closely linked to major rail schemes.⁶⁷

Integrated infrastructure strategies will help ensure that cities in the Midlands and the North can maximise the benefits of the Integrated Rail Plan and will form an important part of delivering a transport network that can support transformational benefits across the country.

An adaptive approach can address these challenges

Even with a well costed Plan that concentrates investment and forms part of a wider economic strategy of complementary policies, there will still be inevitable uncertainty. Costs may still increase due to unforeseen factors. Other projects may overrun and delay construction. The location or size of capacity demand may change. Complementary policies may not be delivered on time or may not deliver economic transformation.

Therefore, while it does make sense to deliver rail investment to address existing issues and contribute to supporting economic outcomes, this does not mean investing in every major project proposed. The current total estimated capital cost of HS2, Northern Powerhouse Rail, the Transpennine Route Upgrade, Midlands Engine Rail and other interventions such as decarbonisation and digital signalling is in the region of £140-185 billion in 2019/20 prices between 2020 and 2045.⁶⁸ Government should exercise some caution, especially on projects where the costs and benefits are less certain.

An adaptive approach can enable government to address this uncertainty. Government could initially set out a commitment to a core set of affordable, stable investments, with a clear funding profile and rigorous costings, that should not be reopened. This will provide stability for stakeholders, enable local bodies to make and enact plans and help provide investors and developers with the confidence to bring forward their own investments, meaning the benefits from rail investment will be seen sooner.

There could then be clear options to either enhance these schemes or add further schemes later. If further funding is available and can be committed, the decisions to progress further enhancements or schemes should be taken within a set framework. For example, only if:

- it is clear the pipeline of core schemes is delivering on time and within the budget
- enhancements and new rail schemes are sufficiently developed with robust cost ranges
- complementary investments are being made that increase the likelihood of major rail investments contributing to transformation.

4. Developing packages of rail investments

The Commission has developed five packages of rail investments within three different illustrative budgets. Proposals for rail investment were identified and grouped into packages based on potential options for eight strategic rail routes. The packages are compared in the next chapter.

The packages are:

- a package focussing on upgrades, in line with the spending on rail investment in the Midlands and the North in the fiscal remit table in the National Infrastructure Assessment
- two packages in line with spending 25 per cent higher:
 - one prioritising regional links
 - one prioritising long distance links
- two packages in line with spending 50 per cent higher:
 - one prioritising regional links
 - one prioritising long distance links.

This chapter covers the Commission's methodology for the three key steps in developing the Assessment:

- identifying proposals for investment
- developing packages of proposals
- assessing the packages.

The relative costs and benefits of the packages are discussed in chapter 5, and more detail on the packages is set out in annexes A-C, which cover the individual packages.

Identifying proposals for investment

To select options that maximise the benefits to the Midlands and the North, the Commission considered strategic rail proposals that met the following two considerations:

- **is the proposal in the scope of this assessment?** The interim report stated that the Commission would not consider proposals for investment outside of the Midlands and the North, local (rather than strategic) rail schemes, or schemes where the costs and benefits were underdeveloped, and the Commission has followed this approach. While those schemes may fall outside the scope of this assessment, other workstreams are being undertaken to consider these further such as *Restoring your Railway*, and Network Rail's long term planning process for the rail network.⁶⁹ Separately, some smaller schemes have been considered under 'quick wins' which can be delivered in the short-term and may help to enable larger schemes to deliver benefits.
- **is there enough information available for the Commission to assess the proposal?** The Commission only considered proposals where plausible cost estimates or evidence on the impact of the proposal on journey time and capacity were either provided by stakeholders or were possible to be developed by the Commission independently in the time available.

Developing the packages

The Commission has developed five potential options for packages of rail investments, within the three illustrative budget options. To do this, the Commission:

- identified eight strategic rail routes where there were clear choices on rail schemes
- considered the costs of the proposed rail schemes
- developed packages of rail schemes with costs that fit within the three illustrative budget options, with two key intended objectives:
 - improving long distance rail connectivity
 - improving connectivity within the Midlands and the North.

The Commission received many suggestions for rail schemes to be included in the Integrated Rail Plan through the Call for Evidence. A summary of responses to the Call for Evidence and the rail schemes suggested will be published alongside this report. The evidence provided through the response to the Call for Evidence has informed the Commission's analysis and understanding of possible interventions across the network.

The eight strategic rail routes

In order to focus on what rail is most effective at – moving people between cities and into dense city centres from the surrounding area – the Commission identified eight strategic intercity rail routes to form the basis of the packages, where there are clear choices to be made about the rail schemes that could be included in the Integrated Rail Plan:

- Birmingham – Manchester
- Leeds – Manchester
- East Midlands – West Midlands
- East Midlands – Yorkshire

- Liverpool – Manchester
- Sheffield – Leeds
- Sheffield – Manchester
- Leeds – Newcastle.

These eight strategic routes are designed to focus the packages on the routes between the biggest cities. These corridors are also where the most significant decisions need to be made across major projects, particularly HS2 and Northern Powerhouse Rail.

The Commission has considered different options for each corridor, including new lines, major upgrades, and other upgrades. These include interventions from Northern Powerhouse Rail, HS2 Phase 2b, Midlands Engine Rail and the Transpennine Route Upgrade, and strategic alternatives to these major schemes where necessary. With the limited time available for the study, optioneering of schemes and packages was not examined in detail. Further planning and design work will be required as part of the Integrated Rail Plan process.

For the corridor from Birmingham to Manchester, HS2 Phase 2a creates a new high speed line from Birmingham to Crewe, so only options for the route from Crewe to Manchester were considered when developing the packages.

The Commission has also considered other corridors where these either:

- meet the scope of the Assessment, for example the Northern Powerhouse Rail proposal between Leeds and Hull
- provide alternative routes between key places
- are relevant to connectivity to Scotland.

Apart from being considered for potential ‘early wins’, specific station improvements with only local benefits have been excluded from the study. However, the Commission has considered investments in stations that enable the delivery of wider network investments, for example where new platforms are required to enable additional capacity on strategic corridors.

While the Commission has provided some views on station design, the Commission is not recommending specific design choices. Many stakeholders raised the possibility of the Commission taking a view on whether an underground or surface station is the right choice at Manchester Piccadilly, given the ongoing debate. Whilst relatively more work has been done on the surface station the Commission does not believe that the costs or benefits of either option are sufficiently robust or comparable to enable a fair side-by-side assessment. The Commission understands that HS2 Ltd, working with local stakeholders, is doing a full assessment of the options to inform a decision. This work should move at pace to inform the hybrid Bill process for the western leg of HS2 Phase 2b. If a decision was made by government to proceed with the underground option at Piccadilly, it may also be necessary to consider the implications for the design of HS2 Phase 2b and Northern Powerhouse Rail services.

Costs and evidence

The volume and complexity of data and the differing approaches across schemes means that completing the analytical programme of work has been challenging. The estimated costs and benefits of many of the schemes in scope have changed during the Assessment, and the costs are often quite wide ranges.

In part, this is because a significant number of schemes are still at a relatively early stage of development – some require further work on complex station or junction proposals, while others are still considering many possible options for routes and stations. However, this means that there is significant uncertainty in relation to the cost, benefits and delivery timetables of many schemes.

For the Commission's central estimates of the cost of package schemes, the Commission has used the upper end of the range of costs for HS2 Phase 2b set out in the Oakervee Review, with adjustments for more recent changes, given the level of upward cost pressures seen in the project to date. In general, the standard optimism bias of 64-66 per cent was applied across schemes, which is similar but slightly lower than the rate used in the central HS2 Phase 2b costs. Given the short timeframe for the assessment and the other work being done on costs, and the possibility that schemes in early development might include elements that are later descope without significantly affecting the outcomes, the Commission judged that this was a sensible approach for central estimates.

The Commission considers that ranges are the most appropriate way of assessing costs and has also used this approach for presenting costs. While it has been necessary to consider central estimates to provide an overall budget for packages, at individual scheme level the Commission believes that ranges are the most appropriate way of assessing costs. Potential cost ranges for packages have therefore also been presented in figure 4.1.

The top end of the range of costs could be considerably higher than the Commission has assumed, particularly for some individual schemes at early stages of development. In order to proceed with these schemes, greater certainty about costs will be needed. Government should undertake further work to better develop the evidence base if it is to both avoid past pitfalls of cost overruns and make the case for the benefits of the Integrated Rail Plan. If scope and efficiency savings are found, action needs to be taken to deliver them effectively, which has not always happened on major rail projects.⁷⁰ Government will also need to reflect the differing levels of development of schemes when producing the Integrated Rail Plan.

Budgets

The Commission's binding fiscal remit requires it to demonstrate that all its recommendations for economic infrastructure are consistent with, and set out how they can be accommodated within, gross public investment in economic infrastructure of between 1 per cent and 1.2 per cent of GDP each year between 2020 and 2050. This includes all public sector economic infrastructure within the Commission's remit, not just rail, and existing schemes.⁷¹

The Commission last published a full fiscal remit table in the *National Infrastructure Assessment*.⁷² There is a lot more uncertainty now than when the *National Infrastructure Assessment* was published as to the amount of money available under the fiscal remit, due to the current economic uncertainty following the Covid-19 outbreak. The latest Budget implied a significant uplift in capital spending and the government has stated in the National Infrastructure Strategy that it intends to review the Commission's fiscal remit next year.⁷³

To accommodate this uncertainty, the Commission has used a range of options for rail budgets in the Midlands and the North between now and 2045, using the rail spending proposed in the *National Infrastructure Assessment* as a starting point.

The Commission has developed packages of rail investments that fit within the three illustrative budgets for rail spending in the Midlands and the North between now and 2045, using the rail spending proposed in the *National Infrastructure Assessment* as a starting point:

- **baseline budget (£86 billion)** – a fiscal envelope consistent with the rail spending proposed in the *National Infrastructure Assessment*’s fiscal remit table
- **plus 25 per cent (£108 billion)** – a fiscal envelope that assumes the money available for rail spending is 25 per cent higher than in the baseline budget
- **plus 50 per cent (£129 billion)** – a fiscal envelope that assumes the money available for rail spending is 50 per cent higher than in the baseline budget.

As set out in chapter 3, the ‘plus 50 per cent’ budget is still not enough to deliver all the proposed schemes in the Midlands and the North.

The government’s budget for the Integrated Rail Plan will need to reflect the range of potential costs. The Commission has compiled packages against these three illustrative budgets using the central estimate of costs, within the cost range calculated for each scheme. The central estimates reflect the Commission’s judgement. They are not necessarily the mid-point of the relevant range. This ensures that the packages can be compared at certain budget levels, but the central estimates are not certain, and should not be taken as such.

Objectives for the packages

Within the baseline budget there was only funding available for completing the western leg of HS2 Phase 2b and upgrading key existing lines. However, in the ‘plus 25 per cent’ and ‘plus 50 per cent’ budgets the packages were put together using two key objectives:

- **improve long distance rail connectivity between regions** – this primarily involves delivering north-south links through HS2 Phase 2b which enables faster links from Leeds and Sheffield (on the eastern leg), and Manchester and Liverpool (on the western leg) to Birmingham and London, thereby improving connectivity between the regions
- **improve links across the Midlands and North** – this involves a mix of addressing congestion in key cities, which can improve productivity by increasing the density of city centres, improving connectivity across the regions and connecting people with services.

These two objectives were designed to test the key strategic choices and trade-offs that the Plan will need to take a view on. They illustrate the different investments government could pick if it prioritises faster, longer distance connections between the biggest cities across the region versus choosing to improve connections between a wider range of places within the Midlands and the North. While there is some overlap between investments in the packages, these strategic objectives provide different ways of prioritising objectives in different cost envelopes; so, for example, an investment may be a lower priority for one objective and so only included at a higher budget envelope, but a better strategic fit with the other objective and so included at a lower budget envelope.

Packages of rail investments

The packages set out different combinations of schemes across the eight strategic corridors that combine to form a package of rail investments that is coherent. The Commission has had high-level technical input from Network Rail and the Office of Rail and Road on the cost deliverability and potential performance of the packages, which fall within one of the three illustrative budgets, see above.

The packages are not designed to be cumulative or additive (i.e. the package prioritising regional links at the 'plus 25 per cent' budget was not designed with the idea that it would be upgraded at a later stage to the 'plus 50 per cent' option). Some schemes are complementary, and some are mutually exclusive.

The five packages are:

- **Focussing on upgrades:** by completing the western leg of HS2 Phase 2b and upgrading key existing lines including the East Coast Main Line and Midland Main Line, in line with the baseline budget
- **Prioritising regional links:**
 - by delivering major upgrades (including some new line) on the Liverpool, Manchester, Leeds corridor, addressing congestion between Leeds and York and improving links to Bradford, a new high speed line from Birmingham to the East Midlands providing direct services to Nottingham, improving links to Birmingham Airport and enhancements across the Midlands through the Midlands Rail Hub, and upgrades to the Midland Main Line, in line with the **plus 25 per cent budget**; or
 - by building new lines across the Liverpool, Manchester, Leeds corridor which also serve Bradford, increasing capacity between Leeds and Newcastle and upgrading the route from Manchester to Sheffield, whilst also delivering a new high speed line into Leeds, providing improved journey times to/from Sheffield, and upgrades to the Erewash Valley route, as well as the Midland Main Line, building a new high speed line from Birmingham to the East Midlands, improving links to Birmingham Airport and enhancements across the Midlands through the Midlands Rail Hub, in line with the **plus 50 per cent budget**
- **Prioritising long distance links:**
 - by focussing on delivering the full HS2 Phase 2b network to improve long distance connections, completing the Transpennine Route Upgrade between Leeds and Manchester, and Midlands Connect schemes that utilise the eastern leg of HS2, in line with the **plus 25 per cent budget**; or
 - by delivering the full HS2 Phase 2b network, along with other schemes in the 'plus 25 per cent' package, as well as adding additional tracks to the Transpennine Route Upgrade between York and Manchester, upgrading connections and capacity from York to Newcastle, and Manchester to Liverpool, and building Midlands Rail Hub to improve capacity into and across the Midlands, in line with the **plus 50 per cent budget**.⁷⁴

HS2 Phases 1 and 2a were out of scope of this Assessment. The costs of these schemes are included in the Commission's fiscal remit (see above) so are included in the three illustrative budgets. However, as these phases were out of scope the marginal benefits from phases 1 and 2a have not been included in the analysis. The costs of each package excluding HS2 Phases 1 and 2a, and discounted to reflect the value of time, have therefore been set out in the list below to enable a like for like comparison of the costs and benefits of each package.

Figure 4.1: Total costs, costs net of HS2 Phases 1 and 2a and discounted costs for each package⁷⁵

Package	Costs of package (£bn) (central)	Net costs of package without HS2 Phases 1 and 2a (£bn) (central estimate)	Net costs of package without HS2 Phases 1 and 2a (£bn) (range)	Net discounted costs, without HS2 Phases 1 and 2a (£bn) (central estimate)	Net discounted costs, without HS2 Phases 1 and 2a (£bn) (range)	Net discounted costs (£bn) without HS2 Phases 1 and 2a, electrification, digital signalling and 'early wins', (central estimate)
Baseline budget						
Focusing on upgrades	81	44	(41-53)	32	29-39	21
Plus 25 per cent						
Prioritising regional links	107	69	(64-85)	46	42-57	36
Prioritising long distance links	105	68	(64-77)	45	39-52	34
Plus 50 per cent						
Prioritising regional links	130	92	(85-113)	60	54-73	49
Prioritising long distance links	128	90	(84-104)	59	52-69	48

Note: There is an allocation for traction decarbonisation (£10bn), railway control systems (£3bn) and 'early wins' (£2bn) within the packages, reflected in the second to sixth columns. However, the benefits of these have not been included in benefit and impacts calculations, so the last column provides the net cost associated with the benefit calculations.

The Commission has included an allocation of at least £15 billion for ongoing transformation programmes for decarbonisation, digital signalling and for 'early wins' in each of the packages, as it is important that these are considered as part of the Plan and funding for them included (see chapter 6). As these ongoing programmes will need to be firmed up, these will have additional benefits that have not been included in the assessment of these packages.

For electrification, a high-level estimate by the Commission suggests that the Traction Decarbonisation Network Strategy published by Network Rail could imply additional infrastructure of £18bn in the North and Midlands.⁷⁶ However, this requires more work on the detailed costings and how much rail line would be appropriate to electrify, so an indicative sum has been left for this. This could include schemes such as Leeds-Hull, where this has not been covered in a package. Most digital signalling would be funded under the renewals programme, but an additional £3bn for enhancements beyond the renewals programme has been included to fund work such as improved signalling of the West Coast Main Line north of Crewe. It will be for government working with industry and stakeholders to decide on the most appropriate balance of spend, but it is important that funding is retained for these important investments alongside major rail schemes.

Chapter 5 sets out a comparison of the benefits of the packages; the packages are each covered in more detail in annexes A-C.

Box 4.1: HS2 across the packages

The Commission has taken varying approaches to HS2 across the packages:

- **HS2 Phases 1 and 2a** were out of scope of this Assessment, so the costs and benefits are treated as described above.
- **The western leg of HS2 Phase 2b** from Crewe to Manchester is included in all the packages as it will help deliver the full benefits of HS2 Phase 2a, which already reaches Crewe from Birmingham, and as there are no viable alternatives to increase capacity into Manchester.⁷⁷ However, not all packages include the Golborne link (see chapter 5). The Commission notes that the government and HS2 Ltd are continuing to prepare legislation for the western leg, reflecting the findings of the Oakervee review that Phase 2b should be delivered in smaller sections with legislation brought forward as it is ready.⁷⁸
- **The full eastern leg of HS2 Phase 2b** from Birmingham to Leeds is included in the packages prioritising long distance links. The packages prioritising regional links do not include the full eastern leg of HS2 Phase 2b, but instead include a mix of new lines and upgrades, which has the potential to provide improved connections from Birmingham to the East Midlands as well as being potentially cheaper and faster to deliver. The 'plus 50 per cent' budget package contains a partial new line between Leeds and Sheffield which provides equivalent journey time and frequency improvements between these cities to the planned Northern Powerhouse Rail scheme, which requires HS2 to be in place. These schemes are presented at a strategic level and detailed planning work would be required on design, scope and fit with the rest of the network.

Assessing the packages

The Commission has developed an alternative methodology for the Rail Needs Assessment. Conventional approaches to cost benefit analysis of transport interventions, which assess the effect of rail interventions in isolation, present challenges in the context of economic transformation. The

Commission's methodology instead approaches the question in terms of assessing the potential for rail investments to support both economic growth and competitiveness, and sustainability and quality of life.

