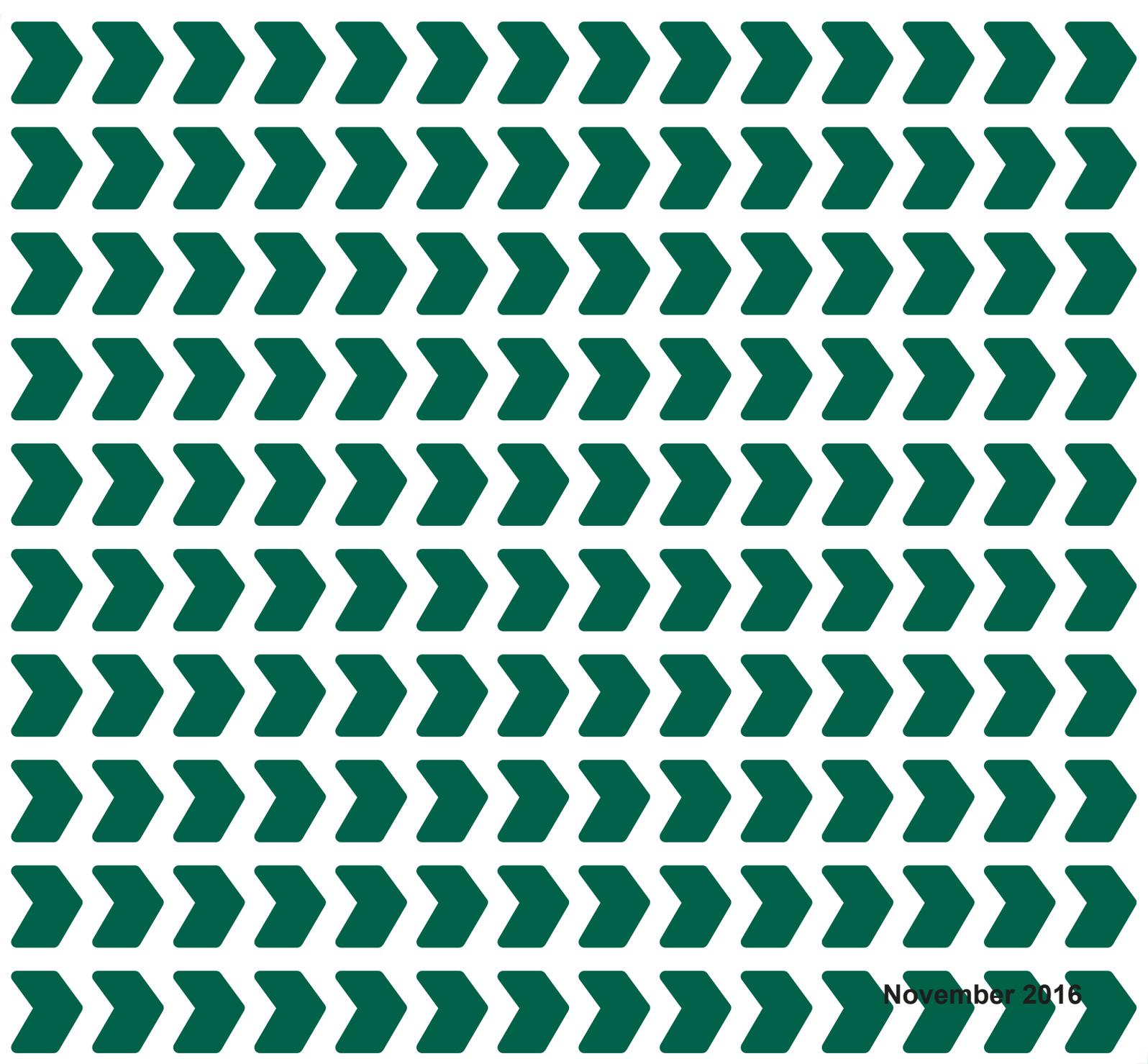




Department
for Transport

High Speed Two Phase 2b Strategic Outline Business Case Strategic Case

Moving Britain Ahead



November 2016

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Executive Summary

High Speed Two (HS2) is a new high speed rail network for the UK, connecting London with major cities in the Midlands and the North of England. It is a Y-shaped network that will be delivered in several stages. Trains will also run beyond the Y network to serve places such as Liverpool, Preston, Newcastle and on to Scotland.

Phase One of HS2 will see a new high speed line constructed from Euston to north of Birmingham, where it will re-join the existing West Coast Main Line (WCML). New high speed trains will serve Birmingham city centre and an interchange station designed to serve the wider West Midlands and Birmingham Airport. At Old Oak Common in West London, a new interchange will be built connecting HS2 with the Elizabeth Line, Heathrow and the Great Western Main Line. Phase One will be built and operational by 2026, subject to Parliamentary approval of the Phase One hybrid Bill.

The proposals for Phase Two will extend the line to the North West and North East, to Manchester with connections to the WCML at Crewe and Golborne, and to Leeds with a connection to the East Coast Main Line (ECML) approaching York. There will be new stations in Manchester city centre and at the airport, and in Leeds and the East Midlands, with trains also serving South Yorkshire and Liverpool. Phase Two will be completed seven years after Phase One, in 2033.

In November 2015 the Government announced its intention to accelerate the delivery of the section of Phase Two between the West Midlands and Crewe to 2027 (Phase 2a). This document sets out the Strategic Case for the remainder of the Phase Two route (Phase 2b), from Crewe to Manchester on the Western Leg, and from Birmingham to Leeds on the Eastern Leg with connections onto the WCML and ECML.

HS2 has the power to change the economic landscape of the country; to transform our cities, communities and the way that people travel and live. It will by-pass congested parts of our existing rail network and deliver extra capacity and improved connectivity that will help unlock growth and regeneration for cities throughout the country. Only through completing Phase 2b can we deliver the full benefits of HS2. That is why we intend to build all the way to Leeds and Manchester by 2033.

To support economic growth, particularly in cities and in knowledge-based sectors, we need to modernise our rail network. Britain's railways have seen unprecedented growth since the mid-1990s. By 2015-16, total passenger journeys on Britain's rail network had increased by 129 per cent since privatisation in 1994-95. The growth in intercity rail travel for all purposes along some of the key HS2 corridors has exceeded average growth in use of the national rail network as a whole, almost tripling since privatisation.

The Government is investing in economic growth, for example through infrastructure and in particular transport. However, there are limits to what can be achieved on the existing network. The extensive scale of current and planned investment in the current rail network cannot keep pace with the rising demand in the longer term, which, if constrained, will undermine the future economic prosperity of the country.

Completing Phase 2b will enable faster journeys between Leeds, Sheffield, the East Midlands and Birmingham, as well as between London and Manchester, Preston and Scotland. Building Phase 2b ensures that the benefits of HS2 are spread as widely as possible, helping to rebalance our economy and making HS2 truly national in scope.

The benefit-cost ratio (BCR) for the HS2 network as a whole, including wider economic impacts, is calculated to be 2.7. This provides £103bn in total benefits to the UK as a whole. As the economic case demonstrates, Phase 2b is an even higher value for money scheme, delivering £52bn of total benefits with a BCR of 3.1 including wider economic impacts. This is a conservative assessment, because the modelling assumes no increase in passenger demand after 2036 and no changes to population or employment as a result of the scheme.

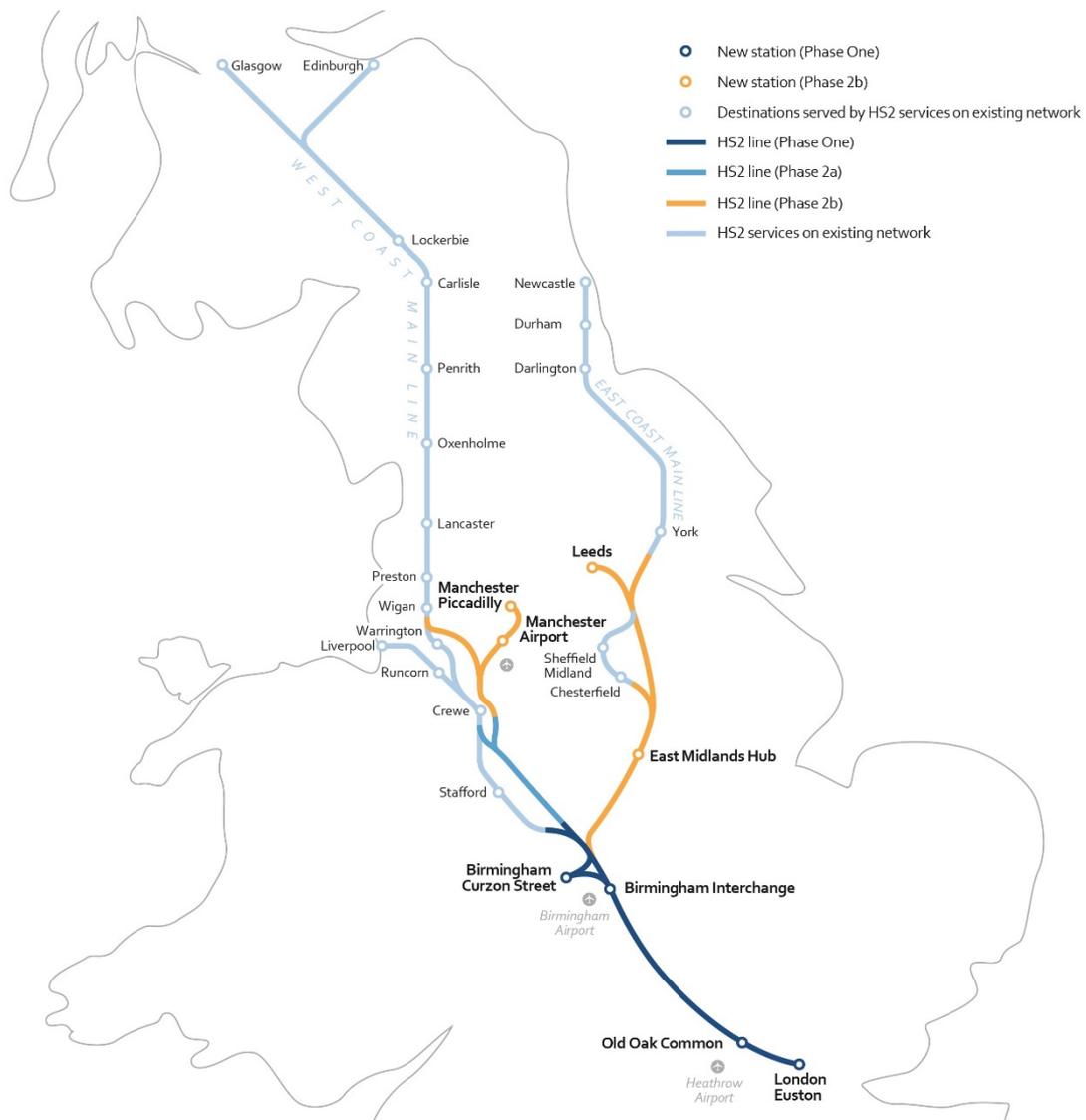
In order to ensure our case is robust, and in line with the requirements of the HM Treasury Green Book, we have considered alternatives to the Phase 2b scheme presented in our Strategic Outline Business Case. We have found no alternative that could deliver the same level of benefit for the country, stand the test of time and provide the same level of capacity, connectivity and service that Phase 2b does in pursuit of our strategic objectives.

We are determined that the benefits of HS2 will be as widely felt as possible. HS2 has the potential to significantly improve the prospects of local areas, to the benefit of the people who live in them and the businesses that employ them. That is why we are funding HS2 places to develop HS2 Local Growth Strategies and why we will continue to work closely with local authorities to maximise the potential of HS2 in their areas.

HS2 will connect people to jobs, businesses to suppliers and make parts of the UK more accessible to leisure travellers and tourists. It will also release capacity on our existing rail network, meaning more commuting and regional services in to major cities such as Manchester, Leeds and Birmingham, and help get more freight off our roads. People who do not travel on HS2 will therefore still benefit from it. The Government is firmly behind HS2, a modern high speed railway for a country and economy that work for all.

1. The route of HS2

1.1 HS2 is a new high speed rail network for the UK, connecting London with major cities in the Midlands and the North of England. It is a Y-shaped network that will be delivered in three stages, integrated with the existing network. Phase One of HS2 will see a new line constructed from Euston to north of Birmingham, allowing fast, direct services to destinations including Crewe, Manchester, Liverpool, Preston and Glasgow. It is due to open in 2026. The proposals for Phase Two extend the line to Manchester, with connections to the West Coast Main Line (WCML) at Crewe and Golborne, and to Leeds with a connection to the East Coast Main Line (ECML) approaching York. This proposed route was consulted on in 2013.



- 1.2 In November 2015 the Government confirmed the HS2 route from the West Midlands to Crewe (Phase 2a) and brought forward the opening date from 2033 to 2027.
- 1.3 The Strategic Case for the programme as a whole was published in October 2013. The Case for accelerating Phase 2a was published in November 2015. This Strategic Case covers the remainder of the Phase 2 route, known as Phase 2b. Proposals for Crewe Hub are being developed for separate decisions and are not part of this business case.
- 1.4 The preferred route for Phase 2b:
 - a. The Western Leg of Phase 2b has a total length of 51 miles (82 km). At its southern end it connects to Phase 2a to the south of Crewe. Going north, it passes under Crewe in a tunnel. At its northern end the Western Leg joins the WCML at Golborne, south of Wigan. A spur from the main line serves a new station at Manchester Airport before entering into an 8 mile (13km) tunnel to reach a new station at Manchester Piccadilly. Following refinements developed since the 2013 consultation, we are proposing that the Western Leg also includes a rolling stock depot located to the north of Crewe, between the HS2 route and the WCML. The [consultation](#) on route refinements for Phase 2a¹, published on 13 September 2016, sought views on whether the infrastructure maintenance depot for the Western Leg might be provided at Stone, further south of Crewe and whether the start point of Phase 2b might move slightly south to allow for a longer tunnel at Crewe. The Government aims to reach a decision on the design that will be incorporated into the Phase 2a hybrid Bill to allow it to be deposited in Parliament by the end of 2017.
 - b. The Eastern Leg has a total length of 123 miles (198 km). At its southern end it connects to the Phase One route at Marston. At its northern end, the Eastern Leg joins the ECML via a connection near Church Fenton. The Eastern Leg includes new stations at Toton (East Midlands Hub) and a spur from the main line goes to a new station at Leeds. Following refinements developed since the 2013 consultation, we are proposing that South Yorkshire is served by HS2 trains running into Sheffield Midland using a dedicated high speed spur, allowing services to join the existing network south of Chesterfield at Clay Cross. The Eastern Leg also includes an infrastructure maintenance depot located at Staveley, and a rolling stock depot at New Crofton, though HS2 Ltd is currently examining alternative locations for this depot.

