hs2 engine for growth

THE STRATEGIC CASE FOR HS2

October 2013

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Department for Transport

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Ministerial foreword

Good quality transport is at the heart of our economic success. The decisions we take today about transport investment will determine our economic future. And there is no bigger decision, or bigger investment, than High Speed Two (HS2) – a new north-south railway for Britain.

This document explains the case for the line, the way it will strengthen our transport network and our economy, and the way it will be built. It draws upon new research into the economic context, the costs and benefits, and the nature of alternative transport investments. Major infrastructure investments like this stand apart from many other decisions made by the public and private sector. They affect the lives of generations of citizens and last centuries, not decades. We still drive on roads originally built by the Romans. We travel on railways built by the Victorians. Inter-continental jets land at airports whose origins lie in the Second World War. And the main elements of our motorway network were approved by the wartime Cabinet.

Large scale investments therefore involve big choices with big impacts. We have to take the best advice and listen to what people say. We have to discuss and confront the consequences of action and inaction. And when as a nation we agree a plan, we need to make sure it is completed.

The new north-south railway is one of the most potentially beneficial, but also challenging infrastructure projects on the planet. In terms of ambition it stands alongside anything we have ever done as a nation; and is a step towards making Britain the best-connected island in the world. It is understandably controversial – but controversy is not a sign it is not needed. Many previous investments were also controversial at the time they were planned and built but have since become an essential part of national life.

The case for the new line rests on the capacity and connectivity it will provide. We need this capacity because in the future, as our economy and our population grows, we will travel more. We need the connectivity because bringing people together drives economic growth. Our current transport system is already under strain and a constraint on growth. Among the many alternatives that have been considered – including new motorways and upgrades to the current rail network – HS2 is the best way of getting ahead of current demand on our core transport network.

The new north-south railway is a long term solution to a long term problem. Without it the West Coast, East Coast and Midland Main Lines are likely to be overwhelmed. With it, we will transform intercity travel, radically improve commuter services into London and our other major cities and increase the amount of rail freight. These transport improvements will help support economic growth and make a major contribution towards rebalancing the economy.

The new railway will be built in two phases. It will be fully integrated with the rest of the railway network. It will bring benefits to places with stations on the new railway including Leeds, Manchester, Birmingham and London; to stations on the classic network like Liverpool, Darlington and Newcastle which will receive high speed services; and to other places on the existing mainlines like Milton Keynes, Rugby and Peterborough which will have better services from released capacity on the existing main lines.

The main benefits of Phase One (from London to Birmingham) will be to provide more intercity train services; additional capacity on the main lines for commuter services in to Birmingham and London and additional capacity for freight. In addition, from day one, Phase One will improve journey times and train services to the North West because these will use the new track from Birmingham to London.

Phase One of HS2 will bring substantial benefits in its own right. Phase Two (from Birmingham to Manchester and Leeds) will spread these benefits further north and improve links between the cities of the north – and in particular between Birmingham and the East Midlands, Sheffield, Leeds and Newcastle.

Now HS2 is about to move to a significant next phase – the introduction to Parliament of a hybrid Bill that will, if Parliament agrees, ultimately grant permission for the construction of the first phase of the new railway. The hybrid Bill will be the subject of intense scrutiny taking over a year. In parallel we will continue to work with the construction and supply industry and with local communities to ensure that this unprecedented investment will deliver the best possible return to the British economy and be built at the lowest possible cost and the lowest possible environmental impact.

Rt. Hon. Patrick McLoughlin MP,
Secretary of State for Transport

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Part 1 – Infrastructure supports economic growth

1. Britain's future prosperity depends on our ability to compete in the world, built on a balanced and strong economy.

2. Growth and prosperity are created by businesses and people – having ideas, taking risks, innovating, working hard and creating jobs. A balanced and successful economy requires modern and efficient infrastructure. To sustain our global competitiveness the debate should not be whether to invest but how best to do so.

3. Government's role is to help create the conditions for success, by providing the security, skills and infrastructure which support our economy.

4. Britain's record on infrastructure is mixed. We have many good roads and railways. Our airports are some of the busiest anywhere. Transport should be a national competitive advantage. But under many past Governments investment has been held back. It has often lagged behind demand and emerging technologies rather than pulled ahead. In 2010, the UK was ranked 33rd in the world for the quality of its overall infrastructure[1]. We are past masters of 'make do and mend'. We delay and patch up and meanwhile people are left standing on trains and stuck in traffic jams. This has a cost to the economy. By investing in transport infrastructure we can reduce costs to business and improve productivity[2].

5. Under this Government, we are now investing heavily. There are ambitious – and funded – programmes in hand for investment in housing, energy, communications, water, flood defences and transport. The Government has brought these together in the National Infrastructure Plan[3].

6. The evidence shows that economic growth and demand for transport go hand in hand. Since 1980 there has been a near doubling in rail demand, a 56% increase in road demand[4] and a 175% increase in domestic aviation[5]. Over this period, the economy has grown by 118%[6].

7. Economic growth will continue to drive transport demand. On current projections, real GDP is expected to increase by 56% over the next 20 years to 2032[7]. In addition, the UK population is projected to grow by 11 million people between 2010 and 2035[8]. The combination of these factors will add to demand on road and railways from passengers and from freight.

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1 Organisation for Economic Co-operation and Development, 2011, *Pension Funds in Infrastructure*, http://www.oecd.org/futures/infrastructureto2030/48634596.pdf

2 Department for Transport, 2011, *What is the Impact of Transport Schemes on Economic Geography? Summary of Position in DfT Guidance, and Supporting Evidence*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/193907/impact-transport-on-economic-geography.pdf

3 HM Treasury and Infrastructure UK, *The National Infrastructure Plan,* October 2010, updated December 2012 https://www.gov.uk/government/organisations/infrastructure-uk/series/national-infrastructure-plan

4 Department for Transport,2010, *Passenger Transport by Mode: Annual from 1952*, assets.dft.gov.uk/statistics/tables/tsgb0101.xls, accessed 15th October 2013

5 Department for Transport,2010, *Passenger Transport by Mode: Annual from 1952*, assets.dft.gov.uk/statistics/tables/tsgb0101.xls, accessed 15th October 2013

6 Office for National Statistics, 2013, *Long-term profile of Gross Domestic Product (GDP) in the UK*, http://www.ons.gov.uk/ons/rel/elmr/explaining-economic-statistics/long-term-profile-of-gdp-in-the-uk/sty-long-term-profile-of-gdp.html

7 Office of Budget Responsibility, 2012, *Fiscal Sustainability Report*, http://cdn.budgetresponsibility.independent.gov.uk/FSR2012WEB.pdf

8 Office for National Statistics, 2011, *National Population Projections, 2010-based Statistical Bulletin*, http://www.ons.gov.uk/ons/dcp171778_235886.pdf

8. Rapid growth in rail travel has continued alongside advances in mobile technology just as travel demand grew alongside previous communications technologies such as the telephone.

9. Lord Heseltine, in his Growth Review *No Stone Unturned* recognised the vital importance and capability of major infrastructure projects to improve competitiveness and drive growth:

"The Treasury's Infrastructure Plans identify many nationally significant projects that require central coordination. It backs these up with spending commitments and government support. These projects are vital. We have seen this in successes of the past – the Channel Tunnel and High Speed 1 (HS1), the Dartford crossings and the London Docklands Development Corporation – that have unlocked growth. Indeed, we need look no further than the extraordinary events in London 2012 just a few months ago for evidence of the power of large scale investments[9]."

10. This success should be reproduced nationwide. There is a disparity in economic output between north and south, particularly London, but there should not be a two-speed economy. All of Britain should deliver to its full potential.

11. Investment in infrastructure can help growth in the regional economies. Transport infrastructure can create opportunities for regeneration and by improving connectivity and in effect bringing cities closer together – opening up new markets, new job opportunities, and new opportunities for growth. It can help to re-balance the economy, rather than accentuate existing divisions. Figure 1[10] illustrates this point.

Figure 1: Why connectivity of a business location matters

[9] Lord Heseltine of Thenford CH, October 2012, *No Stone Unturned in pursuit of Growth*, http://www.bis.gov.uk/assets/biscore/corporate/docs/n/12-1213-no-stone-unturned-in-pursuit-of-growth.pdf

[10] Source: KPMG, *HS2 Regional Impacts*

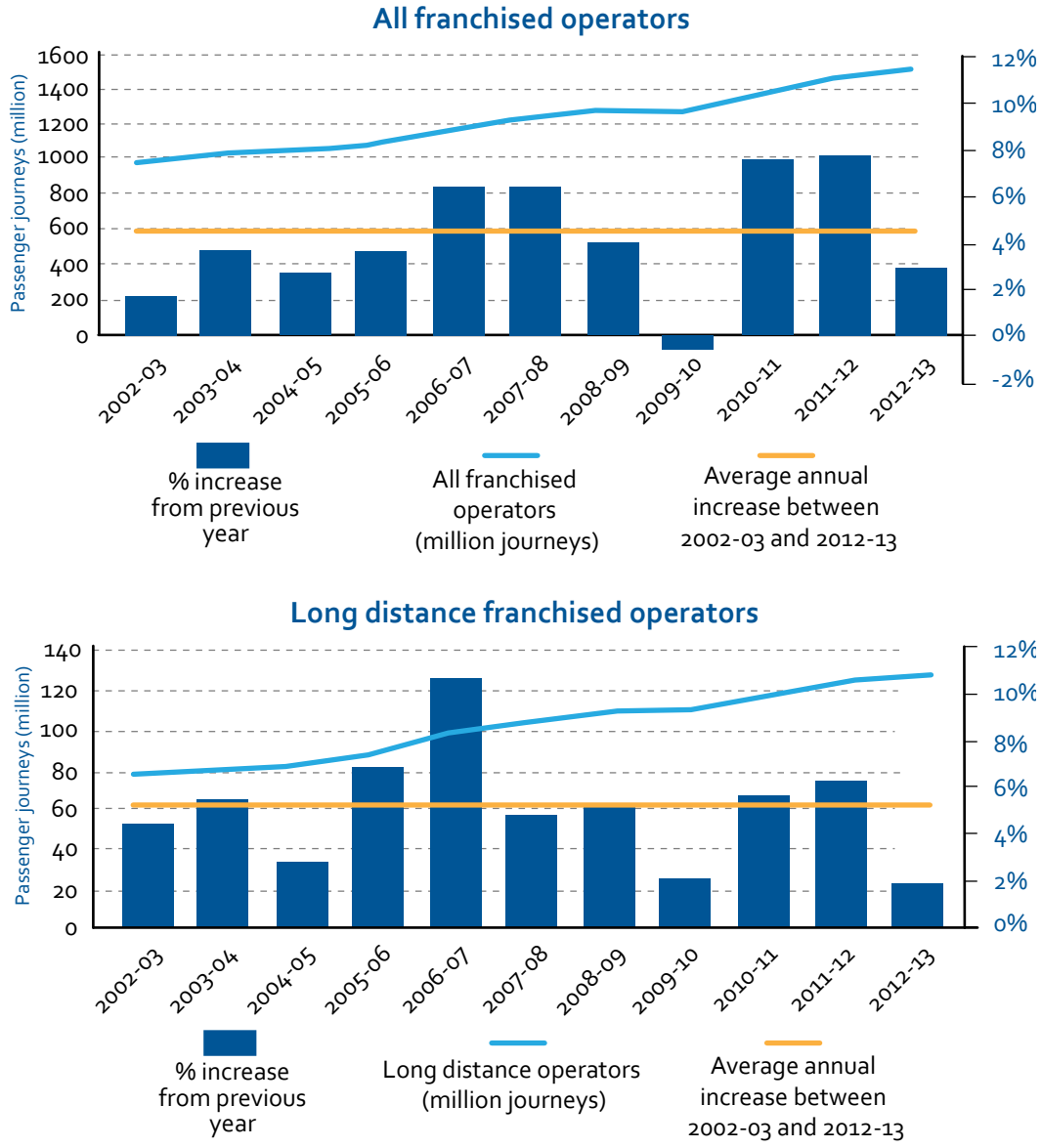
Part 2 – UK transport capacity is filling up fast

12. The existing capacity of our transport networks is a significant inhibitor of demand.

13. Our forecasts predict that by 2040 traffic on strategic roads will have grown by 46%. Under certain projected scenarios, where the economy grows faster than expected, costs of motoring fall and population grows more quickly, traffic could grow by as much as 72%[11].

14. Railways across the country are under pressure. See Figure 2[12]. Parts of the West Coast Main Line are full in terms of the number of trains, many of which are already full to overflowing at certain times of day. And although there is additional capacity in some parts of the north, there are huge potential benefits from improved journey times between our major towns and cities.

Figure 2: Passenger journey growth between 2002-03 and 2012-13



[11] Department for Transport, July 2013, *Action for Roads*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/212590/action-for-roads.pdf

[12] Source: Office of Rail Regulation data portal

15. Rail capacity is dependent on two things: how many people each train can carry, and how many trains there are. Additional seats are being provided by lengthening trains and for a while this will address the problem of growing demand. But this will not address the problem beyond the next 10-15 years. To meet rising demand, we will need to run more trains.

16. However, just as airports have a limited number of landing slots for aircraft, rail lines have limited number of train paths. The West Coast Main Line is under stress because there is more demand for train services than there are train paths available. This not only limits overall capacity, but means there are trade-offs about deciding which services can run. There are similar issues facing the two other north-south main lines – the East Coast and Midland Main Lines.

17. The Government recognises the importance of investment in all forms of transport and has provided for significant capital spending on our transport networks, with total funding of £73bn over the period from 2015 to 2021[13]. See Figure 3[14].

Figure 3: Investing in Britain's future

£m	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
Highways Agency	1497	1907	2316	2614	3047	3764	15145
National Rail	3548	3681	3770	3789	3824	3859	22471
High Speed Two	832	1729	1693	3300	4000	4498	16052
London Transport Investment	925	941	957	973	990	1007	5793
Local Authority Transport	2253	2253	2253	2253	2253	2253	13518
Total	9055	10511	10989	12929	14114	15381	72979

18. This capital programme represents a trebling of the budget for major road schemes between 2015 and 2021. The Highways Agency will add 20% more capacity to the strategic road network by 2040. The private sector is also making huge investments in our ports and airports. Our railways will see the biggest modernisation programme since the Victorian era, including a rolling five-year rail investment strategy. Between 2014 and 2019, Network Rail will spend over £35bn allowing it to continue a substantial programme of expansion and renewal.

19. We are completing Crossrail and Thameslink to transform connections into and across London and the South East. A widespread programme of electrification is under way, including: east-west links across the Pennines, between Oxford and Bedford and northwards along the Midland Main Line, and from London to Bristol, Cardiff and Swansea. The completion of the Northern Hub scheme will provide substantial additional capacity and much stronger rail links between the major cities of the North. And the £5.8bn investment in new Intercity Express Programme trains (IEP) will replace the ageing fleet on the Great Western and East Coast Main Lines[15].

[13] HM Treasury, 2013, *Investing in Britain's future*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209279/PU1524_IUK_new_template.pdf.
[14] Source: HM Treasury, *Investing in Britain's Future 2013*
[15] Rt. Hon. Patrick McLoughlin MP, Secretary of State for Transport, 2013, *Intercity Express Programme (Written Statement to Parliament)*, https://www.gov.uk/government/speeches/intercity-express-programme

20. Rail commuting is increasing, with over 100,000 passengers per day in 2012 standing on their arrival into London in the morning peak period[16], so we are targeting investment to boost commuter capacity around our major cities through platform lengthening and longer trains to provide better services at peak times[17]. And investment is committed to deliver a strategic freight network for rail, to support the growth of this sector[18].

21. But in spite of this investment, we expect our transport network to remain under significant pressure. This is particularly true of the critical north-south corridors which link our major cities. Extra capacity provided in recent years has filled up more quickly than expected. Since being upgraded, the West Coast Main Line has seen trip growth of 36% between 2006 and 2009[19].

22. The north-south main lines are a mixed-use network – with fast, time critical intercity journeys sharing the same infrastructure as slow freight, regional and commuter services. This mixed use reduces their efficiency. The British railway network is now in a similar situation to the road network when the decision was taken to build the motorways.

23. The West Coast Main Line is a good example of the compromises under which our major transport networks have to operate. Despite a major £9bn upgrade lasting 10 years, it has reached its planned capacity[20]. This line carries passenger services of every type, including long distance intercity, inter-regional and commuter passenger services and freight. In the meantime, with intensive use, target levels of service punctuality are being missed. Passenger Focus surveys show that train service punctuality is the most important issue for passengers. But train performance has levelled out at around 85% for the intercity operators of both the East and West Coast Main Lines[21].

24. Congestion on the West Coast Main Line has a noticeably detrimental effect on the reliability of intercity and commuter services that use it. The graphs show how commuter and intercity services on the West Coast Main Line regularly fail to meet their performance target and are below the national average. See Figure 4[22].

25. The West Coast Main Line also carries 43% of all freight on the national rail network including time-critical freight services carrying containers to and from our major ports[23].

26. Once trains (whether passenger or freight) are lengthened to the limits that the infrastructure will allow, further capacity can only be provided by running extra trains. This is why the question of train paths is crucial.

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16 Department for Transport, 2013, *Rail passenger numbers and crowding statistics: 2012*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/224941/rail-passengers-crowding-2012.pdf

17 Department for Transport, 2012, *High Level Output Specification (HLOS) 2012: Railways Act 2005 Statement*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3641/railways-act-2005.pdf

18 Department for Transport, 2012, *High Level Output Specification (HLOS) 2012: Railways Act 2005 Statement*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3641/railways-act-2005.pdf

19 Department for Transport and HS2 Ltd, February 2011, *Economic Case for HS2: The Y network and London – West Midlands*, http://assets.hs2.org.uk/sites/default/files/inserts/hs2-economic-case.pdf

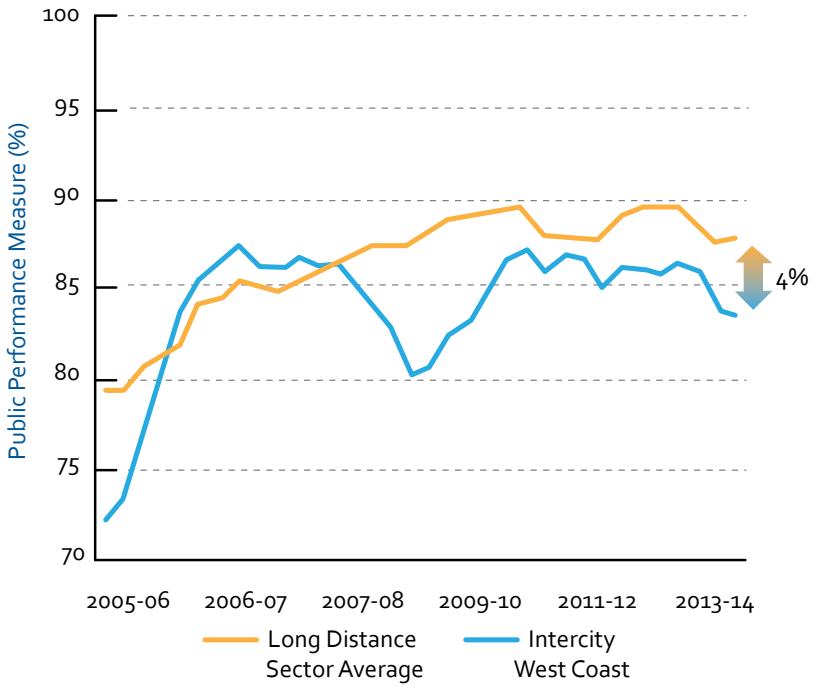
20 Strategic Rail Authority, 2003, *West Coast Main Line Strategy*, http://www.railwaysarchive.co.uk/documents/SRA_WCMLStrat2003.pdf; and Network Rail, 2013, *Current Timetables*, http://www.networkrail.co.uk/aspx/3828.aspx, Accessed 17 October 2013

21 Network Rail, 2013, *Public Performance Figures – 18 August- 14 September 2013,* http://www.networkrail.co.uk/about/performance/, Accessed 17 October 2013

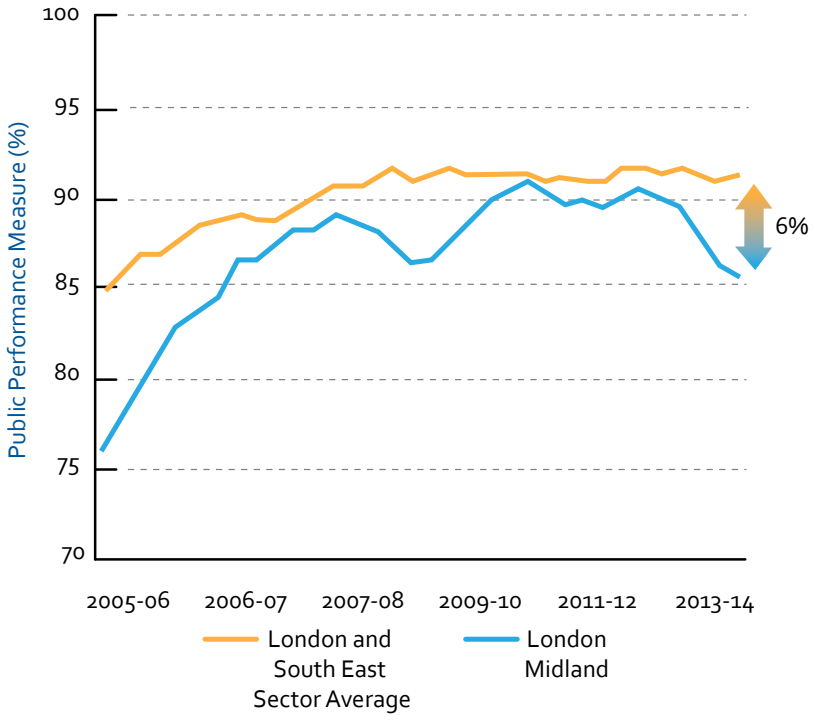
22 Source: Official industry performance data, Office of Rail Regulation National Statistics data portal

23 West Coast Project Briefing Note – Network Rail Media Centre, 2008

Figure 4: West Coast train operating companies' relative punctuality performance



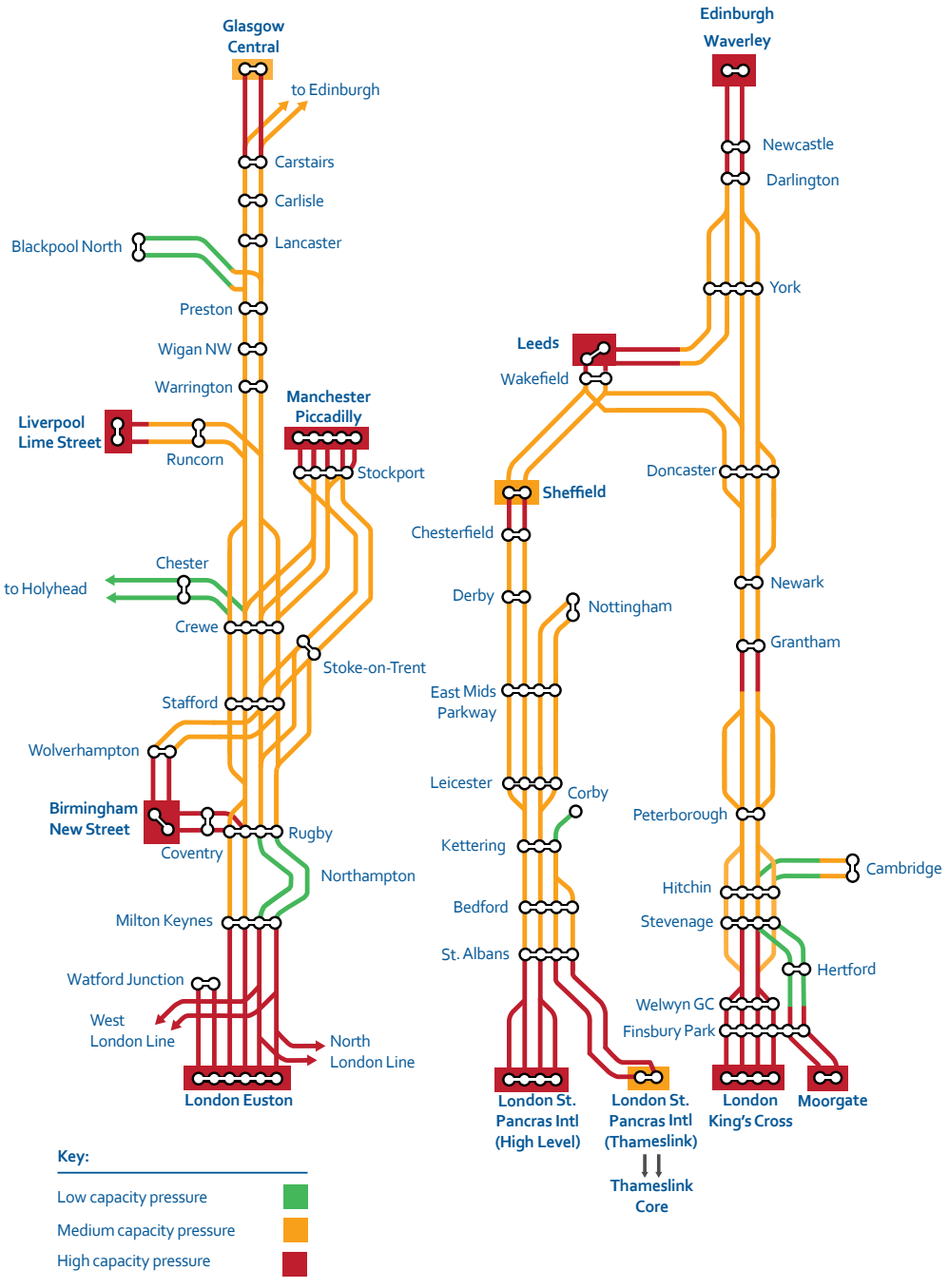
Long distance services on the West Coast Main Line achieve around 85% punctuality, around 4 percentage points worse than the average for other long distance services.



The relevant part of the London Midland franchise, which provides the regional and commuter service on the WCML, is also at around 85% punctuality, 6 percentage points lower than the average for equivalent services.

27. The pressure on the existing north-south rail corridors in terms of demand for train paths is illustrated in Figure 5[24]. The diagram, which represents an expert overview of the capacity pressures on the main north-south lines taking into account committed investments and service changes over the period to 2019, suggests that the network will be under severe pressure on the approaches to the main cities. On these corridors, independent analysts suggest that to accommodate new trains would either require measures such as removing calls at intermediate stations and extending journey times, or would result in compromises to service punctuality and reliability – unless significant infrastructure investment were made.

Figure 5: Expert judgement on post-2019 capacity pressures on north-south main lines

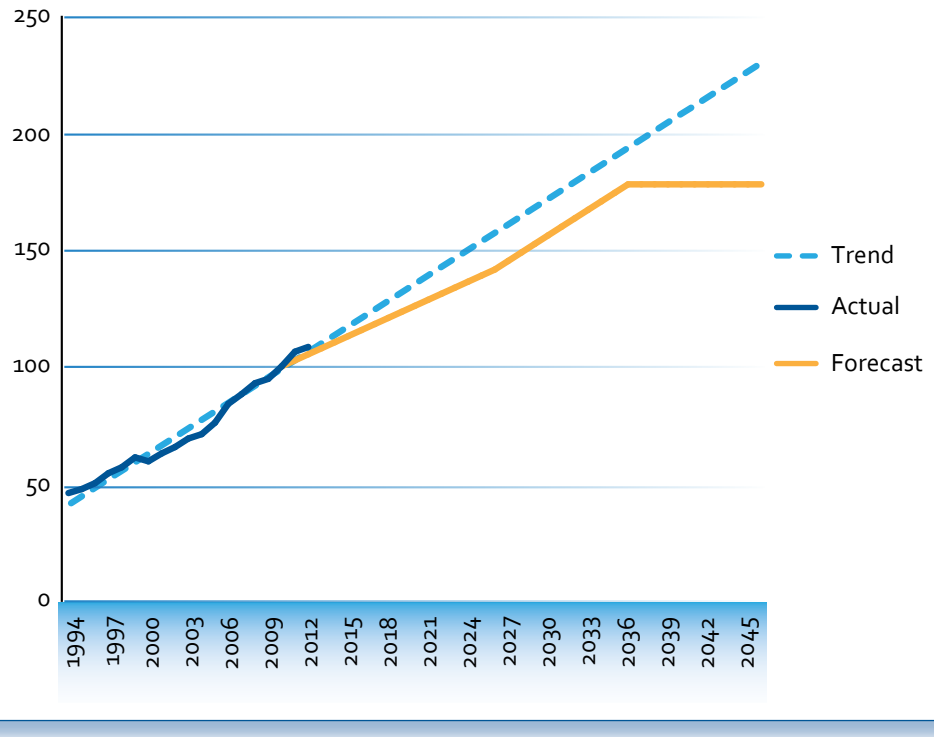


[24] Source: Steer Davies Gleave

28. In addition to rail capacity issues, there is increasingly severe crowding on individual trains and Euston station is forecast to get even busier[25]. Already the commuter service provider (London Midland) advises which services passengers should avoid in the peak hours because of the risk of having to stand for more than 20 minutes.

29. Looking forward, the increase in the number of standing passengers could be dramatic. The HS2 Economic Case models future long-distance passenger demand to increase at a rate equivalent to 2.2% per annum – and then to stop growing altogether in the mid-2030s. This is a conservative approach. The graph below shows the disparity between our forecast growth and the trend of the last 15 years. See Figure 6[26].

Figure 6: Forecasting long distance demand

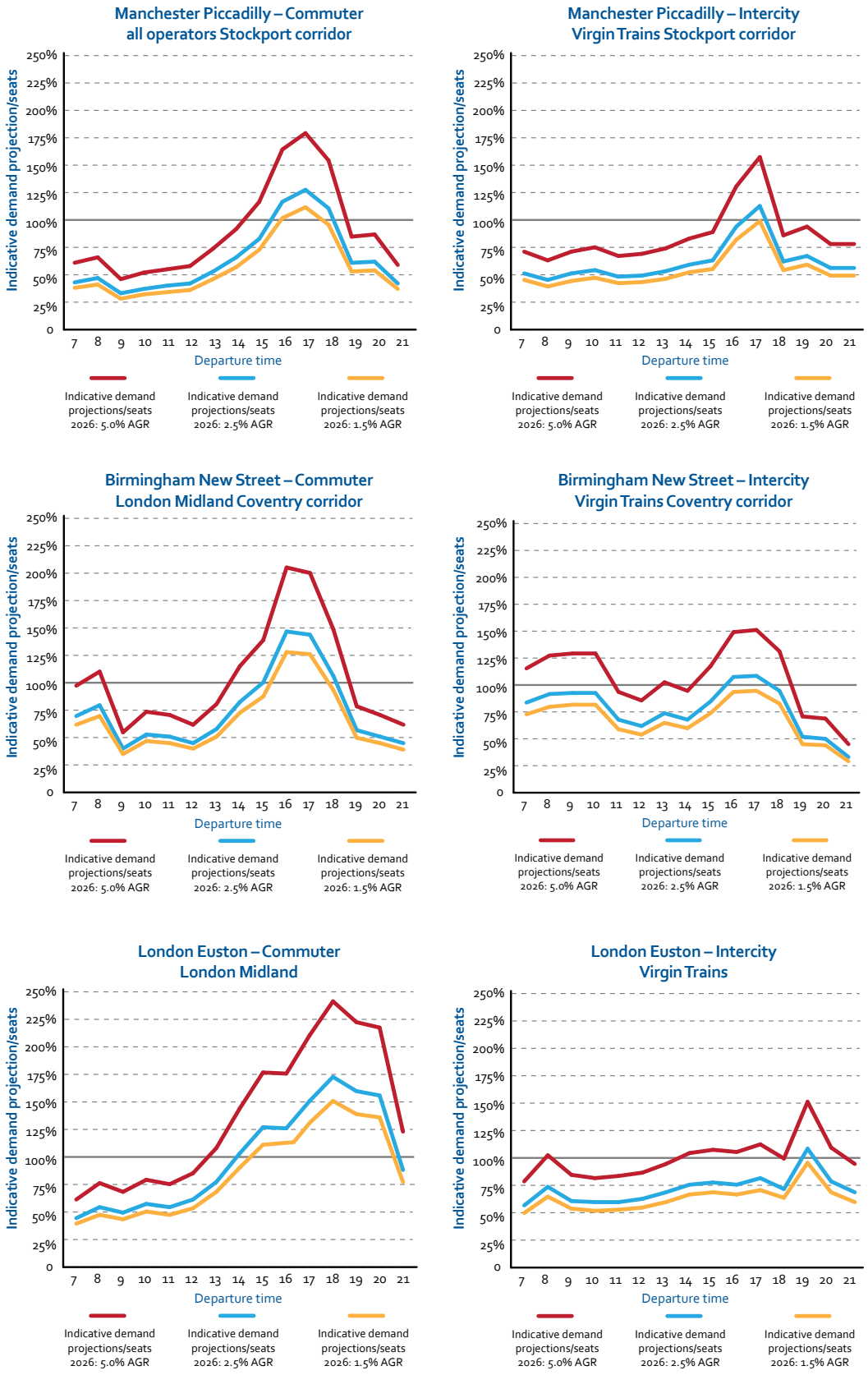


30. One of the criticisms we have faced in the past is that the model used for the economic case is based on all day demand and that we have not taken account of peaks and troughs. We have therefore looked at the existing pattern of rail use at our main stations and looked at the level of demand in relation to the number of seats on an hourly basis.

31. The possible pattern of overcrowding in future years is illustrated in Figure 7[27] where scenarios for demand growth rates of 1.5%, 2.5% and 5% are shown for commuting and intercity travel at London, Birmingham and Manchester. Committed and future investments will provide some additional capacity not represented on these graphs. The graphs are intended to illustrate what today's railway may look like with tomorrow's demand. They do not take account of behavioural changes in response to overcrowding, or the physical capacity of the train, so some of the very high levels of crowding may not occur.

[25] Department for Transport, July 2012, *High Level Output Specification*, https://www.gov.uk/government/publications/high-level-output-specification-2012
[26] Source: HS2 Ltd
[27] Source: Steer Davies Gleave

Figure 7: Indicative passenger demand to seat ratios



32. The graphs illustrate a risk of serious overcrowding on routes serving London, Birmingham and Manchester.

33. Capacity constraints are being felt now and the pressure is set to grow over time. We need to take action and major rail schemes have long lead times. Developing a solution to this challenge presents an opportunity not only to create better travel conditions, but also to improve connectivity – with shorter more reliable journey times – particularly between our major cities.

34. Improved connectivity, through reduced journey times, can help deliver additional benefits and more economic growth than comes from extra capacity alone. It can help re-balance the economy by stimulating and strengthening regional economies and help to make Britain more attractive in the global marketplace.

Part 3 – Our objectives and options for action

35. Government's role is to build a stronger, more balanced economy capable of delivering lasting growth and widely shared prosperity[28]. Transport plays a key part in this.

36. In that context, our objectives are:

- to provide sufficient capacity to meet long term demand, and to improve resilience and reliability across the network; and
- to improve connectivity by delivering better journey times and making travel easier.

37. Any solution must:

- 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; and
- minimise impacts on local communities and the environment.

38. These are the objectives that have been used when assessing the options for action. Public debate around HS2 in recent years has brought forward suggestions for different ways to achieve these objectives. However, although some alternatives achieve some of the objectives, the evidence points to building a new north-south railway as the only way to meet them all. It is also the only option that allows us to leap ahead of demand and reshape the economic geography of the country.

[28] HM Government, 2013, *The Coalition: together in the national interest: Mid-Term Review*, http://assets.cabinetoffice.gov.uk.s3-external-3.amazonaws.com/midtermreview/HMG_MidTermReview.pdf

Possible alternatives to HS2

39. As part of the HS2 programme we have considered a full range of alternatives to a new north-south railway. We have considered:

- **Fares:** to use higher prices to reduce demand for rail travel would involve very significant and highly undesirable price rises and fail to deliver increases in capacity. It would not improve connectivity, one of our key objectives, and have serious consequences for economic productivity and growth;
- **Communications technology:** better communications technology is an essential part of economic growth, but over the last decade growth in the economy and in demand for travel have gone hand in hand with advances in technology;
- **Domestic aviation:** there is a consensus that a major expansion of domestic aviation would not be a sustainable way to address the challenges that we face. It is not a realistic option for increasing domestic intercity capacity – check-in times mean that for most domestic journeys aviation is unlikely to be the best option; and
- **Roads:** we have already planned a major investment in our national and local roads. However, our roads are also under pressure and we do not believe that increasing road capacity alone is the solution. Motorways cannot match the speed of high speed rail, and it is difficult to increase the capacity of urban roads as cities are already highly developed and congested.

40. Analysis of the alternatives therefore shows that rail investment is the best way to meet the rail capacity challenges we face. With rail investment there are two choices. In the past we have carried out incremental improvements to the existing network. The decision to be made now is whether to build a new north-south railway as well.

41. In order to make this decision, we have carried out extensive work to understand the possible benefits from incremental improvements to the existing network. Building on our work over the last four years, we have looked at the possibility of changing the timetables so that additional services can be introduced. We have also looked at proposals for train and platform lengthening and the introduction of new signalling.

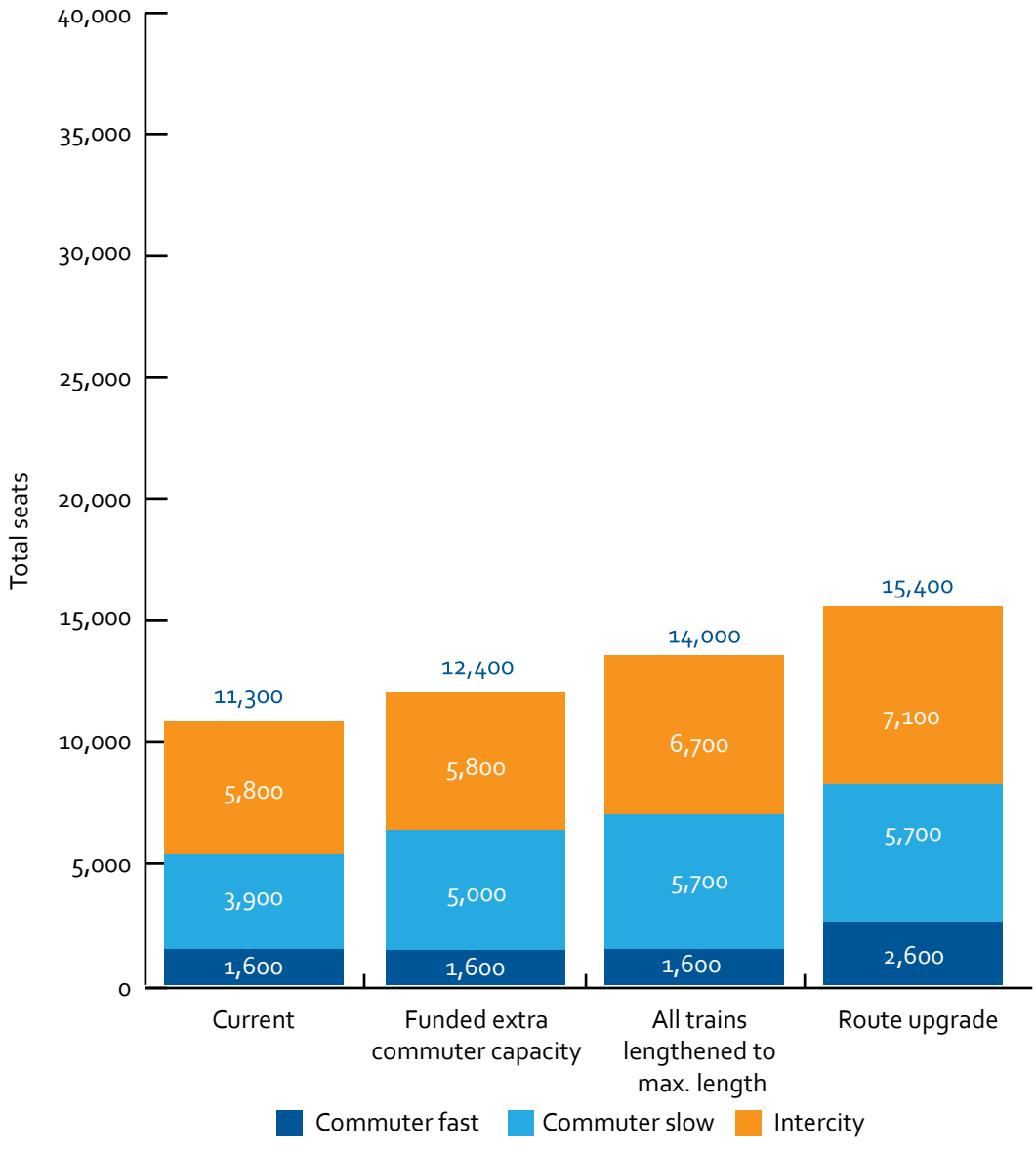
42. However, while this type of approach offers a short term way to tackle some of the worst capacity constraints, it will not help train service punctuality and does not address the long-term capacity challenge, nor does it provide a step change in north-south connectivity.

43. Delivering still more capacity by carrying out infrastructure works to the existing railway would require the laying of new tracks alongside existing railways and the introduction of major junction improvements. However we know from previous experience that the scale of work needed, largely alongside existing 'live' railways, would bring huge disruption to services over many years. The most extensive alternative of this kind that we have examined might take as long as HS2 to build, would cost at least £20bn and would require closures for more than 2,500 weekends to allow construction works to be carried out. This alternative would effectively be untenable because of the scale of disruption.

44. Our economic modelling for HS2 is based principally on all-day demand, but when looking at capacity it is also relevant to look at the periods in the day when demand is highest.

45. Figures 8 and 9[29,30] show the peak hour capacity of the alternatives we have considered at Euston. In the first, we compare the current situation with three alternative scenarios: first the situation where already committed and funded capacity improvements are made; second an assumption that all current trains are extended to their maximum lengths; and third against a combination maximum train lengths and various route works on the West Coast Main Line, which would allow three extra peak hour trains to be fitted in (and with all trains running at maximum length). The total capacity gain achievable in the third scenario is 36%.

Figure 8: London Euston peak hour departure capacity



These options provide a limited capacity

[29] Source: Department for Transport and Steer Davies Gleave

[30] Source: Department for Transport, HS2 Ltd and Steer Davies Gleave. The HS2 Phase One and Phase Two Full Capability scenarios assume that longer 400m trains operate on the existing network, which would require additional investment

46. Figure 9 shows the capacity at Euston with HS2. Compared with today's capacity, HS2 will ultimately triple the seats available. The initial Phase One service plan for HS2 in 2026 doubles seating capacity and more than doubles commuter and regional service seating capacity, where the crowding pressure is greatest.

47. There is a substantial programme of works planned for Phase One of HS2 to achieve this growth in passenger throughput at Euston – including improving connections with London Underground. While there will be disruption to passenger services during construction, a staging plan has been devised to minimise any adverse effects.

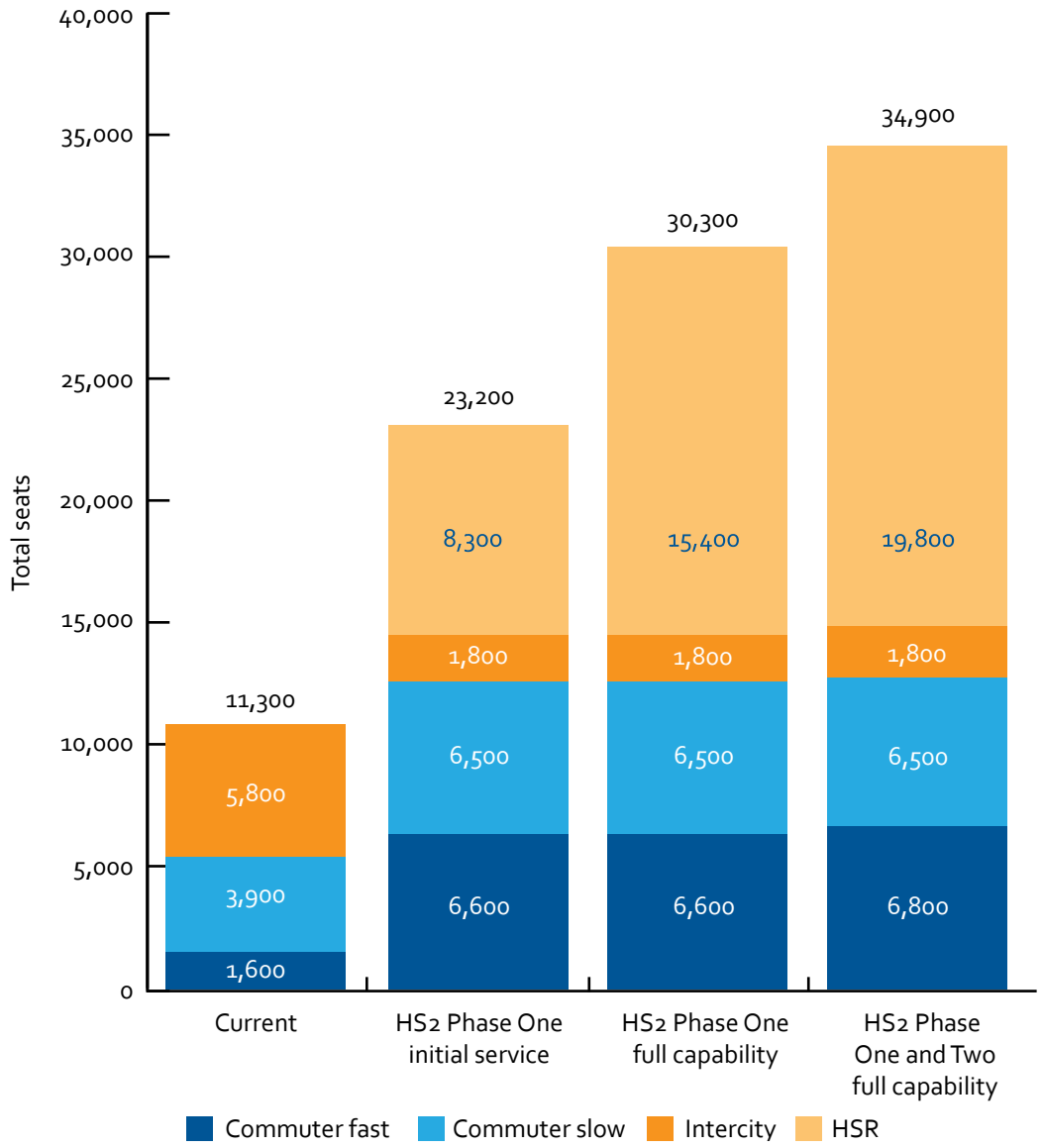
48. The evidence shows that incremental improvements will not achieve our objectives. In particular, they:

- do not provide sufficient additional capacity to meet the long term demand on the north-south railways, with insufficient capacity for intercity travel, commuters and freight;
- fail to offer a robust solution to the problem of poor service performance, particularly on the West Coast Main Line which suffers from unacceptably high levels of unreliability; and
- would significantly disrupt services on existing lines as construction work is carried out, and over a period of many years if a substantial multi-route programme is contemplated.