The Commission has assessed the quantified benefits of each of the packages for:

- improvements to productivity in city centres (from agglomeration impacts)
- improvements to connectivity from faster journeys, primarily between places in the Midlands and the North, but also to Scotland, and the rest of the world via airports
- 'amenity' benefits from connecting people to services concentrated in cities.

The Commission has calculated productivity benefits from the increase in employment density enabled by greater capacity delivered by rail proposals in the packages. This increase will then be multiplied by the impact of greater density on productivity, for which a range of estimates already exist. This approach was set out in the Commission's working paper *Capturing the value of urban transport investments*.⁷⁹ This will establish the potential for improvements in productivity enabled by delivering greater capacity on the rail network.

Improvements to connectivity are shown by a percentage increase in connectivity between places using a rail connectivity metric. The methodology for this metric builds upon the methodology developed for the Commission by Prospective Labs as part of the evidence base for the *National Infrastructure Assessment*. It is calculated for each place by adding up the journey times to other cities in the region, airports, London, and other key places, and weighting this by the resident population of each destination. The journey time is the in-vehicle time, plus a wait time, which depends on service frequency. This metric is also calibrated so that longer journeys are given less weight, to reflect the impact of travel time on willingness to travel.⁸⁰

The Commission has undertaken new analysis to assess how much transport allows people to access 'amenity' benefits.⁸¹

The Commission has also assessed the monetised cost of the loss of natural capital, and lifecycle carbon emissions associated with each package. Programmes of electrification will also reduce emissions from rail in the long term.

The Commission has also considered the benefits in terms of unlocking investment in land around stations (see annexes A-C), on freight (see box 5.4), and on reliability (see chapter 5), but these benefits have not been quantified.

The terms of reference of the Integrated Rail Plan start with a clear government commitment to greater rail investment in the Midlands and the North. In this Assessment, the Commission has considered how best to do this, rather than whether to do it at all. The Commission's methodology therefore assesses which rail interventions deliver the most potential benefits within a given budget, and do not produce a traditional Benefit Cost Ratio. However, the value for money case of the packages is discussed in chapter 5.

It is also worth noting that the Commission's methodology only considers the impacts delivered in the Midlands and the North by these packages. While places outside these regions have been considered in the connectivity analysis – e.g. connectivity to London – the economic benefits to London or other cities outside the region have not been included. The methodology also does not highlight the marginal impacts of phases 1 and 2a of HS2.

Within the region, these will deliver significant benefits for the West Midlands in particular, with the two new HS2 stations in Birmingham and Solihull. But the focus on connectivity to London in phases 1 and 2a also means that London will see significant benefits from these investments.

The strategic case for new rail investment does not lie in the direct benefits that would be measured in a traditional Benefit Cost Ratio, but in the potential impact of a wider levelling up strategy that includes investment in rail. Rail alone is unlikely to transform the economic geography of the Midlands and the North. As set out in chapter 2, any package of rail investments should form part of a wider economic strategy including skills and urban transport. It is the cumulative effects of a broad strategy, not the direct impact of rail investment, that can deliver the benefits to the Midlands and the North.

The Commission's methodology is intended to guide judgements on which rail investments are most likely to deliver economic transformation as part of a wider strategy. The methodology depends on the assumption that the chances of delivering economic transformational change with this wider strategy are best supported by rail interventions that are aimed at improving rail's individual contribution to economic growth.

Full details on the methodology used is set out in the modelling annex published alongside this Assessment.⁸²

Areas for further work

Given the short timeline involved in the assessment, as well as ensuring that the scope of the assessment remains manageable, the Commission has had to focus on the strategic case for investment. While the Commission has considered detailed evidence where possible, it has not undertaken the type of detailed railway planning that a project of this scale will need. Government, along with Network Rail and regional transport bodies, will need to ensure that this detailed work is undertaken for the Plan to be a success.

The Commission's thoughts on the need for better integration (chapter 6) and to create an effective pipeline of potential further investments are set out in detail elsewhere. But in developing the Plan, the government will also need to consider the following areas which the Commission has not been able to fully assess:

- **Disruption during construction:** as set out in box 5.2, significant further work is still required to understand the disruption impact for the majority of schemes that could be included in the Plan.
- **Proposed service specifications:** given the complexity of railway planning the Commission has not been able to assess whether the Train Service Specifications scheme promoters expect are the best way of using new infrastructure. The Assessment has only highlighted where outside factors, such as current performance (see box 4.2), may create barriers to their delivery. Government will need to ensure service specifications are robust if full benefits are to be delivered. There is also significant ongoing work on how to best use released capacity.⁸³ Getting this right will help to maximise the benefits of the Plan.
- **Decarbonisation of the railway:** while Network Rail has published the interim programme business case for its Traction Network Decarbonisation Strategy,⁸⁴ significant further work will be needed to finalise the right set of investments to decarbonise the railway. A rolling programme of electrification should be established as a key pillar of decarbonisation

work, but detailed work will be needed to establish which routes are the priority for early electrification. Alongside this, work will also need to be progressed on the role hydrogen and battery trains will play and where they will need to be employed.

- **Maximising regeneration and development opportunities:** while many opportunities have been identified, government will need to ensure that these are developed in line with rail investment plans to maximise the benefits delivered. There are also opportunities that have not yet been considered in detail, or which could become more attractive depending on the rail investment options chosen, such as wider investment in Bradford.
- **Sequencing of investments:** while the Assessment covers some potential options for sequencing in chapter 6, more detailed technical analysis will be needed to assess how investments could be delivered incrementally and the impact this could have on delivery timings.
- **Integration:** Effectively integrating new high speed lines into the railway network is a significant challenge. For example, the existing network will need to be suitably upgraded to accommodate ambitious HS2 service specifications. Existing pinch points across the network are causing reliability and performance issues and this will only become a bigger issue in future. If the planned HS2 service specification is to be delivered then investment will be needed in the Midlands, East Coast and West Coast Main Lines. The government should consider the following integration issues in the Plan:
 - how to maintain railway performance while line upgrades are completed or new lines built
 - the role of stations, including Leeds and Manchester Piccadilly, in configuring a network that makes the most of new and existing infrastructure
 - interim improvements, for example electrification, line speed improvements and updates to railway control systems, that are aligned with the delivery of major projects.

Even the core set of schemes will require further work and refinement as they go through the consents process. However, it is important that this further work is given sufficient focus to ensure that costs, benefits and delivery plans are robust. There will also be more fundamental work needed to ensure some options are sufficiently well developed. Chapter 4 set out how this could be managed through the development of a pipeline of future investments, as options become more mature.

It is worth emphasising the scale of work involved in some cases, particularly potential strategic alternatives to the full eastern Leg of HS2 if these are to be considered. Further work will be needed to assess the costs and benefits of these potential strategic alternatives, but also to ensure that they are optimised to deliver benefits to the key places on route.

Further specific areas of further work that are required to deliver individual packages are included in each of the package annexes.

Box 4.2: Performance and reliability

Punctuality on the rail network deteriorated between 2011-12 and 2019-20 (performance has improved over 2020 due to fewer services running on the network).⁸⁵ Despite plans to improve, timetable planning has not been effective at maintaining the performance of the network, sometimes causing significant issues for passengers and the network.⁸⁶ There has also been an increase in delays per incident as capacity has become constrained, and poor service recovery when things do go wrong.⁸⁷ Passengers are used to experiencing delays and disruption, and often plan for it, but this can also reinforce the view that public transport is poor value for money.⁸⁸

New rail infrastructure has the potential to improve the performance of the rail network – as has happened with HS1⁸⁹ – but this is not a given, as the performance of new high speed lines will be impacted by performance on the existing network. Government therefore needs to ensure that the right investments are made prior to major projects coming online. For example, if high profile projects such as HS2 are unable to deliver the level of performance their plans require, then the expected benefits are unlikely to be delivered and confidence is likely to be undermined.

5. Comparison of packages

The Commission's analysis suggests that packages of rail investments prioritising regional links are likely to have the most potential benefits for cities in the Midlands and the North. These packages are likely to deliver the highest benefits to productivity as they can support higher densities in city centres.

The package focussing on upgrades is unlikely to meet the strategic objective of levelling up in the North and the Midlands. The benefits it delivers are not at scale and would be less likely to trigger long term economic transformation than other packages.

The packages prioritising regional links appear to be most likely to bring the greatest benefits, overall, to cities in the North and Midlands and to support levelling up.

As part of an adaptive approach, the government could sensibly begin by committing to a core set of programmes. There is a strategic case for increasing the budget to 'plus 50 per cent'. However, this high level of investment would be a strategic bet and comes with higher risks. The costs and benefits of all the necessary schemes are not sufficiently well articulated for the Commission to take a firm view on this. If more funding were available under an adaptive approach, then there are a number of future choices available to the government, including completing the HS2 Phase 2b eastern leg.

Headline costs and benefits

The Commission used a multi-criteria approach to assess the packages, as covered in the previous chapter. Figure 5.1 sets out the headline assessment of the benefits and impacts of the packages that the Commission has quantified. The numbers in this table are discounted, in contrast to figure 0.1 (in the executive summary), which included undiscounted numbers. The numbers in figure 5.1 would only form one part of a traditional Benefit Cost Ratio and should therefore not be interpreted as such. It is the cumulative effects of a broad strategy, not the direct impact of rail investment, that can deliver transformative benefits to the Midlands and the North. However, with some assumptions about the non-monetised benefits, the Commission's analysis suggests the full benefits should meet or outweigh the costs of the packages.⁹⁰ The value for money case is discussed in more detail below.

Figure 5.1: Headline benefits and impacts across packages (discounted)⁹¹

Package	Economic growth and competitiveness		Sustainability and quality of life		Costs
	Improvements to connectivity from faster journeys	Improvements to productivity in city centres, discounted	Benefits from connecting people to city services, discounted	Environmental impact (combined quantified partial valuation of the loss of natural capital and monetised lifecycle carbon impact)	Net discounted costs without HS2 Phases 1 and 2a, electrification, digital signalling and 'early wins', central estimate
Focus on upgrades	7%-9%	£7-12bn	£2-4bn	-£0.2 to -£0.1bn	£21bn
Plus 25 per cent					
Regional links	9%-15%	£12-20bn	£3-7bn	-£0.4 to -£0.3bn	£36bn
Long distance links	10%-11%	£10-17bn	£2-6bn	-£0.4 to -£0.3bn	£34bn
Plus 50 per cent					
Regional links	11%-19%	£16-29bn	£4-10bn	-£0.6 to -£0.4bn	£49bn
Long distance links	11%-12%	£13-23bn	£3-8bn	-£0.5 to -£0.4bn	£48bn

As shown in figure 5.1, the packages prioritising regional links provide the highest combined benefits. At the 'plus 25 per cent' budget, the package prioritising regional links has the highest potential improvements for productivity in cities in the Midlands and the North, and may also provide higher trade benefits to businesses from faster and more frequent connections between cities (potentially up to a 15 per cent improvement compared to 11 per cent for the 'plus 25 per cent' package prioritising long distance links). At the 'plus 50 per cent' budget, the package prioritising regional links has the highest potential benefits of all the packages, both in terms of productivity and trade benefits.

The Commission has also considered the potential benefits of the packages for unlocking investment in land around stations and the potential impact on freight, set out in Annexes A-C, and the impact of each of the packages on connectivity with Scotland and the rest of the world via airports, covered later in this chapter.

Value for money

The Commission's approach estimates monetised benefits and costs from productivity, amenities and environmental impacts. The impact of improvements in connectivity from faster and more frequent long-distance journeys are not easily converted into monetary values, as a full assessment would need to include all transport modes, which lies beyond the scope of this study. With some assumptions about the monetary benefits of improved connectivity, the benefits of the packages should meet or outweigh the costs. This varies by package and there are ranges of both potential costs and benefits for each package which would affect the exact Benefit to Cost Ratio.⁹²

An adaptive approach allows decisions on the budget to be taken incrementally and mitigates the risk of overpromising and overspending. However, the core programme must be at sufficient scale to have the potential to support wider economic transformation. The benefits of packages at the 'plus 25 per cent budget' still appear to meet or outweigh the costs, even with the increase in spending in comparison to the package focussing on upgrades. However, they have a far better change of contributing to economic growth than the package focussing on upgrades.

This is covered in more detail in the modelling annex published alongside this Assessment.⁹³

The Commission's methodology is intended to guide judgements on which rail investments are most likely to support economic transformation as part of a wider economic strategy. It is the cumulative effects of a broad strategy for transformation, not the direct impact of rail investment, that can deliver the biggest benefits to the Midlands and the North. The benefits of rail are also dependent on the assumptions set out in chapter 4.

The Commission has undertaken sensitivity analysis to consider the potential benefits if a wider economic strategy were successful (e.g. if wages in the North and the Midlands were higher) and these are set out in box 5.1. However, these estimates still do not capture the interactions between rail investment and other policies.

Box 5.1: Sensitivity analysis

The Commission has chosen to develop its own methodology to use for the assessment. In order to be transparent and to test the robustness of the results, the Commission has considered a plausible range of impacts for each of its key criteria, based on varying the assumptions about a series of key parameters.

These parameters varied to produce these ranges are:

- **connectivity:** the relative value of longer journeys, compared to shorter ones
- **productivity:** the elasticity used to describe the expected change in productivity resulting from a change in employment density
- **amenity benefits:** the percentage of additional rail capacity used to access amenities
- **environment:** the price of carbon and the value of ecosystem services.

Rather than just using the midpoint of the range, the Commission has used its best estimate for each parameter to provide the central estimate of impacts presented in the report.

In order to further test how robust the results are to different assumptions the Commission has also undertaken a number of sensitivity tests. These tests consider how impacts could change in different scenarios. These scenarios include:

- more, or less capacity released by new lines being able to be used
- what might happen if more people moved to places that become better connected
- a reasonable best case scenario to describe how productivity might be impacted by achieving a transformational level of change
- the natural capital impacts if all land lost had the highest possible value.

At an overall package level, none of these sensitivities changes the messages set out in this report. They also reinforce that the value of rail investment could be higher, if the right complementary policies were put in place to create significant change.

Full details of the assumptions made in the Commission's analysis and the sensitivity tests are included in the modelling annex published alongside this report.

Prioritising regional links is likely to deliver the most benefits

Focussing on upgrades will not address the issues in the Midlands and the North

The significant increase in the cost of many rail schemes since the National Infrastructure Assessment was published two years ago means that the level of funding set out in that Assessment only provides for upgrades and some new lines, as demonstrated in the package focussing on upgrades.

The Commission's judgement is that the package focussing on upgrades is unlikely to meet the strategic objective of levelling up in the North and the Midlands. Although this package provides some improvement to the speed and frequency of trains between cities, and to capacity into city centres and has the lowest environmental impact, the benefits it delivers are not at scale. It would be less likely to trigger long term economic transformation than other packages – investment should be at scale to deliver this (see chapter 2).

The package focussing on upgrades only is covered in more detail in Annex A. There are some upgrades that the government could pursue on a 'no regrets' basis, such as the Midland Main Line electrification. Each package includes some 'no regrets' upgrades.

Box 5.2: Disruption

Building large scale transport interventions inevitably brings disruption. It is very likely that major upgrades will involve more disruption than wholly new rail lines to rail passengers, although other forms of disruption must also be considered. All the packages include new rail lines and upgrades to varying degrees.

New rail lines would still cause a large amount of disruption on existing lines where these are being integrated with new lines, and where major changes are needed to existing junctions and stations, as well as to the road network. The Call for Evidence responses noted that proposals for HS2 Phase 2b could have unprecedented impacts on the Strategic Road Network, with Highways England analysis suggesting work on over 30 junctions is needed and traffic management across key sections of the road network including the M1, M56, M42 and M6 and the realignment of a section of the M1 with 50 mph running for approximately three years. Managing this will be a significant challenge and requires more work on the impacts of road closures, traffic management, construction traffic, traffic mitigation works and interaction with other planned work.