¹ <https://www.gov.uk/government/consultations/hs2-phase-2a-west-midlands-to-crewe-design-refinement-consultation>

2. The purpose of the Strategic Case

- 2.1 This document sets out the Strategic Case for Phase 2b. The [Strategic Case](#) for HS2 as a scheme was robustly set out in October 2013². This set out the case for action, why HS2 is our preferred option and the economic benefits of HS2. This was updated and refined with the Strategic Case [supplement](#) in November 2015³, which further reinforced the case for HS2.
- 2.2 The Strategic Case is part of the Government's Strategic Outline Business Case (SOBC) for HS2 Phase 2b, in line with the HM Treasury Green Book guidelines. The SOBC stage of developing a major project outlines the high level outcomes the project intends to deliver. The five cases are:
- Strategic Case
 - Economic Case
 - Financial Case
 - Commercial Case
 - Management Case
- 2.3 The Strategic Case sets out the need for intervention and how this will fit with the Government's aims and objectives. It provides suggested or preferred ways forward and presents the evidence for decisions taken at this stage. Alternatives to the proposed solution are also considered.
- 2.4 The scope, costs and schedule are refined as the project moves forward, and an Outline Business Case (OBC) is developed. This will be done alongside the deposit in Parliament of a hybrid Bill for Phase 2b in 2019. The business case further refined to give greater confidence in delivery by the time a final investment decision is taken at the Full Business Case (FBC) stage.
- 2.5 Below is our indicative timetable of the key stages of the process:



² <https://www.gov.uk/government/publications/hs2-strategic-case>

³ <https://www.gov.uk/government/publications/hs2-supplement-to-the-october-2013-strategic-case>

3. Our economy is changing and demand for rail travel is increasing

- 3.1 The Government's goal is to build an economy that works for everyone and to make sure that everyone can share in the country's wealth. This section summarises why HS2 is needed as a transformational economic investment for the UK.
- 3.2 The future prosperity of the UK depends on a strong and growing economy that works for all and which enables us to compete on the international stage. That is why the Government is prioritising an industrial strategy that will support the industries that are of most value to our economy and promote them through trade, tax policy, skills, training, research and development (R&D) and infrastructure. HS2 is a key part of this.

Transport infrastructure supports economic activity and allows its benefits to spread

- 3.3 The 2013 HS2 Strategic Case set out the importance of infrastructure for economic growth.⁴ By delivering additional capacity and enhanced connectivity, allowing for more services to more destinations, transport infrastructure allows businesses to grow, work together and access a wide range of customers, suppliers and skilled labour markets.
- 3.4 The 2014 [study](#)⁵ for the Department for Transport (DfT) by Venables, Overman and Laird (2014) considered the link between transport investment and economic performance. It found that transport investments “can deliver economic benefits over and above conventionally measured benefits to transport users”, because:
 - Transport fosters intense economic interaction that raises productivity
 - Transport shapes the level and location of private investment, potentially leading to higher levels of economic activity in some areas⁶
- 3.5 It is self-evident that major transport investments influence future patterns of economic development and population. HS2 will support development in cities and towns, which conversely helps protect our countryside from the spread of urbanisation. However, none of our models fully capture the changes that transport has on the way land is used for housing, manufacturing, the service economy, agriculture and public amenities.

⁴ The Strategic Case for HS2, Pg. 39 and Pg. 40

⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/386126/TIEP_Report.pdf

⁶ Supplement to the October 2013 Case, Pg. 12

Cities are becoming increasingly important as our economy changes

3.6 The 2015 *Supplement to the HS2 Strategic Case* also set out how our city regions are the engine rooms of our economy. Cities are increasingly important for job creation with 700,000 jobs created in Britain’s ten biggest city regions between 2008 and 2014 when only 500,000 jobs were created elsewhere. Since 1994/95 rail and road travel between these city regions has grown at a faster rate than the national network as a whole, increasing the need for better intercity transport links.

Knowledge-based sectors are also becoming increasingly important

3.7 The graph below shows how the structural changes in the UK economy from 1984 to 2014 have seen a move away from manufacturing and towards knowledge and service-based sectors, where we maintain a competitive edge on the world stage. Jobs in these sectors are more likely to be based in cities.

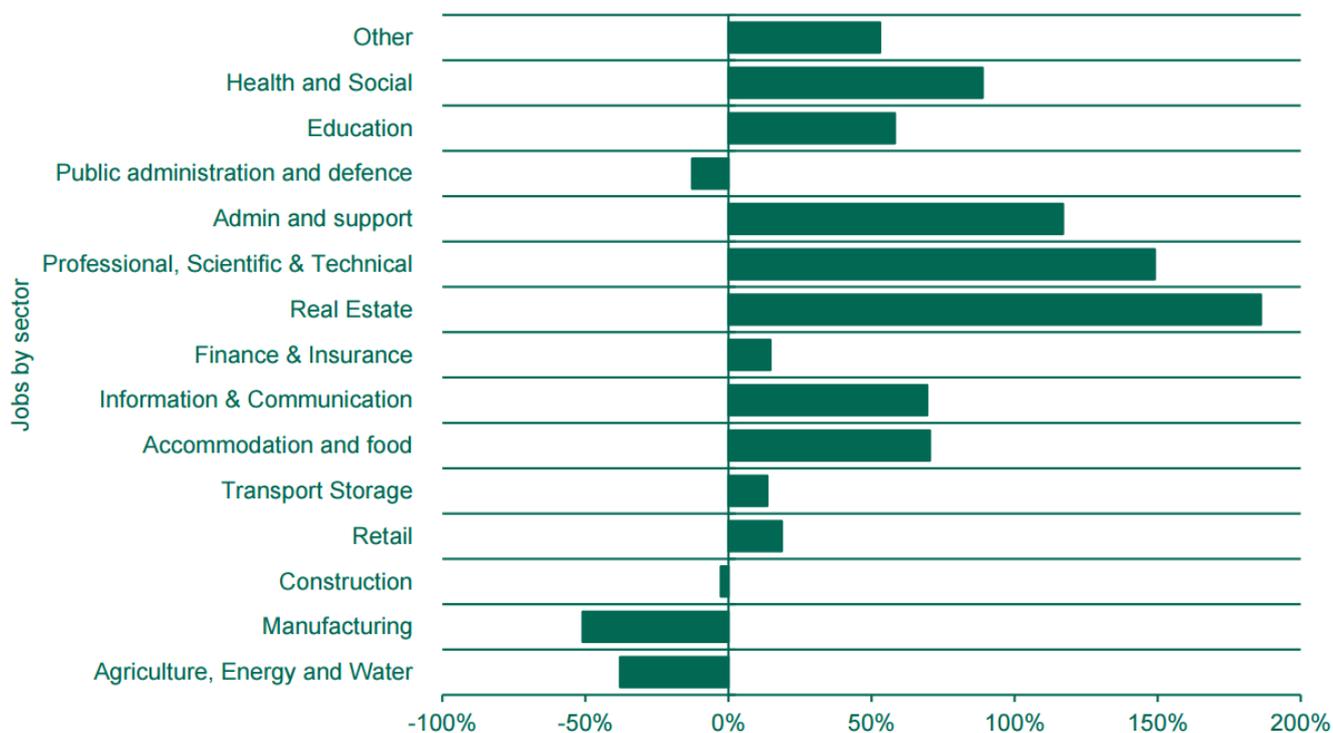


Figure 3.1: Change in UK jobs (1984 to 2014)⁷

⁷ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480649/annex-hs2-and-the-market-for-business-travel.pdf Pg. 13

3.8 Professional, science and technology based industries are among those sectors that have grown most strongly and remained resilient in the years following 2008. These include firms in advanced manufacturing, digital, professional and creative service sectors. As the graph below shows, knowledge-based sectors have grown at nearly three times the rate of job growth in other sectors. In 2014/15 they accounted for 18 per cent of all jobs, 23 per cent of national output and 34 per cent of exports. By 2022 it was projected that job numbers will have grown by a further 40 per cent.

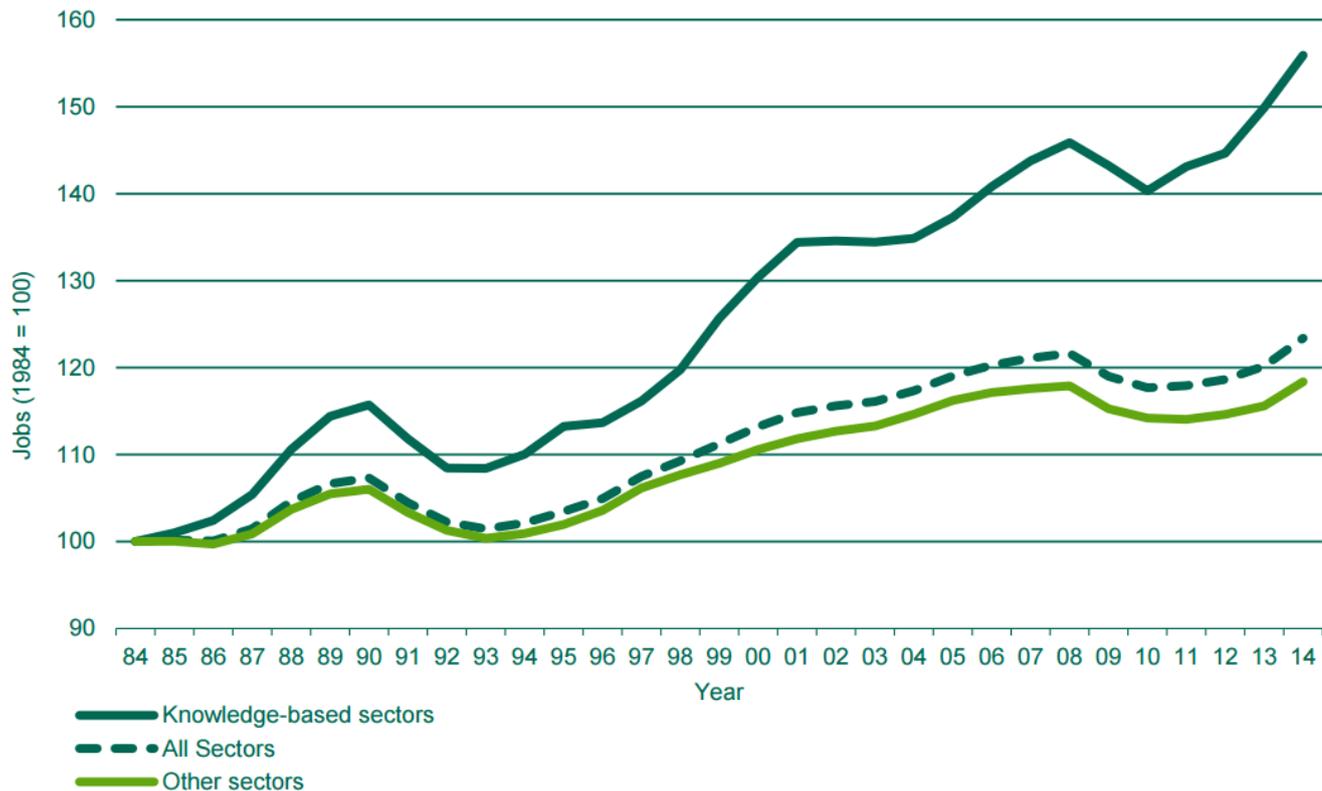


Figure 3.2: Historic Growth in Employment 1984 to 2014⁸

- 3.9 Knowledge-based sectors provide goods and services that support all sectors of the economy. Given this importance of business-to-business transactions there is a need for strong relationships with an extended network of companies. Even with the growth of electronic communication, evidence suggests face-to face interactions are particularly important for firms in knowledge-based sectors.
- 3.10 Growth in knowledge-based sectors is therefore likely to lead to growth in the demand for business rail travel between cities. Motorways will not, in future, be able to match the speed of high speed rail and it is difficult to increase the capacity of urban roads. People working in cities, those in knowledge-based industries and those employed in managerial, professional and technical occupations already have a higher propensity to use rail.
- 3.11 There is already a high volume of business travel on the intercity corridors, and even with the investment already committed, there is a projected shortfall in future capacity. If left unaddressed these constraints will limit the ability of firms in the growing knowledge-based sectors to do business.

⁸ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480649/annex-hs2-and-the-market-for-business-travel.pdf Pg. 21

- 3.12 Knowledge-based sectors are disproportionately located in the South East and London. These areas have seen a higher rate of jobs growth over recent years.
- 3.13 It is important that city-based knowledge sector growth takes place across the country and is easily accessible by surrounding areas.

To support economic growth, particularly in cities and in knowledge-based sectors, we need to modernise our rail network

- 3.14 Britain’s railways have seen unprecedented growth since the mid-1990s. By 2015/16, total passenger journeys on Britain’s rail network had increased by 129 per cent from the 735.1 million recorded at privatisation in 1994-95.
- 3.15 As the graph below shows, for the 20 years to 2013/14 (the latest year for which we have data available) the growth in intercity rail travel for all purposes along the corridors served by HS2 has exceeded average growth in use of the national rail network as a whole, almost tripling since privatisation.

