

High Speed Two Phase Two Strategic Case

Moving Britain Ahead

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Department for Transport
Great Minster House
33 Horseferry Road
London SW1P 4DR
Telephone 0300 330 3000
Website www.gov.uk/dft
General enquiries: <https://forms.dft.gov.uk>



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The benefits of HS2

Connectivity



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



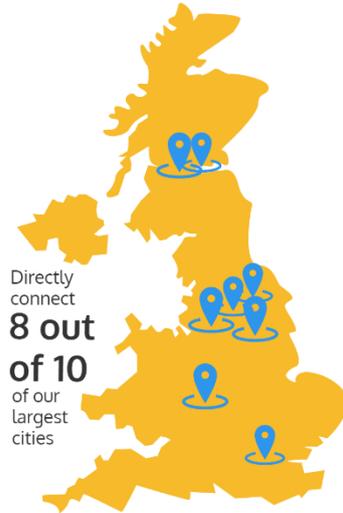
passengers a day on HS2 services, with connections to the existing rail network



HS2 will open up new possibilities for leisure travel



100 cities & towns could benefit from new or improved rail connections



Jobs

2,000



New apprenticeships

25,000



Jobs to build HS2

3,000



New jobs to operate HS2

100,000



Jobs created through growth around HS2 stations

Benefits



Removing lorries off the road, reducing air pollution



Increased reliability for passengers on the rail network



£10m in growth strategy funding for HS2 station places



£92bn in benefits overall. Over 80% of the benefits could translate directly into higher GDP



Rebalancing the economy Helping the Northern Powerhouse and the Midlands Engine to thrive



Over £2 in benefits for every £1 spent

HS2: reducing journey times

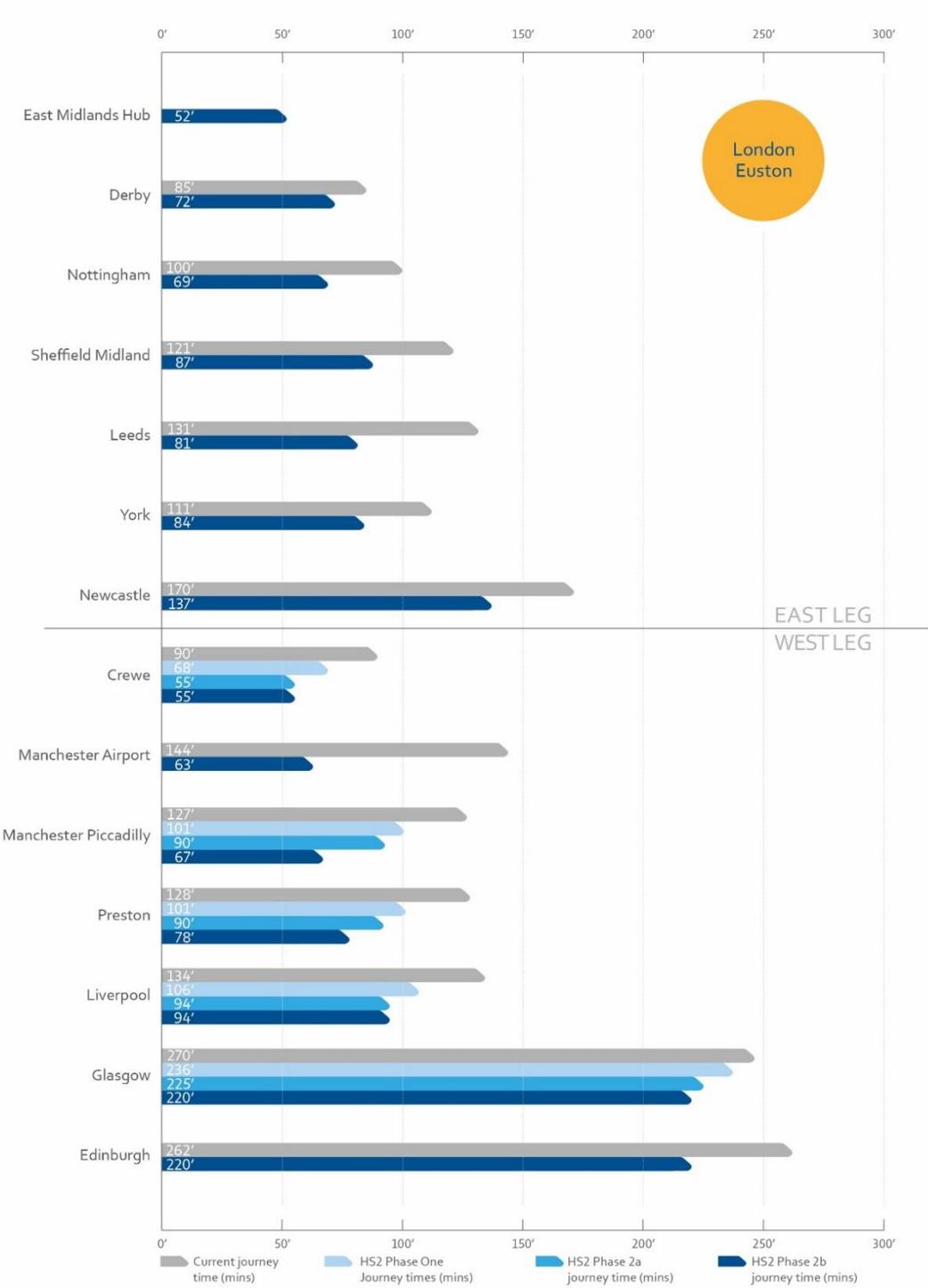


Figure 1 Journey times between London and major economic centres¹

¹ Current journey times are fastest typical times. All HS2 journey times are current estimates showing fastest northbound times. A five minute interchange time is assumed at East Midlands Hub for Nottingham and Derby. The Economic Case takes the slowest of the southbound and northbound times by convention. All journey times for Phase 2a in this document 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. HS2 Edinburgh times are shown to Edinburgh Haymarket.

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 Scotland.
- The key objectives of HS2 are to:
 - a. Provide sufficient **capacity** to meet long-term rail demand and to improve resilience and reliability on the network
 - b. **Improve connectivity** by making journeys faster and easier
 - c. And therefore **boost economic growth** across the UK
- Britain's railways need more **capacity** as they have seen unprecedented growth since the mid-1990s. By 2016-17, total passenger journeys on Britain's rail network had increased by 135 per cent since privatisation in 1994-95. The growth in intercity rail travel on some of the routes that HS2 will serve has exceeded average growth as a whole, almost tripling since privatisation. Though we have made extensive upgrades to the existing network and continue to invest in it, this cannot keep pace with rising demand in the long term.
- HS2 infrastructure has the capacity to provide up to 18 trains per hour running in each direction to and from London by 2033, and the potential for up to a further 12 trains per hour to and from Birmingham. Compared to today, HS2 will more than double the number of seats available from Euston in peak hours and will carry over 300,000 people a day.
- By providing direct intercity services on dedicated high speed lines, there will be extra space for more trains on the existing heavily congested West Coast Mainline (WCML) and East Coast Main Line (ECML). This presents a once in a generation opportunity to improve services on these routes, including passenger services to locations not directly served by HS2, and freight services. This will improve passenger experience by reducing overcrowding on peak time trains and also allow train operators to run more varied and frequent services.
- HS2 will improve **connectivity** and be the new backbone for our national integrated transport network. HS2 will directly connect eight of our ten largest cities and their regions, with significant reductions in journey times. HS2 will connect people to jobs, businesses to suppliers, and make parts of the UK more accessible to leisure travellers and tourists.
- We are accelerating delivery of a section of Phase Two of HS2 between the West Midlands and Crewe (Phase 2a) so that it opens in 2027, six years earlier than originally planned. This means that the North West and Scotland will see more of the economic benefits of HS2 sooner.

- Investment in transport infrastructure is a key part of the Government's proposed industrial strategy. More rail capacity and better connectivity will boost economic **growth**.
- The South East, particularly London, has pulled ahead of much of the rest of the country, while city regions in the north of England and the Midlands are between 10 and 17 per cent below average productivity for the UK². This divergence can in part be attributed to weaknesses in infrastructure and connectivity.
- HS2 will help to build an economy that works for everyone. It will support the growth of knowledge-based businesses by better connecting towns and cities. It will strengthen labour markets, creating greater competition and economies of scale, leading to higher growth and living standards.
- The Government is working to ensure HS2 supports the ambitions for a Midlands Engine and Northern Powerhouse. We are working with local authorities across the UK to develop growth strategies to ensure the benefits of HS2 are fully realised in local areas.
- HS2 will set new standards in passenger experience, reliability, and accessibility. Our ambition is for HS2 to improve journeys for people by shortening journey times, making travel more reliable, and giving passengers a better travelling environment with comfort and accessibility.
- As part of the Phase 2a Outline Business Case (OBC) and Phase 2b Strategic Outline Business Case (SOBC), HS2 Ltd has carried out an economic appraisal of the expected costs, benefits and revenues for HS2. The benefit-cost ratio (BCR) for the HS2 network as a whole, including wider economic impacts, is calculated to be 2.3. This provides £92bn in total benefits to the UK as a whole.
- 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 2a scheme presented in the OBC. 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.
- For Phase 2b the November 2016 SOBC set out the most recent analysis of alternatives. They will be assessed again at Phase 2b's OBC stage.
- We have found no alternatives to Phase 2a or Phase 2b 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 Two does in pursuit of our strategic objectives.

² ONS Sub-regional productivity (March 2016)

1. The purpose of the Strategic Case

- 1.1 The Strategic Case sets out the need for intervention and how the proposed scheme will fit with the Government's aims and objectives. Alternatives to the proposed scheme are also considered.
- 1.2 Recognising that each phase of the HS2 programme is at a different stage of its life cycle, this document sets out for:
 - Phase 2a – The Strategic Case at Outline Business Case (OBC) stage to support the Government's decision to deposit the hybrid Bill in Parliament
 - Phase 2b – An update to the Strategic Outline Business Case (SOBC) *Strategic Case*³ (November 2016). This supports the Secretary of State for Transport's Phase 2b route decision and response to the *Route Refinement Consultation*⁴ (November 2016).
- 1.3 In line with the HM Treasury Green Book guidelines, this document forms part of a five part business case. The five cases are:
 - Strategic Case
 - Economic Case
 - Financial Case
 - Commercial Case
 - Management Case

³ <https://www.gov.uk/government/publications/hs2-phase-2b-strategic-case>

⁴ <https://www.gov.uk/government/consultations/hs2-crewe-to-manchester-west-midlands-to-leeds-route-refinement-consultation-2016>

2. The HS2 Route

2.1 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 several stages. Trains will also run beyond the Y network to serve places such as Liverpool, Preston, Newcastle and Scotland.

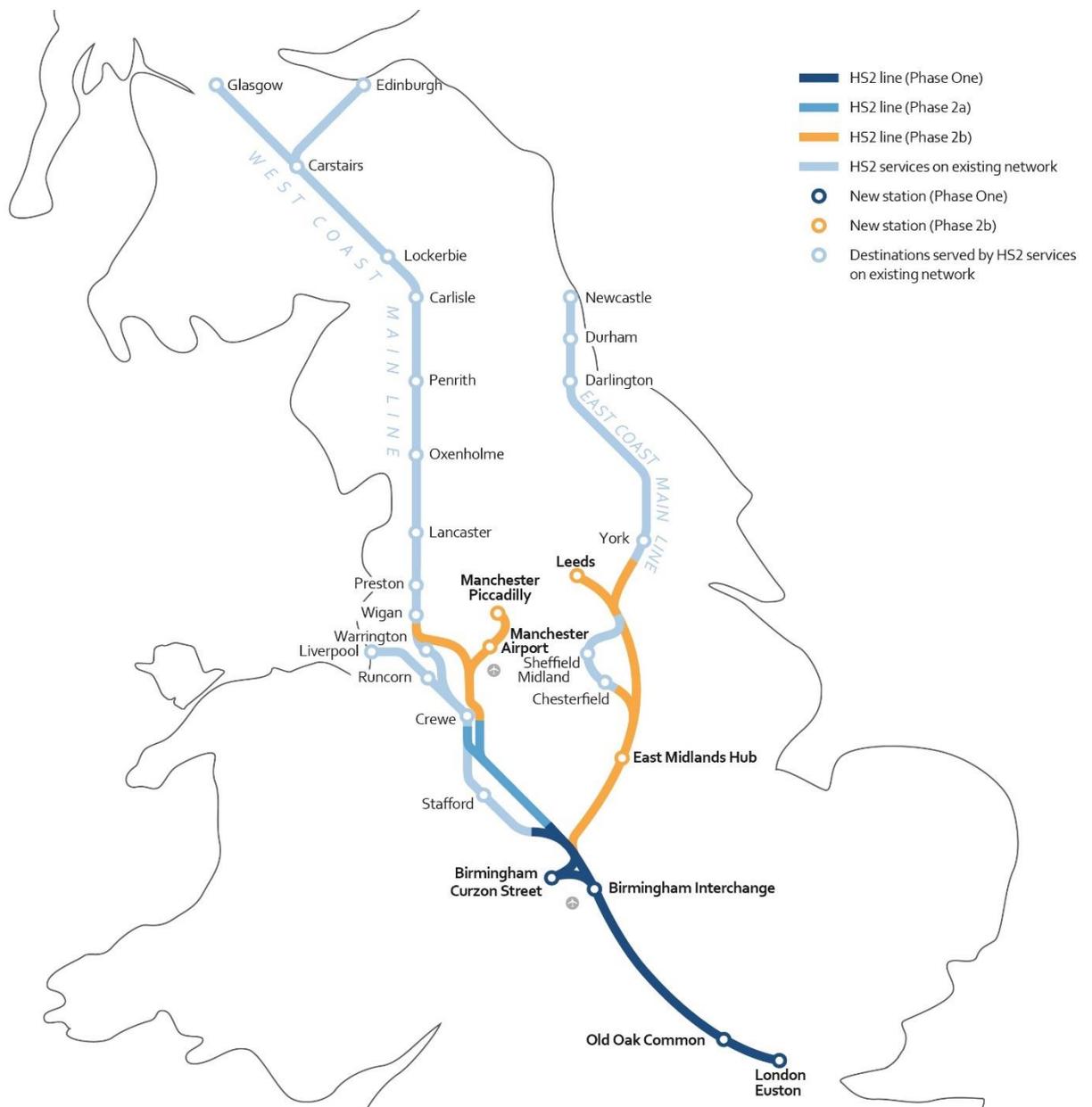


Figure 2 The full Y network

- 2.2 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. At Old Oak Common in West London a new interchange will be built connecting HS2 with Crossrail and the Great Western Main Line. Passenger services are planned to commence on the Phase One route in 2026.
- 2.3 In November 2015 the Government announced its intention⁵ to accelerate the delivery of the section of Phase Two between the West Midlands and Crewe (Phase 2a). At the northern end it will connect with the WCML to the south of Crewe to allow HS2 services to join the WCML and call at Crewe station. Passenger services are planned to commence on the Phase 2a route in 2027 subject to parliamentary approval of the Phase 2a hybrid Bill.
- 2.4 In November 2016 the government confirmed the majority of its preferred route for Phase 2b of HS2, which will complete the full Y network. The southern end of the Western Leg connects to Phase 2a (south of Crewe) and goes onto Manchester with a connection back to the WCML south of Wigan. The Eastern Leg connects to the Phase One route and goes onto Leeds, with a connection back to the ECML at Church Fenton. Passenger services are planned to commence on the Phase 2b route in 2033 subject to parliamentary approval of the Phase 2b hybrid Bill.