49. That leaves the option – despite the challenges and expense – of building a new railway. A new railway would carry intercity traffic and allow us to get better mixed use out of the existing railway. If we are to build a new railway, there is a choice between a conventional railway and a new high speed line. A new high speed line would cost 9% more than a conventional railway and, in certain respects, would have higher environmental costs, but the difference in price and the relatively higher environmental impact is more than outweighed by the economic benefits to be gained from radically reducing journey times and improving connectivity between our main cities. Given the scale of the investment, therefore, and in terms of the future wellbeing of the country as a whole, a high speed line would be preferable to a conventional one.

50. A new railway line – and specifically a new high speed line – therefore presents the best solution and Parts 4 and 5 in the following pages of this document set out the benefits it would provide.

Figure 9: London Euston peak hour departure capacity



Part 4 – HS2, the preferred option

51. HS2 will be a new railway promoted and built in two phases. It will be fully integrated with the existing railway and through services will flow onto the existing network from the day Phase One opens.

52. 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 allowing fast services direct to destinations on the existing line including Manchester, Liverpool, Crewe, Preston and Glasgow. New high speed trains will serve Birmingham city centre and an interchange designed to serve the wider West Midlands. At Old Oak Common in west London, a new interchange will be built connecting HS2 with Crossrail, the Great Western Main Line and the Heathrow Express. As a project in its own right, Phase One would provide a hugely valuable addition to national rail infrastructure.

53. The proposals for Phase Two will see the line extended north and east, to join the West Coast Main Line south of Wigan and the East Coast Main Line approaching York. There will be new stations in the city centres of Manchester and Leeds, with intermediate stations in the East Midlands at Toton and near Sheffield at Meadowhall.

54. HS2 is designed for a top speed of 250mph. Plans envisage services running at up to 225mph, which is becoming the standard capability for new high speed trains. Operation at 250mph will be possible, but the noise impacts (for example) will have to be considered first. New stations on the line would be built to accommodate 400m long trains, each capable of carrying up to 1,100 passengers as is typical for high speed rolling stock.

55. The choices made in the design of HS2 are detailed at length in the consultation documents for Phase One and Phase Two[31]. This strategic case sets out how both phases of HS2 can deliver our objectives (as set out in Part 3). The objectives are relevant to HS2 as whole, though for Phase One the emphasis is towards additional capacity and Phase Two emphasises better connectivity.

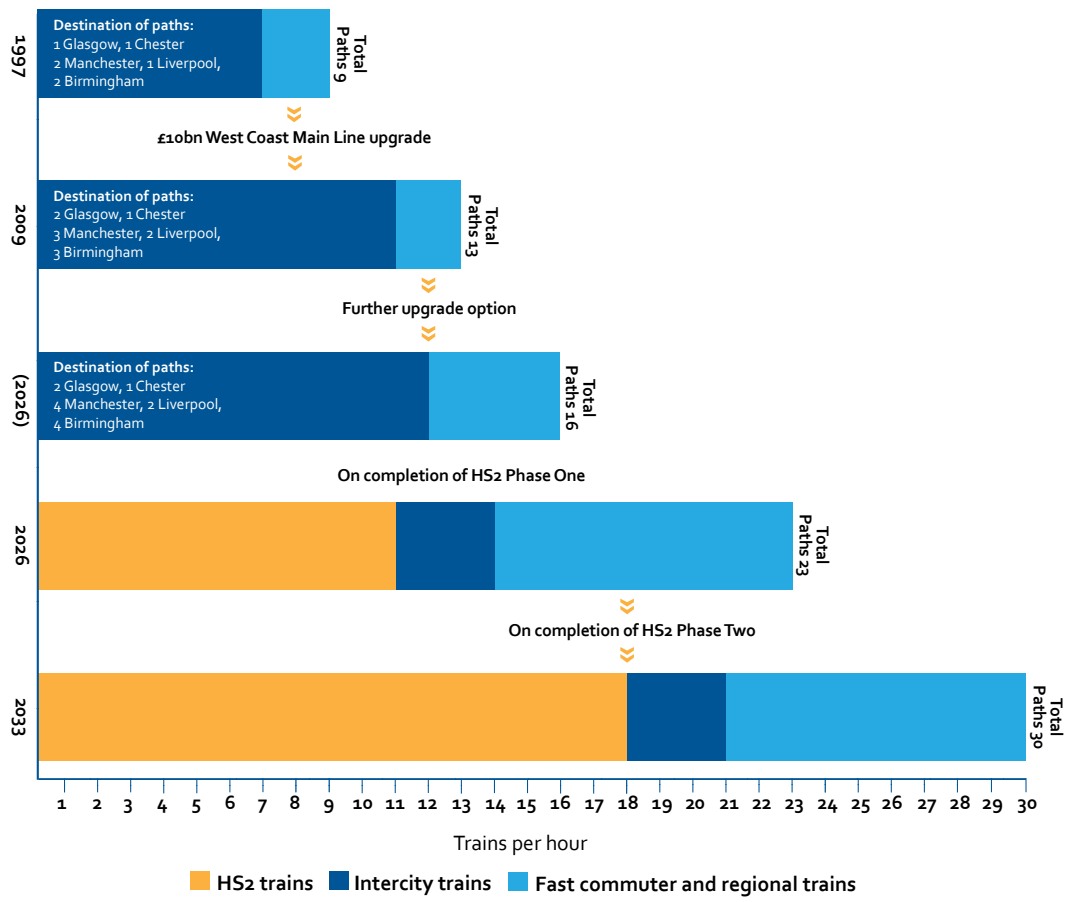
[31] Department for Transport, 2013, *Phase One Consultations*, http://www.hs2.org.uk/developing-hs2/consultations/phase-one; and Department for Transport, 2013, *High Speed Rail: Investing in Britain's Future – Consultation on the route from the West Midlands to Manchester, Leeds and beyond,* http://assets.hs2.org.uk/sites/default/files/consultation_library/pdf/P2C01_Phase%20Two%20Consultation%20Document.pdf

Increasing capacity

56. HS2 provides a very significant increase in intercity and commuting capacity on the rail network. It will deliver a 14 trains per hour capability in Phase One (with 11 used in the initial specification), rising to 18 trains per hour in Phase Two. This will transform intercity rail services.

57. As long distance services transfer onto HS2, capacity will be released on the existing network to introduce new services. Phase One of HS2 will relieve the West Coast Main Line, which currently carries commuter, regional and freight services as well as intercity traffic – as shown in Figure 10[32]. In Phase Two it will relieve the Midland Main Line and the East Coast Main Line, as traffic transfers from these lines onto HS2. This released capacity will also improve commuter and regional services, reliability and resilience.

Figure 10: Peak period fast lines departing Euston



[32] Note: destinations may not number the same as the total train paths because some services split during the journey.
Source: Steer Davies Gleave, Atkins and HS2 Ltd

58. Network Rail estimates that over 100 cities and towns could benefit from new or improved services as a result of capacity released on the existing rail network[33]. Opportunities include:

- additional commuter services into London from places such as Watford, Milton Keynes, Rugby and Northampton;
- new commuter services into Birmingham, Leeds and Manchester;
- new longer distance services, for example providing new and better links between Bradford and London; Lincoln and London; Shrewsbury and London; and Leeds and Cambridge; and
- more paths for rail freight[34], with every extra train taking 40 HGVs off the roads[35].

59. We intend to make the most of this additional capacity in order to maximise the benefits from the new railway whilst ensuring value for money for tax-payers. Railway timetables are always evolving to meet demands for services, and at this stage in the project it is too early to make detailed commitments about how the rail network will operate after HS2 Phase One opens in 2026, or after Phase Two opens in 2033. However, scenarios have already been prepared by HS2 Ltd and Network Rail to illustrate how it will improve commuter and regional services[36].

60. One of the key aims for future service patterns is that all towns or cities which currently have a direct service to London will retain broadly comparable or better services once HS2 is completed.

61. Railway timetables for the 2020s and 2030s will not be written until nearer the time, but it is important to deepen our understanding of how rail services might be reshaped by HS2. In partnership with the railway industry, we intend to announce, shortly, a transparent and participatory process to consider long-term issues, opportunities and options for rail services on HS2 corridors. This will consider how these services can support the delivery of economic growth on a sustainable basis.

33 Network Rail 2013, HS2 benefits to extend across rail network – Network Rail study, http://www.networkrailmediacentre.co.uk/News-Releases/HS2-benefits-to-extend-across-rail-network-Network-Rail-study-1dfe.aspx

34 Network Rail, 2013, *Better Connections: Options for the integration of High Speed 2*, http://www.networkrailmediacentre.co.uk/imagelibrary/downloadmedia.ashx?MediaDetailsID=7162&SizeId=-1

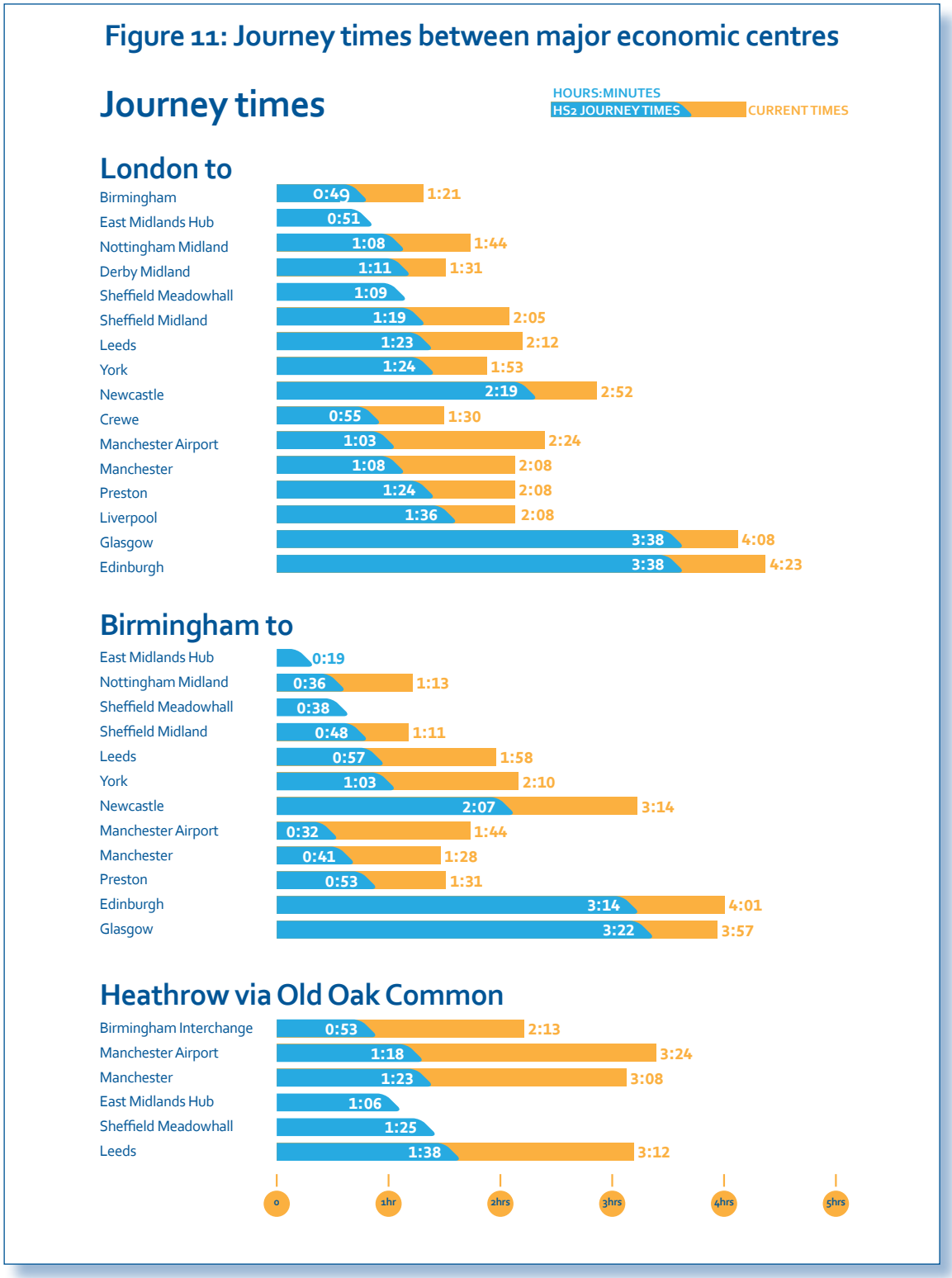
35 Freight Transport Association, 2008, *The Importance of Rail Freight*

36 Network Rail, 2013, *Better Connections: Options for the integration of High Speed 2*, http://www.networkrailmediacentre.co.uk/imagelibrary/downloadmedia.ashx?MediaDetailsID=7162&SizeId=-1

Improving connectivity

62. HS2 will deliver significant journey time reductions (see Figure 11)[37]:

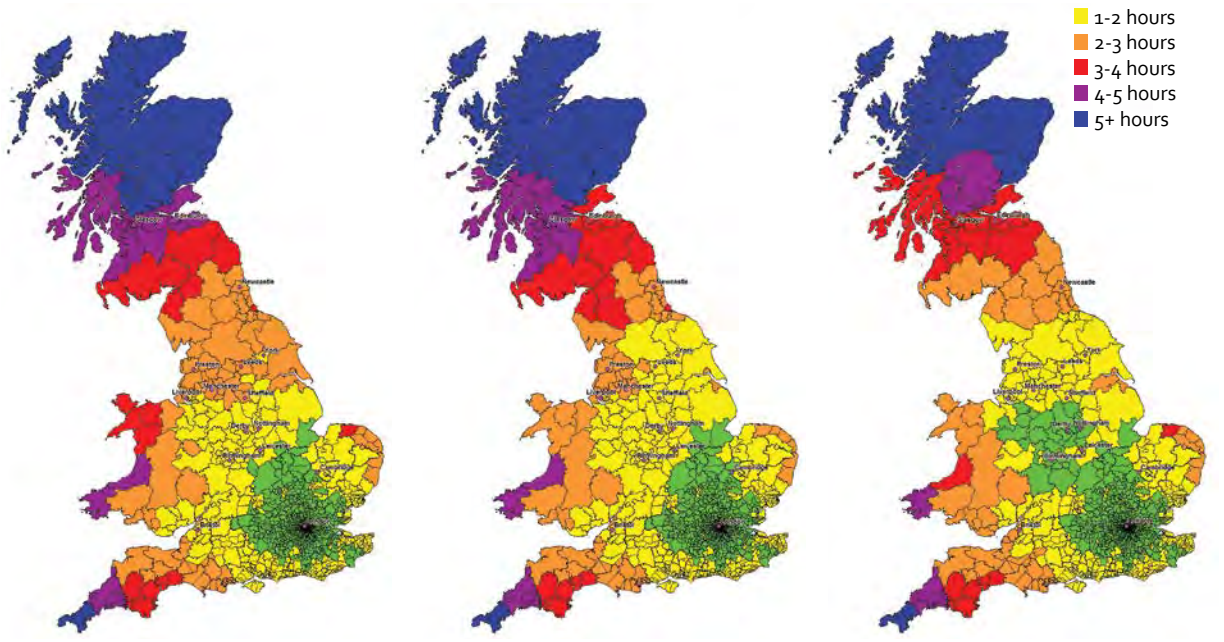
Figure 11: Journey times between major economic centres



[37] Source: HS2 Ltd

63. Passengers will be able to travel from central London to Birmingham in 49 minutes rather than 1 hour 24 minutes today and from London to Manchester in 1 hour 8 minutes rather than the 2 hours 8 minutes it takes today. Figure 12 shows how the economic geography of the country will be transformed with many more people being brought to within one hour of London (areas shaded green) and two thirds of the population brought to within two hours (areas shaded yellow). It also shows how HS2 delivers significantly better connectivity than the best alternative.
See Figure 12[38].

Figure 12: Illustrative journey time comparisons for HS2 Phase One and Two and rail alternative



64. HS2 will provide new links between regional cities, and will directly connect eight out of our 10 largest cities: London, Birmingham, Manchester, Liverpool, Glasgow, Edinburgh, Sheffield and Leeds. At the heart of the rail network north of London, Birmingham will also have the potential to connect Bristol, Wales and the South West to the other Core Cities.

65. People will be able to meet their work commitments, make new contacts, find new jobs, and spend their time productively when travelling. The evidence shows that people place a premium on being able to get to places quickly[39]. HS2 will broaden the options available to people in terms of where to live, where to locate their business and how to travel.

[38] Source: Atkins
[39] Wardman M, Batley R et al (2013), *'Valuation of Travel Time Savings for Business Passengers'*.

66. Scotland will benefit from high speed services from Edinburgh and Glasgow as soon as Phase One of HS2 opens. Phase Two is expected to reduce journey times by up to an hour without the need to change trains, benefiting the Scottish economy. The Government's goal is a national network that brings the country closer together, so we are taking forward a study with the Scottish Government to consider how these benefits could be extended further. This is looking at how best to boost capacity and cut journey times between Glasgow/Edinburgh and London to less than three hours, and options will be developed on the basis of this work.

67. HS2 will also improve international connectivity. It will directly serve Manchester and Birmingham airports. The planned interchange at Old Oak Common will offer a connection on to services direct to Heathrow airport. The potential also remains, pending decisions after the Airports Commission's report and the strength of the supporting evidence, to provide a direct link in Phase Two from the Midlands and the North to Heathrow Airport. The HS1/ HS2 link will provide for direct train services from the HS2 network to mainland Europe.

Environmental impacts

68. The choice of route for HS2 and its detailed design have been informed by numerous consultations with local communities and by a very detailed and ongoing assessment of its environmental effects. For Phase One of the route, an Environmental Statement (ES) almost 50,000 pages long will be published alongside the hybrid Bill later this year[40]. In designing the route and in mitigating the impacts of constructing and operating the railway, we have done as much as reasonably possible to avoid or reduce environmental impacts, particularly those that might affect residential areas, historic buildings, conservation areas, sensitive habitats and areas of natural beauty. For example, we will provide more than 150 miles of tunnels and cuttings, make extensive use of sound barriers and plant a total 4 million trees along the line of the route.

[40] Following publication, the Environmental Statement will be subject to public participation and consideration by Parliament

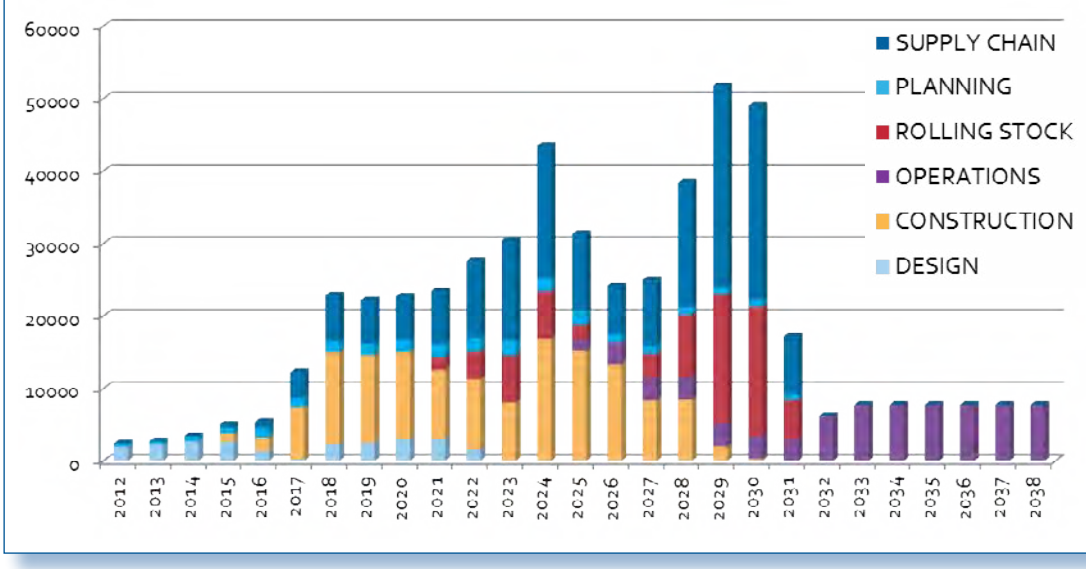
Part 5 – The economic benefits of HS2

69. The transport benefits of HS2 are set out previously, but transport is not an end in itself. It is an enabler which can unlock potential and help the economy to grow. A strong, balanced economy is vitally important to our future prosperity as a nation. As such, it is also important to make an assessment of how the new railway will contribute to the economy at local, regional and national level.

Jobs and regeneration

70. HS2 will be the biggest infrastructure project in Europe and will have a significant direct impact on local jobs, particularly in engineering and construction. Our most up to date estimates indicate that while HS2 is being built it will create 24,600 full-time equivalent (FTE) construction jobs, excluding jobs in the supply chain[41]. Other published analysis, using alternative methodologies, has estimated that, at its peak, HS2 will create 50,000 jobs, as illustrated in Figure 13[42].

Figure 13: Full Y network jobs profile



71. Subject to legislation, construction is due to start in 2017. It will be essential to ensure that British industry and workers benefit as much as possible from the unprecedented scale of this project. We will therefore be working with the different supply chains over the coming months and years to ensure that they are ready and prepared to compete successfully for the contracts that will be awarded. We have great foundations to build on after the construction of HS1 (the Channel Tunnel Rail Link) on time and on budget, the success of the Olympics and the impact on skills and jobs brought about by Crossrail. But HS2 is bigger than all of these projects and will require an unprecedented effort by industry and government to ensure that the skills and potential are in place to make the most of it.

[41] Temple ERM for HS2 Ltd, 2013, *High Speed Rail: Consultation on the Route from the West Midlands to Manchester, Leeds and Beyond – Sustainability Report, Volume 1*, http://assets.hs2.org.uk/sites/default/files/consultation_library/pdf/PC205 Vol 1 Sustainability Statement 180713.pdf

[42] Albion Economics (for Greengauge 21), 2013 , HS2 Jobs Analysis, http://www.greengauge21.net/wp-content/uploads/HS2Jobs_Report_Final_photo-refs.pdf

72. Beyond the construction of the railway and stations themselves, associated development and regeneration triggered by HS2 can have important local impacts, just as HS1 did. Already HS1 has attracted over £10bn private sector investment around the new station sites. Google, the Crick Institute and other major international firms are moving in to the area around King's Cross and St. Pancras. Regeneration is underway at Ebbsfleet, with plans for new communities and facilities, and East Kent has experienced accelerated growth as a result of high speed services on both HS1 and the classic lines.

73. The key to success is to start planning now. Local authorities along the HS2 route have already begun to consider how they can maximise the economic opportunities from the investment. For example, Birmingham and Solihull intend to use the proposed development of the Washwood Heath Depot to maximise employment[43], including the jobs and training opportunities created during the construction period and at the depot itself once operational, in a part of the city which suffers from high levels of unemployment[44]. In Manchester, the Council has similar plans to link the disadvantaged communities of Wythenshawe with the opportunity provided by the Manchester airport station[45].

74. Investment has already begun around the airport with the £800m Airport City business park, to be constructed on land between Manchester Airport and Wythenshawe. A Chinese construction company – Beijing Construction Engineering Group – was recently confirmed as a partner in the joint venture that will develop the Airport City scheme over the next 12 years. Airport City sits at the heart of Greater Manchester's Enterprise Zone, which means companies choosing to locate there will be able to benefit from advantageous business rates.

75. HS2 will also provide the scope for a boost to the rolling stock industry in the UK[46], and railway supply industries. HS2 Ltd expects there to be 3,100 permanent job opportunities running and maintaining the railway[47].

76. In order to maximise these benefits, the HS2 Growth Task Force has been established to ensure that no stone is left unturned in pursuit of growth on the back of HS2. The task force is led by Lord Deighton and contains members from business, local government and academia. In their initial report[48], the task force highlighted the areas that they intend to explore in their recommendations to the Government early in 2014. The task force is looking at development opportunities around stations, wider regeneration in station places, working with the supply chain and increasing skills and apprenticeships to meet the demands of HS2.

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43 Birmingham City Council, 2013, *HS2 Consultations*, http://www.birmingham.gov.uk/cs/Satellite?c=Page&childpagename=Transport-Planning-and-Consultation%2FPageLayout&cid=1223412184288&pagename=BCC%2FCommon%2FWrapper%2FInlineWrapper, Accessed 15th October, 2013

44 Birmingham City Council, 2013, *Unemployment Briefing*, http://ebriefing.bgfl.org/bcc_ebrief/content/resources/resource.cfm?id=10150&key=&zz=20130912110344494&zs=n

45 Manchester City Council Executive, 2013, *Manchester City Council, Report for Resolution, Manchester Airport City Enterprise Zone: Update*

46 Department for Transport, 2012, *High Speed Rail: Investing in Britain's Future – Decisions and Next Steps*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3648/hs2-decisions-and-next-steps.pdf

47 Based on estimates in the HS2 Ltd, July 2013, *Sustainability Statement* (Phase Two) and the forthcoming *Environmental Statement* (Phase One)

48 HS2 Growth Task Force, 23 October 2013, *HS2 Growth Taskforce: The Challenge* https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/252219/hs2-growth-taskforce-the-challenge.pdf

77. In addition to the potential benefits for jobs and local regeneration, we have also considered the economic impacts of HS2 at a national level. Using the Government's standard approach to appraisal, we estimate that the overall benefits to the economy could be over £53bn (present value (PV) 2011 prices). This recognises the productivity benefits to business from faster journeys and reduced crowding as well as the value of increased production and benefits to company efficiency from being closer together.

78. There has been much debate about the scale of the potential economic benefits of HS2 and their distribution between north and south. With advice from an independent panel of experts, HS2 Ltd commissioned KPMG to consider the potential impacts of HS2 on the economy at a city and city region level. The results of the analysis suggest that HS2 could increase economic output by £15bn per year. Even with more cautious assumptions the annual benefit could be £8bn. In addition the analysis shows that, while all regions benefit, the city regions in the Midlands and the North do particularly well. Given differences in approach it is not directly comparable to the standard appraisal described above but it does suggest that there may be benefits not captured in the transport appraisal and the analysis is a step forward in improving the evidence in this area. The benefits calculated by this new method are not simply additional to the benefits measured in a conventional appraisal, which we describe next. In the meantime, we will continue to develop this work to understand the regional benefits brought by HS2.

Benefit-cost ratio appraisal and the benefit-cost ratio

79. In addition to considering the economic growth generated by HS2, it is a requirement to carry out a benefit-cost assessment. This forms an important part of the evidence that supports the case for HS2, but it cannot tell the whole story. The method for calculating benefit-cost ratios has been developed over a number of years with particular reference to road, rail and other transport schemes of all sizes. The benefit-cost ratio methodology was not developed with a scheme in mind on the scale of HS2. But even with these limitations the benefit-cost ratio for Phase One alone shows medium value for money and the benefit-cost ratio for the full Y network shows that the scheme will deliver high value for money.

80. The benefit-cost ratio is calculated by comparing the transport user benefits and 'wider economic impacts' to the capital costs, operating costs and revenues over a 60 year period. The capital and operating costs include all the costs of building the scheme and running and maintaining HS2 over 60 years. These costs include, for example, the cost of periodically replacing the railway track, replacing the rolling stock after 30 years and employing train drivers.

81. Our 'standard assessment' of the scheme – as with other transport investments from road junction improvements to major rail upgrades – assumes that demand will stop growing at a pre-determined level in the future. In the case of HS2 this level would be reached in 2036 – just three years after Phase Two opens. We have therefore also examined the 'long term' benefits for HS2 which allows for some growth in demand past the 2036 cut-off year.

82. A full economic case for HS2, prepared by HS2 Ltd, is being published in parallel with this strategic case and is summarised in Chapter 5 of this document.

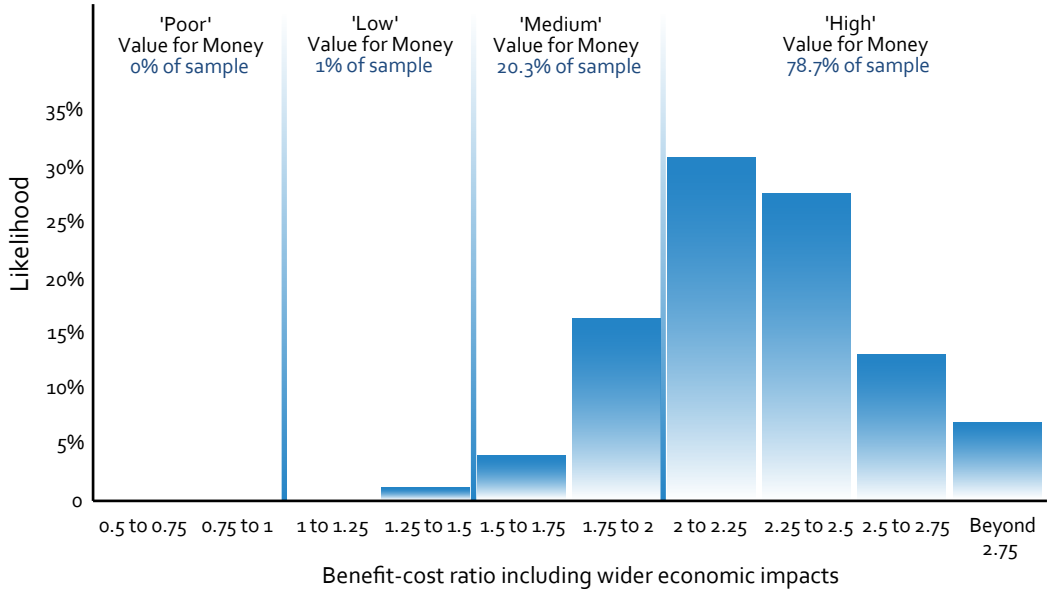
Headlines from the standard appraisal

83. HS2 Ltd has reviewed all the key elements of the economic case for HS2 since the last appraisal was published in August 2012[49]. This includes using updated demand figures and values of time, as well as incorporating the latest assessment of the costs of HS2, as set out in the Government's Spending Round announcement in June 2013[50].

84. All of the work has been subject to extensive quality assurance, audit and peer review. The main conclusion is that, using standard assumptions, HS2 shows a good return on investment with a benefit-cost ratio of 2.3 for the full Y network (Phase One and Two combined) and 1.7 for Phase One on its own. Under the government's assessment system the full Y network will therefore deliver 'high' value for money and Phase One on its own will deliver 'medium' value for money. This is similar to Crossrail and higher than the benefit-cost ratio for some other major projects when approved, such as Thameslink and the Jubilee Line extension.

85. HS2 Ltd has undertaken extensive analysis to understand the robustness of the benefit-cost ratio to changes in the assumptions made, including on economic growth, demand growth and costs. These demonstrate that our benefit-cost ratio is extremely robust and that even if a raft of downside risks materialised, the full Y network will still deliver 'medium' value for money. We will continue to keep our assessment under review as the scheme progresses to take account of new information to ensure it continues to reflect both upside and downside risks. See Figure 14[51].

Figure 14: Standard appraisal: distribution of benefit cost ratios for the full network



[49] Department for Transport, 2012, *Economic Case for HS2: Updated appraisal of transport user benefits and wider economic benefits*, https://www.gov.uk/government/publications/economic-case-for-hs2-updated-appraisal-of-transport-user-benefits-and-wider-economic-benefits

[50] HM Treasury, 2013, *Spending Round 2013*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209036/Notepending-round-2013-complete.pdf

[51] Note: Impact on benefit-cost ratio of uncertainty around long-term economic growth, construction costs, demand forecasting and values of time
Source: HS2 Ltd

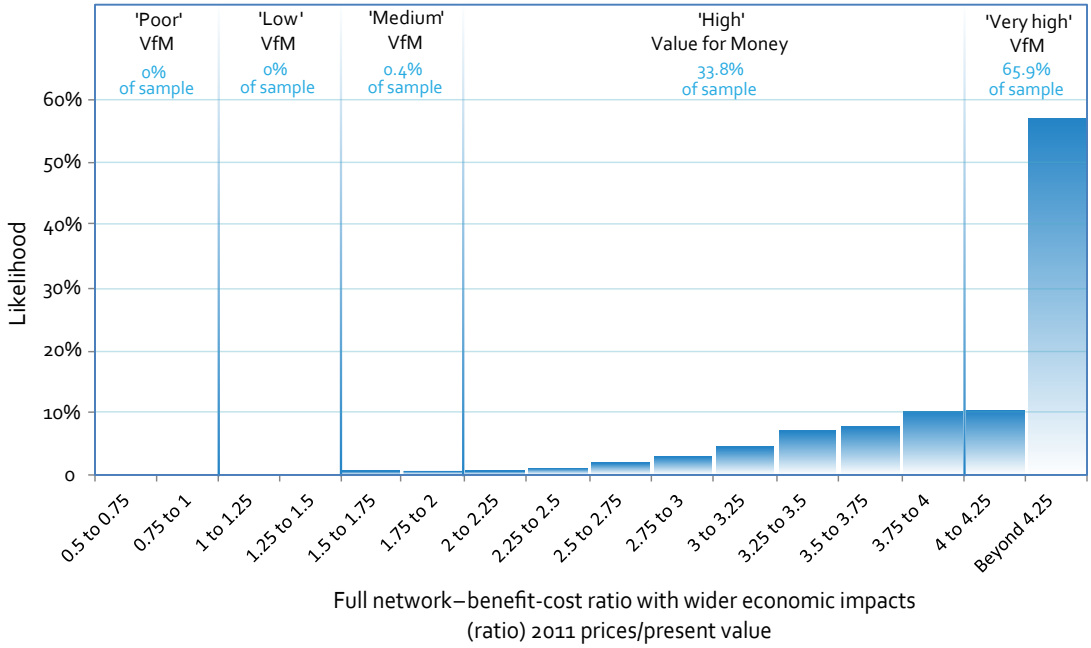
Headlines from the long-term appraisal

86. We have tested the limit that is placed on future demand in the standard appraisal. It is conventional to assume that growth in rail demand driven by a new investment will stop at a pre-determined level or year in the future. This is a standard modelling approach, to allow projects to be directly compared to one another and also to account for modelling uncertainty.

87. When following this standard approach, demand for HS2 would be projected to freeze in 2036, which is only three years after Phase Two will open. This assumption will effectively mean that after 2036 there was absolutely no increase in the number of passengers using HS2 at any point in the future. This is a conservative assumption – and is unlikely to be true in practice.

88. We have therefore examined what would happen to the benefit-cost ratio if demand continued to rise to 2040 or 2049. This has a very significant positive impact on the benefit-cost ratio showing that the benefit-cost ratio would rise to between 2.8 and 4.5. The upper end of this range, which would still have British people travelling considerably less by rail than people in Spain or Italy do now, would deliver 'very high' value for money. Even on the most pessimistic scenarios, the full Y network with a demand 'cut-off' year in 2049 (just 16 years after the completion of the railway) would be 'high' value for money. See Figure 15[52].

Figure 15: Demand growth stops at 2049



[52] Note: Impact on benefit-cost ratio of uncertainty around long-term economic growth, construction costs, demand forecasting and values of time
Source: HS2 Ltd

New evidence

89. There has been much public debate about how our benefit-cost ratio takes into account the fact that some people work while travelling by train and how we value travel time savings. We have looked at this issue again. First, the values we attach to all travel time savings (business, commuter and leisure) have been reviewed for use in all transport assessments, including HS2, to take account of new data. The values we now use for business travel time savings in the HS2 appraisal are almost one third lower than previous appraisals. Second, we have undertaken a comprehensive review of the evidence on values which have been estimated using different academic approaches[53]. This shows that the values we use for business travel time savings lie very comfortably in the middle of the range suggested by other research evidence. The Department has therefore concluded that these values are a suitable representation of businesses' willingness-to-pay for quicker journeys and take appropriate account of the extent to which people work on trains.

[53] See Department for Transport position statement October 2013 and research review by ITS Leeds, M Wardman, P Mackie et al

Part 6 – Building HS2

The legal framework

91. The legal framework starts in Parliament. Given the scale of HS2, it is right that Parliament should itself provide the necessary permission for the scheme to go ahead. This will be done through a 'hybrid' Bill process, which will enable significant and detailed scrutiny of the case for the scheme by both Houses of Parliament.

92. In preparation for the hybrid Bill the Government has introduced the High Speed Rail (Preparation) Bill which will provide advanced approval for the Government to spend money on detailed design, land acquisition, compensation, and preparatory works for the new railway. The Bill was voted through at Second Reading in June 2013 by 333 votes to 27. We hope to achieve Royal Assent by the end of the year.

93. In order to introduce the hybrid Bill in to the House a huge amount of work has been done. We have developed numerous options for the railway, undertaken detailed analysis of the railway and alternatives, planned the route in detail, consulted at local and national level, carried out a hugely detailed environmental impact assessment, issued safeguarding orders to protect the proposed route and consulted on associated issues like property compensation. We have listened carefully to what people have said and have changed our plans in response to consultation, but we have nonetheless been challenged in the Courts. Of the 10 points on which we have been challenged, the Courts have upheld an appeal on one regarding our consultation on property compensation[54]. The deficiencies identified by the Courts in this regard are now being put right.

94. The detailed powers for the new railway (including development consent) will be sought from Parliament through two hybrid Bills, first for Phase One and then Phase Two. Having completed the work set out above, we expect to lay the first hybrid Bill before the end of 2013 and the second in the next Parliament.

Managing costs

95. The project has been allocated a budget in the 2013 Spending Round and will not exceed that allocation.

96. Managing costs is at the heart of everything we do. The funding envelope has been allocated on the basis of very detailed planning and meticulous cost estimates carried out by project planners with Olympic and global experience.

97. Having established the budget we are now putting in place rigorous cost controls and have a detailed efficiency plan that is looking at ways to achieve savings in all parts of the project.

98. The Phase One cost estimates have been developed over the four years since work began on HS2. They have been subject to assurance and cross-checks, and independent review to establish that the assumptions are reasonable in comparison with other experience and comparative projects. The result is that we have a high degree of confidence that the project can be delivered on budget and on time.

[54] The judgement of the Supreme Court on the outstanding appeals is expected shortly

99. The Phase Two cost estimates and the associated design are at an earlier stage. They are based on more preliminary survey work and engineering designs and the use of applicable unit rates. The route is still subject to public consultation and so is not finalised. We have therefore allocated a higher level of contingency to Phase Two than to Phase One.

100. The Government announced at the time of the Spending Round in June 2013 that it recognised a potential funding requirement for HS2 of £42.6bn, at 2011 prices. This breaks down to £21.4bn for Phase One and £21.2bn for Phase Two – figures which include a total contingency for both phases of £14.4bn. This will ensure that the project can be delivered on budget and on time.

101. However, managing costs is essential and so the Government has agreed with HS2 Ltd that the target price for the construction of Phase One is not the £21.4bn funding allocation but £17.16bn. Figure 16[55] summarises the cost estimates and contingency allowances.

Figure 16: HS2 total funding envelope (£bn, 2011 price, excludes VAT)

	Phase One	Phase Two
Target price	17.16	n/a
Point estimate	15.65	12.5
Contingency at P95	5.75	8.7
Total at P95	**21.4**	**21.2**

P95 is the level at which there is a 95% degree of confidence that the project can delivered with its current scope at that cost. The more usual figure to use is P50, a 50% chance of delivering on budget would be £19.4bn for Phase One and £19bn for Phase Two.

102. In line with Olympic practice, there will be additional financial controls placed on the delivery of HS2 to ensure that no spending above £17.16bn for Phase One can take place without the explicit agreement of the Department for Transport, working with HM Treasury.

103. As the project develops and confidence in delivery increases, we will also work with the private sector to ensure that there is a full private sector contribution to the scheme. HS2 will deliver significant increases in land value and excellent development and regeneration opportunities. We expect to work with the private sector to take advantage of this and reduce the overall cost to the public purse.

104. We are also carefully considering the future operating model for the railway and the potential to realise revenue benefits from it as a valuable part of national infrastructure.

[55] Source: Department for Transport

105. In addition there are a number of options available to realise the value of HS2 once it is completed. The completion of HS1 (the Channel Tunnel Rail Link) in 2008 was followed three years later by letting a 30 year infrastructure concession. While the Government has not decided at this stage whether to pursue a similar model for HS2, the new railway could attract a large private sector valuation in the late 2030s; a further sum could be raised by an infrastructure concession sale 30 years later – and so on. The Government would also have the opportunity to strike the optimum balance between up-front income from a concession and taking the benefit from annual improvements to the operating income of the railway.

Conclusion

106. This document is just one step towards building HS2. It follows a period of intense work over several years which will enable us to deposit the Phase One hybrid Bill by the end of this year.

107. Subject to gaining the necessary powers, we intend to start construction in 2016/17. In the meantime we will continue to work up our proposals and plan for the building of the railway and its ultimate operation in co-operation with Network Rail, construction and supply companies, the train operating companies, local authorities, communities and the private sector.

108. This process will take us from design and development to construction so that when powers are granted – subject to the will of Parliament – the Government and its public and private sector partners are ready to build it.

About this document

All Government projects must be supported by a robust business case – and HS2 is no exception. The Strategic Case for HS2 explains the context for the project and the reasons why the Government needs to act. It describes the strategic objectives; the alternative options that have been considered and why HS2 emerges as the preferred way forward. It also sets out the economic benefits that HS2 will bring and confirms that the project represents good value for money; that it is affordable and will be delivered to budget and will be managed and procured effectively. An economic case for HS2, prepared by HS2 Ltd, is published in parallel to this document.

1 Chapter 1 – The context

Summary

This chapter sets out the links between economic growth and transport and considers the importance to the economy of investing in transport infrastructure. It looks at population growth and GDP as potential drivers of demand and how both are forecast to continue to increase.

1.1 Global competitiveness

1.1.1 Britain is in a global race and the country's future prosperity will depend on a modern, strong and growing economy that supports our ability to compete internationally. For the UK economy to succeed through the 21st century, it requires world-leading infrastructure which will act as a foundation for growth.

1.1.2 Growth and prosperity are created by people – having ideas, working hard, building companies and taking commercial risks. What Government must do – at the national and local level – is create the conditions in which people can do those things. Building the right national infrastructure is a critical part of meeting that responsibility.

1.2 Infrastructure supports economic growth

1.2.1 There is evidence that infrastructure has a stronger positive effect on growth than other forms of investment[56]. It provides essential networks to enable businesses to thrive.

1.2.2 Infrastructure delivery requires significant up front funding and too often we have seen chronic under-investment that has failed to meet long-term infrastructure needs[57]. Other nations are investing in their own infrastructure[58]. We are falling behind our competitors. The World Economic Forum currently ranks the UK 28th in the world for the quality of its infrastructure and the Organisation for Economic Co-operation and Development (OECD) has consistently cited improvement in the country's infrastructure, especially in the transport sector, as a priority to promote growth[59].

1.2.3 That is why the Government has drawn up a National Infrastructure Plan – the first of its kind – bringing together the investment programmes we need over the coming decades to meet the demands of our modern, dynamic economy and growing population[60]. The Plan includes 40 priority projects ranging from investment in renewable energy schemes to major transport schemes and broadband investment.

[56] Organisation for Economic Co-operation and Development, 2009 *Infrastructure and Growth: Empirical Evidence*, Egert, B, Kozluk, T and Sutherland, D

[57] Organisation for Economic Co-operation and Development Journal on Budgeting, 2006, *Public Investment in the United Kingdom*, http://www.oecd.org/unitedkingdom/43469354.pdf

[58] World Economic Forum, 2013,*The Global Competitiveness Report 2013-14*

[59] Organisation for Economic Co-operation and Development, 2013, *Economic Policy Reforms 2013: Going for Growth*

[60] The National Infrastructure Plan, October 2010 and updated in December 2012, https://www.gov.uk/government/organisations/infrastructure-uk/series/national-infrastructure-plan

1.2.4 Overall, the Government has set out plans for public capital investment of £300bn over the next Parliament and has committed now to expenditure on a pipeline of specific projects between 2015/16 and 2020/21 amounting to over £100bn. Transport lies at the heart of the investment plan, with over £70bn of capital spending on transport. Capital spending on transport is forecast to rise by at least 30% by 2020-21[61].

1.3 The importance of transport infrastructure

1.3.1 Various studies in recent years have charted the links between transport and the economy[62]. Whilst the relationship is complex, there is a strong positive correlation between transport and economic growth. The CBI has stated that "Quality infrastructure is vital for boosting exports, unlocking business investment across the UK, and supporting our leading firms – an essential element of a meaningful industrial strategy"[63].

1.3.2 As Lord Heseltine noted in his recent report on the UK's growth, "central government has a fundamental responsibility to create the national economic capacity upon which local growth relies… national and regional interconnectivity is critical to our future prosperity"[64].

1.3.3 By delivering additional capacity and enhanced connectivity, transport infrastructure allows businesses to grow, work together and access a wide range of customers, suppliers and skilled labour. Business investment too is encouraged by the quality of transport links, influencing the decisions of international companies as to where to locate, and in turn, increasing investment in the UK[65].

1.3.4 Transport infrastructure has particular economic significance for UK cities. In 2009, London and the Core Cities (Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield) and their wider urban areas contributed almost 50% of UK GDP. The Core Cities deliver 27% of the UK's GDP, and need to be better connected to thrive and achieve higher levels of growth if they are to close the performance gap between the South East and the rest of the country[66].

1.3.5 The nature of work in the 21st century is evolving fast and will continue to evolve. The infrastructure needed to support this activity has to adapt to changes which are likely to be founded on more flexible work patterns and the ability to use broadband communications both to work remotely and to be active while travelling, particularly on trains. Overall there has been a significant and continuing increase in business travel by rail. This is why the Government has announced its intention to invest in high speed mobile broadband access on Britain's rail network.

1.3.6 Face-to-face contact remains, and will continue to be, key to business activities, despite the ability to communicate remotely. Providing the kind of infrastructure that allows reliable and regular business contact is essential to the productivity and success of our businesses.