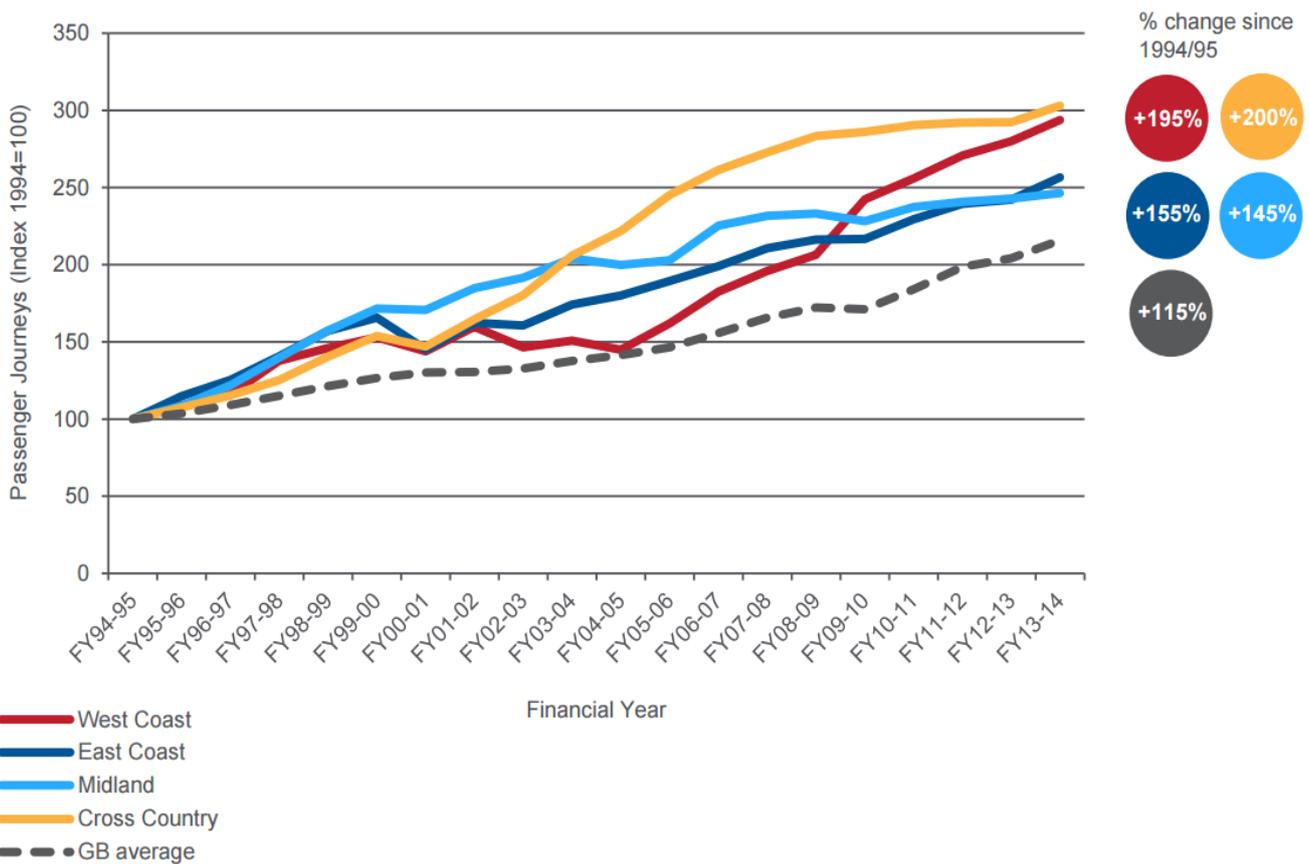


Figure 3.3: Growth in Intercity Rail Journeys by Corridor, 1994 to 2013/14⁹

- 3.16 The largest increase in demand has occurred on the WCML, facilitated by the £9 billion WCML renewal and upgrade, which increased capacity, frequency and reduced journey times for intercity services.

⁹ Data source: RUDD (LENNON) and Transport Statistics Great Britain (DfT, 2014)

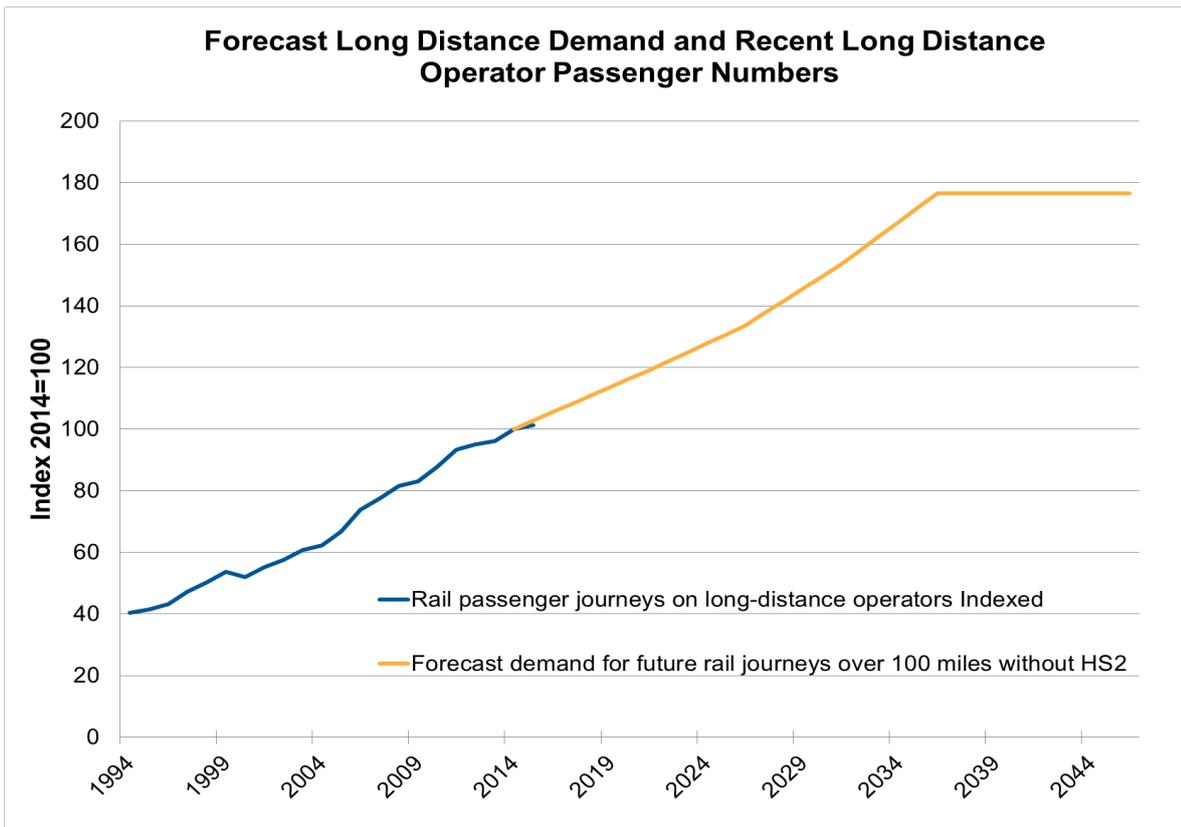


Figure 3.4: Forecast increase in long distance rail journeys

- 3.17 As the graph above illustrates, the demand forecast used in making the Economic Case is a conservative assessment, as the modelling assumes no increase in passenger demand after 2036 and no changes to population or employment as a result of the scheme.
- 3.18 To accommodate these levels of growth, and support our economy and the needs of passengers, the Government has a huge programme of investment in the existing network. In the period 2014-2019 Network Rail is spending more than £40bn on enhancing, renewing and maintaining the railway. This includes major station upgrades (e.g. Birmingham New Street, Peterborough, London Bridge), the franchising programme (e.g. increases in services such as London to Norwich in 90 minutes), major investment in rolling stock (e.g. more than £11bn as part of major projects like Thameslink and the Intercity Express Programme), and electrification (such as in North West England).
- 3.19 Even at this scale of investment the network cannot keep pace with rising demand in the longer term, which if constrained will undermine the economic growth of the country. There are limits to what can be achieved on the existing network.
- 3.20 The most recent major improvement to the WCML, which links London, Birmingham, Manchester, Liverpool and Glasgow, was the £9bn investment programme between 1998 and 2008, including increasing peak service levels from nine trains per hour (tph) to 13-14 tph¹⁰ and reducing journey times between London and Manchester by around 20 per cent. The scale of growth since 2008 meant that by 2015 two thirds of the additional intercity seat capacity provided is already being utilised.

¹⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480647/annex-demand-and-capacity-pressures.pdf
Demand and Capacity Pressures on the West Coast Main Line, 2015, Pg. 6

- 3.21 This intense utilisation of the WCML has also begun to negatively affect reliability, punctuality and passenger comfort due to increasingly crowded trains. Since its upgrade, Virgin West Coast's Passenger Performance Measure (PPM) has plateaued, averaging 85.0 per cent over the four year period up to Quarter One 2015/16. Over the same period, average PPM for the long distance sector as a whole has been 87.6 per cent.
- 3.22 The following chapter sets out how HS2 will address the challenges both of providing a railway to support the needs of the changing economy, and of meeting the existing capacity constraints on the existing network.

4. HS2 will provide significant benefits for passengers and the country and is good value for the taxpayer

4.1 The Government's aim is to build a strong and balanced economy that works for all and is capable of delivering lasting growth. Expanding railway capacity in line with growing demand and improving connectivity between our major cities are critical to this, as set out in the previous chapter. HS2 is a key part of the Government's response to these twin challenges. Our strategic objectives for HS2 were set out in the 2013 Strategic Case:

- Provide sufficient capacity to meet long term demand between city centres, and to improve resilience and reliability across the network
- Improve connectivity by delivering better journey times and making travel easier

And so build a stronger, more balanced economy capable of delivering lasting growth and widely shared prosperity

4.2 In order to ensure that we meet these objectives we have developed seven strategic goals:

HS2 will add capacity and connectivity as part of a 21 st century integrated transport system	HS2 will be a catalyst for sustained and balanced economic growth across the UK	HS2 will deliver value to the UK tax payer and passenger	HS2 will set new standards in passenger experience	HS2 will create opportunities for skills and employment	HS2 will create a railway designed, built and operated with world-class health, safety and security standards	HS2 will create an environmentally sustainable solution and be a good neighbour to local communities
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Figure 4.1: The Strategic Goals of HS2

HS2 will add capacity to our constrained network

4.3 HS2 infrastructure can provide up to 18 trains per hour running in each direction to and from London by 2033, and up to an additional 12 trains per hour to and from Birmingham. HS2 will more than triple the number of seats available from Euston in peak hours, have the capability of carrying over 300,000 people a day, release capacity on the existing rail network for new services, and allow more freight on the West Coast Main Line (WCML) that could take up to 800 lorries off the road, on average, each day. Network Rail estimate that around 100 cities and towns could benefit from new or improved rail connections as a result of HS2.

HS2 will increase connectivity and be a new backbone for our national and integrated transport network

- 4.4 HS2 will become the new backbone of our rail network and be well integrated into wider transport systems. HS2 will directly connect 8 out of 10 of our largest cities and their regions, with significant reductions in journey times:
- London to Manchester from 2 hours 7 minutes to 1 hour 7 minutes
 - London to Leeds from 2 hours 11 minutes to 1 hour 21 minutes
 - London to Glasgow from 4 hours 31 minutes to 3 hours 40 minutes
 - Birmingham to Manchester from 1 hour 28 minutes to 40 minutes
 - Birmingham to Leeds from 1 hour 58 minutes to 49 minutes
- 4.5 Old Oak Common station will be making journeys easier and much quicker from our Northern cities to the Thames Valley, Heathrow, and the Elizabeth line through to central London, the City and the east of London.

HS2 will be a catalyst for sustained and balanced economic growth across the UK

- 4.6 HS2 will support the Northern Powerhouse and the Midlands Engine to re-balance our economy so that national economic growth is distributed more evenly across the country, bringing together cities in a critical mass to compete globally.
- 4.7 We are funding HS2 places to develop Local Growth Strategies to ensure they maximise the benefits from these opportunities. For example, in the West Midlands an Urban Growth Company will take advantage of the Interchange Station site adjacent to the National Exhibition Centre (NEC) and Birmingham Airport. A business-oriented 'Garden City' will deliver 16,000 jobs and 1,900 homes. At Birmingham Curzon Street Enterprise Zone business rates will fund infrastructure to create 36,000 jobs in creative, digital and professional services. In London the Old Oak and Park Royal Development Corporation plans to turn one of London's largest brownfield sites into a vibrant area, delivering 24,000 new homes and 55,000 new jobs.

HS2 will create opportunities for skills and employment

- 4.8 HS2 will create 25,000 jobs to build the railway and 3,000 to operate it once finished. More than 70 per cent of the jobs will be outside London and we are requiring HS2 Ltd and contractors to create at least 2,000 new apprenticeships. This will create direct opportunities for promoting UK leadership and business in high-skilled construction and engineering. The civil engineering contracts for Phase One alone are worth up to £11.8 billion and there are up to around £570m in contracts for design work on Phase Two.
- 4.9 We are getting ready for this now. From 2017 the National College for High Speed Rail in Birmingham and Doncaster will train more than 1,000 people each year.

HS2 will set new standards in passenger experience

4.10 HS2 is being designed, developed, and constructed to be focused on the needs of passengers. Our ambition is for HS2 to improve journeys for people by providing faster journeys that connect to where people want to travel, making travel more reliable, and giving passengers a better travelling environment with comfort and accessibility.

HS2 will deliver value for money to the UK taxpayer and passenger

4.11 HS2 is good value for money. The latest economic case suggests that for every £1 invested the UK will receive over £2.50 in benefits, delivering £103bn in benefits overall. 80 per cent of the benefits calculated in the Economic Case will translate directly into higher GDP.

4.12 Like any programme of this scale, controlling costs over time will be challenging. Costs will be kept strictly under review and we will maximise the opportunities for efficiency, utilise international best practices and benchmarking, and deliver value for money for the taxpayer. Given this, and the Government's wider commitment to manage public finances more effectively, we do not expect to be able to extend the scope of the programme further within the funding envelope.

HS2 will be designed and constructed as an environmentally sustainable solution and be responsive to communities

4.13 HS2 Ltd's Sustainability Policy seeks to avoid significant adverse effects on communities, businesses and the natural, historic and built environment. Where impacts do occur, it seeks to minimise these and provide other enhancements as far as practicable with the objective of no net loss to the natural environment. Throughout all of this HS2 will be developed in consultation and engagement with communities and stakeholders.

HS2 will be designed, built and operated with world-class health, safety and security standards

4.14 We aim for HS2 to match the excellent safety record of other high speed rail systems, such as High Speed One (HS1) between St. Pancras and the Channel Tunnel. We will achieve this by running trains on a dedicated high speed passenger service, using proven standards, not using level crossings and mitigating risks.

5. Phase 2b will deliver the benefits of the full Y network for passengers, local places and the wider economy

The case for HS2 rests on the Government's aim for widespread economic growth and the contribution improved rail connectivity can make towards that aim. This chapter sets out the specific economic challenges the North and Midlands face, and then the role HS2 Phase 2b plays in delivering improved connectivity and journey times for cities north of Birmingham. Only by completing Phase 2b will HS2 have a truly national impact.