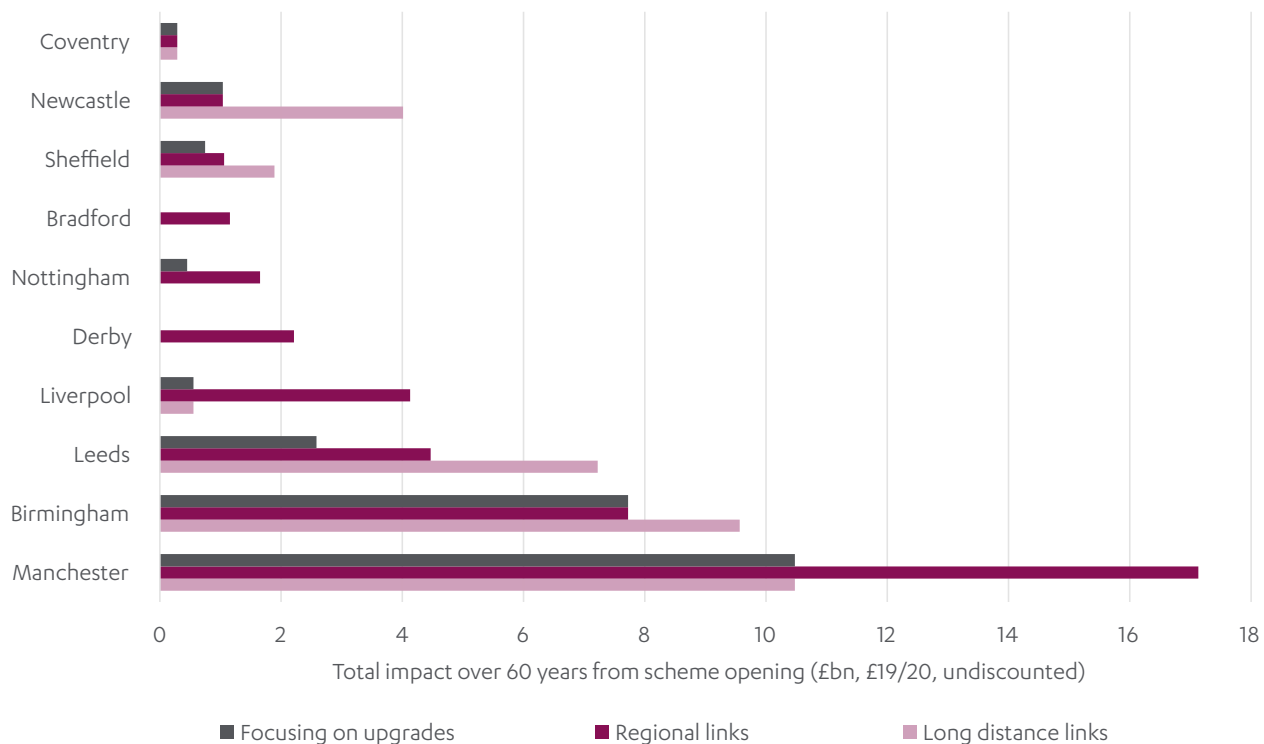
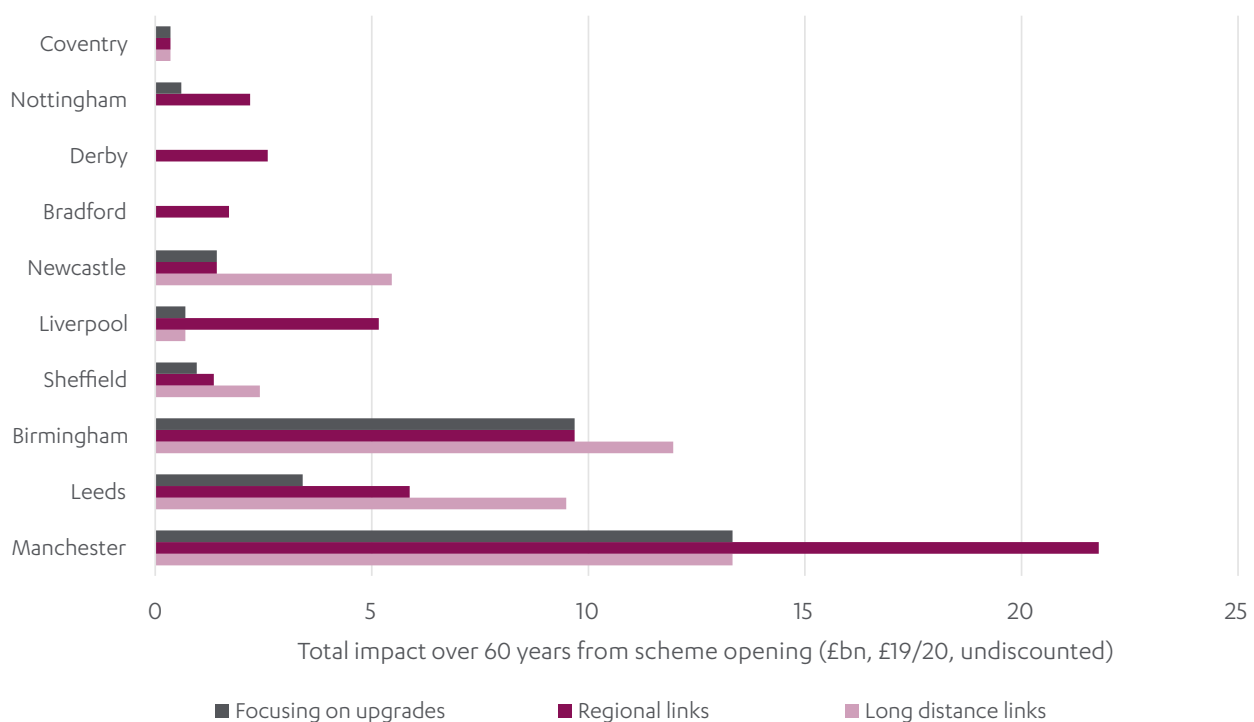
Levels and duration of rail disruption will vary considerably between different schemes and will be determined by the extent of engineering work on and adjacent to the railway, the construction methodology adopted and the programming of works. Therefore, while disruption is a major issue and is likely to be somewhat worse with upgrades, this will depend on many factors. Further work is needed on the scale of disruption and how the impacts can be mitigated.

At the 'plus 25 per cent' budget, the package prioritising regional links appears to deliver the most benefits for cities in the Midlands and the North

The Commission considered two different packages in the 'plus 25 per cent' budget: prioritising regional links and prioritising long-distance links. The package prioritising regional links appears to be most likely to support the strategic objective of levelling-up the Midlands and the North, as it is likely to offer the highest benefits. The package prioritising regional links can:

- improve the quality of regional, largely east to west rail links between cities within the Midlands and the North, which are generally inferior to longer distance rail links
- focus on schemes that can provide the biggest potential improvements in productivity across the Midlands and the North
- deliver greater improvements to connectivity for several key cities, including Nottingham, Coventry, Derby, Manchester and Liverpool, while also providing significant improvements to a range of smaller places, such as Crewe, Doncaster, Huddersfield and Warrington, and potentially Hull under the electrification programme
- address the biggest problems of existing poor capacity and connectivity, with significant further capacity added to Birmingham, Manchester and around Leeds, particularly on the route to York, and improved connectivity between and within the West and East Midlands, for example improving journey times between Birmingham and Nottingham
- focus improvement on the journeys that people are most likely to take – into cities from the surrounding area, rather than into London (for example, in 2018-19, 60 per cent of rail journeys in Yorkshire and the Humber were between places in the region, while only 10 per cent were to London).⁹⁴ Specific journey time improvements are set out in annex B.

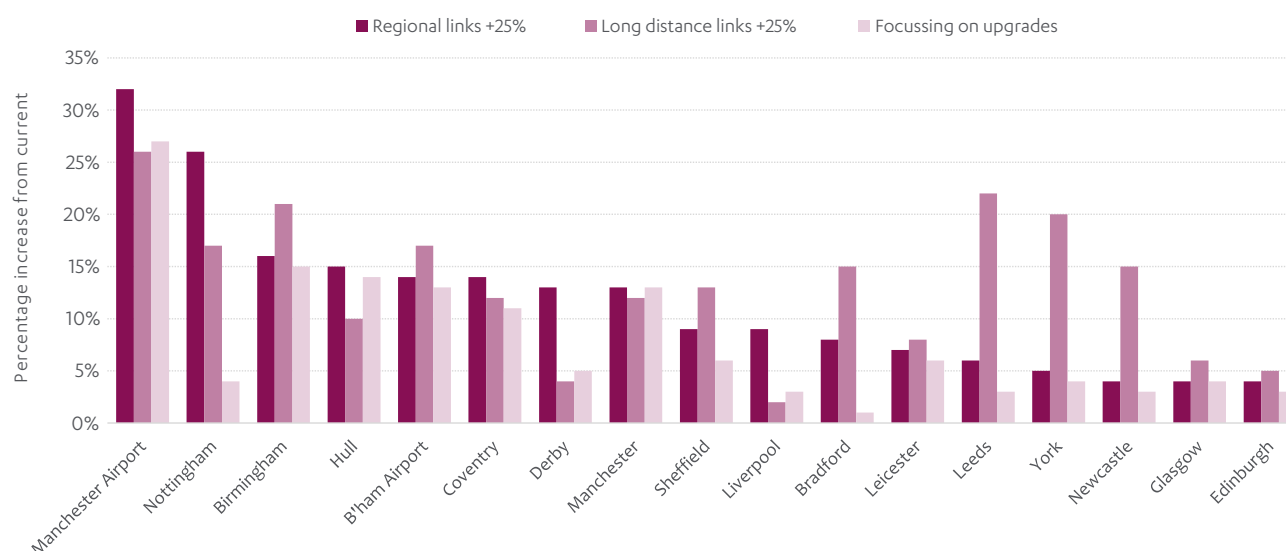
The 'plus 25 per cent' package prioritising regional links provides the highest improvements for productivity in city centres overall – estimated to be around 20 per cent higher than the potential improvements from the 'plus 25 per cent' package prioritising long distance links (see figure 5.1).

Figure 5.2: Total productivity benefits per city, central estimates⁹⁵**Figure 5.3: Total impact of agglomeration (amenity and productivity benefits) per city, central estimates⁹⁶**

It also performs better than the package prioritising long distance links on other measures:

- the range of potential improvements to connectivity is higher (up to 15 per cent, compared to up to 11 per cent, see figure 5.1)
- the range of potential benefits of connecting people to city services is higher (£3-7 billion, compared to £2-6 billion, see figure 5.1)

Figure 5.4: Percentage increase from current connectivity for key cities – NIA consistent and +25% packages, central estimates⁹⁷



More detail on this package and its benefits can be found in annex B.

Box5.3: Prioritising highly connected clusters of cities

The Commission also considered a further option in the ‘plus 25 per cent’ budget, which focussed on linking nearby cities within regions. This provided another way of addressing the rail needs in the Midlands and the North, by improving the speed and frequency of journeys linking nearby cities to create ‘clusters’ of cities, which could deliver benefits to businesses by connecting them with wider markets.

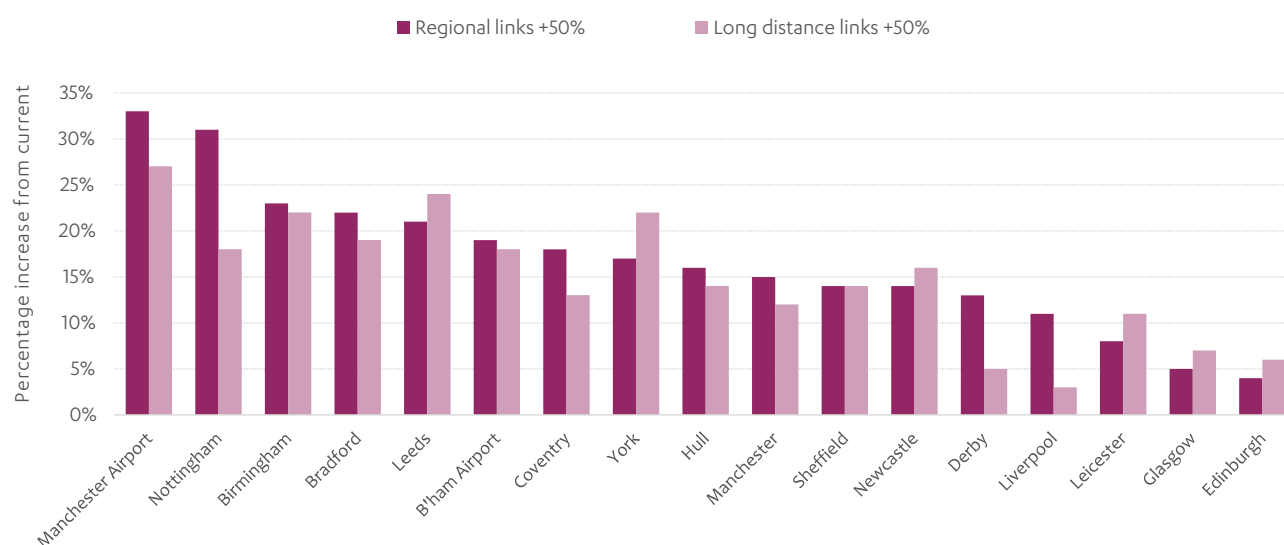
The package formed several clusters, using a mix of new lines and upgrades: in the North West around Crewe, Manchester and Liverpool; across the Midlands between Birmingham, Nottingham, Derby and Leicester; and in Yorkshire between Leeds, Bradford, Sheffield and York.

This package delivered benefits comparable to, but not higher than, the other two packages within this budget. On balance, the Commission decided that this option was very close to, and delivered very similar benefits to, the package prioritising regional links, and so has not included it as a comparator.

The packages in the ‘plus 50 per cent’ budget have higher benefits, but also higher risks

The ‘plus 50 per cent’ budget option prioritising regional links has the highest potential benefits of all the packages. It performs better on all measures than the package prioritising long distance links at this level of funding, including for benefits to businesses from providing faster and more frequent connections between cities (see figure 5.5). However, the environmental impacts of the ‘plus 50 per cent’ packages are also higher as they typically involve constructing more new lines.

Figure 5.5: Percentage increase from current connectivity for key cities – ‘plus 50 per cent’ packages, central estimates⁹⁸



There is a strategic case for increasing the budget to ‘plus 50 per cent’ under certain conditions. However, increasing the budget would be a strategic bet and comes with higher risks. The costs and benefits of the schemes themselves are not sufficiently well articulated to take a firm view on this. Government should also be confident that complementary investments in areas such as local transport, which increase the likelihood of major rail investments contributing to transformation (see chapter 2), are in place.

Box 5.4: Freight

It is important that major schemes and upgrades consider how they may impact on freight services, particularly where they interact with the existing network, to understand the interaction between different types of services and ensure that interventions deliver the greatest benefits. Allocating paths to freight reduces the paths available to passenger trains, and vice versa, and the allocation of paths to freight may impact some of the benefits in the Commission’s analysis.

The packages prioritising regional links would deliver benefits for freight flows through the Midlands and across the Pennines. In the ‘plus 25 per cent’ package there would likely be little increased capacity for freight on the West and East Coast Main Lines, which means it would be likely for there to be only limited improvements for long distance freight traffic to Scotland. Freight crossing the Pennines would benefit from the upgrades and additional capacity between Manchester and Leeds, and freight in the Midlands and North West would benefit from the capacity released by the western leg of HS2

(excluding the Golborne Link). In the 'plus 50 per cent' budget package, the West and East Coast Main Line improvements, the Midlands Rail Hub, increased capacity between Manchester and Leeds, and, potentially, the Midland Main Line would all further support freight.

The packages prioritising long distance links would be likely to give the most benefits for long distance freight going to and from Scotland. In the 'plus 25 per cent' package, the improvements to the West Coast Main Line via Golborne would support freight to an extent. The Midlands Rail Hub would also help and new lines would create capacity for freight on the conventional rail network. Transpennine freight could see benefits from the Transpennine Route Upgrade and HS2 Phase 2b capacity in the North West.

The 'plus 50 per cent' package would deliver more benefits for freight, providing upgrades on the East Coast Main Line and improving the route from Manchester to Liverpool, which could offer some limited benefits for freight by alleviating capacity constraints on the local network.

An adaptive approach based on the 'plus 25 per cent' package prioritising regional links

If the government wishes to invest more in rail in the Midlands and the North, the Commission advises that this should form part of an adaptive approach. The Commission has had to develop packages on the basis of existing proposals which do not necessarily fit within this approach, so it is not possible to set out here exactly which additional schemes should be considered under an adaptive framework. However, if the pipeline of investments were based on a similar set of investments to the Commission's 'plus 25 per cent' package prioritising regional links or something similar, further schemes or enhancements might include:

- a phased approach to the remaining sections of the eastern leg from the East Midlands to Leeds
- prioritising improved connectivity between Sheffield and Leeds, as set out in the 'plus 50 per cent' package prioritising regional links
- improved connectivity between Sheffield and Manchester
- a new line from Manchester to Leeds via Bradford, building on the partial new line option in the 'plus 25 per cent' package.

The development of these schemes should continue so decisions can be made on the best possible evidence. This may require continuing development funding in the short term.

While the Commission's analysis suggests that the highest local economic benefits are likely to be delivered by initially prioritising regional links, this does not rule out the further development of options such as the HS2 Phase 2b full eastern leg that also have strategic value. There is the possibility of approaching the eastern leg in phases, starting with a high-speed line between the West and East Midlands to significantly enhance capacity and connectivity.

Further insights from the Commission's analysis

Connectivity with Scotland

The Commission has assessed the impact that the different rail packages have on connectivity with Scotland. Given the Commission's remit is UK government competencies and the focus of this Assessment is the rail needs of the Midlands and the North specifically, none of the packages include investment options which would fall wholly or partially within the responsibility of the Scottish government, such as cross-border high speed lines.

While there are some improvements to connectivity to Scotland from the Commission's packages, these are relatively modest. The full HS2 delivers up to a 50-minute reduction in journey times between London and Scotland. However, Phase 2b only reduces the journey time from London to Glasgow by a further five minutes, compared to Phases 1 and 2a,⁹⁹ although it is also worth noting that HS2 trains do not start serving Edinburgh until phase 2b.

Figure 5.6: Connectivity improvements for Edinburgh and Glasgow across the packages, central estimates¹⁰⁰

	Upgrades only	Regional links + 25%	Long distance links +25%	Regional links + 50%	Long distance links + 50%
Edinburgh	3%	4%	5%	4%	6%
Glasgow	4%	5%	6%	5%	7%

Some Northern Powerhouse Rail interventions, for example between Leeds and Newcastle, will have some benefits for connectivity to Scotland. And improvements on the East and West Coast Main Lines could help address the rail needs of the Midlands and the North while also improving connectivity to Scotland. For example, addressing the signalling and performance issues on the West Coast Main Line, some of which were highlighted in chapter 3, could have a significant performance benefit for London to Glasgow trains.

This means that the package focussing on upgrades delivers benefits for Scotland that are comparable with the more expensive packages, particularly at the 'plus 25 per cent' budget, given the improvements to the East Coast Main Line (see figure 5.6).

Much of the discussion around connectivity to Scotland has focussed on the UK and Scottish Governments' jointly agreed 'ultimate aim' of a three hour journey time between London and Scotland.¹⁰¹ The Assessment has not considered whether the three hour ambition is the right one, but if it is to be achieved then significant further investment would be needed.

One way of improving journey times to Scotland would be to change the design of the Golborne Link, part of the current western leg of HS2 phase 2b. The Golborne link contributes to phase 2b's modest impact on journey times to Scotland by allowing HS2 trains serving Scotland to bypass more of the West Coast Main Line. Making the link longer – bypassing more of the West Coast Main Line by joining it further north – has the potential to further reduce journey times to Scotland as well as releasing additional capacity on the West Coast Main Line.

The Golborne Link has not been included in all packages; (see annexes A-C) given its modest impact on connectivity with Scotland, whether to include it or not was based on the strategic fit with the aims of the package and cost considerations. While the Commission has not been able to consider alternative designs as part of the Assessment and a longer link would require increased funding, the potential higher benefits from a longer link are worth exploring.

The recently launched Union Connectivity Review¹⁰² is an opportunity to consider the level of priority and funding that government wishes to give to cross-border rail connections. Government must ensure that the outcome of this review is joined up and aligned with the priorities set out in the Integrated Rail Plan.

Connectivity with the rest of the world

The Commission has also assessed the impact of the rail packages on connectivity with the rest of the world via Birmingham and Manchester airports. All the packages improve the speed and frequency of journeys to and from the airports, with the strongest impacts for Manchester Airport, primarily due to the western leg of HS2 Phase 2b, which is included in all the packages. It is worth noting that, given its proximity to the HS2 Phase 1 Birmingham Interchange Station, Birmingham Airport is already likely to see significant connectivity improvements.