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61 HM Treasury, June 2013, *Investing in Britain's Future,* https://www.gov.uk/government/publications/investing-in-britains-future

62 Sir Rod Eddington, 2006, *The Eddington Transport Study, Standing Advisory Committee on Trunk Road Appraisal (SACTRA), 2000. Transport and the Economy: Full Report* and Venables, 2004, *Evaluating Urban Transport Improvements*

63 http://www.cbi.org.uk/media-centre/press-releases/2013/09/faltering-speed-of-delivery-on-infrastructure-could-undermine-efforts-to-secure-the-recovery/

64 Lord Heseltine of Thenford CH, October 2012, *No Stone Unturned in pursuit of Growth*, http://www.bis.gov.uk/assets/biscore/corporate/docs/n/12-1213-no-stone-unturned-in-pursuit-of-growth.pdf

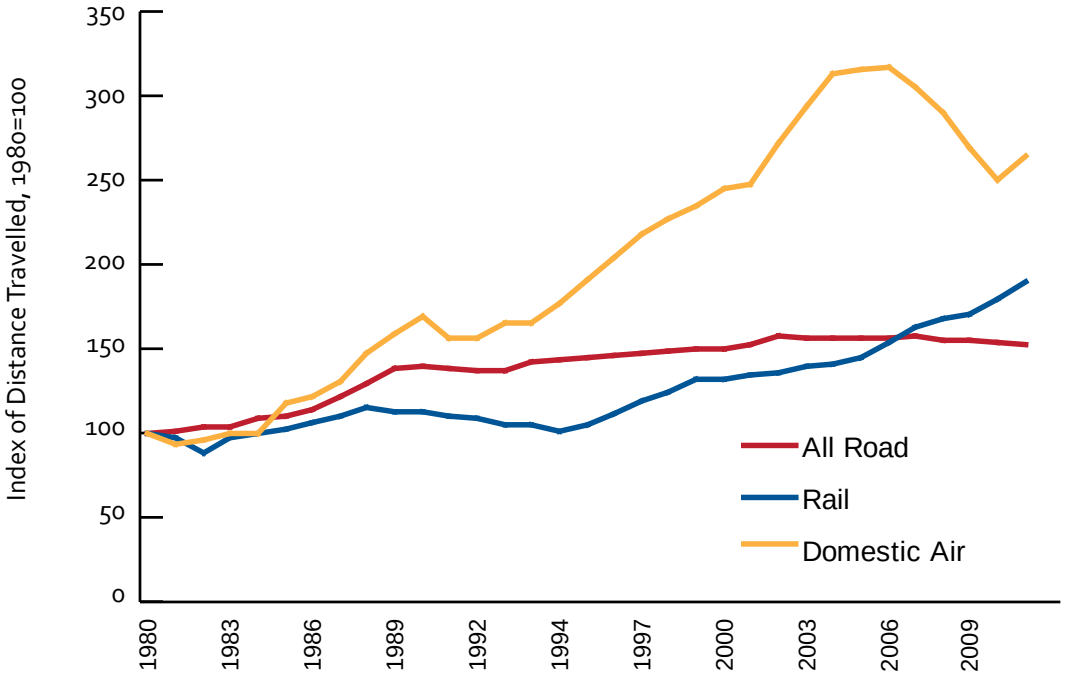
65 Crushman and Wakefield, 2010, *The European Cities Monitor*, shows transport is the fourth most important factor in international firms' location decisions. http://www.europeancitiesmonitor.eu/wp-content/uploads/2010/10/ECM-2010-Full-Version.pdf

66 Volterra/Arup Report,2011, *Understanding the transport infrastructure requirements to deliver growth in England's Core Cities, Final Report,* http://www.corecities.com/sites/default/files/images/publications/Transport%20infrastructure%20requirements%20report%20final.pdf

1.4 Economic and demographic trends

1.4.1 As personal wealth and the country's economic output increases, so the need and desire to travel increases. The last 30 years have seen growth in demand for domestic travel across all modes.

Figure 1.1: Growth in domestic passenger km travelled by mode, 1980 to 2011



1.4.2 Figure 1.1[67] shows that since 1980 there has been a 56% increase in road demand[68] and a 175% increase in domestic aviation[69]. Over this period, the economy has grown by 118%[70]. In the case of rail, those increases in the distance travelled have been unexpectedly sharp and resilient in the face of the downturn in the economy in 2008; nearly doubling since the early 1990s.

[67] Department for Transport, Statistics, 2010, *Passenger transport: by mode, annual from 1952*, assets.dft.gov.uk/statistics/tables/tsgb0101.xls https://www.gov.uk/government/publications/transport-statistics-great-britain-2012

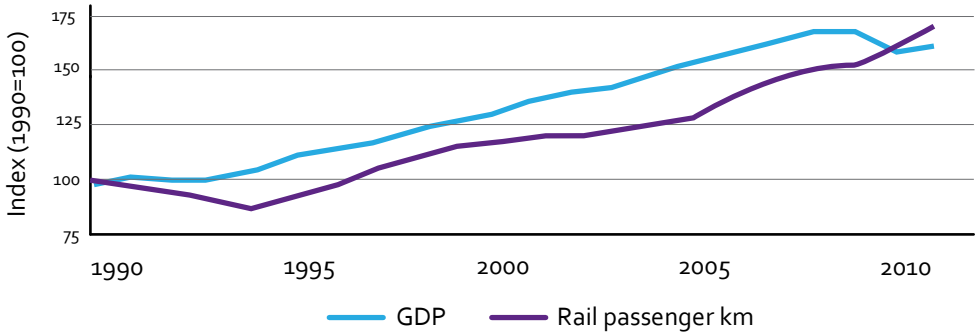
[68] Department for Transport, Statistics, 2010, *Passenger transport: by mode, annual from 1952*, assets.dft.gov.uk/statistics/tables/tsgb0101.xls https://www.gov.uk/government/publications/transport-statistics-great-britain-2012

[69] Department for Transport, Statistics, 2010, *Passenger transport: by mode, annual from 1952*, assets.dft.gov.uk/statistics/tables/tsgb0101.xls https://www.gov.uk/government/publications/transport-statistics-great-britain-2012. Domestic air is based on UK airlines and includes travel to and from Northern Ireland

[70] Office for National Statistics Report, 2013, *Long term profile of Gross Domestic Product (GDP) in the UK* (accessed 15/10/2013) http://www.ons.gov.uk/ons/rel/elmr/explaining-economic-statistics/long-term-profile-of-gdp-in-the-uk/sty-long-term-profile-of-gdp.html

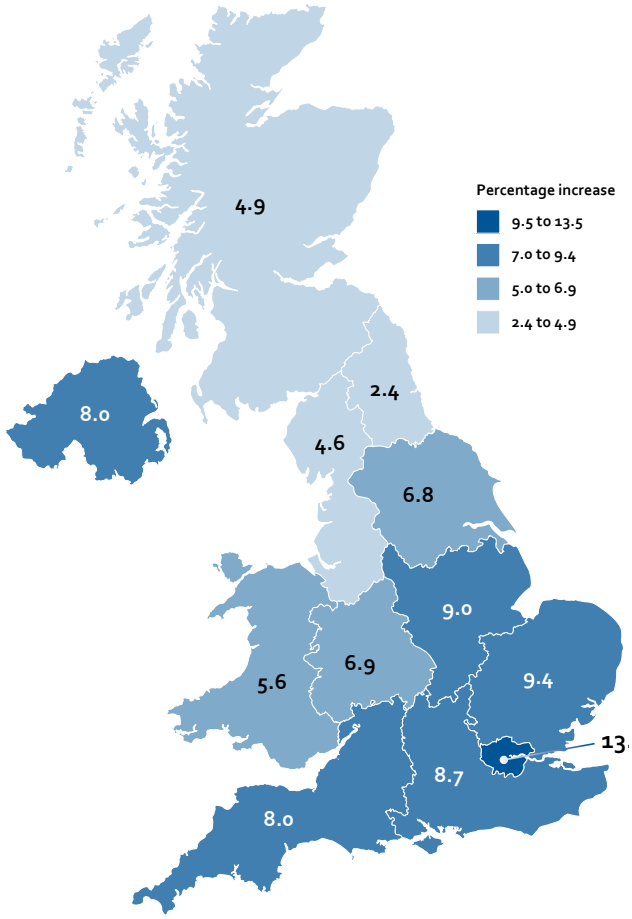
1.4.3 While road traffic experienced a moderate fall in response to the economic downturn, rail use has continued to rise, particularly intercity travel and commuting, as the principal cities become more important economic centres. This historic growth is demonstrated in Figure 1.2[71].

Figure 1.2: Growth in GDP and in rail passenger demand



1.4.4 Population has also grown over the last decade, increasing from 59.1 million to 62.7 million from mid-2001 to mid-2012. See Figure 1.3[72]. The population living in urban areas increased from 30.9 million to 33.3 million over the same period.

Figure 1.3: Change in mid-year population estimates for constituent countries and regions of the United Kingdom, mid-2001 to mid-2012



[71] Source: HS2 Ltd
[72] Source: Office for National Statistics

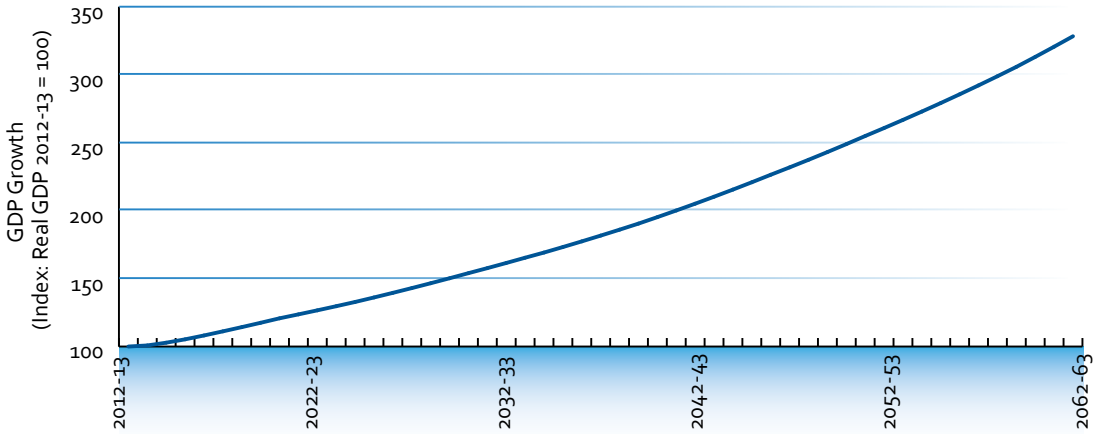
1.4.5 The long term drivers of demand to travel – GDP and population growth – are forecast to increase substantially over the next 30 years. Under the central projection from the Office of National Statistics, the UK population is predicted to grow by 11 million people from 2010 to 2035[73]. See Figure 1.4[74].

Figure 1.4: Projected growth in UK population

	2010	2015	2020	2025	2030	2035
United Kingdom	62.3	64.8	67.2	69.4	71.4	73.2
England	52.2	54.5	56.6	58.6	60.4	62.1
Wales	3.0	3.1	3.2	3.2	3.3	3.4
Scotland	5.2	5.4	5.5	5.6	5.7	5.8
Northern Ireland	1.8	1.9	1.9	2.0	2.0	2.0

Population: millions

Figure 1.5: Real GDP growth (Index)



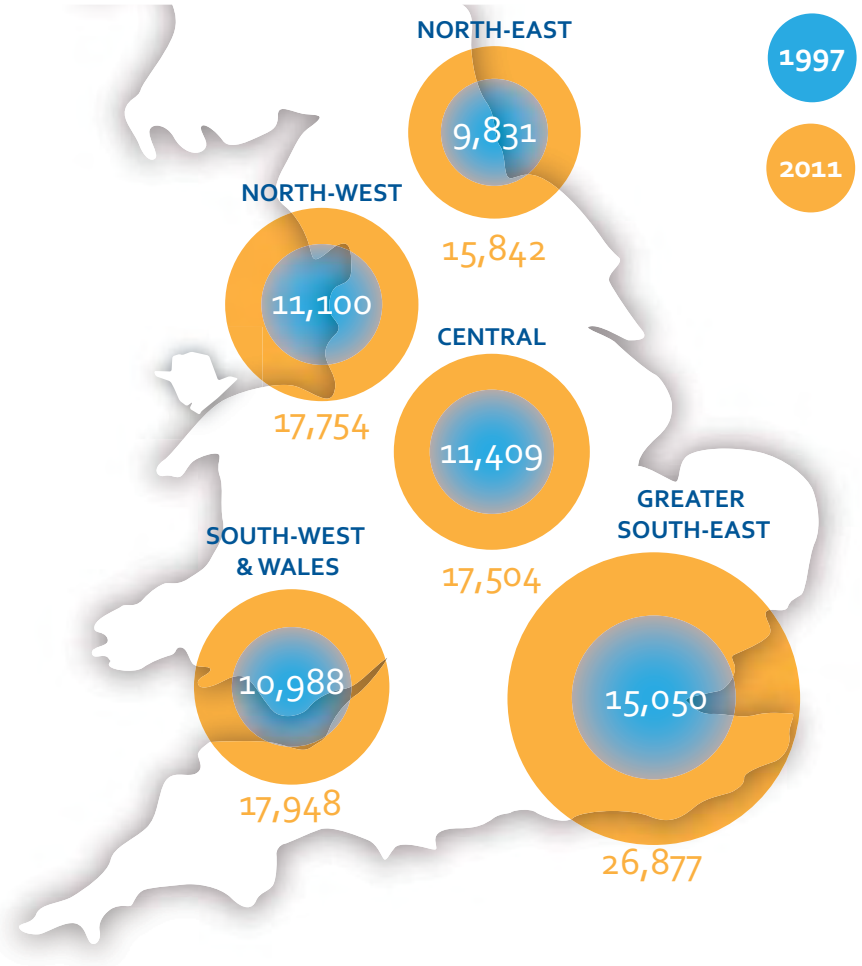
1.4.6 There will always be uncertainty when forecasting the future. However, given the lead times for major infrastructure we need to take the decisions now to meet demand in the 2020s and 2030s and to prioritise investments that will be flexible enough to meet the country's needs in the face of a range of different future scenarios. See Figure 1.5[75].

1.4.7 One economic trend we would like to address is the ongoing disparity between economic output in the north and the south of the country. The chart on the following page shows the economic output per person in the North East, North West, Central, South West and Wales and the Greater South East.

1.4.8 It shows clearly the disparity between the South East and the rest of the country. While productivity has increased in all areas, the difference has increased from around £5,000 per person to just over £11,000. See Figure 1.6[76].

[73] Office for National Statistics, http://www.ons.gov.uk/ons/dcp171778_235886.pdf
[74] Source: Office for National Statistics
[75] Source: OBR, Fiscal sustainability report – July 2013, Supplementary data series
[76] Source: Office for National Statistics, 2013, *Statistical bulletin: Annual Mid-year Population Estimates, 2011 and 2012*

Figure 1.6: Productivity per head (£)



NORTH-WEST North-West England

NORTH-EAST North-East England

CENTRAL The Midlands and Yorkshire and the Humber

SOUTH-WEST & WALES South-West England and Wales

GREATER SOUTH-EAST East and South-East England and London

2 Chapter 2 – The case for action

Summary

This chapter sets out how we expect passenger growth to continue into the future and we are already investing heavily in additional capacity. But without a step change in capacity our main north-south railways will be overwhelmed.

2.1 Growth in demand

2.1.1 The growth in transport demand that we have seen over the past 20-30 years has been underpinned by two broad underlying factors: population growth and economic growth. There have been structural changes in the economy, particularly the move towards a service economy, and an increased level of business travel and commuting.

2.2 Roads

2.2.1 There have been fluctuations in road traffic levels in recent years with a decline of around 4% between 2007 and 2010 in response to the economic downturn and the rising price of oil but traffic levels have since stabilised. Recent research has pointed to a decline in car use following changes in company car taxation and to a reduction in car use by young adult males over the last 10 years. This trend has been centred on major cities, especially London. However, the overall picture is one of continuing increased car use[77]. Road traffic grew from 255.7bn vehicle miles in 1991 to 302.6bn in 2012[78]. Road vehicles continue to be the most heavily used form of transport in Britain, accounting for close to 90% of passenger journeys and two thirds of freight.

2.2.2 Strategic roads – motorways and trunk roads – may be under more pressure than local roads[79]. Between 2000 and 2012, motorists drove an extra 10bn miles on strategic roads, while traffic was steady on the rest of the network. The Government's most recent forecasts, published alongside the command paper *Action for Roads*, suggest that year-on-year growth in traffic will continue.

2.2.3 Those forecasts estimate that by 2040, traffic on strategic roads will rise by 46% on central assumptions. That could result in a quarter of all travel time being spent stuck in traffic, with an impact on productivity in the order of 100 million lost working days[80].

2.2.4 We have just announced the biggest-ever upgrade of our motorways and key A-roads – our strategic road network. We are:

- investing £15.1bn in our strategic roads by 2021 to counter the effects of past underinvestment;
- Adding a further 221 lane miles of extra capacity to our busiest motorways.

77 RAC Foundation, 2012, *On the Move*, http://www.racfoundation.org/assets/rac_foundation/content/downloadables/on_the_move-le_vine_&_jones-dec2012.pdf

78 Department for Transport, 2012, *Annual Road Traffic Estimates in Great Britain*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/208950/road-traffic-statistics-2012.pdf

79 Department for Transport, 2013, *Actions for Roads*, https://www.gov.uk/government/publications/action-for-roads-a-network-for-the-21st-century

80 Department for Transport, 2013, *Actions for Roads*, https://www.gov.uk/government/publications/action-for-roads-a-network-for-the-21st-century

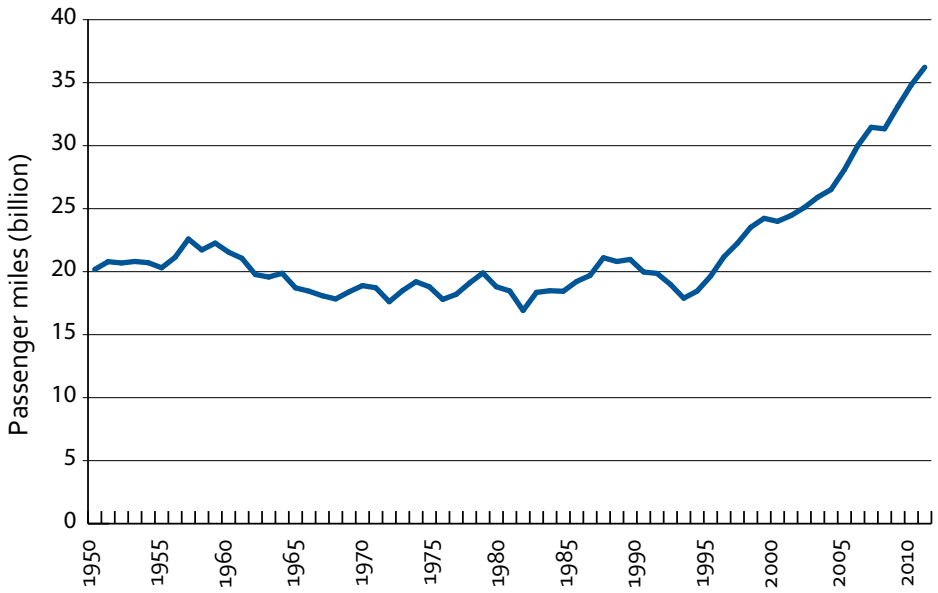
- building 52 national road projects in this parliament and the next, subject to value for money and deliverability;
- investing more than £12bn in maintaining our network, including over £6bn to resurface over 3,000 miles of the strategic road network; and
- identifying and funding solutions to tackle some of the most notorious and long-standing road hot spots.

2.2.5 By 2021, spending on road enhancements will have tripled from today's levels, and we will have resurfaced 80% of the network. However, this major investment programme by itself is not enough to meet the growth in transport demand.

2.3 Rail

2.3.1 Rail has seen strong and consistent growth in the last two decades. See Figure 2.1[81]. The already busy network is expected to get even busier.

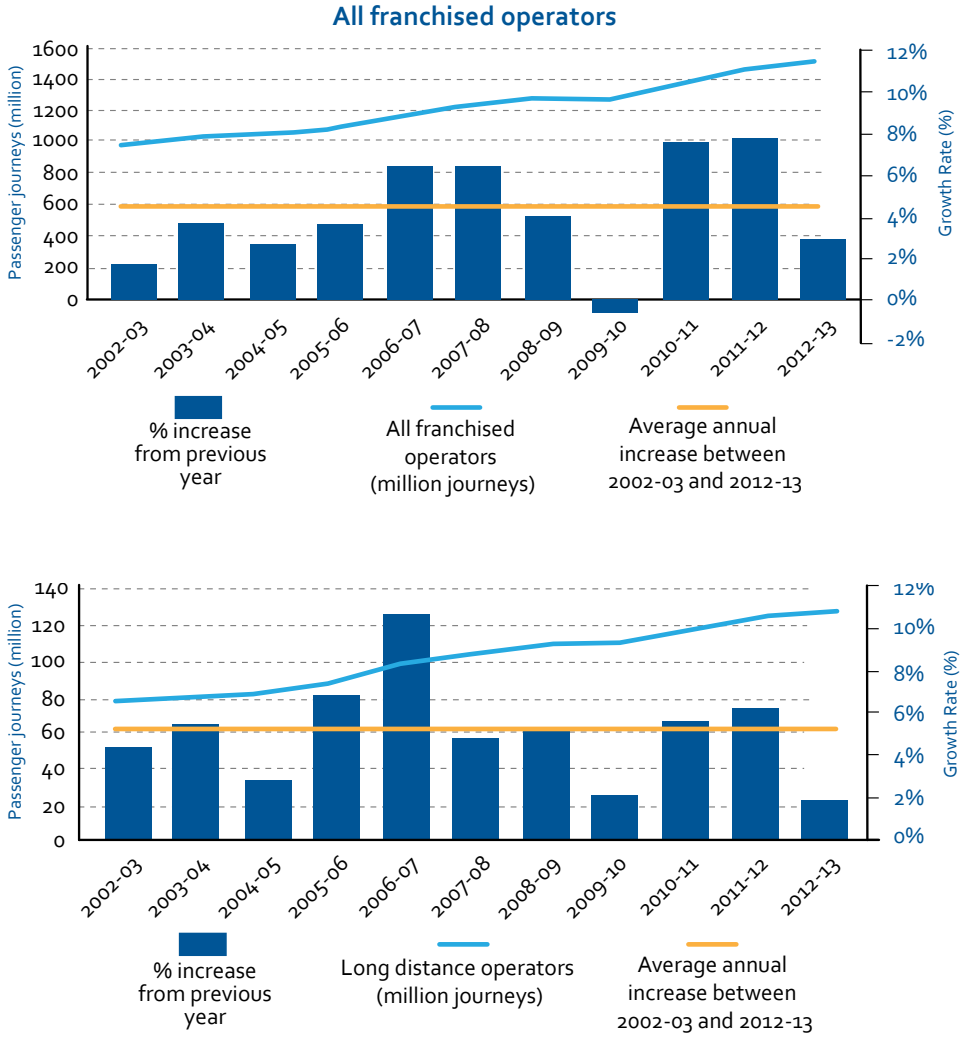
Figure 2.1: Rail demand: 1950-2010



2.3.2 The number of passenger miles travelled on the national rail network increased from 20bn in 1992/93, to 36bn in 2012/13. In terms of the number of rail passenger journeys, there has been an increase from 976 million in 2002-03 to 1,502 million in 2012-13. This represents a 54% increase in demand in a 10 year period and is equivalent to an annual year-on-year growth rate of 4.4%. Intercity journeys increased by 65% over the same period, with journeys increasing from 77 million to 128 million. This is a 5.2% annual year-on-year growth rate[82]. Over the same period, GDP grew by 43% or 3.6% per year[83]. The graphs in Figure 2.2[84] show the profile of journey growth over a 10-year period.

[81] Source: Office of Rail Regulation (ORR)
[82] Source: Office of Rail Regulation
[83] Source: Office for National Statistics (ONS)
[84] Source: Office of Rail Regulation data portal

Figure 2.2: Passenger journey growth 2002/3-2012/13



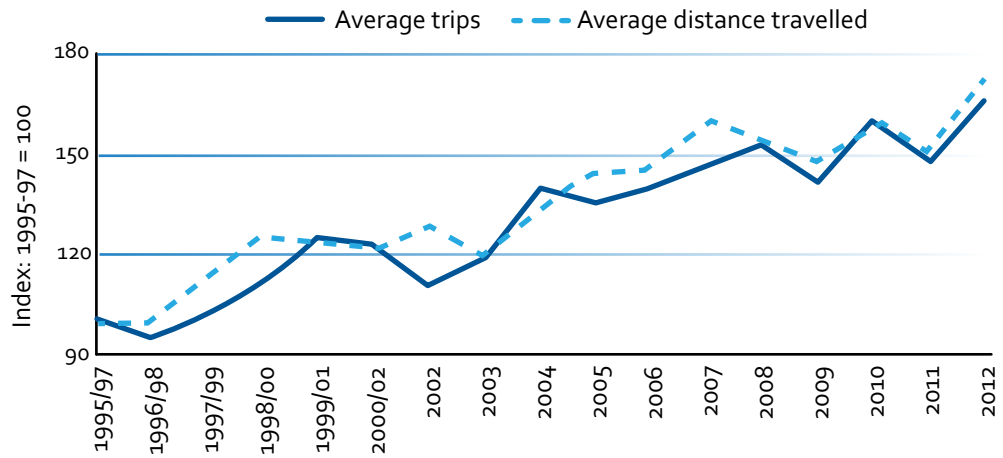
2.3.3 Our railway is effectively the same size as 15 years ago but there are now 4,000 more train services a day; a 20% increase[85].

[85] Association of Train Operating Companies (ATOC), July 2013, *Growth and Prosperity* http://www.atoc.org/download/clientfiles/files/ATOC%20Growth%20and%20Prosperity%20report.pdf

2.3.4 Rail's market share (measured by the overall number of kilometres travelled) has seen a significant upwards shift. Since 1995, the proportion of journeys over 25 miles made by rail increased from 8% to 14%[86]. People are using rail more often. See Figure 2.3[87].

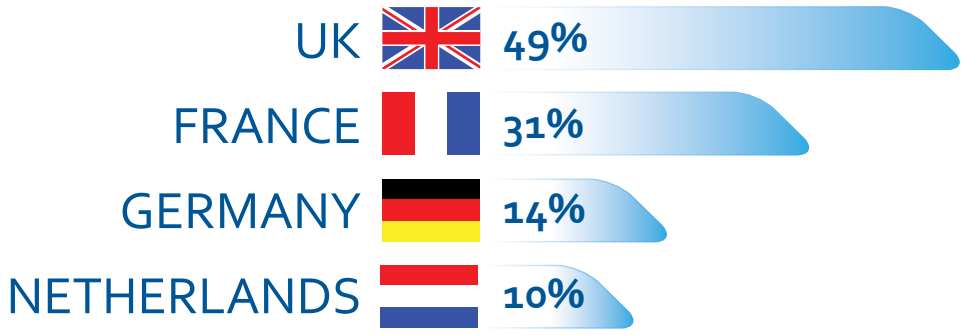
- the average rail trip rate increased by 66% since 1995/97 to 19 trips per person per year in 2012;
- the average distance travelled per person per year by rail increased by 73% to 553 miles in 2012; and
- 58% of Britons used rail at least once a year in 2012, compared to 49% in 1998-2000.

Figure 2.3: Index of rail trip rate/distance travelled: Great Britain



2.3.5 Furthermore, the growth performance of the UK's railways is significantly ahead of other major European countries, as shown in Figure 2.4[88].

Figure 2.4: Rail journey growth in Britain against European comparators, 1998-2010



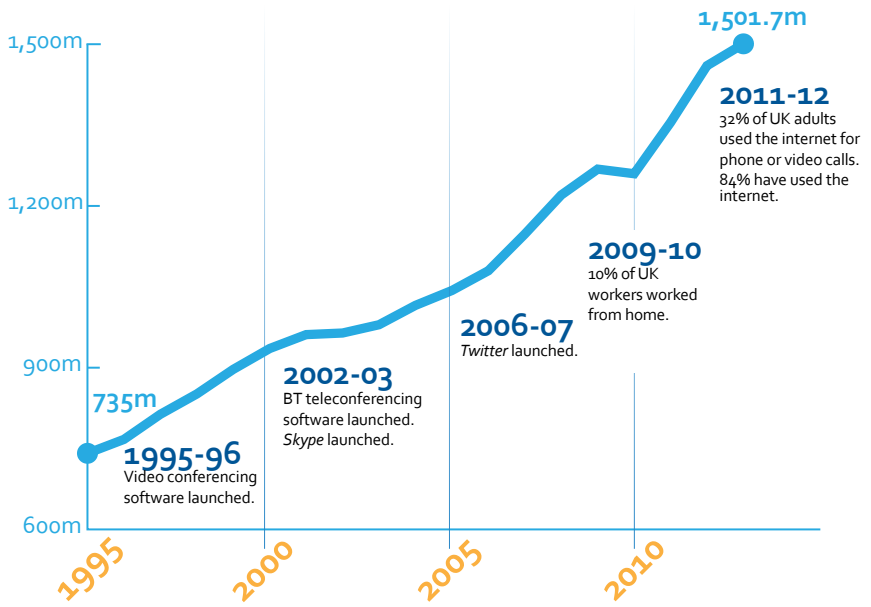
[86] Department for Transport, *Rail passenger numbers and crowding in several major cities in England and Wales for 2012*, https://www.gov.uk/government/publications/rail-passenger-numbers-and-crowding-on-weekdays-in-major-cities-in-england-and-wales-2012

[87] Source: National Travel Survey, https://www.gov.uk/government/statistical-data-sets/nts01-average-number-of-trips-made-and-distance-travelled

[88] Source: Association of Train Operating Companies (ATOC) Growth and Prosperity Report, http://www.atoc.org/download/clientfiles/files/ATOC%20Growth%20and%20Prosperity%20report.pdf

2.3.6 Some have questioned whether new information and communication technology will provide a substitute for travel in the future. In fact, advances in mobile IT, teleconferencing, email, the World Wide Web, and social media have occurred at exactly the same time as the rapid growth in rail travel. See Figure 2.5[89].

Figure 2.5: Demand for passenger journeys continues to grow alongside advances in communications technology



2.4 Freight

2.4.1 Freight traffic plays an important and growing role on the rail network. In recent years 8-9% of freight moved in Great Britain each year has been moved by rail[90], a total of 21bn tonne km in 2011. As well as the economic benefits, rail freight's environmental advantage over road haulage has encouraged leading supermarket chains such as Tesco and Morrisons to send goods by rail.

2.4.2 As with passenger rail journeys, the rail freight sector has shown strong growth. Freight carried by rail has increased by an average of 2.5% annually in the last 20 years[91]. This growth has continued in recent years despite the tough economic conditions, with rail freight traffic increasing between 2009 and 2011[92].

89 Source: Office of Rail Regulation

90 Department for Transport, *Rail Trends Factsheet* (2011/12) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/142668/rail-trends-factsheet-2011-12.pdf

91 Measured in tonne kilometres

92 Network Rail, April 2013, *Freight Market Study (Consultation Draft)*, http://www.networkrail.co.uk/improvements/planning-policies-and-plans/long-term-planning-process/market-studies/freight/

2.4.3 This demonstrates the success of the rail freight industry in developing its markets over the past twenty years, and we believe the demand for carrying freight by rail will only grow. Industry is concerned by rising diesel prices which they predict will rise by 36% by 2040. They see rail as playing an increasing role in transporting freight to maintain affordable prices for our goods in the future[93]. The Government also sees an increasing role for rail freight in transporting goods around the country. The congestion and carbon benefits that this can provide as lorries are moved off the road network will increase economic activity and support the recovery. See Figure 2.6[94].

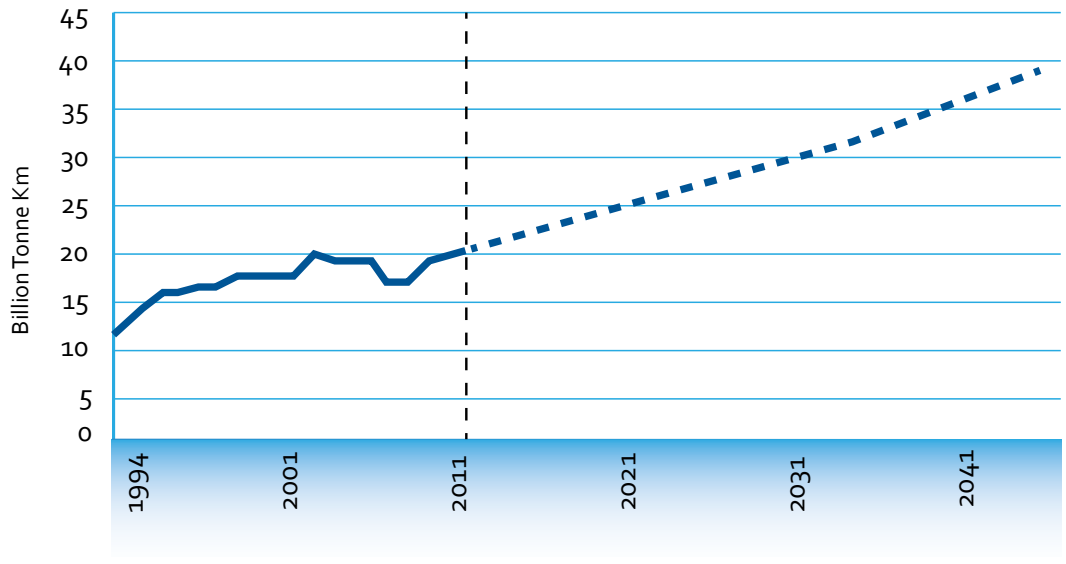
Figure 2.6: Potential for a fully-loaded freight train to replace lorries

Commodity	Fully loaded train potential	Equivalent number of heavy goods vehicles
Coal	1,500 tonnes	52
Metals and ore	1,000 to 2,500 tonnes	60
Construction materials	1,000 to 3,000 tonnes	77
Oil and petroleum	2000 tonnes	69
Consumer goods	600 to 1,100 tonnes	43
Other traffic	1,000 to 1,500 tonnes	43

2.4.4 Strong growth to date is set to continue in the future. Forecasts in the Network Rail *Freight Market Study consultation document* show potential annual growth in freight tonne km of 2.2% to 2033 and 2.1% to 2043. This would lead to a doubling in freight tonne km by 2043[95]. See Figure 2.7[96].

2.4.5

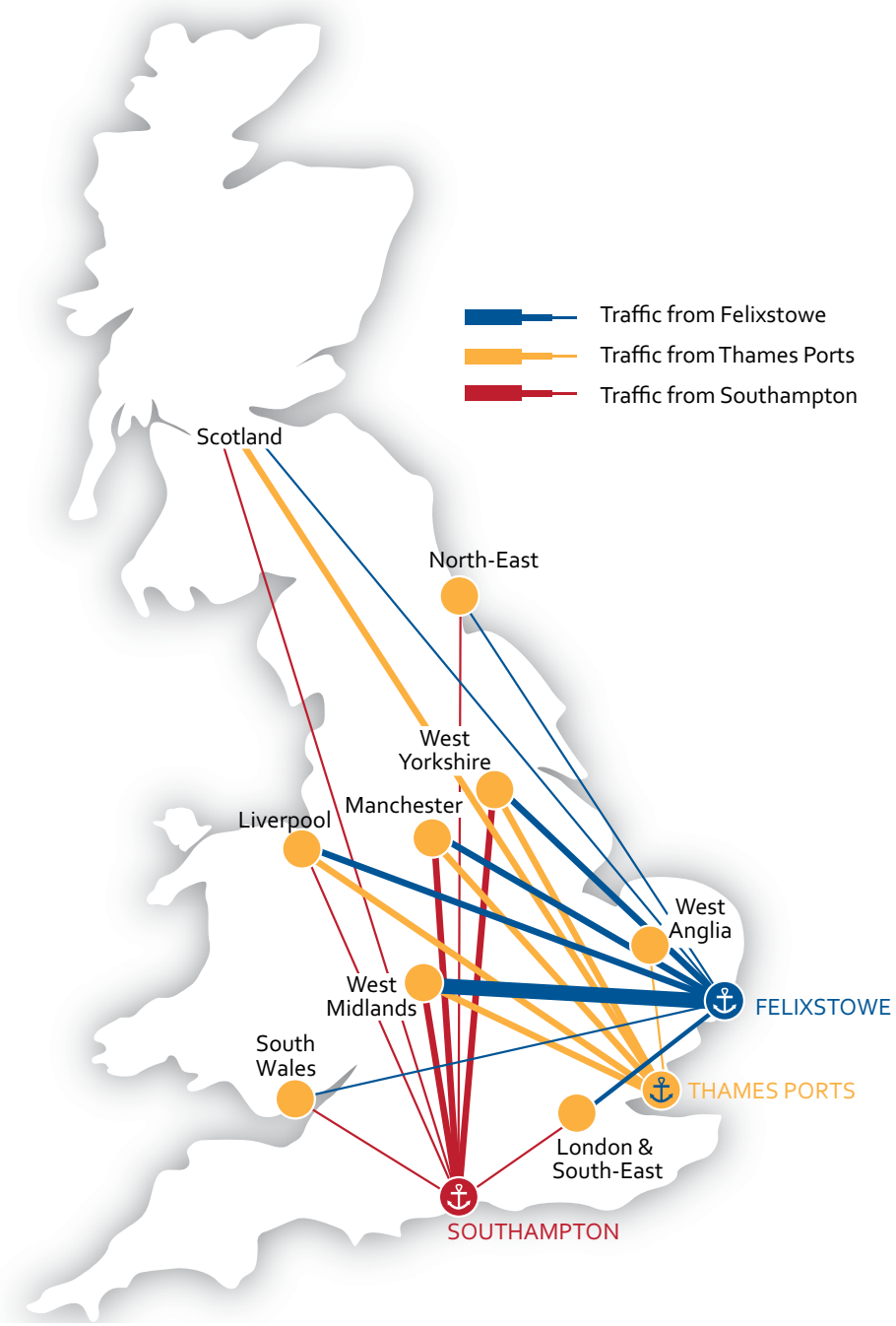
Figure 2.7: Network Rail forecasts for rail freight growth



93 Letter to The Times from CEOs of UK rail freight sector, 28 September 2013
94 Source: Network Rail, April 2013, *The Value and Importance of Rail Freight*
95 Network Rail, April 2013, *Freight Market Study consultation document*, http://www.networkrail.co.uk/improvements/planning-policies-and-plans/long-term-planning-process/market-studies/freight/
96 Source: Network Rail

2.4.6 Growth has been particularly strong in intermodal transport and is predicted to continue with the opening of the new port at London Gateway, which has been designed to facilitate onward rail shipment. Intermodal goods transported from our major ports and through the Channel Tunnel are forecast to show overall annual growth of 5.5% by 2033[97], reflecting continued trade growth. The main traffic flows in 2030 are expected to continue to be from Felixstowe, the Thames ports and Southampton to major economic centres. The next map shows that the main flows of freight are from south to north. See Figure 2.8[98].

Figure 2.8: Freight traffic from major sea ports



[97] Network Rail, *Network Rail Freight Market Study (Consultation Draft)*, April 2013, http://www.networkrail.co.uk/improvements/planning-policies-and-plans/long-term-planning-process/market-studies/freight/

[98] Source: Department for Transport, September 2009, *Britain's Transport Infrastructure Strategic Rail Freight Network: The Longer Term Vision*

2.5 Investment

2.5.1 The Government is investing heavily in the UK's transport networks. For London, we are providing around £5bn towards the £15bn Crossrail scheme, that will open, in stages, from 2018. We are also supporting investment of around £6bn in the Thameslink upgrade programme. See Figure 2.9[99].

2.5.2 The 2013 Spending Round Announcement set out plans for £73bn of capital spending on transport between 2015/16 and 2020/21.

Figure 2.9: Investing in Britain's future

£m	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	Total
Highways Agency	1497	1907	2316	2614	3047	3764	15145
National Rail	3548	3681	3770	3789	3824	3859	22471
High Speed Two	832	1729	1693	3300	4000	4498	16052
London Transport Investment	925	941	957	973	990	1007	5793
Local Authority Transport	2253	2253	2253	2253	2253	2253	13518
Total	9055	10511	10989	12929	14114	15381	72979

2.5.3 Beyond 2015 our investment plans will equate to a trebling of the budget for Highways Agency major road schemes by 2021, alongside £6bn in this Parliament and £12bn in the next invested in maintaining and renewing the road network.

2.5.4 And in local transport, as well as funding over 50 major schemes on the local road and public transport network in the period to 2015, the Government has created the Local Growth Fund, worth at least £2bn every year to 2021.

2.5.5 But even with this much higher level of investment in our roads and our local transport, we do not expect capacity on the roads to keep pace with future demand. The implication is that congestion will increase over time.

2.5.6 On rail, Network Rail will spend over £35bn from 2014-19. Within this, the Government's rail investment strategy allocates over £9bn for enhancements. Figure 2.10 shows this in map form[100]. This will:

(i) support economic growth by providing for 120,000 additional commuting trips per day into London in the morning peak and an additional 20,000 into our other major cities;

(ii) improve connectivity between cities in a way that complements our plans for HS2. For example, investments in the north of England will lead to journey time savings of 20%-30% between the major cities of the north;

[99] Source: HM Treasury, *Investing in Britain's Future*, June 2013

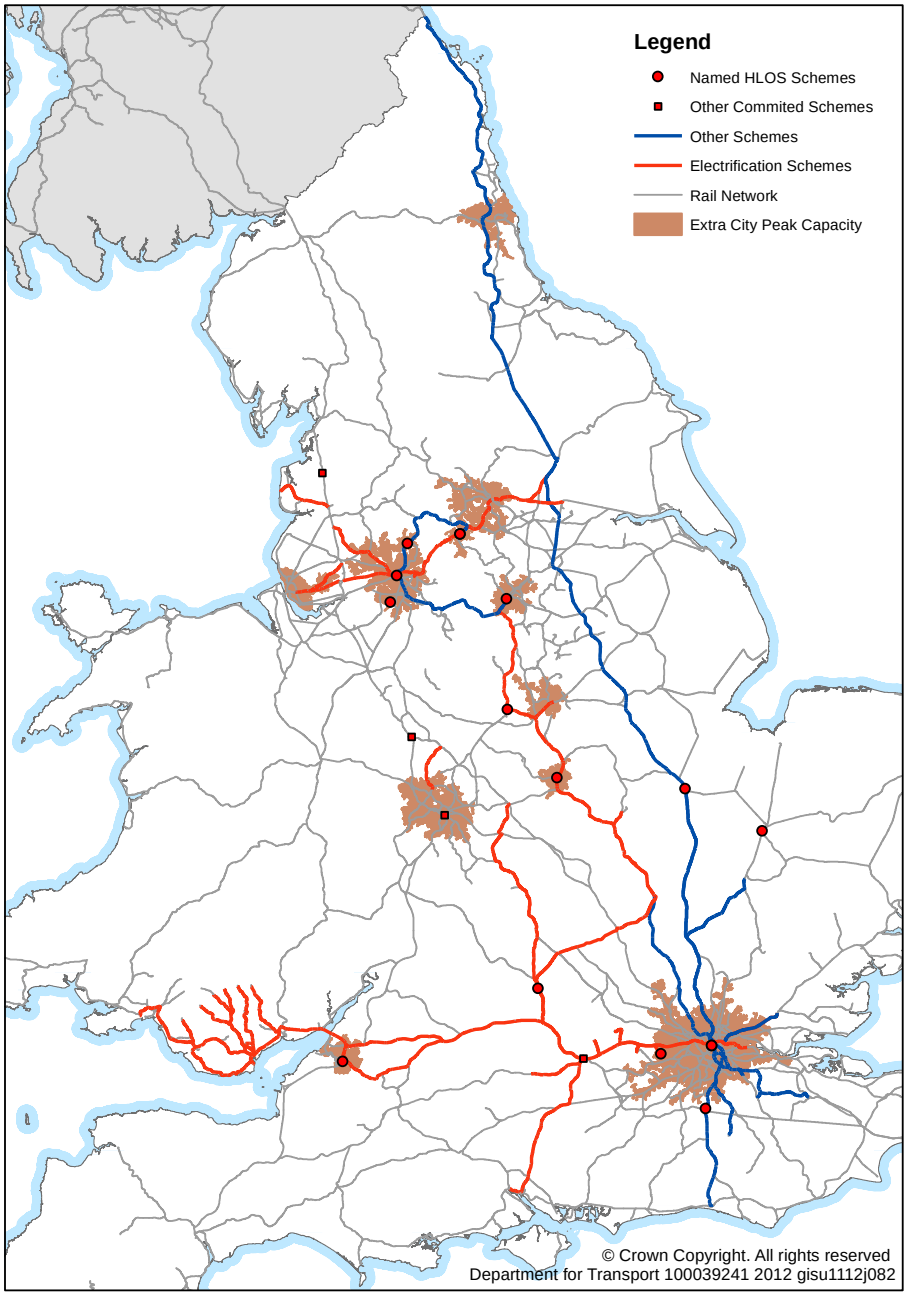
[100] Source: Department for Transport, 100039241, 2012

(iii) continue our rolling programme of electrification, reducing journey times on key links, and improving energy efficiency;

(iv) continue our support for rail freight, particularly the economically important container flows to and from our major ports; and

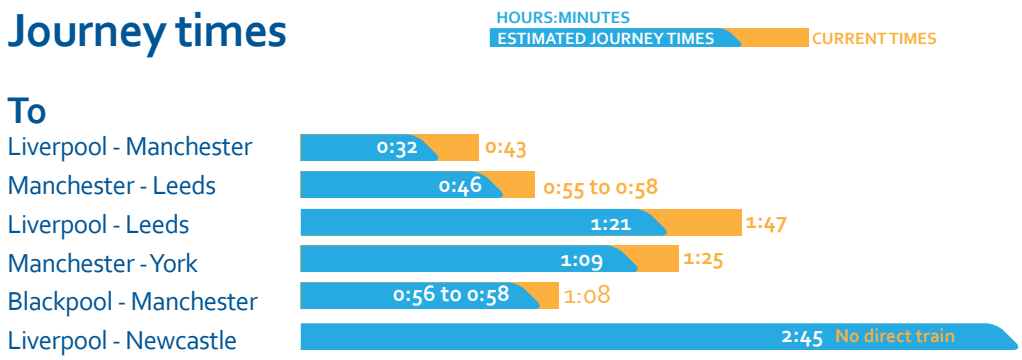
(v) reduce journey times to Heathrow from the west by around 30 minutes thanks to a new connection to the Great Western Main Line.

Figure 2.10: Other major rail infrastructure projects



2.5.7 For the cities of the North, the combination of the Northern Hub and trans-Pennine electrification unlocks a key bottleneck allowing new direct services to be introduced between major centres (such as Bradford-Manchester Airport and Newcastle-Liverpool) and generally shortened journey times between the major Northern cities. See Figure 2.11[101].

Figure 2.11: Estimated journey time improvements across the North of England from planned investments



2.5.8 Investment is also taking place on the Midland Main Line (electrification) and new intercity trains are to be introduced on the East Coast Main Line and Great Western Main Line, which is also being electrified. For London, the combination of Crossrail and Thameslink will transform rail connectivity and capacity, east-west and north-south across London.