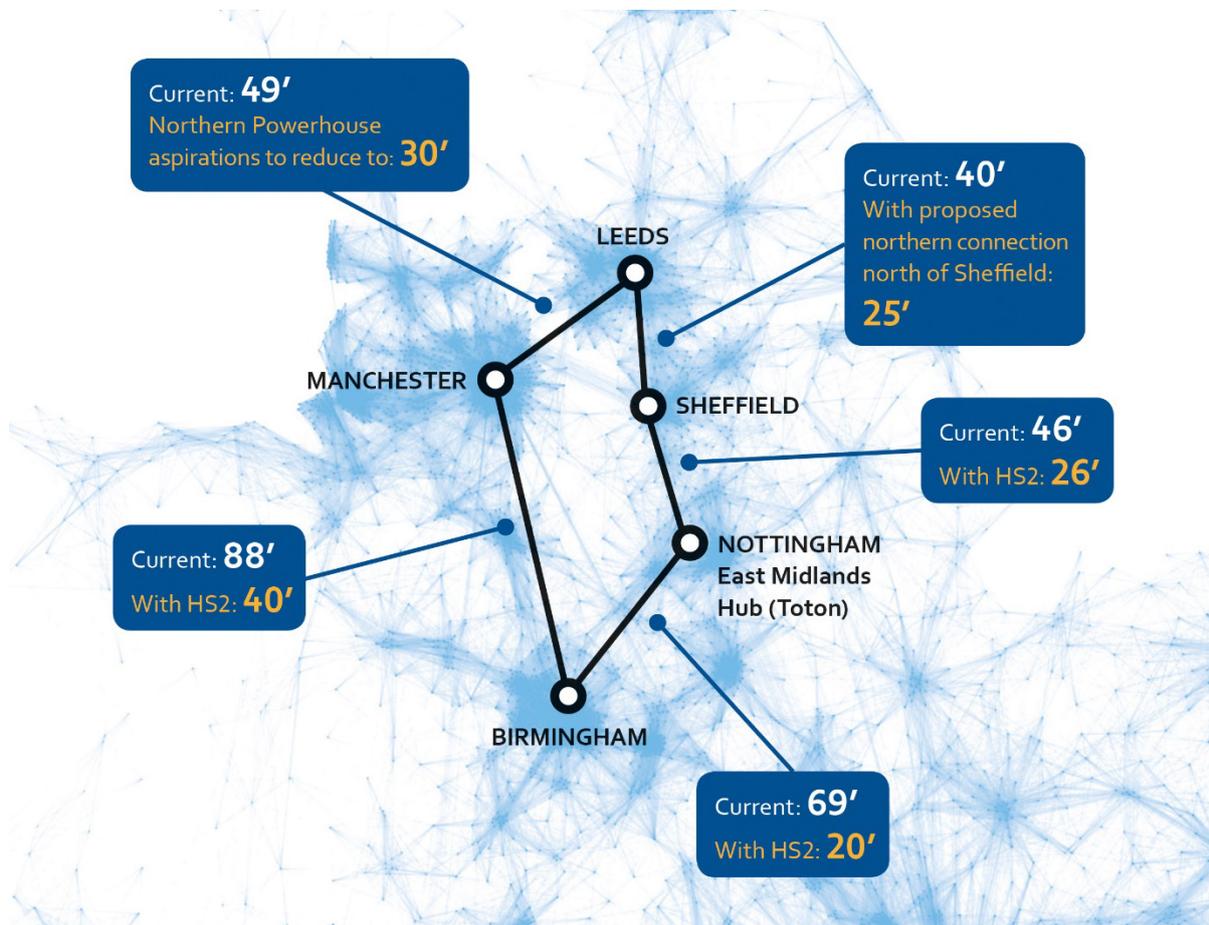


Figure 5.1: Journey times¹¹ between the Midlands and the North with HS2¹²

¹¹ Current journey times are the fastest typical times. All HS2 journey times are current estimates showing fastest southbound times.

¹² The background to this map shows transport flows across the UK. Source: Alasdair Rae, University of Sheffield

The economic potential of the Midlands and the North is being restrained by poor connectivity between key centres

5.2 The Northern Transport [Strategy](#) in 2015¹³ set out how better connecting cities can create more unified economies and labour markets to promote growth and agglomeration. This is at the heart of the Northern Powerhouse vision to rebalance the economy of the UK through increasing productivity in the North of England. It also underpins the Midlands Engine agenda of better connecting the East and West Midlands. HS2 Phase 2b will transform connectivity across the region with the exception of Manchester to Leeds, Liverpool and Sheffield, which are all central to Transport for the North's work. Our aim is for the North and Midlands to develop as a prosperous, well connected, multi-centre economy similar to the Randstad region in the Netherlands and the Rhine-Ruhr region in Germany.

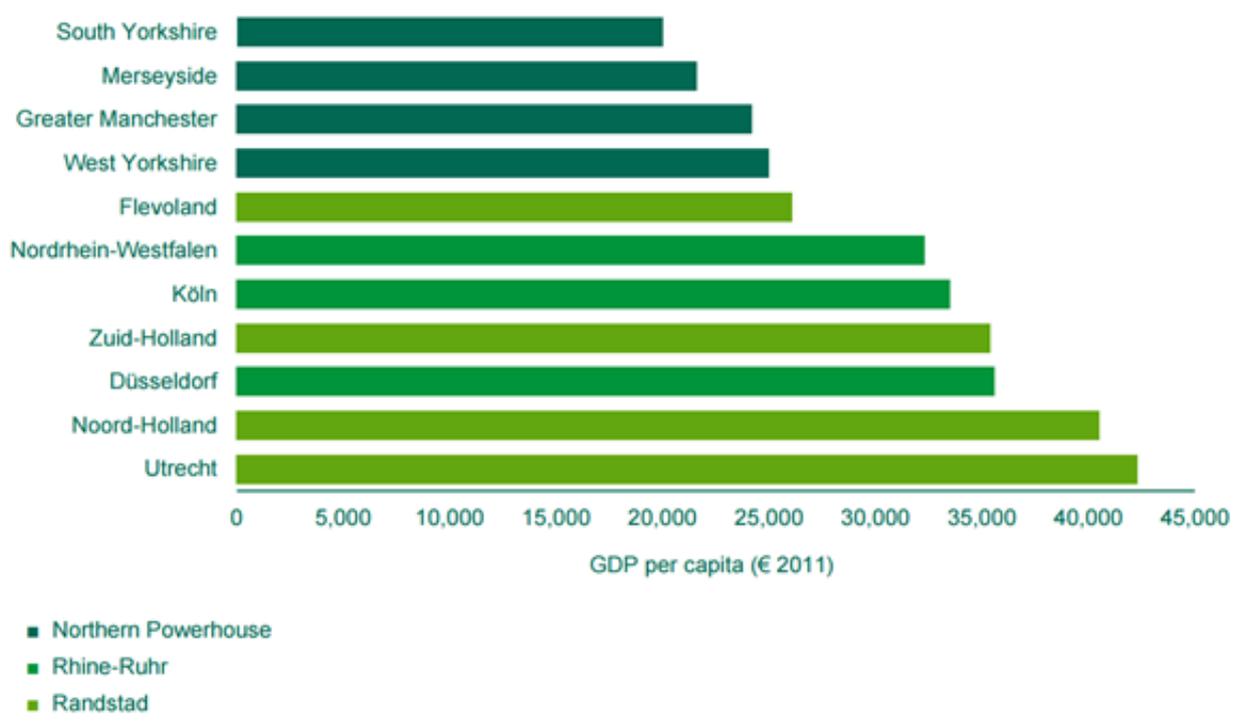


Figure 5.2: GDP per Capita (€ 2011)¹⁴

- 5.3 The graph above highlights the difference in the economic performance of the Northern city regions and the performance of comparator regions in Europe.
- 5.4 Randstad is one of the largest metropolitan areas in Europe and includes the four most populous cities in the Netherlands (Amsterdam, The Hague, Rotterdam and Utrecht). Its population is almost eight million people and it generates around half of the Netherlands' output (£210 billion in 2011). The four cities are between 30 and 50 miles apart and served by an extensive road network as well as fast and frequent rail services. The Randstad supports Europe's largest seaport (Rotterdam) and one of Europe's largest hub airports (Schiphol).
- 5.5 Rhine-Ruhr is the largest metropolitan area in Germany and includes the five cities of Dortmund, Dusseldorf, Duisburg, Essen and Cologne. It has a population of ten million and accounts for 13 per cent of Germany's output (£250 billion in 2011). The

¹³ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427339/the-northern-powerhouse-tagged.pdf

¹⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480649/annex-hs2-and-the-market-for-business-travel.pdf Pg. 29

region has a network of fast intercity rail services and is linked by an extensive Autobahn network.

- 5.6 In comparison to these well-connected regions, journey times between city regions in the North and Midlands are long. The 2014 One North [report](#)¹⁵ suggests poor journey times as one reason why the cities of the North lack the cohesion of the Randstad and Rhine-Ruhr regions. Poor connectivity limits their ability to deliver consistent economic growth.
- 5.7 The spring 2016 [update](#)¹⁶ to the Northern Transport Strategy set out how HS2 infrastructure will contribute to this vision. Furthermore, HS2 will also free up space on the existing network, which could be utilised for more rail freight from ports.
- 5.8 The transformational improvements in rail capacity and connectivity provided by HS2 Phase 2b, and subsequent agglomeration, will contribute significantly to the economic growth of the Midlands, the North and the country as a whole. Only through completing all of Phase 2b will we deliver that balanced economic growth across the Midlands and the North.
- 5.9 Improvements to journey times, more seats, better reliability and a high-quality travelling environment will reduce the barriers to business between these city regions.
- 5.10 As the figure below makes clear, HS2 provides a proportionately greater improvement in connectivity for the Midlands and North compared to London. The analysis in this map is based on the HS2 route design, service specification and demand forecasts that underpinned the HS2 business case in 2012. While it does not capture changes to the HS2 scheme design and demand forecasts since then, the conclusion that HS2 delivers proportionately greater improvements in connectivity to the Midlands and North remains valid.

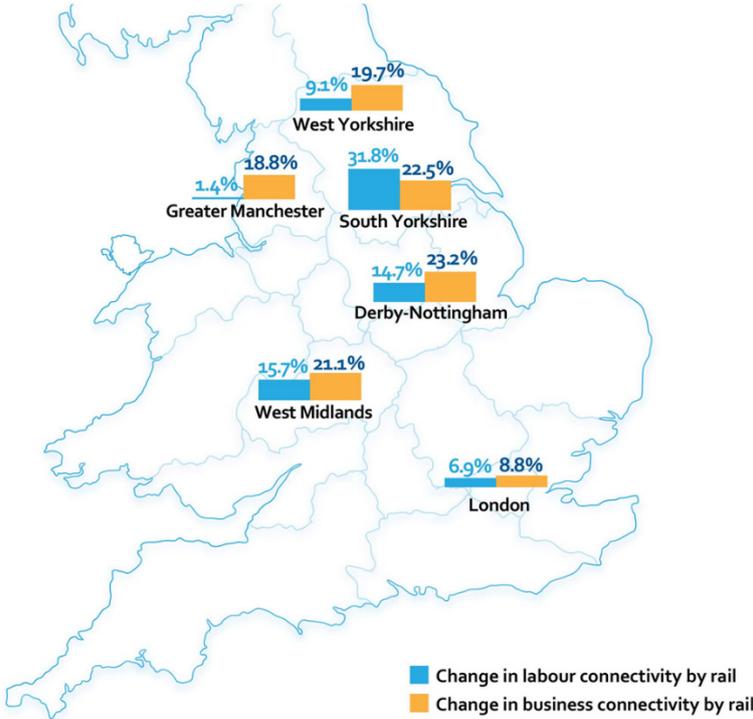


Figure 5.3: Improvements in labour and business connectivity from HS2

¹⁵ <http://www.westyorks-ca.gov.uk/uploadedFiles/Content/News/Articles/One%20North.pdf>

¹⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/505705/northern-transport-strategy-spring-2016.pdf

5.11 The next figure illustrates some of the wider effects associated with this economic transformation.



Figure 5.4: Productivity and Economic Growth through Greater Connectivity

Cities in the Midlands and the North are already promoting the knowledge-based sectors which will be supported by HS2

5.12 Key to the economic fortunes of the North, as in the UK more widely, is the promotion of knowledge based sectors. The Strategic Economic Plans of the Midlands and Northern city regions focus strongly on promoting knowledge-based sectors, such as advanced manufacturing, digital and creative industries and financial and professional services. As noted previously, employees in these sectors have a higher propensity to travel by rail, and it is these sectors that will benefit most from the better inter-city connections provided by HS2.¹⁷

5.13 The Government is developing an Industrial Strategy and looking at a number of key industry sectors. To illustrate the economic growth potential HS2 will support, we have looked at some case studies of some key industry sectors in the North. These are set out in the following pages.

¹⁷ Supplement to the Strategic Case, 2015, Pg. 6

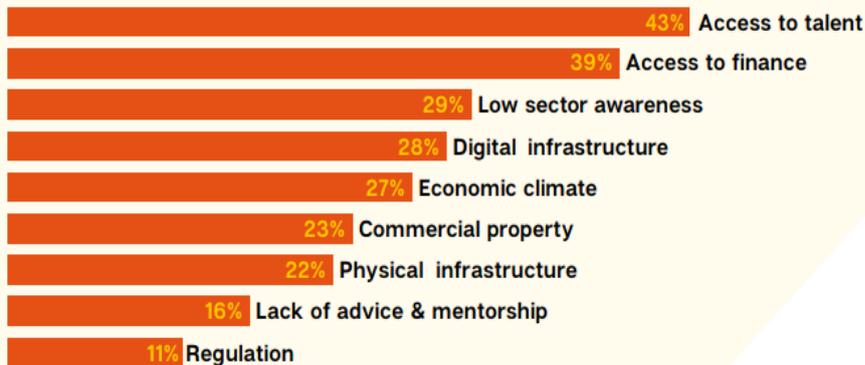
HS2 CONNECTIVITY WILL SUPPORT GROWTH OF THE UK'S TECH CLUSTERS

The digital sector is a significant source of growth and employment in the UK, with output worth seven per cent of UK GDP that has grown by over 20 per cent between 2010 and 2015. **The North of England is home to digital clusters that employed over 280,000 people in 2014.** Manchester is the largest digital cluster outside of London by number of employees and Leeds has expertise in health technology and Big Data. Newcastle is home to thousands of software technology, electronic gaming and creative businesses and Liverpool has strengths in the areas of gaming and connected devices.

Digital firms cluster together to reap the benefits of face-to-face contact, which remains important for collaboration and access to mentors, support and finance. The London digital cluster benefits from being located close to London's financial centre. London accounted for 25 per cent of digital businesses but received 50 per cent of private equity and venture capital finance into the UK tech sector in 2014/15.

The majority of firms in Northern digital clusters source experienced talent from the local cluster of similar businesses and 36 per cent target local universities for graduates. Five of the UK's top universities for quality of computer science research are in the North of England. However the North East and North West lost around 35 per cent of their Science, Technology, Engineering and Maths (STEM) graduates from major universities in 2012/13, while 55 per cent left Yorkshire and the Humber. Digital companies in Manchester, Leeds and Liverpool consider lack of talent to be one of their most significant challenges.