Figure 5.7: Connectivity improvements for airports across the packages, central estimates¹⁰³

	Upgrades only	Regional links + 25%	Long distance links + 25%	Regional links + 50%	Long distance links + 50%
Birmingham airport	13%	14%	17%	19%	18%
Manchester airport	27%	32%	26%	33%	27%

The proposed East Midlands Hub in Toton

The East Midlands Hub is a planned new railway station on the eastern leg of HS2 Phase 2b. It is intended to be in Toton, Nottinghamshire, between Nottingham and Derby. The East Midlands Hub will allow HS2 services to run through the East Midlands from Birmingham and provide opportunities to run services from Leicester on to Leeds using HS2 infrastructure, as well as Birmingham on to Nottingham via the East Midlands Hub.

A range of local councils, MPs, Midlands Connect and local enterprise partnerships strongly support the proposed East Midlands Hub.¹⁰⁴ The Toton Development Corporation has been set up to lead on the local growth plan associated with Toton, which proposes housing development in Toton and Chetwynd Barracks as well as an ‘innovation campus’, an industry and employment zone at Ratcliffe Power Station and enabling airport growth at East Midlands Airport.¹⁰⁵ There are also ‘Access to Toton’ connectivity proposals from Midlands Connect which link Derby, Nottingham, Mansfield and Leicester to the East Midlands Hub through a series of proposed road and rail investments and a tram extension from Nottingham to Derby via Toton. The first phase of this programme is estimated to cost £455m and the full package totals up to £2.7 billion.¹⁰⁶

Improving connectivity between places in the East Midlands is particularly important given comparatively slow and infrequent services between cities in the region. Journeys to key cities in neighbouring regions, such as Nottingham and Birmingham, or between Leicester and Coventry are also poor. Upgrading these regional links to and within the East Midlands should be a key consideration for the Integrated Rail Plan.

The East Midlands Hub in Toton is included in the long distance packages where the full Eastern leg of HS2 is being delivered, to enable people from different cities and towns in the East Midlands to access HS2 services. These packages also include the rail investments from the 'Access to Toton' scheme as, if the station at Toton is to be a success, significant investment in local and regional transport alongside HS2, as well as in the wider development plan, will be required.

Under different scenarios, it is less clear to the Commission that a hub station at Toton would still be the right solution for improving connectivity across the Midlands. Setting aside costs, Toton requires the development of a new site on railway brownfield, requiring the relocation of existing rail facilities and extensive work on nearby junctions. In addition, its location means that high speed services would not directly serve any of the cities in the East Midlands, although Midlands Connect have proposed schemes that would provide direct services into Nottingham, with a new junction on the HS2 line and link to the conventional railway.¹⁰⁷

An alternative option for consideration would be to improve the existing East Midlands Parkway station next to the Ratcliffe Power Station site, which was previously considered for the eastern leg of HS2 Phase 2b. This is included in the packages prioritising regional links, as using East Midlands Parkway, would better enable faster rail services between Nottingham and Birmingham (potentially 27 minutes, compared to 53 minutes via the Toton East Midlands Hub or 33 minutes with Midlands Connect's conventional compatible services in addition to Toton).

This could still enable development at Ratcliffe and the East Midlands Airport, which is a major hub for freight and therefore has scope for employment linked to logistics and other services. East Midlands Parkway also benefits from being situated on the Midland Main Line, allowing it to still accommodate improved connectivity to and between Derby, Nottingham and Leicester. This option could also make investment in East Midlands cities, particularly Nottingham, more attractive. Further work would need to be undertaken on this option, including to explore opportunities for development and regeneration under this scenario.

If government wishes to take an adaptive approach in the Integrated Rail Plan, there is the possibility of building the HS2 Phase 2b eastern leg in phases in order to deliver benefits earlier. Under this approach, the government would need to consider with local stakeholders the best option for the main rail hub in the East Midlands, taking account of economic and regeneration opportunities.

Whatever decisions are taken, government needs to ensure that it commits to them. Without a strong commitment to a plan, wider investment is unlikely to be forthcoming meaning that the development and regeneration benefits being sought for the East Midlands may not be delivered.

Box 5.5: Station design

Stations have a major impact on costs and benefits across the rail network and can contribute to supporting local economies. The Commission has not considered as part of this assessment the best design solution for the redevelopment of stations in the Midlands and the North. Some general considerations to bear in mind when considering station design and location are listed below:

- **City centre vs parkway stations:** Stations should be in places people want to go – city centres where businesses, services, entertainment and growing populations are situated. Unless parkway stations are part of a plan to achieve a city with multiple centres, they can reduce the possible productivity benefits that can arise from increasing the density of city centres. Parkway stations are typically far less used than city centre stations: for example, Liverpool South Parkway saw 2.7 million journeys in 2018-19, compared with 14.2 million for Liverpool Lime Street.¹⁰⁸
- **Terminus vs through stations:** Through stations can be used both to terminate trains and provide onward connections, and therefore offer better connectivity, capacity and operational efficiency in city centres than terminus stations (which can allow onward connectivity, but require trains to be turned around, which takes longer). However, through stations require additional track through city centres which can be difficult and expensive.
- **Surface vs underground stations:** Where space is constrained, putting track and stations underground can minimise the impact of construction and new infrastructure on urban communities and reduce the loss of future urban development opportunities, although construction of underground stations can still be disruptive. Underground infrastructure construction costs will generally be higher but may be offset by both the lower land, property and compensation costs, and the lower cost of other network infrastructure. Underground stations can therefore make through stations more attractive in some city centres, particularly if land values are very high.

Design principles for stations

Following the Commission's design principles will ensure station design focusses on climate, people, places and value.¹⁰⁹ A successful station will:

- support an environmentally sustainable society by being flexible and resilient to climate change and taking every opportunity to mitigate emissions
- be accessible, inclusive and easy to navigate around with the range of views of passengers, workers and nearby communities considered and reflected in the design
- integrate well with the natural and built environment, complementing the local character and culture and seeking opportunities to sustain local ecosystems and support local plans for growth and investment
- recognise that good design does not necessarily cost more and explore every option for increasing value, including commercial development.

6. Long term commitments and short term wins

Whichever package of rail schemes the government chooses to deliver in the Integrated Rail Plan, the benefits from many of the schemes may not be seen until the 2030s or 2040s under current plans. Government should systematically consider how to accelerate major schemes and ensure it delivers benefits in the short to medium term.

In the past, long term plans have sometimes been subject to delay due to disagreement and appeals. To ensure the Plan endures the government should build consensus with local stakeholders.

The government has legislative commitments to reaching net zero greenhouse gas emissions, and public environmental concern is high. Ensuring the Plan contributes to net zero and environmental net gain is not only important for its own sake but will also reduce the risk of the Plan being disputed.

Government will also need to consider how the Plan can deliver benefits within the next decade, by considering early wins and phasing and sequencing, and removing barriers to delivery.

The government should ensure the Plan endures

Build consensus with local stakeholders

Partnering with local stakeholders to develop national transport strategies should reduce the risk of them being disputed. Local stakeholders need to be involved in decisions where national plans affect their area and it is important that stakeholders are able to develop local plans in parallel. This can maximise the potential benefits and ensure national transport networks integrate with local ones.

Once the Plan is published, government should continue to engage with local stakeholders as rail interventions are planned and prepared, including in the preparation of hybrid bills. This needs to happen to ensure that local stakeholders are bought into and can agree to plans, rather than plans being imposed on them.

It will also enable them to effectively develop local transport plans in tandem. A set of local transport interventions that complement the Plan and are delivered to an appropriate timescale will help the full benefits of the Plan to be realised. Increasing the number of seats into city centres will not help if passengers cannot move quickly and easily within those cities when they get there. Given their smaller scale, local transport schemes have the potential to deliver benefits significantly faster than many major rail projects and can demonstrate progress and deliver improvements for passengers while strategic projects are being completed.

Government will need to work with local stakeholders to ensure that necessary improvements to local transport are made, as set out in chapter 3.

Box 6.1 Local engagement with rail planning

Responsibility for strategic rail planning falls between several bodies, including Network Rail, central government, regional transport bodies and, recently, the Northern Transport Acceleration Council. Regional transport groups, such as Transport for the North and Midlands Connect, are a vital part of ensuring that regional leaders can contribute meaningfully to the prioritisation and planning of investments for their regions, with the Department for Transport and Network Rail providing network-wide oversight.

The involvement of regional transport groups has not always been planned effectively. For example, Transport for the North has been asked to scope and prioritise Northern Powerhouse Rail. This enables places across the North to be involved in decision making. However, as Transport for the North does not have a budget for the rail investments or face accountability for delivery, the task of prioritisation is much more challenging.

Government may wish to consider reviewing how regional transport bodies are set up, and the remits they are given, to ensure that they can most effectively work alongside government and Network Rail to enable a coordinated and prioritised approach to rail investment. The Commission has recommended greater devolution of powers and funding to cities over their local transport, and government should also consider how that can function alongside regional transport arrangements to ensure that national transport infrastructure effectively integrates with local networks.

Ensure the Plan contributes to net zero

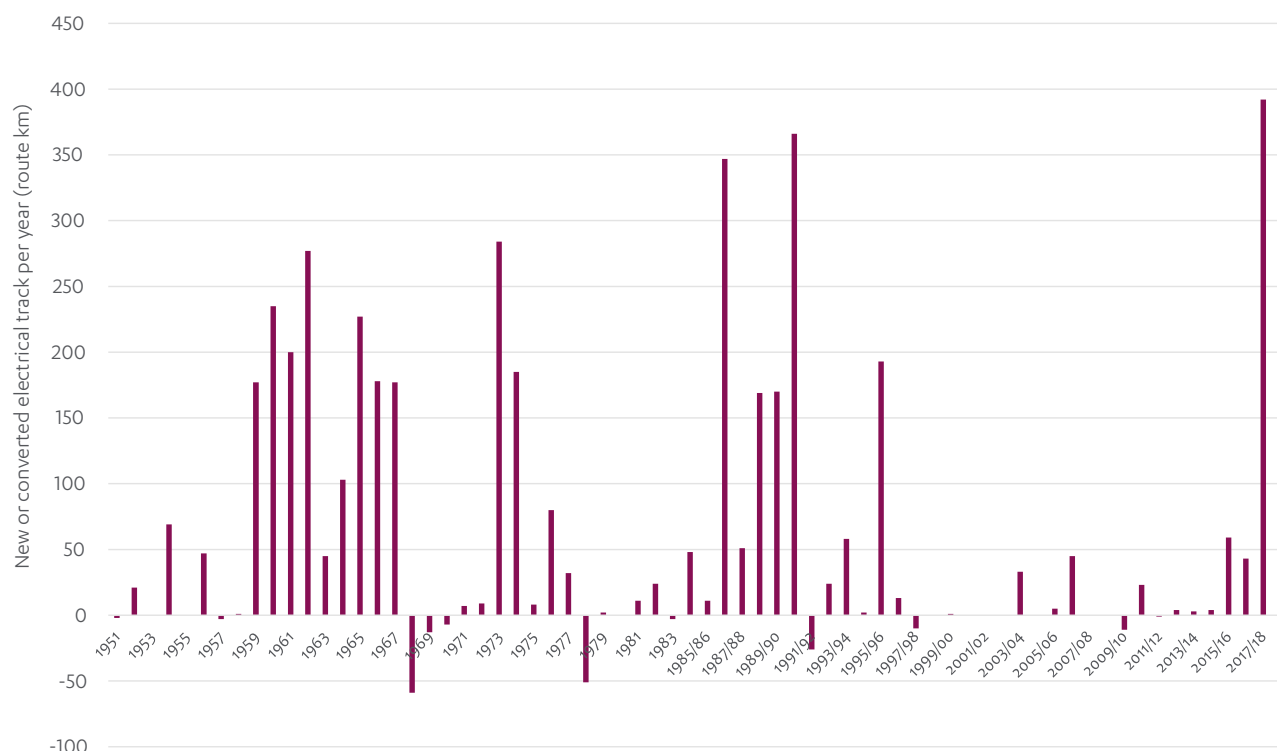
The UK government has committed to reaching net zero greenhouse gas emissions by 2050, based on the Climate Change Committee's advice. The Committee's 'further ambition' scenario, which provides a pathway to a 96 per cent reduction in net greenhouse gas emissions from 1990 levels by 2050,¹¹⁰ assumes a 55 per cent reduction in rail emissions by 2050.¹¹¹

Rail is a relatively low carbon form of transport, making up 1.5 per cent of the UK's domestic transport emissions in 2018,¹¹² while 10 per cent of passenger miles travelled in Great Britain were by rail.¹¹³ However, it can also be costly to decarbonise.

Although the railway is becoming less carbon intensive as new trains come into service and the railway uses greener electricity, the Department for Transport forecasts that without intervention, and with some caveats, greenhouse gas emissions from rail will rise by 19 per cent between 2018 and 2050, against an increase in passenger demand of 60 per cent over the same period.¹¹⁴

There are significant environmental benefits in moving towards more sustainable transport and heavy rail has a role to play in this, particularly where it shifts journeys from road and aviation on to electrified rail. However, the carbon savings from any shift away from road for long distance journeys will become smaller as road transport decarbonises – sales of new petrol and diesel cars are now set to end by 2030 – but there will be congestion and other environmental benefits.

Rail electrification in the Midlands and the North has been stop-start over recent years. While there has been recent electrification of lines in the North West,¹¹⁵ there are still gaps on some city to city links: examples include from Manchester to York, the Midland Main Line in the East Midlands, and some suburban routes across the study area. Electrification reduces rail emissions by up to 85 per cent, which will likely offset some of carbon emissions from construction.

Figure 6.1: Annual track converted to electricity or new electrified track in Great Britain (1951 – 2017/18)¹¹⁶

The Integrated Rail Plan should include a rolling programme of electrification to help decarbonise the railways. This will help deliver industry efficiencies and provide certainty to the supply chain. However, electrification is not the only route to decarbonisation.

Each package the Commission has developed includes funding for decarbonisation to allow for investment in hydrogen and battery infrastructure, alongside a rolling programme of electrification.

Box 6.2: Decarbonising rail freight

Rail freight accounted for nine per cent of freight moved in Great Britain in 2018.¹¹⁷ While the volume is small, and has declined over recent years, rail freight has clear advantages over road transport for some sectors, including:

- **long distance containerised freight transport**, for example transporting freight that arrived from ports in England to Scotland, which does not have its own deep seaports, on the East or West Coast Main Lines
- **aggregate and construction materials**, for example rail freight is needed to move stone out of some quarries and is more practical to haul the large volumes involved.
- **bulky goods**, for example transpennine freight flows are vital for moving biomass to Drax power station.

In the right circumstances, rail freight can deliver wider social and environmental benefits. This is particularly the case where it can provide more space for cars on roads or provide savings on the marginal costs associated with HGVs (air quality, noise, greenhouse gas emissions, accidents).¹¹⁸

However, there are challenges in making best use of a constrained network, particularly where bottlenecks exist. This can be resolved by increasing capacity, for example by passing loops for freight services or segregated track, and interventions on the network should consider how different kinds of services may interact.

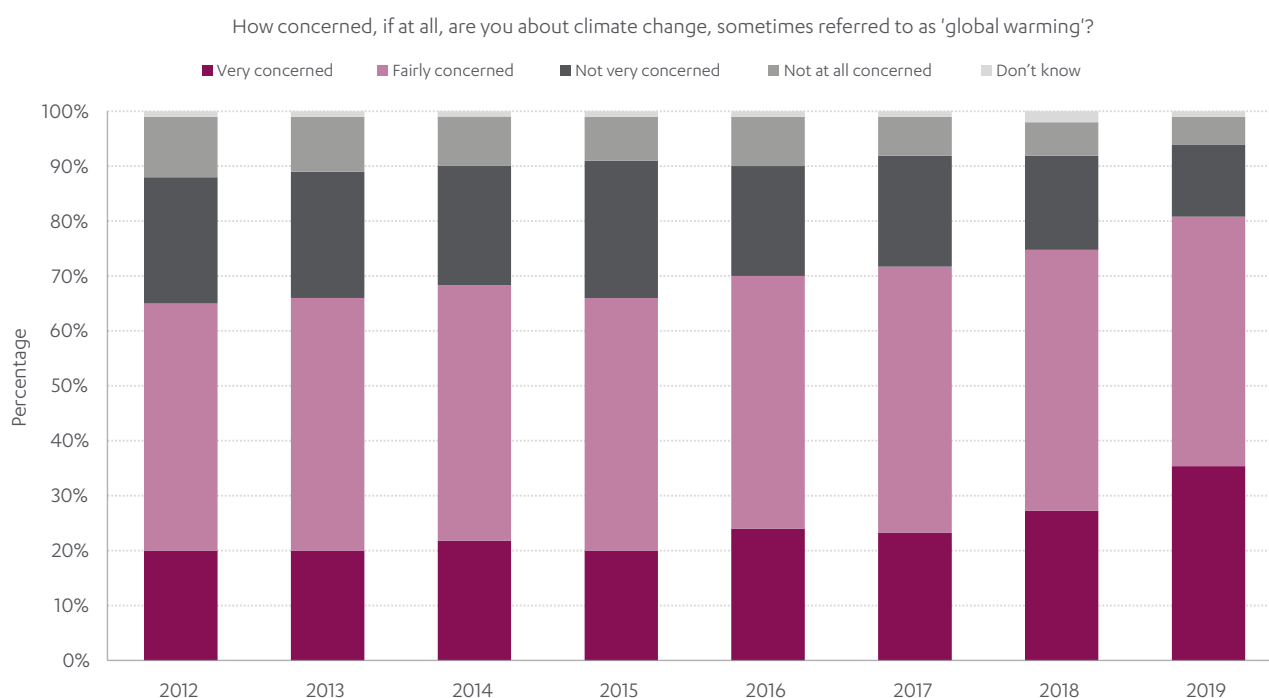
Since the costs of these interventions are largely born by taxpayers, there is a balance to be struck between the cost of upgrades to accommodate growth in rail freight and the potential benefits. The role of freight on the rail network therefore needs to focus on the routes where rail freight can deliver the highest benefits and has clear advantages.

It is also vital that there is a plan to decarbonise rail freight, especially as progress is made on decarbonising HGVs. As recommended in the Commission's Freight Study, government should publish by the end of 2021 a full strategy for rail freight to reach zero emissions by 2050, specifying the investments and/or subsidies that it will provide to get there.¹¹⁹ Government should ensure that the impact of upgrades or new infrastructure, and their delivery, on freight services is understood when developing the Plan.