2.5.9 But this major investment programme does not change the fact that the UK's railways are a mixed use network – with fast, time critical intercity journeys sharing the same infrastructure as inter-regional, commuter and slow freight services. Adding trains to a busy railway is not straightforward. Train services conflict, and trade-offs are needed in designing the timetable. Fast trains catch up with slower ones. More trains means they need to travel closer together. A system like this is inherently vulnerable to disruption meaning that delays to one service inevitably impact on others.

2.6 The West Coast Main Line: a route capacity problem

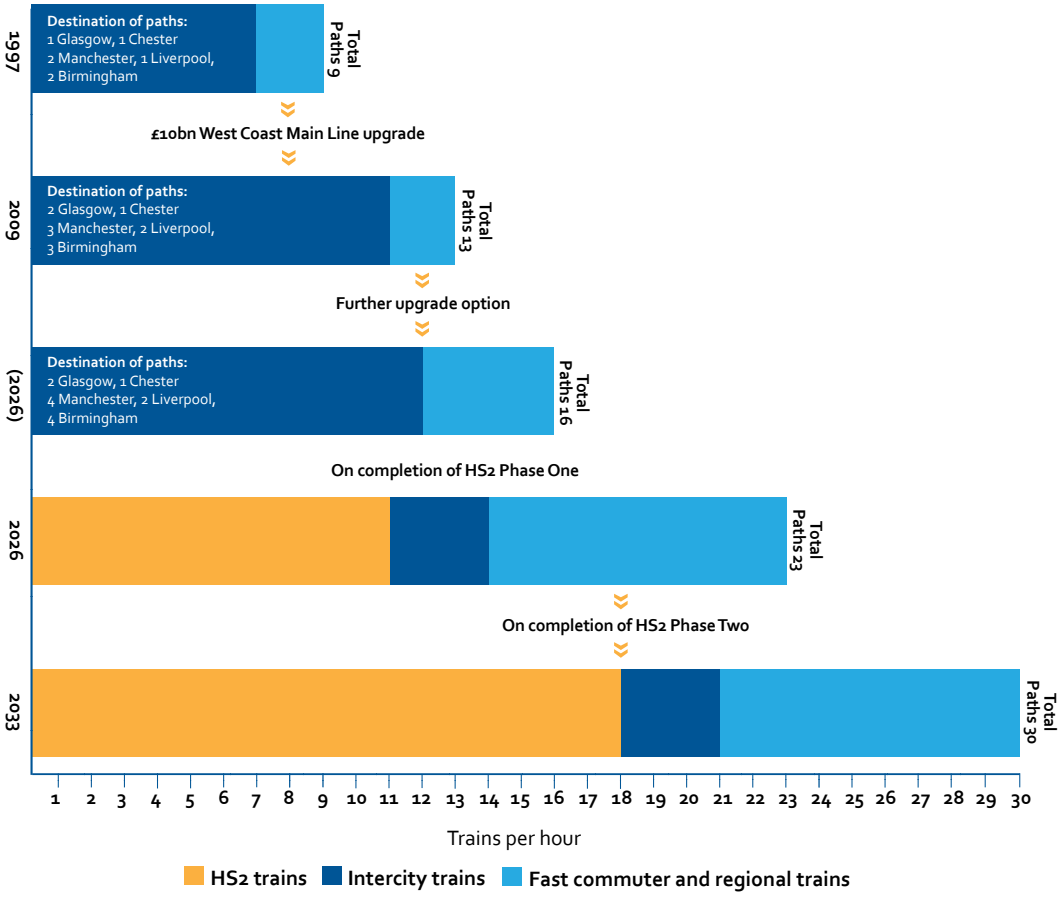
2.6.1 The West Coast Main Line is the busiest mixed-traffic corridor in Europe, carrying an intense mix of passenger and freight traffic nearly 20 hours per day[102]. Over 40% of all national rail freight uses the West Coast Main Line[103].

[101] Source: HS2 Ltd
[102] Network Rail, January 2013, *A better railway for a better Britain*, http://www.networkrail.co.uk/publications/strategic-business-plan-for-cp5/
[103] Network Rail, *West Coast: Overview of Project 2008*, http://www.networkrailmediacentre.co.uk/ImageLibrary/downloadMedia.ashx?

2.6.2 The West Coast Main Line has already been the subject of a major renewal and modernisation programme costing £9bn, completed in 2008 after a decade of major works. Nearly one hundred million person-hours of work enabled 1,000 additional trains to run every week[104]. Resulting increases in maximum speeds and the associated timetable changes reduced key long distance journey times by 20%[105]. The benefits of the upgrade were substantial, but such major works on live railways are hugely disruptive. In the case of the West Coast Route modernisation described above, passengers endured rail replacement bus services repeatedly over five years. The route via Stoke-on-Trent had to be closed entirely for over two months. Even small scale works have a major impact: for example work next year to renew crossings and signalling equipment in the Watford area will cause major disruption to passengers in 2014[106].

2.6.3 The scope for further services to be introduced on the southern part of the West Coast Main Line is now very limited. The West Coast Route modernisation programme, as overseen by Department for Transport through to delivery of a much enhanced timetable in December 2008, envisaged that there would be a maximum of 13-14 trains/hour in the peak hour, using the fast lines out of Euston. This was considered to be the capacity of the route[107]. See Figure 2.12[108].

Figure 2.12: Peak period fast lines departing Euston



[104] Network Rail, *West Coast: Overview of Project 2008*, http://www.networkrailmediacentre.co.uk/ImageLibrary/downloadMedia.ashx?
[105] Ref: http://www.networkrailmediacentre.co.uk/ImageLibrary/downloadMedia.ashx?
[106] Network Rail, 2013, *Major improvement work for the West Coast Main Line at Watford*, http://www.networkrailmediacentre.co.uk/News-Releases/Major-improvement-work-for-the-West-Coast-Main-Line-at-Watford-1e18.aspx
[107] National Audit Office Report by the Comptroller and Auditor General, HC 22 Session 2006-2007, 22 November 2006, *The Modernisation of the West Coast Main Line*, http://www.nao.org.uk/report/the-modernisation-of-the-west-coast-main-line/
[108] Source: Steer Davies Gleave, Atkins and HS2 Ltd

2.6.4 The idea of adding an extra two commuter paths/hour as soon as next year, is under active consideration. This would require multiple unit operation at higher speeds which causes certain technical challenges. But if they can be introduced successfully, they would help to alleviate commuter congestion over the next 10-12 years. But it will be for the ORR to decide if this is possible and consistent with achieving the required level of performance reliability. At 15 trains/hour in peak periods on the fast pair of tracks out of the capital, this is at the highest end of levels achieved on main line railways elsewhere in Europe – even those such as high speed lines with purpose-built train control systems, let alone a railway with a mix of diesel and electric traction, commuter, freight and intercity services. Once this level of throughput has been achieved, it would be very difficult to add further commuter trains to the route.

2.6.5 Since 1994 the number of intercity train services operating on the West Coast Main Line has increased significantly. There are now more than 45 intercity train services between London and Manchester every day, compared with 17 in 1994. Likewise, between London and Birmingham there are 49 compared with 31 in 1994[109]. While it is clearly beneficial to create these additional services, it inevitably means that there is less scope to add further services in the future.

2.6.6 In July this year, for example, the ORR turned down an application by Virgin Trains to run two additional services a day from London to Blackpool and Shrewsbury. According to the ORR's assessment, "extensive analysis of Virgin Trains' recent application for new passenger services on the West Coast Main Line showed that there is not currently sufficient space on the line to run all of the additional West Coast Main Line services. The proposals would have also caused further deterioration in punctuality by adding traffic to what is already a very busy route. The proposals would have a detrimental impact on the journeys of millions of passengers travelling on the route[110]."

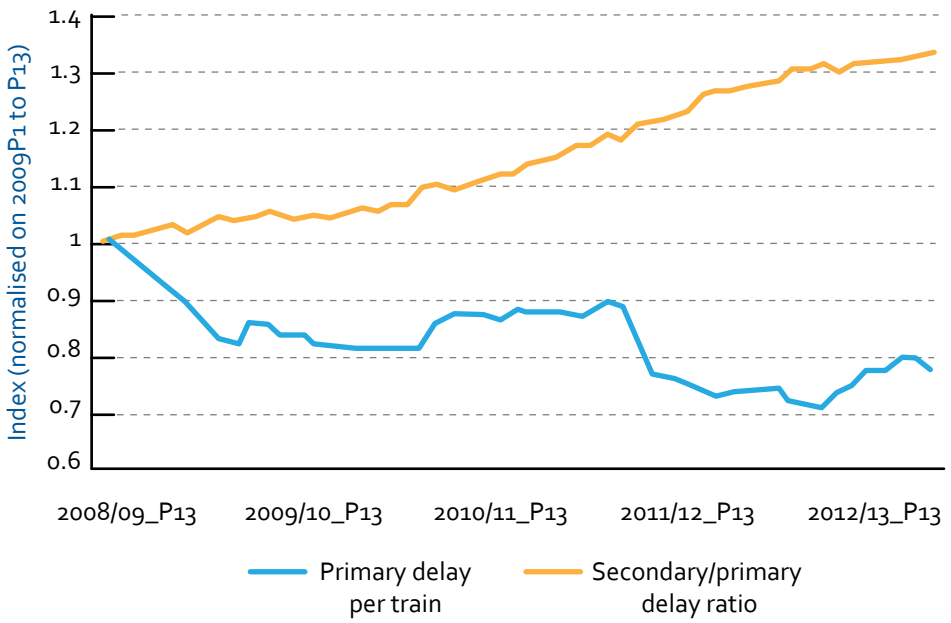
2.6.7 The adverse effect on performance can be seen in Figure 2.13[111]. The yellow line shows that the proportion of reactionary delay, or delay caused to other trains, has been increasing over the past five years even though the primary delay per train (the blue line) is falling. Higher utilisation has led to increased knock-on effects from any delays, even though the initial delays themselves have decreased.

[109] Association of Train Operating Companies, 2013, *Growth and Prosperity Report*, http://www.atoc.org/download/clientfiles/files/ATOC%20Growth%20and%20Prosperity%20report.pdf

[110] Office of Rail Regulations, 2013, *ORR decision on West Coast track access application*, http://www.rail-reg.gov.uk/server/show/ConWebDoc.11219

[111] Source: Network Rail performance data

Figure 2.13: The knock-on effects of train delays



2.6.8 Long distance services on the West Coast Main Line achieve around 85% punctuality, around four percentage points worse than the average for other long distance services, as shown in the top graph in Figure 2.14[112]. The performance of the relevant part of the London Midland franchise, which provides the regional and commuter service on the route, is also at around 85% punctuality. This is six percentage points lower than the national average for equivalent services, as shown in the bottom graph in Figure 2.14.

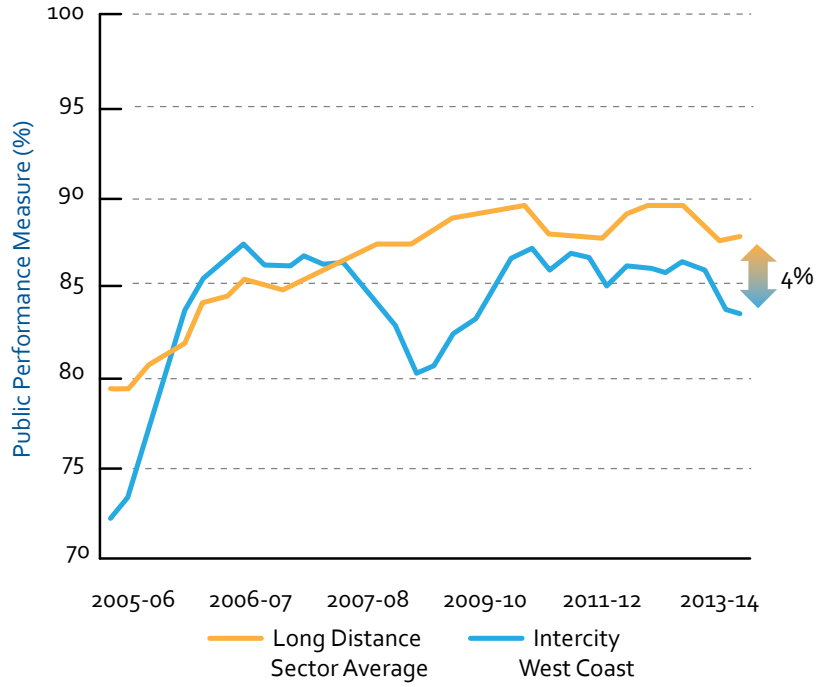
2.6.9 It is not just Virgin Trains that would like to operate more services on the busy West Coast Main Line. London Midland would like to add an additional train in the peak hours to relieve overcrowding; CrossCountry would like to be able to route their service from Yorkshire/the North East via Birmingham International and Coventry and open access service operators would like to add further long distance services too. Additional freight services are also required, including to/from London Gateway when it is up and running.

2.6.10 All the north-south main lines are under pressure (see Figure 2.15[113]). Where routes are shown coloured red, additional services can only be added, in general, by making timetable changes. Independent analysts suggest that to accommodate new trains would require measures such as removing calls at intermediate stations and extending journey times, or would result in compromises to service punctuality and reliability – unless significant infrastructure investment were made.

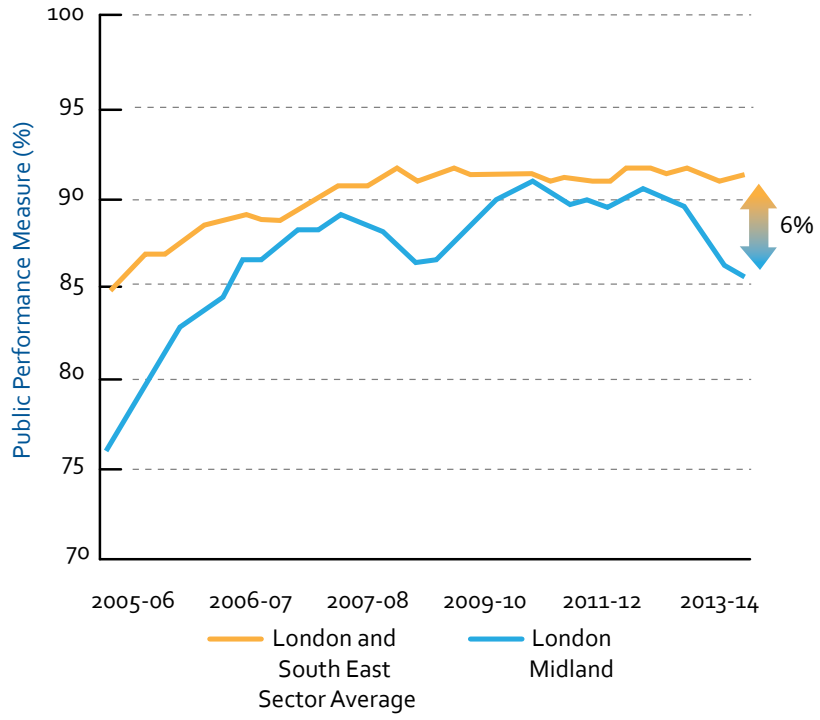
2.6.11 The West Coast Main Line is operating at a level of intensity that is making it extremely difficult to achieve target levels of performance reliability. Adding further trains to the network would be a good way to increase capacity, but risks worsening performance reliability further. So the question of whether trains (both freight and passenger) can be lengthened to accommodate more demand is crucial, at least in the short term.

[112] Source: Official industry performance data, Office of Rail Regulations National Statistics data portal
[113] Source: Steer Davies Gleave

Figure 2.14: West Coast train operating companies' relative punctuality performance



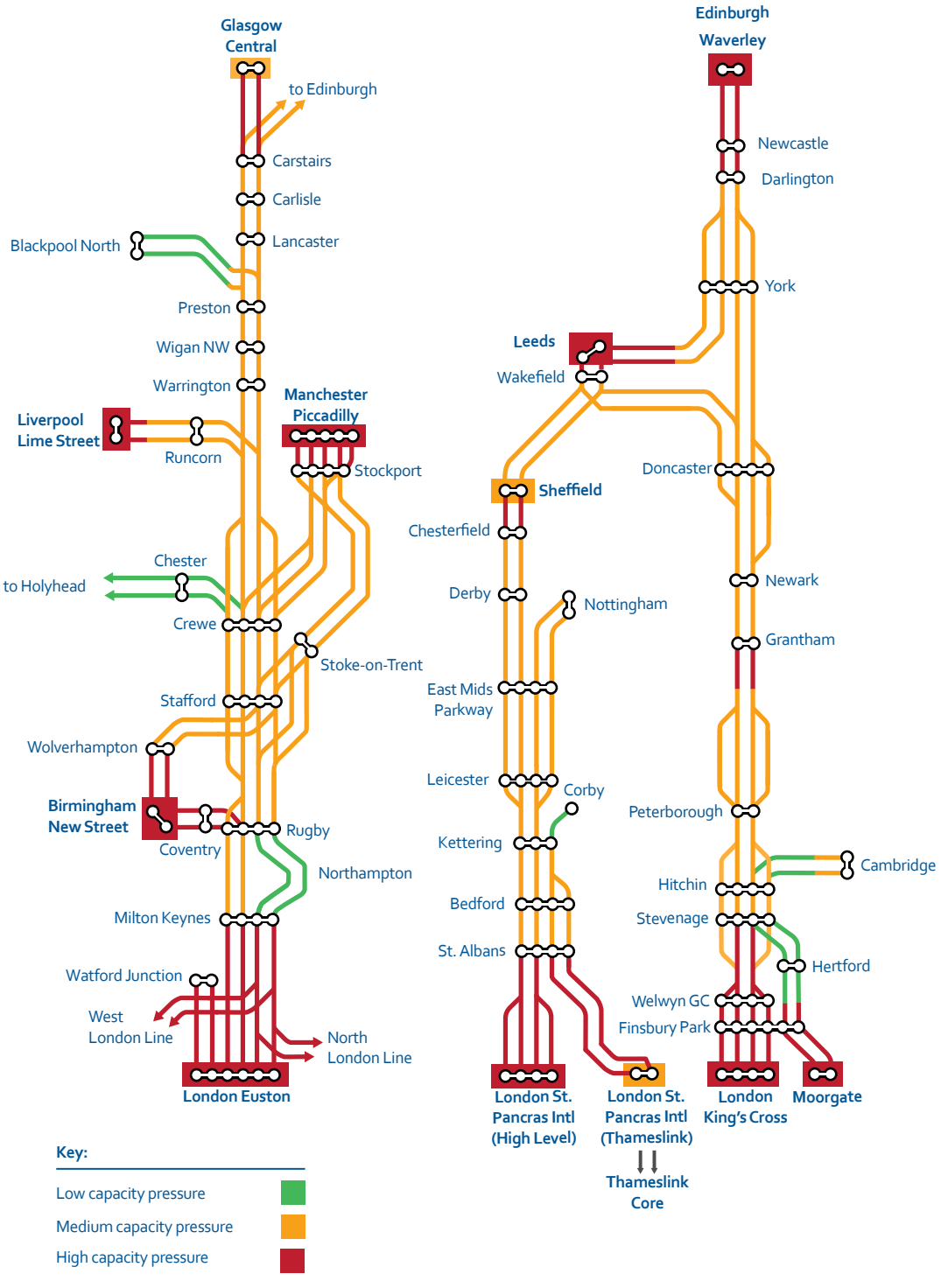
Long distance services on the West Coast Main Line achieve around 85% punctuality, around 4 percentage points worse than the average for other long distance services.



The relevant part of the London Midland franchise, which provides the regional and commuter service on the WCML, is also at around 85% punctuality, 6 percentage points lower than the average for equivalent services.

2.6.12 Figure 2.15 shows the level of demand on the West Coast Main Line.

Figure 2.15: Expert judgement on post-2019 capacity pressures on North-South main lines



2.6.13 Figure 2.15 is based on expert opinion; it is a summary and an overview of a very complex situation after allowance is made for changes being brought about in Control Period 5. In essence it shows that at the approaches to the main cities, the rail network is, in effect, full. It would not be possible to add a further train path in peak travel periods unless something else changes, such as:

- a deterioration in train service punctuality;
- the need to make some changes in the timetables of existing services (e.g. changing stopping patterns, or extending some journey times);
- the introduction of a different type of train;
- route re-signalling;
- the need for a complete re-cast of the train plan; and/or
- significant infrastructure investment.

2.7 Crowding on trains

2.7.1 Much of the growth in capacity that has been provided on our railways in recent years has been accommodated through train lengthening and additional service frequency. Yet on a typical weekday in 2012 over one hundred thousand passengers arriving into London in the morning peak period had to stand[114]. At Euston, over 40% of trains in the morning and evening peak periods already have passengers standing. In the morning peak hour, trains arrive every two and a half minutes, and between them they carry over 11,000 passengers in that hour[115], not including London Overground passengers. Some trains between Euston and Birmingham carry as many as 160 passengers for every 100 seats[116]. Passenger throughput at Euston increased by 16% between 2010 and 2011 alone[117].

2.7.2 Overcrowding is not a problem confined to London. More than 10% of passengers arriving on peak hour services into Birmingham, Leeds, Manchester and Sheffield are standing.

2.7.3 Train operators are responding with innovative mitigations, such as the information on relative crowding on peak services[118]. For instance, London Midland provide information to help passengers choose a less busy train (see Figure 2.16 which also shows that a third of trains leaving Euston in the evening peak three hours entail significant numbers of passengers standing for over 20 minutes).

2.7.4 But ideas like this are not a long-term solution, especially with strong demand growth expected to continue. They help use existing trains more efficiently, but do not add capacity.

[114] Department for Transport, 2012, *Rail passenger numbers and crowding on weekdays in major cities in England and Wales: 2012*, https://www.gov.uk/government/publications/rail-passenger-numbers-and-crowding-on-weekdays-in-major-cities-in-england-and-wales-2012

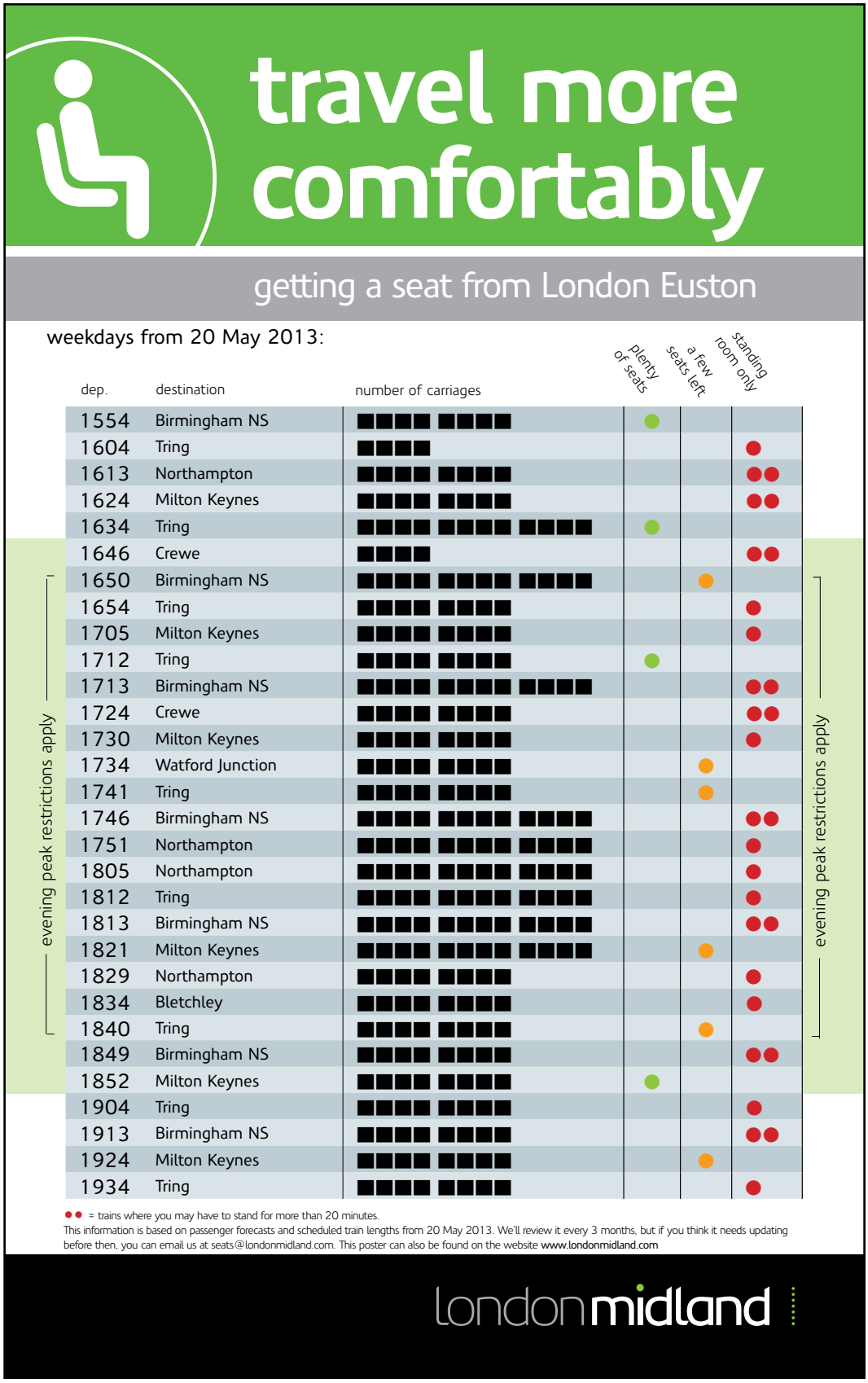
[115] Department for Transport, Rail Statistics

[116] Department for Transport, 2013, R*ail passenger numbers and crowding in several major cities in England and Wales for 2012*, https://www.gov.uk/government/publications/rail-passenger-numbers-and-crowding-on-weekdays-in-major-cities-in-england-and-wales-2012

[117] Network Rail, July 2013, *London North Western Summary Route Plan,* http://www.networkrail.co.uk/browse%20documents/strategicbusinessplan/cp5/supporting%20documents/our%20activity%20and%20expenditure%20plans/route%20plans/london%20north%20western%20route%20plan.pdf

[118] Source: London Midland, © London Midland

Figure 2.16: London Midland advice to passengers



2.8 Illustrating the challenge

2.8.1 Our economic modelling for HS2 has been based on long term projections for all day demand. This gives us the estimates of long term demand that allow us to plan for the future with confidence. The estimates in the economic case assume that long distance demand will grow at a rate equivalent to 2.2% per year for the period until 2036. This demand growth will place growing pressure on rail capacity over the coming decades.

2.8.2 In order to illustrate the impact of this hour by hour, we have looked at overcrowding in terms of the number of passengers compared to the number of seats. This also responds to criticisms by some that our modelling has only been based on all day demand. Currently, on commuter services leaving Euston during the final hour of the evening peak, on average there are 120 passengers for every 100 seats. This means that one in six passengers is standing. The situation on certain trains is worse.

2.8.3 The charts shown in Figure 2.17[119] are illustrative of what the ratio of passengers to seats could look like in the future, assuming that there was no change in behaviour (such as taking a different train or not travelling at all) in response to overcrowding. They look at three different potential demand growth rates, the highest being 5% reflecting the fact that over the last decade total rail demand has grown by an average of 4.4%, while intercity demand has grown by 5.2% per annum.

2.8.4 The possible pattern of overcrowding in future years is illustrated on the following page with scenarios for demand growth rates of 1.5%, 2.5% and 5% shown for commuting and intercity travel at London, Birmingham and Manchester. These graphs reflect today's capacity. Committed and future investments will provide some additional capacity not represented on these graphs. They are intended to illustrate what today's railway may look like with tomorrow's demand. The Euston figures relate to passengers travelling out of central London to destinations beyond Greater London (and Harrow &Wealdstone by fast trains); they do not include London Overground services, which serve shorter distance trips.

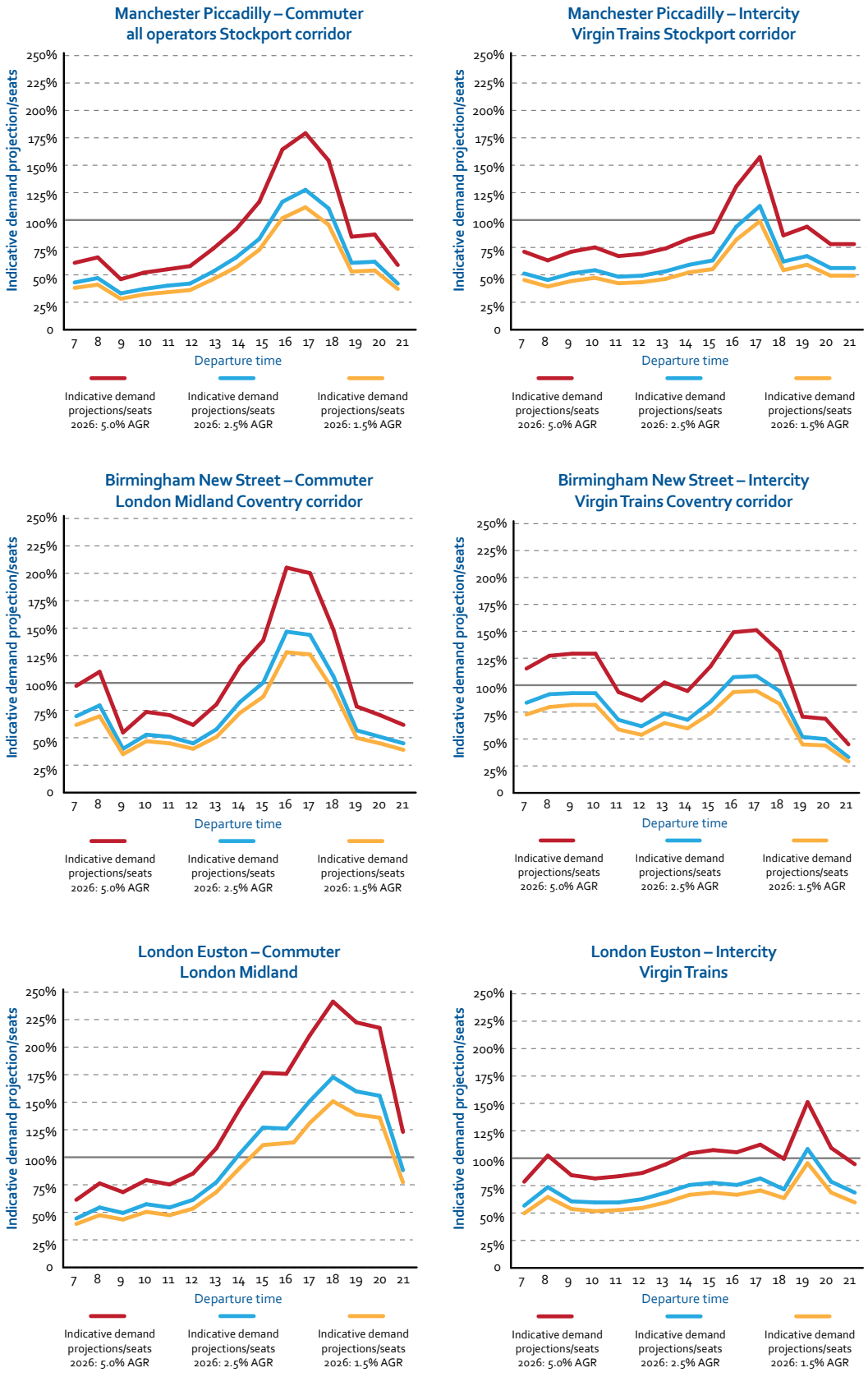
2.8.5 Intercity demand is actually highest on Friday and Sunday afternoons and evenings when people make leisure trips for the weekend in addition to business/work travel. Friday evening demand is 20%-25% higher than mid-week. We would therefore expect individual services to be worse than mid-week average and intercity weekend services to be seriously overcrowded sooner.

2.8.6 Figure 2.17 also illustrates a risk of serious overcrowding on both commuter and intercity routes serving London, Birmingham and Manchester.

2.8.7 These charts are intended to illustrate the scale of the capacity challenge faced by the network and the need to take action beyond what is currently committed. They do not try to second guess future capacity enhancements; they are simple illustrations rather than the product of a complex economic model. They do not take account of behavioural changes in response to overcrowding, or the physical capacity of the train, so some of the very high levels of crowding may not occur. Nor do these charts try to represent traffic forecasts.

[119] Source: Steer Davies Gleave

Figure 2.17: Indicative passenger demand to seat ratios



2.9 The opportunity

2.9.1 There is clearly a significant challenge to overcome. However, there is also a significant opportunity. By taking forward looking decisions about infrastructure and investment instead of trying to mend and make do, we can help significantly improve our transport network.

2.9.2 To try simply to maintain the status quo would be a missed opportunity. We have an opportunity not just to provide a long term solution to the capacity challenge, but also to improve connectivity, particularly between our major cities. Improved connectivity, such as reduced journey times and easier journeys, can help deliver additional benefits and growth, and help make Britain more competitive in the global marketplace.

2.9.3 The example of the Docklands shows how increased connectivity with better transport links – the Docklands Light Railway and the Jubilee line extension – helped support significant regeneration, economic growth and a re-drawing of the economic map of London. Applying the same concept of enhanced connectivity to the links between our major cities is a very significant opportunity to help to re-balance the economy by helping to unlock regional potential, regeneration and growth.

2.10 Conclusion

2.10.1 In summary, the Government has a major programme of investment in hand across the national railway network. The main north-south railways are 'mixed-traffic', with a variety of train types to be accommodated. The pressures created on the network are especially critical on the West Coast Main Line. It is achieving below-par performance reliability and recent applications to add further services to this part of the network have been rejected by the Rail Regulator.

2.10.2 With additional train services increasingly difficult to accommodate, additional demand is being met by train lengthening. The busiest peak services already have the longest trains the network can readily accommodate. But in places demand is already outstripping seating capacity at peak times, with passengers advised which trains to avoid if possible because of the level of overcrowding. And even at only half the recent rate of growth capacity there will be a severe problem by the mid 2020s. Crowding levels will be untenable. A step change is needed.

3 Chapter 3 – Objectives and options

Summary

This chapter sets out our objectives when assessing the options for meeting the capacity challenge. The overarching objective is to support a robust, balanced economy that delivers growth. To do this, we must provide the capacity to meet rising demand and improve the connectivity between our cities. Any solution should minimise disruption on the existing network, use proven technology, be affordable and represent good value, and minimise the impacts on local communities and the environment. The chapter then assesses options against these objectives, including a do-nothing case, using fares to manage demand, as well as domestic aviation, roads and rail.

3.1 Objectives

3.1.1 Government's role is to build a stronger, more balanced economy capable of delivering lasting growth and widely shared prosperity[120]. Transport plays a key part in this.

3.1.2 In that context, our objectives are to:

- provide sufficient capacity to meet long term demand, and to improve resilience and reliability across the network; and
- improve connectivity by delivering better journey times and making travel easier.

3.1.3 Any solution must:

- 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; and
- minimise impacts on local communities and the environment.

3.1.4 We have assessed a wide range of policy options against these objectives to meet the challenges identified in Chapter 2.

[120] See HM Government, 2013, *The Coalition: together in the national interest – Mid-Term Review*, http://assets.cabinetoffice.gov.uk.s3-external-3.amazonaws.com/midtermreview/HMG_MidTermReview.pdf

3.2 Options

Do nothing

3.2.1 One option would be to do nothing. Instead of providing new or better infrastructure the Government could allow the finite capacity of the existing network to limit demand. This would effectively mean allowing crowding to worsen to such an extent that individuals would be deterred from travelling.

3.2.2 However, not providing for growing demand would not fit with the Government's objectives for economic growth and could significantly constrain the UK's economic potential. Nor is it consistent with the 2011 National Infrastructure Plan's aim 'to improve connectivity and capacity between main urban areas and between them and international gateways, to deal with longer term capacity constraints'[121].

3.2.3 We do not believe it is tenable to do nothing. In addition to the negative economic effects, there would be severe individual impacts either crowding people off the network, or allowing the experience to become so unpleasant that people choose not to travel.

Using fares to constrain demand

3.2.4 We have recently published the *Rail Fares and Ticketing Review* which sets out the Government's fares policy. This considers the scope for demand management through price-setting, which could help to postpone the need for large infrastructure schemes by spreading demand beyond peak times. We have announced plans for a flexible ticketing trial to examine the potential of using flexible fares to do this.

3.2.5 These initiatives are not intended to limit overall demand or price people off the railways. The Government has explicitly ruled out any 'super peak' pricing for demand management.

3.2.6 To use fares to manage demand and meet the scale of the challenge set out in Chapter 2 would require very large price increases during the busiest times. Evidence suggests that to produce a 3% switch in travel away from the morning peak hour would need a 40% fare differential[122]. To suppress demand across the network would therefore involve very significant and highly undesirable price rises. It would also not improve connectivity, our other key objective. It would have serious consequences for economic productivity and growth.

Aviation

3.2.7 The Government's aviation policy is set out in the *Aviation Policy Framework* (2013). This summarised the Government's approach to the relationship between aviation and rail by noting that 'an important part of our approach is to enable more people to take the train, instead of air transport, for domestic and short-haul European journeys, both in order to achieve environmental benefits and to release capacity at airports'.

[121] See HM Treasury, 2011, *National Infrastructure Plan*, https://www.gov.uk/government/publications/national-infrastructure-plan-november-2011

[122] Steer Davies Gleave, 2011, *Rail Value for Money Study: Research Project on Fares*

3.2.8 Domestic aviation is also unlikely to be the most appropriate option for increasing domestic intercity capacity. Air travel is most economically viable for journeys over 400 miles[123], which is about the distance from London to Glasgow or Edinburgh. London to Manchester is around 200 miles and Birmingham to London around 100. Check-in times mean that for many shorter intercity journeys, road or rail will almost always be a better option than domestic aviation.

Road

3.2.9 Another option could be to significantly increase road capacity. The strategic road network is of vital importance and we have a policy to increase capacity. However, we do not believe that increasing road capacity alone is the solution to meeting our strategic objectives.

3.2.10 In Chapter 2 we described the Government's decision to provide the biggest ever upgrade of our strategic road network. By 2021, spending on road enhancements will have tripled. This will counter the effects of past under-investment, maintain the network and add some extra capacity where it is needed to ease congestion on existing motorways.

3.2.11 But, these enhancements do not provide the additional capacity needed to allow roads alone to soak up the predicted increase in passenger demand. Significant as they are, they are only part of the wider transport response. To put into context the scale of road building that would be required, HS2 will deliver capacity roughly equivalent to two new dual three-lane motorways. We also know that roads are not well suited to improving connectivity between city centres, because traffic speeds are limited, or for providing additional commuter capacity into major cities, because of the traffic constraints that exist there.

Rail

3.2.12 We believe that expanding the rail network is the only way to meet all our strategic objectives. It could provide huge extra capacity and improve connectivity with fast, reliable and frequent services.

3.2.13 Rail supports cities and urban centres better than the alternatives. It reinforces more sustainable patterns of development. It complements initiatives being taken in urban transport to reduce carbon and improve air quality. It will help drive economic growth for businesses and for employers generally by expanding travel to work catchment areas. In the process it will open up more choices for individuals in terms of places to work.

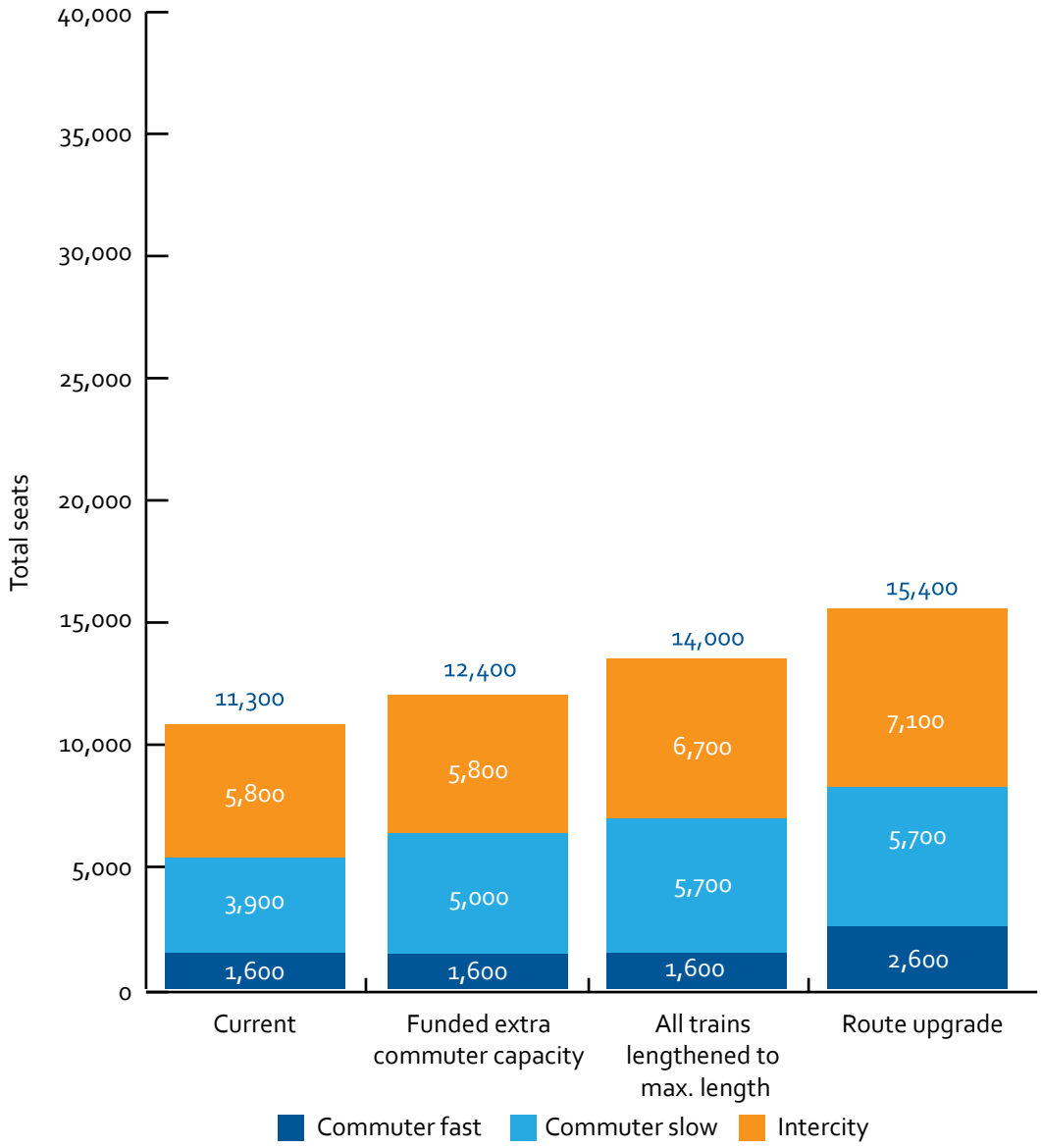
3.2.14 The extent to which we increase capacity and improve connectivity depends on how we expand the network. We have a choice – we can either continue with incremental improvements to the existing network, or deliver transformational change by building new lines.

3.2.15 We have done a significant amount of work to design and assess a range of possible alternative works we could do to the existing network including specifically for the West Coast Main Line. This work is described in Chapter Six – Assessment of Strategic Alternatives.

[123] Steer Davies Gleave, 2009, *Potential for Modal Shift from Rail to Air for UK Aviation*

3.2.16 Figure 3.1[124] shows the maximum capacity measured using peak hour service patterns of the alternatives we have considered at Euston. The first column represents current capacity. The second, the currently committed and funded capacity improvements. The third column assumes that all current trains are extended to their maximum lengths. The final column shows the impact of additional works to the West Coast Main Line, with three extra peak hour trains, with all trains running at maximum length. The total capacity gain achievable is 36%[125].

Figure 3.1: London Euston peak hour departure capacity



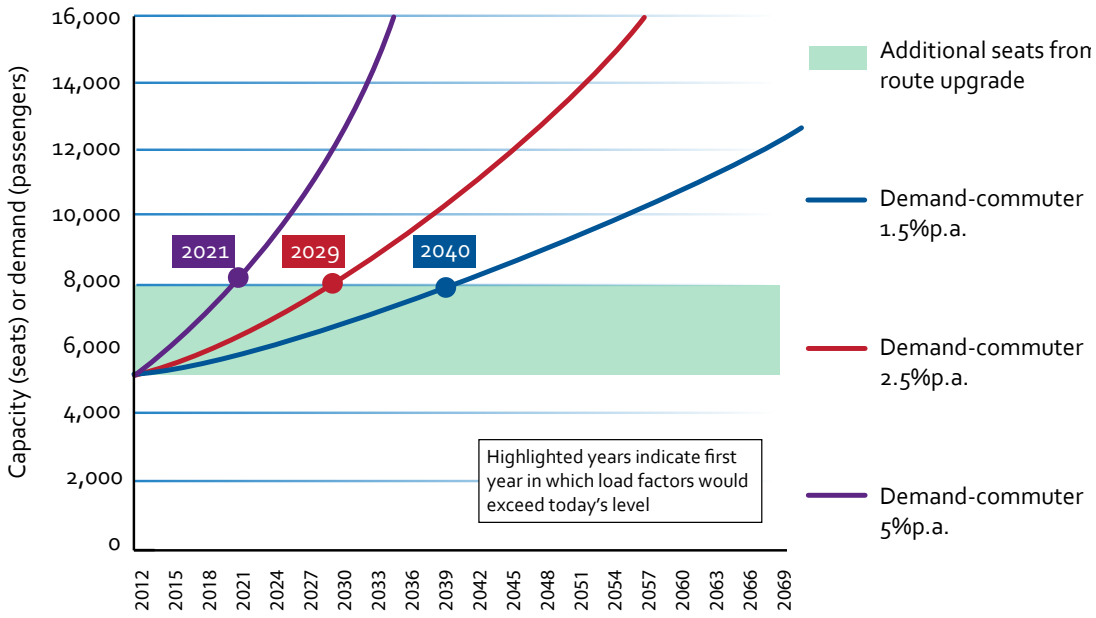
These options provide a limited capacity

[124] Source: Department for Transport and Steer Davies Gleave

[125] This analysis is based on the evening peak, with a peak demand for commuters from 17h00-18h00 and the peak hour for intercity travel occurring later, and with significantly higher travel volumes at weekends (Friday/Sunday evenings). The morning peak hour is more 'peaked' with higher levels of overcrowding on individual trains. Services departing London Euston in the evening peak, from 17h00-18h00. It excludes consideration of local London services provided by London Overground at Euston

3.2.17 The extra capacity for commuters is provided in the upgrade alternative by adding two extra peak hour trains and lengthening all trains to the maximum of 12-cars. Figure 3.2[126] sets out the illustrative calculations of how commuter demand could grow under different scenarios. The calculations have different assumptions from those in the economic model, which is based on demand across the whole day. The graph also sets out today's demand (the bottom of the shaded green area) and the extra seated capacity the route upgrade could provide (the shaded green area). The top of the shaded green area represents the level of demand at which today's crowding conditions would recur with the capacity upgrade. The calculation demonstrates that the extra capacity provided by route upgrades would be fully used up by 2029 under the 2.5% scenario and by 2021 under the 5% scenario. At this stage for every seat added an additional commuter will be travelling. So with the upgrade alternative, at some stage in the 2020s, based on this analysis with a growth rate of at least 2.5%, commuters would be back to facing the same conditions as today – with the train operator advising on which specific trains to avoid because of overcrowding. The difference is that by then all practical means of adding further capacity would have been used up.