21. Challenges to growth according to digital tech businesses



Tech City UK, Nesta, Tech Nation 2016 Survey

HS2 will enhance the benefits of being in a cluster for Northern digital firms by improving access to finance, experienced industry talent and markets. Academic studies have previously showed that distance can deter venture capitalists in the UK, US and Germany from investing in companies. HS2 will reduce the effective distance between London-based investors and digital firms in the North. By supporting economic growth in the Midlands and the North, HS2 will help to attract and retain the skills that will support expansion of digital clusters in those regions. Improved connectivity to London via HS2 will also allow digital sector workers to network with potential clients, collaborators and mentors in the capital while retaining their base in regions outside of London.

HS2 WILL EXPAND OPPORTUNITIES FOR PROFESSIONAL AND BUSINESS SERVICES IN THE NORTH

The Professional & Business Services (PBS) sector is a major UK success story and makes a significant contribution to the economies in the North of England. The Leeds City Region has 15,000 people employed by over 200 law firms, 150 accountancy firms and 14,000 people employed in middle and back office functions. More than a quarter of a million people work for international banks, accountancy firms, law firms and consultancies in Greater Manchester. The legal sector in Liverpool is well established, employing around 10,000 people, and Cheshire and Warrington has specialisms in financial services support functions such as legal and Information and Communications Technology services.

PBS firms are already expanding their presence outside of London. The so-called 'northshoring' of activities by PBS firms from London to centres in the Midlands and North of England is increasingly common, with large accountancy and financial sector companies relocating and expanding outside of London. The legal sector exemplifies this trend. Pressures from clients, growing international competition and changing business structures are driving a search by law firms for cost savings and new business opportunities. Several major law firms are opening new offices and relocating staff to regional centres, attracted by the potential cost savings and by access to a strong pipeline of graduate skills. Since 2012, Leeds and Manchester have seen the highest take-up of office floor space by legal services firms of any UK cities outside London.

By improving connectivity between London, the Midlands and the North, HS2 can help to accelerate the expansion of PBS firms in cities and regions outside of London. High speed rail connections will allow PBS firms to reap the benefits of moving front office staff to regional urban centres whilst retaining access to clients and markets for their services in London. Taking an example, the financial services sector is the largest source of demand for legal services in the UK. HS2 would provide fee-earning staff of legal firms with fast, frequent and reliable travel from offices in regional centres to visit clients in London's financial centre. HS2 can also help cities and regions in the Midlands and the North of England to attract and retain the skills and talent to support the relocation and expansion of PBS activities.

HS2 WILL EXPAND OPPORTUNITIES FOR THE TOURISM SECTOR IN THE NORTH

HS2 offers tourist destinations such as Cumbria and North Yorkshire the opportunity to expand the reach of their tourism markets. Both counties feature in the top 10 most visited counties in the UK, with a strong and diverse tourism offer. Tourism provided over 16,000 jobs in Cumbria in 2014 and the visitor economy of Yorkshire was worth almost £6 billion in 2012. Despite these strengths, visitors to Cumbria and North Yorkshire tend to originate from nearby locations. Visitors from London and the South East accounted for a relatively low share of total visitors to the Yorkshire and Humber region (five per cent in 2011) and to Cumbria (13 per cent in 2014). HS2's improved connectivity to London offers tourist destinations such as the Lake District and York the opportunity to increase visitor numbers from the South East. HS2 will also make these tourist destinations more accessible to international tourists by bringing them closer to Heathrow, Birmingham and Manchester Airports.

CUMBRIA

HS2 will bring the Lake District within the same journey time from London as the Peak District is currently, which attracts a significant number of staying visitors from London and the South East. HS2 will reduce the rail journey time from London Euston to Oxenholme from 2 hours and 34 minutes currently to 1 hour and 54 minutes (allowing for interchange between HS2 services). Even allowing for extra time to access the Lake District from Oxenholme by public transport or car hire, the HS2 journey time will be competitive with travelling between London and the Lakes by car.

YORK

HS2 offers York the opportunity to replicate Canterbury's marketing in the London visitor market following the opening of domestic high speed rail services to the capital. Rail journey times on HS2 between Canterbury and London were cut by almost 40 minutes as result of HS1. HS2 will deliver an almost identical similar journey time saving for rail trips between London and York and at around 1 hour and 24 minutes will make day trips feasible.

INTERNATIONAL COMPARISON

International experience suggests that high speed rail can support the tourism sector. The introduction of high speed rail in Spain resulted in significant modal shift from air to rail travel, with rail's share of total trips between Madrid and Seville increasing from 16 per cent in 1991 (the year before the opening of Spain's first high speed rail line) to 51 per cent in 1994. The high speed TGV network in France has supported growth in a number of French tourist and visitor destinations. In Marseille there has been a significant change in tourist behaviours and types of tourism forms, with a significant evolution of visitor volumes. That is, an increase in short-stay travel and visits by young adults, seniors, certain socio-economic groups and international visitors.

The impact of increasing rail demand is being felt across the Midlands and the North

- 5.14 Rail can only play a role in promoting economic opportunity in the North if it is capable of meeting future demand.
- 5.15 Between 1999 and 2009 demand for long distance travel between London and Manchester grew 70 per cent. The average yearly growth of the three main train operating companies servicing the HS2 Phase 2b stations (Virgin West Coast, Cross Country, Virgin East Coast) has exceeded the forecast average demand growth (2.2 per cent) since 2010-11. Passenger journeys have gone up by an average of 4.3 per cent per annum on the West Coast Main Line (WCML), 3.5 per cent p.a. for Cross Country and 2.7 per cent p.a. on the East Coast Main Line (ECML). These patterns demonstrate the importance of city-to-city links, not only to and from London but also between cities in the North and the Midlands.
- 5.16 The train operating companies have been responding to this demand by adding more trains onto an already busy network. In 1994 there were 17 trains per day from Manchester to London. This has increased to 48 trains per day by 2016. However, at peak times critical parts of the network now run at close to 100 per cent capacity and so relatively minor problems can cause knock-on delays that continue for some time¹⁸, which has an impact on reliability.
- 5.17 There are significant constraints on the ability of the present network in the North and the Midlands to expand to accommodate this demand. These include particular bottlenecks on the current route into Manchester, a two-track section of WCML between Crewe and Weaver junction and the approach to Leeds Station.

HS2 Phase 2b provides a step change in capacity on commuter journeys on the WCML corridor in to Manchester and on the Eastern Leg to Leeds

- 5.18 HS2 Phase 2b will be capable of running up to 18 trains per hour to and from London and up to 12 new services to and from Birmingham. HS2 trains will be up to 400m in length, carrying up to 1100 seats compared to the longer intercity trains which are, or shortly will be, in use on the WCML and the ECML that have around 600 seats.

¹⁸ <http://www.networkrail.co.uk/timetables-and-travel/delays-explained/knock-on-delays/>

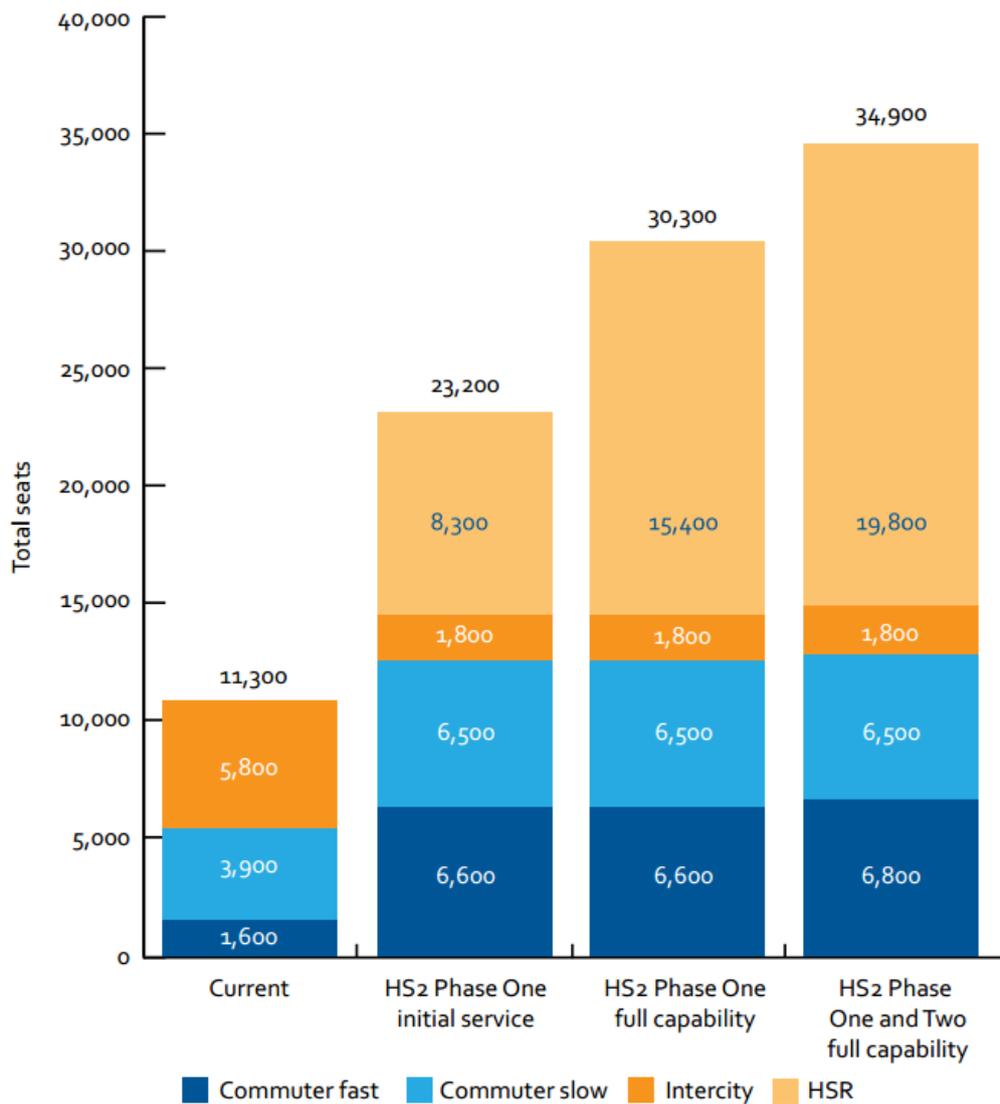


Figure 5.5: Increase in the number of seats from London Euston

5.19 For the Western Leg of HS2 the chart above shows the increase in seat capacity between London and the Midlands and the North provided by HS2 Phases One and Two, including released capacity on other services.

5.20 In the east the ECML currently has higher crowding than WCML. The current rail investment programme and Intercity Express Programme (IEP) will provide large increases in capacity yet forecasts show that there will be a need for further substantial increases in capacity, to serve cities in Yorkshire and the North East, by the 2030s.

Phase 2b radically improves connectivity between cities in the North and the Midlands, and with London and the South East, through better links and significantly reduced journey times

5.21 HS2 Phase 2b more than doubles the number of places served compared to Phase One (from 14 to 30), including 8 out of 10 of the largest cities. The Eastern Leg in particular connects London, Birmingham, Leeds, Sheffield, York and Newcastle. Passengers will be able to travel more quickly between key cities (see chart below) and services will also be more reliable.

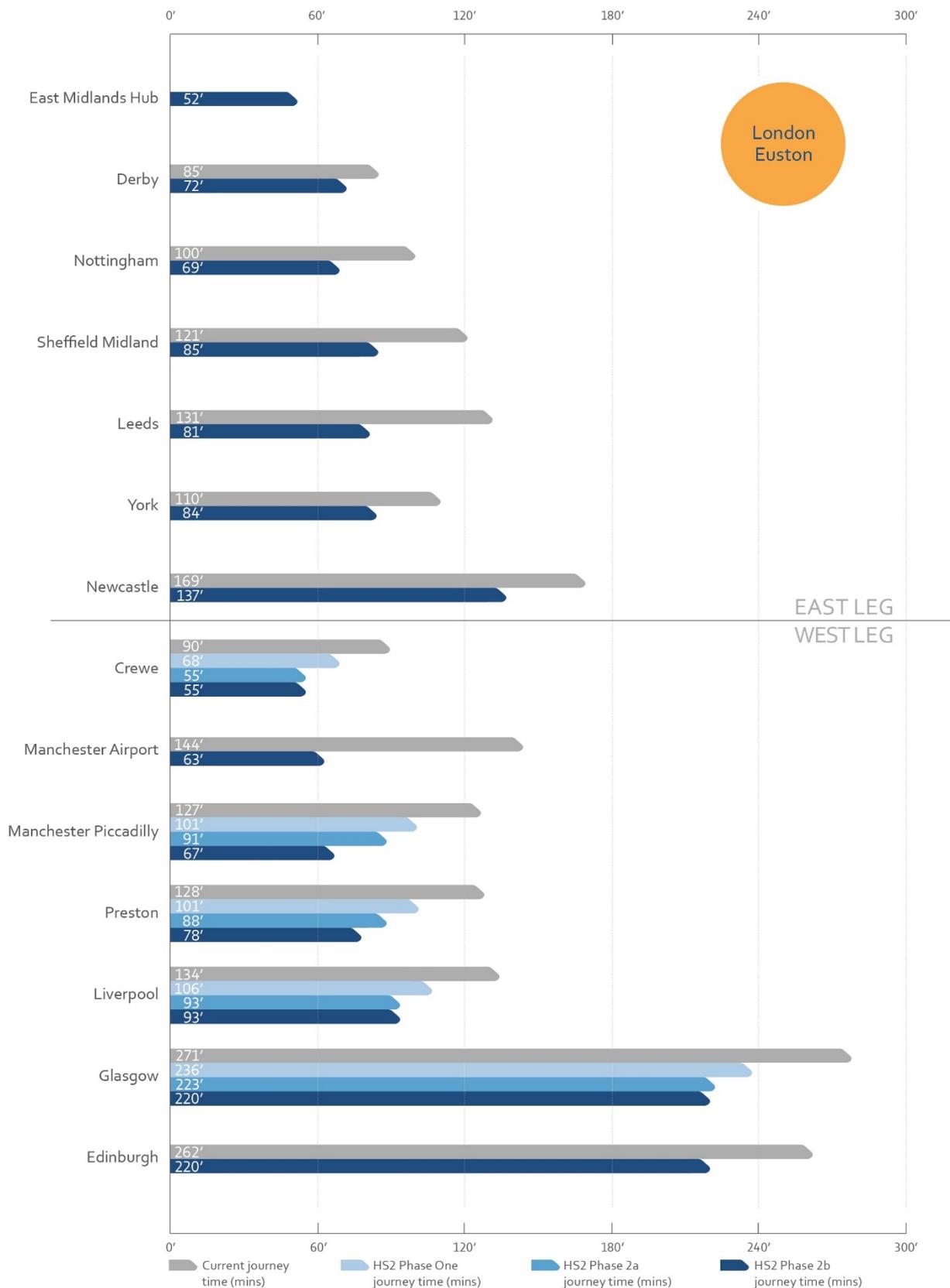


Figure 5.6: Journey times between London and major economic centres¹⁹

¹⁹ Current journey times are the fastest typical times. All HS2 journey times are current estimates showing fastest southbound times. The Economic Case for Phase 2b takes the slowest of the southbound and northbound times by convention. The journey times for Phase 2a include a timetabling allowance due to routing all three London to Manchester services on the HS2 network to Crewe, and corresponds to the 'first alternative scenario' set out in the 2015 Phase 2a Strategic Outline Business Case. This is set out in more detail in The Economic Case for Phase 2b. A 5min interchange time is assumed at East Midlands Hub. HS2 Edinburgh times are shown to Edinburgh Haymarket.