⁵ <https://www.gov.uk/government/publications/hs2-phase-two-east-and-west-the-next-steps-to-crewe-and-beyond>

3. The case for HS2

3.1 This chapter sets out the case for HS2. It states:

- Our previous analysis
- The strategic goals we have developed for the scheme
- The case for Phase 2a
- Our latest analysis of the benefits of the capacity HS2 releases on the existing network

Previous Analysis

3.2 *The Strategic Case for HS2*⁶ (October 2013) set out how HS2 would meet the Government's objectives to:

- Provide sufficient **capacity** to meet long-term rail demand and to improve resilience and reliability on the network
- **Improve connectivity** by delivering better journey times and making travel easier
- And therefore **boost economic growth** across the UK

3.3 The following important points in respect of the West Coast Main Line (WCML) were noted:

- Over the last two decades, Britain's railways have seen an unprecedented period of growth, with a doubling in journeys. Across the network, journeys grew from 735 million in 1994/95 to 1,501 million in 2012/13. Growth on the WCML, particularly in inter-city travel, has outperformed this national trend, despite a five-year period when major works took place along the line of route and passenger numbers did not grow.
- The WCML modernisation programme in the 2000s envisaged that following the upgrade, there would be a maximum of 13-14 trains per hour (tph) using the fast lines into and out of Euston. By October 2013 plans were being developed to squeeze in more fast commuter services which would take the peak service level up to 15-16tph. This is a higher intensity of operation than on major fast lines in other European countries, including purpose-built high speed lines
- Operating the WCML at this level of intensity was making it challenging to achieve target levels of performance reliability. In 2013 long distance services on the WCML were achieving 85 per cent punctuality, around four percentage points worse than average for other long distance services. The performance of the relevant parts of the London Midland franchise was also around 85 per cent, 6 per cent below the national average for equivalent commuter services

⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/260525/strategic-case.pdf

- 3.4 The Strategic Case went on to set out the medium to long-term consequences for overcrowding on trains, if the constraints on WCML route capacity, highlighted above, meant that additional services could not be added to the timetable. It noted that in 2013:
- Some trains between Euston and Birmingham carry as many as 160 passengers for every 100 seats
 - More than 10 per cent of passengers arriving on peak hour services into Birmingham and Manchester were standing
 - Intercity services were experiencing significant surges of demand on Friday and Sunday afternoons and evenings when people make leisure trips for the weekend in addition to business/work travel
- 3.5 Given these trends, there was seen to be a risk of worsening overcrowding by 2026 on both WCML commuter and intercity trains serving London, Birmingham and Manchester.
- 3.6 The Strategic Case then considered how both HS2, and strategic alternatives⁷, would address the growing congestion on the WCML. It concluded that the alternatives to HS2:
- Would not provide sufficient additional capacity to meet the long-term needs for the railway
 - Would not release significant additional capacity for commuter and freight traffic on the WCML
 - Would fail to solve the problem of resilience and performance on the WCML
- 3.7 The Strategic Case examined how improvements in connectivity brought about by HS2 could increase the competitiveness of areas outside London and change the future pattern of economic growth in Britain. These effects were expressed in two ways:
- Businesses becoming better connected to one another – improved transport links mean that businesses are better able to connect with potential suppliers enabling them to access higher quality and/or lower cost inputs. Businesses are also better able to connect with potential customers enabling them to supply markets further afield
 - Businesses becoming better connected to employees – improved transport links mean that individuals are able to access more jobs, whilst businesses are able to draw on a wider and deeper pool of potential workers
- 3.8 The Strategic Case demonstrated that HS2 would bring about transformative improvements in labour and business connectivity by rail. Whilst all regions would benefit, these benefits would be proportionately greater in the North and Midlands than they would be in London and the South East. Therefore, HS2 could make an important contribution to the Government's wider strategy of rebalancing the economy.
- 3.9 In 2015, a Supplement to the 2013 Strategic Case was published alongside the Strategic Case for Phase 2a. This drew upon further analysis of the latest levels of passenger demand and forecast growth, as well as patterns of business travel. These cases demonstrated that:

⁷ Packages of interventions designed to get more capacity out of the existing network

- With growth in demand for rail travel in the UK continuing to be strong, the case for major investment in the capacity of the WCML and in Britain’s rail network more widely, remained compelling
- Structural changes in the UK economy, such as the growing importance of knowledge-based industries, indicate that HS2 is the right transport intervention to boost productivity, the economy in general, and support the emerging Northern Powerhouse in particular
- Accelerating delivery of a section of Phase Two between the West Midlands and Crewe (Phase 2a) so that it opened in 2027, six years earlier than planned, meant that the North West and Scotland would see the economic benefits of HS2 sooner
- Phase 2a was the right section to accelerate when compared to the alternatives considered

3.10 In 2016 we published the *HS2 Phase 2b Strategic Case*⁸ which included analysis of the benefits of HS2 to different industrial sectors and set out that:

- Phase 2b unlocks the full benefits of HS2. It 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

3.11 Since then we have developed further analysis of the benefits of the capacity released on the existing transport network. We have also developed our understanding of the industry sectors that stand to benefit from HS2.

3.12 This analysis, when taken together with all previous analysis, demonstrates that HS2 is critical for Britain's future transport network and for boosting economic growth across the UK.

Strategic Goals

3.13 In order to ensure that HS2 delivers the core objectives of **capacity, connectivity and growth**, 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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HS2 will add capacity to our constrained network:

3.14 HS2 infrastructure can provide up to 18 tph running in each direction to and from London by 2033, and has the potential for up to a further 12 tph to and from Birmingham. HS2 services will be up to 400m in length, with almost double the number of seats as the longest Pendolino (11 car) in operation today. This means

⁸ <https://www.gov.uk/government/publications/hs2-phase-2b-strategic-case>

that compared to today HS2 will more than double the number of seats available from Euston in peak hours. It will carry over 300,000 people a day, release capacity on the existing rail network for new services, and allow more freight on the existing network that would take lorries off the road, helping to improve air quality and reduce road congestion.

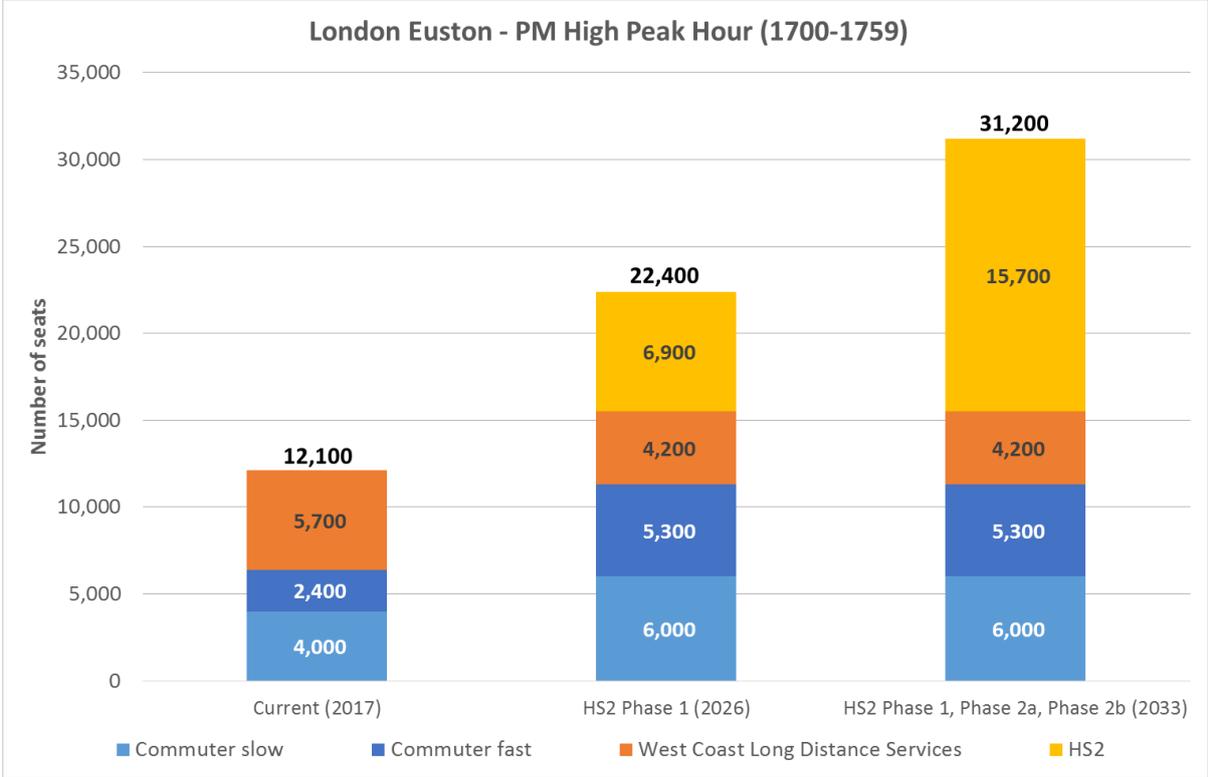


Figure 3 Increase in number of Euston seats in the evening peak

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

3.15 HS2 will become the new backbone of our rail network and be integrated into wider transport systems. HS2 will directly connect eight of our ten 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 30 minutes to 3 hours 40 minutes
- Birmingham to Manchester from 1 hour 28 minutes to 40 minutes

3.16 Network Rail estimate that around 100 cities and towns could benefit from new or improved rail connections as a result of HS2.

3.17 People travelling to and from the North and the Midlands will be able to use Old Oak Common station for easier and quicker journeys to and from the Thames Valley, Heathrow and across London on the Elizabeth line.

3.18 HS2 will improve access to major and regional airports across the UK:

From 2026:

- Old Oak Common will allow HS2 passengers to connect to frequent rail services to Heathrow Airport
- Birmingham Interchange will use a high capacity people mover to provide passenger access from the station to Birmingham Airport (taking approximately 6 minutes)

From 2033:

- Manchester Airport station will allow passengers from Birmingham and London fast and frequent access to the Airport
- East Midlands local authorities are considering options for direct links to East Midlands Airport from the East Midlands Hub at Toton

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

- 3.19 The South East, particularly London, have pulled ahead of much of the rest of the country, while city regions in the north of England and the Midlands are between 10 and 17 per cent below average productivity for the UK⁹. This divergence can in part be attributed to weaknesses in infrastructure. The economic potential of the Midlands and the North is being restrained by poor connectivity.
- 3.20 HS2 will help to build an economy that works for everyone. It will support the growth of a knowledge-based economy by better connecting cities and their regions. It will strengthen labour markets, creating greater competition and economies of scale, leading to higher growth and living standards.
- 3.21 The Government is working to ensure HS2 supports the ambitions for a Midlands Engine and Northern Powerhouse. We are working with local authorities across the UK to develop growth strategies to ensure the benefits of HS2 are fully realised in local areas.

HS2 will create opportunities for skills and employment

- 3.22 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 the Government is requiring HS2 Ltd and contractors to create at least 2,000 new apprenticeships. From September 2017 the National College for High Speed Rail in Birmingham and Doncaster will offer a range of training opportunities, with the expected number of learners starting at approximately 100 in the 2017/18 academic year, and increasing to more than 1,000 new learners starting in the 2021/22 academic year.

HS2 will set new standards in passenger experience:

- 3.23 HS2 is being designed, developed and constructed to be focused on the needs of passengers. Our ambition is for HS2 to improve journeys by:
- Giving passengers more choice, both in the range of services available and the flexibility with which people can use them, by for example using smart ticketing
 - Making travel more convenient with faster journeys that connect efficiently to where people want to travel, with integrated stations, planning and connections
 - Providing reliable rail travel, and giving passengers a better travelling environment with comfort and accessibility for all passengers

⁹ ONS (2016) Sub-regional productivity: March 2016

3.24 To help achieve this HS2 Ltd has:

- Consulted passengers through Transport Focus to better understand their needs
- Appointed an independent design panel bringing together experts who have produced the *HS2 Design Vision*¹⁰ (April 2017) to focus design on three core principles of people, place and time

3.25 The West Coast Partnership, who will run existing West Coast services and design and run the initial high speed services, will have passengers at its heart. The Government has specified that the key purpose is to put the passenger first and foremost in every decision, both on the existing service and when designing for the future.

3.26 The successful bidder will need to think like a customer by:

- Anticipating, shaping, and delivering what passengers of today and tomorrow will want
- Shaping the whole journey experience to deliver what passengers need – keeping it simple
- Ensuring passengers are always informed and up to date through ongoing communications
- Maximising capacity to benefit the passenger

The West Coast Partnership

In June 2017 we announced the short list of pre-qualified bidders for a new rail franchise which will combine operation of the current InterCity West Coast services with the development and introduction of HS2 services and we will publish the Invitation to Tender in November 2017.

The new franchise – the West Coast Partnership – will be responsible for operating services on the West Coast Main Line from 2019, designing and running the initial high speed services and recast West Coast Mainline services from 2026.

The franchise has attracted world-class bidding groups to develop and enhance the service for West Coast passengers and pave the way for the introduction of HS2 services in the future.

The successful bidder will have a blend of skills including; operating conventional rail services, high speed rail services, developing and delivering innovation, driving great customer service and the ability to work with other stakeholders to achieve success. At every stage the Partnership will innovate by:

- Bringing leading edge technology into rail travel
- Designing services for now and the future, that maximise the value of the route
- Challenging the conventional way of doing things on the railway

¹⁰ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/607020/HS2_Design_Vision_Booklet.pdf

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

3.27 HS2 is high value for money. The latest economic case suggests that for every £1 invested the UK will receive £2.30 in benefits, delivering £92bn in benefits overall. Over 80 per cent of the benefits calculated in the Economic Case could translate directly into higher GDP.

3.28 The funding envelope for HS2 is £55.7bn. The Government is committed to delivering HS2 within this envelope. 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.

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

3.29 HS2 Ltd has developed a Supply Chain Health and Safety Standard¹¹. It sets out how health and safety will be embedded in all aspects of HS2 through:

- Workforce safety
- Public and neighbour safety
- Occupational health and wellbeing
- Safe design
- Safe supply chain life cycle
- Operations safety
- SMART assurance

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

3.30 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. HS2 will be developed in consultation and engagement with communities and stakeholders.

The case for Phase 2a

3.31 As mentioned previously, in November 2015 the Government decided that a section of Phase Two between the West Midlands and Crewe (Phase 2a) should open in 2027, six years earlier than planned. It is a relatively straightforward section of route from an engineering point of view. It does not pass through any major urban areas, nor require the construction of new stations, meaning that it can be developed and built to achieve a 2027 opening date. It also does not require additional rolling stock, as the Phase One train service specification will be maintained. All of these factors mean that this section of HS2 Phase Two can feasibly be delivered earlier than other sections of the route.

3.32 Phase 2a has the potential to relieve some of the pressure on a particularly constrained section of the WCML, and to deliver additional capacity, reliability and performance benefits to the railway over and above the benefits from faster journey times. Despite the significant WCML upgrade work that was completed in 2009 there

¹¹ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/509296/CS433A_Supply_Chain_H_S_A4_V3_WEB.pdf

are a number of infrastructure constraints between the West Midlands and Crewe that currently impact on the capacity and performance of the WCML. Improving these existing bottlenecks has been the focus of a number of Network Rail projects.

- 3.33 Despite these major investments, a number of infrastructure constraints still remain. These restrictions limit the timetable that can be run and the number of train paths available. They also impact on the resilience and performance of the WCML.
- 3.34 Phase 2a will deliver faster journeys beyond the new high speed rail network from London to Manchester, Crewe, Liverpool, Preston, Warrington, Wigan and Glasgow. Long distance trains will run on dedicated high speed track as far as Crewe before re-joining the existing network. By building Phase 2a six years earlier than planned, the cities in the North of England and Scotland will see the benefits of HS2 more quickly.

Crewe

- 3.35 In *High Speed Two: From Crewe to Manchester, the West Midlands to Leeds and beyond*¹² (November 2016), the Government supported the conclusion of the work undertaken by Network Rail that, if the Crewe Hub scheme is to be taken forward, it should be located at the site of the existing station.
- 3.36 Current work has established what infrastructure would be required at Crewe to support the business case train service for Phase 2a, and this is included in the Phase 2a hybrid Bill. Work continues to see if there is a better long term solution for Crewe. Network Rail and HS2 Ltd have been assessing a range of options for Crewe that could:
- Facilitate local services
 - Allow more HS2 stops
 - Accommodate splitting and joining of 400m HS2 meaning other destinations such as Stoke-on-Trent could be served by a high speed service
 - Give a connection back onto the Phase 2b HS2 network north of Crewe, so that more HS2 trains can stop at Crewe
- 3.37 These options are set out in the Crewe Hub consultation launched today.