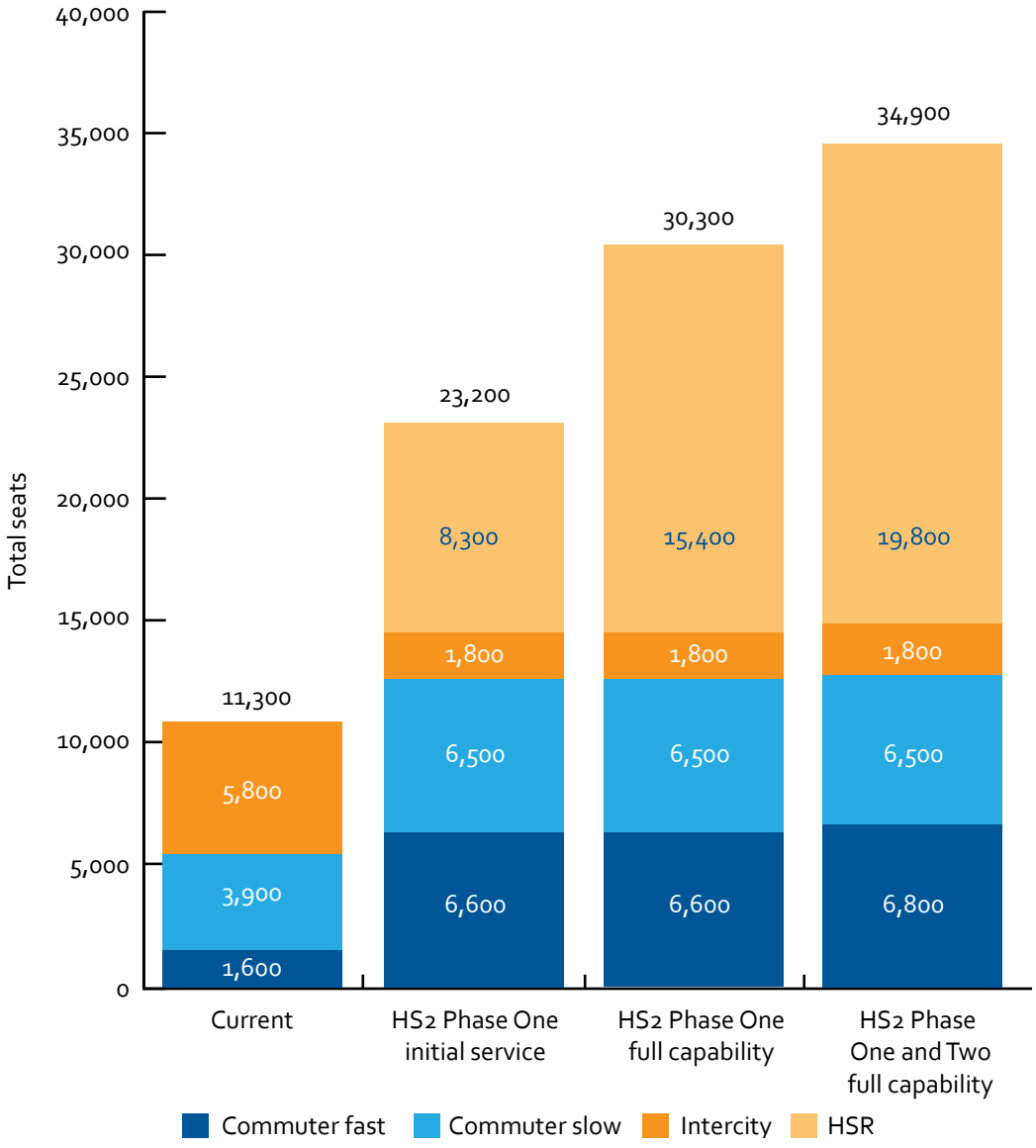
Figure 3.2: Commuter demand and route capacity achievable through upgrading the existing West Coast Main Line



[126] Source: Steer Davies Gleave

3.2.18 For intercity travellers, the trains are less suited to accommodating standing passengers, passengers travel with more luggage and there is a weekend as well as a daily peak pattern of demand to be accommodated. For this market, the upgrade would add an extra intercity peak train and would provide full length 11-car trains across the whole fleet. Our estimates of peak demand assuming 5% annual growth indicate that the extra seating capacity created would be used up by 2020. In other words, for every extra seat provided for intercity travellers, an additional passenger would be travelling. When this situation is reached, in the Department's view, there will be no practical prospect of further enhancement. And by 2028, at this rate of intercity demand growth, there would be as many passengers as seats across the evening peak hour, which in practice means serious levels of overcrowding.

Figure 3.3: London Euston peak hour departure capacity



3.2.19 Figure 3.3[127] shows the capacity at Euston with HS2. Compared with today's capacity, ultimately HS2 will triple the seats available. The initial Phase One service plan for HS2 in 2026 doubles seating capacity and more than doubles commuter seat capacity, where the crowding pressure is greatest.

3.2.20 Our conclusion is that only a new railway will deliver a step change in terms of increased capacity. There is a choice when building a new railway – classic rail, or high speed rail. A conventional speed line would cost 9% less than a high speed line, but would deliver far fewer benefits in terms of journey time savings. A conventional speed line would have impacts on local communities, as would high speed rail. Overall, the journey time benefits from high speed outweigh the additional costs when compared to a conventional line by a factor of more than five to one[128].

3.2.21 In addition, a new north-south railway line would release capacity on the existing East Coast, West Coast and Midland Main Lines. This would mean that in addition to new high speed services we would be able to provide new commuter, regional and freight services using the space that was previously occupied by traffic transferred to the high speed line.

3.2.22 A new north-south railway will therefore have a double dividend – it will revolutionise intercity travel on the new railway; and it will also release capacity on the existing mainlines for new services, including more frequent and more reliable commuter and regional services and for freight. This is explained in more detail in Chapter 4.

[127] Source: Department for Transport, HS2 Ltd and Steer Davies Gleave. The HS2 Phase One and Phase Two Full Capability scenarios assume that longer 400m trains operate on the existing network, which would require additional investment

[128] Department for Transport, February 2011, *Economic Case for HS2,* http://assets.hs2.org.uk/sites/default/files/inserts/hs2-economic-case.pdf

4 Chapter 4 – HS2: The preferred option

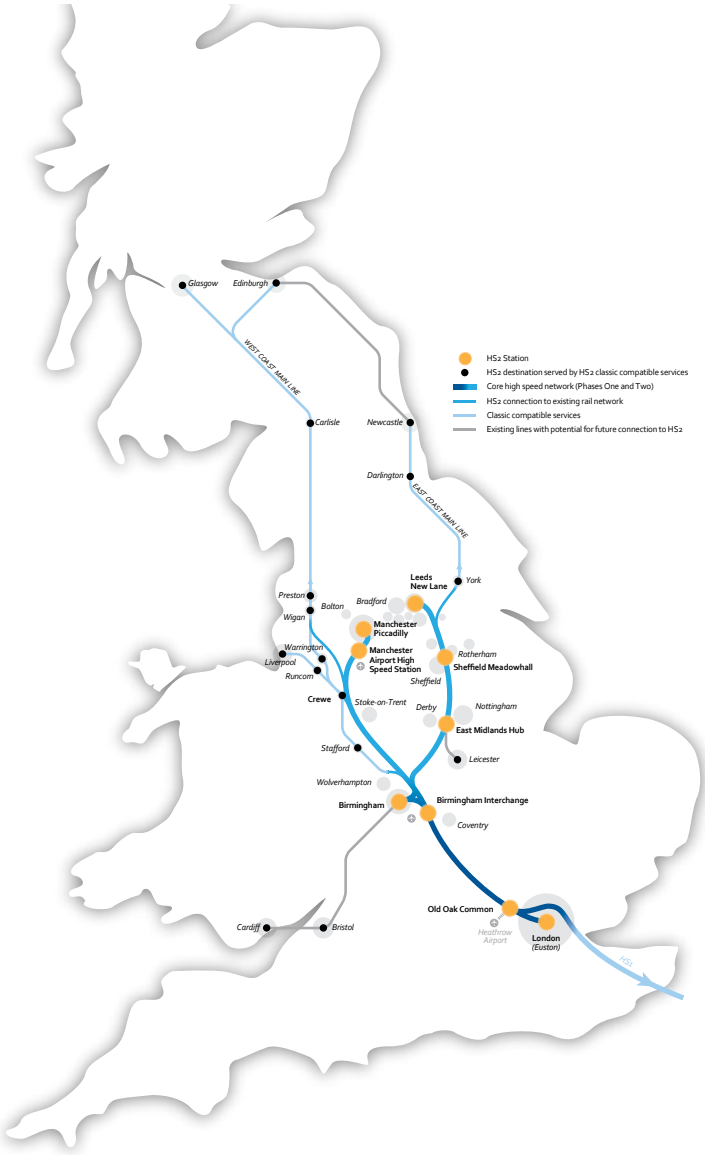
Summary

This chapter describes the scope of HS2; explains how it delivers against the objectives set out in Chapter 3 and how it will be fully integrated into the UK transport network.

4.1 The new railway

4.1.1 HS2 represents the Government's preferred option to meet the objectives and address the problems described in the previous chapters. It is designed to be a long term answer to the capacity problem we face and a radical way to improve the connections into and between our major cities. It will be built in two phases. See Figure 4.1[129].

Figure 4.1: Vision for high speed Britain



[129] Source: HS2 Ltd

4.1.2 Phase One of HS2 will see a new high speed line constructed from Euston to north of Birmingham, where it will reconnect with the existing West Coast Main Line allowing fast services to serve important destinations on the existing line including Manchester, Liverpool, Crewe, Preston and Glasgow. In Phase One, about half of the mileage covered by HS2 trains will be on today's main lines. New high speed trains will serve Birmingham city centre and an interchange station serving Birmingham Airport and 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. The Crossrail journey from Old Oak Common to Heathrow will take 11 minutes.

4.1.3 The proposals for Phase Two will see the line extended north and east, to join up with the West Coast Main Line north of Warrington and with the East Coast Main Line approaching York. There will be new stations in the city centres of Manchester and Leeds, with intermediate stations in the East Midlands at Toton and near Sheffield in South Yorkshire at Meadowhall.

4.1.4 HS2 will be built using proven railway technology which is already widely in service around the world and has been designed using integrated system engineering principles to deliver very high performance. Modern train control systems and rolling stock will ensure a punctual and reliable service. International high speed networks routinely operate with very high levels of punctuality and we expect the same from HS2.

4.1.5 HS2 is designed to a top speed of 250mph although trains will run at up to 225mph – the standard for new high speed lines. Operation at 250mph will be possible, but the noise impacts (for example) will need to be considered first. New stations on the line will be built to accommodate 400m long trains – much longer than trains in use today, each capable of carrying up to 1,100 passengers.

4.2 Capacity

4.2.1 The modelling set out in the economic case for HS2, published alongside this document, shows that there is a long term demand for additional capacity on our north-south railways.

4.2.2 HS2 will provide a very significant expansion of the network's ability to carry passengers and freight. The high speed line itself would be capable of carrying fourteen trains per hour in each direction, rising to eighteen trains when the network is complete. New stations on the line would be built to accommodate 400m long trains – much longer than those currently in use on the network and each capable of carrying up to 1,100 passengers.

4.2.3 At the same time as transforming intercity travel, space will be released on the existing network to enable commuter and freight traffic to grow, and for a well-planned timetable of other services to places not served by HS2. At present intercity trains occupy 11 of the 14 hourly train paths on the West Coast Main Line fast lines. These will be available for new services.

4.2.4 There are many options for making best use of this released capacity, including extra commuter and freight trains, and other regional and local services that would otherwise be impossible to run. Network Rail estimate that over 100 cities and towns could benefit from new or improved services as a result of capacity released on the existing rail network[130]. By increasing capacity in this way, there is also the chance to relieve pressure on the overworked main lines and help improve performance, reliability and timetable resilience.

4.2.5 HS2 Ltd and Network Rail have started work to identify the opportunities for new services. It is too soon to set a final train timetable at this stage –but it is the beginning of a process which will allow us to identify the best possible use of the post-HS2 rail network.

4.2.6 The Government intends to apply the following high level principles in making best use of the released capacity that HS2 delivers:

- an aim that all places with a direct London service today retain a broadly comparable or better service after HS2 opens;
- to provide additional commuter capacity where it is most needed;
- to spread the benefits of long distance and inter-regional services to the many towns and cities that can be served by the capacity created on the existing rail network;
- to fully integrate HS2 services into the wider national rail network;
- to provide capacity for the growing railfreight sector; and
- to improve performance by making timetables more robust.

Our aim is that all towns or cities which currently have a direct service to London will retain broadly comparable or better services once HS2 is completed. Planning the future use of the network, at high speed and conventional speed, is a major task that will need to involve Government, the rail industry and the views of passengers. Decisions on future services will be taken nearer the time, but we will shortly be taking the next step in considering long-term issues, opportunities and options for rail services on HS2 corridors, factoring in how these services can support the delivery of economic growth on a sustainable basis. We will seek a wide range of views, including from rail industry representatives such as Network Rail and the train and freight operators, as well as members of Parliament, and other interested parties such as local and regional bodies. We will announce further details of the process shortly.

4.2.7 The work has identified the following potential service improvements.

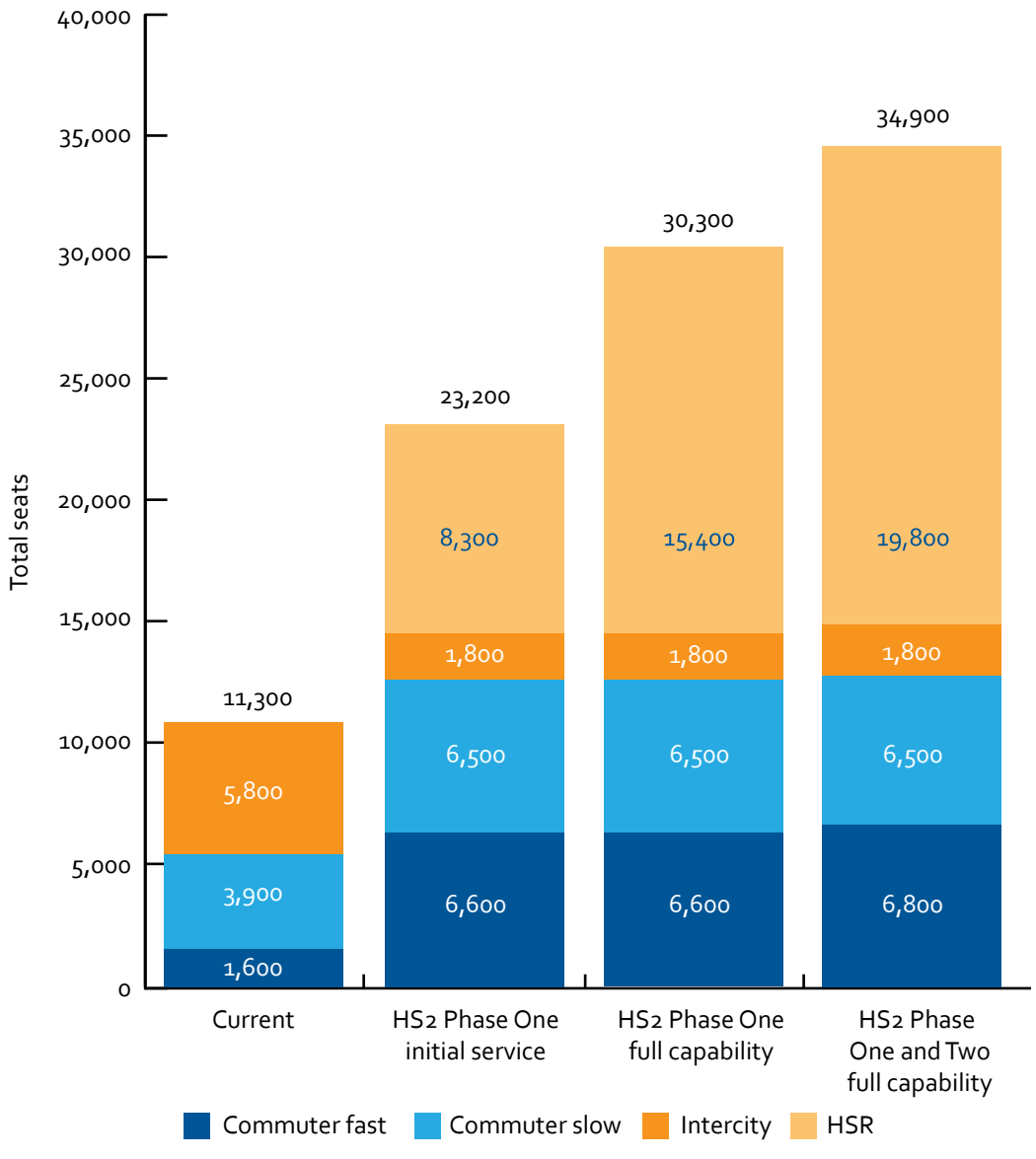
[130] Network Rail, 2013, *Better connections: options for the integration of High Speed 2*, http://www.networkrail.co.uk/improvements/high-speed-rail/better-connections-options-for-the-integration-of-high-speed-2.pdf

4.3 Phase One – options for improved rail services

4.3.1 The construction of the new high speed line between London and Birmingham will allow the potential for improved services on today's West Coast Main Line; not only on the new high speed line, but also on the classic rail network. Phase One will bring substantial benefits in its own right, providing additional capacity and improved connectivity.

4.3.2 Figure 4.2[131] illustrates the scale of the step change in capacity offered by HS2. It will dramatically increase capacity at Euston[132].

Figure 4.2: London Euston peak hour departure capacity with HS2

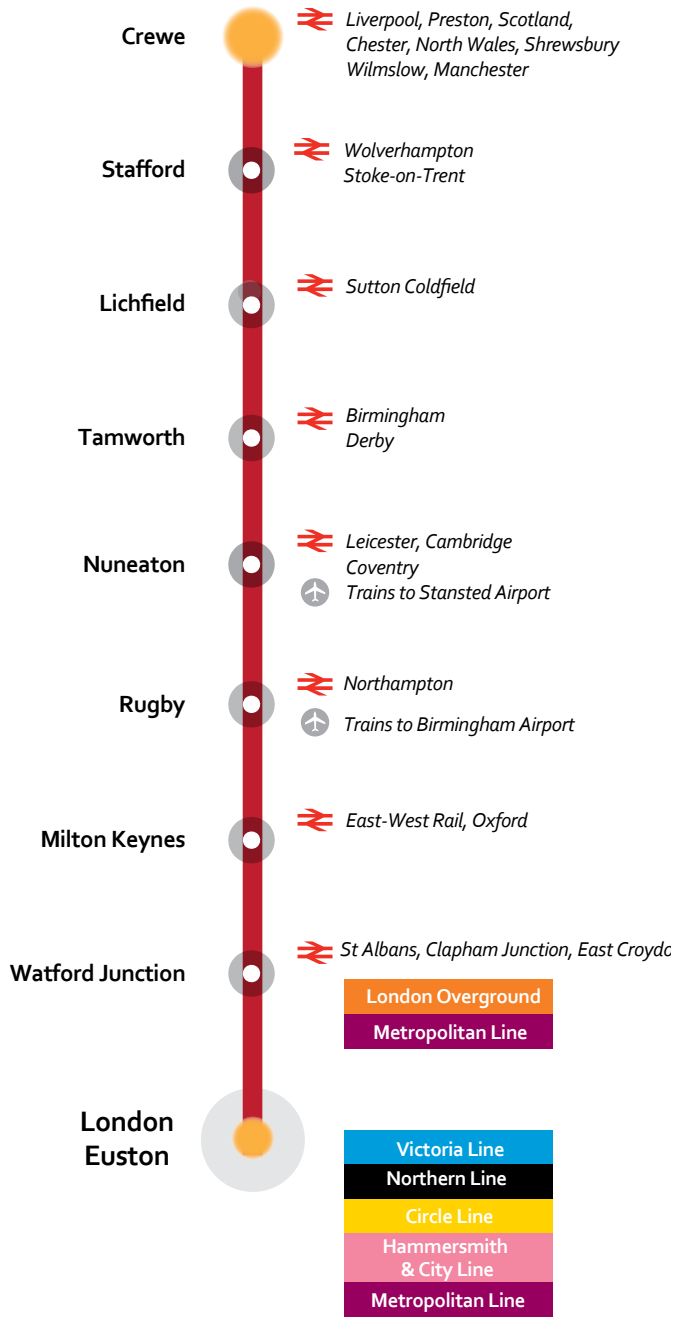


[131] Source: Department for Transport, HS2 Ltd and Steer Davies Gleave

[132] The HS2 Phase One and Phase Two Full Capability scenarios assume that longer 400m trains operate on the existing network, which would require additional investment

4.3.3 Between Euston and Birmingham, the West Coast Main Line timetable could be restructured, offering better services from locations such as Coventry, Rugby, Northampton, Milton Keynes and Watford. This will bring significant benefits to commuters. There is the potential to create a high quality network of intercity rail services for places not directly served by HS2. It would make it possible to run services so that the stations illustrated in Figure 4.3 meet their full potential as connecting hubs.

Figure 4.3: Better network of services to intermediate destinations



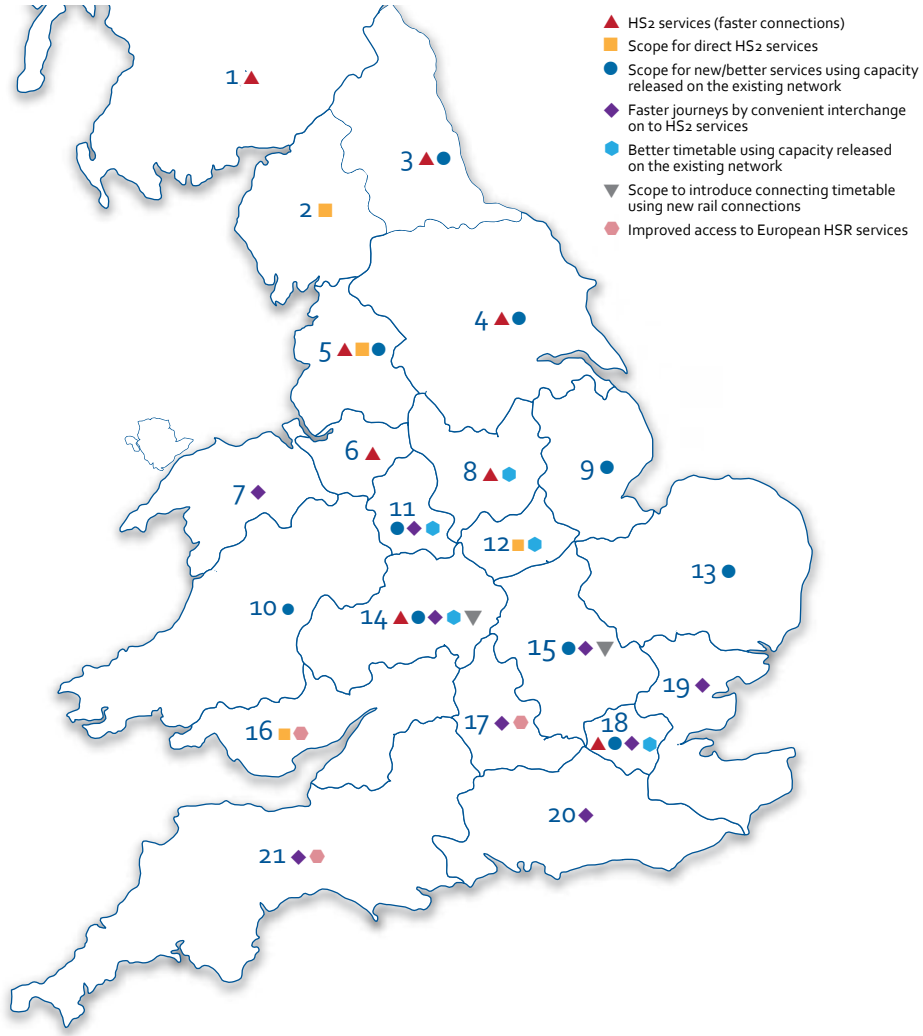
4.4 Phase Two – options for improved rail services

4.4.1 Phase Two will provide new lines directly to the heart of Manchester and Leeds, and will also serve Sheffield, East Midlands and Manchester airport with new stations. These will unlock further improvements to the existing rail network. These would include:

- more capacity for local and regional services serving the West Midlands from the North, Staffordshire, Cheshire and Manchester;
- a re-orientation of the routes from Leeds to Sheffield, Wakefield and Doncaster, allowing more frequent commuter trains into these centres; and
- a bypass of the congested East Coast Main Line, especially the two-track bottleneck south of Stevenage.

4.4.2 The service improvements that could be brought about by the full Y network and released capacity on the classic network are very widespread (see Figures 4.4 and 4.5)[133].

Figure 4.4: How HS2 will improve services across the country



[133] Source: Steer Davies Gleave and HS2 Ltd

Figure 4.5: How HS2 could improve services across the country

Key	County, region or nation	Benefits D – Direct (all on HS2 trains), I – Indirect (partly on HS2 trains) R – Released Capacity (new classic service)
1	**Scotland**	**Faster trains to Preston, Birmingham and London, from Glasgow and Edinburgh.** Services from Aberdeen to London in 6:11. From Edinburgh or Glasgow to London in 3:37. Services from Motherwell to Birmingham in 3:12. D
2	**Cumbria**	**Scope for direct HS2 services to London.** Carlisle will be 2:50 from London and 2:05 from Birmingham. D
3	**North-East**	**Direct HS2 services from Newcastle and Darlington to London and Birmingham.** Darlington to London wil take 1:51 instead of more than two hours at present. Durham will be less than two hours from Birmingham. Newcastle will be 2:18 from London and 1:10 from Sheffield Meadowhall. D Scope for additional services from Sunderland and Tees Valley using capacity liberated on the East Coast Main Line. R
4	**Yorkshire**	**HS2 services from Leeds, York and Sheffield Meadowhall.** Leeds will be less than an hour from Birmingham and 1:22 from London; Meadowhall will be 1:10 from London and only 38 minutes from Birmingham. D Trains from Sheffield city centre will take 1:19 to London and 48 minutes to Birmingham. Possible faster direct service: e.g. (Halifax) – Bradford – Wakefield – London; and Harrogate – London. R Bradford will be two hours from London. I Possible direct service Leeds – Cambridge/Stansted. R Barnsley to Birmingham in 1:12, and to London in 1:44. Rotherham to Birmingham in 1:03. York to Heathrow will take 1:36, more than an hour faster than at present. I Opportunities for new services from Hull to London and Leeds. R
5	**Greater Manchester, Merseyside and Lancashire**	**HS2 services from Liverpool, Manchester, Preston, Wigan.** Liverpool will be 1:33 from London,. Manchester will be 3:53 from Paris and Brussels. Services from Preston to Birmingham in 53 minutes. Warrington to London will take 1:13, and Wigan to Birmingham will take only 35 minutes. D Runcorn to Heathrow will take 1:28. I Possible new direct services from Blackpool to London Euston, with a journey time of less than two hours. R Possible HS2 services from Lancaster. D
6	**Cheshire**	**HS2 services between Crewe and London will take less than an hour.** D
7	**North Wales**	**Faster journeys to Birmingham and London via Crewe.** I
8	**Derbyshire and Nottinghamshire**	**HS2 services from Toton** - direct services will take only 51 minutes. Trains from Derby to London will take 1:11 and from Nottingham 1:08. D/I
9	**Lincolnshire**	**Possible increase in direct services from Lincoln to London.** R

Key	County, region or nation	Benefits D – Direct (all on HS2 trains), I – Indirect (partly on HS2 trains) R – Released Capacity (new classic service)
10	**Shropshire and Mid-Wales**	**Possible new direct services from Shrewsbury/Telford to London Euston.** R
11	**Staffordshire**	**Better London services from Lichfield and Tamworth.** Stafford to London services will take only 53 minutes, rather than 1:15. R Direct access from the Potteries to HS2 hub at Crewe. I
12	**Leicestershire**	**Better Midland Main Line timetable.** R **Scope for HS2 services to Yorkshire and the North East.** I
13	**East Anglia**	**Possible new direct service to Leeds via East Coast Main Line.** R **Scope to expand Cambridge – Kings Cross commuter services.** R
14	**Birmingham, West Midlands, Warwickshire, Worcestershire and Herefordshire**	**HS2 services from new Birmingham city centre station integrated with both Moor Street and New Street stations.** D **Birmingham Interchange station will connect destinations across the West Midlands to other destinations -** for example, Nottingham will be 32 minutes away.I **Birmingham to Paris in three and a half hours.** **Faster services to Scotland/North-West England and Yorkshire and the North East via HS2.** D **More capacity for commuter services in the Coventry – Birmingham corridor.** R **More capacity for Coventry – London passengers.** R **Peak-hour fast services to Milton Keynes.** R **More Nuneaton – London fast services.** R **Capacity to introduce Kenilworth services.** R
15	**Bedfordshire, Hertfordshire Buckinghamshire and Northamptonshire**	**More capacity for commuter trains to London.** R **More fast commuter services to London.** R **More long-distance intercity services from Watford Junction.** R **Direct fast connections from Milton Keynes with cities in the West Midlands and North West – including peak-period services, currently precluded by capacity constraints.** R **Connecting timetable with services over East–West rail link at Milton Keynes.** R
16	**Bristol, Gloucestershire and South Wales**	**Possible direct services using HS2 to the North West, Yorkshire and North East.** D Bristol to York will take 2:45, rather than four hours at present. Cardiff to Leeds will take around three hours instead of over four, and Cheltenham to Leeds will take less than 2 hours. I **Easier access to European high speed services through interchange at Old Oak Common.** I
17	**Berkshire and Oxfordshire**	**Access to fast HS2 services to the North via Old Oak Common.** I Reading to York will take less than two hours and services to Manchester will take 1:46. I **Access to European high speed services via interchange at Old Oak Common.** I
18	**London**	**HS2 services to the Midlands, the North and Scotland.** D **More commuter capacity from Milton Keynes/South Midlands.** R **Improved connectivity from Crossrail.** I
19	**Kent and Essex**	**Scope for faster journeys to the Midlands/North via HS1 – HS2 link.** I
20	**Surrey, Sussex and Hampshire**	**Faster journeys to the North and Scotland, via Euston.** Brighton to Manchester will take 2.52. Southampton to Liverpool will take 3:46. I
21	**South-West**	**Potential for direct services from Bristol to the North via Birmingham.** Exeter will be 3:42 from Leeds and 3:50 from York. I **Access to European high speed services via interchange at Old Oak Common.** I

4.5 Freight

4.5.1 As described in Chapter 2, demand for rail freight is expected to double over the next thirty years. It might not be possible to accommodate this with our existing infrastructure. But HS2 has the potential to increase the amount of freight that can be carried by rail between London and the West Midlands by using the existing mainline capacity that it releases.

4.5.2 Each freight train typically takes 40 lorries off the roads[134], thereby easing congestion, reducing carbon emissions and improving safety. HS2 could provide space for an extra 20 West Coast Main Line freight paths (and possibly more subject to detailed train planning). As an indication of the value of additional freight paths, previous analysis carried out by WSP (*HS2 and Freight – A Hidden Benefit*) concluded that 40 additional freight paths could remove up to 1,600 lorries a day from the motorways and could deliver benefits of up to £1.3bn to the economy. The forecast growth in the industry is encouraging and the Government is committed to working closely with the industry to discuss the options and develop plans for making the best use of the released capacity, both for passengers and freight.

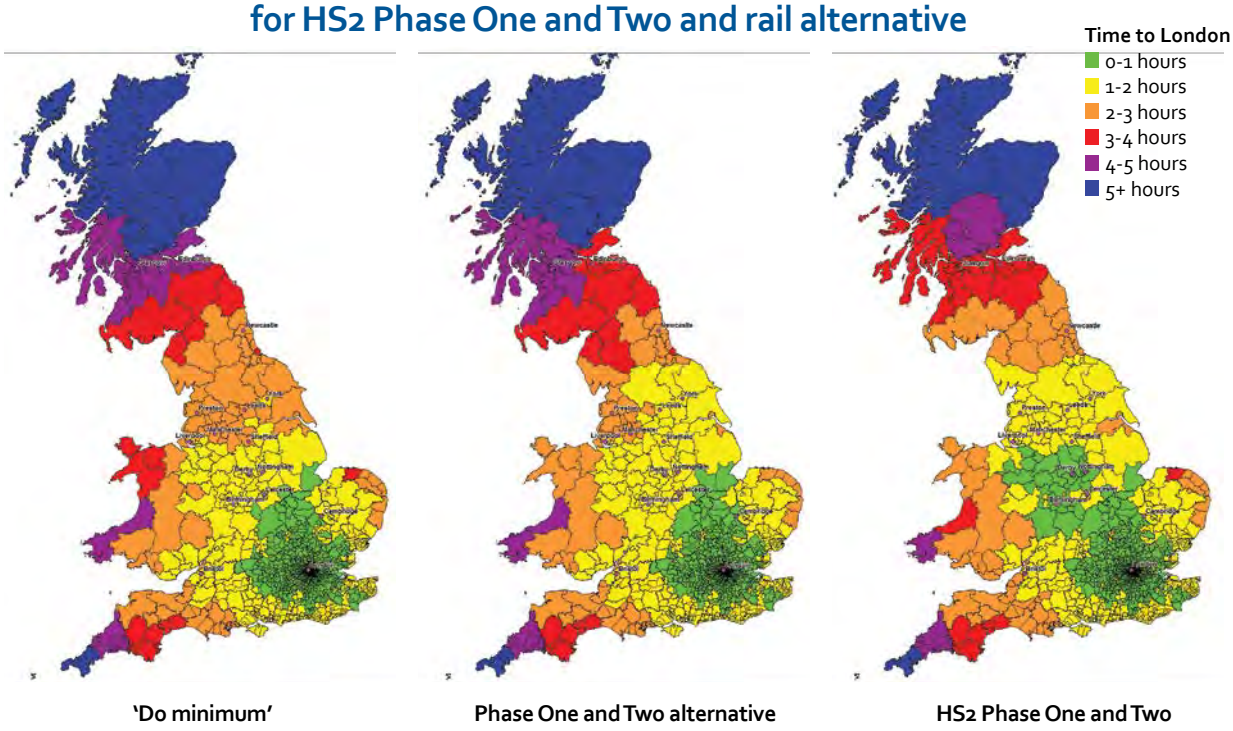
4.6 Improving connectivity

4.6.1 Integrated into the existing rail network, HS2 will deliver more frequent, more reliable and faster journeys between our major economic centres. It will connect 8 out of our 10 largest cities (London, Birmingham, Manchester, Liverpool, Glasgow, Edinburgh, Sheffield and Leeds) and bring two-thirds of the population of England within two hours of London.

[134] WSP, 2013, *HS2 Could Save Carbon and Money in Increased Freight Capacity (news release)*, http://www.wspgroup.com/en/WSP-UK/Who-we-are/Newsroom/News-releases1/2013/hs2-could-save-carbon-and-money-in-increased-freight-capacity/

4.6.2 The maps in Figure 4.6[135] show the impact HS2 will have on journey times to London from the rest of the country. They illustrate the journey time assumptions that we make for modelling purposes to illustrate potential savings between different parts of the country and London stations (the green shaded areas are within one hour of London, the yellow shaded areas within two hours). It also shows that HS2 delivers significantly better connectivity than the best alternative.

Figure 4.6: Illustrative journey time comparisons for HS2 Phase One and Two and rail alternative



4.6.3 But HS2 is not only about travel to London. It will provide new links between eight out of our ten largest cities, and in particular between the Midlands and the North of England. The Birmingham, East Midlands, Sheffield and Leeds stations will each be connected by journeys of less than 20 minutes. This uplift in connectivity will unlock significant productivity benefits for the economy. Birmingham, Manchester and Leeds commuter trains will no longer share the track with long distance express trains, making it easier for labour markets serving these great cities to expand. Businesses will be able to access wider markets and it will be easier for people to make new contacts and meet their work commitments. Horizons will expand for both individuals and businesses. The economic geography of the country will be transformed.

4.7 Journey time savings

4.7.1 Even in Phase One journey time savings will be important and noticeable, but Phase Two will offer even more opportunities for faster and more varied journeys which take advantage of HS2 for at least part of the trip. Figure 4.7[136] shows how HS2 would transform journey times between various towns and cities, both on and off the HS2 network in 2033. For illustrative purposes, a 20-minute interchange is assumed where passengers would have to transfer on to the classic rail network to complete their journey, although in practice interchange times could be longer or shorter.

[135] Source: Atkins
[136] Source: Steer Davies Gleave

Figure 4.7: Journey times on the enhanced national network

ABERDEEN	HS2	Now
*LONDON	06:11	07:04
*BIRMINGHAM	06:07	06:38

BARNSLEY	HS2	Now
*LONDON	01:44	02:27
*BIRMINGHAM	01:12	01:41

BIRMINGHAM	HS2	Now
LONDON	00:49	01:21
*GATWICK	02:04	02:25
*HEATHROW	01:00	02:12
*PARIS	03:30	04:26

BIRMINGHAM INTERCHANGE	HS2	Now
LONDON	00:38	01:13
*NOTTINGHAM	00:32	01:46

BLACKPOOL	HS2	Now
*LONDON	02:02	02:40
*BIRMINGHAM	01:35	02:13

BRADFORD	HS2	Now
*LONDON	02:00	02:50
*BIRMINGHAM	01:33	02:40

BRIGHTON	HS2	Now
*MANCHESTER	02:52	03:39
*GLASGOW	05:21	05:49

BRISTOL	HS2	Now
*YORK	02:45	03:59
*EDINBURGH	05:06	05:44

CARDIFF	HS2	Now
*LEEDS	03:13	04:07
*EDINBURGH	05:42	05:53

CARLISLE	HS2	Now
*LONDON	02:50	03:16
BIRMINGHAM	02:05	02:40

CHELTENHAM	HS2	Now
*LEEDS	01:55	02:50
*EDINBURGH	04:24	05:03

CREWE	HS2	Now
LONDON	00:55	01:30
*HEATHROW	01:10	02:22

DARLINGTON	HS2	Now
LONDON	01:51	02:17
BIRMINGHAM	01:33	02:40

DERBY	HS2	Now
*LONDON	01:11	01:31

DURHAM	HS2	Now
*LONDON	02:26	02:43
BIRMINGHAM	01:50	02:57
*NOTTINGHAM	01:46	02:32

EAST MIDS	HS2	Now
LONDON	00:51	
BIRMINGHAM	00:19	
NEWCASTLE	01:42	

EDINBURGH	HS2	Now
LONDON	03:38	04:23
BIRMINGHAM	03:14	04:01
*HEATHROW	03:52	05:19

EXETER	HS2	Now
*LEEDS	03:42	04:38
*YORK	03:50	04:47

GLASGOW	HS2	Now
LONDON	03:38	04:08
BIRMINGHAM	03:22	03:57
*HEATHROW	03:52	05:05

LEEDS	HS2	Now
LONDON	01:23	02:12
BIRMINGHAM	00:57	01:58
EAST MIDS	00:29	
*HEATHROW	01:38	03:12

LIVERPOOL	HS2	Now
LONDON	01:36	02:08
*CANTERBURY	02:56	03:45
*HEATHROW	01:48	03:12
*PORTSMOUTH	03:56	04:25
*PARIS	04:18	05:13

MANCHESTER	HS2	Now
LONDON	01:08	02:08
BIRMINGHAM	00:41	01:28
BIRMINGHAM INTERCHANGE	00:50	01:50
*GATWICK	02:27	03:10
*HEATHROW	01:23	03:08
*BRUSSELS	03:48	05:06
*PARIS	03:53	05:11

MEADOWHALL	HS2	Now
LONDON	01:09	
BIRMINGHAM	00:38	
*HEATHROW	01:25	

MOTHERWELL	HS2	Now
*LONDON	03:57	04:13
BIRMINGHAM	03:12	04:05

NEWCASTLE	HS2	Now
LONDON	02:19	02:52
BIRMINGHAM	02:07	03:14
*DERBY	02:02	02:30
MEADOWHALL	01:10	

NOTTINGHAM	HS2	Now
*LONDON	01:08	01:44
*BIRMINGHAM	00:36	01:13
*NEWCASTLE	02:03	02:50

PRESTON	HS2	Now
LONDON	01:24	02:08
BOURNEMOUTH	04:01	04:31
BIRMINGHAM	00:53	01:31
*PARIS	04:02	05:05

READING	HS2	Now
*MANCHESTER	01:46	03:10
*YORK	01:59	02:57
*EDINBURGH	04:15	05:30

ROTHERHAM	HS2	Now
*LONDON	01:35	01:59
*BIRMINGHAM	01:03	01:34

RUNCORN	HS2	Now
LONDON	01:13	01:48
*HEATHROW	01:28	02:52

SHEFFIELD	HS2	Now
*LONDON	01:19	02:05
*BIRMINGHAM	00:48	01:11

SOUTHAMPTON	HS2	Now
*LIVERPOOL	03:46	04:11
*LEEDS	03:35	04:17

STAFFORD	HS2	Now
LONDON	00:53	01:15

WARRINGTON	HS2	Now
LONDON	01:13	01:44
*HEATHROW	01:28	02:41

WIGAN	HS2	Now
LONDON	01:24	01:55
BIRMINGHAM	00:35	01:17

YORK	HS2	Now
LONDON	01:24	01:53
BIRMINGHAM	01:03	02:10
*DERBY	01:05	01:26
*NOTTINGHAM	00:59	01:41
*HEATHROW	01:36	02:45

*Interchange required

4.8 Regional connectivity

4.8.1 HS2 will be integrated into the places it serves, both in terms of the local transport connections and in terms of the spatial planning decisions that will need to be taken in those places over the next 20 years.

4.8.2 Improved connectivity around HS2 stations will be delivered through investment in links between the new railway and the existing transport networks, subject to agreement of suitable funding arrangements. Measures include:

- in central London, better tube connections at Euston through a larger ticket hall and direct access to Euston Square station providing access to the Circle and Metropolitan underground lines;
- in west London, a brand new interchange linked to a major regeneration project at Old Oak Common, connecting Crossrail and the Great Western Main Line into HS2;
- the construction of brand new intermodal interchange stations at Birmingham, Toton – between Derby and Nottingham – and Sheffield Meadowhall. Connections at these stations will link the wider regions of the Midlands and Yorkshire into HS2; and
- airport connections at Birmingham and Manchester, two of Britain's major airports and into Heathrow.

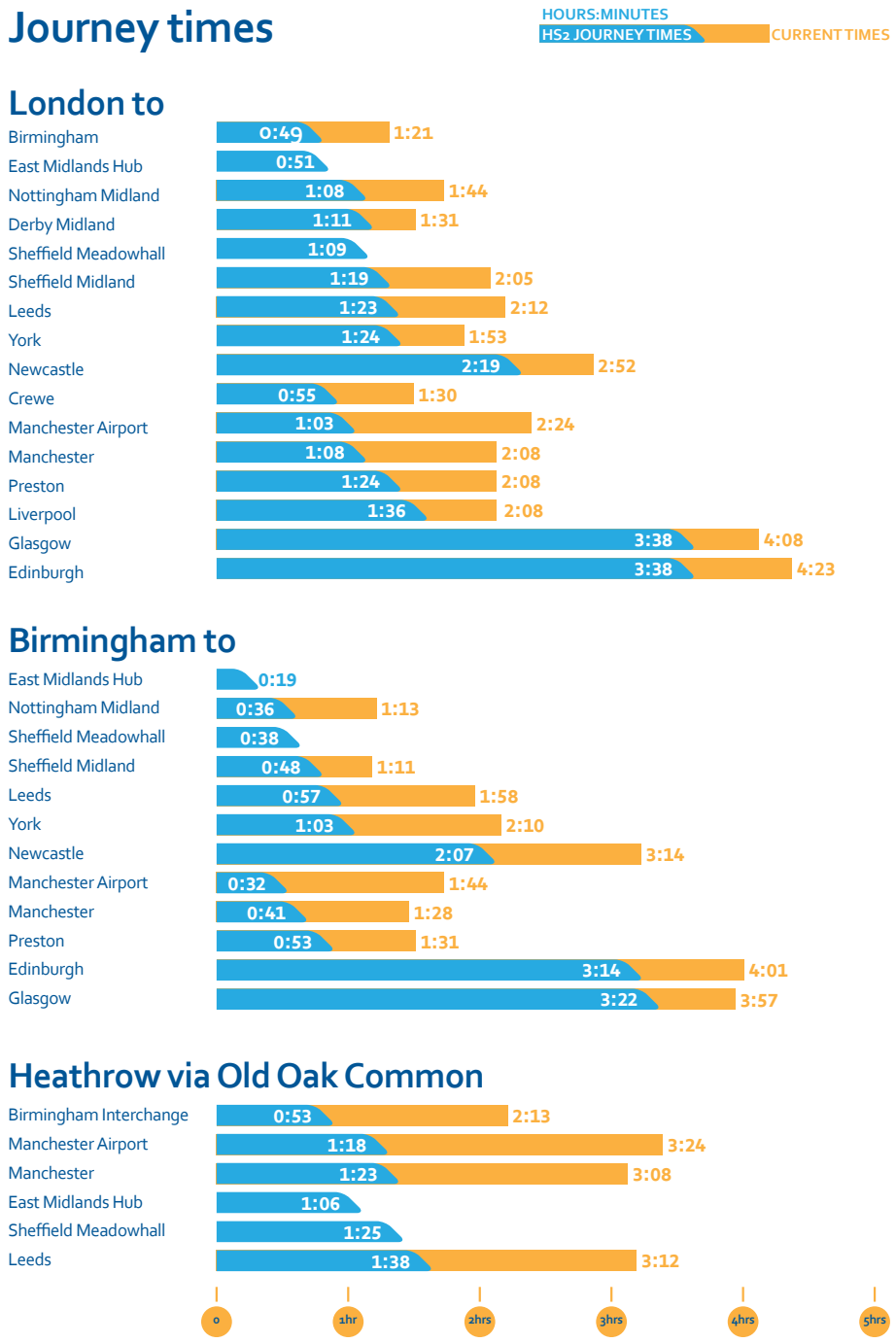
See Figure 4.8[137].