5.22 Phase 2b gives transformational reductions in journey times within the Midlands and the North, as well as to London. Some of the biggest journey time reductions are on the Eastern Leg between Leeds, York, Newcastle, Sheffield, the East Midlands and Birmingham. For example, journey times between Birmingham and Leeds, which currently takes around two hours, will reduce to 49 minutes (see charts below).

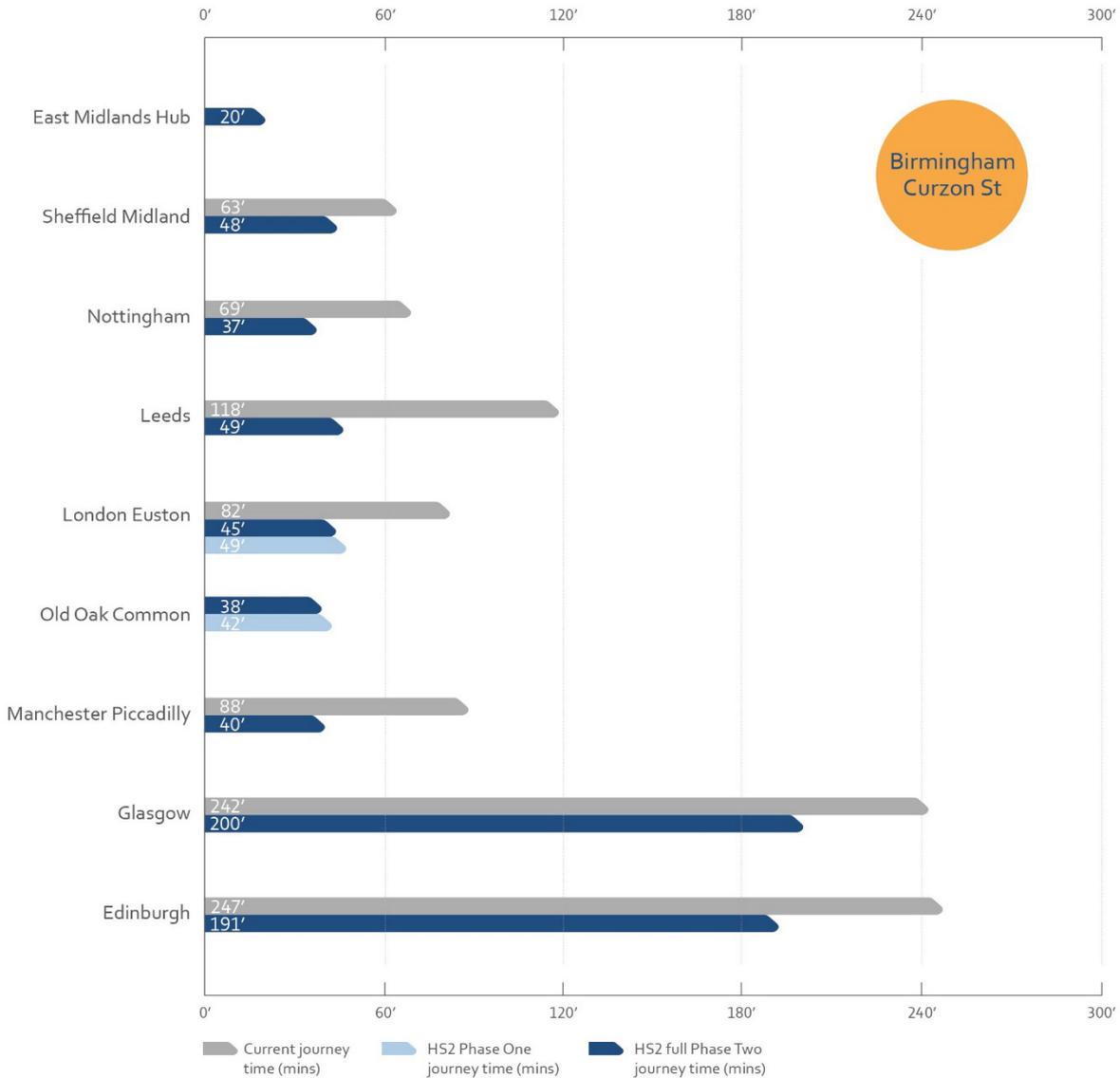


Figure 5.7: Journey times from Birmingham²⁰

²⁰ Current journey times are the fastest typical times. All HS2 journey times are current estimates showing fastest southbound times. See footnote 19 for more detail.

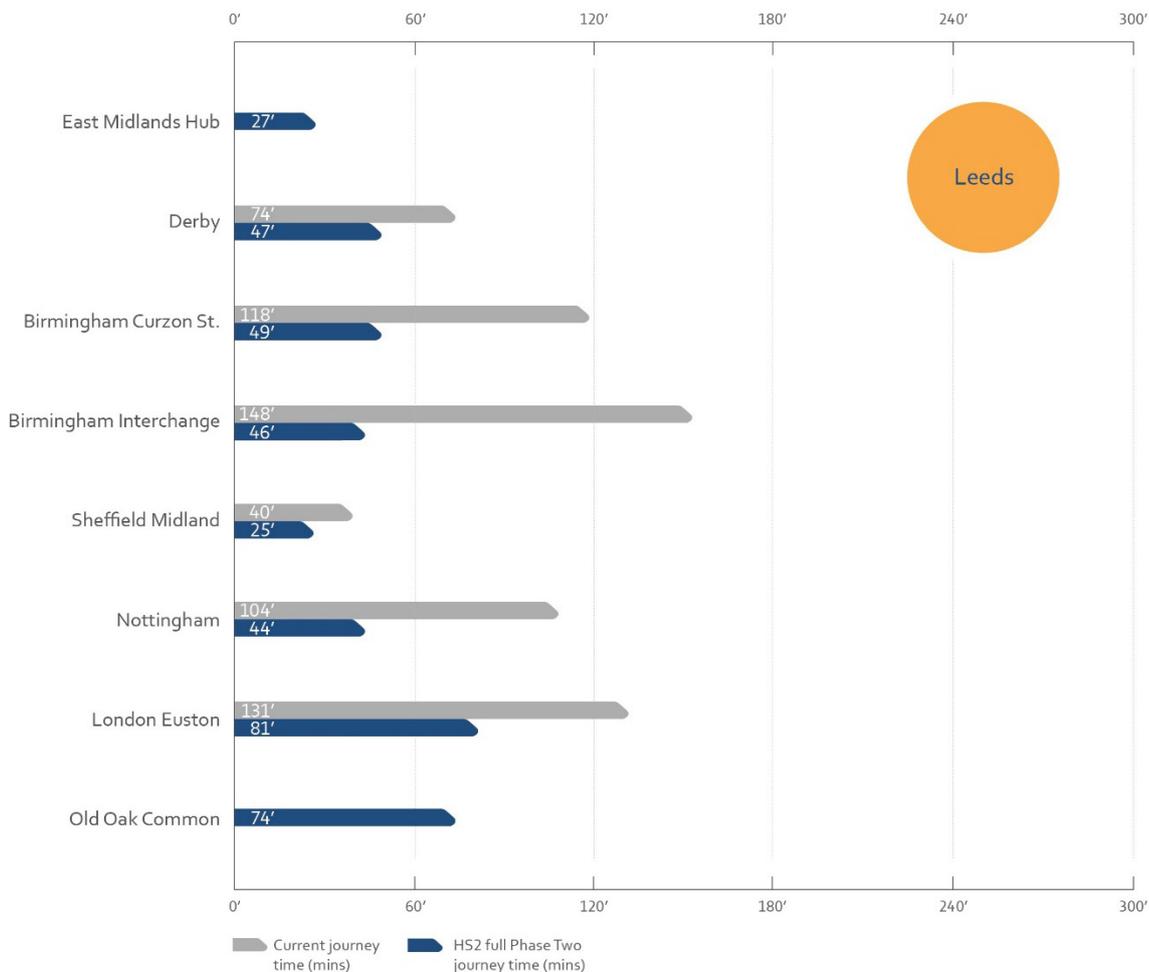


Figure 5.8: Journey times from Leeds²¹

- 5.23 Phase 2b HS2 trains will run on the existing networks north of the HS2 line, delivering journey time improvements to and from destinations far beyond Manchester and Leeds all the way to London. On the Western Leg, journey time improvements will be seen to Cumbria and Scotland. For example, journeys to Glasgow from London will take 3 hours 40 minutes as opposed to around 4 hours 30 minutes now.
- 5.24 Capacity on the current rail network will be released by Phase 2b where HS2 services replace conventional services. In some areas, this will enable better connectivity to be provided to intermediate stations by retaining intercity services to places not served by HS2. The 2013 Strategic Case detailed how over 100 cities and towns could benefit from new or improved services as a result of capacity released on the existing network.
- 5.25 In some locations, for instance between Crewe and Manchester, Phase 2b will free up capacity which could be used by extra freight trains. This is subject to there being sufficient capacity available elsewhere on the rail network so that the extra trains can run. This could help improve the capacity for rail freight between the South, the West Midlands and locations in the North West.

²¹ Current journey times are the fastest typical times. All HS2 journey times are current estimates showing fastest southbound times. See footnote 19 for more detail.

We are working closely with Transport for the North (TfN) on options for the city links that HS2 does not deliver directly

- 5.26 In the development of Phase 2b since the consultation closed in 2014 our aim has been to futureproof HS2 for use as part of Northern Powerhouse Rail (NPR) where that makes sense. Significant progress has been made to develop practical options where HS2 interfaces with Transport for the North's (TfN) work. HS2 will play its role in meeting the National Infrastructure Commission recommendation that TfN develop a Single Integrated Strategy for NPR by the end of 2017. In this way we expect that we will be able to incorporate elements of TfN's strategy into the development of the Phase 2b hybrid Bill, planned for deposit in Parliament in 2019.
- 5.27 Our new approach in South Yorkshire could make a very significant contribution to TfN's aspirations for Sheffield to Leeds connectivity, particularly with the Northern junction at Clayton. Building a northern connection would result in Sheffield being served by a 'loop' rather than a 'spur', enabling services stopping at Sheffield Midland to continue onto destinations further north. This would allow a Sheffield-Leeds journey time of 30 minutes or less – hugely improving connectivity between the two cities that arguably have the poorest rail connections of any pair of cities in the North. Furthermore, this infrastructure would also make it possible for HS2 services to improve connectivity from the Sheffield City Region to the East Midlands and Birmingham.
- 5.28 In addition to the potential created by HS2 to improve Leeds-Sheffield journeys, the changes to the Leeds HS2 station also better integrate HS2 into the existing and future Northern Powerhouse rail services. Options have also been identified that would allow through running of some services from HS2 through the national network station at Leeds towards Hull or Newcastle.
- 5.29 In the West TfN have examined improving connectivity to Liverpool from Manchester and/or the airport potentially using HS2. HS2 Ltd believe such options are practical and could be delivered, subject to a satisfactory business case and funding proposition being developed to support them.
- 5.30 TfN has also examined modifications to the plans at Manchester Piccadilly that would allow NPR services to serve Manchester en-route from Liverpool to Leeds, Sheffield and beyond. The best NPR options for Manchester will be closely linked with decisions around the alignments TfN wishes to promote east and west of Manchester. These complex decisions should be addressed in the TfN Single Integrated Strategy at the end of 2017 and can be incorporated in the Phase 2b hybrid bill as necessary.

We will work closely with Midlands Connect to capitalise on the improved connectivity and wider benefits that HS2 offers to support the Midlands Engine

- 5.31 The Midlands Engine is central to many of the UK's major transport routes and is key to connectivity across the country. Four out of five of the main UK rail freight routes and 45 per cent of British rail freight goes through the Midlands.
- 5.32 The stations already in place as part of HS2 at Curzon Street and Birmingham Interchange will bring transport and economic benefits to the Midlands and provide increased capacity across the area. Building HS2 Phase 2b to Manchester and, via

East Midlands Hub, to Leeds will bring further Midlands Engine benefits. In particular, the new proposals for Sheffield would bring high speed trains to Chesterfield.

- 5.33 Phase 2b will reduce journey times from Birmingham to Nottingham by more than an hour and increase connectivity between the Midlands and the North.
- 5.34 The Government has committed £17m to support Midlands Connect, and the connectivity HS2 delivers will be central to the success of the Midlands Engine. Midlands Connect is developing a dedicated HS2 readiness work package ensuring the Midlands capitalises on the economic benefits of HS2, reaching out beyond the three Midlands HS2 stations to the wider area. Midlands Connect will publish its full East Midlands HS2 Growth Strategy in July 2017 and this will also consider how to make the best connections between HS2 and existing rail services.

6. Economic appraisal of Phase 2b

6.1 As part of the Strategic Outline Business Case (SOBC), HS2 Ltd have carried out an economic appraisal of Phase 2b. This sets out the expected costs, benefits and revenues for the scheme, both as an increment in addition to Phase One and Phase 2a, and as part of the full Y network. This chapter summarises the main findings of this work – the more detailed explanation and modelling is included in the Economic Case and in HS2 Ltd’s supporting analysis, which also sets out the train service specifications used for modelling purposes.

Phase 2b is a high value for money scheme

6.2 The results set out in the Economic Case show that the preferred route for Phase 2b (the ‘M18/Eastern route’) has a central benefit-cost ratio (BCR) of 3.1 with wider economic impacts (WEI), which indicates that the scheme is ‘high’ value for money. Phase 2b delivers over £52bn of total benefits in present value terms over the appraisal period to 2093²². The cost is assumed to be the indicative funding allocation for Phase 2b from the 2015 Spending Review, as shown in the Financial Case.

6.3 The risk analysis and sensitivity testing that we have undertaken shows that this value for money assessment is robust to variations in a number of our modelling and appraisal assumptions. The risk analysis (which reflects uncertainty in the input assumptions for which we have a probability distribution, such as GDP or population growth) indicates that Phase 2b has over a 90 per cent chance of having a BCR of at least 2, and therefore would be reliably considered to be high value for money.