Released Capacity

- 3.38 Since the last business case publication, we have further developed our analysis of the benefits of the capacity created by HS2.
- 3.39 HS2 will deliver a step change in capacity on the UK's long distance rail network. By providing direct intercity services on dedicated high speed lines, HS2 will free up train paths and platforms on the heavily congested WCML and ECML. This presents a once in a generation opportunity to improve services on these corridors, including passenger services to locations not directly served by HS2, and freight services. This will not only improve passenger experience by reducing overcrowding on peak time trains but will also allow train operators to run more varied and frequent services. Once HS2 is completed, there will be an increase in frequency of services to

¹² https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/568208/high-speed-two-crewe-manchester-west-midlands-leeds-web-version.pdf

Liverpool, Preston, Scotland and Newcastle, though not all journey opportunities on the existing network can be transferred onto HS2 for their entire journey.

3.40 The map on the following page sets out the existing rail lines where capacity for new services is made available by each phase of HS2. These services may be able to extend on to other destinations.

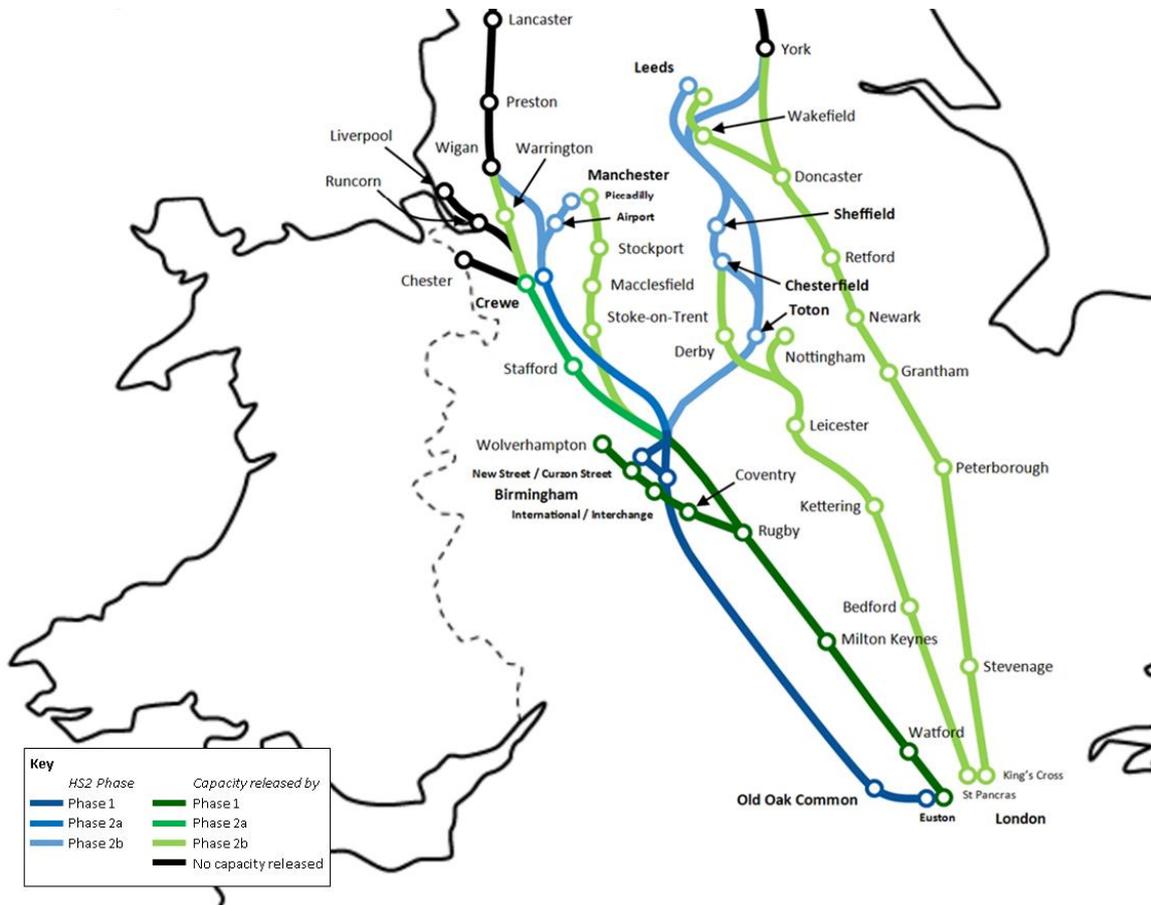


Figure 4 Existing rail lines where capacity for new services is made available by each phase of HS2

3.41 We next set out the capacity benefits of the HS2 and conventional train service assumed in the Phase One Economic Case and benefits under a range of scenarios available for Phase 2a and Phase 2b. No decisions on the use of this released capacity have yet been taken. As the scheme develops we will consider options for inclusion in the final HS2 timetable.

3.42 For Phase One and Phase 2a, the West Coast Partnership will work to maximise the benefits of both HS2 and WCML services, including to places not directly served by HS2. This work will include consultation with passengers, communities and freight operators in order to finalise options.

Phase One

3.43 HS2 Phase One could increase the combined capacity for fast trains on HS2 and the West Coast Fast Lines to/from London Euston from 15tph to 23tph. In turn, increasing the number of outer suburban commuter trains on the fast lines would allow a more even stopping pattern on the WCML slow lines. This could allow an

increase from 8tph to 10tph on the Slow Lines. Leaving some of this extra capacity unused could improve performance and reliability.

3.44 London Midland services experience levels of overcrowding that are higher than the London/South East average.

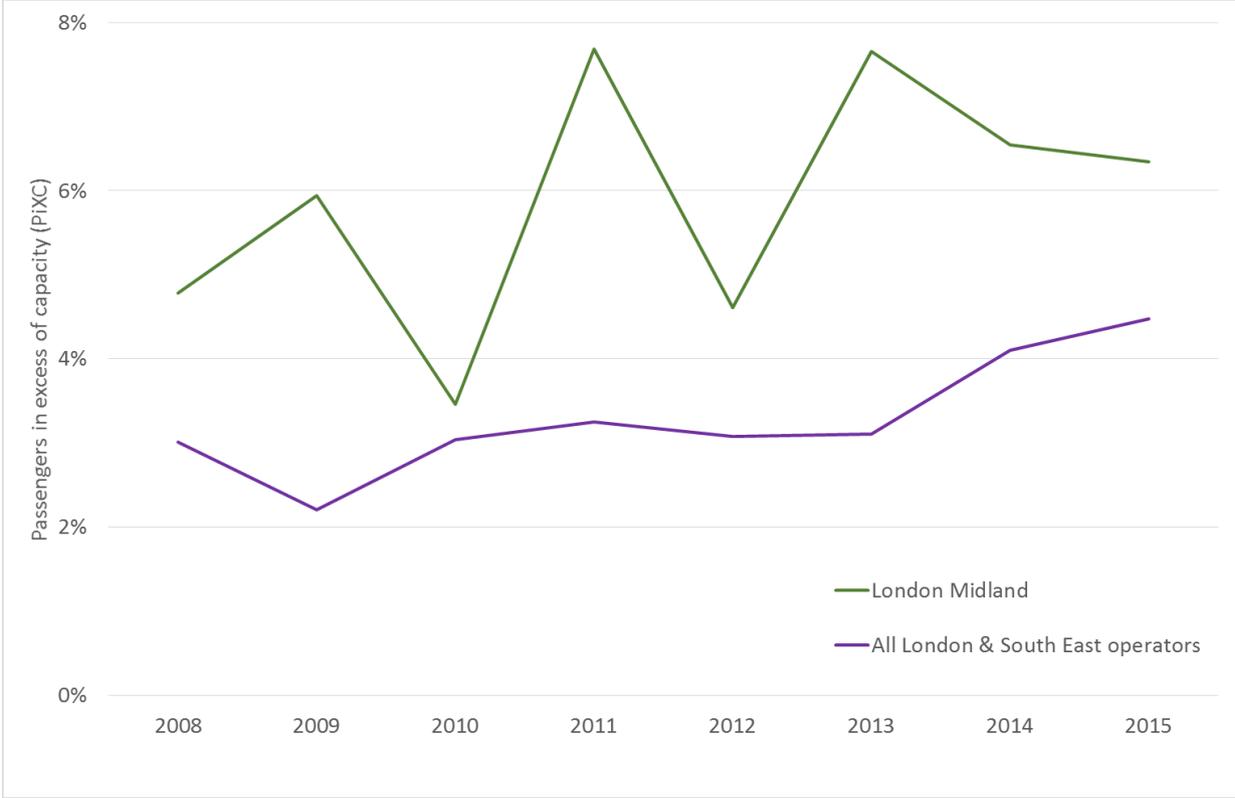


Figure 5 Passengers in excess of capacity on London Midland services and all London & South East services 2008-2015

3.45 In order to show the benefit of the capacity HS2 Phase One releases on existing lines, we have analysed ‘capacity hotspots’ on the WCML between Euston and Birmingham, such as Milton Keynes. London and the South East had an average of 102 percent passenger growth between 1997 and 2014. In contrast, places like Milton Keynes and Northampton had 120 percent passenger growth, well above the regional average.

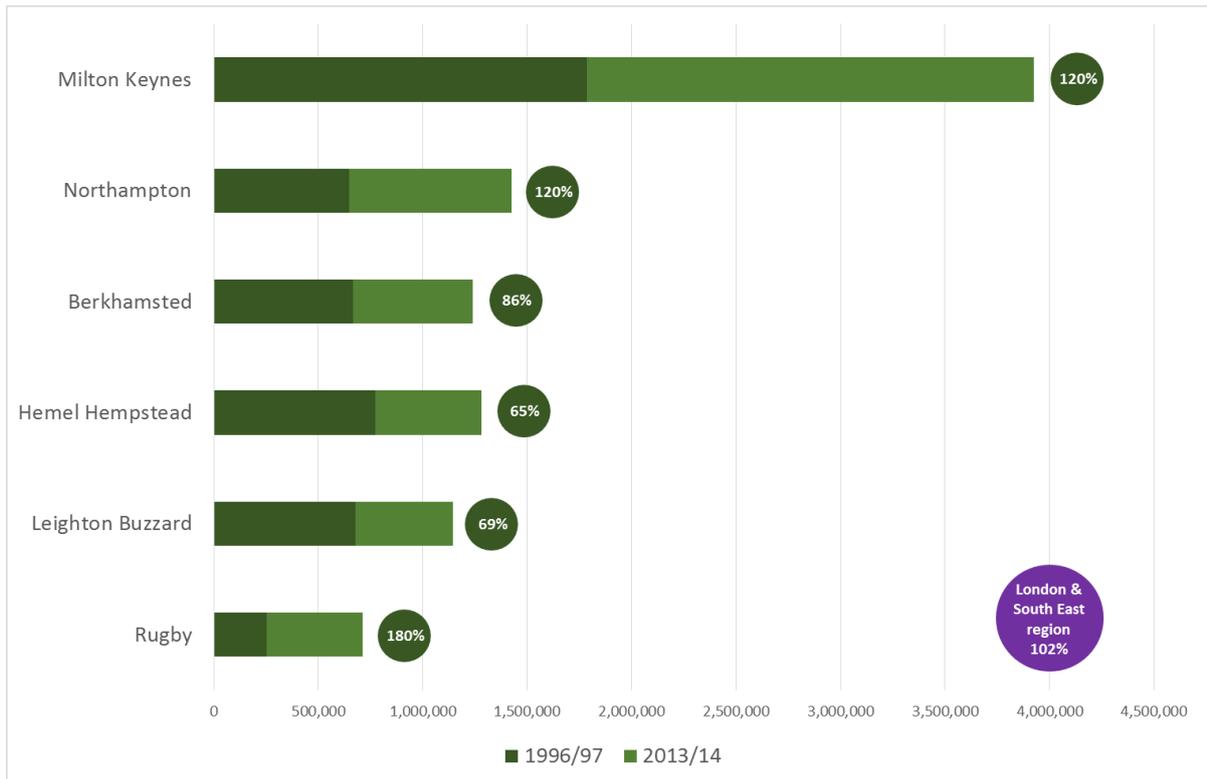


Figure 6 Growth on key London Midland flows to/from London

Milton Keynes

Milton Keynes is home to a number of large employers including Open University, Santander, Volkswagen, Network Rail and Mercedes Benz. It has one of the highest business start-up rates in England and is one of the top 20 UK cities for share of knowledge-intensive business services jobs. It is anticipated that by 2031, the total employment in Milton Keynes will increase to 204,000 jobs – an increase of 19 percent over 2015 figures.

The population of Milton Keynes is forecast to increase from 252,000 in 2012 to 312,000 by 2031. This suggests that station usage will also increase significantly in the upcoming years. The station usage of Milton Keynes has already increased by 46 percent from 2007/08 to 2014/15 which suggests that Milton Keynes will continue to grow as a commuter hotspot in the future in line with employment growth.

3.46 During peak hours, there are few London Midland services without standing passengers. The four fastest trains from Leighton Buzzard to Euston, which take 35 minutes or less to get into London, have standing room only between 7:07 and 8:07. Trains that have seats available take between 47 and 53 minutes to get into London from Leighton Buzzard.

3.47 London Midland figures for punctuality and performance during peak hours are lower than the London commuter service average. London Midland services achieved 80 percent punctuality in 2016/2017 during peak hours, when combining both London and South East and regional London Midland services. All-day results show that

London Midland London and South East services have consistently worse punctuality and performance figures than London Midland regional services by about 6 percent.

- 3.48 The performance of London Midland services is reflected in passenger satisfaction surveys. One in three passengers on London Commuter services report that they “usually stand”. This is a higher figure than on West Coast long-distance trains.
- 3.49 Until the opening of HS2 Phase One, passenger numbers are expected to grow by 1.9 percent per annum on London Midland services and 1.3 per cent per annum on the Intercity West Coast services.
- 3.50 Introducing extra train services to Milton Keynes when HS2 is built would decrease the crowding on services to Milton Keynes that depart London Euston between 5pm and 6pm. Load factors on these services were 115 per cent in 2015 (i.e. 15 percent more passengers than seats). The transfer of long distance passengers to HS2 services in 2026 and the introduction of additional services on the existing network could mean a fall in the load factor to 81 per cent for Milton Keynes passengers.
- 3.51 Together, the increase in frequency of services and the lengthening of trains could result in a 76 per cent increase in total seats on commuter services from London Euston to key commuter destinations in the evening peak.
- 3.52 Building HS2 will therefore enable more commuter capacity and more frequent services on the WCML to reduce capacity pressures.

Phase 2a

- 3.53 As well as faster journeys, Phase 2a will also release capacity on the conventional rail network. Phase 2a extends the HS2 route from north of Birmingham to a junction with existing lines just to the south of Crewe station. This means that six trains per hour can be transferred onto Phase 2a lines, freeing up capacity on the WCML from Lichfield to Crewe. Subject to future decisions about the railway, Phase 2a could free up capacity in the following areas:
- Increasing the frequency of services to Nuneaton, Tamworth, Lichfield and Rugeley from hourly to half-hourly or better, subject to capacity at Crewe or Stoke-on-Trent. In order to provide wider connectivity, these services could be combined with Manchester and Liverpool commuter services to the north and with services from London to Northampton to the south
 - Increasing the frequency of services from London to Chester, from one to two trains per hour. These services could be extended to destinations in North Wales
 - Capacity released by Phase 2a could instead be used for freight services as far as Crewe. Additional freight services from the London area, Southampton and Felixstowe beyond Crewe would be subject to constraints elsewhere on the network. For example, freight services beyond Crewe towards Liverpool would be possible if capacity improvements could be delivered between Crewe and Weaver Junction

Phase 2b

- 3.54 Phase 2b will complete the Y-shaped HS2 network. In the west, Phase 2b allows HS2 services to Manchester to run entirely on dedicated high speed lines and services to Preston and Scotland to bypass the WCML around Crewe and Warrington. In the east, Phase 2b allows HS2 services to run on dedicated lines into Leeds and to the connection to the ECML for services to York, Darlington, Durham and Newcastle.