Connectivity with Scotland

4.8.3 Scotland will benefit from high speed services from Edinburgh and Glasgow as soon as Phase One of HS2 opens. Phase Two is expected to reduce journey times by up to an hour without the need to change trains. The Government's goal is a national network that brings the country closer together, so we are taking forward a study with the Scottish Government to consider how these benefits could be extended further. This is looking at how best to boost capacity and cut journey times between Glasgow/Edinburgh and London to less than three hours, and options will be developed on the basis of this work.

[137] Source: HS2 Ltd

Figure 4.8: Journey times between major economic centres



As a single integrated network, HS2 will deliver more dependable and faster journeys between our major economic centres.

HS1/HS2 link

4.8.4 As part of Phase One, we propose to construct a train link between Old Oak Common and HS1 (the Channel Tunnel Rail Link) just north of St. Pancras. The dedicated single track line will take up to three trains per hour in each direction (more than between St. Pancras and Paris on a Friday afternoon[138]) and will allow for direct services from HS2 to mainland Europe.

[138] Eurostar, 2013, *Timetable – Core Destinations 2nd June to 14th December 2013*, http://www.eurostar.com/sites/default/files/pdf/timetable/UK_timetable(1).pdf, Accessed October 24th 2013

Airport connectivity

4.8.5 HS2 will also improve airport connectivity. It will directly serve two key airports, Manchester and Birmingham. There will be a link between Old Oak Common and Heathrow on Crossrail, taking only 11 minutes with a walk of less than 100m between HS2 and Crossrail at the Old Oak Common Station. The potential also remains, pending the outcome of the Airports Commission, and the strength of the supporting evidence, to provide a direct HS2 link to Heathrow Airport too.

4.9 A deliverable solution

4.9.1 Inevitably, there will be impacts on the existing network while HS2 is being constructed, particularly at the points where the new rail line intersects with the existing railway such as at Euston station. There is a substantial programme of works planned for Phase One of HS2 to accommodate the growth in passenger throughput at Euston – including improving connections with London Underground. While there will be disruption during construction to passenger services, a staging plan has been devised to minimise any adverse effects.

4.9.2 Our current plan involves:

- Completing the works affecting the conventional lines to allow access for HS2 to commence works as soon as possible;
- Using existing Network Rail access arrangements at Euston wherever possible, although some additional possessions will still be needed. The additional possessions would allow a continued, though reduced service operation from Euston during the works;
- Maintaining service levels. Initial timetabling analysis has shown we can offer today's service provision with some possible variations in timings. A very small number of service reductions in the 'peak' could be required for a limited period of time, and even then the increase in affected journey times will be less than 10%; and
- HS2 and Network Rail engaging in on-going discussions with the train operating companies (TOCs) and freight operating companies (FOCs) about the impacts of the works. These discussions have explored robust methods to minimise the disruption and impacts on performance as a result of the overall platform reduction

4.10 Environmental impacts

4.10.1 The Government understands that a large project like HS2 will affect those who live close to the route and where the costs are justified everything reasonably possible is being done to mitigate the impact of HS2 on individuals, communities and the natural and built environment.

4.10.2 The proposed line of route has been carefully designed to avoid or reduce local environmental effects wherever possible by seeking to avoid the most significant impacts on centres of population and by using tunnels, deep cuttings and, where feasible, existing transport corridors. The views of local people and communities have been important. In designing the route and in mitigating the impacts of constructing and operating the railway, we have done as much as reasonably possible to avoid or reduce environmental impacts, particularly those that might affect residential areas, historic buildings, conservation areas, sensitive habitats and areas of natural beauty.

4.10.3 In May 2013, a 50,000 page draft Environmental Statement was published, detailing the impacts of the HS2 Phase One route between London and Birmingham. Responses to that consultation will inform the Environmental Statement to be published with the hybrid Bill for Phase One, which will be deposited in Parliament before the end of the year. Following publication, the ES will be subject to public participation and consideration by Parliament during the passage of the hybrid Bill.

4.10.4 Figure 4.9[139] summarises key environmental impacts of the two phases of HS2:

Figure 4.9: Environmental impacts of HS2

	Phase One	Phase Two Manchester	Phase Two Leeds
Route characteristics (km)			
Total	220.5	150.4	184.8
Tunnel	54.3	17.6	9.7
Cutting	74.9	55.8	78.1
Property and settlements			
Residential demolitions	338	139	139
Noise			
People affected by noise (mitigated scheme)	~900	~250	~1,400
People affected by noise (mitigated scheme) per km	~4.1	~1.7	~7.6
Landscape			
Areas of Outstanding Natural Beauty crossed at surface (km)	8.9	0	0
Cultural heritage			
Listed buildings and scheduled monuments directly affected	20	3	5
Biodiversity and wildlife			
Sites of Special Scientific Interest affected	3	0	1
Ancient woodlands directly affected	18	5	9

4.10.5 During construction the building works will be controlled by applying and practising the requirements of a comprehensive Code of Construction Practice. Local Environmental Management Plans will be prepared for each section of the route to ensure relevant environmental issues are accounted for during construction and the means to reduce effects or avoid them entirely are put in place. The plans will make provision for communicating effectively with those living nearby.

4.10.6 Air quality will be maintained by using modern efficient equipment and dust will be suppressed. In a few locations air quality along roads affected by construction movements or redirected traffic could elevate NOx emissions however these effects are predicted to be limited and temporary in nature.

[139] Source: *Phase Two Sustainability Statement*, HS2 Ltd

4.10.7 Construction noise will be consented through Section 61 of the Control of Pollution Act and best practicable means will be applied to the construction activities to keep the temporary effects of construction noise to an acceptable level. Measures will include using modern efficient equipment, temporary noise screens and working to agreed times. Provision is made for noise insulation to be installed where necessary to overcome certain noise effects over intensive periods of work.

4.10.8 Traffic management plans will be agreed with relevant highway authorities to ensure the local road network is able to operate effectively for all users including the necessary lorry movements that will be required to enable the railway to be built. Pollution risks will be anticipated and emergency plans will be developed in the event that an incident should occur. This will ensure effective pollution control, provide the means to contain any pollution incident and enable effective clean-up.

4.10.9 In terms of property, the Government is committed to compensating fairly those who are affected by HS2. There will be a generous and wide ranging package of measures which go beyond what is required by law.

4.10.10 HS2 has the potential to play a key part of the UK's future low-carbon transport system. At scheme opening HS2 will have lower carbon emissions per passenger kilometre that most other modes of transport[140]. HS2 is publishing a carbon assessment for Phases One and Two alongside this document[141]. It shows that while carbon emissions will occur, over the full lifespan of the project (i.e. 120 years) HS2 is expected to be carbon beneficial.

4.10.11 Most of the emissions associated with both the construction and operation of HS2 will fall within the EU ETS (Emissions Trading System) – a 'cap and trade' system with a decreasing cap over time. This means that, overall, most of HS2's carbon emissions should not contribute to an increase in Europe-wide carbon emissions. Furthermore, HS2 Ltd's Sustainability Policy which seeks to minimise the carbon footprint of HS2 and deliver low carbon long distance journeys supported by low carbon energy, will encourage carbon reduction in both the traded and non-traded sectors.

[140] Department for Transport, 2012, *Total greenhouse emissions from transport: disaggregated data, giving breakdown by modes of transport,* https://www.gov.uk/government/publications/total-greenhouse-gas-emissions-from-transport

[141] Temple ERM for HS2 Ltd, High Speed Rail: *Consultation on the route from the West Midlands to Manchester, Leeds and beyond/Sustainability Statement/Appendix F – HS2 and Carbon/Assessment of carbon emissions for Phase One and Two*

4.11 Assessment against objectives

4.11.1 In Chapter 3 we set out the specific transport objectives to support the Government's role in building a stronger, more balanced economy capable of delivering lasting growth and widely shared prosperity. HS2 meets all of those objectives:

Objective: to provide sufficient capacity to meet long term demand and to improve resilience and reliability across the network.

4.11.2 By building a new north-south high speed railway, HS2 provides a step change in capacity that can meet demand for the long term. While HS2 itself provides additional intercity capacity, the released capacity on the classic network allows for new commuter and freight services.

4.11.3 By providing a new line, rather than more services on an existing line, HS2 can help resilience and capacity on the network. Moving fast, intercity services onto HS2, with commuter and freight trains on the West Coast Main Line will help the problems caused by the current mixed use of the West Coast Main Line.

Objective: to improve connectivity by delivering better journey times and making travel easier.

4.11.4 HS2 will significantly reduce journey times between cities, bringing them closer together. It is not just about making it easier to get to London. The Birmingham, East Midlands, Sheffield and Leeds stations will each be connected by journeys of less than 20 minutes. HS2 will also be integrated with existing local transport networks.

Any solution must:

4.11.5 **Minimise disruption to the existing network.** By building a new line, HS2 is less disruptive than upgrading existing, heavily used transport corridors. While there will be some disruption to passenger services, a staging plan has been devised to minimise any adverse effects. Our plans include:

- Completing the works affecting the conventional lines as soon as possible;
- Using existing Network Rail access arrangements at Euston wherever possible;
- Maintaining service levels as far as we can; and
- HS2 and Network Rail engaging TOCs and FOCs.

4.11.6 **Use proven technology that we know can deliver the desired results:** HS2 will use proven high speed rail technology. It does not rely on possible future technology that may or may not be developed. We successfully delivered HS1, and are very confident we can deliver HS2 on time, to budget and with the desired operational specification.

4.11.7 **Be affordable and represent good value to the taxpayer:** The capital construction costs of HS2 are spread over the construction period and are affordable. It is good value for the taxpayer and will deliver high value for money. The next chapter looks at the economic appraisal of the scheme, which has a strong benefit-cost ratio. HS2 would be a long-term asset, which could also be operated as a concession to offset some of the construction costs.

4.11.8 **Minimise negative impacts on local communities and the environment:** The route and design of HS2 have been informed by numerous consultations with local communities and a very detailed environmental impact assessment. The route avoids large residential areas, historic buildings, conservation areas, sensitive habitats and areas of natural beauty as much as reasonably possible. Where an impact on the environment is unavoidable and where the costs are justified we propose to spend hundreds of millions of pounds to mitigate these impacts. For example, using tunnels, cuttings and sound barriers and the planting of 4 million trees along the whole line of the route.

5 Chapter 5 – The economic benefits of HS2

Summary

This chapter sets out the potential impact on jobs and the regeneration opportunities of HS2 and the steps we are taking to ensure they are delivered. It explores the wider impacts on the economy and presents new evidence on the regional economic impacts of HS2. It goes on to set out the results of updated analysis of the value for money of HS2 which shows a 'standard' benefit to cost ratio of 2.3 delivering high value for money. The 'long term' benefit cost ratio, allowing for demand to grow to 2040 or 2049 will be between 2.8 and 4.5.

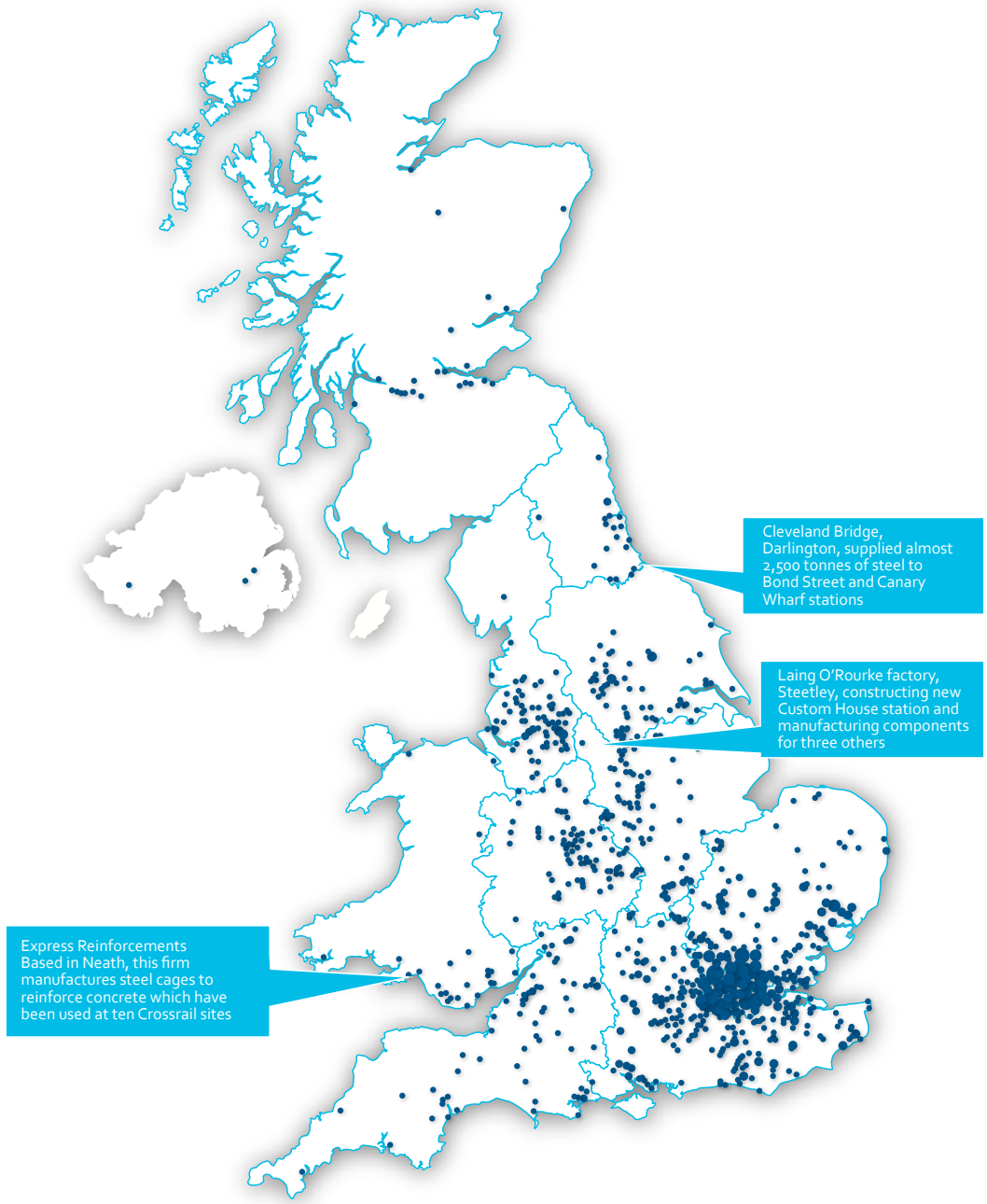
5.1 Jobs and growth

5.1.1 HS2 will be the biggest construction project in Europe. It will therefore be a major generator of jobs directly linked to the project, across a wide range of disciplines and directly benefiting communities across the country.

5.1.2 It is clear that these benefits will fall across a wide range of industrial sectors. Construction jobs will be created in order to build the railway and develop stations along the route. Civil engineering and rail industry jobs will be generated by the large scale construction of tunnels, bridges, viaducts and tracks needed to bring the railway into existence. Wider engineering and technology sectors will be boosted by the creation of power equipment, signalling and other technical infrastructure needed to operate the railway. There will be massive opportunities for the manufacturing sector to design and build the rolling stock for HS2; and also in the professional services sector to ensure the efficient delivery of these projects. We have great foundations to build on after the success of the Olympics and enhanced skills and experience brought about by Crossrail. See Figure 5.1[142].

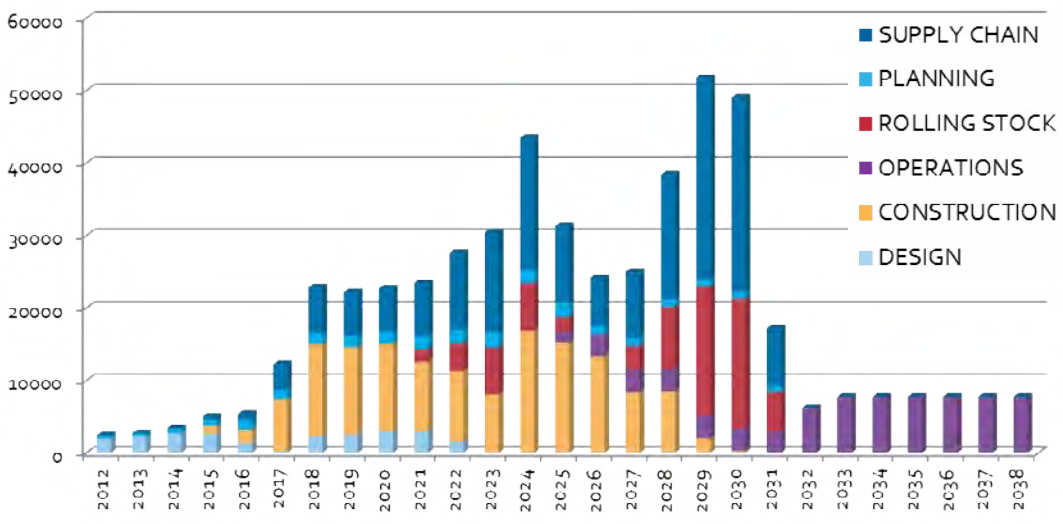
[142] Source: Crossrail

Figure 5.1: Crossrail UK supply chain



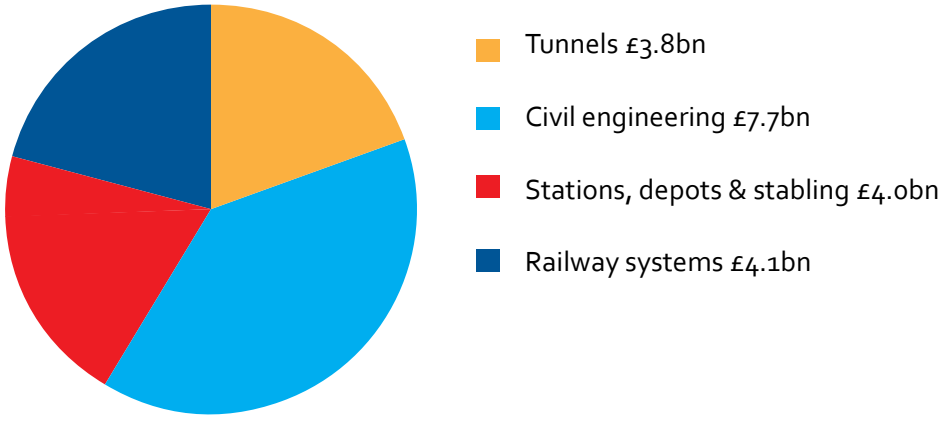
5.1.5 Our most up to date estimates, based on more developed information about actual works, indicate that HS2 could create 24,600 temporary FTE construction jobs excluding jobs in the supply chain[143]. Other published analysis, using alternative methodologies, have estimated that, at its peak, HS2 will create 50,000 jobs, as illustrated in Figure 5.2[144].

Figure 5.2: Full Y network jobs profile



5.1.6 The procurement strategy for the railway, within the appropriate legal framework, will ensure that British companies can compete for work in line with best value for taxpayers' money. It is clear that the contracts arising from a project of the scale of HS2 will be significant. HS2 is expected to lead to contracts worth over £10bn in civil engineering and tunnelling including viaducts, bridges and tracks; around £4bn in station and depot works; £4bn in railway systems such as signalling and power supply equipment; and around £7bn in the design and manufacture of rolling stock. These figures cover investment in both Phase One and Phase Two. See Figure 5.3[145].

Figure 5.3: Potential value of HS2 contracts by sector



[143] Source: Temple ERM, July 2013, *Sustainability Statement,* http://assets.hs2.org.uk/sites/default/files/consultation_library/pdf/PC205 Vol 1 Sustainability Statement 180713.pdf

[144] Source: Albion Economics (for Greengauge 21), 2013 , HS2 Jobs Analysis, http://www.greengauge21.net/wp-content/uploads/HS2Jobs_Report_Final_photo-refs.pdf | Source: *Albion Economics for Greengauge 21, July 2013*

[145] Source: HS2 Ltd

5.1.7 It is important that UK industry is well-placed to take advantage of this opportunity. High speed rail is a global industry. The project provides an opportunity to align industrial and infrastructure policy, and use HS2 to develop UK industries which can compete effectively on the global stage.

5.1.8 The UK industrial base has evolved considerably over the last 30 years, with our manufacturing expertise now reflecting the UK's competitive advantage in high-tech engineering, construction and industrial technology. British manufacturing expertise in aerospace, car production and other areas shows the potential for our companies to compete internationally in the area of high speed rail. But to ensure this, it is important that we invest correctly in the skills base of the British workforce. We need to ensure that educational and skill levels across the workforce, particularly in the technical areas that will be vital to deliver HS2, are at the right level at the right time so that British industry can take advantage of HS2.

5.1.9 The design, build and operation of HS2 will also create opportunities for apprenticeships for our young people and create a lasting skills legacy. For example, Crossrail committed to delivering at least 400 apprenticeships through its supply chain over the lifetime of the project (or equivalent to one apprentice per £3m of contract spend).

5.1.10 In order to support this, the Government has created an HS2 Growth Task Force to advise and challenge on where further work might be done to ensure that we are well-placed to maximise the benefits from HS2. The Task Force will make its recommendations early in 2014 to inform the passage of the Phase One Bill through Parliament. See Figure 5.4[146].

[146] Source: HS2 Ltd

Figure 5.4: The HS2 Growth Taskforce

The Growth Taskforce, chaired by Lord Deighton, was created by Government to recommend further actions that are needed to help unlock the full economic potential of HS2.

The Taskforce membership spans the private sector, public sector and academia.

Sir Howard Bernstein	CEO, Manchester City Council
Sir Albert Bore	Leader of Birmingham City Council and Core Cities Transport Lead
Sir John Rose	Former CEO, Rolls Royce
Frances O'Grady	General Secretary, TUC
Neale Coleman	Mayor of London's Adviser on Olympic Legacy
Professor Tony Venables	University of Oxford
Alison Nimmo	CEO, Crown Estate
Pete Waterman	Cheshire and Warrington Local Enterprise Partnership (LEP)
Cllr Julie Dore	Leader, Sheffield City Council
Cllr Matthew Colledge	Leader, Trafford Council
Lorraine Baldry	Chair, London and Continental Railways
Ray O'Rourke	Chairman, Laing O'Rourke Group
Steven Norris	Businessman and former Minister for Transport
Roger Marsh	Chair, Leeds City Region LEP

The Taskforce has published an initial report and will publish a final report early in 2014. In their initial report, the Taskforce identified three areas that they will explore and make recommendations on in the final report:

- **Connectivity**. The improved connectivity between eight of our major cities increases accessibility for people and businesses to interact, trade, and stimulate economic growth. The Taskforce will explore how they can support and enhance local partners' work to plug local transport networks into HS2 – and therefore spread the potential for jobs and growth over a wider area.
- **Unlocking development and regeneration**. Investment in HS2 station sites will create a focal point around which local areas can kick-start development and regeneration for the good of their cities. The Taskforce will explore how the development of stations and depots can transform and regenerate local areas.
- **Delivering through our industries and workforce**. Constructing HS2 will rely on procuring goods and services and ensuring that we have a workforce in place capable of meeting the construction and engineering skills need of a modern, high speed railway. The Taskforce is keen to ensure that Britain's businesses and workforce are ready to maximise the opportunities that HS2 will present.

5.2 Regeneration

5.2.1 HS2 will also generate economic opportunities and development beyond the impacts of this direct expenditure which can have serious local impacts. HS2 Ltd predicts that additional commercial development brought forward as a result of HS2 in areas immediately surrounding HS2 stations could support up to 100,000 jobs[147]. The Core Cities Group – representing eight of the largest city economies outside London – puts that figure at 400,000.

[147] Temple ERM, July 2013, *Sustainability Statement*, http://assets.hs2.org.uk/sites/default/files/consultation_library/pdf/PC205 Vol 1 Sustainability Statement 180713.pdf

Visualisation of potential HS2 development in Leeds

5.2.2 The jobs that will be generated through building the railway and associated developments have the potential to support local regeneration by allowing people from areas of need, with relatively high rates of unemployment, to access areas with HS2-related job opportunities.

5.2.3 Local authorities along the HS2 route have already begun to consider how they can maximise the economic opportunities from the investment, and how they can use this to tackle the problems in areas of need in their cities. For example, in Manchester, the Council has plans to ensure that the disadvantaged communities of Wythenshawe have the opportunity to benefit from the development of the nearby proposed Manchester airport station.

5.2.4 Similarly in Birmingham, the City Council wants to use the arrival of HS2 to maximise employment and training opportunities in a part of the City that suffers from high levels of unemployment.

Greater Birmingham to maximise the regeneration benefits of HS2

"As an 'engine for growth' HS2 will bring forward transformational economic benefits for Birmingham. The predictions for jobs growth for the Greater Birmingham area are unprecedented – nearly 13,000 jobs – and will require a joined-up and targeted approach.

Birmingham City Council through its Employment Access Team (EAT) has a successful track record in working alongside planners and developers in the regeneration of Birmingham. Working with the private and public sector, Birmingham has brought forward opportunities in a range of sectors, including construction and manufacturing, and has been able to consistently target these opportunities to communities under-represented in the local labour market.

The success of this approach has been due to collaborative working with strategic partners and local high quality further- and higher-education as well as Third Sector training provision. This has resulted in the development of bespoke 'routeways' into jobs, apprenticeships and skills leading to guaranteed interviews with employers. This targeted approach is taken into the heart of the most deprived areas of the city and enables those who are under-represented to train, up-skill and ready themselves linked to both construction and end-use jobs. Birmingham's work to prepare for the arrival of HS2 will be a key opportunity to further this approach."

Birmingham City Council

5.2.5 HS2 also offers the potential to support local growth. We know that associated development and regeneration triggered by HS2 will stimulate jobs around stations, just as happened with HS1 (the Channel Tunnel Rail Link). St. Pancras currently receives around 40m visitors a year – nearly a quarter of whom are not there to get a train but rather to use the shops and restaurants that have arisen as a result of development of the station. Looking at the wider area, planning permission exists for 2,000 new homes and apartments, 25 large new office buildings and the restoration of 20 historic buildings[148].

[148] http://www.kingscross.co.uk/the-development

5.2.6 Improved connectivity is an enabler of economic growth, and local partners will need to plan effectively to maximise the opportunities that HS2 will bring to their area. Some already are:

UK Central

"The 'UK Central' Masterplan, commissioned by Solihull Metropolitan Borough Council in partnership with the Greater Birmingham and Solihull Local Enterprise Partnership, targets investment in local infrastructure and commits to delivering the proposed HS2 'interchange' station and an expanded airport. The result is that the benefits for the area – and the UK – are significant.

The area – UK Central – represents a sub-regional network of connected locations at the centre of the UK's high-skilled manufacturing heartland. It is the point at which north meets south through HS2 and the confluence of the UK motorway network; new routes to Indian and Chinese markets are realised through Birmingham Airport; and the most populous conurbations of the Midlands (Sheffield, Nottingham, Derby, Coventry, Oxford and Birmingham) intersect. It is also connected to other major cities by the existing West Coast Main Line and locally the point at which the regeneration initiatives of North Solihull and East Birmingham combine with the economic opportunities afforded by Jaguar Land Rover, the National Exhibition Centre (NEC), Solihull Town Centre and the business parks of the M42 corridor.

UK Central capitalises on the success stories of Europe where High Speed Rail investment, coupled with local investment in sub-regional transport connectivity, creates a multi-sector growth network. One which is so well connected that company location anywhere within the network gives good access to all of the other prerequisite for growth: skilled staff, education, digital infrastructure, housing and investment activities elsewhere within the network." **– Solihull Metropolitan Council**

Visualisation of potential HS2 development in Manchester

5.3 Impacts on the national economy and economic geography

5.3.1 The standard approach to estimating impacts of transport schemes, as set out in the Department's transport appraisal guidance, seeks to capture the impacts on business as well as wider society. The analysis set out later in this chapter suggests that the overall benefits to business estimated in this way could be over £53bn. This includes amongst other things the benefits to business travellers from faster journeys and reduced crowding as well as the value of increased production and the benefits to company efficiency from being closer together.

5.3.2 There has been much debate about the scale of the potential economic benefits of HS2 and their distribution between north and south. With advice from an independent panel of experts, HS2 Ltd has undertaken a programme of work to help us understand these impacts and how the benefits of HS2 might be spread across the country. This work complements the conventional assessment of economic impacts described above[149].

5.3.3 The analysis, carried out by KPMG on behalf of HS2 Ltd, looks at the potential benefits of HS2 by examining how improvements in connectivity would increase competitiveness of areas outside of London and change the future pattern of growth. These effects are expressed in two ways:

- Businesses becoming better connected to one another – businesses are better able to connect with potential suppliers, enabling them to access higher quality and/or lower cost inputs; closer to competitors, with opportunities to learn from each other and pressure for increased efficiency; and better able to connect with potential customers, enabling them to supply markets further afield; and
- Businesses becoming better connected to labour – individuals are able to access more jobs, whilst businesses are able to draw on a wider and deeper pool of potential workers.

This is supported by well-established economic theory[150], but it is also common sense. The closer people and businesses are, the easier it is for them to connect and trade, and the greater the scope for efficiency gains and increased productivity.

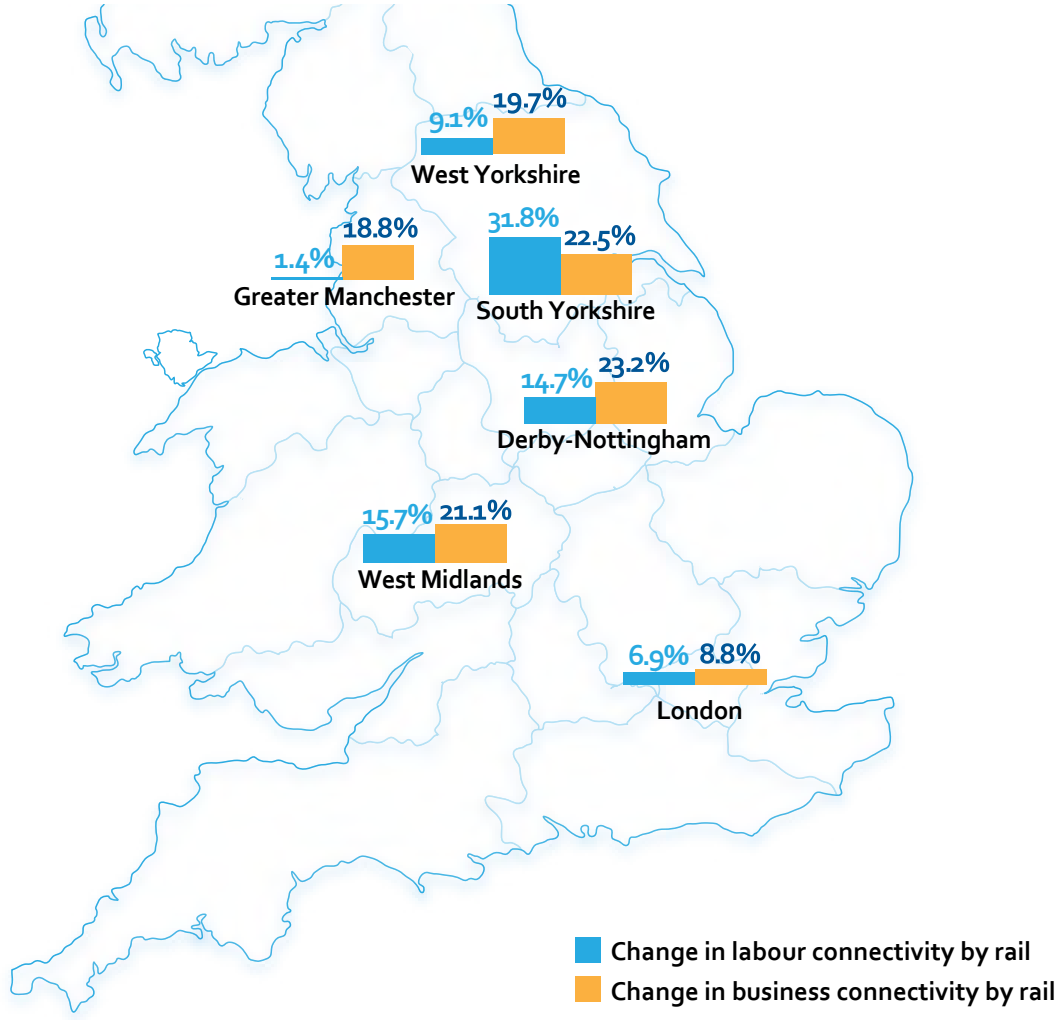
5.3.4 The results from the KPMG analysis suggest that HS2 could increase economic output by £15bn per year. Even with more cautious assumptions the annual benefit could be £8bn[151]. In addition, the analysis shows that while all regions benefit, the city regions in the Midlands and the North do particularly well. For example, it suggests that HS2 could provide a boost to the Birmingham city region equivalent to between 2.1% and 4.2% of its GDP. For the Manchester city region the figure is 0.8%-1.7%, for the Leeds city region 1.6% and for Greater London 0.5%. This contradicts suggestions that London will benefit from HS2 at the expense of the North.

[149] The economic appraisal set out later in this chapter calculates net national impact, and cannot be used to analyse sub-national impacts.

[150] Eddington, December 2006, *The Eddington Transport Study, The Case for action: Sir Rod Eddington's advice to Government; SACTRA – Transport and the Economy: full report, SACTRA*, http://webarchive.nationalarchives.gov.uk/20050301192906/http:/dft.gov.uk/stellent/groups/dft_econappr/documents/pdf/dft_econappr_pdf_022512.pdf;
Venables, A.J., 2007, *Evaluating urban transport improvement: cost benefit analysis in the presence of agglomeration and income taxation Journal of Transport Economics and Policy, 41, 173-188*

[151] Results are modelled for 2037, and reported in 2013 prices

Figure 5.5: Improvements in productivity for labour markets and business travel



5.3.5 The analysis in Figure 5.5[152] was commissioned and is presented here to answer questions about the regional impacts of HS2. Given differences in approach it is not directly comparable to the standard assessment set out below and cannot be added to the benefit-cost ratio, but it does suggest that there may be benefits not captured in the transport appraisal and is a step forward in improving the evidence in this area. We will continue to develop this work to understand the regional benefits brought by HS2.

[152] Source: KPMG and HS2 Ltd

5.4 Benefit-cost appraisal

5.4.1 A standard part of all government projects is to carry out a benefit-cost appraisal. The appraisal of HS2 is based on a systematic analysis of the effects of the scheme, conducted in accordance with best practice and based on the most up-to-date evidence available. At each stage of development over the last four years, we have reviewed the expected costs and benefits before deciding to proceed further.

5.4.2 Over the course of the last year HS2 Ltd has made significant improvements to their analytical tools and there has been an extensive review of the evidence supporting key assumptions. We therefore have a much improved understanding of the costs and benefits of the proposal.

5.4.3 Our analysis shows that the 'standard' benefit-cost ratio for HS2 is 'high' value for money at 2.3 including wider economic impacts. Based on projections about longer term growth in demand, the 'long term' benefit-cost ratio would be 'very high' value for money, ranging from 2.8 to 4.5 if demand grows at 2.2% a year to 2040 or 2049, respectively. Even for Phase One alone the benefit-cost ratio is estimated at 1.7.

Modelling with standard assumptions

5.4.4 The appraisal of the costs and benefits of HS2 uses the Department's well-established approach. The general guidance on evaluating proposals is published by HM Treasury in The Green Book[153], and the Department for Transport provides more detailed advice on how to apply Green Book principles to transport investments at the 'WebTAG' transport analysis guidance website[154]. This guidance has been refined over many years, is updated with extensive consultation, and has therefore benefited from input from experts and the general public alike. Comparisons show that the UK appraisal system compares very well with those in other countries and the UK has led the world in setting out its guidance in an open and transparent way[155]. The starting point for the latest update has been the standard assumptions used in typical transport appraisals which could include large and small schemes ramping up from new road junctions to major rail upgrades.

[153] HM Treasury, *The Green Book*, https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government
[154] Department for Transport, April 2011, *Transport Analysis Guidance – Web Tag*, http://www.dft.gov.uk/webtag
[155] Peter Mackie and Tim Worsley, Institute for Transport Studies, April 2013, *International Comparisons of Transport Appraisal Practice*, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209530/final-overview-report.pdf

Benefits

5.4.5 The benefits from HS2 are calculated by generating a present value (PV) of benefits up to 2093, 60 years after opening of the full network. They include a broad range of impacts from direct benefits to transport users from travel time savings, reductions in crowding and improvements in reliability to wider economic impacts, safety and environmental impacts such as noise and air quality. Since January 2012 HS2 Ltd has reviewed all the key elements which make up the benefits of the scheme and these are set out in detail in its report. The most substantive changes have included:

- Updates and enhancements to improve HS2 Ltd's ability to forecast accurately the number of people who will use the railway, including:
  - updates to take account of recent Government decisions on investment in the rail network, such as electrification and other upgrades to the Midland Main Line;
  - improvements to the approach to forecasting the demand for travel by rail, for example taking account of better information on the purpose of journeys and a revised assessment of how demand changes in response to economic growth;
- revisiting and refining assumptions about the services that could operate on HS2 and the capacity released on the existing network once the scheme is open. For example, further work has identified opportunities for additional services on the southern part of the West Coast Main Line, to places such as Hemel Hempstead. Even so, the service pattern we have used in the modelling remains just one of many possible combinations of services that could run on the network once it is open, and it does not use all available train paths on either HS2 or on the capacity released on the existing network. For example, we have removed Heathrow services to reflect the Government's decision to pause consideration of the Heathrow Spur while the Airports Commission conducts its review, but we have not allocated the paths to other services; and
- updated assumptions on factors such as the value that is placed on reductions in journey times and the levels of crowding across the network.

5.4.6 Figure 5.6[156] summarises the expected benefits of HS2 reflecting the impact of these changes. This shows that HS2 can be expected to generate benefits totalling over £28bn for Phase One and over £70bn for the Y network.

Figure 5.6: Breakdown of benefits from the proposed HS2 scheme

	Phase One	Full Network
Time savings	17,334	45,679
Crowding benefits	4,068	7,514
Improved reliability	2,624	5,496
Car user benefits	568	1,162
Total transport user benefits	**24,594**	**59,852**
Wider economic impacts	4,341	13,293
Other impacts	407	788
Loss to Government of indirect tax	-1,208	-2,912
Total	**28,134**	**71,020**
		£m PV 2011 Prices

[156] Source: HS2 Ltd

Costs

5.4.7 The costs of HS2 are also calculated by generating a present value (PV) of costs up to 2093. They include:

- capital costs – including purchasing land, constructing the railway, stations and depots, procuring rolling stock as well as replacement costs over 60 years (for example, we include the cost of replacing rolling stock after 35 years and replacing track after 30 years); and
- operating costs – including operation and maintenance of train and track, train crew and station staff.

5.4.8 Cost estimates included in the appraisal have also undergone a comprehensive review. Changes in capital costs include the latest assessment of the costs of HS2, as set out in the Government's Spending Round announcement in June 2013 (see Chapter 7).

5.4.9 For Phase One, improved detail and accuracy of the scheme design has meant that HS2 Ltd has been able to improve the accuracy of its cost estimates and develop a much better understanding of risk. This has allowed us to adopt a more sophisticated approach that quantifies the risk associated with different elements of the design.

5.4.10 Phase Two cost estimates have also been refined in line with the development of the proposal which is currently being consulted upon. The cost estimates and the associated design are at an earlier stage than Phase One and this is reflected in the level of contingency factored into the analysis[157].

5.4.11 HS2 Ltd has improved its estimates of the cost of purchasing, operating and maintaining the rolling stock for the railway. The present value total capital costs, including rolling stock, included in the appraisal are £21.8bn for Phase One and £40.5bn for the full Y network (PV 2011 prices).

5.4.12 Operating costs have also undergone a thorough review to ensure they are based on the most up-to-date information. Some of the most significant changes relate to train electricity consumption and the approach taken to including contingency (optimism bias). HS2 Ltd has considered the risks associated with operating costs savings at a more disaggregated level and adjusted the level of optimism bias accordingly. This now varies between 10% and 41%, and optimism bias is no longer applied to operating cost savings. Overall, the review of operating cost savings has left them broadly unchanged compared to August 2012. The present value operating costs in the business case are £8.2bn (PV 2011 prices) for Phase One and £22.1bn (PV 2011 prices) for the full Y network.

[157] For both Phase One and the full Y network, the reference case is based on capital cost at P50, £19.4bn and £38.4bn respectively (2011 prices). This includes contingency for Phase One of £3.7bn and Phase Two of £6.5bn

Revenues

5.4.13 The analysis suggests that following the introduction of HS2, the GB rail network will generate additional revenues of £13.2bn (PV 2011 prices) for Phase One and £31.1bn (PV 2011 prices) for the full network. This estimate is based on conservative assumptions using the same fares structure as the existing railway.

5.4.14 The operating structure and regulatory environment in which HS2 might operate has yet to be determined. This is to be expected at this stage of the project. Nonetheless, HS2 Ltd has started to investigate how the responses of train operators to different operating environments might impact on the economic case. Early work has considered how competition between rail operators on some routes might influence the fares charged. This analysis suggests that while reductions in fares on the existing network could reduce revenues on HS2, this would be offset by an increase in revenue on the existing network. The benefit-cost ratio for the scheme would therefore not be significantly affected.

'Standard' benefit-cost ratio

5.4.15 Figure 5.7[158] sets out the overall results of the standard appraisal and compares it to the last analysis published in August 2012. The benefit-cost ratio for the full Y network on the basis of these calculations is 2.3 including wider economic impacts and 1.7 for Phase One alone. The scheme as a whole therefore is 'high' value for money.

Figure 5.7: Standard appraisal – changes to costs and benefits over 60 years (£ million)

	Phase One		Full Network	
	Aug 2012	Oct 2013	Aug 2012	Oct 2013
Transport benefits (Business)	12,566	16,921	34,292	40,529
Transport benefits (Other)	7,198	7,673	16,742	19,323
Other quantifiable benefits	593	407	1,046	788
Indirect taxes (loss to Govt)	-1,587	-1,208	-3,831	-2,912
Net transport benefits	**18,770**	**23,793**	**48,250**	**57,727**
Wider economic impacts	4,849	4,341	15,377	13,293
Total costs	26,942	29,919	58,672	62,606
Revenues	13,189	13,243	32,938	31,111
Net cost to Government	**13,753**	**16,676**	**25,734**	**31,495**
Benefit cost ratio (inc WEIs)	**1.7**	**1.7**	**2.5**	**2.3**

[158] Source: HS2 Ltd

5.4.16 The changes to the benefit-cost ratio compared to August 2012 are driven by the following factors. Upward influences on the benefit-cost ratio are associated with improvements in services through use of released capacity, including to towns such as Preston, York and Milton Keynes, and better evidence on travel patterns which mean we are now forecasting more business travellers on key routes served by HS2. These are offset by downward pressures on the benefit-cost ratio from factors such as increases in costs and the reduction in the value of business travel time savings.

5.4.17 HS2 Ltd has also looked at the incremental benefits and costs of proceeding with Phase Two of the scheme once Phase One has been completed. This demonstrates a compelling case and is consistent with the high value for money of the Y network as a whole. The benefit-cost ratio for Phase Two once Phase One is built is expected to be 2.7 including wider economic impacts[159].

5.4.18 Some people have questioned the relationship between the benefits estimated in the benefit-cost appraisal and those set out in the broader strategic case for the scheme. This issue was raised most recently by the National Audit Office[160]. The standard tools and methods used for assessing transport schemes are in line with international best practice. Nonetheless, a scheme on the scale of HS2 with significant changes in journey opportunities and travel times presents challenges for these tools and methods. This is because they rely on existing patterns of travel demand and land use. HS2 Ltd has undertaken extensive work to address a number of these challenges, for example the analysis set out elsewhere in this chapter to understand uncertainties around future growth in travel demand and the scale and distribution of regional economic impacts. But there are other impacts which are less amenable to quantified analysis. Some of these are described below and taken into account in the value for money assessment (but not the benefit-cost ratio).

5.4.19 There are, however, some aspects that are relevant to the strategic case for HS2 but do not form part of the economic appraisal and crucially they relate to capacity. HS2 provides significant capacity benefits, not just in terms of the amount of capacity which will meet demand for travel and improve opportunities, but also because of the overall benefits that it will provide to the transport network. The economic case does not capture, for example, the benefits of:

- Increased resilience offered through the provision of flexible capacity on HS2 and the existing network. Reducing congestion on the network can reduce the knock-on delays from any incident.
- Flexibility to respond to uncertain future economic developments. The scale and pattern of economic activity will be influenced by many factors in addition to HS2. The capacity provided by HS2 will bring significant flexibility to accommodate a wide range of alternative journey opportunities opening up a large number of options for services. The economic case assesses just one of these.

5.4.20 We will continue to gather further evidence on some of these impacts.

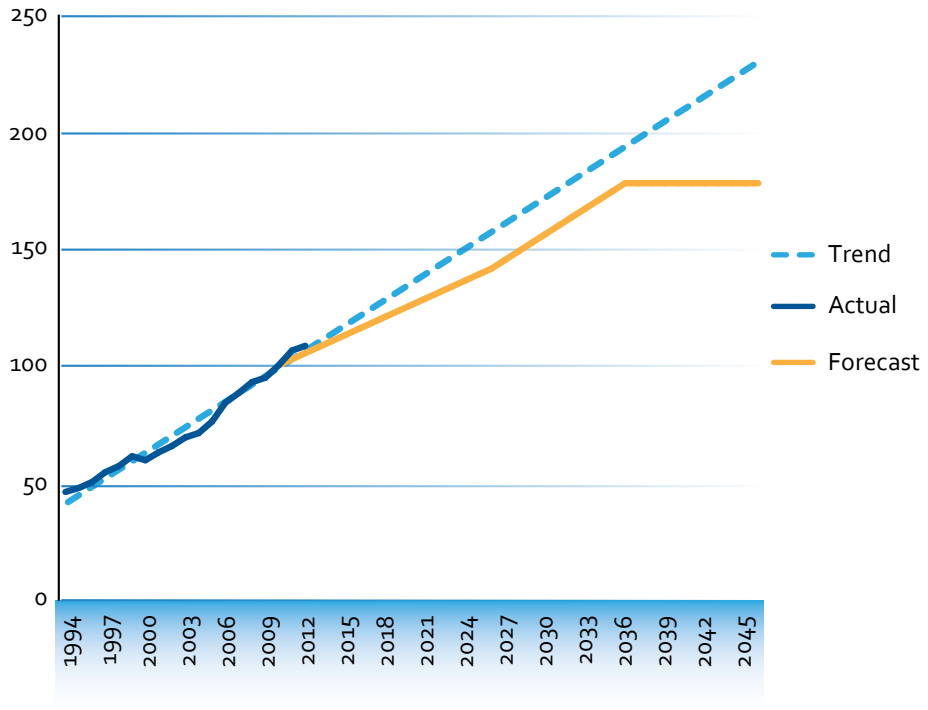
[159] 2.1 excluding wider economic impacts

[160] National Audit Office, May 2013, *High Speed 2: A review of early programme preparation,* www.nao.org.uk/report/high-speed-2-a-review-of-early-programme-preparation/

The 'long term' benefit-cost ratio[161]

5.4.21 Rail demand has grown very strongly over the last 20 years and even during the recent recession it has shown little sign of slowing. In the decade from 2002 to 2012 the annual growth in long distance rail travel was 5.2%. There are two reasons to believe that the assumption we make about long term demand growth in the standard appraisal may be conservative. First, our appraisal assumes demand growth equivalent to just 2.2% a year. Second, it assumes that after 2036 – only three years after opening – there will be no further growth in the number of people using HS2 for the next 57 years. This does not even allow for population growth to generate additional demand. Figure 5.8[162] shows how the demand forecast for long distance rail used in the reference case compares to an extrapolation of recent trends.