Ensure the Plan contributes to environmental net gain

Major rail projects can have a significant impact on the natural environment, changing land use in areas with high natural capital. The public is increasingly conscious of the environment and averse to projects that will further damage it. While the Commission's analysis suggests that the impacts on natural capital are likely to be relatively small, they still need to be considered. Ensuring the Plan contributes to environmental net gain is important for the sake of the environment but will also avoid the risks of plans being delayed at a later stage due to controversy around the potential environment impact. This is in line with the government's ambitions on embedding environmental net gain for development including housing and infrastructure, as set out in the 25-year environment plan.¹²⁰

Figure 6.2: Public environmental concern is high¹²¹



The Integrated Rail Plan should set out a strategic approach to mitigating impacts on the local environment and natural capital, adopting a ‘net gain’ approach. Routes for new lines set out in the Plan should adhere to the ‘mitigation hierarchy’.^{122, 123} It should avoid impacts on irreplaceable habitats such as ancient woodland wherever possible, and where environmental impacts of new rail lines cannot be avoided the government should ensure that the mitigations (e.g. habitat creation and restoration) follow the Lawton principles – ‘more, bigger, better and joined’ – to maximise the economic, social, and environmental benefits. Working with stakeholders (e.g. local authorities, land managers, statutory agencies) at the appropriate scale (i.e. catchment, landscape) will help realise these benefits.¹²⁴

Accelerating schemes and delivering benefits in the shorter term

Phasing and sequencing

Careful phasing and sequencing can bring several benefits:

- ensure there is a minimum level of ongoing work for the supply chain
- help identify schemes that can be done independently of other big programmes, and which are therefore easier to accelerate
- ensure that critical dependencies are considered – for example some elements of the Northern Powerhouse Rail package require at least part of HS2 Phase 2b to be in place.

Some elements of the major rail projects proposed for the Midlands and the North present opportunities for earlier delivery, as work is underway already or because they are independent of other major schemes. Potential options for earlier delivery include:

- the **Transpennine Route Upgrade** where work is already underway
- the **Hope Valley Line Upgrade between Sheffield and Manchester** being taken forward by Network Rail
- **Midlands Engine Rail**, including Midlands Rail Hub and Birmingham Airport connectivity, much of which can be delivered incrementally and is independent of HS2 Phase 2b.

There are also some schemes, including upgrades on the East and West Coast Main Lines, that need to be progressed earlier in the timeframe to allow other schemes to advance. Government should also ensure necessary upgrades to the conventional network are completed in time to enable the integration of new, faster rail lines like the HS2 Phase 2b western leg.

Early wins

The benefits from some of the major rail improvements in the Integrated Rail Plan may not be seen, on current estimates, until the late 2030s and early 2040s. However, there are existing problems on the rail network that need to be addressed as soon as possible, and not in two decades once major rail schemes have been completed. This is important given the poor services that passengers in the Midlands and the North currently experience, and as the economic benefits will support recovery and levelling up. The priorities for early action include:

- **crowding and congestion** – before the Covid-19 crisis, many routes into city centres had overcrowded trains, and suffered from congestion on the network.¹²⁵
- **assets that need to be upgraded** – older diesel rolling stock is still running on the UK's rail networks, for example fleets used by the Cross-Country, East Midlands Railway and Northern franchises, and signalling systems also need to be upgraded.¹²⁶

Addressing these within the next decade by setting out a programme of 'early win' investments as part of the wider Integrated Rail Plan will deliver benefits sooner, reduce the future risk of infrastructure failures by upgrading and replacing old infrastructure assets, and give confidence to the supply chain.

Replacing diesel **rolling stock** could also increase capacity and deliver other improvements in the next decade. This is likely to be the quickest way of providing benefits to large numbers of passengers and there is currently no long term rolling stock strategy. The Commission has not looked at this in detail and the funding for rolling stock is (with the exception of HS2) not treated as capital, but would still need to be found.¹²⁷ The specification of rolling stock will also need to be considered carefully to avoid delays due to integration issues.

There are several **smaller scale interventions**, particularly station improvements, that could deliver earlier benefits in the Midlands and the North. Schemes that could be completed within the next decade include:

- the Northumberland Line scheme, which plans to turn an old freight line into a new passenger route between Newcastle and Ashington that would provide two trains per hour (as well as freight services) to six towns along the Northumberland Coast
- Darlington Station Expansion & Growth Hub Redevelopment, with funding approved by the government in March, which will see the station readied for HS2 and Northern Powerhouse Rail services by increasing rail capacity through the station by up to 300 per cent and by unlocking capacity constraints at Darlington South Junction
- improvements to Middlesbrough station, which secured funding this year to lengthen platforms in 2021 (allowing benefits such as direct services to London), and will also add a further platform to deliver additional capacity if further funding is secured, supporting the rollout of new development as part of the station masterplan
- re-opening platform 4 of Birmingham's Snow Hill Station, which will allow more services to call and terminate at Snow Hill and free up more space at Moor Street station.

These are only some of the potential options for early wins. Government should consider further options for delivering benefits earlier in the Plan. The Commission has included £2 billion in each package for delivering early wins.

Signalling upgrades could also enable benefits within the next decade. Network Rail claim that digital signalling can, in some circumstances, increase capacity (allowing up to 40 per cent more trains on the track), reduce delays, enhance safety and drive down costs by up to 30 per cent.¹²⁸ Digital signalling is largely covered under the renewals programme, although there is a case for some elements to be brought forward as enhancements, such as the West Coast Main Line north of Crewe. Each of the Commission's packages includes a broad allocation of around £3 billion for additional digital signalling.

Removing barriers to progress

A major rail project can currently take at least twenty years from the initial concept and feasibility assessment until opening. There can be many sources of delays throughout the process, ranging from initial decisions about design, routes and station location to acquiring powers or the fitting out and testing of technology and services.

There are opportunities to accelerate some elements and reduce delays. And there are examples of major projects that were delivered or constructed more quickly: for example, three new high speed lines were constructed in France in just six years (although planning began in advance of this).¹²⁹

The government is undertaking a programme of work to speed up the delivery of major infrastructure projects. The National Audit Office has also recently published a report on lessons learnt on major projects, which notes the importance of clarity and certainty on scope, robust costs and scheduling, interdependencies, considering operations at an early stage, governance and oversight.¹³⁰ The lessons learnt should be applied to the schemes in the Integrated Rail Plan. From the Commission's perspective, there are areas which could be addressed to enable schemes to deliver faster, including:

- **Acquiring the necessary consents** for new rail schemes, which typically takes around three years, has become a major delay in progressing new rail schemes. After planning permission has been provided it can then take several years for final agreements on conditions to be reached and there are often weak incentives for parties to reach agreement. Decisions often now take longer than for previous schemes. Upgrades are not necessarily straightforward either, as seen for the Great Western Electrification Programme.¹³¹
- **The existing regulatory framework** does not support long term investment, as there is no long term budget for rail schemes or certainty for the supply chain about future work.¹³² An adaptive framework with a set of core schemes, with committed funding for these and a process for adding enhancements or additional schemes, could secure greater certainty.
- **The supply chain** needs greater certainty. There is a risk that if demand on the supply chain exceeds capacity this will lead to a significant jump in construction costs. Providing more certainty would enable the supply chain to better meet future demand and ensure there is always a minimum level of work.
- **The typical approach to upgrading existing lines** is to close lines at the weekend and overnight to complete the work while keeping the line operational, although line closures are used in some circumstances. This leads to high costs and long delivery times for upgrades to be completed. However, another option is to wholly close the line, which would enable the benefits of upgrades to be delivered much faster but is less popular with passengers and rail freight users. Using this approach would save time and money compared to the normal approach.

Box 6.3 Supply chain

The Commission has drawn upon work elsewhere in government to consider the capability of the supply chain to deliver major increases in rail investment. Based on predicted responses from industry it seems reasonable to assume that:

- the construction demand of the programmes of investment set out in this Assessment could initially be met using existing industry capacity
- specialist railway resources such as for electrification, timetable planners and signalling design staff will require careful management
- increasing investment significantly above historic levels of funding would require a level of certainty over the future pipeline for the supply chain, for an enhanced programme of investment to be delivered successfully.

Annex A. The package focussing on upgrades

This package sets out an example of a programme of rail investments that would be achievable within the baseline budget, for comparison with other packages with larger funding envelopes. Given the cost of constructing new lines, this package focusses on upgrades to existing lines. It includes the completion of the western leg of HS2 Phase 2b and some upgrades to key lines including the East Coast Main Line and Midland Main Line.

The Commission's three illustrative budgets for rail spending include a baseline budget of £86 billion, which is consistent with the rail spending in the Midlands and the North proposed in the National Infrastructure Assessment's fiscal remit.¹³³ This package is designed to be consistent with the baseline budget, however the costs are estimates and there is some uncertainty. The cost of this package without HS2 Phases 1 and 2a is £44 billion.

The following are included in this and all the packages:

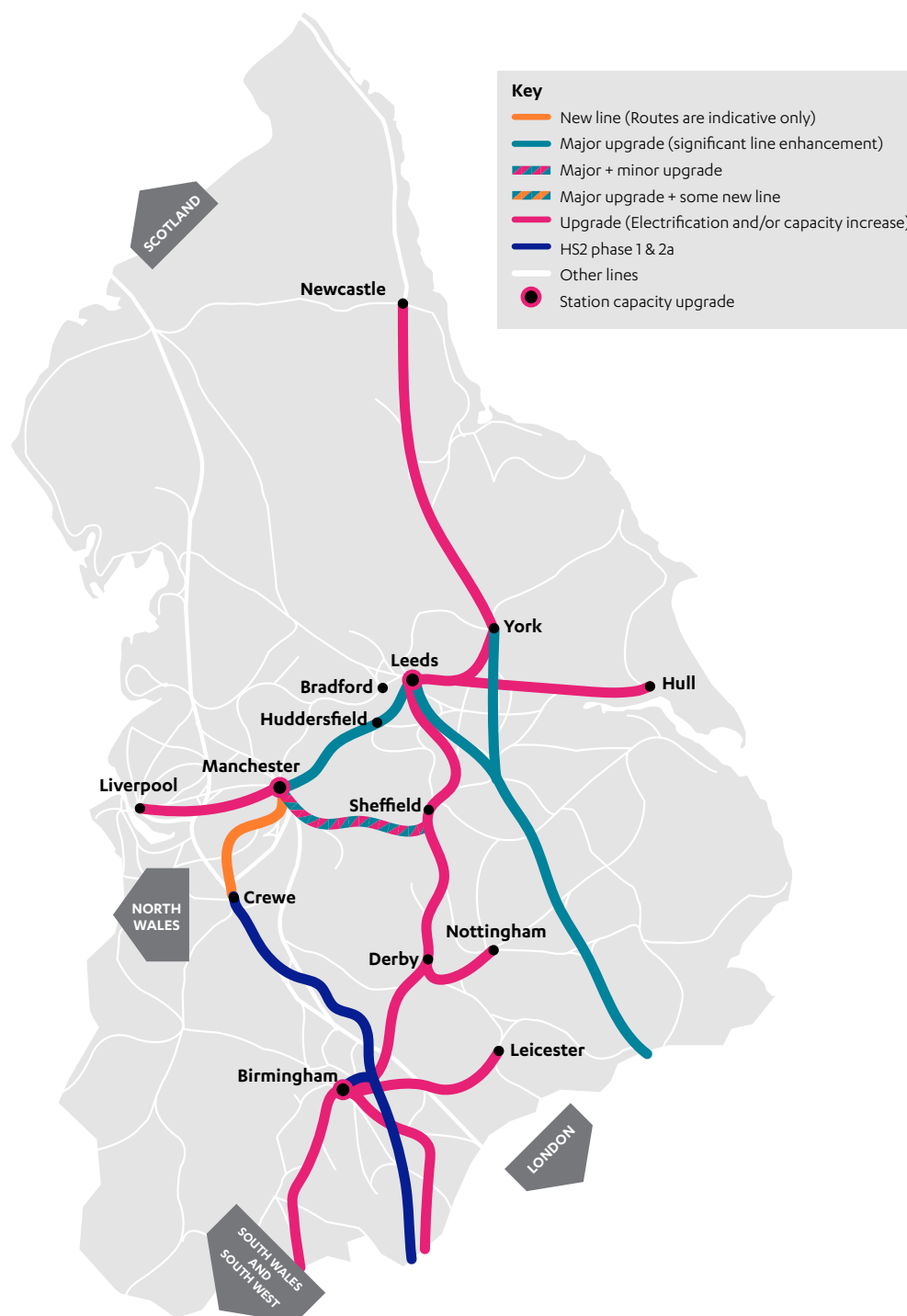
- HS2 Phases 1 and 2a, which were included in the National Infrastructure Assessment's strategic rail budget – these schemes were not part of the scope of this study and the decision to proceed with them was outside the scope of the *National Infrastructure Assessment*
- the western leg of HS2 Phase 2b, in order to realise the full benefits of HS2 Phase 2a, which already reaches Crewe from Birmingham, and as there are no viable alternatives to increase capacity into Manchester
- at least £15 billion funding for decarbonisation, digital signalling and 'early wins'
- an allowance for optimism bias.

The further additions to this package include:

- Transpennine Route Upgrade – includes line speed increases and full electrification from Manchester to York and four tracking between Huddersfield and Dewsbury to allow fast trains to bypass stopping services
- East Coast Main Line – including line speed increases from 125mph to 140mph and capacity upgrade at Welwyn, which improves journey times between London and Leeds, York, Newcastle and Edinburgh
- Midlands Rail Hub – line speed and capacity benefits to rail links between Birmingham, Leicester, Nottingham, Coventry, Derby, Hereford and Worcester and improved services to Wales and the south west

- Midland Main Line – line speed increases and electrification between Derby and Sheffield and platform extensions at Belper, Dronfield and Duffield
- Manchester to Sheffield – includes line speed increases in the Peak District National Park and capacity upgrades
- Birmingham Airport Connectivity - improves links to Birmingham International airport and Coventry from Derby and Sheffield in the North and Oxford and Reading in the South.

Focussing on upgrades



Infrastructure interventions are shown indicatively, not service origins and destinations. Not all stations shown.

This package is proposed as an illustration of what is achievable within the baseline budget and to provide a baseline against which the benefits of the packages with larger funding envelopes can be compared.

This package should be the quickest to deliver as construction of all the individual upgrades it contains are estimated to take five to six years to complete. On current estimates, aside from completing the western leg of HS2, the upgrade elements of this package could all be delivered by 2035. The Transpennine Route Upgrade and likely some Midlands Engine Rail schemes could be delivered in the 2020s. The latest part would be the western leg of HS2 Phase 2b from Crewe to Manchester, which is expected to complete in 2038.

What does the package deliver?

Figure A.2 sets out the headline assessment of the benefits and impacts of the package that the Commission has quantified.¹³⁴

Figure A.2: Headline benefits and impacts for the package¹³⁵ (benefits are measured over 60 years from scheme opening)

Economic growth and competitiveness	Improvements to connectivity from faster journeys			7-9%
	Improvements to productivity in city centres	Ave. annual impact		£0.3-0.5bn
		60-year appraisal period	Undiscounted	£18-30bn
			Discounted	£7-12bn
Sustainability and quality of life	Benefits from connecting people to city services		Undiscounted	£7-15bn
			Discounted	£2-4bn
	Loss of natural capital (partial valuation)			£35-45m
	Lifecycle carbon emissions			2 MtCO2e

Connectivity

The main improvements in journey times that this package provides result from the new high speed line from London to Manchester via Birmingham: journey times between Birmingham and Manchester are more than halved.

Upgrades to the East Coast Main Line improve journey times to London for Leeds, York, Newcastle and Edinburgh. But there is little improvement in journey times between nearby cities. The biggest improvements in journey times are between cities in the Midlands and the North and London (see figure A.3).

Figure A.3: Journey times (minutes) and trains per hour between key cities in the Midlands and the North¹³⁶

Origin - destination pair	Current		Package focussing on upgrades	
	Journey time	Trains per hour	Journey time	Trains per hour
Birmingham-Manchester	90	2	40	4
Birmingham-Leeds	120	1	116	1
Leeds-Manchester	50	5	43	6
Birmingham-Nottingham	72	2	72	3
Manchester-Liverpool	36	4	36	4
Leeds-Newcastle	88	3	76	3
Derby-Sheffield	35	5	32	5
Bradford-Leeds	19	up to 8	19	up to 8
Leeds-Sheffield	42	3	39	3
Sheffield-Manchester	55	2	41	4
Sheffield-London	132	2	119	2
Birmingham-London	73	8	48	10
Leeds-London	119	2	113	2-3
Manchester-London	119	3	73	4-5
Newcastle-London	193	2	145	3
Nottingham-London	109	2	109	2

Figure A.4 shows the overall improvements to connectivity for major cities as a result of this package. The places that see the most improvements are Birmingham, Manchester, Hull, and Birmingham and Manchester Airports.

Figure A.4: Improvements to connectivity against the baseline by place, central estimates¹³⁷

Birmingham	Manchester	Leeds	Liverpool	Sheffield	Newcastle	Nottingham	Leicester	Hull	Bradford		Edinburgh	Glasgow		Birmingham Airport	Manchester Airport
15%	13%	3%	3%	6%	3%	4%	6%	14%	1%		3%	4%		13%	27%

Capacity

There are some improvements to productivity in city centres in the Midlands and the North due to increased capacity (see figure A.2, productivity, and A.5, capacity). The main productivity benefits are from the completion of HS2 to Birmingham and Manchester, which provides a large increase in capacity into and out of those cities. However, the overall improvements to capacity and productivity across the whole of the Midlands and the North are modest.

Figure A.5: Increase in number of seats and standing spaces on commuter lines compared to current (during the morning peak, key cities) , central estimates¹³⁸

	Package focussing on upgrades
Birmingham	20,000
Coventry	1,000
Leeds	12,000
Liverpool	2,000
Manchester	29,000
Newcastle	4,000
Nottingham	2,000
Sheffield	3,000

Productivity and amenity benefits

Figure A.6 shows the Commission's estimates for the productivity and amenity benefits for the major cities that result from the increased capacity provided by these packages. Birmingham, Leeds and Manchester are the main beneficiaries.

Figure A.6: Total productivity plus amenity benefits provided by the package investments over a 60 year period from the opening of schemes (undiscounted), central estimates¹³⁹

City	Productivity plus amenity benefits (£ billion)
Birmingham	9.7
Bradford	0.0
Coventry	0.4
Derby	0.0
Leeds	3.4
Liverpool	0.7
Manchester	13.3
Newcastle	1.4
Nottingham	0.6
Sheffield	1.0

Risks and further work required

For this package to be delivered effectively, further work is likely to be needed on several key areas:

- the volume of upgrades to the existing network will likely result in a considerable level of disruption for both passengers and freight traffic. Significant further work will be needed to both estimate and plan for this, to minimise the impact, particularly for key routes like the East Coast Main Line.