6.4 Sensitivity tests looked at varying assumptions on costs (further identified savings and optimism bias), demand (GDP growth and the demand cap) and appraisal (rail fares and reliability benefits). The impact on the median BCR including WEIs for Phase 2b is shown in the table below.

Sensitivity test	Impact on median BCR
Achieving further identified savings beyond the 2015 Spending Review envelope, as shown in the Financial Case	+ 0.6
50 per cent optimism bias	- 0.2
10 per cent lower / 10 per cent higher GDP growth rate	- 0.6 / + 0.7
Allowing demand to increase in line with population growth after the cap year (in 2036)	+ 0.5
High / low fares across all rail services	- 0.9 / + 1.2
No reliability benefits	- 0.7

²² The standard appraisal period is 60 years after scheme opening; for HS2 this is 60 years after Phase 2b opens in 2033.

- 6.5 There are impacts of Phase 2b that are not included as part of the BCR appraisal that are assessed in the Economic Case. These include both landscape and non-monetised impacts. Consideration of these additional impacts is not believed to alter the value for money assessment of Phase 2b. However, the extent to which we can incorporate this estimate accurately into our assessment is restricted by the limitations of the methodology.
- 6.6 The Economic Case also highlights ways in which we believe this could be considered a conservative estimate of the benefits of Phase 2b (and HS2 as a whole). The application of a demand cap could be regarded as conservative as there is no evidence to suggest that demand for rail will stop growing only three years after Phase 2b opens. Our modelling also doesn't capture the second-round effects on the economy, as it doesn't include factors such as business and labour relocations, clustering of economic activity, or economic gains from regeneration along the HS2 route.

Phase 2b maintains high value for money for the Full Y Network

- 6.7 The whole HS2 Y network has a central BCR of 2.7 with WEIs, so is also considered a high value for money scheme. Phase 2b delivers 51 per cent of the benefits of the entire HS2 scheme, and has a higher BCR than that of the full Y network.
- 6.8 The risk analysis shows that there is a high likelihood of the full Y network delivering high value for money, when varying those uncertain input assumptions for which we have a probability distribution.
- 6.9 The BCR for the full HS2 network has increased from the 2015 Economic Case estimate of 2.2 including WEIs due to changes in the appraisal framework and new data. The largest impact comes from updates to the model to reflect more recent outturn demand data from 2011-14. A number of other changes from previous analyses (such as adopting the latest DfT estimates of the value of travel time savings and a more sophisticated approach to aggregate transport user benefits) have also influenced benefit estimates, while improving the overall robustness of the analysis. These updates to the modelling approach are set out in more detail in the Economic Case for Phase 2b.

Phase 2b: how it meets our strategic objectives

- 6.10 As outlined in this Strategic Case, the strategic objectives of HS2 are to improve capacity and connectivity, and therefore support economic growth. Completing Phase 2b has the potential to make a substantial contribution to unlocking growth and regeneration across the UK.
- 6.11 We assess the economic benefits of connectivity in Phase 2b by looking at the value of improving journey times – not just to London, but also connecting Northern cities to the Midlands. 40 per cent of the benefits of Phase 2b, circa £21bn, are attributed to journey time savings.
- 6.12 The economic benefits of providing additional capacity are assessed through the services we assume to run in the future, on both HS2 and the classic network through released capacity. Furthermore 18 per cent of the benefits of Phase 2b, £9.6bn, are attributed to the reduction in crowding brought about by the uplift in capacity.

- 6.13 HS2 Phase 2b has the potential to generate significant benefits for the real economy through bringing firms and people closer together to:
- a. Share knowledge and best-practice ('agglomeration benefits')
 - b. Reduce transport and production costs ('business user benefits') and increase output (in markets with imperfect competition)
 - c. Improve access to jobs and encourage labour market participation
- 6.14 These potential benefits are estimated by looking at the transport user benefits and Wider Economic Impacts generated by Phase 2b, the latter using the Department's Wider Impacts in Transport Appraisal (WITA) tool. This estimates that Phase 2b will generate approximately £11bn of wider economic impacts (the whole programme generates £21bn).
- 6.15 DfT has worked closely with leading transport economists to develop a conservative, standard approach to estimating how the welfare benefits of transport schemes translate into impacts on economic output. Through adopting this approach we estimate that the full HS2 'Y' Network could generate £86bn of GDP over the appraisal period to 2093. In other words, over 80 per cent of the benefits assessed in the economic case are expected to translate into the real economy. Phase 2b in particular makes a substantial contribution to achieving these GDP impacts; generating £44bn or 51 per cent of the full 'Y' network GDP impacts over the appraisal period. As explained above these estimates do not fully capture the impacts of HS2 on the UK economy.
- 6.16 Further objectives of HS2 considered in the Economic Case include the environmental sustainability and passenger experience. Some sustainability impacts are monetised as part of the BCR, such as the noise and carbon impacts from people switching from using cars to HS2 trains. For Phase 2b these net benefits (as set out in HS2 Ltd's supporting analysis) are estimated at just under £250m. There is a further consideration of non-monetised impacts on the natural and cultural landscape.
- 6.17 Standards of passenger experience are assessed in the Economic Case through monetising improved access in stations and reductions in walk time. As part of non-monetised impacts, we identified the potential for 'slight beneficial' impacts on journey quality from new rolling stock and stations.

7. Alternatives to Phase 2b

Previous consideration of alternatives

- 7.1 In line with the requirements of the HM Treasury Green Book, we have considered alternatives to HS2 throughout its development to ensure the case for the scheme is robust. Previous work carried out by the Government and HS2 Ltd showed that a dedicated high speed network is the best way to meet HS2's strategic objectives, and that a Y-shaped network was the best configuration.
- 7.2 The 2013 Strategic Case for HS2 considered a wide range of alternatives and concluded comprehensively that HS2 was the best way to address the challenges identified:
- Domestic aviation is most economically viable for journeys over 400 miles. For most journeys between the UK's biggest cities road or rail will almost always be a better option than domestic aviation
 - Planned road enhancements will not provide the additional capacity to allow roads alone to cater for the predicted increase in demand. Roads are also not well suited to improving links between city centres as traffic speeds are limited, or for providing commuter capacity into major cities
 - Fares increases would need to be large to address capacity problems, and would not encourage transfer to more environmentally-friendly modes of transport or improve connectivity between cities. This would also have serious consequences for economic productivity and growth
 - A new rail line, rather than complex upgrade projects, was considered the best way to meet the overall objectives

Phase 2b alternatives

- 7.3 We have updated the analysis of the rail alternatives to the Phase 2b scheme. We did not consider that there was sufficient new information to lead us to look again at alternatives that involve road, air or demand management or alternative network shapes. We have however updated our assessment of rail alternatives in light of new rail schemes built or committed since 2013, committed franchise changes, work by Network Rail to consider capacity and speed enhancements on the East Coast Main Line (ECML), and the acceleration of HS2 West Midlands to Crewe (Phase 2a).
- 7.4 The alternatives have been designed to replicate the improvements in train service frequencies and journey times of Phase 2b, as far as possible. In assessing the alternatives we have looked at how well the alternatives deliver HS2's strategic objectives compared to Phase 2b.

7.5 The work was carried out by consultants Atkins and the Department for Transport (DfT) has published their report²³.

Options examined

7.6 The alternatives proposed to Phase 2b were designed to serve both Eastern and Western HS2 destinations together, so replicating as far as possible the journey times and frequencies of Phase 2b from both London and Birmingham. After the introduction of Phase 2a, there are fewer options on the West Coast Main Line (WCML) and the alternatives work has focused mainly on different options for the ECML and Midland Main Line (MML).

7.7 In all alternative options, a connection is proposed from Phase One to the current rail line from Birmingham to the East Midlands in the Tamworth area, and the WCML north of Crewe is upgraded. Five alternative options were developed which take different approaches to serving Leeds and Edinburgh. In four of these, part of the M18 HS2 route south of Leeds is built, with Option 2 looking at two different lengths of high speed route. The short option has high speed line from Leeds to just south of Mexborough and in the long option the line is built as far south as Killamarsh. A summary of the variation between alternative options is shown below. For each option the cost of new infrastructure and network upgrades has been reviewed by Network Rail.

Option	Route option to Edinburgh	Route option to Leeds	Route option to Nottingham
Option 1	Via ECML	Via ECML	Via new link to HS2 Phase 1
Option 2S	Via ECML	Via new link to HS2 Phase 1 and <u>short</u> new section of HS2 M18 route	Via new link to HS2 Phase 1
Option 2L	As 2S	As 2S except <u>longer</u> new section of HS2 M18 route	As 2S
Option 3	Via HS2 and WCML north of Preston	As 2S	As 2S
Option 4	As 2S	As 2S	Via upgraded MML

²³ See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568309/strategic-alternatives-to-hs2-phase-2b-atkins-report.pdf

Option assessment

- 7.8 The options above have been compared with Phase 2b in how well they deliver each of the strategic objectives of HS2:
- Providing sufficient capacity to meet long term demand and improving resilience and reliability
 - Improving connectivity by delivering better journey times
 - Supporting the Government's aim of building a stronger, more balanced economy
 - Providing value for money

Capacity

- 7.9 Atkins have assessed the capacity and remaining 'spare' capacity generated by each of the options. The infrastructure included in each option is intended to generate sufficient capacity to run a similar train service as HS2 Phase 2b. Both HS2 and the alternative options create some spare capacity on the national network; however HS2 Phase 2b also generates spare capacity on its own network. These comparisons are set out in more detail in the Atkins report. One particular limitation of the alternatives is that they will not stand the test of time into Manchester. The alternatives considered rely on using existing routes which are highly capacity-constrained, and because of this, Birmingham services have to go to Victoria station not Piccadilly.
- 7.10 A key consideration is the seating capacity that the alternatives can provide, compared to Phase 2b. The alternatives do not propose trains longer than 260m. HS2 by contrast will run 400m trains to Manchester, Leeds and Birmingham generating significantly increased seat capacity to Phase 2b's key markets. For some destinations, such as into Liverpool, the alternatives generate more on-train capacity than the current economic modelling assumptions for HS2 which are based on 200m services. We are continuing to review the optimal length for HS2 trains that leave the high speed network and no final decision has yet been taken.

Reliability and resilience

- 7.11 For the alternatives options where trains are running on HS2 lines, they are assumed to experience the same improvements in reliability as HS2 services. However under the alternatives, 20 more trains each hour run onto and off the HS2 network which increases the risk of importing delays onto the high speed network. We therefore believe it is likely they would be less reliable than HS2.

Connectivity

- 7.12 The table below shows the journey times for the alternative options compared to Phase 2b. HS2 Phase 2b provides a quicker connection between all cities served compared to any of the alternatives considered, apart from journey times to Sheffield which are similar.
- 7.13 The best journey times the alternatives deliver for London to Leeds are options 2, 3 and 4 which include a section of high speed line into Leeds. The 1:48 London-Leeds journey time shown is from option 1 – the only option which does not use some high speed line.

Destination		HS2 time from London	Alternatives time from London	HS2 time from Birmingham	Alternatives time from Birmingham
Leeds	With stops	1:21	1:48 – 1:59	1:15 ²⁴	1:17 – 1:40
	Non-stop	1:15 ²⁵	1:30 – 1:35	0:49	1:07
Manchester	With stops	1:11	1:20	0:41	1:10
	Non-stop	1:08	1:17		
Newcastle	With stops	2:18		1:56	2:29 – 2:54
	Non-stop		2:26		
Nottingham	Non stop	0:52 (Toton)	1:12	0:20 (Toton)	0:37 – 0:42
Sheffield	With stops	1:25	1:23 – 1:31	0:48	0:52 – 0:58

*Journey times*²⁶

Economic benefits and value for money

7.14 The costs and benefits of the alternative options compared to Phase 2b are set out in the table below.

2015 PV	Option 1	Option 2 (Short M18)	Option 2 (Long M18)	Option 3	Option 4	HS2 Phase 2b
Net Transport Benefits	£27.1bn	£29.4bn	£29.8bn	£29.6bn	£28.2bn	£41.2bn
Net Benefits including WEIs	£34.9bn	£37.2bn	£37.8bn	£37.5bn	£36.1bn	£52.4bn
Net Costs to Government	£12.8bn	£11.0bn	£12.0bn	£9.7bn	£11.5bn	£16.7bn
BCR (excl WEIs)	2.1	2.7	2.5	3.0	2.4	2.5
BCR (incl WEIs)	2.7	3.4	3.1	3.9	3.1	3.1
NPV (excl WEIs)	£14.2bn	£18.4bn	£17.8bn	£19.9bn	£16.7bn	£24.5bn
NPV (incl WEIs)	£22.1bn	£26.2bn	£25.8bn	£27.8bn	£24.6bn	£35.8bn

7.15 The economic benefits are assessed here through welfare benefits and how these translate into a stronger economy through higher Gross Domestic Product (GDP). The alternative options are estimated to provide between £35bn and £38bn in total welfare benefits, including wider economic impacts (WEIs), which is on average £15bn lower than the benefits provided by HS2 Phase 2b. Using the same approach outlined in Chapter 6 to estimating how welfare benefits of transport schemes translate into economic output, we estimate GDP benefits would be around £13bn lower on average compared to Phase 2b over the appraisal period to 2093.

²⁴ Indicative estimate if taking loop via Sheffield from Birmingham to Leeds

²⁵ A London-Leeds service would take 1:15 if the Toton stop assumed in the business case was removed. This would require a change to the modelled train service specification.

²⁶ HS2 journey times have been calculated using the Train Service Specification (TSS) in the Economic Case modelling for the proposed route for Phase 2b M18 loop. It should be noted that this work was undertaken prior to any amended TSS for serving Sheffield Midland being made public and as such the comparisons stated in the Atkins report compare to the 2013 consulted route TSS via Meadowhall. Journey times vary over the alternative options. Best regular journey times for each option have been compared to HS2's best regular journey time, and services on HS2 (in both Phase 2b and the alternatives) labelled 'non-stop' from London include a stop at Old Oak Common. Journey times for HS2 Phase 2b to Nottingham/Derby involve interchange at Toton.

- 7.16 The alternative options are all at an earlier stage of design than Phase 2b, and hence the cost estimates are more immature. The alternative costs include 66 per cent optimism bias in accordance with current DfT guidance. With the limited design work that has been done there is an inherent risk of costs being much larger than these estimates. Following recent cost over-runs experienced on the national rail network, we believe we should be cautious about using such cost estimates in drawing conclusions.
- 7.17 Network Rail's review of the cost estimates for the alternatives proposed that the capital costs should be considered as a range; the high end of the range could increase capital costs by on average 15 per cent. Atkins also test a high cost sensitivity in which the infrastructure cost of schemes is 20 per cent higher in all options, to account for any further schemes that could be required to operate the alternatives' train services. In Atkins' high cost sensitivity test, the BCRs for all alternatives but one fall below that of Phase 2b (option 3 has the highest BCR, equalling Phase 2b at 3.1 including WEIs).