3.55 To illustrate how released capacity on existing lines could be utilised post Phase 2b, The Department for Transport commissioned Steer Davies Gleave, who developed and made a preliminary assessment of six scenarios, each with different primary objectives:

- 1 Regular Interval Connections: Enhancing London services for the principal intermediate stations on the WCML and ECML, providing a higher frequency service between these stations and much improved cross-network connectivity
- 2 New Destinations: Introducing new London intercity services and/or improving services to stations that currently receive fewer than 4 return services a day
- 3 Cross-country: Enhancing non-London city to city existing services and extending services to new markets
- 4 London Commuter on the ECML: Enhancing commuter services on the ECML from London to existing destinations
- 5 Regional Transport Aspirations: Building on initiatives put forward by regional bodies to enhance local and commuter services into Manchester and Leeds
- 6 Freight: Using released freight paths to enhance long-distance freight services that use the WCML and ECML

3.56 This analysis shows that, compared to today, the combination of changes to conventional services alongside new HS2 services has the potential under certain scenarios to more than double evening peak seats from Manchester Piccadilly on the Stoke and Crewe corridors and almost double seats from London to Peterborough and other East Coast destinations further north. The final train timetable with HS2 Phase 2b could be a mix of these scenarios. In determining this timetable, we will continue to build an open and shared evidence base and consult passengers, communities and freight users in order to finalise options.

3.57 The scenarios are described below and train service schematics for each scenario can be found in the Released Capacity Study Summary Report Appendix to the Strategic Case.

Scenario 1 – Regular Interval Connections

3.58 The capacity released by Phase 2b can be used to give a higher frequency service between intermediate locations between London and the end points of HS2 at Birmingham, Manchester and Leeds. This can be used to increase service to existing long distance to London markets, as well as commuter capacity to London, Manchester and Leeds. Better interchange opportunities can also be provided to cross-country and inter-regional services at locations such as Nuneaton, Tamworth, Peterborough, Grantham and Doncaster.

3.59 The table on the following page shows the potential increases in frequency of services on the west coast and east coast Mainlines.

	Dec 2016 frequency (trains per hour)	Scenario 1 frequency (trains per hour)
To Manchester from:		
Rugby, Nuneaton, Tamworth, Lichfield, Rugeley	1 (requiring a change)	2
Stafford	2	2

Stoke	5	5
Macclesfield	3	7
To Leeds from:		
Retford	0-1 (requiring change ¹³)	2
Newark Northgate	1-2 (requiring change ¹⁴)	2
Grantham	1	2
To London King's Cross from:		
Peterborough	3	5
Grantham	3	4
Newark Northgate	2	5
Retford	0-1	2
Doncaster	4	5

Scenario 2 – New Destinations

3.60 Another way to improve connectivity that has been examined is using released capacity from HS2 Phase 2b to improve long distance connectivity between London and destinations that are either not currently served or served irregularly by today's railway. These destinations are shown in the table below.

	Limited service to London today	No current service to London today
WCML	Telford Shrewsbury Wrexham Blackpool North Wales	Rochdale Bolton Walsall Barrow-in-Furness Whitehaven & Workington
ECML	Lincoln Hull Bradford Halifax Skipton Harrogate Middlesbrough Sunderland Hartlepool	Nottingham via Grantham Huddersfield Grimsby Scunthorpe Boston

¹³ number of reasonable connections per hour, all with changes; excluding open access

¹⁴ number of reasonable connections per hour, all with changes; excluding open access

Scenario 3 – Cross-country

3.61 Capacity on the existing mainline railways could be used to provide new cross country inter-regional type services, increasing frequency and reducing journey times between non-London destinations. This could include:

Opportunity	Routes	
New direct services	Manchester	Derby/Nottingham/Leicester
		Northampton
		Trent Valley stations
	Manchester Airport	Derby/Nottingham
		Trent Valley stations
	Leeds	Cambridge
		Norwich
	Sheffield	Cambridge
		Norwich
	Liverpool	Trent Valley stations
	Northampton	
Enhancements to existing services	Manchester	East Anglia
		Stoke-on-Trent
		Birmingham
	Sheffield	East Anglia
	Nottingham	

Scenario 4 – London Commuter services on the ECML

3.62 Whilst HS2 Phase One services unlock benefits for London commuters on the WCML as set out in the Phase One section above, Phase 2b's Eastern Leg unlocks capacity that can be used for commuter services into London on the ECML. This could involve a higher frequency of services to some combination of Stevenage, Hitchin, Huntingdon, Letchworth, Royston, Cambridge and Ely.

3.63 The chart below shows the effect on seating into London if extra commuter services were provided to Peterborough. Extra seats on Peterborough services are assumed before HS2 as a result of train lengthening. However, a more frequent Peterborough commuter service could be provided using HS2 Phase 2b released capacity, resulting in more seats for locations such as Huntingdon, Hitchin and Stevenage.

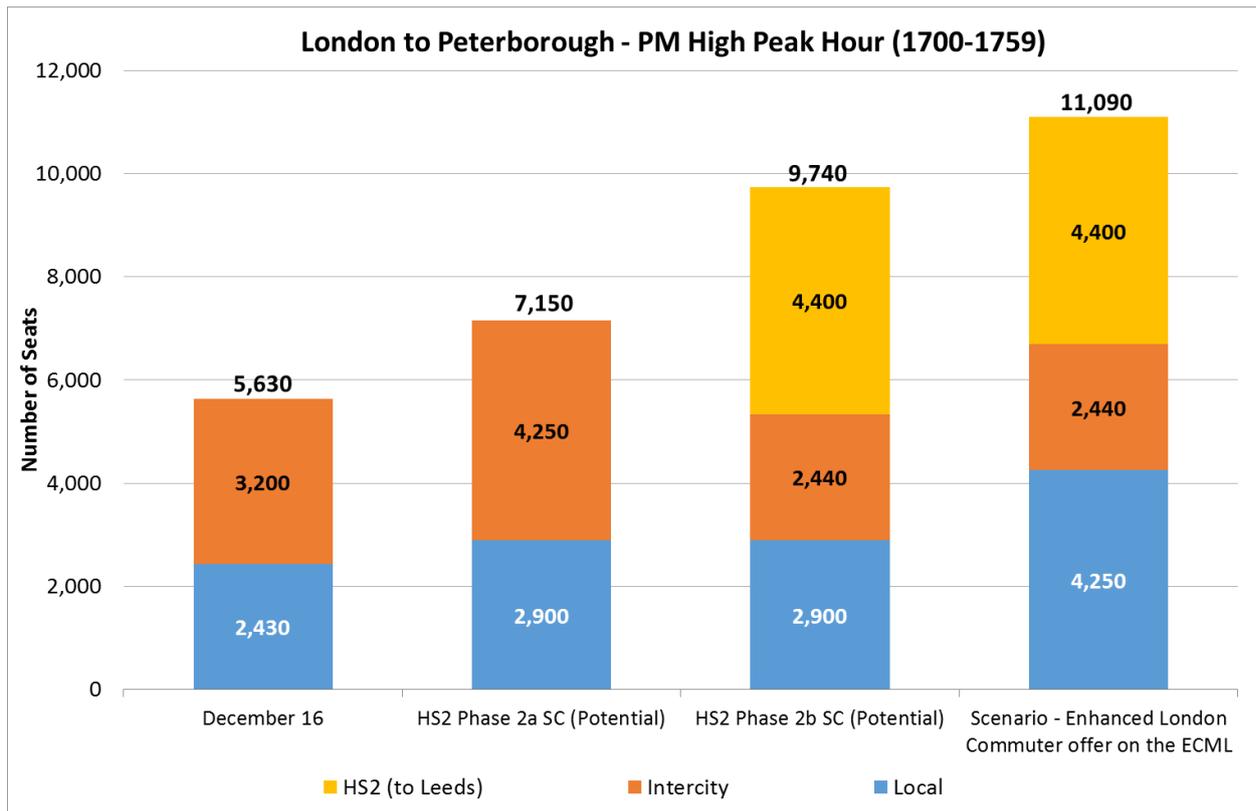


Figure 7 Seating capacity from London on the ECML under Scenario 4¹⁵

3.64 There are synergies between serving London commuter markets and Cross Country markets, since a single service being transferred onto HS2 could be replaced with both a London-Cambridge/Peterborough and a Cambridge/Norwich-Leeds service for example.

Scenario 5 – Regional Transport Aspirations

3.65 HS2 will improve city-to-city connectivity in line with the aspirations of sub-national transport bodies. The current business case includes:

- Sheffield to Leeds: two trains per hour with a journey time of 27mins
- Birmingham to Manchester: two trains per hour with a journey time of 40mins
- Birmingham to Nottingham (via East Midlands Hub): three trains per hour with a journey time of 37mins¹⁶
- The connection between the existing network and HS2 north of Crewe discussed in the Crewe Hub consultation would also allow improved Crewe connectivity to Birmingham and Manchester.

3.66 Capacity released on the WCML and ECML could also be used to meet the future rail aspirations of sub-national transport bodies such as Transport for North and Midlands Connect. Examples of routes over which services could be improved include:

¹⁵ Seat counts are based on assumptions on rolling stock types and lengths. For comparison with the scenario, lengthened trains are shown from 2026

¹⁶ Assuming a 5min interchange onto a connecting conventional service at East Midlands Hub

- Leeds-Sheffield via Doncaster
- Crewe-Manchester
- Stoke-Manchester
- Northampton-Wolverhampton via Birmingham New Street

3.67 The graphs below shows that taking into account HS2 and conventional changes, evening peak seating capacity could more than double from Manchester on the Crewe and Stoke corridors and from Leeds on the Doncaster corridor through the improvement to services in this scenario. There are also similar improvements in the morning peak.

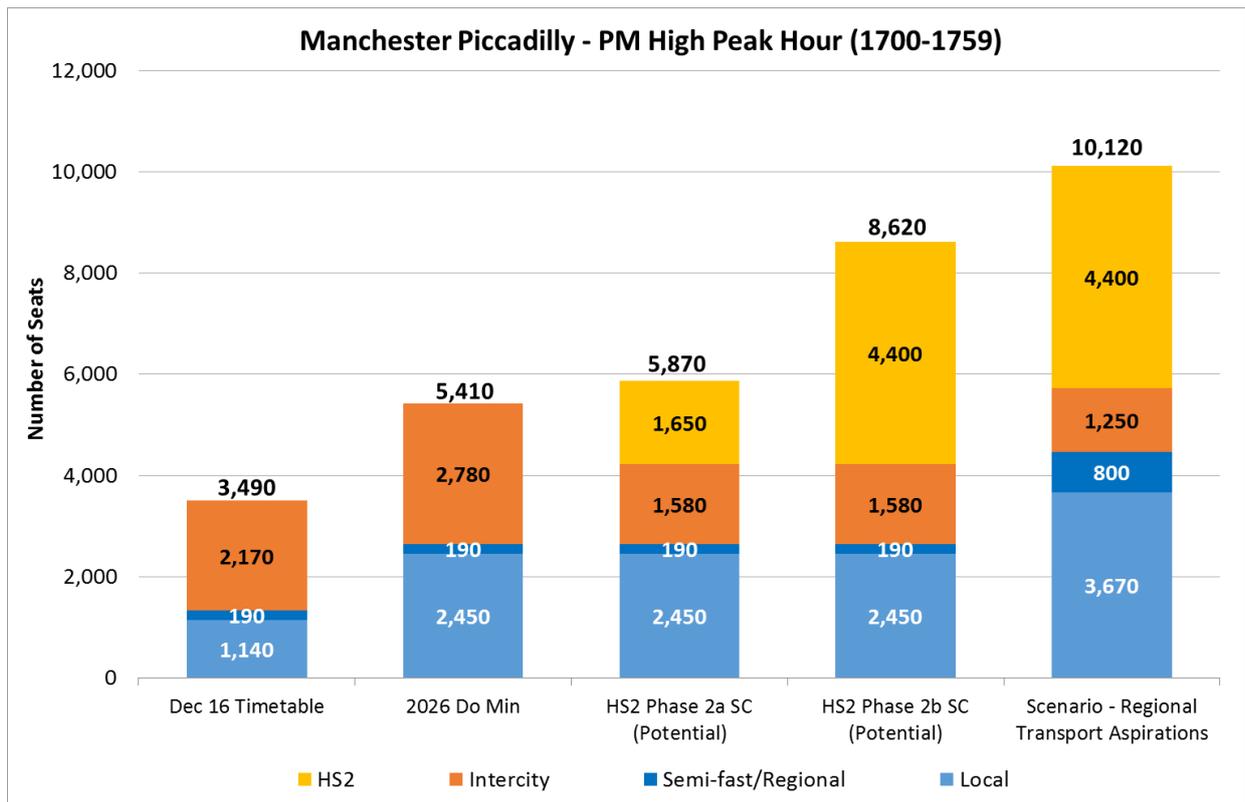


Figure 8 Seating capacity from Leeds in scenario 5¹⁷

¹⁷ Seat counts are based on assumptions on rolling stock types and lengths. For comparison with the scenario, lengthened trains are shown from 2026

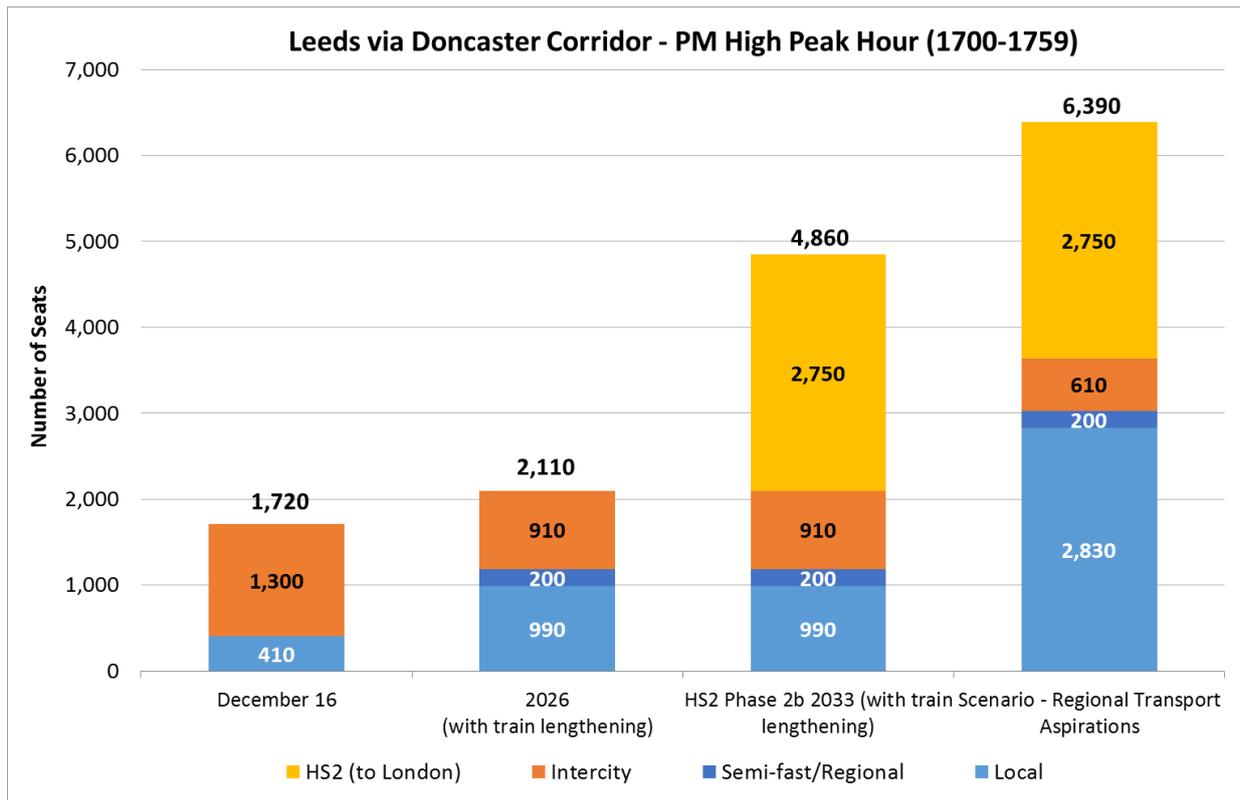


Figure 9 Seating capacity from Leeds in scenario 5¹⁸

Scenario 6 – Freight

3.68 Network Rail's most recent freight review forecasts freight tonne-kms growth of 3 per cent per year between 2011 and 2033.¹⁹ Increasing demand for intermodal freight is driven by increasing global trade and from growth in transportation within the UK as part of supply chains serving supermarkets and other retailers.