Figure 5.8: Forecasting long distance demand



5.4.22 We have therefore examined what would happen to the benefit-cost ratio if we assumed that demand continued to rise at 2.2% per year until 2040 and 2049.

5.4.23 This analysis suggests that if demand continued to grow to 2040 or 2049, HS2 could deliver 'very high' value for money with a benefit-cost ratio between 2.8 and 4.5[163]. Analysis undertaken by HS2 Ltd and set out in their report also demonstrates that the potential for higher returns is very much greater than the potential for lower returns from more cautious assumptions.

[161] Benefit-cost ratio allowing for demand to grow until 2040 or 2049

[162] Source: HS2 Ltd

[163] It is helpful to compare UK travel trends with those of comparable European countries. Adopting these assumptions implies that in 2040 households would be making an average of 3.1 long distance trips by train annually and 3.6 long distance trips in 2049 compared with a rate of 9.9 and 10.3 in Spain and Italy respectively

Impacts on the environment

5.4.24 The Government recognises the effects a large scheme like HS2 will have on the environment. The work undertaken by HS2 Ltd to develop the Environmental Statement for Phase One and Appraisal of Sustainability for Phase Two ensures that we have a thorough understanding of these impacts. The issues our assessment takes into account include amongst other things:

- noise associated with running HS2 services;
- greenhouse gases, including carbon, associated with changes to the amount of travel and switch to less polluting modes;
- air quality – associated with changes in the amount of travel and switch to less polluting modes;
- landscape – associated with the value people place on the natural environment or undeveloped land;
- heritage – buildings, parks and sites of architectural or historical significance;
- townscape – the physical and social characteristics of the built environment and the way we perceive those characteristics;
- biodiversity – degree of variation of life forms;
- water environment – the availability of water resources; and
- option values – the value attached to having the option of using a transport service whether or not it is actually used.

5.4.25 The impacts have been taken into account and have had a profound impact on the design of HS2. The choice of route as a whole aims to minimise the impacts on the environment and the detailed design of the scheme includes hundreds of millions of pounds worth of mitigation measures like tunnels.

5.4.26 For the purposes of our benefit-cost analysis, it is easier to measure and value some impacts than others. Some environmental impacts such as noise, carbon and air quality are captured in the benefit-cost ratio and our estimates have been updated in the latest analysis. Other effects such as the visual intrusion of infrastructure on landscape, and impacts on our heritage, are much harder to express in monetary terms.

5.4.27 The Department has thoroughly reviewed its previous assessment of landscape impacts. These impacts attempt to capture the value people place on the natural environment or undeveloped land as places to enjoy. The impacts on landscape have been estimated at £1bn for Phase One and £2.9bn for the full Y network. These estimates are not included in the benefit-cost ratio analysis described previously because of the uncertainties around their measurement. Impacts valued as set out above would have a small negative effect on the value for money of the scheme, reducing the benefit cast ratio in both cases by 0.1.

5.4.28 In summary, HS2 has been designed to minimise adverse impacts on the environment and mitigate impacts as far as possible where they occur. In addition, our value for money assessment takes account of the full range of environmental effects and remains robust even when hard to measure impacts such as those described above are taken into account.

The robustness of the 'standard' and 'long term' appraisal

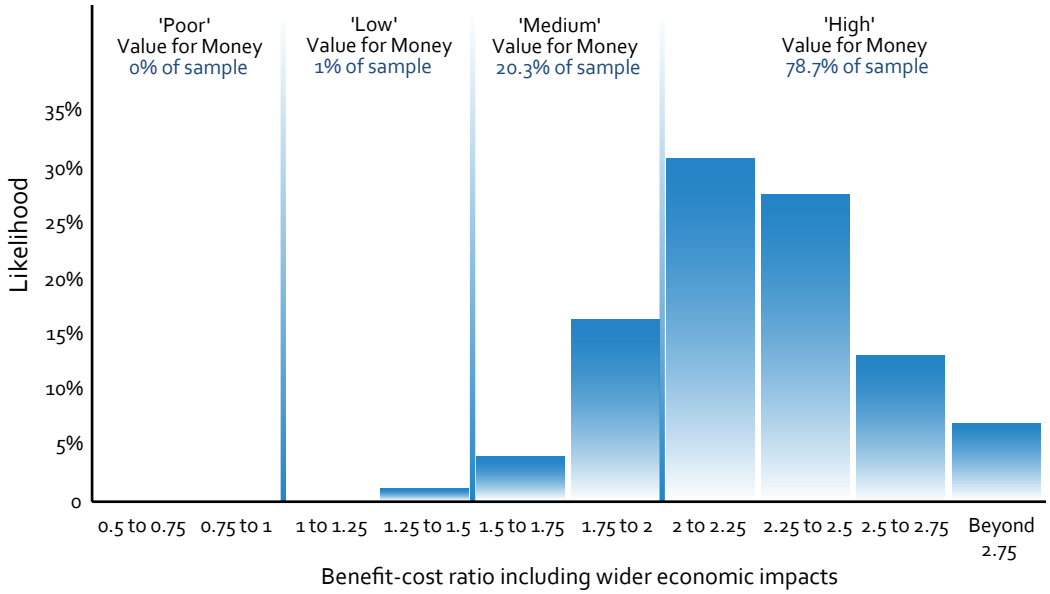
5.4.29 HS2 will generate benefits for the UK for generations to come. Forecasting travel patterns such a long way into the future is inherently challenging. It is particularly important to understand the uncertainty attached to those factors in the appraisal which will have the greatest impact on the investment case. In the case of HS2, as with many transport investments, this means understanding in particular the impact of a range of different assumptions about economic growth – growth in demand for rail travel, construction costs and the valuation of time savings.

5.4.30 HS2 Ltd has carried out an assessment of the robustness of the economic case to a range of different assumption associated with these factors, using the standard assumptions underpinning the reference case set out above as the starting point.

5.4.31 The analysis presented by HS2 Ltd captures the range of different benefit-cost ratios that could result from combinations of different assumptions and is based on an understanding of the probability of different events occurring. For instance, we have looked at the probability of the long term rate of economic growth being below 2% per year, and the statistical probability of demand growth being higher or lower than expected. Other factors such as possible variations in construction costs, the sensitivity of demand to economic growth and fares and the value of time are also included. The probabilities attached to these assumptions have been developed in consultation with external independent experts. A computer model has been used to run thousands of simulations on the basis of these probabilities, and the results have been used to assess how the returns on investment would vary for different combinations of these factors.

5.4.32 The analysis cannot capture all possible outcomes because there are some events that cannot be described in terms of probabilities in this way. However it does provide a systematic way of assessing the range of different outcomes that could occur. It also yields information on the relative likelihood of different outcomes, and therefore guards against undue weight being placed on extremely optimistic or pessimistic assumptions.

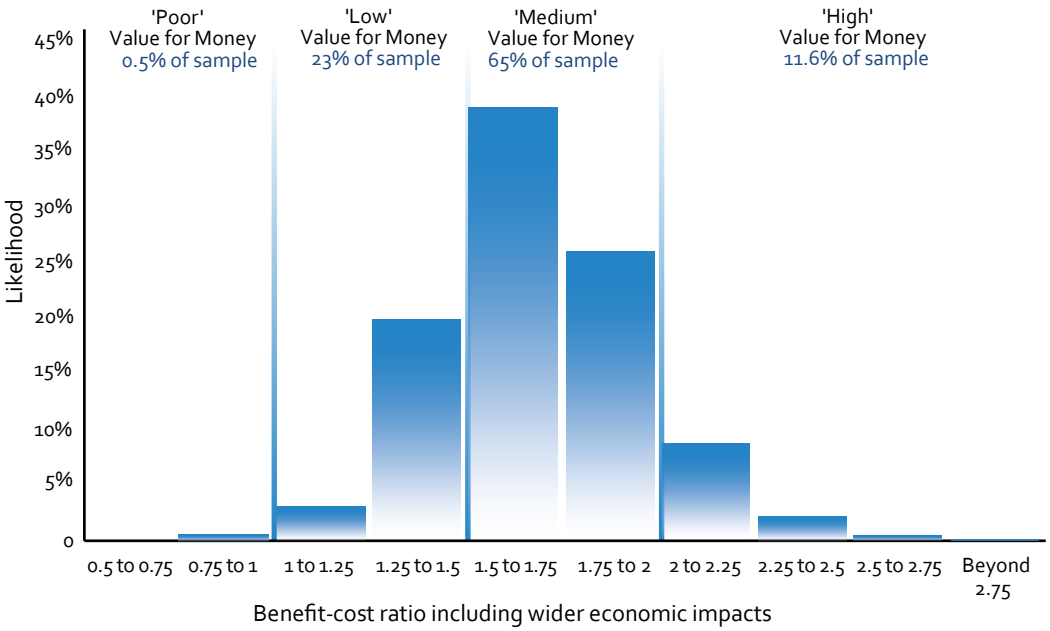
Figure 5.9: Standard appraisal: distribution of benefit-cost ratios for the full network



5.4.33 Figure 5.9[164] illustrates the results of this analysis for the 'standard' benefit-cost ratio for the full Y network and shows the range of possible benefit-cost ratio outcomes mapped against the Department's value for money categories to allow comparisons with other schemes. From this analysis, we can have confidence that the scheme will offer 'high' value for money. Even under the most pessimistic scenarios with high construction costs, historically low economic growth, low values of time and low growth in demand, the scheme would still offer positive returns on investment.

[164] Source: HS2 Ltd
Note: Impact on benefit-cost ratio of uncertainty around long-term economic growth, construction costs, demand forecasting and values of time

Figure 5.10: Standard appraisal: distribution of benefit-cost ratios for Phase One



5.4.34 Figure 5.10[165] shows the results of this analysis for the 'standard' benefit-cost ratio for Phase One of the scheme. It also provides us with confidence that our conclusions on the value for money of Phase One are sound. While the overall return is lower than for the full Y network, there is a high likelihood, greater than 75%, of Phase One being 'medium' or 'high' value for money. The likelihood of Phase One offering poor value for money is extremely remote.

[165] Source: HS2 Ltd
Note: Impact on benefit-cost ratio of uncertainty around long-term economic growth, construction costs, demand forecasting and values of time

5.4.35 HS2 Ltd has also considered the robustness of the 'long term' appraisal, allowing for demand to grow by 2.2% per annum up to 2040 and 2049 as described above. Figures 5.11[166] and 5.12[167], show that modest changes to the demand cap can lead to significant changes in the benefit-cost ratio, and that in the scenarios in which demand grows in the way described, there is a low probability that HS2 offers anything less than 'high' value for money[168].

Figure 5.11: Demand growth stops at 2040

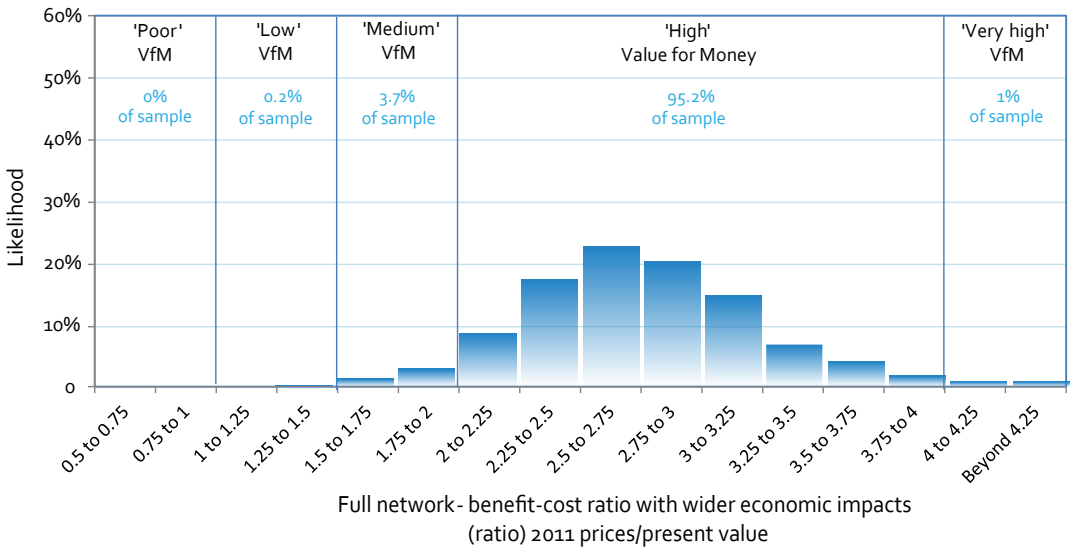
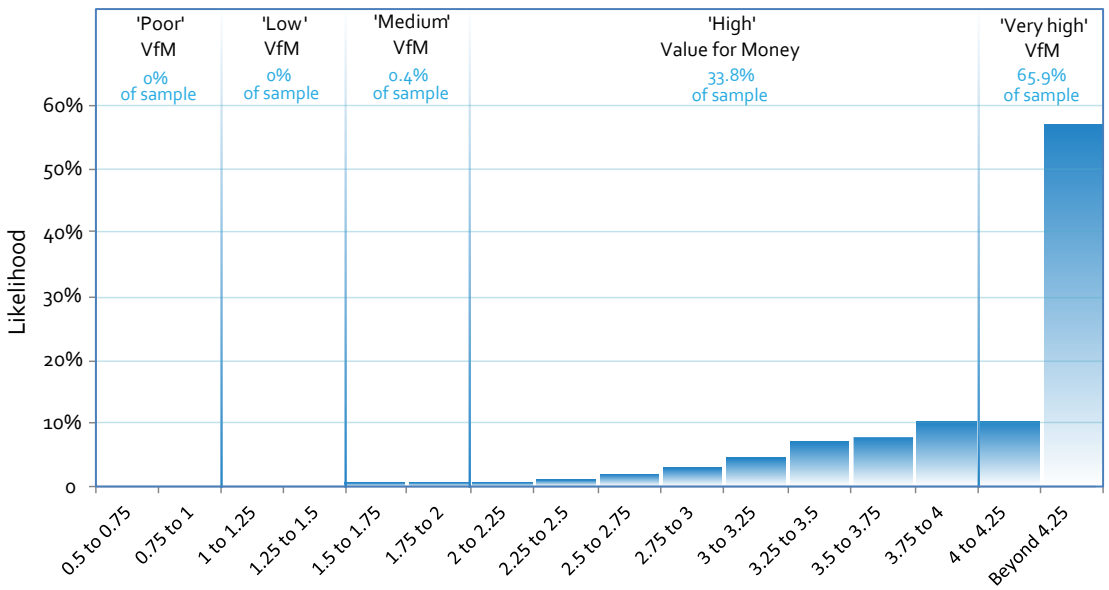


Figure 5.12: Demand growth stops at 2049



[166] Source: HS2 Ltd
[167] Source: HS2 Ltd
[168] Note: Impact on benefit-cost ratio of uncertainty around long-term economic growth, construction costs, demand forecasting and values of time

Valuation of time savings

5.4.36 The appraisal of benefits requires that we attach a value to the time savings travellers enjoy as a result of HS2. The approach to this issue has been debated over several decades and was raised by the Public Accounts Committee in its recent report[169].

5.4.37 Over the last year, the Department has therefore undertaken a comprehensive review of the valuation of travel time savings. First, the WebTAG values have been reviewed for use in all transport assessments, including HS2, to take account of new data. This has resulted in the changes set out in Figure 5.13[170].

Figure 5.13: Values of time per person (£ per hour, 2010 prices and values)

£ p/hr	Current WebTAG values	Updated values
Business	47.18	31.96
Commuting	6.46	6.81
Leisure	5.71	6.04

5.4.38 Second, we have undertaken a comprehensive review of the evidence on values which have been estimated using different academic approaches[171]. Figure 5.14[172] illustrates the range of alternative values for rail and all transport modes. The values adopted in WebTAG rail assessments are shown to lie very comfortably in the middle of the range suggested by research evidence. The Department has therefore concluded that these values are a suitable representation of businesses' willingness to pay for quicker journeys and the fact that some people work on trains.

5.4.39 This information provides the Department's interpretation of the current evidence base, based on a review undertaken by the Institute for Transport Studies at the University of Leeds[173]. This considered UK and international evidence on values of in-work travel time savings resulting from different valuation approaches. The chart shows the average of values resulting from studies using a range of different approaches and distinguishes between values from UK and other European evidence. Ranges are also shown, representing the uncertainty around the average of the values resulting from the studies reviewed[174].

5.4.40 Figure 5.14 on the following page shows the values of travel time savings proposed by the different studies against the value adopted by WebTAG.

[169] Public Accounts Committee, 2013, *High Speed 2: A review of early programme preparation* http://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news/high-speed-2-report/

[170] Source: Department for Transport

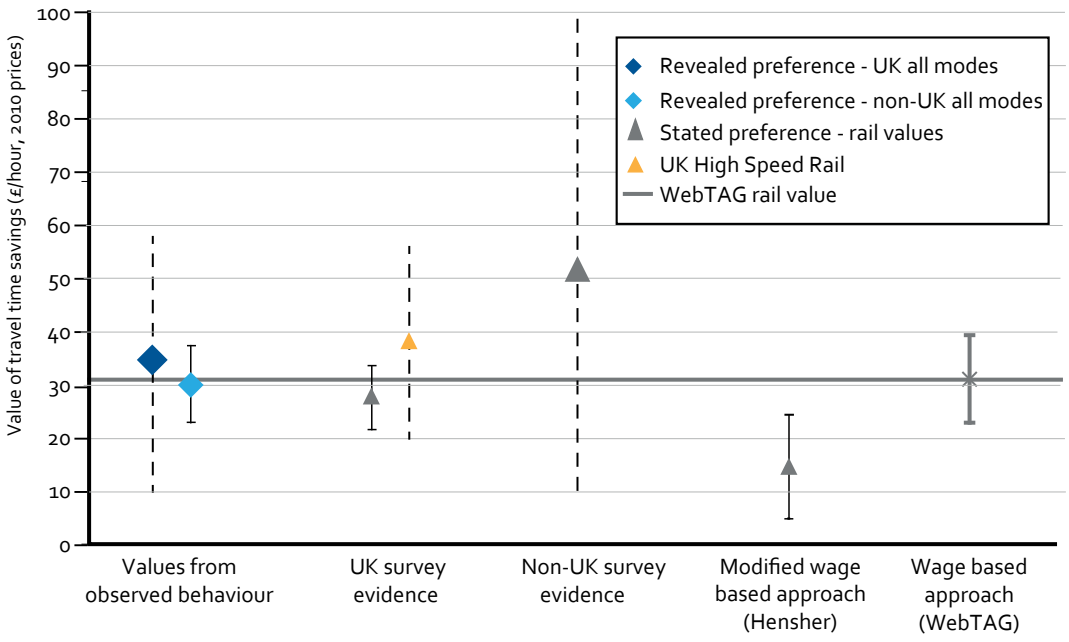
[171] See Department for Transport position statement October 2013 and research review by Institute for Transport Studies (ITS) Leeds, *M Wardman P Mackie et al*

[172] Source: Institute for Transport Studies Leeds and Department for Transport

[173] Wardman M, Batley R et al (2013), *'Valuation of Travel time Savings for Business Passengers'*, Institute for Transport Studies Leeds

[174] For the revealed and stated preference evidence, the range represents the 95% confidence interval based on the standard errors reported by Institute for Transport Studies Leeds. The range around the Hensher values is mainly based on uncertainty around the 'r' parameter, what proportion of saved travel time will be converted to work or leisure

Figure 5.14: Business values of time



5.4.41 The information in Figure 5.14 suggests that the value attached to saving time on business travel is considerably higher than the value people attach to saving time on leisure or commuting trips[175]. This is particularly important for HS2 which is designed to improve connectivity between major economic centres and we forecast that it will carry a relatively high proportion of business travellers.

5.4.42 There are, however, reasons to believe that high speed rail schemes should be assessed with values of time higher than those applied to conventional rail schemes. The ITS Leeds study concluded that when considering values of time for high speed rail the existing evidence points to a valuation in excess of that applied in the WebTAG economic analysis by as much as 40-50%[176].

5.4.43 The rationale for these higher values is explained by a number of factors including:

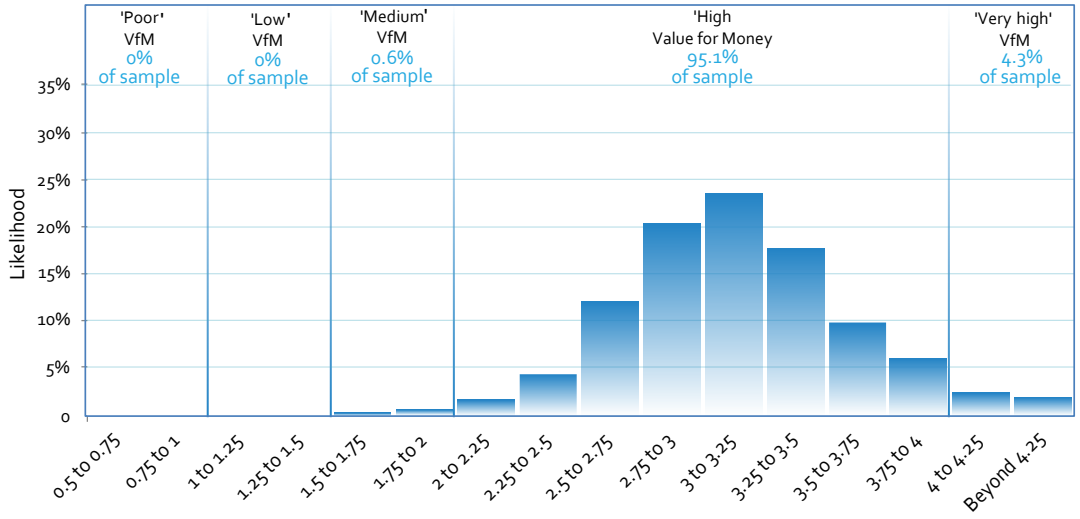
- The long distances served by high speed rail services, and the positive relationship between the length of a journey and the value of time;
- The higher productivity of business travellers using high speed rail services;
- The substantial time savings offered by high speed rail schemes, for example a large time saving of 30 minutes may allow more client meetings to take place which could increase the productivity of that trip at the destination; and
- Other effects such as the ability to avoid overnight stays.

[175] Wardman M, Batley R et al (2013), *'Valuation of Travel time Savings for Business Passengers'*, Institute for Transport Studies Leeds

[176] Department for Transport, April 2011, *Transport Analysis Guidance – Web Tag Unit 3.5.6 (2012), Values of Time and Operating Costs*, http://www.dft.gov.uk/webtag/documents/expert/pdf/u3_5_6-vot-op-cost-120723.pdf

5.4.44 Applying values of time consistent with the evidence on high speed rail would significantly strengthen the economic case for the scheme. HS2 Ltd has tested the impact of using a business value of time for long distance rail users 40% higher than the standard WebTAG 2013 values. The benefit-cost ratio in this case is expected to be greater than 3 and taking account of the risks and uncertainty which have been quantified there would be little or no chance that the benefit-cost ratio will fall below 2 as shown by the Figure 5.15[177].

Figure 5.15: Higher willingness to pay for long journeys



Assuring the quality of the analysis

5.4.45 All the work undertaken on this update to the economic case has been subject to rigorous quality assurance. Systems are in place to ensure the HS2 Ltd economic modelling is checked, not just by HS2 Ltd staff, but by leading modelling practitioners, including internal reviews, peer reviews, formal audit and independent expert advice. Since the summer of 2012, this has amounted to over 1,000 days of assurance work.

5.4.46 As a result, HS2 Ltd's quality assurance procedures meet the recommendations of the Macpherson Review of Quality Assurance of Government Models[178]. The NAO has also noted its satisfaction that the audit process is "detailed and thorough"[179]. On this basis the appraisal and analysis that has been deployed in regard to HS2 is fit for purpose and well-based on best practice, both in the UK and internationally. The appropriate methodology has been applied rigorously, underpinned by a number of mechanisms to give this assurance. We are confident that the conclusions set out here can be relied on.

177 Source: HS2 Ltd
178 https://www.gov.uk/government/publications/review-of-quality-assurance-of-government-models
179 National Audit Office, May 2013, *High Speed 2: A review of early programme preparation,* www.nao.org.uk/report/high-speed-2-a-review-of-early-programme-preparation/

5.5 Conclusions

5.5.1 The extensive analysis undertaken by HS2 over the course of the past year demonstrates that there is a sound economic case for proceeding with HS2. On the basis of the analysis set out in this chapter we have reached two main conclusions:

- that there is a strong case for proceeding with the scheme based on the 'standard' benefit-cost ratio: HS2 shows a good return on investment with a benefit-cost ratio of 2.3 for the full Y network and 1.7 for Phase One on its own; and
- allowing for longer term demand growth, the benefit-cost ratio could be considerably higher. In scenarios where demand for HS2 continues growing until 2040 or 2049, the benefit-cost ratio could range from 2.8 to 4.5.

5.5.2 Furthermore, HS2 Ltd's analysis demonstrates that the economic case is robust to a wide range of different assumptions, including on economic growth, demand growth and costs. We will continue to keep our assessment under review as the scheme progresses to take account of new information to ensure it continues to take account of both upside and downside risks.

6 Chapter 6 – Assessment against the alternative: to upgrade today's railway

Summary

This chapter assesses the suggestion that a better way of delivering new capacity on the national rail network could be to upgrade the existing infrastructure and compares the case for upgrades with the case for HS2.

6.1 The context for developing alternatives

6.1.1 The context for this work is the operational complexity of the existing rail network, and the compromises that sometimes need to be made in planning and delivering the different services that use the most congested infrastructure – particularly the West Coast Main Line.

6.1.2 The Government is committed to significant investment to maximise the effectiveness of the existing infrastructure. Plans for the 2014-2019 period include those developed for the East Coast Main Line (where the new Intercity Express (IEP) fleet is expected to lead to greater passenger capacity and some shortening of journey times); and the electrification of the Midland Main Line.

6.1.3 The challenge of delivering extra capacity (for passengers and for freight) – especially over the busier sections of the network is typically being addressed through:

- the introduction of longer trains (which may require consequential infrastructure changes);
- adding additional services to the timetable in some places, where this is still possible; but opportunities to do this are becoming scarce, especially on the approaches to major cities; and
- addressing the differential speeds of the various types of trains using the line. By reducing speed differentials between successive trains it may be possible to deliver more train paths. But again the scope to do this is limited.

6.1.4 Changes such as these, including introducing further services on the busy north-south main lines, can typically only be achieved by recasting timetables. This can paradoxically mean less frequent trains at some intermediate stations and may also prejudice train service punctuality.

6.1.5 There are examples of where timetable changes on the West Coast Main Line have required cuts to some services in order to enhance others, including:

- forcing one out of every two Chester – Northwich – Manchester peak commuting trains to run only as far inbound as Stockport, in order to accommodate additional long distance services between Stockport and Manchester;
- restricting direct services between the West Midlands and Milton Keynes in commuter peaks, because of train overcrowding issues; and
- removal of direct services between Watford and North West England, in order to accommodate a separate service given higher priority.

6.1.6 This illustrates the kind of trade-offs that have to be made with a very busy mixed traffic railway.

6.1.7 These limitations also mean that there is insufficient space in the timetable to introduce new services. For example:

- it will be difficult to accommodate all of the potential growth in services that could use the new East West rail link because they will need to use parts of the overcrowded West Coast Main Line;
- long standing aspirations, such as the operation of a second hourly Cross Country service to link Coventry and Birmingham International with Yorkshire, cannot currently be accommodated: the railway is already over-stretched in this area; and
- there is further rail freight to be accommodated, including an extra 16 intermodal freight trains each day as the London Gateway port develops.

6.1.8 On some parts of the network, there are bottlenecks for which localised solutions might be found. In this category are, for example:

- the twin-track section of route at Welwyn and the two and three track route sections between Peterborough and Huntingdon on the East Coast Main Line;
- the busy junctions in Staffordshire at Colwich and Norton Bridge on the West Coast Main Line (the latter is already the subject of a major investment by Network Rail); and
- the congested section between the Thameslink platforms at St. Pancras International and Kentish Town, where intercity trains merge with an intense suburban service.

6.1.9 The way that incremental investments are devised in practice is a matter for the rail industry and takes into account projections of demand and operator requirements – and also the need for future ongoing maintenance requirements. There are many possible permutations that could be developed. The best option for improving existing infrastructure will vary depending on the circumstances and state of any given part of the route.

6.1.10 The West Coast Main Line has recently been modernised and is essentially a very busy four-track railway extending from London to Crewe (where the main routes diverge). It may be possible, by re-timing services on the West Coast Main Line fast lines, to add a very limited number of new train paths – subject to demonstrating that performance would not suffer as a consequence, and recognising that for some intermediate stations there is likely to be some reduction in connectivity.

6.1.11 Thereafter, once trains have been lengthened to the greatest extent practicable, the ability to significantly increase West Coast Main Line capacity further would require the construction of additional tracks alongside the current railway. Thus incremental options for this route therefore centre on using maximum train lengths in the first instance, together with an intensification of services.

6.1.12 The East Coast Main Line has already been subject to a series of incremental investments designed to reduce conflicts between different train types, especially freight and passenger. Any substantial investment package for this line would have to address the remaining bottlenecks, some of which extend over significant distances.

6.1.13 The Midland Main Line (on the southern section) is dominated by the Thameslink service pattern, with a more limited overlay of longer distance services and freight trains. While route options north of Kettering can be used to create additional capacity, avoiding what otherwise would be a bottleneck at Leicester, the southern section of the route from Bedford to St. Pancras is very constrained by the intensive Thameslink service plan.

6.2 Alternatives to HS2

6.2.1 In developing the case for HS2 from 2009 onwards, the Department for Transport, with assistance from Atkins and Network Rail has considered a wide range of incremental investment alternatives to HS2. This work was published in a series of reports the conclusions of which are summarised as follows.

6.2.2 *High Speed 2 Strategic Alternatives Study, Strategic Outline Case* (March 2010). This report contained an assessment of five packages of rail upgrade alternatives to HS2 Phase One:

- The first package (RP1) looked at addressing capacity by significantly *lengthening* intercity trains (to 14 or 17 cars). This was found to be very expensive and highly disruptive and was ruled out from further consideration;
- The second package (RP2) increased service *frequency* out of Euston (as well as lengthening all Pendolino trains) and offered shorter journey times, delivered in part by removing intermediate stops on long distance services. This option had infrastructure costs of £3.7bn (2009 prices); and
- The remaining packages RP3, RP4 and RP5 would progressively provide further additional capacity, provided by upgrading the Chiltern line (and building some new connections). Journey times would not be improved significantly and the infrastructure costs were in the range £12.5bn – £19.8bn (2009 prices). Benefit-cost ratios were between 0.93 and 1.24; RP2 on the other hand had a benefit-cost ratio of 2.85 and was taken forward in subsequent studies.

6.2.3 *Strategic Alternatives to the Proposed Y Network* (February 2011) assessed three upgrade rail packages across the West Coast, Midland and East Coast Main Lines as alternatives to the full Y network – identified as Scenarios A, B and C. Scenario A was based on train lengthening, Scenario B on increasing service frequency (with some journey time improvements) and Scenario C involved a more comprehensive package of infrastructure investment with some new alignments to bypass sections of track with low line speeds. Only Scenario B (with a capital cost of £13.1bn) had a benefit-cost ratio over 1.

6.2.4 *High Speed 2 Strategic Alternatives Study – Update Following Consultation* (January 2012) further updated the analysis of the best-performing rail-based strategic alternatives to HS2 (RP2 and Scenario B) in order to ensure consistency with the updated appraisal of HS2. It took into account the findings from the HS2 consultation process, and incorporated the findings of a review undertaken by Network Rail of the rail upgrade alternatives.

6.2.5 Two further developments of RP2 were also assessed: RP2A and 51M. In the RP2A variant, 'performance allowances' that had been reduced in the RP2 case (which had the effect of speeding up journey tines) were re-instated. The 51M proposal was put forward by a group of local authorities opposed to HS2. This scheme proposed some further capacity increases over the currently committed capacity enhancements on the West Coast.

6.2.6 The conclusions[180] that the Government drew from these appraisals were that, while the benefit-cost ratios in general were high or very high (except in the case of Scenario B), an approach reliant on upgrading the existing main lines would:

- generate only a relatively small increase in overall capacity in comparison to new lines – and this would be particularly small in relation to the commuter, regional and freight markets, because much of the new capacity generated would be used for long-distance services;
- achieve much smaller improvements in journey times in comparison to those delivered through high speed rail;
- deliver comparatively few 'wider economic benefits';
- may not support job creation to the same degree as high speed rail, nor match the regeneration opportunities associated with new high speed rail stations;
- not enhance interchange opportunities as they would rely on the same stations and interchanges as were currently in place; and
- be likely to result in significant disruption to passengers during the construction phase[181].

6.2.7 Since then, the Department has continued to examine possible alternatives to HS2, looking at options for all three North-South main line routes, as well as Cross Country services north of Birmingham. These alternatives included consideration of all types of train service, including intercity, commuter, regional and freight and were designed to address the full set of objectives described in Chapter 3 including both capacity and connectivity objectives.

6.2.8 As before, the Department drew upon specialist input from Atkins and Network Rail whose work is being published alongside this Strategic Case. The work allowed for changes to be made to the alternatives to reflect the substantial programme of rail investment that had been committed since 2010 when the alternatives were first assessed. In some cases, what had previously been included as part of an upgrade package – such as electrification of the Midland Main Line – could now be taken as happening in any event.

[180] Department for Transport, 2011, High Speed Rail: *Investing in Britain's Future Consultation*, p58-59
[181] Atkins, October 2013, *HS2 Strategic Alternatives*, with supporting technical annex from Network Rail

6.2.9 Given the huge number of possible approaches, the process followed was one of progressive sifting and refinement of over 100 candidate interventions, in order to:

- identify whether more capacity could be provided by running longer trains (typically up to the 11 or 12 car limit set by existing platform lengths on the network, although recognising the need for and value of platform lengthening);
- provide more capacity, first by relieving bottlenecks for example through junction improvements, second by increased segregation of fast and slow services and third by the provision of sections of new track; and
- address ways of speeding up intercity and commuter trains, in particular by accelerating the former to 140mph (from a 125mph ceiling today), as well as other measures to reduce journey times.

6.2.10 The Department took the opportunity to develop further alternatives to HS2 Phase One, changing some aspects of the previous versions (RP2 and 51M). This formed the primary basis of looking for alternatives in the West Coast corridor since the earlier work had demonstrated diminishing returns from more extensive (and more expensive) approaches.

6.2.11 Alternatives to the full Y network were significantly enhanced from the 2011 Scenario B specification with the aim of better meeting the objectives of HS2. They were in particular designed to deal more explicitly with short distance and cross-country flows.

6.2.12 For the next stage in the process, which was the comparison between HS2 and the alternatives, we considered packages of measures that would perform best in relation to the objectives. These alternatives were considered in two contexts: one looking just at Phase One alternatives and the other at alternatives to the full Y network. In each case, we selected the best performing option available from the analysis.

6.2.13 Comparison with the Phase One alternative showed that it provided only a small proportion of both the capacity and connectivity gain that HS2 would provide, while risking performance reliability both from the disruption caused during construction and ongoing because of the proposed very high intensity of use of essentially the same route network.

6.2.14 With regard to the full Y network alternatives, our work showed that very extensive infrastructure works would be required in pursuit of the aim to provide a step change in service provision. These would lead to a scale of works on the existing network with consequential disruption to services over a lengthy period, which could be untenable in practice. The full Y network alternatives would also not deliver the scale of connectivity and capacity benefits that HS2 brings.

HS2 Phase One alternative

6.2.15 The Phase One alternative would make changes on the West Coast Main Line. It would provide additional capacity, mainly through a programme of train lengthening of intercity and suburban services, but also through an increase in frequency and by switching a first class coach to standard class in the Pendolino services in order to increase the number of seats available. It would incorporate a set of infrastructure schemes on the existing line which would tackle bottlenecks, and the modernisation of junction designs as well as the provision of additional tracks in some locations. Several of these would extend north of the section of route addressed by HS2 Phase One. This package would have a capital cost of £2.5bn[182].

6.2.16 The primary objective of the Phase One alternative was therefore to deliver additional capacity on the West Coast Main Line, by addressing:

- train service frequency on the West Coast Main Line 'fast' lines, which would be increased to 16 trains per hour (tph) into London Euston;
- intercity capacity improvements delivered through assuming that all Pendolino trains would be extended to 11 cars, with the conversion of one First Class carriage to Standard to increase the number of seats; and
- commuter capacity requirements by assuming all commuter services would be extended to 12 cars.

6.2.17 To deliver the service enhancements it was assumed that a number of key network improvements would need to be made. The principal schemes included the following:

- some platform lengthening to accommodate longer trains;
- a new grade-separated junction near Leighton Buzzard, to reduce conflicts between fast Northampton and intercity trains;
- a new grade separated junction to separate the Manchester from the Stafford intercity trains at Colwich Junction, Staffordshire; and
- additional passing loops for freight trains.

6.2.18 Some of these improvements in this option could be worth doing in their own right, whether or not HS2 proceeds. A good example would be capacity improvements north of Preston which are likely to be needed to allow freight growth to be accommodated over the prime Anglo-Scottish freight route[183].

[182] All values for costs, benefits and disruption in this chapter are taken from Atkins, October 2013, *HS2 Strategic Alternatives*, The cost quoted includes optimism bias but not rolling stock costs

[183] HS2 Ltd has recognised the possible need for some infrastructure investment on the relevant parts of the West Coast Main Line

Alternative to the full Y network

6.2.19 The alternative to the full Y network would require far more extensive infrastructure works and consequently would have a much higher capital cost (of £19.2bn). It would address short-comings across the West Coast, Midland and East Coast Main Lines, and (parts of) the Cross Country Routes. In addition to the service improvements of the HS2 Phase One Alternative it would provide:

- an 11 train per hour timetable for long-distance East Coast Main Line services, with all services assumed to be operated by 140mph capable IEP sets with:
  - Nottingham and Sheffield served from Kings Cross (via Grantham), and
  - Leeds and Newcastle both having a 4tph service from Kings Cross (the former with 2tph extending to Bradford and the latter with 3tph continuing to Edinburgh).
- a 6 train per hour long-distance service pattern on the Midland Main Line;
- doubling of the service frequency between Birmingham and Manchester, with some modest journey time benefits;
- journey time and frequency improvements from Birmingham to Derby, Nottingham, Sheffield, Leeds, York and Newcastle; and
- enhancements to commuter services.

6.2.20 To deliver these service enhancements, the following principal schemes would be needed, in addition to those assumed in the Phase One Alternative would need to be made.

6.2.21 East Coast Main Line infrastructure works includes:

- extension of all platforms at Kings Cross to permit 12 car operation (but losing one of the platforms in the process);
- a new, two track railway with a tunnelled/surface section of new line approximately 30 miles long from inner North London to North of Hitchin, bypassing the Welwyn Viaduct;
- upgrade of some parts of the East Coast Main Line to 140mph (from 125mph today);
- grade separation of the railway at Newark and Doncaster;
- electrification and upgrade of Grantham to Nottingham to enable Nottingham and Sheffield services to be served from the East Coast Main Line;
- four-tracking sections of Doncaster to Wakefield and a new tunnel from near Wakefield into Leeds to provide better access with additional platforms provided at Leeds;
- creation of a new line bypassing the lower speed section through Durham partly using the former Leamside line alignment; and
- other works to provide parallel routes along much of the East Coast Main Line suitable for freight including electrifying the 'Joint Line' through Lincolnshire.

6.2.22 Midland Main Line infrastructure works includes:

- platform alterations at St. Pancras station;
- a turn-back in the Luton area for suburban services;
- electrification of the Erewash Valley line, and some line speed enhancements to 110mph to support services from King Cross to Sheffield via Nottingham;
- a tunnel and four-track approach to Sheffield from the south;
- two extra platforms at Nottingham; and
- an additional platform at Chesterfield.

6.2.23 Cross Country route infrastructure works includes:

- a series of four tracking schemes and junction remodelling works;
- infrastructure works between Birmingham and Derby/Nottingham and from Nottingham to the East Coast Main Line;
- new infrastructure in West/South Yorkshire to address the capacity and journey time challenges in the Sheffield – Leeds corridor including four tracking and line speed improvements; and
- station and platform works in particular at Manchester and Newcastle.

6.2.24 Not summarised here, but covered in the supporting summary of the analysis[184], were options which would address another question – namely, assuming that Phase One of HS2 had been built, what upgrade options would exist (and how good would they be) as an alternative to progressing with the second phase of HS2. These options may be of particular relevance to those considering their response to the Phase Two Route Consultation. The cost estimate of the Phase Two alternatives is around £16.8bn, and they were found to have similar benefit-cost ratios to HS2 Phase Two (in the circumstances where it is assumed that HS2 Phase One had already been built). However, as with the full Y network alternatives as described later, the substantial disruption of the necessary infrastructure works counts heavily against these options, as well as the more limited connectivity gains.

[184] Atkins, October 2013, *HS2 Strategic Alternatives*, with a technical annex by Network Rail, October 2013, a report for the Department for Transport

6.3 HS2 and the alternatives: which approach best meets the objectives?

6.3.1 We assessed the alternatives against the same set of overarching economic objectives that are set out in Chapter 3. We have therefore looked at options in terms of their ability:

- To provide sufficient capacity to meet long term demand, and to improve resilience and reliability across the network; and
- To improve connectivity by delivering better journey times and making travel easier.

Together with the need to:

- 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; and
- Minimise impacts on local communities and the environment.

Performance comparison – 1: the capacity objective

6.3.2 The alternatives together with the Phase One and Phase Two versions of HS2 are set out in Figure 6.1[185] in respect of key measures on capacity[186].

Figure 6.1: Capacity assessment

	HS2 Phase One	Phase One Alternative	HS2 Both Phases	Phase One and Two Alternative
1.1 Additional peak hour seats – west coast corridor only (London Euston)	+10,800	+3,000	+13,100	+3,000
1.2 Potential Freight Capacity Release (additional daily paths southern section of West Coast Main Line)	+20	0	+20	0
1.3 Network resilience: Fast line path utilisation (West Coast Main Line South - trains paths per hour released)	+1	-3	+1	-3
RAG rating	Green	Red	Green	Red

6.3.3 The best summary indicator on capacity impact for passengers is the estimate of additional seats provided. While the upgrade options can only add 3,000 peak hour seats to the west coast corridor – over and above those to be operated with committed funding – HS2 provides an extra 10,800 seats in the west coast corridor (rising to 13,100 when a greater proportion of 400m long trains are deployed in Phase Two).

6.3.4 HS2 provides scope for additional freight paths in Phase One over the southern section of the West Coast Main Line; the upgrade alternative does not.

[185] Source: Steer Davies Gleave and HS2 Ltd

[186] Notes:
1. Additional peak hour seats is for Euston, long distance and commuter capacity combined (London Overground services excluded); against a base in which funded train lengthening is assumed. The figures for HS2 Phase One represent the initial service seating capacity against a base in which train lengthening is assumed
2. Potential freight capacity release
- HS2 estimates for freight path release is a preliminary estimate (it may be possible, dependent on more detailed train planning that there is the potential for further additional freight paths on the West Coast Main Line)
- Phase Two – estimates for freight path release (10 and potentially up to 20 paths on the West Coast Main Line in each direction including non-London freight flows) is a preliminary estimate and will be dependent on detailed train planning; and
- HS2 full Y network and the alternative to it are both likely to facilitate additional non West Coast Main Line freight paths Network Rail in their July 2013 report *'Options for the integration of High Speed 2'* identified a series of freight growth opportunities created by the HS2 Y network on both the Midlands Main Line and East Coast Main Line, for example

6.3.5 The question of the quality of the infrastructure capacity provided is reflected in its resilience and this is affected crucially by the intensity of use of the railway. The critical difference here arises on the West Coast Main Line, and specifically on the fast pair of tracks. Whereas the use of these lines will be reduced in the HS2 case, it will be intensified under the upgrade options. These tracks are today the busiest 125 mph railway in Europe and under the upgrade option set to get even busier. This means that under the upgrade options service reliability is unlikely to be better and may well be worse in comparison to the situation today.

6.3.6 Overall, the alternatives do not match the capacity enhancement that HS2 brings for passengers, or freight. In addition, they do not increase the resilience of the network.