- the upgrades to the East Coast Main Line considered in the package require further development, as these have come out of the work on strategic alternatives to HS2 – see chapter 5.
- further work may be required at Manchester Piccadilly in the absence of planned Northern Powerhouse Rail infrastructure, and at Edgeley junction, to accommodate the increased frequency of services between Manchester and Sheffield.

There is also a risk around network capacity with this package, as the upgrades between Liverpool and York are unlikely to be able to accommodate expected growth in demand in the medium to long term.

Unlocking investment in land around stations

This package would deliver benefits for Manchester Piccadilly, with the completion of the high-speed line from Crewe to Manchester and the Transpennine Route Upgrade. This is aligned with the Greater Manchester Combined Authority's growth strategy for HS2 which expects the redevelopment of Manchester Piccadilly to accommodate HS2 to create new commercial developments and 13,000 new homes.¹⁴⁰ The Greater Manchester Combined Authority favours an underground station design which it argues is needed to realise the full potential of HS2 and Northern Powerhouse Rail services as well as of development around the station. This package would also help deliver redevelopment at Manchester Airport in line with Greater Manchester Combined Authority's 2040 Transport Strategy.¹⁴¹

Annex B. The package prioritising regional links

These packages focus on capacity improvements for regional, largely east-west connections in the Midlands and the North. Long distance north-south improvements are concentrated on the western leg of HS2 and upgrades to some conventional lines. Further spending is focussed on connecting Birmingham, Derby, Nottingham and Leicester in the Midlands, and Manchester, Liverpool, Leeds and York in the North.

The Commission has developed two packages of rail investments that prioritise regional links. Alongside the schemes included in all the packages (see annex A), the two packages include the following:

- the first, in line with the 'plus 25 per cent' budget:
 - delivers major Northern Powerhouse Rail upgrades (including some new lines) on the route between Liverpool, Manchester and Leeds
 - deliver the Transpennine Route Upgrade, which includes line speed increases and full electrification from Manchester to York and four tracking between Huddersfield and Dewsbury to allow fast trains to bypass stopping services
 - addresses congestion between Leeds and York
 - improves links between Leeds and Bradford
 - delivers a new high speed line from Birmingham to the East Midlands which provides direct services to East Midlands Parkway and Nottingham
 - upgrades the Midland Main Line from East Midlands to Sheffield and Leeds
 - upgrades the East Coast Main Line between Leeds and London, which will also benefit the North East.
 - delivers line speed and capacity benefits to rail links between Birmingham, Leicester, Nottingham, Coventry, Derby, Hereford and Worcester and improved services to Wales and the south west through the Midlands Rail Hub
 - improves links to Birmingham International airport and Coventry from Derby and Sheffield in the North and Oxford and Reading in the South, due to the Midlands Engine Rail programme

- **the second, in line with the ‘plus 50 per cent’ budget:**
 - delivers wholly new Northern Powerhouse Rail lines on the route between Liverpool, Manchester and Leeds, which would also serve Bradford (replacing the options in the ‘plus 25 per cent’ package)
 - 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.

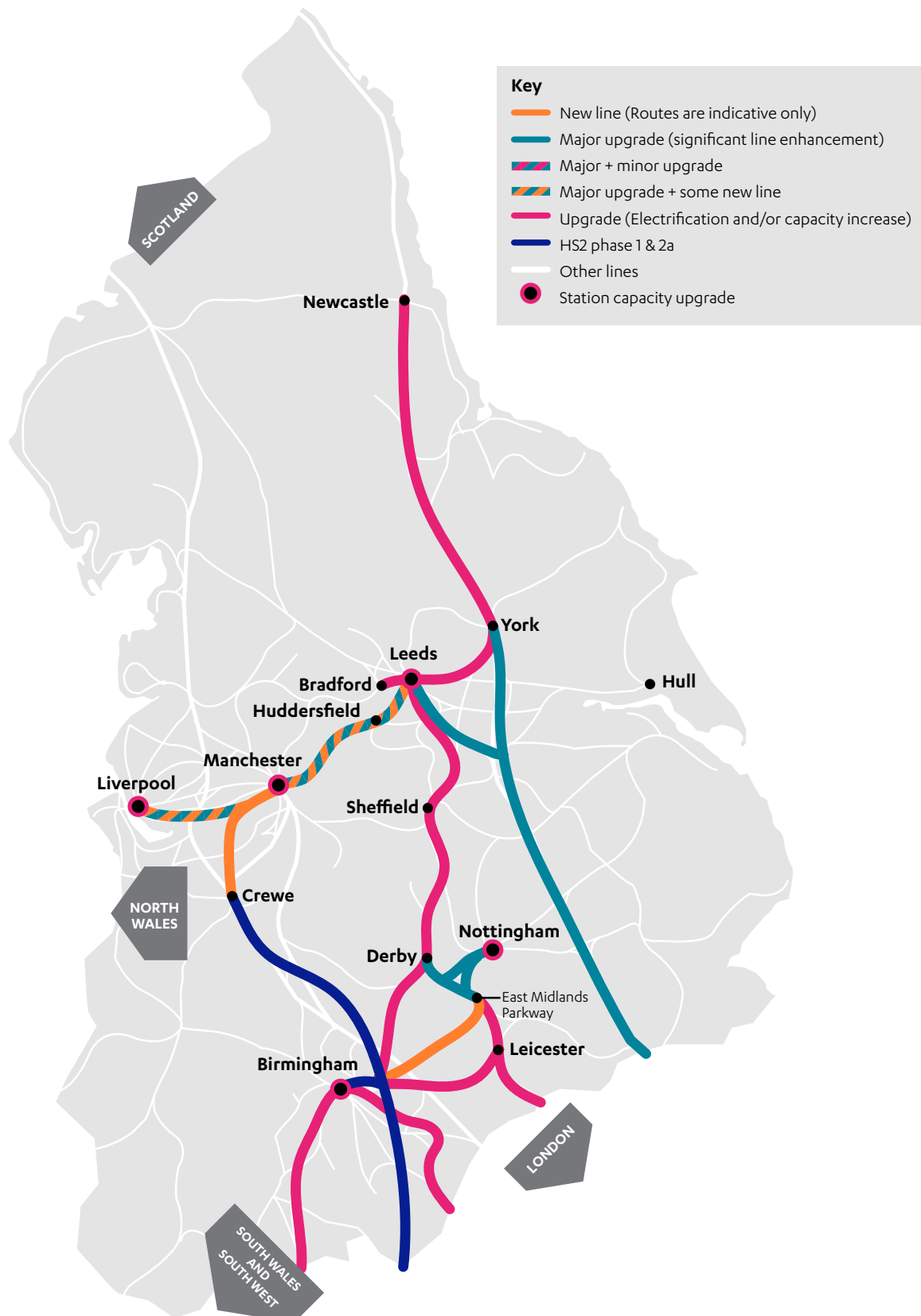
Costs for the packages prioritising regional links are £69 billion (in the package in line with the ‘plus 25 per cent’ budget) and £92 billion (in the package in line with the ‘plus 50 per cent’ budget), net of HS2 Phase 1 and 2a and including £15 billion for decarbonisation, digital signalling and ‘early wins’.

HS2 will mainly be concentrated on the western leg, with a mix of new lines and upgrades to connect the East Midlands and Yorkshire, rather than the full eastern leg of HS2 Phase 2b, under both 25 per cent and 50 per cent budget options.

The partial eastern leg of HS2 Phase 2b included in the packages (as far as East Midlands Parkway with use of the conventional rail network to reach Nottingham and Derby) has the potential to significantly improve connections between the West and East Midlands, reducing journey times between Birmingham and Nottingham from 72 to 27 minutes. Meanwhile, the new line running into Leeds in the ‘plus 50 per cent’ package could provide equivalent journey time and frequency improvements between Leeds and Sheffield as the proposed Northern Powerhouse Rail scheme, which relies on HS2 infrastructure, would do. This new line would also improve connections between West Yorkshire, South Yorkshire and the East Midlands.

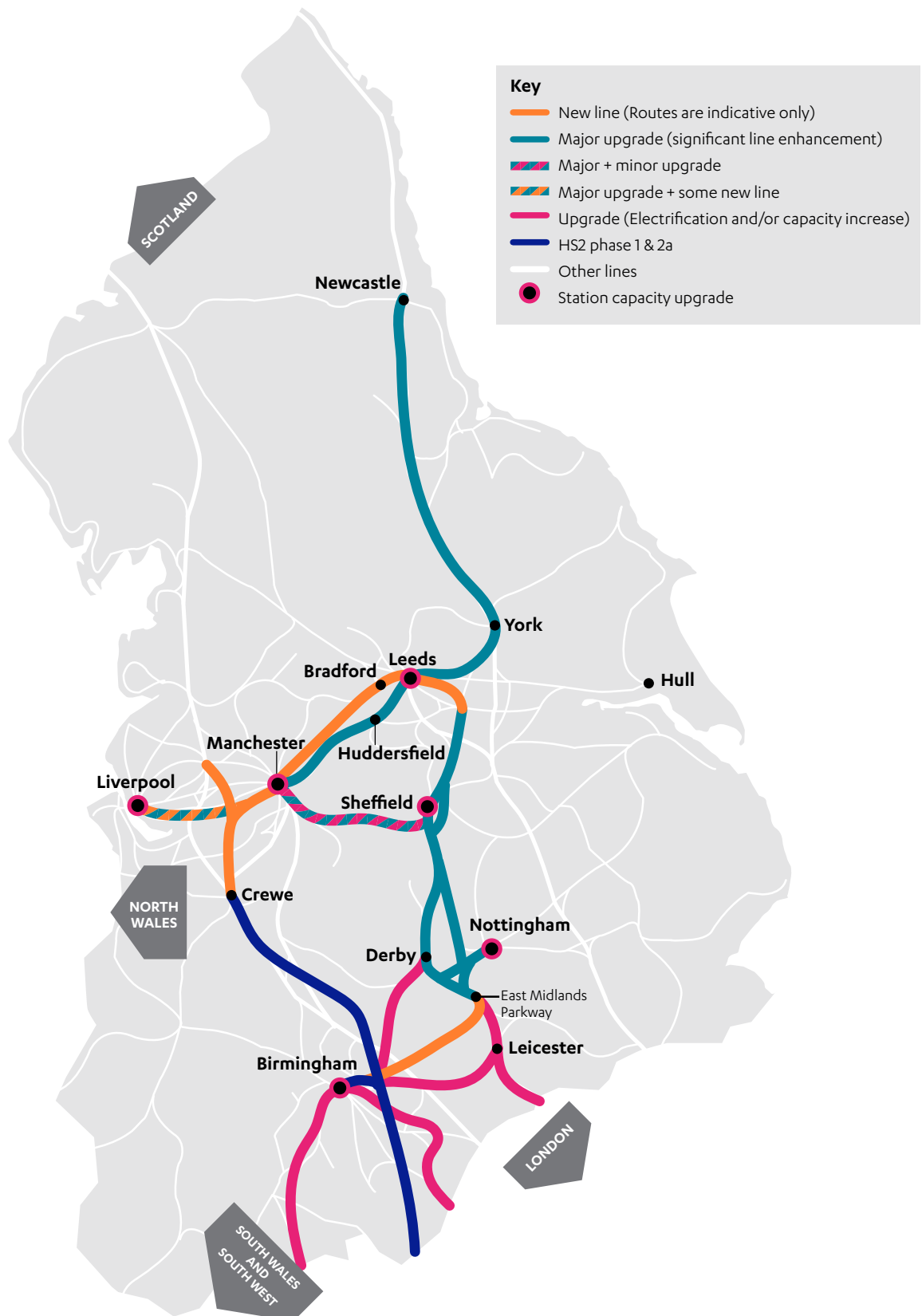
Early elements of the Transpennine Route Upgrade are underway with plans also progressing for further work, and it is likely that some Midlands Engine Rail schemes, and the Midland Main Line electrification, could also be delivered in the 2020s. The western leg of HS2 Phase 2b from Crewe to Manchester is expected to be completed in 2038. Large scale interventions in this package will require bills to be passed through Parliament, which will likely push back delivery of some schemes until the 2030s. However, delivering a mix of new lines and upgrades to connect the East Midlands and Yorkshire, rather than the eastern leg of HS2 Phase 2b, should be able to deliver connectivity faster than delivering the full eastern leg.

Prioritising regional links (plus 25 per cent)



Infrastructure interventions are shown indicatively, not service origins and destinations. Not all stations shown.

Prioritising regional links (plus 50 per cent)



Infrastructure interventions are shown indicatively, not service origins and destinations. Not all stations shown.

What does the package deliver?

Figure B.2 sets out the headline assessment of the benefits and impacts of the package that the Commission has quantified.¹⁴²

Figure B.2: Headline benefits and impacts for the package (benefits are measured over 60 years from scheme opening)¹⁴³

				'plus 25 per cent'	'plus 50 per cent'
Economic growth and competitiveness	Improvements to connectivity from faster journeys			9-15%	11-19%
	Improvements to productivity in city centres	Ave. annual impact		£0.5-0.8bn	£0.7-1.2bn
		60-year appraisal period	Undiscounted	£30-51bn	£41-71bn
			Discounted	£12-20bn	£16-29bn
Sustainability and quality of life	Benefits from connecting people to city services		Undiscounted	£11-26bn	£16-38bn
			Discounted	£3-7bn	£4-10bn
	Loss of natural capital (partial valuation)			£105-135m	£215-275m
	Lifecycle carbon emissions			4MtCO2e	6 MtCO2e

These packages appear to deliver the highest benefits and are most likely to support the strategic objective of levelling up the North and the Midlands.

Connectivity

In both packages there are big improvements to journey times between Birmingham and Nottingham (72 minutes to 27 minutes) and Leeds and Manchester (50 minutes to 31 minutes and 26 minutes in the 'plus 25 per cent' and 'plus 50 per cent' packages respectively). Journey times do not improve substantially between Birmingham and Leeds in the 'plus 25 per cent' budget package, but they are halved in the 'plus 50 per cent' budget package. Journey times and the frequency of services between Leeds and Sheffield improve substantially under the 'plus 50 per cent' package – which more than halves the current journey times – with a small improvement to journey times in the 'plus 25 per cent' package as well.

Figure B.3: Journey times (minutes) and trains per hour between key cities in the Midlands and the North¹⁴⁴

Origin – destination pair	Current		Regional links 'plus 25 per cent'		Regional links 'plus 50 per cent'	
	Journey time fastest (minutes)	Trains per hour	Journey time (minutes)	Trains per hour	Journey time (minutes)	Trains per hour
Birmingham-Manchester	90	2	40	4	40	4
Birmingham-Leeds	120	1	117	1	60	3
Leeds-Manchester	50	5	31	8	26	10
Birmingham-Nottingham	72	2	27	4	27	4
Manchester-Liverpool	36	4	29	8	26	8
Leeds-Newcastle	88	3	76	4	62	5
Derby-Sheffield	35	5	32	5	32	5

Bradford-Leeds	19	up to 8	19	up to 8	13	up to 14
Leeds-Sheffield	42	3	39	3	24	7
Sheffield-Manchester	55	2	55	2	41	4
Sheffield-London	132	2	104	3	93	3
Birmingham-London	73	8	48	10	48	10
Leeds-London	119	2	113	2-3	93	3-4
Manchester-London	119	3	73	4-5	73	4-5
Newcastle-London	193	2	145	3	177	3
Nottingham-London	109	2	58	4	58	4

Figure B.4 sets out the improvements in connectivity for the listed cities that these two packages provide.

Figure B.4: Improvements to connectivity against the baseline by place, central estimates¹⁴⁵

	Birmingham	Manchester	Leeds	Liverpool	Sheffield	Newcastle	Nottingham	Leicester	Hull	Bradford		Edinburgh	Glasgow		Birmingham Airport	Manchester Airport
+25%	16%	13%	6%	9%	9%	4%	26%	7%	15%	8%		4%	4%		14%	32%
+50%	23%	15%	21%	11%	14%	14%	31%	8%	16%	22%		4%	5%		19%	33%

Capacity

The schemes in the 'plus 25 per cent' package provide the highest improvements for productivity in city centres at this budget – estimated to be around 20 per cent higher than the potential improvements from the 'plus 25 per cent' package prioritising long distance links – and these benefits are primarily for cities in the Midlands and the North. These benefits are based on the increases to capacity (see figure B.5) which can support higher densities in city centres.

Figure B.5: Increase in number of seats and standing spaces on commuter lines compared to current (during the morning peak, key cities), central estimates¹⁴⁶

	'plus 25 per cent'	'plus 50 per cent'
Birmingham	20,000	20,000
Bradford	7,000	13,000
Coventry	1,000	1,000
Derby	5,000	5,000
Leeds	21,000	42,000
Liverpool	14,000	14,000
Manchester	47,000	64,000
Newcastle	4,000	8,000
Nottingham	7,000	7,000
Sheffield	4,000	16,000

Productivity and amenity benefits

Figure B.6 shows the Commission estimates for the productivity and amenity benefits for the major cities that result from the increased capacity provided by these packages. Birmingham, Leeds, Liverpool and Manchester receive the greatest benefits under both packages (and Sheffield in the 'plus 50 per cent').

Figure B.6: Total productivity plus amenity benefits provided by the package investments over a 60 year period from the opening of schemes (undiscounted), central estimates¹⁴⁷

City	Productivity plus amenity benefits (£ billion)	
	25 per cent	50 per cent
Birmingham	9.7	9.7
Bradford	1.7	3.2
Coventry	0.4	0.4
Derby	2.6	2.6
Leeds	5.9	11.8
Liverpool	5.2	5.1
Manchester	21.8	29.6
Newcastle	1.4	3.1
Nottingham	2.2	2.2
Sheffield	1.4	5.2

Risks and further work required

Further work is likely to be required on this package in a number of areas:

- The interventions between the East Midlands and Yorkshire are likely to bring an element of disruption to rail passengers and freight users, which will need careful consideration by the rail industry as projects are taken forward. There will also be some disruption on the roads, although there will be less than if the full eastern leg of HS2 were built.