3.69 Capacity released by HS2 Phase 2b on the existing network could be used to increase capacity for freight services. Capacity released by Phase 2b could be used to serve a number of important and growing freight markets including:

- **Intermodal traffic:** This is the largest segment of the freight market and accounts for most port traffic
- **Car traffic:** Traffic from the Jaguar Landrover facility at Halewood (near Liverpool) to Southampton (three trains per day)
- **Biomass:** There has been strong growth in biomass to Drax Power Station (located close to the ECML), which has been converted from coal to biomass as part of the national programme to reduce carbon emissions
- **Thames Gateway:** The development of the new London Gateway Port in Thurrock is generating intermodal rail freight traffic, including transfer from the Port of Tilbury
- **Construction:** This industry is still strong thanks in particular to construction activity in London and the South East. Most of this segment is served by the

¹⁸ Seat counts are based on assumptions on rolling stock types and lengths. For comparison with the scenario, lengthened trains are shown from 2026

¹⁹ August 2016 report

Midland Mainline (from Leicester/Trent Valley/Hope Valley) and by some on the Great Western Mainline (from the Mendips)

- **Slade Green Freight Terminal:** A new rail freight terminal is being developed adjacent to Slade Green depot
- **Domestic intermodal:** This industry, which includes supermarkets, is strong and makes up a significant proportion of freight trips between Thames Gateway, Daventry, North of England and Scotland. Additionally, the Royal Mail site at Wembley is responsible for four postal trains per day
- **Steel:** Teesside is generating more demand to resumed steel production at Redcar

3.70 However, the use of capacity released by Phase 2b on the WCML and ECML by freight may require investments on local lines, since freight services generally do not begin or end their journeys on the WCML or ECML themselves.

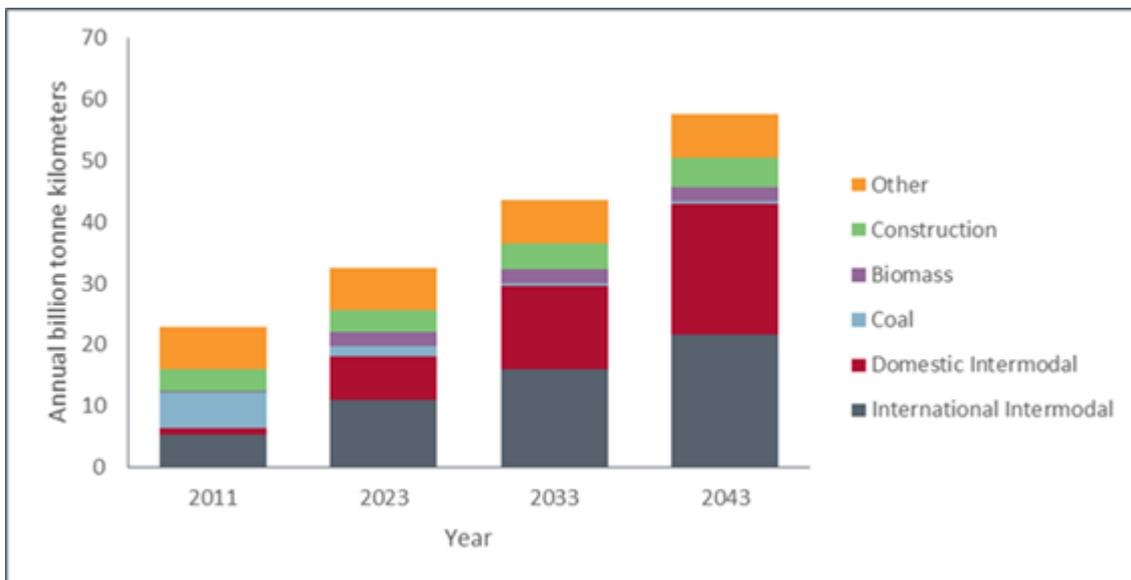


Figure 10 Freight Market Study forecast for rail freight in Great Britain

4. HS2: Engine for Growth

4.1 This chapter sets out:

- How improving transport infrastructure is a key part of the UK's proposed industrial strategy
- The importance of cities and knowledge-based industries for economic growth
- How HS2 will rebalance the economy, support key industry sectors and local growth ambitions

4.2 As a major transport infrastructure project, HS2 is helping to drive growth across the whole country by:

- Better connecting people, places and businesses, helping cities and regions to thrive in an increasingly knowledge-based economy
- Working with local areas to develop growth and regeneration strategies
- Creating 25,000 jobs for construction and 3,000 for operation
- Training a generation of high-skilled workers through the National College for High Speed Rail (NCHSR) in Doncaster and Birmingham
- Using procurement to strengthen the UK supply chain

HS2 and our modern industrial strategy

4.3 Between January and April 2017 the Government consulted on plans for the UK's industrial strategy. Its aim is to improve living standards and economic growth by increasing productivity and driving growth across the whole country.

4.4 While progress has been made towards rebalancing the economy since 2010, the disparities in economic performance between different parts of the UK should not be underestimated. The record of recent decades is one of a gap in productivity and, as a consequence, living standards.

4.5 The South East, particularly London, has pulled ahead of much of the rest of the country. Since 1997, London's Gross Value Added (GVA) per capita has moved from 59 per cent above the UK average to 72 per cent above²⁰. This divergence has been driven in part by the underperformance of many of the UK's cities.

4.6 In England, Bristol has been the only other core city to consistently enjoy higher productivity than the national average, while city regions in the north of England and the Midlands are between 10 per cent and 17 per cent below average productivity for the UK²¹.

²⁰ ONS (2016) Sub-regional productivity: March 2016

²¹ Ibid



Figure 11 Productivity in different regions of England and Wales

- 4.7 This stands in contrast to countries such as France and Germany where most of the biggest cities outperform the national average in productivity, innovation and other measures of economic performance²².
- 4.8 The differences in incomes between different parts of the country can in part be attributed to weaknesses in infrastructure and connectivity, which can limit growth in areas with lower productivity.
- 4.9 Though the United Kingdom has pioneered many types of infrastructure from railways to mobile telecoms, the quality of our transport infrastructure has been rated as second lowest among G7 countries²³, and business highlights it as a key issue. A survey²⁴ in 2015 by the Confederation of British Industry found that 90 per cent of businesses were concerned that trains are full.
- 4.10 These national weaknesses are felt more acutely in certain areas of the country exacerbating regional disparities. People experience lengthy journey times and poor transport links, particularly outside London and the South East.
- 4.11 Investment in economic infrastructure is a key part of the industrial strategy. Good transport infrastructure does not just reduce delays; it can raise productivity by enabling towns and cities to achieve agglomeration effects, and so support the rebalancing of our economy.
- 4.12 Better connected towns and cities have deeper labour markets, greater competition and greater economies of scale, leading to higher growth and living standards.
- 4.13 In *Transport investment and economic performance* (October 2014) Venables, Overman and Laird considered the link between transport investment and economic

²² ESPON (2011) Secondary Growth Poles in Territorial Development in Europe: Performance, Policies and Prospects

²³ World Economic Forum (2017) Global Competitiveness Report 2016-17

²⁴ CBI Infrastructure Survey 2015

performance. They 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 areas

The diagram on the following page shows how the improved transport connectivity as a result of HS2 will support productivity and economic growth.



Supporting cities and knowledge based sectors to grow

- 4.14 Improving our transport infrastructure is becoming increasingly important due to the changing nature of our economy.
- 4.15 The 2015 Supplement to the HS2 Strategic Case 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.
- 4.16 We are also seeing a shift towards a knowledge-based economy. 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.

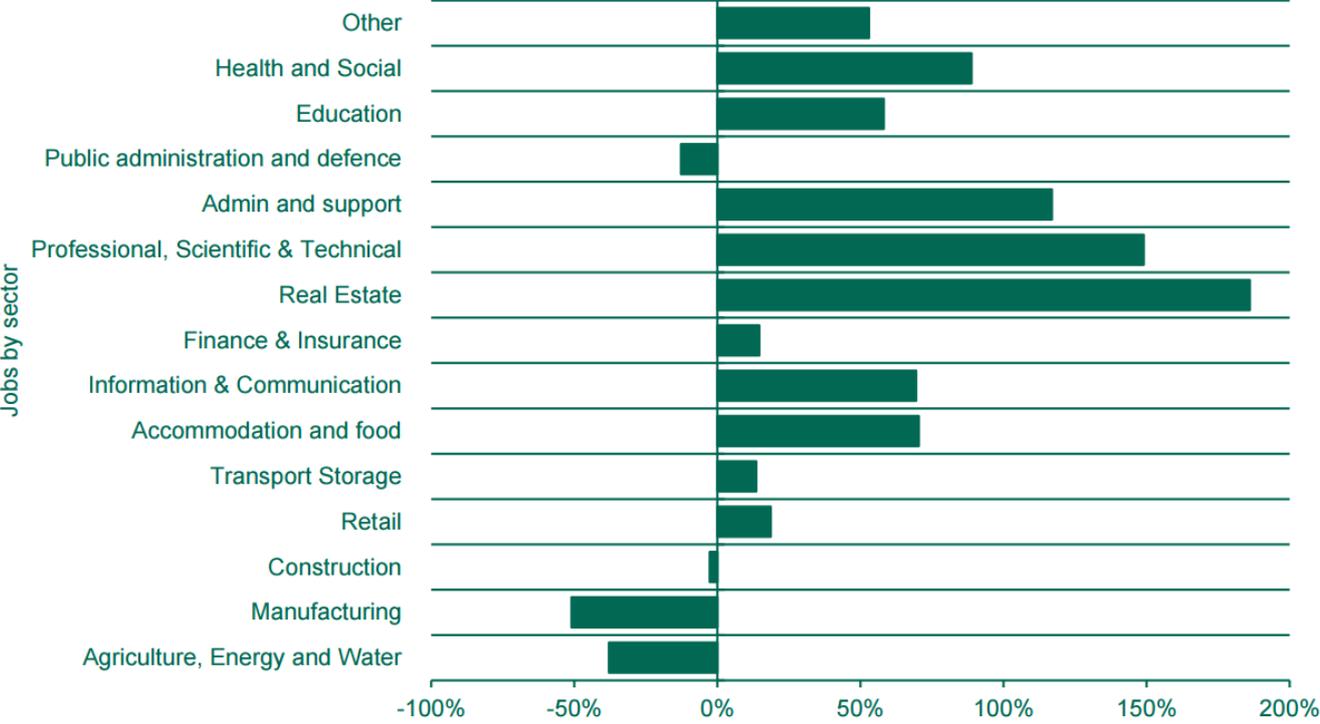


Figure 12 Change in UK jobs (1984 to 2014)²⁵

4.17 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 is projected that job numbers will have grown by a further 40 per cent.

²⁵ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480649/annex-hs2-and-the-market-for-business-travel.pdf

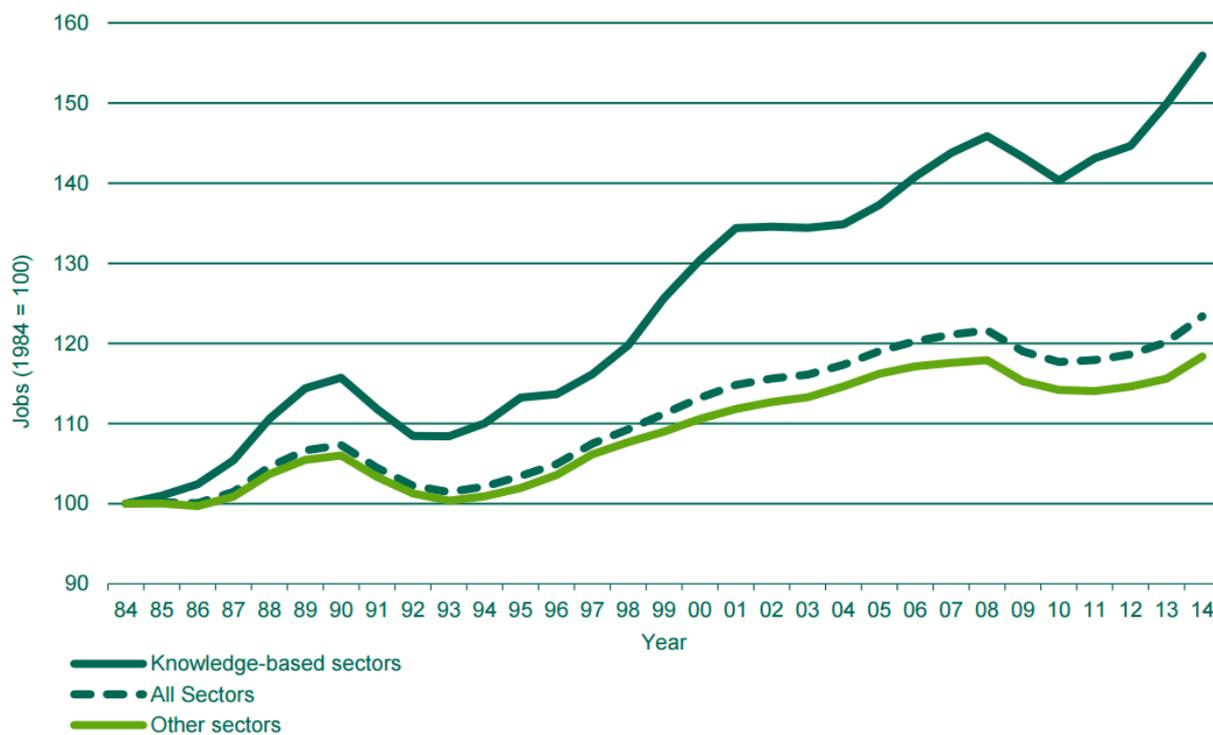


Figure 13 Historic Growth in Employment 1984 to 2014²⁶

- 4.18 Knowledge-based sectors provide goods and services that support all sectors of the economy. Given the 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 that face-to face interactions are particularly important for firms in knowledge-based sectors.
- 4.19 Growth in knowledge-based sectors is therefore likely to lead to growth in the demand for business rail travel between cities. Motorways will not be able to match the capacity and 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.
- 4.20 There is already a high volume of business travel on the intercity routes 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.
- 4.21 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.
- 4.22 It is important that city-based knowledge sector growth takes place across the country and is easily accessible by surrounding areas.
- 4.23 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 employees

²⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480649/annex-hs2-and-the-market-for-business-travel.pdf

in these sectors have a higher propensity to travel by rail, it is these sectors that will benefit most from the better intercity connections provided by HS2.

Rebalancing the economy

- 4.24 As set out above the city-regions of the Midlands and the North are less economically productive than those in other regions, particularly the South East.
- 4.25 The Northern Transport Strategy²⁷ in 2015 set out how better connecting northern 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.
- 4.26 HS2 will transform connectivity between London, the Midlands and the North. 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.