Environmental impacts and disruption

- 7.18 In their high level assessment of the environmental impacts of the alternatives, Atkins advise that compared to HS2 the alternatives are likely to have a smaller environmental impact as there is less new line constructed. Some of the alternative infrastructure schemes may have a significant local impact where they require new land away from railway estate.
- 7.19 Network Rail were asked to provide an assessment of the disruption that constructing the infrastructure associated with the alternatives options would cause. The estimated number of possessions required was shown to be the equivalent of 7-9 years of weeknight closures, seven years of Sunday closures and two years' worth of weekend or longer closures. Although this is on different lines (so more than one could in theory be closed at the same time), there is also a risk the final picture could be worse.

Conclusions

7.20 Our assessment of the Phase 2b alternative options is set out in the summary table below.

A relative comparison of the rail alternatives to HS2 Phase 2b			
Red: worse, Yellow: equivalent, Green: better			
Objective		HS2 Phase 2b	Rail alternatives comparison
Capacity	Train paths	significant spare capacity on HS + spare released capacity on classic	some spare capacity on classic network, will not stand the test of time into Manchester
	Seats	Fewer seats where 200m trains are assumed e.g. Liverpool, Newcastle although this could be matched depending on rolling stock decisions	Mixed picture, but fewer seats into biggest markets (Manchester and Leeds/York)
	Reliability	reliable and resilient high speed network	20 more trains travel between HS and classic so not as reliable
Connectivity	London journey times	e.g. 1:08 to Manchester 1:21 to Leeds	broadly similar, although: +9 mins to Manchester +9 mins to Leeds (non-stop) +27 mins to Leeds (equivalent stops)
	Birmingham journey times	e.g. 0:41 to Manchester 0:49 to Leeds	typically slower: +29 mins to Manchester +18 mins to Leeds
Economic Growth	Transport benefits (PV)	£41bn	£27-30bn
	Wider economic impacts (PV)	£11bn	£8bn
Value for Money	Affordability (PV net costs)	£17bn	£10-13bn
	<i>Benefit-Cost Ratio</i>	3.1	2.7-3.9
Other issues	Environmental impact	Circa 175km of new line Slight-moderate adverse impacts	Circa 40kms of new line, likely to have less impact
	Disruption	Built separate from existing lines, some disruption at junctions	More construction on existing lines, closures lasting 7-9 years (weeknights) + 7 years (Sundays) + 2 years (weekend or longer)

7.22 In summary the strategic alternatives have similar BCRs and lower costs to Phase 2b, but they do not deliver as well on the strategic objectives the Government has set for the HS2 programme, in particular:

- They don't deliver the same track capacity. HS2 Phase 2b creates additional high speed paths above what is being used by the train service specification assumed in the Economic Case modelling. These spare paths are being considered for use by Midlands Connect and Transport for the North. The alternatives also will not stand the test of time into Manchester, relying on highly capacity-constrained conventional routes
- They can't deliver the same seat capacity, especially to Manchester, the single biggest market
- They will not be as reliable – an extra 20 trains each hour travel between the HS2 network and the existing network to serve Phase 2b destinations, interacting with other services – or built to the latest standards of weather resilience
- They do not deliver the same journey times, and in particular cannot give the same transformational change in connectivity between Birmingham, the East Midlands and the North. We believe this is a critical part of creating an economy that works for all, drawing on the Randstad/Rhine-Ruhr experience. The alternatives work shows that there is no better way of serving Leeds than with a high speed line
- They have lower benefits, which would result in lower GDP growth over the appraisal period
- They create significant disruption during construction – initial estimates are for the equivalent of 7-9 years of weeknight closures, seven years of Sunday closures, two years' worth of weekend or longer closures. Although this is on different lines (so more than one could in theory be closed at the same time), there is also a risk the final picture could be worse

7.23 There are some important limitations of this analysis which would be likely to strengthen the case for HS2 Phase 2b over the alternatives:

- The demand cap (and ability of models to cope with transformational change) means we are likely to under-estimate the benefits of Phase 2b compared to the alternatives
- The alternatives are developed to a much earlier stage of design than Phase 2b, so there is more uncertainty in their costs. NR's review of costs suggested that presenting as a range would better reflect this uncertainty. Atkins' costs are towards the lower end of these ranges; the high end of the range could increase capital costs by on average 15 per cent. Atkins undertook a higher cost sensitivity looking at a 20 per cent cost uplift for additional scope proving necessary, which causes all alternative BCRs to fall below that of Phase 2b

7.24 We consider the alternatives will not therefore stand the test of time, or support economic growth and rebalancing of the economy as well as Phase 2b. Overall, the work on alternative options leads the Government to agree with the conclusions Sir David Higgins reached in his report *Rebalancing Britain* (October 2014) that the strategic proposal for HS2 Phase Two is right.

7.25 In addition, Phase 2b offers the best opportunity to transform the economic geography of the country, support the Northern Powerhouse and the Midlands Engine, and create an economy that works for all.

8. Making the most of the opportunities of HS2

- 8.1 HS2 is not just about the benefits to passengers. It will also underpin the plans of local areas to grow their economies and regenerate urban areas, to the benefit of people who may never use HS2 directly, as well as those who do.

Local Growth Strategies

- 8.2 We are funding HS2 places to develop HS2 Local Growth Strategies to maximise the benefits from these opportunities. Phase 2 places are currently working on plans similar to those set out in Chapter 4 for Phase One at Old Oak Common and Park Royal, Birmingham Interchange and Birmingham Curzon Street. The delivery of Phase 2b is crucial to the realisation of these ambitions.

An example from the East Midlands

- 8.3 The Local Enterprise Partnership for Derby, Derbyshire, Nottingham and Nottinghamshire (D2N2 LEP) is leading the work with partners in the East Midlands to produce a strategy to ensure the region makes the most of the arrival of HS2. The local Growth Strategy is being aligned with the wider Midlands Engine growth opportunities through Midlands Connect.
- 8.4 The East Midlands Hub Station will be located on the western edge of the Nottingham conurbation, close to both Derby and Leicester. It therefore presents an opportunity which is quite different to many of the other HS2 station locations, which will be centrally located within cities.
- 8.5 Broxtowe Borough Council has already produced a strategic masterplan to facilitate mixed use development around the East Midlands Hub Station, including a minimum of 43 hectares of land for economic development and 500 new homes together with education and community infrastructure. This gateway location is envisaged as a hub for high value activity linked to the local strengths in technology, high value manufacturing, and innovation, with excellent connectivity to related clusters in the Midlands, London, and the North.
- 8.6 Excellent connectivity has been identified as a key objective, to the centres of the Derby, Leicester and Nottingham, but also to other key development areas. Efficient road, rail, tram, and bus interchange is key to maximising the benefits across the wider area. The Growth Strategy work has already identified connectivity issues for the Hub Station and this will be developed as the work progresses.
- 8.7 In addition to the existing city centres (Derby, Leicester, and Nottingham), which will be able to build on their existing strengths, there are other places where opportunities will be enhanced or arise (e.g. East Midlands Airport, the former Stanton Ironworks site and the Chetwynd Barracks site). Agglomeration benefits from improved local

and national connectivity has the potential to significantly improve the prospects of many local businesses in these areas as they find it easier to work with a wider range of partners and clients.

An example from Leeds and West Yorkshire

- 8.8 Leeds and the wider West Yorkshire region are also committed to fully capitalising on the growth possibilities that will be brought by HS2. The City Region has recently refreshed its Strategic Economic Plan, which sets out its ambitions for growth over the next 20 years. The plan will help the City Region to build on its strong foundations and world class assets – in business, advanced manufacturing, energy, health innovation or digital technology – along with its enabling capabilities of financial and professional services, logistics, and further and higher education.
- 8.9 The huge investment and increase in connectivity and capacity that HS2 will bring is a key part of delivering the area’s ambitions. A growth strategy is also being developed which will detail how the benefits of HS2 can be spread across the whole of the region, supporting connectivity and growth in all of its cities and towns, enabling them to achieve a step change in economic performance.
- 8.10 Leeds station is already the busiest station in the North of England and is a major transport hub. The future vision is for a truly integrated station that will enable people to move quickly and efficiently between classic and high speed services, including Northern Powerhouse Rail, and local transport networks to the city and beyond.
- 8.11 The remodelled station will also be an attractive place of exchange and interaction, providing a gateway into the city and leading to newly regenerated public and commercial spaces to both the north and south of the station. Investment is already underway with the £20m Leeds Station Southern Entrance opened in January 2016. Further plans will look at how improvements and investments can be phased so that they are delivering benefits to passengers even before the arrival of new services.
- 8.12 To the north of the station, there are plans to create a new transformational gateway to Leeds at City Square. This is being supported by a package of £130m in highways improvements to be delivered by 2021. To the south of the station is the South Bank - one of the largest regeneration projects in Europe. There are ambitious plans for redeveloping this area, which will result in a doubling of the size of Leeds city centre, creating new parks waterfront areas, roads paths and connections, and establishing new neighbourhoods for living, working and for leisure.
- 8.13 A master plan to unlock the opportunities in the South Bank is progressing well and a public consultation on the key options is currently underway. Major companies are already locating or expanding into the area, for example, the world famous British luxury brand Burberry is to locate its UK manufacturing operation in the South Bank.

An example from Greater Manchester

- 8.14 Another example of a city region developing plans to complement HS2 is Greater Manchester, which will benefit from two HS2 stations – at Manchester Piccadilly and Manchester Airport. Greater Manchester Combined Authority (GMCA) and other partners recognise the huge significance of the arrival of HS2, as well as other initiatives such as the Northern Powerhouse.
- 8.15 At Piccadilly, the vision is for a fully integrated, multi-modal transport hub that enables seamless transfers to different transport networks and acts as a gateway to the city. Work is well underway with a Strategic Regeneration Framework developed

in 2014 for Piccadilly Station setting out options for its redevelopment and for the regeneration of surrounding neighbourhoods.

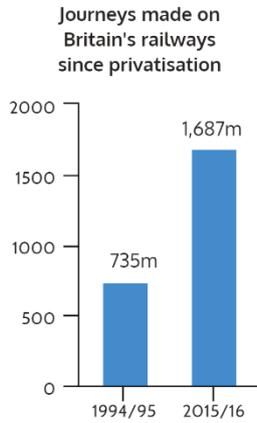
- 8.16 The Manchester Airport HS2 station is strongly linked to the growth and development being taken forward in the area through the Airport City Enterprise Zone, which has secured £800m of privately-led investment. The development of an HS2 station could increase the already significant growth expected at the airport and support economic development of the local area and across the city region.
- 8.17 In Manchester, the Combined Authority is working closely with Transport for Greater Manchester (TfGM) and Manchester City Council (MCC) to develop a comprehensive growth strategy for the two stations. The strategy will:
- Identify how best to integrate HS2 (and Northern Powerhouse Rail) with local transport networks to maximise connectivity across the whole region
 - Set out how the stations themselves and the neighbourhoods around them can benefit from regeneration and redevelopment as part of the arrival of HS2
 - Explore how local businesses and local residents can take advantage of the very significant opportunities brought by HS2 for growth and employment

Summary

- 8.18 It is through this kind of cooperative work at a local level that the fullest benefits of HS2, following the construction of Phase 2b, can be realised. As the environment for success improves and business and people in the Midlands and the North begin to benefit, this will only make these parts of the country even more attractive places to in which to live, work and locate businesses. This could then have a self-sustaining effect, with more companies being attracted there to invest.
- 8.19 HS2 also brings with it the potential to reduce the risks of investment in the North, because of the comparative better proximity to London and the reliability of the network that HS2 brings. This in turn could encourage more foreign direct investment in HS2 places.

HS2: The Case for Action

Existing Capacity



of the inter-city peak capacity provided by the West Coast Main Line upgrade has already been used

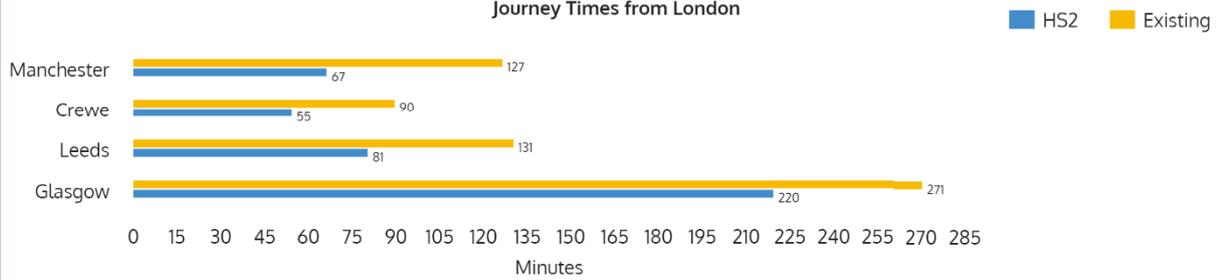


Trains between London and Manchester per day



Journey Times

Journey Times from London



HS2 will deliver significantly reduced journey times and increase connectivity across the North and UK

Jobs



Up to £11.8bn

for main civil engineering works for Phase One and Phase 2a



1,000+

trainee construction workers per year at new National College for High Speed Rail from 2017



3,000

new railway operations jobs



25,000

private sector jobs to build HS2



100,000

jobs created through growth around HS2 stations

HS2: The Case for Action

Connectivity



Up to 18 trains per hour by 2033 in each direction from London



3X the number of seats leaving Euston daily

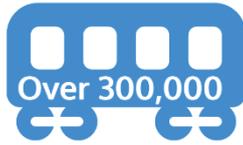


of the jobs created between 2012 and 2022 are expected to be in knowledge based sectors. People working in these sectors tend to travel more by rail

Directly connect **8 out of 10** of our largest cities



HS2 will open up new possibilities for leisure travel



a day on HS2 services, with connections to the rest of the rail network

Benefits



800 lorries

off the road, on average, each day



£103bn

in benefits overall. 80% of the benefits will translate directly into higher GDP



100 cities & towns

could benefit from new or improved rail connections



new and redeveloped stations developing recent success of B'ham New Street, Manchester Victoria



Helping the Northern Powerhouse and the Midlands Engine to rebalance our economy



£7.5m

in growth strategy funding for Phase 2 locations



2,000

new apprenticeships



Many substantial journey time savings, including nearly one hour off the journey between London and Manchester



Over £2.50

in benefits for every £1 spent