- Under these options, there would need to be significant station redevelopment at Leeds. Plans for the redevelopment of Leeds Station are based around current plans for HS2 and Northern Powerhouse Rail, so further work is likely to be needed to ensure that the design works for the schemes set out in these packages. In particular, these interventions are focused on delivering additional trains as part of Northern Powerhouse Rail through additional track capacity and platforms. More widely, bringing the plans for the station and capacity together with area regeneration is part of the Leeds Integrated Station Masterplan which will need to consider plans in more detail as the scheme options are developed.
- The new line to East Midlands Parkway, included at both budgets, the East Coast Main Line upgrades, included at the 'plus 25 per cent' budget, and the new line into Leeds and further interventions south to Sheffield, included in the 'plus 50 per cent' budget, will require further development, as these have come out of the work on strategic alternatives to HS2 – see chapter 5.

In order to maximise the potential benefits of packages and deliver as much of the current HS2 and Northern Powerhouse Rail service specifications as possible, the line between Leeds and Hull would also need to be upgraded and fully electrified. The route between Leeds and Hull is therefore an obvious candidate for early intervention through the budget allocated to a rolling programme of electrification.

Unlocking investment in land around stations

These packages may deliver some further benefits, particularly for Leeds and the surrounding area and the Midlands, alongside the benefits set out in annex A for Manchester and Liverpool from the western leg of HS2 Phase 2b.

Some of the benefits from improved connectivity and agglomeration will be capitalised into higher land prices. But there can also be an additional effect on land prices as rail investment, particularly around stations, can act as an anchor investment, signalling to the market that the location is worth investing in. These effects will be expected to be present where land values elsewhere in the city are high, signalling scarcity, and where development will increase density so that scarcity constraints are eased.¹⁴⁸

The 'plus 50 per cent' packages include the full planned redevelopment of Leeds station – before the Covid19 crisis, the present station was expected to reach capacity by 2026 – as well as significantly improved connections to Bradford, York and Newcastle. The Leeds Inclusive Growth Strategy includes the aspiration to 'double the size of the city centre', with a rebuilt Leeds station seen as the key element to providing the 'capacity required to support the rapid expansion of the city centre.'¹⁴⁹

There are also potential benefits in the Midlands, with both packages delivering Midlands Connect local links to Birmingham Curzon Street and Birmingham Interchange, which are the focus of regeneration activity. The redevelopment of Birmingham Moor Street aims to create a 'one station' concept where the station shares a square with Curzon Street station, with a footbridge in between the stations and better pedestrian access to Birmingham New Street.¹⁵⁰

Annex C. The package prioritising long distance links

These packages aim to improve long distance connectivity between the biggest, most congested cities in the Midlands and the North, with the complete HS2 Phase 2b releasing capacity on the East Coast and West Coast Main Lines and improving north-south journey times.

The Commission has developed two packages of rail investments that prioritise long distance links. Alongside the schemes included in all the packages (see annex A) the two packages include the following:

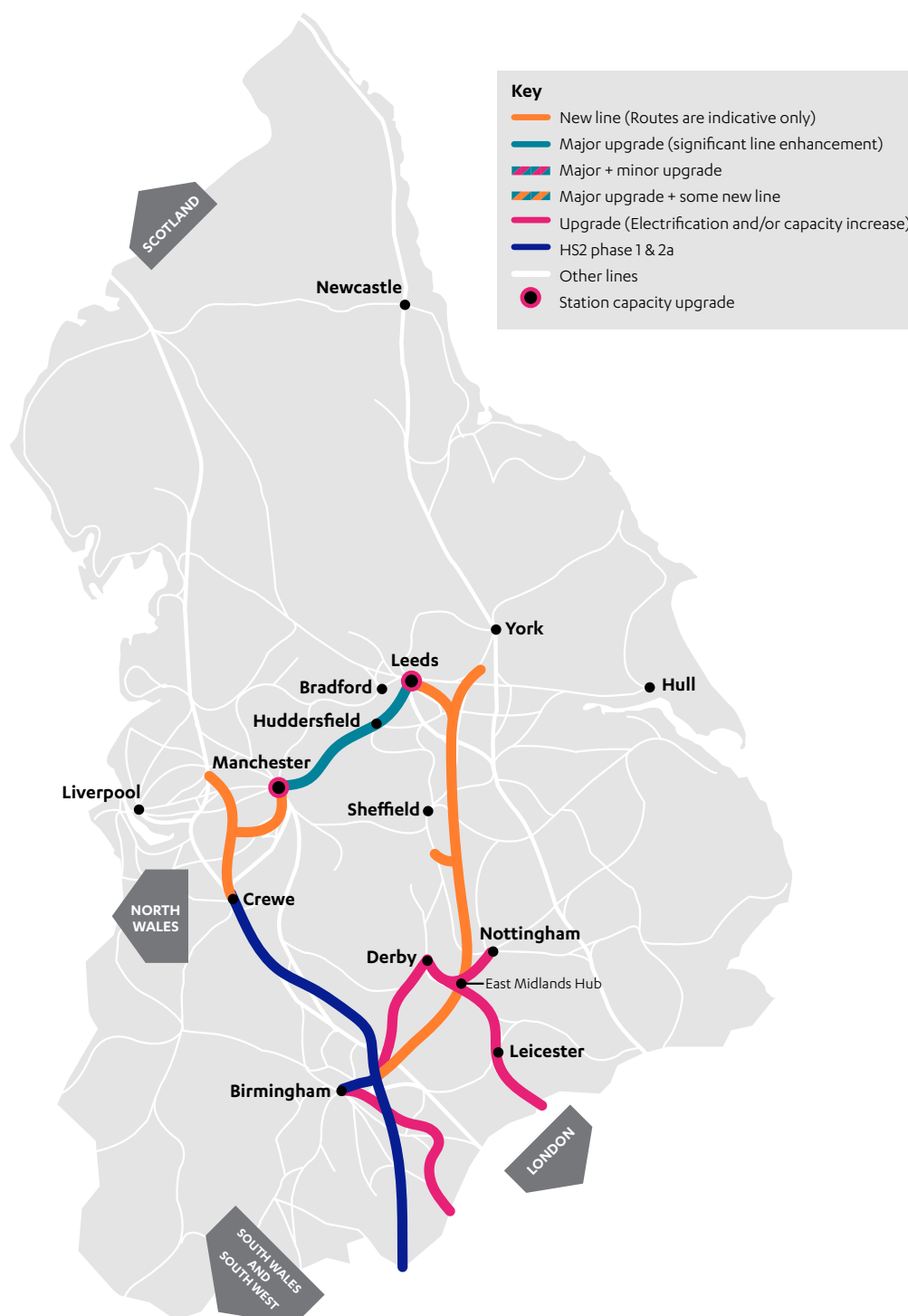
- **the first, in line with the ‘plus 25 per cent’ budget, includes:**
 - the full HS2 Phase 2b eastern leg
 - **Transpennine Route Upgrade: electrification of sections of the line between Manchester and York and some line speed increases**
 - **Midlands Connect schemes using the eastern leg of HS2**
- **the second, in line with the ‘plus 50 per cent’ budget, includes schemes listed above plus:**
 - a wider range of upgrades across the Midlands and the North
 - a mix of new lines and upgrades between Manchester and Leeds as well as the Transpennine Route Upgrade between Manchester and York
 - upgraded connections and capacity from York to Newcastle
 - an upgrade to the Manchester to Liverpool line via Warrington Central
 - delivers line speed and capacity benefits to rail links between Birmingham, Leicester, Nottingham, Coventry, Derby, Hereford and Worcester and improved services to Wales and the south west through the Midlands Rail Hub
 - improves links to Birmingham International airport and Coventry from Derby and Sheffield in the North and Oxford and Reading in the South, due to the Midlands Engine Rail programme.

Costs for the packages prioritising long distance links are £68 billion (in the package in line with the ‘plus 25 per cent’ budget) and £90 billion (in the package in line with the ‘plus 50 per cent’ budget), net of HS2 Phases 1 and 2a and including £15 billion for traction decarbonisation, digital signalling and ‘early wins’.

Once the full HS2 Phase 2b network connecting London to Manchester and Leeds via Birmingham is included in the 'plus 25 per cent' budget option, there is only enough funding remaining to deliver the Transpennine Route Upgrade as proposed currently and some of the smaller Midlands Connect schemes. This means that the Northern Powerhouse Rail route enhancement between Liverpool, Manchester, Leeds and Newcastle cannot be included in this package without exceeding the budget.

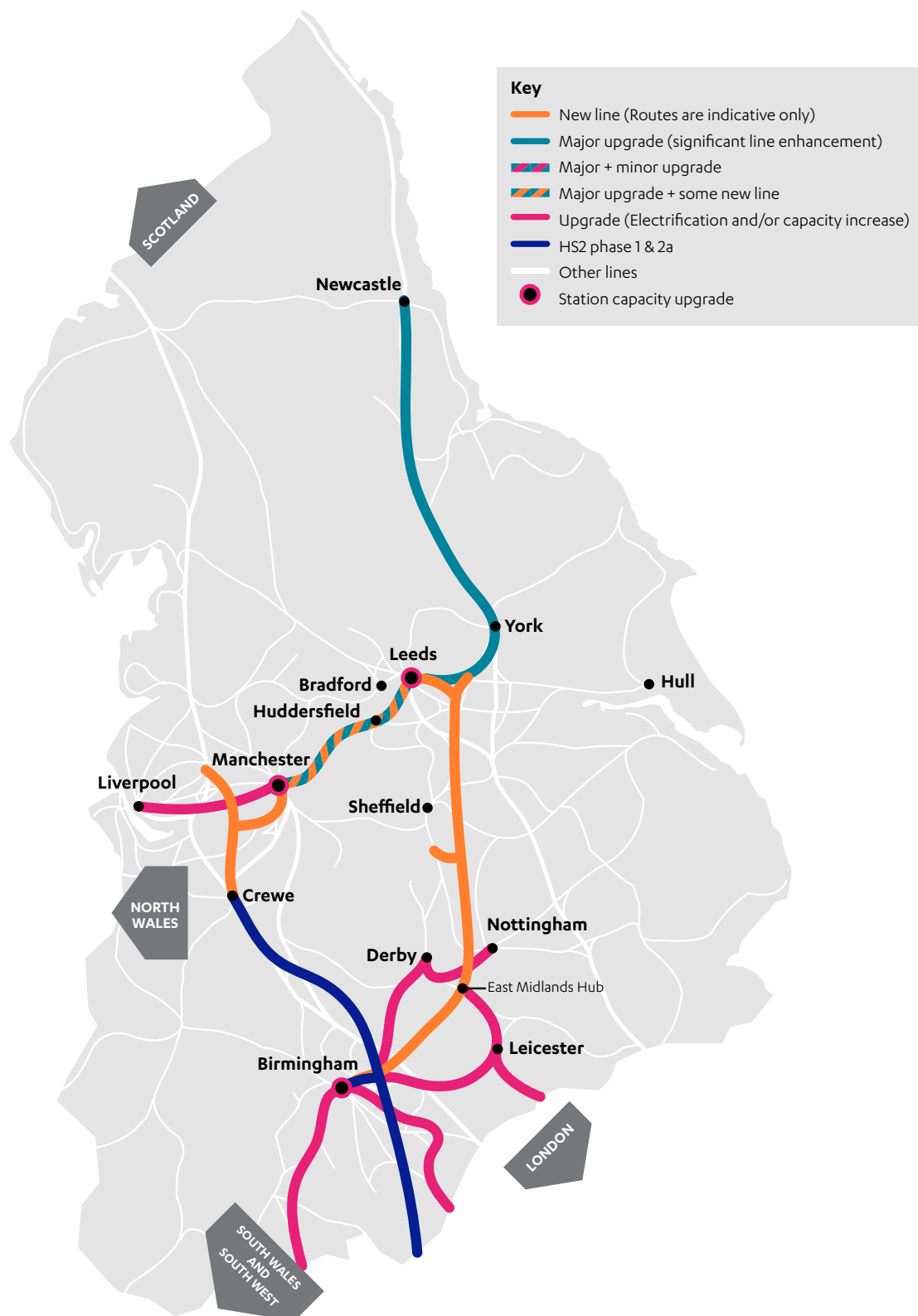
In the 'plus 50 per cent' package, Northern Powerhouse Rail services would be able to run between Manchester and Newcastle via Leeds and York.

Prioritising long distance links (plus 25 per cent)



Infrastructure interventions are shown indicatively, not service origins and destinations. Not all stations shown.

Prioritising long distance links (plus 50 per cent)



Infrastructure interventions are shown indicatively, not service origins and destinations. Not all stations shown.

While the Transpennine Route Upgrade and likely some Midlands Engine Rail schemes could be completed in the 2020s, HS2 Phases 1 and 2a and the Midlands Engine Rail schemes would all only be delivered in the 2030s. From 2035-45, further construction would be delivered to complete the full HS2 Phase 2b network. In the 'plus 50 per cent' package, this later period will also see a mix of new lines and upgrades between Manchester and Leeds delivered as well as upgrades to routes from Leeds to Newcastle and Sheffield.

What does the package deliver?

Figure C.2 sets out the headline assessment of the benefits and impacts of the package that the Commission has quantified.¹⁵¹

Figure C.2: Headline benefits and impacts for the package (benefits are measured over 60 years from scheme opening)¹⁵²

				'plus 25 per cent'	'plus 50 per cent'
Economic growth and competitiveness	Improvements to connectivity from faster journeys			10-11%	11-12%
	Improvements to productivity in city centres	Ave. annual impact		£0.4-0.7bn	£0.5-1bn
		60-year appraisal period	Undiscounted	£25-43bn	£33-58bn
			Discounted	£10-17bn	£13-23bn
Sustainability and quality of life	Benefits from connecting people to city services		Undiscounted	£10-22bn	£13-31bn
			Discounted	£2-6bn	£3-8bn
	Loss of natural capital (partial valuation)			£95-120m	£175-220m
	Lifecycle carbon emissions			4MtCO2e	6MtCO2e

Connectivity

These packages are designed to give the most improvements for long distance connectivity between the Midlands and the North. This is delivered through the full HS2 Phase 2b linking Birmingham with Manchester and Leeds, alongside the Golborne and Church Fenton links, which improve journey times from London and the Midlands to the North West, the North East and to Scotland (see figure C.3). In the 'plus 50 per cent' package, journey times between Leeds and Newcastle are also improved due to upgrades along this section of the network.

Figure C.3: Journey times (minutes) and trains per hour between key cities in the Midlands and the North¹⁵³

Origin – destination pair	Current		Long distance links 'plus 25 per cent'		Long distance links 'plus 50 per cent'	
	Journey time fastest (minutes)	Trains per hour	Journey time (minutes)	Trains per hour	Journey time (minutes)	Trains per hour
Birmingham-Manchester	90	2	40	4	40	4
Birmingham-Leeds	120	1	49	3	49	3
Leeds-Manchester	50	5	43	6	31	8
Birmingham-Nottingham*	72	2	53	5-6	53	5-6
Manchester-Liverpool	36	4	36	4	36	4
Leeds-Newcastle	88	3	88	3	62	5
Derby-Sheffield	35	5	35	3	35	3
Bradford-Leeds	19	up to 8	19	up to 8	19	up to 8
Leeds-Sheffield	42	3	42	3	42	3
Sheffield-Manchester	55	2	55	3	55	3
Sheffield-London	132	2	87	3	87	3
Birmingham-London	73	8	48	10	48	10
Leeds-London	119	2	81	4	81	4
Manchester-London	119	3	73	4-5	73	4-5
Newcastle-London	193	2	143	4	140	4
Nottingham-London	109	2	89	6	89	6

In the 'plus 25 per cent' budget, the package prioritising long distance links delivers the same improvements to connectivity at the lower end of the range of potential benefits as the package prioritising regional links, but less at the higher end. However, the connectivity benefits are spread more evenly between places than in the 'plus 25 per cent' package prioritising regional links, (see figures B.4 and C.4).

In the 'plus 50 per cent' budget, the package prioritising long distance links delivers lower overall improvements to connectivity for cities in the Midlands and the North (11-12 per cent compared to 11-19 per cent for the 'plus 50 per cent' budget package prioritising regional links).

* Midlands Connect have proposed infrastructure changes in the Toton area and to the HS2 scheme to allow HS2 to run conventional compatible services between Birmingham and Nottingham, which could reduce journey times to 33 minutes. However, it is not clear what frequency would be possible for this service.

Figure C.4: Improvements to connectivity against the baseline by place, central estimates¹⁵⁴

	Birmingham	Manchester	Leeds	Liverpool	Sheffield	Newcastle	Nottingham	Leicester	Hull	Bradford		Edinburgh	Glasgow		Birmingham Airport	Manchester Airport
+25%	21%	12%	22%	2%	13%	15%	17%	8%	10%	15%		5%	6%		17%	26%
+50%	22%	12%	24%	3%	14%	16%	18%	11%	14%	19%		6%	7%		18%	27%

Capacity

These packages provide some additional capacity on the rail network, primarily due to delivering new lines into the biggest, most congested cities through HS2 – Leeds, Manchester, Birmingham – and the Transpennine Route Upgrade, which also releases some capacity on the West and East Coast Main Lines. Figure C.5 shows the increases in capacity into major cities in both packages. **Figure C.5: Increase in number of seats and standing spaces on commuter lines compared to current (during the morning peak, key cities), central estimates¹⁵⁵**

	'plus 25 per cent'	'plus 50 per cent'
Birmingham	24,000	31,000
Bradford	0	7,000
Coventry	1,000	1,000
Leeds	33,000	47,000
Liverpool	2,000	2,000
Manchester	29,000	38,000
Newcastle	15,000	19,000
Nottingham	0	2,000
Sheffield	7,000	7,000

Productivity and amenity benefits

Figure C.6 shows the Commission's estimates for the productivity and amenity benefits for the major cities that result from the increased capacity provided by these packages.

Figure C.6: Total productivity plus amenity benefits provided by the package investments over a 60 year period from the opening of schemes (undiscounted), central estimates¹⁵⁶

City	Productivity plus amenity benefits (£ billion)	
	25 per cent	50 per cent
Birmingham	12.0	15.4
Bradford	0.0	1.7
Coventry	0.4	0.4
Derby	0.0	0.0
Leeds	9.5	13.3
Liverpool	0.7	0.7
Manchester	13.3	17.5
Newcastle	5.5	7.2
Nottingham	0.0	0.6
Sheffield	2.4	2.4

Risks and further work required

There are two aspects of disruption in these packages that would need further work:

- Delivering new lines generally leads to less disruption for rail users but is likely to impact the road network more severely. Constructing the eastern leg of HS2 Phase 2b could cause significant disruption to the road network without mitigation, particularly on the M1. While key interactions between HS2 and the road network have been identified, mitigations need to be developed to plan for and mitigate impacts on road users.
- Constructing new lines will also cause disruption to passengers where it interacts with the existing rail network or requires upgrades. This potential disruption to rail passengers and freight users will need careful consideration by the rail industry as projects are taken forward.