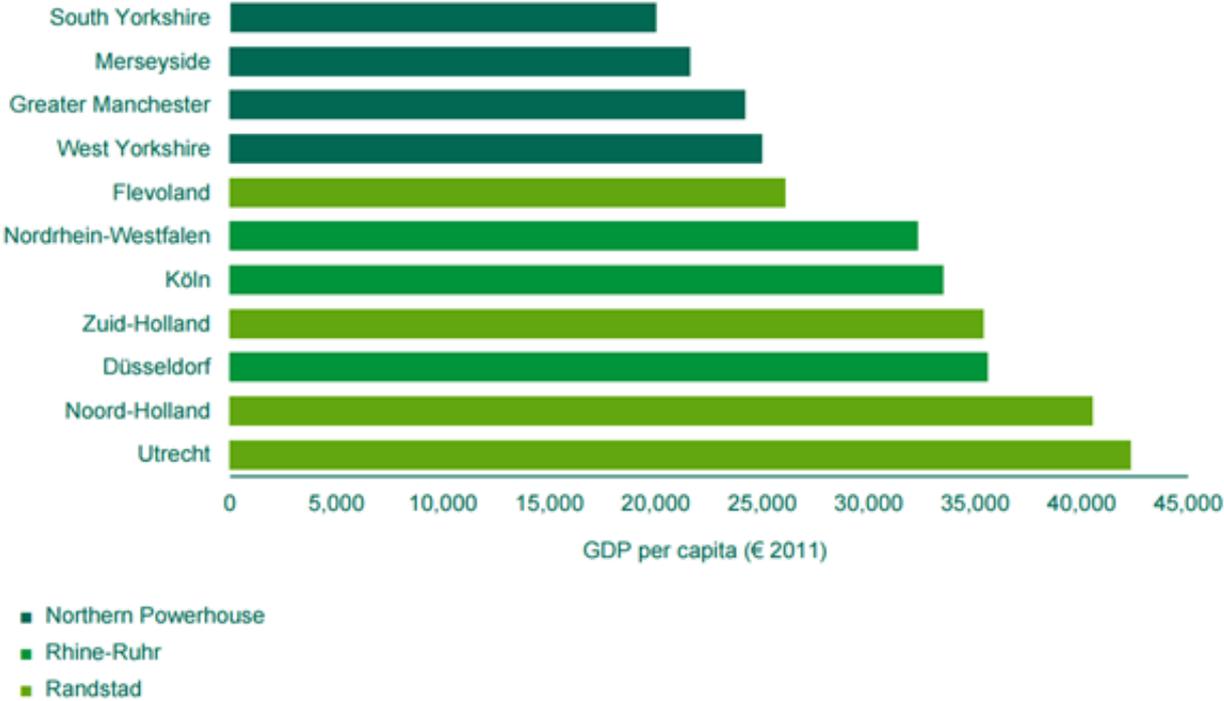


Figure 14 GDP per Capita (€ 2011)²⁸

- 4.27 The graph above highlights the difference in the economic performance of the Northern city regions and the performance of comparator regions in Europe.
- 4.28 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 (£210bn 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

²⁷ <https://www.gov.uk/government/publications/northern-transport-strategy>
²⁸ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/480649/annex-hs2-and-the-market-for-business-travel.pdf

services. The Randstad supports Europe's largest seaport (Rotterdam) and one of Europe's largest hub airports (Schiphol).

- 4.29 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 (£250bn in 2011). The region has a network of fast intercity rail services and is linked by an extensive Autobahn network.
- 4.30 In comparison to these well-connected regions, journey times between city regions in the North and Midlands are long. The 2014 One North report²⁹ 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.
- 4.31 The spring 2016 update to the Northern Transport Strategy³⁰ set out how HS2 infrastructure will contribute to this vision. HS2 will radically slash journey times between the cities of the Midlands and the North and also free up space on the existing network for other services.

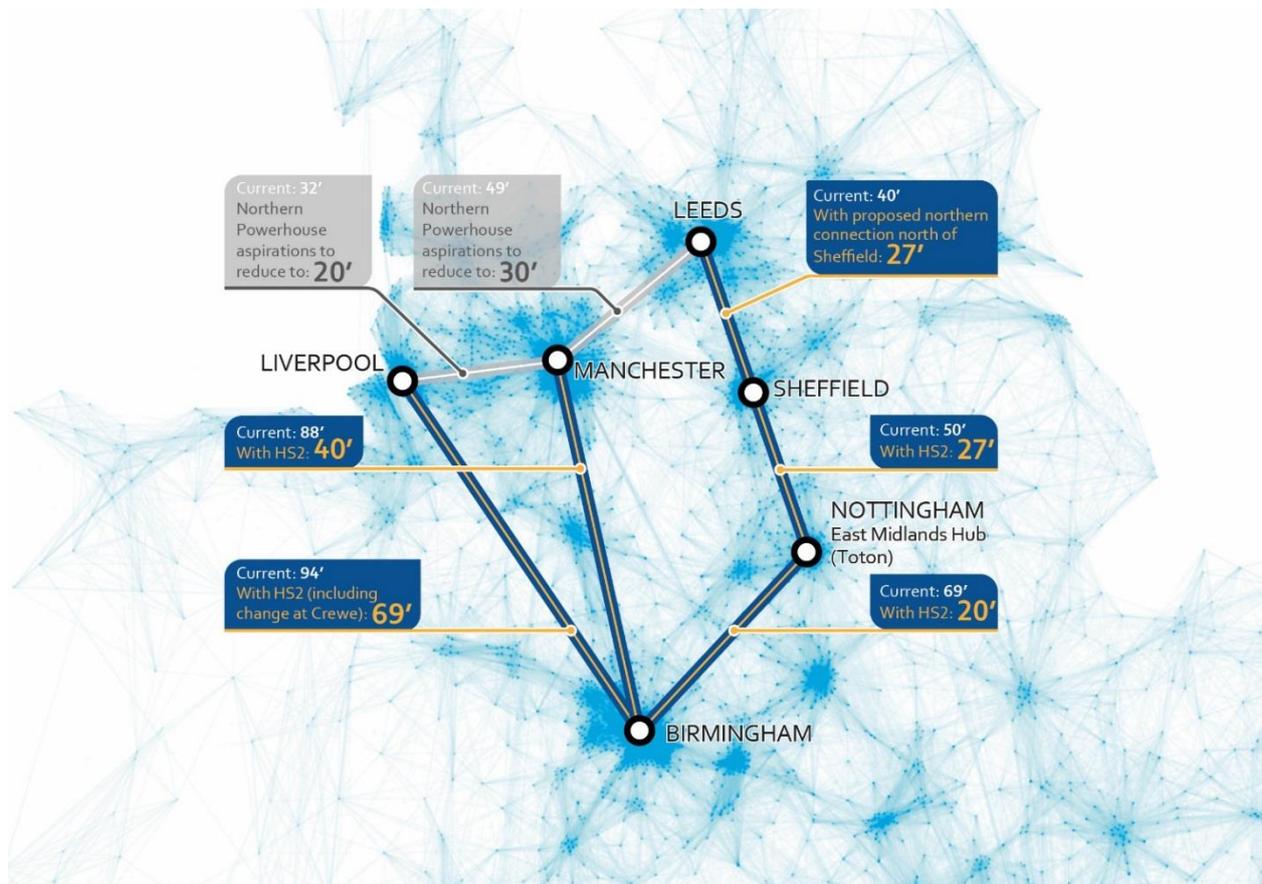


Figure 15 Journey times between the Midlands and the North with HS2³¹

²⁹ <http://www.westyorks-ca.gov.uk/uploadedFiles/Content/News/Articles/One%20North.pdf>

³⁰ <https://www.gov.uk/government/publications/northern-transport-strategy-spring-2016>

³¹ The background to this map shows transport flows across the UK. Source: Alasdair Rae, University of Sheffield. Current journey times are fastest typical times. All HS2 journey times are current estimates showing fastest northbound times. Journey times at Nottingham are shown for the East Midlands Hub at Toton. Birmingham to Liverpool journey time assumes an option for Crewe Hub is adopted and a five minute interchange is assumed at Crewe.

4.32 Improvements to journey times, more seats, better reliability comfort and accessibility will reduce the barriers to business between these city regions.

Supporting the Midlands Engine and the Northern Powerhouse

4.33 HS2 will transform connectivity for the Midlands and the North, and the Government is working to ensure it supports the ambitions for a Midlands Engine and Northern Powerhouse.

4.34 Connectivity for the Midlands will be central to the success of Midlands Engine. To support this the Government has committed £17m to support the transport arm of the Midlands Engine, Midlands Connect (a partnership of 23 local authorities and nine Local Enterprise Partnerships) right across the Midlands. They are developing a dedicated HS2 readiness work package ensuring the Midlands capitalises on the economic benefits of HS2.

4.35 Northern Powerhouse Rail (NPR) is the shared ambition of Government and Transport for the North (TfN) to significantly improve the capacity, speed and frequency of train services between Manchester, Liverpool, Leeds, Sheffield, Newcastle, Hull and Manchester Airport. NPR aims to boost economic growth by developing fast, frequent, comfortable and reliable trains with enough capacity for commuting, business and leisure.

4.36 Together with TfN, the Government is continuing to work with HS2 Ltd and Network Rail in support of these aspirations. We are looking to develop a clear set of proposals which relate directly to the HS2 network before the end of 2017. Further details are set out in HS2: From concept to reality³²

Developing skills

4.37 The industrial strategy sets out the importance of developing skills for the UK economy.

4.38 The UK has some of the top universities in the world and a larger proportion of our population have degree level qualifications than most of our competitors. However, technical education has been relatively neglected. A bewilderingly complex array of qualifications, some of which are poor quality, makes the system hard to use for students and employers. Consequently, we have a shortage of technical-level skills, and rank 16th out of 20 OECD countries for the proportion of people with technical qualifications³³.

4.39 HS2 Ltd, along with the transport, engineering and infrastructure industries as a whole, are facing a significant skills challenge in finding the required numbers of people with the type and level of skills needed.

4.40 The NCHSR, supported by HS2 Ltd, directly addresses this shortfall in high-level, technical expertise. Delivered to its full potential, it will transform the future of the rail industry and of skills-based vocational training in the United Kingdom. Its mission is to train the next generation of engineers for a career in rail, and to upskill the existing workforce with skills for now and the future. Based in Doncaster and Birmingham, it

³² <https://www.gov.uk/hs2>

³³ OECD (2014) Skills Beyond School Synthesis Report

should spread socio-economic benefits around the country, and also bring them to the communities of which it is a part.

4.41 The College's vision is to:

- Deliver a step-change in vocational learning for the rail sector
- Attract a wider pool of talent into science, engineering and technology
- Build the highly skilled workforce that is needed to deliver and maintain HS2, and to meet the future requirements of the wider railway industry
- Place the rail industry at the cutting edge of innovation, transforming its image
- Be a catalyst for regeneration and growth in and around Birmingham and Doncaster

4.42 The NCHSR will offer a curriculum focused on high level technical skills at level 4 and 5 in High-Tech railway engineering and digital infrastructure. Opening in September 2017 the College will offer Higher Apprenticeships and a HNC equivalent qualification. It will provide training to new entrants, workforce upskilling and CPD opportunities. The expected number of learners will start at approximately 100 in the 2017/18 academic year, and will increase to more than 1,000 new learners starting in the 2021/22 academic year.

4.43 We will also make sure that employers throughout the supply chain need to invest in skills. For the companies that design and construct HS2, investing in the skills of their workforce will not be a discretionary activity. HS2 is aligned with the Government's Transport and Infrastructure Skills Strategy, and we will use procurement to drive skills development and deliver a significant increase in the number of apprenticeships right through our supply chain. We are committed to creating at least 2,000 apprenticeships during construction.

4.44 HS2 should help to strengthen the UK's global trade by developing a new wave of High Speed Rail skills that can be exported around the world.

Improving procurement

4.45 The industrial strategy sets out how, used strategically, government procurement can encourage innovation, competition, and investment in skills.

4.46 HS2 is building on good practice adopted in major infrastructure programmes by adopting a balanced scorecard approach to ensure the impact of procurement on the growth of small business and UK supply chains, skills and apprenticeships is taken into account when considering the value for money of different bids.

4.47 HS2 Ltd has produced a supplier guide³⁴ to provide advice to prospective suppliers about how HS2 Ltd undertakes procurement and what it will be looking for from the supply chain. This includes further information about how suppliers are assessed using a balanced scorecard which reflects HS2 Ltd's strategic goals.

4.48 The scorecard also reflects ways that we expect to work with the supply chain on issues including Equality, Diversity and Inclusion (EDI) and Building Information Modelling (BIM).

³⁴https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/522038/CS508A_Supplier_Guide_Update_V5_WEB.pdf

Supporting key industry sectors

4.49 To illustrate the economic growth potential HS2 will support across the UK we have looked at some case studies of some key industry sectors. These are set out in the following pages.

HS2 will expand opportunities for the tourism sector in the Midlands and the North

4.50 HS2 will offer tourist destinations such as Birmingham, Cumbria, and North Yorkshire the opportunity to expand the reach of their tourism markets.

4.51 Birmingham is experiencing a renaissance in tourism as the number of leisure and business visitors has soared in recent years to all-time highs. Both Cumbria and Yorkshire feature in the top 5 most visited counties in the UK, with a strong and diverse tourism sector. 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 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 (11 per cent in 2011) and to Cumbria (13 per cent in 2014). HS2 will improve connectivity to London offering 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.

Birmingham

4.52 Birmingham tourism hit an all-time high in 2015, with 38.1 million visitors. That total includes an 18 per cent increase in domestic visitors since 2008 and a record-breaking 1 million overseas visitors, who represent an increasing share of total visitors having increased by 163,000 (or 17.3 per cent) from 2014. These are the largest rises in visitor numbers for any UK city outside London, for the second year running.

4.53 Research reveals that the city is the fourth most visited place in the UK by international tourists after London, Edinburgh and Manchester. Birmingham is becoming more popular with European holidaymakers, particularly visitors from France and the Netherlands, as well as the United States of America

4.54 Birmingham's hotel sector has seen its most successful year in history, with occupancy rates for 2016 peaking at 99 per cent capacity and averaging at 75 per cent, both the highest on record.

4.55 The influx of visitors to Birmingham in 2016 means more spending, with revenue from the tourism economy reaching £6.2bn; the average spend per head increasing to £82 in 2016, up from £61 three years ago. In 2015, foreign visitors spent £386m, an increase of £87m on the previous year.

4.56 The proportion of leisure visitors to Birmingham has also increased - from 45 per cent in 2013 to 76 per cent in 2016. This is the largest rise in numbers of any UK regional city.

4.57 By providing fast, frequent and reliable travel between Birmingham and the rest of the UK, HS2 could help the tourism sector in Birmingham to grow further.

Cumbria

- 4.58 HS2 will bring the Lake District within the same journey time from London as the Peak District, which currently 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 55 minutes³⁵. Even allowing for extra time to access the Lake District from Oxenholme by public transport or car hire, the HS2 journey time will be much better than travelling between London and the Lake District by car.

York

- 4.59 HS2 will offer York the opportunity to replicate Canterbury's attractiveness to the London visitor market following the opening of domestic high speed rail services to the capital. Rail journey times between Canterbury and London were cut by almost 40 minutes as a result of HS1. HS2 will reduce the rail journey time from London to York by 27 minutes to 1 hour 24 minutes, making it more attractive as a day trip destination.

International comparison

- 4.60 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 the 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.

HS2 connectivity will support growth of the UK's tech clusters

- 4.61 The digital sector is an important source of growth and employment in the UK. It grew by over 20 per cent between 2010 and 2015, and is worth seven per cent of UK GDP.
- 4.62 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.
- 4.63 Birmingham has an effective eco-system that supports start-ups with funding, social media, legal and contracts. It is also a great location for tech start-ups because of its access to university skills and talent. Its digital enterprise ecology is thriving but there is still a need to promote the sector and gain more recognition.
- 4.64 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. However, due to cost pressures in London, tech firms, which are often small and innovative start-ups, are considering moving their operations away from the capital in

³⁵ Including a 10 minute interchange at Preston

search of a more viable base. For the last few years, Birmingham has had the highest number of new start-ups and active businesses of any UK city outside of the capital.

4.65 In the North of England, digital companies in Manchester, Leeds and Liverpool consider lack of talent to be one of their most significant challenges. The majority of firms in these 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.

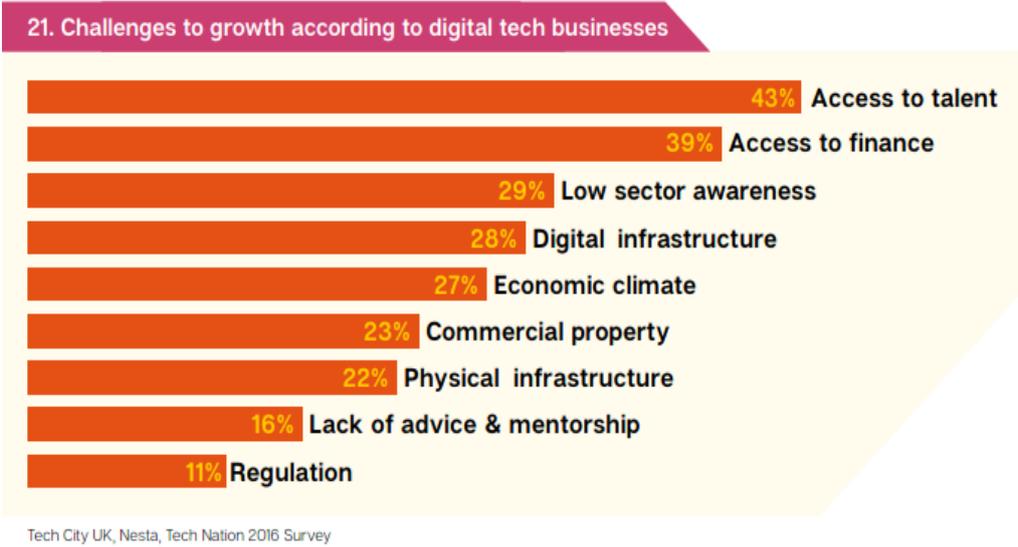


Figure 16 Challenges to growth according to digital tech business

- 4.66 For the Birmingham digital cluster, limited access to finance has been cited as their most significant challenge to growth. London is the UK's hub for business angels, venture capitalists and private equity investors that provide the finance for start-ups and growing businesses. Academic studies have previously shown that distance can deter venture capitalists in the UK, US and Germany from investing in companies.
- 4.67 HS2 will help to tackle both of these challenges by by improving access to finance, experienced industry talent and markets. It will reduce the effective distance between London-based investors and digital firms in the Midlands and the North.
- 4.68 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 London.

HS2 will expand opportunities for Professional Business and Financial Services (PBFS) in the Midlands and the North

4.69 The PBFS 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 and 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 financial services support functions such as legal and Information and Communications Technology services. In the West Midlands, the PBFS sector contributes 25 per cent of Gross Value Added. It supports nearly 95,000 employees, and is home to over 300 company headquarters.

- 4.70 PBS firms are already expanding their presence outside of London. The so-called 'northshoring' of activities by PBFS firms from London to centres in the Midlands and the 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. Pressure 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. Birmingham's financial services includes major players such as HSBC, Deutsche Bank and PwC. PBFS has one of the highest employment growth forecasts across the Greater Birmingham and Solihull Local Enterprise Partnership (LEP) with a 33 per cent uplift expected between 2015 and 2030.
- 4.71 By improving connectivity between London, the Midlands and the North, HS2 can help to accelerate the expansion of PBFS firms in cities and regions outside London. High speed rail connections will allow PBFS 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. For 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 PBFS activities.

HS2 will expand opportunities for advanced manufacturers

- 4.72 The West Midlands lies at the heart of UK manufacturing and advanced engineering, with the highest concentrations of high-value manufacturing businesses in Europe and their supply chains. Manufacturing is worth £11.7 billion a year to the West Midlands economy, employing one third of a million people. The region is the UK's largest manufacturer of transport equipment, accounting for one fifth of national production. The area is particularly strong in the areas of automotive and aerospace manufacturing and is home to some of the world's leading businesses and their supply chains.
- 4.73 The strength of advanced manufacturing in the West Midlands lies in its cluster of large manufacturers, their supply chains and its strong connections to collaborations and partners:
- World class manufacturers: including Jaguar Land Rover, JCB, Rolls Royce, and Aston Martin
 - Advanced manufacturing clusters, business parks and hubs, home to innovators and supply chains, including: Ansty Park, the Advanced Manufacturing Hub, Mucklow Park i54, and auto clusters in Coventry and Warwickshire

- Research and innovation collaborations including: the Advanced Propulsion Centre, Energy Systems Catapult and 'Midlands Innovation', a world class research and innovation partnership combining the power of university research with the unique strengths of Midlands industry to drive cutting-edge research, innovation and skills development

4.74 Face-to-face contact between manufacturers, their supply chains and centres of research and development help foster innovation and new technologies, which are vital to the competitiveness of UK manufacturing. Knowledge sharing, new discoveries and serendipity are encouraged when engineers, scientists and researchers are able to come together and collaborate. British manufacturers collaborate with supply chains and research centres that increasingly cut across traditional sector boundaries and are becoming more geographically dispersed across the UK.

4.75 HS2 will support face-to-face collaboration by effectively shrinking the distance between manufacturing plants, their suppliers, universities and research centres in the West Midlands and other regions of the UK. HS2 will offer fast, frequent and reliable access for manufacturers and suppliers located in the West Midlands to:

- Yorkshire and the North East including: the Advanced Manufacturing Research Centre, Boeing, BAE Systems, Nissan, and the Centre for Process Innovation Catapult at Newcastle University
- The North West and Scotland including: BAE Systems, Leyland Trucks, and the Advanced Forming Research Centre Catapult;
- London and the South East including: supply chains, technology innovators, finance, Ford and Heathrow airport.

HS2 will be a catalyst for regeneration

4.76 The full benefits of HS2 to the economy will only be realised if stations are well integrated into local transport networks. The Government has provided funding for HS2 places to develop growth strategies to maximise the benefit of HS2 in their local areas. Work between local authorities, LEPs and others local stakeholders, Network Rail and the Department of Communities and Local Government (DCLG) has been key to developing these plans. City leaders preparing growth strategies can be confident that HS2 is coming, taking the once-in-several-generations opportunity to plan for the future with a transformed transport network.

4.77 Local areas' estimates show that HS2 has the potential to support:

- Euston (London) – Up to 14,100 jobs and 3,800 homes in a new Central London District transformed by a world class interchange with access to great outside spaces, and a range of retail offers³⁶
- Old Oak Common (London) – Up to 65,000 new jobs and 25,500 new homes at one of the UK's largest regeneration projects backed by a new Mayoral Development Corporation (under the Greater London Authority)³⁷
- Greater Birmingham and Solihull – Up to 52,500 jobs across the Local Enterprise Partnership area plus over 5,900 homes³⁸. Birmingham Interchange station, near Solihull, is regarded as a key development opportunity - its untapped potential

³⁶ Growth Strategy for Euston - http://www.eustonareaplan.info/wp-content/uploads/2012/09/Euston-Growth-Strategy_Final.pdf

³⁷ https://www.london.gov.uk/sites/default/files/strategic_plan_2016-2019.pdf

³⁸ Curzon Investment Plan - https://www.birmingham.gov.uk/downloads/file/5174/curzon_investment_plan and the Midlands HS2 and Growth Strategy - <http://centreofenterprise.com/wp-content/uploads/2017/02/HS2-GS-FINAL.pdf>

and connectivity is generating significant interest among investors and developers.

- Constellation Partnership (including Crewe, Stoke-on-Trent and Stafford) – 360° connectivity through Crewe station could transform the housing and jobs markets across the partnership. The Partnership is aiming to publish its growth strategy by the end of 2017.
- East Midlands (hub serving Leicester, Derby, Nottingham) – Potentially 74,000 extra jobs created across the East Midlands area. There may be opportunities to develop land close to the station and there is interest in attracting technology companies to the East Midlands. Growth strategy plans also include a focus on redevelopment of Chesterfield, where HS2 trains will call, and Staveley.
- Leeds – Backed by local leaders, the ambition is to integrate the HS2 station and the national network station in a shared concourse that will bring growth, jobs, housing and regeneration into the heart of the city, and see benefits spread across the city region. The redevelopment of South Bank will be one of the largest regeneration projects in Europe, aiming to provide 4,000 new homes and 35,000 jobs³⁹. At Leeds station work is looking at developing local connectivity via the local public highway network, and potentially through more public space and new mass public transit.
- Manchester – The Growth Plan aims to maximise the economic potential of HS2 and NPR. The Greater Manchester Combined Authority (GCMA) estimates that reducing travel times and increased business productivity through improved connectivity will bring up to 180,000 new jobs to the region by 2040. The development of Manchester Piccadilly could also support around 4,500 new homes⁴⁰. Key issues to resolve include the requirements for integrating the NPR ambitions in the plans for HS2 at Manchester Piccadilly, development of the Metrolink system at the station, and the development and regeneration of the area surrounding the station. The roles played by Manchester City Council, Transport for Greater Manchester (TfGM) and GMCA have been key to shaping these plans.
- Liverpool will be served by two HS2 trains per hour from day one of HS2, when Phase One opens in 2026. Current journey times to London of 2 hours 14 minutes will fall to 1 hour 46 mins. These journey times will improve further, to 94 minutes, when Phase 2a opens between the West Midlands and Crewe. HS2 will also free up space on the existing network which could be used for more commuter, regional and freight services. GVA in the Liverpool City Region could increase by up to £517m per year and HS2 could support up to 13,300 additional jobs⁴¹. A range of options for Manchester to Liverpool, and the wider Northern Powerhouse Rail network are in development. The Government and Transport for the North continue to develop a single integrated strategy for NPR. Options outlined in the Crewe Hub consultation could also result in faster journey times for some Liverpool services.
- Sheffield – There is an opportunity to boost growth across Sheffield City Region by maximising key growth opportunities in sectors such as advanced manufacturing, logistics & distribution and creative & digital. Key issues in

³⁹ Leeds HS2 Growth Strategy - <https://www.westyorks-ca.gov.uk/uploadedFiles/Content/News/Articles/HS2%20Growth%20Strategy.pdf>

⁴⁰ https://www.greatermanchester-ca.gov.uk/news/article/104/hs2_stations_confirmed_for_greater_manchester

⁴¹ Independent Economics Study: HS2 and the Liverpool City Region, Steer Davies Gleave

Sheffield will include how best to integrate NPR services into Sheffield Midland station, Parkway station proposals, or for the extension of HS2 services north of Midland station. The government has confirmed that a second tranche of £625k will be made available to Sheffield City Region shortly, now that the station location in South Yorkshire has been confirmed.

5. Economic Appraisal

5.1 As part of the Phase 2a Outline Business Case (OBC) and Phase 2b Strategic Outline Business Case (SOBC), HS2 Ltd has carried out an economic appraisal of the expected costs, benefits and revenues for HS2. This assesses the Phase 2a scheme assuming that Phase One has already been built, and the Phase 2b scheme assuming that Phase 2a has already been built. This chapter summarises the main findings of this work. The more detailed explanation and modelling are 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 2a and Phase 2b are value for money

- 5.2 Viewed as a 'standalone' scheme (an incremental addition to Phase One assuming a purely hypothetical scenario where the rest of Phase Two is not built by 2033), Phase 2a has a central benefit-cost ratio (BCR) of 1.9 including wider economic impacts (WEIs). This is at the upper end of 'medium' value for money, near the threshold of 'high' value for money⁴². On its own, Phase 2a delivers nearly £4bn of benefits in present value terms over the 60 year appraisal period⁴³. Phase 2a is intended to be a stepping stone to completing the whole HS2 Y network, which is due for completion in 2033. By building this section of Phase Two earlier than planned, the preferred option delivers benefits to Northern cities sooner than previously envisaged for Phase Two. Viewed as an acceleration of infrastructure from 2033 to 2027, this represents very high value for money.
- 5.3 As a 'standalone' scheme, assuming that Phase 2a has already been built, Phase 2b has a central BCR of 2.6 including WEIs. This means that Phase 2b is 'high' value for money. Phase 2b generates a further £49bn benefits in present value terms over the 60 year appraisal period.
- 5.4 The total cost assumed for Phase 2a and 2b is an adjusted version of the indicative funding allocation to Phase 2a and 2b from the 2015 Spending Review, as shown in the Financial Case. There is no change in the overall cost to Phase Two.
- 5.5 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.
- 5.6 There are impacts of Phase 2a and 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. However, the extent to which

⁴² Initial value for money categories are 'medium' where BCRs are between 1.5 and 2 and 'high' where BCRs are between 2 and 4. Value for money assessments then also take account of any other relevant quantitative and qualitative information.

⁴³ The standard appraisal period is 60 years after scheme opening; for Phase 2a this is 2087, 60 years after opening in 2027.

we can incorporate this estimate accurately into our assessment is restricted by the limitations of the methodology.

- 5.7 The Economic Case also highlights ways in which we believe this could be considered a conservative estimate of the benefits of HS2. For example, the demand forecasts used in our economic appraisal are well below the historic growth rate in long distance rail demand observed over the last 20 years. Our modelling also doesn't capture the second-round effects on the economy, such as business and labour relocations, clustering of economic activity, or economic gains from regeneration along the HS2 route.
- 5.8 Our economic appraisal is based around the working assumption that Phase 2a will operate the same Train Service Specification (TSS) as Phase One, except that journey times are improved as a result of the extended high speed line to Crewe and all London-Manchester services are routed via Crewe rather than Stoke-on-Trent. The Phase 2b TSS increases service frequency and train length on the Western Leg due to the completion of the HS2 line into Manchester and to the connection with the West Coast Main Line (WCML) just south of Wigan. The Phase 2b TSS also introduces services on the Eastern Leg towards Leeds and Newcastle.
- 5.9 Economic analysis has been updated and the full Y network is expected to deliver £92bn of benefits in present value terms over the appraisal period. The central case BCR for the full Y network is estimated at 2.3 with WEIs, so is considered a high value for money scheme.
- 5.10 A number of updates have been made to improve our modelling and appraisal framework, ensuring we are using the most up-to-date information and are consistent with the latest guidance in rail scheme appraisal. HS2 Ltd have produced a full report⁴⁴ on the changes we have made to our analysis for this Economic Case. This has led to the full Y BCR reducing from 2.7 to 2.3 and the Phase 2b BCR reducing from 3.1 to 2.6. The graph below shows that the BCR has remained high value for money (including WEIs) at each stage of assessment.

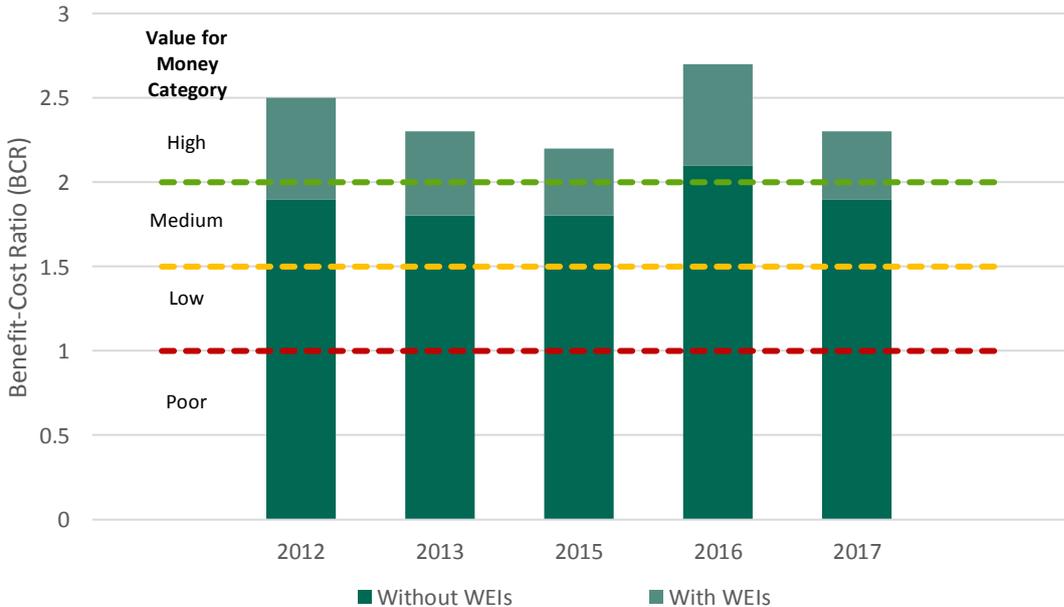


Figure 17 Full y network BCR at each stage of assessment

⁴⁴ Summary of Key Changes to the Economic Case Since 2016, HS2 Ltd, (month 2017)

5.11 The most significant changes have been to demand forecasts and appraisal assumptions which have had a negative impact on the full Y network BCRs since our 2016 analysis.