In order to maximise the potential benefits of packages and deliver as much of the current HS2 and Northern Powerhouse Rail service specifications as possible, further work would be needed on:

- In the 'plus 50 per cent' package – to consider whether planned Northern Powerhouse Rail services between Liverpool and Newcastle could still be accommodated in full. Current Northern Powerhouse Rail plans are based on more substantial upgrades between Liverpool and Manchester than are included in the package.
- In both packages – the route between Leeds and Hull is a strong candidate for early intervention through the budget allocated to a rolling programme of electrification. The much wider extent of Northern Powerhouse Rail interventions in the 'plus 50 per cent' package mean this is likely to be most attractive at this budget.

In the 'plus 25 per cent' package there are also risks to network capacity, which is unlikely to meet the expected growth in demand in the medium to long term. This is likely to be most relevant between Liverpool and Leeds.

Unlocking investment in land around stations

Alongside the benefits set out in annex A for Manchester and Liverpool from the western leg of HS2 Phase 2b, these packages deliver some further benefits, particularly for Leeds and the surrounding area and in the Midlands.

The 'plus 50 per cent' packages includes the full planned redevelopment of Leeds station and connections to York and Newcastle. The Leeds Inclusive Growth Strategy includes the aspiration to 'double the size of the city centre', with a rebuilt Leeds station seen as the key element to providing the 'capacity required to support the rapid expansion of the city centre.'¹⁵⁷ Before the Covid-19 crisis, the present station was expected to reach capacity by 2026. Neither of these packages includes an expected Northern Powerhouse Rail line to serve Bradford.

In the West Midlands, there are also potential benefits in the Midlands with both packages delivering Midlands Connect local links to Birmingham Curzon Street and Birmingham Interchange, which are the focus of regeneration activity. The redevelopment of Birmingham Moor Street, included in the 'plus 50 per cent' package, aims to create a 'one station' concept where the station shares a square with Curzon Street station, with a footbridge in between the stations, and also better pedestrian access to Birmingham New Street.¹⁵⁸

In the East Midlands, there are economic developments associated with HS2 planned at Ratcliffe Power Station, East Midlands Airport and the proposed 'Innovation Campus' near Toton. In addition, housing redevelopment at Toton and Chetwynd Barracks around the East Midlands Hub aims to deliver 4,500 new homes.¹⁵⁹

Acknowledgements

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The list below sets out organisations that have engaged with the Commission in delivering this report, including by responding to the Commission's Call for Evidence and Interim Report.

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20 Miles More	Buro Happold	Craig Whitaker MP
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Action for Yorkshire Transport	Campaign for Borders Rail	Culcheth and District Rail Action Group
AECOM	Campaign for the Protection of Rural England	Culcheth and Glazenbury Parish Council
Alec Shelbrooke MP	Capita	Cumbria County Council
Alstom UK & Ireland	CBRE Limited	Cumbria Local Enterprise Partnership
Andrew Bridgen MP	Centre for Cities	Cumbrian Community Rail Partnerships
Angel Trains Ltd	Chartered Institute of Logistics and Transport	D2N2 Local Enterprise Partnership
Ashby Canal Association	Cheshire and Warrington Local Enterprise Partnership	David Brice Consultancy Ltd
Ashby Canal Trust	Cheshire Association of Local Councils	Department for Transport
Ashfield District Council	Cheshire East Council	Derby City Council
Association of British Ports	Chesterfield Borough Council	Derbyshire County Council
Atkins	Chesterfield Canal Trust	East Coast Main Line Authorities
Bechtel	Commercial Estates Group	East Midlands Chamber
Birmingham Airport	Confederation of British Industry	East Midlands Councils
Black Country Chamber	Councillor Martin Gannon, Chair NE Joint Transport Committee	East Midlands Local Enterprise Partnerships
Black Country Local Enterprise Partnership	Coventry and Warwickshire Local Enterprise Partnership	Eversholt Rail
Blackpool Council		Expedition Engineering
Bradford City Council		Fabian Hamilton MP
British Chambers of Commerce		

Gazeley	Lord Patel of Bradford	Royal Society for the Protection of Birds
Greater Birmingham and Solihull Local Enterprise Partnership	Lord Shutt of Greetland	Rt Hon Hilary Benn MP
Greater Birmingham Chambers of Commerce	Lord Wallace of Saltaire	Rt Hon Karen Bradley MP
Greater Lincolnshire Local Enterprise Partnership	Mace Group	Scottish Government
Greater Manchester Combined Authority	Manchester Airports Group	Settle Carlisle Railway Development Company
Greengauge 21	Manchester and East Midlands Rail Action Partnership	Sheffield City Council
Halifax & District Rail Action Group	Manchester City Council	Sheffield City Region Combined Authority
Harworth Group Plc	Mid Cheshire Rail Users Association	Siemens
High Speed Rail Group	Midlands Connect	SKA Developments
Highways England	Minsters Rail Campaign	Skipton-East Lancashire Rail Action Partnership
Hilary Benn MP	Mott MacDonald	Solihull Metropolitan Borough Council
Historic England	Muslims in Rail	Southport Travellers' Association
HM Treasury	National Farmers' Union	Staffordshire Chambers of Commerce
Holly Lynch MP	National Trust	Staffordshire County Council
Howard Pack Consulting	Natural England	Stockport Council
HS2 Ltd.	Network Rail	Stoke on Trent City Council
Hull & East Riding Rail Users' Association	Nexus	Stoke-on-Trent and Staffordshire Enterprise Partnership
IFPA	Nichols Group	Stone Railhead Crisis Group
INECO	Nigel Adams MP	Tatton Group
Inland Waterways Association	North Cheshire Rail Users Group	Tees Valley Combined Authority
Institute of Civil Engineers	North East Joint Transport Committee	The Marches Local Enterprise Partnership
IPPR North	North East Combined Authority	The Piece Hall
Jack Brereton MP	North East England Chamber of Commerce	The Wildlife Trusts
Jacobs	North of Tyne Combined Authority	Tracy Brabin MP
Jason McCartney MP	North West Leicestershire District Council	Trafford Council
Jo Gideon MP	Northern Powerhouse Partnership	Transport Focus
Jonathan Gullis MP	Northern Rail Industry Leaders	Transport for Greater Manchester
Judith Cummins MP	Nottingham City Council	Transport for the North
Kevin Hollinrake MP	Nottinghamshire County Council	Transport for the West Midlands
Kilbride Holdings Limited	Office of Road and Rail	Transport for Wales
Lakes Line Rail Users Group	Ormskirk Preston	Travel Watch North West
Lancashire Country Council	Ove Arup	Tritax Symmetry
Lancaster City Council	Park Lane Group	Trucktrain Developments Ltd
Lee Rowley MP	Peel Group	Turner and Townsend Project Management
Leeds City Council	Pickmere Parish Council	Tyne Valley CRP
Leeds Civic Trust	Plastic Omnium	UK Major Ports Group
Leeds Studio	Port of Tyne	UK2070 Commission
Leicester and Leicestershire Local Enterprise Partnership	Porterbrook	Urban Growth Company
Leicestershire County Council	Rail Delivery Group	Vastint
Leicester City Council	Rail Forum Midlands	Warrington Borough Council
Liverpool City Region Combined Authority	Rail Freight Group	Waxwing Engineering Ltd
	Rail Future	Welsh Local Government Association
	Rail Safety and Standards Board	
	Railway Industry Association	

West Midlands Combined Authority
West Midlands LEP Chairs
West Midlands Rail Executive
West Yorkshire Combined Authority
Weston Williams and Partners
Wigan Council
Wildlife Trusts
Woodland Trust
Worcestershire County Council
Worcestershire Local Enterprise
Partnership
WSP
Yeme Architects
Yorkshire and Humberside Green Party
Yorkshire Rail Campaign

Endnotes

NB: References for facts in the Executive Summary are included in the chapters in the rest of this report.

- 1 2019/20 prices between 2020 and 2045
- 2 Centre for Cities (2016), **Building the Northern Powerhouse**
- 3 European Commission (2016), **Working paper: Towards regional and urban indicators on rail passenger services, using timetable information** (Map 2)
- 4 National Audit Office (2016), **Modernising the Great Western railway**. Rebased from 2012/13 prices to 2019/20 prices using HMT's GDP deflator
- 5 Douglas Oakervee (2020), **Oakervee Review of HS2**. Oakervee took the latest cost estimates from the HS2 Chairman's stocktake and adjusted them to 2019 prices
- 6 National Infrastructure Commission (2018), **National Infrastructure Assessment**
- 7 The Commission's binding fiscal remit requires it to demonstrate that all its recommendations for economic infrastructure are consistent with, and set out how they can be accommodated within, gross public investment in economic infrastructure of between 1.0 per cent and 1.2 per cent of GDP each year between 2020 and 2050. The Commission last published a full fiscal remit table in the **National Infrastructure Assessment** in 2018. The budgets for the Rail Needs Assessment were set out in the technical annex published alongside the Commission's interim report.
- 8 Commission calculations, for more detail see the modelling annex published alongside this Assessment
- 9 Commission calculations based on expected scheme costs. Excluding HS2 Phase 1 and 2a
- 10 The numbers in figure 0.1 would only form one part of a traditional Benefit Cost Ratio and should therefore not be taken as such
- 11 Note: Benefits from HS2 Phase 1 and 2a are not included in this table:
 - Improvements to connectivity from faster journeys: Average percentage improvement in overall rail connectivity between places in the Midlands and the North, including how connected these places are to Scotland, regional airports and key places in the south, calculated for the whole package in 2045 versus the winter 2019 timetable.
 - Improvements to productivity in city centres: Aggregate of productivity increase from agglomeration plus impact of workers moving to higher value jobs. £2019/20 prices, real terms, undiscounted, total over 60 years of benefits.
 - Benefits from connecting people to city services: Aggregate of recreational impacts from improving access to city centres. £2019/20 prices, real terms, undiscounted total over 60 years of benefits.
 - Loss of natural capital: Total monetary value of natural capital lost. £2019/20 prices, real terms, undiscounted, total from 2028 to 2098.
 - Lifecycle carbon emissions: Million tonnes of carbon dioxide equivalent, construction plus 60 years of operation. Undiscounted figures represent 60 years of benefits at a constant annual rate.
- 12 The Commission has used estimates from Stephen Gibbons, Teemu Lyytikäinen, Henry Overman and Rosa Sanchis-Guarner (2019), **New Road Infrastructure: the effects on firms**, **Journal of Urban Economics**, and further assumptions to convert improvements in connectivity into monetised benefits which, combined with the other benefits in the table, produce monetised benefits that appear to meet or outweigh the costs of the packages. This is covered in more detail in the modelling annex to be published alongside this Assessment at nic.org.uk
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- 31 Department for Transport (2017), **High Speed Two Phase Two Strategic Case**
- 32 Commission calculation using Department for Transport MOIRA outputs. Data on similar journeys in Netherlands and Germany from Centre for Cities (2016), **Building the Northern Powerhouse**. To calculate average journey speed, the average journey time is divided by the track distance. London and the South East includes journeys between London and the seven largest Travel to Work Areas (TTWAs) outside greater London in the South East and East of England. Journeys in the Netherlands and Germany are in the Randstad, the Netherlands, and the Rhine Ruhr, Germany.
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- 91 NB: Benefits from HS2 Phases 1 and 2a are not included in this table. Shading in this table is based on an ordinal ranking between the packages on the benefit divided by cost for each criteria:
- **Improvements to connectivity from faster journeys:** Average percentage improvement in overall rail connectivity between places in the Midlands and North, including how connected these places are to Scotland, regional airports and key places in the south, calculated for the whole package in 2045 versus the winter 2019 timetable.
 - **Improvements to productivity in city centres:** Aggregate of productivity increase from agglomeration plus impact of workers moving to higher value jobs. £2019/20 prices, real terms, discounted to 2020, total over 60 years of benefits.
 - **Benefits from connecting people to city services:** Aggregate of recreational impacts from improving access to city centres. £2019/20 prices, real terms, discounted to 2020, total over 60 years of benefits.
 - **Loss of natural capital:** Total monetary value of natural capital lost. £2019/20 prices, real terms, discounted to 2020, total from 2028 to 2098.
 - **Lifecycle carbon emissions:** Monetised lifecycle carbon impact calculated from million tonnes of carbon dioxide equivalent for each package. £2019/202 prices.
 - **Costs:** The central estimates represent the Commission's best judgement within the range calculated. £2019/20 prices. Discounted to 2020.
- Discounting uses the Green Book discount rate.

- 92 The Commission has used estimates from Stephen Gibbons, Teemu Lyytikainen, Henry Overman and Rosa Sanchis-Guarner (2019) 'New Road Infrastructure: the effects on firms', **Journal of Urban Economics**, and further assumptions to convert improvements in connectivity into monetised benefits, which, combined with the other benefits in the table, produce monetised benefits that appear to meet or outweigh the costs of the packages. This is covered in more detail in the modelling annex published alongside this assessment.
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- 97 Commission calculations based on capacity estimates from HS2 Ltd, the Department for Transport, Midlands Connect and Transport for the North. More detail on how these impacts have been estimated is available in the methodological annex. Central estimates represent the Commission's best judgements within the calculated range.
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- 134 The numbers in figure A2 would only form one part of a traditional Benefit Cost Ratio and should therefore not be taken as such
- 135 Undiscounted figures represent 60 years of benefits at a constant annual rate. Discounted figures reflect the value of time, at the standard Green Book rate. Productivity benefits are also inflated for projected economic growth using Office for Budget Responsibility March 2019 estimates to 2068 and a flat rate thereafter.
- NB: Benefits from HS2 Phases 1 and 2a are not included in this table:
- **Improvements to connectivity from faster journeys:** Average percentage improvement in overall rail connectivity between places in the Midlands and the North, including how connected these places are to Scotland, regional airports and key places in the south, calculated for the whole package in 2045 versus the winter 2019 timetable
 - **Improvements to productivity in city centres:** Aggregate of productivity increase from agglomeration plus impact of workers moving to higher value jobs. £2019/20 prices, real terms, total over 60 years
 - **Benefits from connecting people to city services:** Aggregate of recreational impacts from improving access to city centres. £2019/20 prices, real terms
 - **Loss of natural capital:** Total monetary value of natural capital lost. £2019/20 prices, real terms, total from 2028 to 2098
 - **Lifecycle carbon emissions:** Million tonnes of carbon dioxide equivalent, construction plus 60 years of operation. The central estimates represent the Commission's best judgement within the range calculated
- 136 The values in figure A.3 represent the fastest departure to arrival journey times between city pairs, taken from the latest information provided to the Commission by stakeholders for each of the packages. In some cases there are a number of different estimates of indicative journey times, depending upon the assumptions made on the scheme and operations and in such cases the Commission has used the most recent material, while ensuring consistency between packages where there are different sources. There are some differences from the numbers shown here and those used in the connectivity analysis, which use detailed model outputs provided by key rail bodies and experts, and also include allowances for waiting times and interchanges. Journey times and performance are sensitive to infrastructure provided, and detailed timetabling (including stopping patterns). Journey times could vary either up or down, if the package were to be implemented. Released capacity services will be dependent upon the use made of the network for freight, local and regional passenger services as well as improvements to rail performance. Further work will be required to understand the impacts in more detail as plans are taken forward..
- 137 Commission calculations using journey time data from HS2 Ltd, the Department for Transport, Midlands Connect and Transport for the North. More detail on how these impacts have been estimated is available in the methodological annex. Average percentage improvement in overall rail connectivity between places in the Midlands and the North, including how connected these places are to Scotland, regional airports and key places in the south, calculated for the whole package in 2045 versus the winter 2019 timetable. Central estimates represent the Commission's best judgements within the calculated range.
- 138 Released capacity estimates calculated by the Commission, based on data from HS2 Ltd, the Department for Transport, Midlands Connect and Transport for the North. More detail on how these impacts have been estimated is available in the methodological annex. Central estimates represent the Commission's best judgements within the calculated range. Rounded to the nearest thousand.
- 139 Commission calculations underpinned by capacity estimates from HS2 Ltd, the Department for Transport, Midlands Connect and Transport for the North. More detail on how these impacts have been estimated is available in the methodological annex. Central estimates represent the Commission's best judgements within the calculated range. 2019/20 prices
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- 142 The numbers in figure B.2 would only form one part of a traditional Benefit Cost Ratio and should therefore not be taken as such.
- 143 Undiscounted figures represent 60 years of benefits at a constant annual rate. Discounted figures reflect the value of time, at the standard Green Book rate. Productivity benefits are also inflated for projected economic growth using Office for Budget Responsibility March 2019 estimates to 2068 and a flat rate thereafter.
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- 144 The values in figure B.3 represent the fastest departure to arrival journey times between city pairs, taken from the latest information provided to the Commission by stakeholders for each of the packages. In some cases there are a number of different estimates of indicative journey times, depending upon the assumptions made on the scheme and operations and in such cases the Commission has used the most recent material, while ensuring consistency between packages where there are different sources. There are some differences from the numbers shown here and those used in the connectivity analysis, which use detailed model outputs provided by key rail bodies and experts, and also include allowances for waiting times and interchanges. Journey times and performance are sensitive to infrastructure provided, and detailed timetabling (including stopping patterns). Journey times could vary either up or down, if the package were to be implemented. Released capacity services will be dependent upon the use made of the network for freight, local and regional passenger services as well as improvements to rail performance. Further work will be required to understand the impacts in more detail as plans are taken forward.
- 145 Commission calculations using journey time data from HS2 Ltd, the Department for Transport, Midlands Connect and Transport for the North. More detail on how these impacts have been estimated is available in the methodological annex. Average percentage improvement in overall rail connectivity between places in the Midlands and the North, including how connected these places are to Scotland, regional airports and key places in the south, calculated for the whole package in 2045 versus the winter 2019 timetable. Central estimates represent the Commission's best judgements within the calculated range.
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- 151 The numbers in figure C.2 would only form one part of a traditional Benefit Cost Ratio and should therefore not be taken as such
- 152 Undiscounted figures represent 60 years of benefits at a constant annual rate. Discounted figures reflect the value of time, at the standard Green Book rate. Productivity benefits are also inflated for projected economic growth using Office for Budget Responsibility March 2019 estimates to 2068 and a flat rate thereafter.
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- **Lifecycle carbon emissions:** Million tonnes of carbon dioxide equivalent, construction plus 60 years of operation. The central estimates represent the Commission's best judgement within the range calculated.

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