- The largest negative impact comes from changes in forecast demand, which have been updated in line with the latest Office of Budget Responsibility (OBR) forecast of annual growth in Gross Domestic Product (GDP)
- We have also updated many economic appraisal assumptions consistent with the current WebTAG Databook, including latest information on car costs, fuel efficiencies, population growth rates, etc.
- Following the publication of a change in the Department for Transport's (DfT) rail appraisal guidance, the appraisal replaces the previous 'demand cap' with the assumption that benefits and revenues increase in line with future population forecasts in the long-term. This has a positive impact on the BCR and is discussed further in Economic Case

5.12 Although BCRs (including the full Y network BCR) have declined since 2016 for the reasons given above, the incremental Phase 2a BCR was last assessed and published in 2015. The net change in the 2a BCR compared to the 2015 SOBC has been an increase from 1.3 to 1.9. Highlights of these changes from 2015 on the 2a BCR include:

- An update in the TSS, which now routes all three London to Manchester services via Crewe. Previously, one of these services was routed via Stoke-on-Trent
- Phase 2a is now presented in 2015 prices as opposed to 2011 prices
- In 2016 the demand model was updated leading to a significant increase in the demand for travel in the base year (2014/15)
- Updates to the Values of Time in 2016 across different passenger groups had a positive impact on the BCR
- The cost of Phase 2a has decreased compared with 2015

Phase 2a and Phase 2b: how we meet our strategic objectives

5.13 As outlined in this Strategic Case, the strategic objectives of HS2 are to improve capacity and connectivity, and therefore support economic growth. Phase 2a has the potential to contribute to unlocking growth and regeneration across the UK, and this increases when Phase 2b completes the full Y network.

5.14 We assess the economic benefits of connectivity in Phase 2a by looking at the value of improving journey times. Phase 2a meets the strategic objectives we set for the scheme. The preferred option improves journey times and connectivity north of Birmingham. Accelerating the delivery of the section of Phase Two between the West Midlands and Crewe delivers journey time savings of up to 13 minutes in addition to journey time savings already delivered by Phase One. A significant proportion of the benefits of Phase 2a are attributed to journey time savings.

5.15 Once Phase 2a opens, people will be able to travel to Crewe from London in 55 minutes. Liverpool, Preston and Warrington will all benefit from up to 13 minutes of journey time savings, while journeys from London to Manchester would also be faster than under Phase One.

- 5.16 We assess the economic benefits of Phase 2b by estimating the value of:
- further improving HS2 journey times on the Western Leg to locations including Manchester, Preston and Scotland
 - constructing a high speed station in Manchester, allowing HS2 trains to be extended from 200m in length to 400m, improving capacity
 - constructing the eastern leg, bringing journey time improvements and capacity to the East Midlands, Sheffield, Leeds and East Coast Main Line stations such as Newcastle and York
- 5.17 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.
- 5.18 HS2 Phase 2a and Phase 2b have the potential to generate significant benefits for the real economy through bringing firms and people closer together to:
- Share knowledge and best-practice ('agglomeration benefits')
 - Reduce transport and production costs ('business user benefits') and increase output (in markets with imperfect competition)
 - Improve access to jobs and encourage labour market participation
- 5.19 These potential benefits are estimated by looking at the transport user benefits and WEIs generated by Phase 2a, the latter using the DfT Wider Impacts in Transport Appraisal (WITA) tool. This estimates that Phase 2a will generate approximately £700m of wider economic impacts with some £10bn generated by Phase 2b. The whole programme is estimated to generate £17.6bn.
- 5.20 DfT has worked closely with leading transport economists to develop a standard approach to estimating how some of the welfare benefits of transport schemes assessed in the Economic Case can be translated into economic output as measured by GDP. Through adopting this approach we estimate that the full Y Network could generate £79bn of GDP over the appraisal period to 2093. In other words, over 80 per cent of the benefits assessed in the economic case are estimated to translate into the real economy. Phase 2a is estimated to generate £3.7bn in GDP impacts over the appraisal period while Phase 2b is estimated to generate £41bn. These estimates do not fully capture the impacts of HS2 on the UK economy.
- 5.21 Future governments and taxpayers could also expect to share in the proceeds of that GDP growth through tax revenue⁴⁵. This could offset the cost of HS2 or help fund public services and further investment. It should be noted that this would depend on future government decisions and the financial environment faced at the relevant time.
- 5.22 The Economic Case for Phase Two also considers 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 2a these benefits (as set out in HS2 Ltd's supporting analysis) broadly net out as a neutral impact. The Economic Case also contains an indicative estimate of the landscape impact of Phase 2a of around £240m (PV, 2015 prices, over 60 year appraisal period), equivalent to a reduction of around 0.1 in the BCR. Similarly for Phase 2b, the estimated landscape impact is around £880m, equivalent

⁴⁵ In 2015 around 33% of GDP was seen in tax receipts. The degree to which scheme benefits translate into tax revenue only affects the ultimate incidence of benefits, it does not yield additional benefits to those already included in the economic case.

to a reduction in the BCR by less than 0.1. There is also further consideration of non-monetised impacts on the natural and cultural landscape.

5.23 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.

6. Alternatives to Phase Two

Previous consideration of alternatives

- 6.1 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.
- 6.2 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, due to the following:
- 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

Alternatives to Phase 2a

- 6.3 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. Similarly, we do not consider that the scope of the scheme has changed to lead us to explore further rail alternatives to those considered in November 2015 as part of the Phase 2a Strategic Outline Business Case (SOBC).
- 6.4 We have however updated our assessment of the rail alternatives set out as part of the Strategic Outline Business Case, in light of the efficiencies created in the new design and the significant updates to the modelling and appraisal framework that have taken place since 2015.
- 6.5 The alternatives have been designed to replicate the improvements in train service frequencies and journey times of Phase 2a, as far as possible. In assessing the alternatives we have looked at how well the alternatives deliver HS2's strategic objectives compared to Phase 2a.

Options examined

- 6.6 As part of the 2015 SOBC, the DfT's consultants Atkins developed a number of potential alternatives to Phase 2a. These options were then sifted down to three options, which were taken forward for detailed analysis. Each option requires construction of some new high speed railway up to approximately 2/3 of the length of Phase 2a. Whilst they would remove the need for a new junction south of Crewe, each option would require constructing a new junction somewhere else on the route, with the associated significant local environmental impacts.
- 6.7 The criteria used for sifting options was that they needed to:
- enable delivery of the Phase 2a train service
 - deliver a similar level of capacity as Phase 2a
 - deliver an environmental impact that is no worse than Phase 2a
- 6.8 The options taken forward were then assessed against the Phase 2a objectives. Two of these options (the low and medium cost options) focus on enhancing the classic rail network to improve connectivity and capacity by bypassing some of the current capacity constraints on the WCML, and so delivering some improvements to journey time and performance. These two options are:
- Low cost option – Colwich cut-off and Stafford bypass: this involves 4.2 miles (6.8km) of new 140mph (225km/h) alignment, which joins onto the Stone line via a grade separated junction. This section of the Stone line would be upgraded to allow 140mph (225km/h) running. This would connect onto 6.7 miles (10.8km) of new 140mph (225km/h) alignment which would finally connect onto the WCML north of Norton Bridge. This option has three flat junctions and one grade separated junction with the WCML
 - Medium cost option: this involves using 9.5 miles (15.2km) of the Phase 2a alignment from Streethay Junction to Great Haywood, a 3 miles (4.8km) high speed spur to Stone Line, upgrade of 4 miles (6.5km) of Stone Line to 140mph (225km/h), and 6.7 miles (10.8km) of new 140mph (225km/h) alignment to WCML near Norton Bridge. It involves building one flat junction with the WCML and two flat junctions on to the Stoke-on-Trent branch.
- 6.9 The third option looked at a different way of delivering Phase 2a so that it connects with the WCML further south of Crewe at Baldwin's Gate:
- High cost option: this involves using 26.4 miles (42.5km) of the Phase 2a alignment from Streethay Junction joining the WCML 11.4 miles (18.3km) south of Crewe at a flat junction onto the WCML where high speed trains would run along these fast lines for 11.4 miles (18.3km) to Crewe.

Options assessment

- 6.10 Alternatives to Phase 2a need to meet the HS2 programme objectives, supporting the Government's aim of building a stronger, more balanced economy capable of delivering lasting growth and widely shared prosperity. In this context, alternatives need to:
- Enable the construction of the rest of Phase Two, delivering the long-term benefits of HS2

- Provide sufficient capacity to meet long term demand, and to improve resilience and reliability across the rail network
- Improve connectivity by delivering better journey times and making travel easier
- Minimise disruption to the existing network
- Use proven technology that we know can deliver the desired results
- Be affordable and represent good value to the taxpayer
- Minimise impacts on local communities and the environment
- Alternatives also need to meet the Phase 2a objectives of:
 - Improving connectivity and journey times for cities north of Birmingham
 - Delivering benefits to Northern cities sooner than previously envisaged for Phase Two
- Enable the efficient delivery of the rest of Phase Two

6.11 As part of the SOBC, Atkins provided an assessment of the alternatives against a number of strategic objectives around journey time, capacity, reliability and construction⁴⁶. For the purposes of the OBC, we summarise them as follows:

Journey Time Improvements

6.12 The journey time improvements the alternatives deliver are re-stated in the table below. These are based on the fastest journey times that can be delivered.

Option	Journey time reduction
Phase 2a	13 mins
High cost option	10.5 mins
Medium cost option	7.5 mins
Low cost option	5.5 mins

6.13 None of the options deliver the same journey time improvements as Phase 2a.

Capacity

6.14 The alternatives would result in sections of the classic network being used at relatively high intensity, and so are less future proof than Phase 2a.

6.15 As a result, the alternatives offer less flexibility than Phase 2a to run further additional services beyond those included in the TSS. This could constrain the ability to run a more ambitious train service in the future. There is also less scope for residual capacity to be used by freight (particularly at peak hours), which could constrain the ability of the WCML to cope with future demands from the rail industry relative to Phase 2a.

Reliability

6.16 The alternatives are all expected to offer lower reliability than Phase 2a, as a result of their requirement for the exclusive use of the WCML fast lines during normal operations. In reality, all four lines of the WCML are needed by classic services.

⁴⁶ Atkins 2015, Rail Alternatives to HS2 Phase 2a, <https://www.gov.uk/government/publications/hs2-rail-alternatives-to-phase-2a>

Planned maintenance or an incident could result in the closure of two of the four sets of lines.

Construction

6.17 The low cost option would be the most disruptive, as it would require a grade separated junction to be built at Rugeley, new flat junctions to be built along the WCML, and a lightly used section of the classic network to be upgraded. The medium cost option also requires a section of the classic network to be upgraded, and three new junctions to be built between Birmingham and Crewe. Atkins do not believe that these need to be grade separated, and as such, the options would probably be less disruptive than the low cost option. Atkins' assessment suggests that the high cost option would be expected to have a lower level of disruption to the WCML than Phase 2a, on the basis that a simpler junction is built as part of this option.

Connectivity

6.18 The alternatives trade off connectivity with costs for Phase 2a. But by building a shorter section of track, reductions in journey times are not as great. Set against this, HS2 Ltd has already found cost savings for the preferred route's connection with the WCML. As well as saving costs, the new design has a reduced impact on the environment. Both these benefits are delivered without compromising on journey times.

Value for money assessment

6.19 As with the Phase 2a case, we have assessed the value for money of the three alternatives in two ways, as an incremental case and as part of the full Y network. The incremental case examines the impact of the alternatives compared to a baseline where Phase One exists but the rest of Phase Two is not built.

6.20 Considered in isolation, the high cost option is the only option that provides higher value for money when compared with Phase 2a. This is because although the benefits, revenues and costs are all lower for the alternatives, the reduction in costs is proportionately smaller than the reduction in benefits. The BCRs have been calculated on the basis of the Reference Case in the Phase 2a Economic Case, which is consistent with the methodology used in the 2015 HS2 Economic Case.

£bn 2015, 2015 PV	<i>Incremental Phase 2a</i>	<i>Incremental High Cost Option</i>	<i>Incremental Medium Cost Option</i>	<i>Incremental Low Cost Option</i>
Net Transport User Benefits (PVB)	3.2	2.9	2.1	1.6
Wider Economic Impacts	0.7	0.6	0.4	0.3
Net Benefits including WEIs	3.9	3.5	2.6	2.0
Total Costs	4.2	3.6	3.4	2.9

Revenues	2.1	1.9	1.4	1.0
Net Costs to Government (PVC)	2.0	1.8	2.0	1.1
BCR with WEIs	1.9	2.0	1.3	1.1
BCR without WEIs	1.6	1.7	1.1	0.9

6.21 If our objective was to deliver benefits between Birmingham and Crewe, and never build the rest of Phase Two, then the high cost option could be considered as an alternative to Phase 2a. However, Phase 2a is an integrated part of Phase Two, which Government is committed to, so should be considered in that context.

6.22 When assessed as part of the full Y network (assumed completed by 2033), the analysis shows that Phase 2a and the alternatives deliver very similar BCRs.

£bn 2015, 2015 PV	Full Y incorporating Phase 2a	Full Y incorporating the High Cost Option	Full Y incorporating the Medium Cost Option	Full Y incorporating the Low Cost Option
Net Transport User Benefits (PVB)	74.6	73.9	72.6	71.8
Wider Economic Impacts	17.6	17.5	17.2	17.0
Net Benefits including WEIs	92.2	91.4	89.8	88.8
Total Costs	83.4	83.1	82.9	82.3
Revenues	43.6	43.1	42.3	41.7
Net Costs to Government (PVC)	39.8	39.9	40.6	40.5
BCR with WEIs	2.3	2.3	2.2	2.2
BCR without WEIs	1.9	1.9	1.8	1.8

6.23 The alternatives all show a reduction in the magnitude of benefits and revenue for the full Y network compared with Phase 2a (when the alternatives are viewed as a permanent substitution for Phase 2a). The reason for this is that in comparison with the preferred option, all passengers who travel on the Western Leg of Phase Two suffer from longer and less reliable journeys. This leads to reduction in benefits, as

well as a fall in revenues. The cost saving in the context of the full Y network is also relatively small, meaning that the BCRs are lower than full Y network for the low and medium cost options. The high cost option has a similar BCR in comparison to Phase 2a, because the reduction in benefits is matched by the reduction in costs.

Conclusion⁴⁷

6.24 In summary the alternatives have similar BCRs and lower costs to Phase 2a, but they do not all deliver as well in terms of value for money or in terms of the strategic objectives the Government has set for the HS2 programme, in particular:

- do not provide the same level of connectivity benefits for the major cities of the Midlands and the North due to lower journey time improvements
- do not provide as much additional capacity to meet the long term needs for the north-south railway as Phase 2a
- do not provide as much additional released capacity for commuters and freight on the WCML as Phase 2a, limiting the potential of the WCML to cope with increases in demand
- offer a less robust solution to the problem of resilience and performance, particularly on the WCML which suffers from relatively high levels of unreliability
- could have a greater impact on services on existing lines as construction work is carried out (the low and medium cost options only)
- might be worth considering if the objective was only to improve journey times to Crewe, but do not provide as good a step towards the full HS2 network

6.25 As a result we have concluded that proceeding with Phase 2a is the option which best meets our objectives.

Alternatives to Phase 2b

6.26 The Phase 2b SOBC Economic Case in November 2016 set out the most recent analysis on the alternatives to Phase 2b⁴⁸. This updated previous alternatives analysis published in 2013 to take into account recent developments in the rail industry. We have not re-evaluated the alternatives as we do not expect the relative value for money of the alternatives compared to the Phase 2b scheme to have changed significantly due to the change in appraisal assumptions.

6.27 The 2016 analysis 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.

6.28 Alternatives will be assessed again at Phase 2b's OBC stage.

⁴⁷ It is important to note the alternatives are developed to a much earlier stage of design than Phase 2a, so there is more uncertainty in their costs, which has also not been reflected in the assessment

⁴⁸The full report from Atkins on the rail alternatives to Phase 2b can be found at <https://www.gov.uk/government/publications/strategic-alternatives-to-hs2-phase-2b>