Performance comparison – 2: the connectivity objective

6.3.7 The same alternatives have been assessed against the connectivity objective as set out in Figure 6.2[187,188].

Figure 6.2: Connectivity

	HS2 Phase One	Phase One Alternative	HS2 Both Phases	Phase One and Two Alternative
Illustrative journey time savings as a % reduction against 'do minimum'				
London-West Midlands	42%	0-13%	46%	0-13%
London-East Midlands	n/a	n/a	42%	18%
London-North West	20%	4%	38%	4%
London-Yorkshire/North East	n/a	n/a	23%	14%
West Midlands-Yorkshire/North East	n/a	n/a	49%	38%
Journey reliability: indicative outcomes				
London-West Midlands	↑↑	↘	↑↑	↘
London-East Midlands	↔	↔	↑↑	↔
London-North West	↑	↘	↑↑	↘
London-Yorkshire/North East	↔	↔	↑↑	↔
West Midlands-Yorkshire/North East	↔	↔	↑	↔
RAG rating	Green	Red	Green	Amber

[187] Source: Steer Davies Gleave, Atkins and HS2 Ltd

[188] Notes:

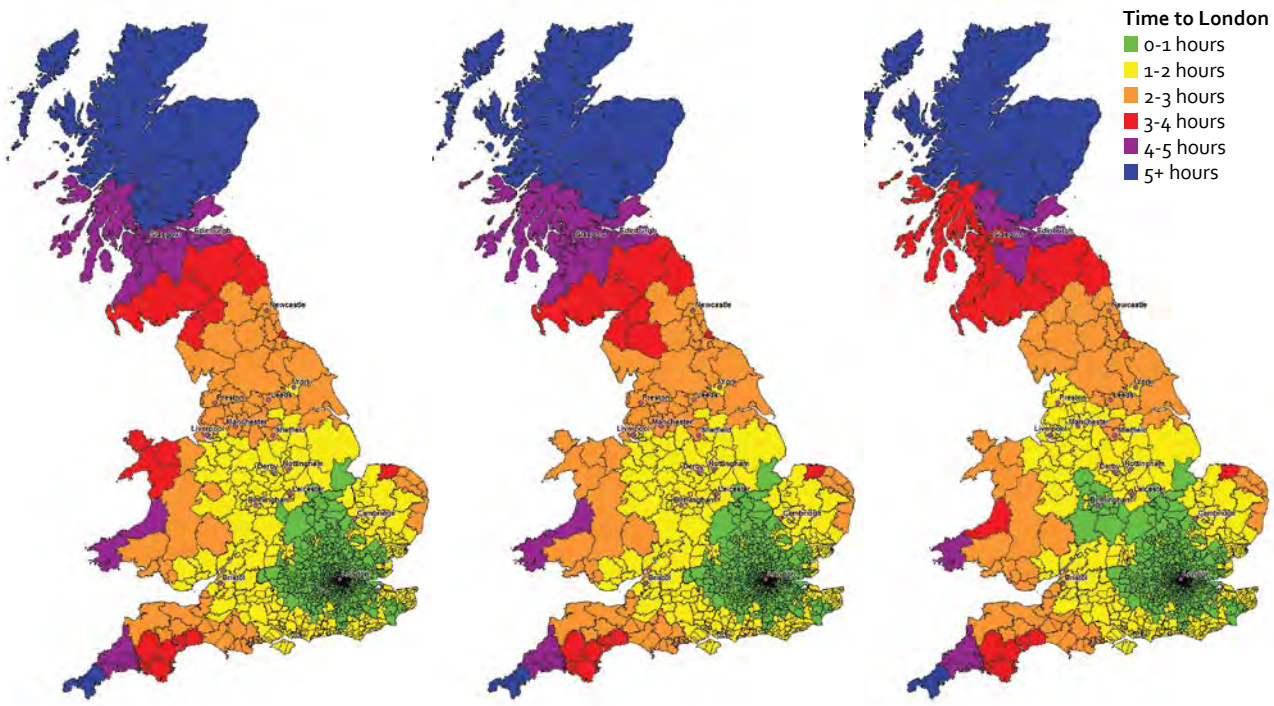
1. Alternative journey time savings for London – West Midlands are shown as a range between 0% (no change) and a 13% journey time saving which has been assumed to be achieved for London – Birmingham journeys with two out of three intermediate stops removed

2. The UK railway uses defined 'performance' measures to describe how reliable or punctual a train service will be. The indicative performance outcomes are shown as ↑↑meaning a major improvement, ↑an improvement and ↔ meaning no significant change, and ↘ indicating a risk that performance will worsen. This is intended to differentiate between the broad likely impacts of alternatives in the longer term

6.3.8 The journey time savings from HS2 are substantial for each of the corridors illustrated in Figure 6.2. They are much lower for the alternatives. However, under the full Y network there are good journey time savings offered to the East Midlands, to Yorkshire/the Humber and to the North East. Even so, the full HS2 scheme offers much faster journeys and so much better connectivity gains.

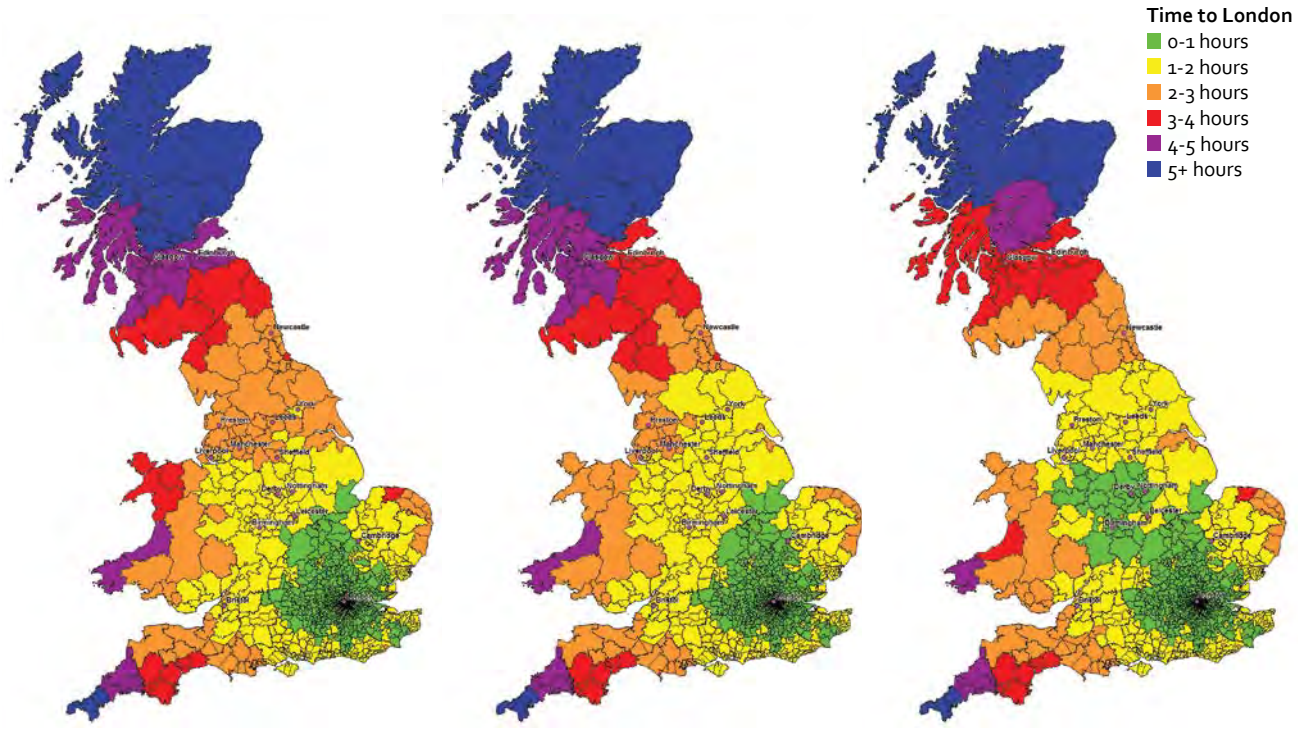
6.3.9 A comparison of the connectivity journey time effects of the rail alternatives and HS2 against a modelled 'do minimum' (which assumes additional rail enhancements) is shown in Figure 6.3[189] and Figure 6.4[190]. These maps illustrate the journey time assumptions that we make for modelling purposes to illustrate potential savings between different parts of the country and London stations.

Figure 6.3: Illustrative journey time comparisons for HS2 Phase One and rail alternative



[189] Source: Atkins
[190] Source: Atkins

Figure 6.4: Illustrative journey time comparisons for HS2 Phase One and Two and rail alternative



6.3.10 The *quality* component of journey times – and an essential part of delivering better connectivity – is passenger service reliability. This is usually measured in terms of the Public Performance Measure (PPM) which records the number of trains running on time (in fact to within 5 minutes of schedule in general and within 10 minutes for long distance services).

6.3.11 Although there are no established statistical methods for forecasting service reliability in the longer term, we know a certain amount from experience. Dedicated high speed services on HS1 achieve a 99.7% level of punctuality. Javelin services which use the high speed route achieve a 94% level of punctuality, whereas the Gatwick Express services achieve only 86%. We also know from analysis conducted by ORR that adding just a single train path to the West Coast Main Line in selected hours of the day is estimated to worsen punctuality performance by 0.5%.

6.3.12 It is therefore possible to identify with a reasonable level of confidence the *direction* of change in service reliability performance for each of the alternatives. The estimates shown in Figure 6.2 are indicative only; but they show that in every corridor considered, the full HS2 network is judged likely to perform better on this score than the incremental investment alternative.

Performance comparison – 3: deliverability

6.3.13 Under the heading of deliverability, the question of proven technology does not arise as a discriminator since both HS2 and the alternatives rely only on existing technology. We have examined the issues of disruption to the existing rail network and the scale of local impacts, as shown in Figure 6.5[191,192].

Figure 6.5: Deliverability

	HS2 Phase One	Phase One Alternative	HS2 Both Phases	Phase One and Two Alternative
Disruption (indicative number of weekend closures)	223	410	386	2790
Local Impacts: additional mileage of double-track railway (route length rather than track length)	136	~20	350	~155
RAG rating	Amber	Amber	Amber	Red

6.3.14 The alternative to the full Y network entails a huge amount of disruption to the existing network. Network Rail's judgement is that the scale of service closures involved across three main lines makes the Phase One and Two alternatives very unattractive. While some works could be programmed to coincide in terms of network down-time, this scale of work on the existing network would entail 14 years of weekend closures to allow the necessary upgrade works to be carried out. With work on multiple (parallel) routes, the scope to use adjacent main lines for diversionary routes is also diminished.

[191] Source: Network Rail and HS2 Ltd

[192] Notes:

1. The estimate for disruption impacts are preliminary for all options. The method used for assessing the disruption impacts varies between the four cases
2. Preliminary approximation of additional tracks for Phase One Alternative 20 miles of widened or track loops alongside existing rail lines, for the Phase One and Phase Two Alternative 85 miles of new or reopened tracks, and 70 miles of widened or track loops alongside existing rail lines

6.3.15 In addition, larger-scale disruptions require major logistic exercises to commission and operate an intense coach-replacement service, bearing in mind that a crowded intercity train with 500 passengers aboard requires something like to six to eight replacement coaches. Net revenue loss from West Coast Route modernisation was considerable, and estimated at £590m in the period 2002/3 – 2005/6[193], and the losses could be higher given the larger scale of infrastructure works required by the Phase One and Two alternative, and the growth in passenger numbers and revenue since the West Coast route modernisation was carried out.

6.3.16 With regard to local impacts as set out in Figure 6.5, the upgrade alternative would have lesser effect than HS2 Phase One, as reflected in the much greater mileage of new build. The important issue in HS2 Phase One is the impact of the works at Euston (as described in Chapter 4). Within the estimate of weekend possessions needed for HS2 Phase One, current HS2 Ltd plans envisage eighteen full weekend possessions arising from HS2, and the disruptive works would be contained in the initial years of the construction period.

6.3.17 With regard to the full Y network and the alternative to it, both have major impacts locally with substantial lengths of new build railway (it is worth noting that the additional tracks required will in many cases be in built-up residential areas). As part of the appraisal of the rail alternatives, an indicative assessment of possible environmental impact was carried out by Atkins. As the level of scheme development of the alternatives was a generally at pre-feasibility level, this work served only to identify the broad nature of potential environmental impact of the schemes and is detailed in the Atkins report.

6.3.18 Overall with regard to deliverability, it would be possible to carry out some works to the existing main lines to increase capacity through train lengthening and timetable changes. In terms of disruption to existing services these might have a not dissimilar level of impact to HS2 (and have a lesser environmental impact). However, this approach would not provide the step change in capacity and connectivity needed. In order to achieve anything approaching that step change on the existing mainlines would require a very extensive package of works – such as at the level contained in the full Y network alternative examined here. The disruption caused by this scale of work would be so wide-ranging and of such long duration that it would be untenable. Our conclusion therefore is that even if we were to spend approaching £20bn on the existing network, we could not meet both our connectivity and capacity goals, and the scheme would in any case be unacceptable in terms of disruption to existing passengers.

[193] National Audit Office, 2006, *Modernisation of the West Coast Main Line*, p19, http://www.nao.org.uk/wp-content/uploads/2006/11/060722.pdf

Benefit-cost analysis[194]

Figure 6.6: Capital costs and benefits

	HS2 Phase One	Phase One Alternative	HS2 Both Phases	Phase One and Two Alternative
Capital costs (£bn)	19.4	2.5	38.4	19.2
Benefit-cost ratio	1.7	2.0	2.3	3.1
Benefits £bn	28.1	8.5	71.0	30.7

6.3.19 As shown in Figure 6.6[195], the cost of HS2 Phase One is much higher than the alternative option with which it is compared. The Phase One and Two alternative would have a capital cost of £19.2bn – a cost not dissimilar to Phase One of HS2. The capital cost of the required work for the East Coast Main Line is (at £11bn including optimism bias) about the same as the stand-alone cost of the Eastern side of the Y network.

6.3.20 The benefits of the Phase One alternative would be 30% of those delivered by HS2 Phase One. The benefits of the Phase One and Two alternative would be less than half of those delivered by the full Y network.

[194] Notes:
1. Capital costs are shown undiscounted and in 2011 prices
2. Benefits are shown as discounted present values and include wider economic impacts
3. Benefit-cost ratios are shown reflecting the full set of costs and benefits as described in Chapter 5 – *they are **not** formed by the ratio of capital costs and benefits shown in this summary table but by all of the factors described in full in Chapter 5*

[195] Source: Atkins and HS2 Ltd

6.3.21 The benefit-cost ratios (which take into account operating costs, revenues tax impacts and other factors besides the benefits and capital costs shown in the table) are also shown in Figure 6.6. In this table, benefit-cost ratios are shown with wider economic impacts included, but in each case with a demand cut off year of 2036. The benefit-cost ratios are presented with two caveats:

- the alternatives are at an early stage of development. The costs and planning issues are therefore uncertain; and
- both are presented with a demand cap in 2036. If this was pushed out, the alternative would fall further and further behind HS2 Phase One because their total capacity is much less than HS2 and they would be overwhelmed long before HS2 became fully utilised.

6.3.22 While it might be thought that the capacity of the alternatives could, in the longer term, be addressed by adopting further upgrade measures, the evidence from earlier work on this type of alternative showed a pattern of diminishing returns, with lower benefit-cost ratios as the upgrades became more extensive[196]. On the West Coast Main Line itself, if the upgrades assessed here were carried out, the next capacity increment would be likely to require a radical step change such as the provision of further tracks over the London – West Midlands section. The cost of that would be many billions of pounds. And as we noted in Chapter 3, at that point it is clear that a high speed solution offers best value for money and that the best return on tax-payer investment is likely to lie with HS2.

6.3.23 Both the full HS2 Y network and the alternative would deliver 'high' value for money. However, the greater capacity provided by HS2 in the longer term is a factor that has to be considered in judging overall value for money. Furthermore, the disruption caused by the implementation of the full Y alternative would have significant negative impacts that have not been fully taken into account in the benefit-cost ratio.

[196] Atkins, 2010, *High Speed 2 Strategic Alternatives Study: Rail Interventions Report*, http://webarchive.nationalarchives.gov.uk/20110131042819/http://www.dft.gov.uk/pgr/rail/pi/highspeedrail/alternativestudy/pdf/railintervention.pdf, Accessed 16 October 2013

6.4 Conclusion

6.4.1 Our assessment shows that only a new railway line can fully meet the objectives of the HS2 programme.

6.4.2 The alternatives to Phase One and the full HS2 scheme would each offer ways of providing some additional capacity on the network. Some of the upgrade schemes are likely to be taken forward as part of Network Rail's normal forward planning process to modernise the network. However they do not deliver satisfactorily against the objectives set for HS2. In particular, they:

- do not provide sufficient additional capacity to meet the long term needs for the north-south railway;
- do not provide significant additional released capacity for commuters and freight on the West Coast Main Line;
- fail to offer a robust solution to the problem of resilience and performance, particularly on the West Coast Main Line which suffers from unacceptably high levels of unreliability;
- would significantly disrupt services on existing lines as construction work is carried out over a period of many years. In the case of the full Y alternative, there would be large scale disruptive work on the three main north-south lines. Network Rail has estimated that this could result in up to 14 years of service disruption which the Government considers is not acceptable; and
- fail to provide the scale of connectivity benefits for the major cities of the Midlands and the North. This, together with limited capacity gains in the longer term for commuters, freight and long distance travel, means that they would not achieve the overarching economic aim set for HS2.

6.4.3 Figure 6.7[197] summarises the comparison of alternatives against HS2 Phase One and the full Y network.

Figure 6.7: Summary of alternatives compared to HS2

Comparison of rail alternatives to HS2	HS2 Phase One	Phase One Alternative	HS2 Both Phases	Phase One and Two Alternative
Capacity increase (seats for West Coast corridor only compared to committed upgrades)	87%	24%	105%	24%
Connectivity journey time improvements	20-42%	0-13%	23-49%	0-38%
Train service reliability				
Cost (£bn 2011)	19.4	2.5	38.4	19.2
Value for Money Category	Medium	Medium	High	High
Disruption impact				
	Major works at Euston and connections to West Coast at Lichfield	Line closures will be required to deliver enhanced capacity through junction improvements, additional tracks and passing loops at around 10 separate locations	In addition to Phase One impacts, station works at Manchester, and Toton as well as connections to West Coast at Crewe and to the East Coast near York	In addition to Phase One Rail Alternative, station works at Kings Cross, St Pancras and Nottingham, numerous junction improvements and additional 3 and 4 tracking at numerous locations on the Midland Main Line, East Coast and Cross Country routes

6.4.4 Taking these findings together, HS2 is the better option.

[197] Source: Steer Davies Gleave, Atkins, HS2 Ltd and Network Rail

7 Chapter 7 – Delivering HS2

Summary

This chapter looks at how we will deliver HS2. It looks at how we will control costs and our governance arrangements. It also considers a potential procurement strategy and an operating model for HS2.

7.1 Introduction

7.1.1 The sequence for getting HS2 into place as a key part of our national infrastructure is to secure the relevant permissions and funding, build it and to ensure it operates effectively. In terms of powers, HS2 is a project that will be considered by Parliament through two hybrid Bills promoted by Department for Transport covering Phase One (London to the West Midlands) and Phase Two (Leeds, Manchester and Heathrow). Prior to the first hybrid Bill, the Department is promoting the High Speed Rail (Preparation) Bill. This ensures that there is Parliamentary approval for preparatory expenditure in advance of the hybrid Bill, which will enable the programme to be delivered effectively. For example, this Bill would allow HS2 Ltd to incur expenditure on detailed design, on land acquisition and on compensation and would allow preparatory works to progress before the hybrid Bill for Phase One receives Royal Assent.

7.1.2 To construct HS2, a wide range of engineering, environmental, technical, financial, service and logistical resources will need to be deployed and managed to realise the objectives and deliver the associated benefits. The planning and construction phase will last for 15 to 20 years and provides the UK supplier base with an unparalleled opportunity for growth with consequential positive impact on the UK economy. The Department, working closely with HS2 Ltd as its delivery partner and with HM Treasury and Infrastructure UK (IUK) will ensure that there is a strong governance structure that enables the programme to be delivered efficiently as an integrated system and that costs are successfully managed within the budget set, drawing on the lessons learned from the successful delivery of the London 2012 Olympic Games.

7.1.3 Department for Transport with HS2 Ltd will decide how to manage the necessary contracts in the planning, delivery and operational stages in accordance with an overarching commercial strategy.

7.1.4 The operational phase of HS2 will require infrastructure and train operators to be established in an agreed commercial and regulatory framework integrated with the existing rail network. The introduction of HS2 services will require a major change to the structure and scope of rail franchises compared with those currently operating. The revision to the overall franchise programme following the Laidlaw and Brown reviews is consistent with HS2 being factored into necessary franchise preparations in due course.

7.1.5 It is forecast that HS2 will make a significant operating surplus and consequently a commercial case could be made for the transfer of relevant parts of the operation of HS2 into the private sector. Such a sale could generate a significant income to the UK exchequer.

7.2 Managing costs

Cost estimates and contingency

7.2.1 This section explains the work which has gone into providing confidence about costs and associated risks (which give rise to the need for appropriate levels of contingency). Cost control arrangements are explained subsequently. HS2 Ltd has prepared cost estimates covering the planning, implementation and operation of the HS2 network, split by:

- Phase One costs;
- Phase Two costs; and
- rolling stock costs.

7.2.2 The Phase One cost estimates have been developed from engineering drawings and designs that have been prepared to support the hybrid Bill. The design development work has included extensive survey work, refinement of the design, and development of plans for how the railway will be constructed, land referencing and development of environmental impact mitigation measures. This has led to an appropriately detailed and robust, bottom up estimate of the costs of the project. For each area of cost – property, tunnels, civils, stations, systems and indirect cost – there has been a team responsible for the production of the cost estimate. This has then been subject to further assurance from a top-down analysis. Cross-checks have been applied to establish that the assumptions are reasonable in comparison with other experience and comparative projects. Finally, there has been independent review, particularly through the Department's Project Representative. The result is that the proposals are well developed. In comparison to other projects which have been authorised through hybrid Bills, the costings for Phase One are more developed and provide a higher degree of confidence than was the case when previous hybrid Bills were presented to Parliament.

7.2.3 The Phase Two cost estimate and the associated design is at an earlier stage and the ongoing consultation running until 31 January 2014 is seeking views on proposed route and station options. The cost estimate is based on more preliminary survey work and preliminary engineering designs and the use of applicable unit rates (such as a mile of tunnel). The Phase Two estimate has benefited from the development of Phase One for example in the assessment of land and property costs. A higher contingency allowance has nonetheless been applied for Phase Two to reflect its earlier stage of development.

7.2.4 The rolling stock estimate has been based on known costs for high speed trains across the UK and Europe, and as with the Phase Two scheme these costs will be refined as the design and procurement process for rolling stock develops. No decision has been taken on whether the rolling stock will be directly grant funded, like Crossrail, or whether initial investment would be funded by the private sector, like the Intercity Express and Thameslink Programmes.

7.2.5 Clarity over the development of costings, and particularly the work to review Phase One costings has enabled HM Treasury, through the 2013 Spending Round settlement, to set a clear funding envelope within which HS2 will be delivered. The funding envelope includes of £21.4bn for Phase One, £21.2bn for Phase Two and £7.5bn for rolling stock (all in 2011 prices, excluding VAT). Within this envelope HS2 Ltd has been set a demanding target price for construction of Phase One of £17.16bn (this is explained in more detail below).

7.2.6 The envelope has been derived from the current estimates of costs alongside an appropriate level of contingency. When setting year-by-year budgets which represent firm spending commitments, there is a need to have a high level of assurance that out-turn costs will not be exceed the provision that Government has made. This is why the 2013 Spending Round settlement incorporated funding assumptions based on the 'P95' level of assurance (P95 is explained below). This is £42.6bn for Phases One and Two. A summary of the current cost estimates and the levels of contingency for Phases One and Two are shown in Figure 7.1[198]. P95 is the level at which there is a 95% degree of confidence that the project can delivered with its current scope at that cost. The more usual figure to use is P50; a 50% chance of delivering on budget would be £19.4bn for Phase One and £19bn for Phase Two.

Figure 7.1: HS2 total funding envelope (£ billion, 2011 prices, excludes VAT)

	Phase One	Phase Two
Target price	17.16	n/a
Point estimate	15.65	12.5
Contingency at P95	5.75	8.7
Total at P95	**21.4**	**21.2**

7.2.7 The current cost estimates are higher than the estimates that were published at the time of the January 2012 Command Paper, which signalled the Government's intention to proceed with HS2. This overall increase in the cost estimate has been for two reasons.

7.2.8 First, as the level of design development has increased, so our understanding of the challenges and constraints of delivering the route, especially through urban sections has become more clearly defined. On Phase One this has resulted in necessary revisions to the design and consequent increases in the cost estimates. Examples include the route at Bromford near Birmingham and through Hanger Lane in London.

7.2.9 In addition, the Government's policy has been to involve the public in consultations on the scheme at a relatively early stage. This has the benefit of enabling people to have their say and influence proposals, but has also resulted in a number of important amendments that have been made to the scheme in response to representations over time. An example of this is the proposal for a new station at Manchester Airport as part of Phase Two. Whilst it is expected that this would attract a significant private sector contribution, the costs have been included in the forecast in order to be consistent with our economic modelling.

[198] Numbers do not always sum due to rounding. Source: Department for Transport

Phasing and affordability

7.2.10 Expenditure on HS2 will be spread over a 15 to 20 year period and, at less than 0.17% of annual GDP, this is a level of investment that the country can sustain. In fact through the 2013 Spending Round settlement the Government has made provision to Department for Transport for capital funding of £16.052bn through to 2020-21, providing for the project costs in that period.

7.2.11 Looking beyond the Spending Round period, our analysis has also considered the impact that HS2 will have on overall rail affordability. HS2 services, when introduced, are forecast to deliver a strong operating surplus, but they will also result in changes to the structure of rail franchises compared with the current position, and therefore the impact on fixed and variable access track charges. This analysis concluded that after the introduction of HS2, the overall operating position to Government, in the reference case, will be an improvement in the annual subsidy/premium balance for the railways. This is a benefit for the taxpayer. There will be a decision to be made about whether to realise that value upfront.

7.2.12 There will be an uplift in land value resulting from the new line. We are considering the implications of this. Where there is a case for a contribution to the project – whether it is core project support, land, or aligned investment – we would expect those parties to contribute. Such contributions will help emphasise the importance of the project to the regional economies that will benefit from the capacity and connectivity improvements that HS2 will deliver.

7.2.13 In addition there will be commercial opportunities at the new HS2 stations and on land acquired for HS2 construction works. We intend to make the most of these opportunities and would expect them to help meet the costs of constructing the new railway.

Cost management and governance

7.2.14 The section above sets out why the Department believes that the level of costs are well founded and have been subject to appropriate assurance. This section explains the mechanisms that are in place to ensure that costs are controlled as the project goes forward.

7.2.15 Figure 7.1 indicates that the point estimate for Phase One is some £15.6bn. The costs within this baseline are delegated to HS2 Ltd. The Department has set Sponsor's Requirements for HS2 Ltd which outline the outputs which have to be delivered within this cost (e.g. journey times, train frequency, service quality, and environmental mitigation). HS2 Ltd has flexibility to develop the scheme within this base cost estimate, while remaining compliant with the Sponsor's Requirements, and is establishing a project controls function in accordance with best practice. The project controls function will develop a series of processes and procedures that will monitor and assess progress against the programme and budgets. A critical element of managing costs will be to manage change. The project controls processes will be established in such a way that any proposed change must have clear benefits, be within the Sponsor's Requirements and have identified budget to deliver it. HS2 Ltd's progress on managing the scheme to cost will be overseen by the Department's sponsorship team, with issues escalated as necessary to a sponsorship board chaired by the relevant Department for Transport director.

7.2.16 The Phase One point estimate of some £15.6bn includes no contingency. The Department has therefore agreed with HS2 Ltd that the company will aim to deliver Phase One within a target price of £17.16bn, representing approximately a 10% contingency provision above base cost. This is a stretch target of managing with a tight contingency which emphasises the importance of affordability and that HS2 Ltd and Department for Transport will work constructively together to deliver the required outputs efficiently. In particular, this involves recognising the importance of looking critically at any proposals which may add to the cost of the scheme.

7.2.17 Decisions which could cause costs to rise above the baseline will need specific approval. The Department for Transport has been given delegated authority from the Treasury to manage costs within a £19.4bn ceiling for Phase One. This cost envelope has been derived from a P50 level (the funding at which there is a 50% degree of confidence that the project can be delivered within its current scope at that cost). HS2 Ltd is required to report on any cost changes which are within their control and within current scope, and therefore which should be absorbed within their £17.16bn target price. Where costs fall outside that target price, for example, because the cause is beyond HS2 Ltd's control or if it would be an extension of scope, the change would be considered at a board chaired by the Department for Transport with HS2 Ltd in attendance. If necessary because of the implications of the change, for instance because of the impacts on budgets, the issue will be escalated to the High Speed Rail Board or the Department's Board Investment and Commercial Committee as appropriate. Access to funding above the P50 level of £19.4bn requires the approval of HM Treasury and would involve penalty payment by the Department for Transport.

7.2.18 This approvals framework for costs has been implemented to ensure there is a clear structure for managing costs following the Spending Round.

7.2.19 The specific processes for project cost control of Phase One are described above. They form part of a wider oversight regime in which Department for Transport will remain responsible for delivering HS2, and under the leadership of a dedicated Director General, Department for Transport is working closely with HS2 Ltd, Network Rail and HM Treasury and Infrastructure UK to ensure that Phase One of HS2 will be delivered cost effectively. This oversight regime includes:

- a dedicated High Speed Rail Board which has representation from HM Treasury and Infrastructure UK which oversees the overall HS2 programme and reports progress to Department for Transport's Senior Board and to Ministers;
- clear roles and responsibilities between Department for Transport and HS2 Ltd with delegated authority levels to enable efficient project development and delivery without the recourse to lengthy Governmental approvals;
- management reporting and controls to enable Department for Transport as Sponsor to have visibility of programme costs and exposure against risk limits, and agreed trigger points where intervention or escalation is needed;
- cross-departmental oversight between Department for Transport, HM Treasury and Infrastructure UK on progress of Phase One against cost programme and levels of risk exposure through a remitted 'Cost and Risk Group'; and
- the establishing of an Efficiency Challenge Programme to actively monitor and progress identified initiatives to reduce the delivery cost of the programme through efficient ways of working.

7.2.20 As the HS2 programme progresses, and particularly as it moves into the delivery phase, the governance process will evolve as major suppliers and delivery partners are procured. The Delivery and Operating Models employed will be designed to ensure a degree of risk transfer away from Government, and consequently management controls will change to ensure that they support the delivery phases.

7.2.21 In relation to Phase Two of HS2, the route is not yet finalised as it is currently subject to public consultation. It has not had the degree of design development to which Phase One has been subject. Therefore a proportionately higher contingency is included in estimated costs. The fact that Phase Two is at an earlier stage gives more opportunities to 'design to cost' as the scheme develops from its consultative stage to be worked up in preparation for a second hybrid Bill in due course.

Efficiencies

7.2.22 In order to deliver HS2 as cost effectively as possible, it is important not only to have the structured approach above to bear down on potential increases, but to actively seek opportunities to secure efficiencies, to deliver for less.

7.2.23 HS2 is planning to use off-site manufacturing wherever possible on the construction of the infrastructure, as the benefits of doing so are multiple: as assets are constructed in a controlled (e.g. inside rather than outside) environment and on a more repetitive basis, the assets should be of better quality and more reliable than if constructed on site, thereby reducing maintenance costs of the assets. Less time is needed, thereby causing less disruption to those living near the line of the route, the assets should be safer to construct and install, and the overall costs should be lower.

7.2.24 In addition to controlling costs, HS2 Ltd will therefore seek to deliver efficiencies and cost savings through its design policies, procurement processes and contracting strategy. In order to ensure that the design of HS2 is fit for purpose and not 'gold plated', HS2 Ltd will ensure that designers and contractors working together at the outset of the construction programme to develop the most cost effective means of delivering – and operating and maintaining – the new high speed network. Key to this structure will be programme-level incentives that are cascaded to all companies in the supply chain and that ensure that all of the suppliers are incentivised to find ways to deliver at an overall lower cost – not just to maximise the benefit out of their individual contract.

7.2.25 An example of this is that HS2 Ltd and its suppliers will use Building Information Modelling (BIM). This is an important efficiency development – proposed assets are generated and managed digitally, which allows for better sharing and more efficient working between HS2 Ltd and its suppliers. HS2 Ltd and its suppliers can collaborate within a computer system to deliver product and process efficiencies as well as minimising the likelihood of re-design and re-work. In the Heathrow Terminal 5 and Olympics projects, BIM created a single 3D computer model to design, build and ultimately maintain the buildings – to help deliver the projects cost effectively.

Commercial strategy and working with the supply chain

7.2.26 The Department, working with HS2 Ltd, is considering contractual and commercial options for both the delivery and operation of HS2.

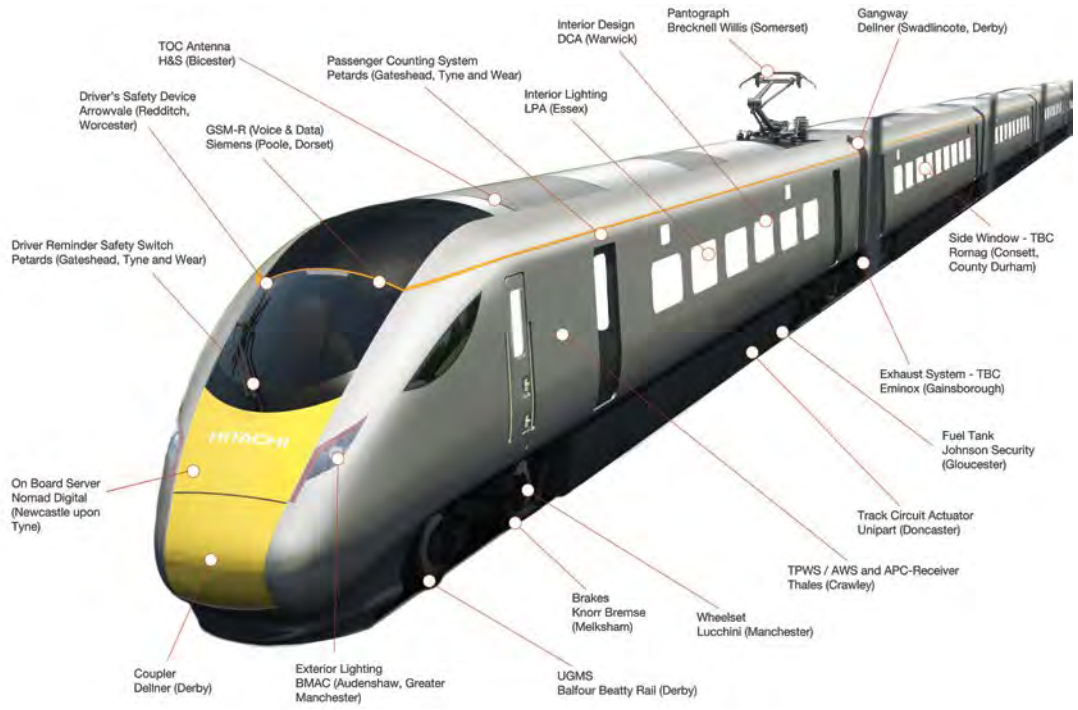
7.2.27 The Secretary of State has recently appointed Sir David Higgins to the chair of HS2 Ltd. Sir David brings a wealth of experience in project delivery. This confirms that HS2 Ltd will have a continuing key role in delivering the new railway. It is unlikely that a project as complex as HS2 could be delivered simply by one organisation being given sole responsibility for implementing it, given its scale, linking with the existing rail network and potential delivery partners including Network Rail. Therefore an important consideration is how best to align roles of different bodies. The structure of how HS2 will be delivered requires careful analysis and consideration, and consequently a joint group led by Department for Transport and including HM Treasury and Infrastructure UK and HS2 Ltd is undertaking options analysis to consider what is the most appropriate structure for the delivery of HS2. Decisions on the best delivery model will be based on the following principles:

- maximise best practice disciplines;
- deliver an appropriate risk-reward balance for private sector partners;
- align incentives across the public and private sectors;
- deliver the project within budget and programme, offering efficiency savings and enabling value-engineering processes as designs develop;
- identify if any 'end state' Operating Models are precluded in future by the Delivery Model;
- facilitate an industry strategy which creates the environment in which British industry is able to respond in a competitive way to the needs of HS2 and delivers transparency in spend and price certainty; and
- ensure that there is seamless integration between infrastructure, rolling stock and operations of high speed services.

7.2.28 HS2 Ltd is engaging with the wider supplier base and is holding an initial Industry Day in November 2013. This will start formal dialogue with suppliers to understand the scale and timing of HS2, and enable suppliers actively to plan for it. It will be necessary for HS2 Ltd and Department for Transport to clearly lay out the programme of works and to translate that to sector specific requirements to assist the industry in preparing for the challenge of delivering HS2.

7.2.29 We will follow best practice from the Olympics, Crossrail and the Intercity Express Programme (IEP) in making sure that UK industry is well placed to bid for contracts, whilst running a competitive process that gets the best price and quality for taxpayers. Figure 7.2[199] shows a snapshot of the components of the new IEP trains that are from UK suppliers as at summer 2013, with more contracts to be awarded.

Figure 7.2: UK suppliers selected for the new Intercity Express Programme (IEP) train since December 2012



[199] Source: Hitachi

7.2.30 As we develop our thinking on the delivery model, we will also address the operating model for HS2, and the strategy for the procurement of rolling stock. It will be necessary to define the role of the infrastructure manager and train operator(s) and rolling stock supplier(s). The strategy and timing of their procurement is being developed, and is likely to need to start from 2015. These will be important future contracts that – in keeping with UK and EU policy – will see a separation of train and infrastructure operator. Central to their success will be clear responsibilities and incentivisation for providing an integrated passenger system that delivers the required train services both on the new high speed and Network Rail infrastructure. Following Royal Assent of the Phase One hybrid Bill it will be necessary to start the procurement of these contracts in order that both train operator and infrastructure manager are actively involved in the delivery and integration of the infrastructure and rolling stock as well as planning for the operational phases. Informal engagement with the industry will need to begin while the Bill is passing through Parliament. A summary of the key milestones with indicative dates up to Phase One opening is shown in Figure 7.3[200].

Figure 7.3: Key milestones up to the introduction of Phase One services

Industry engagement	November 2013
Deposit Phase One hybrid Bill	By end 2013
Delivery Model agreed	by Spring 2014
Select Committee stage of Phase One Bill	Mid 2014
Operating model agreed	by Summer 2014
Ministerial decision on Phase Two route	Late 2014
Initial delivery contracts let	2014
Maintainer procurement starts*	[2015]
Operator procurement starts*	[2015]
Rolling stock procurement starts*	[2015]
Enabling works start	Mid 2015†
Main works start	2017
Operator and maintainer input	2019
New rolling stock delivery starts	2024
Main works complete	2025
Start of Phase One service	2026

*Timing and grouping depend on the outcomes of the delivery and operation models
† Subject to Parliament

[200] Source: Department for Transport and HS2 Ltd

7.2.31 As a consequence of the introduction of the HS2 services, some of the existing rail franchises, in particular the Intercity West Coast franchise will need to be redefined, as HS2 services replace some existing long distance services, and the opportunity to enhance commuting or inter-regional services is created. The Department will coordinate the timing of the impacted franchises to allow their specification and competition to align with the programme for the introduction of HS2 services. So, for example, after the extension of the existing Virgin Trains franchise for the West Coast Main Line, a new franchise will operate from April 2017 for a period likely to be between seven and 10 years. The replacement of this franchise will therefore align with the opening of HS2 Phase One.

Creating an asset with commercial value

7.2.32 All Government capital expenditure is subject to rigorous appraisal to ensure that it is worthwhile and delivers suitably high returns in terms of benefit to the economy. HS2 is no exception but it will also create an asset that will have a commercial value.

7.2.33 The ultimate completion of HS1, the high speed line from London to the Channel Tunnel was followed three years later by letting an infrastructure concession for 30 years. This returned £2.1bn to HM Treasury – approximately one third of the construction cost. Another concession could be let at the end of the first, providing in the long term another cash return. The lesson is that there is an opportunity for private sector funding which might be particularly accessible after the project is constructed (meaning construction risks have been dealt with separately from future income risks) and there is some track record of operation which reduces the risk on future income streams. At that point the Government is also able to take a more informed view on the assurance it would need to provide as part of any concession – consistent with State Aid requirements.

7.2.34 It would be premature for Government to decide on whether it wishes to pursue a similar model for HS2. But *if* it were to be decided to follow the model it pursued successfully with HS1 in 2010, then it is estimated that HS2 as a whole could attract a large private sector valuation in the late 2030s; a further sum could be raised by an infrastructure concession sale 30 years later – and so on. The Government would have the opportunity to strike the optimum balance between up-front income from an HS2 concession, noting that this could create a net subsidy requirement for classic rail, and taking ongoing financial benefit from annual improvements to the level of premia generated by GB railway overall. Alternatives to HS2 which would depend on enhancement expenditure on today's railway do not offer the same range of options which could yield a return to Government.

7.3 Conclusion

7.3.1 We are in the process of obtaining the necessary permissions to build the new railway. The costs of the project have been fully tested. In the case of Phase One, the baseline costs have been subject to extensive analysis, which provides confidence. A robust framework has been put in place to ensure that costs are carefully controlled and issues are escalated as necessary. There is clear allocation of responsibilities between Department for Transport and HS2 Ltd. HS2 Ltd is pursuing a programme to drive efficiency in the project.

7.3.2 In addition to a specific focus on costs, there is a work-plan to decide on and put in place the delivery model which will best achieve construction of the railway, with the right incentives to ensure the efficient delivery and operation of HS2, integrated with the national rail network. There is the opportunity for realising value from the railway asset following construction.

8 Chapter 8 – Conclusion

8.1.1 This document sets out the clear case for the creation of a new high speed rail network in the UK. This is a challenging project, but it is necessary to be ambitious to meet our objectives and support Britain's future prosperity by investing in a modern and reliable network that will help Britain compete on a global basis.

8.1.2 What is presented here is just one step on the path towards building HS2. It is the culmination of the work to update the business case in preparation for deposit of the Phase One hybrid Bill by the end of the year.

8.1.3 It is only one part of the many wider workstreams already well under way to make sure we deliver on time and to budget all the way through until Phase Two opens in 2033.

8.1.4 While this is a long term project, it is not long until we begin construction. We hope to obtain the necessary powers to construct and operate Phase One of HS2 by securing Royal Assent for the hybrid Bill in 2015 and then to start construction in 2016/17.

8.1.5 We are determined to be ready and maximise the benefits from HS2 from the very beginning. We have already set up the Growth Taskforce to help us do this. We will be working with colleagues across Whitehall to get British businesses in the best place to compete for contracts. We also want to align the skills and apprenticeship agenda so that we have a generation or more of skilled British workers building world-class infrastructure.

8.1.6 In the meantime we will continue to work up our proposals and plan for the building of the railway and its ultimate operation in co-operation with Network Rail, construction and supply companies, the train operating companies, local authorities, communities and the private sector.

8.1.7 This process will take us from design and development to construction so that when powers are granted by Parliament through enactment of the hybrid Bill for Phase One of HS2, the Government and its public and private sector partners are ready to build it.

Glossary

Appraisal of Sustainability (AoS) – A phased appraisal of the extent to which HS2 options support objectives for sustainable development, including reducing greenhouse gas emissions and combating climate change; natural resource protection and environmental enhancement; creating sustainable communities; and sustainable consumption and production.

ATOC – Association of Train Operating Companies.

Brown Review (of the rail franchising programme) – Following the cancellation of the competition to run the InterCity West Coast franchise, the Secretary of State asked Richard Brown, Chairman of Eurostar, to carry out an urgent assessment of the implications of the flaws in the West Coast procurement for the rest of the rail franchising programme.

In his independent report, Mr Brown makes a number of recommendations for the future of the rail franchising programme – https://www.gov.uk/government/publications/the-brown-review-of-the-rail-franchising-programme.

Building Information Modelling (BIM) – is a collaborative way of working, underpinned by the digital technologies which unlock more efficient methods of designing, creating and maintaining our assets.

Classic rail – The existing non-high speed railway in Britain.

CBI – The Confederation of British Industry.

Control Period 5 (CP5) – 1st April 2014-31st March 2019. Network Rail financial and other planning period that spans five years.

Crossrail – An infrastructure project under construction that will deliver a new railway for London and the South East.

Department's Board Investment and Commercial Committee – The Department for Transport Committee (BICC) which makes informed decisions on 'Tier 1 Projects' within an economic, financial and commercial context at key points within each project.

Delivery Partners – Stakeholders such as local authorities and passenger transport executives critical to the delivery of the project with whom we have had discussions in confidence.

DfT – Department for Transport.

Docklands – An area of East and Southeastern London which was subject to an extensive redevelopment programme in the 1980s and 1990s.

East Coast Main Line (ECML) – A major mixed-traffic railway route on the eastern side of Britain, linking London, the South East and East Anglia with Yorkshire, the North East Regions and Scotland.

Eastern side of the Y network – The Phase Two route from the West Midlands to Leeds and which connects to the East Coast Mainline south west of York.

Economic case – Part of the 5 part transport business case which demonstrates whether the proposal is value for money. See https://www.gov.uk/government/publications/transport-business-case.

Environmental Impact Assessment (EIA) – An assessment of the possible wider impacts that a proposed project may have on the environment.

Environmental Statement (ES) – In the case of projects which are likely to have a significant impact on the environment, an ES must be submitted to Natural England for approval before the project can proceed. The ES will include a detailed description of the project and its environmental impacts.

European Union Emissions Trading System (EU ETS) – Part of the European Union's policy to combat climate change and reduce industrial greenhouse gas.

Full Y Network – The full line of the proposed HS2 route from London to Manchester and Leeds.

Full Time Equivalent (FTE) – The equivalent number of full time employees for the workforce required.

GB Railway – The railway system in the United Kingdom, when considered in its entirety.

GDP – Gross Domestic Product.

Gross Value Added (GVA) – A measure of the value of goods and services.

HGVs – Heavy Goods Vehicle.

High Speed Rail (HSR) – A type of passenger rail transport that operates at speeds higher than the normal speed of rail traffic.

High Speed 1 (HS1) – The high speed railway line running from London St Pancras through Kent to the Channel Tunnel (formerly Channel Tunnel Rail Link (CTRL)).

High Speed 2 (HS2) – The scheme for a national high speed rail network in Britain, serving London, Birmingham, Manchester and Leeds and a number of intermediate stations, with links to Heathrow Airport and the High Speed 1 line to the Channel Tunnel.

High Speed Rail Board – a programme-level board which is a key part of the HS2 governance structure.

HMT – Her Majesty's Treasury.

HS2 Growth Task Force (Task Force) – The HS2 Growth Taskforce is examining how to maximise economic growth and job opportunities from the government's plans to build a high speed rail network. https://www.gov.uk/government/policy-advisory-groups/hs2-growth-taskforce.

High Speed 2 Limited (HS2 Ltd) – The company tasked with providing advice to Government on the introduction of a national high speed rail network in Britain. http://www.hs2.org.uk/

Hybrid bill – A bill with characteristics of both a public bill and a private bill.

IEP – Inter City Express Trains.

ITS – Leeds Institute for Transport studies.

IUK – Infrastructure UK is a unit within the Treasury, that works on the UK's long-term infrastructure priorities and secures private sector investment.

January 2012 Command Paper – High Speed Rail: Investing in Britain's Future – decisions and next steps. The decisions reached by the Government in the light of the Consultation in 2011 and an outline of the immediate next stages of the project.

January 2013 Command Paper 'High Speed Rail: Investing In Britain's Future Phase Two – The Route To Leeds, Manchester And Beyond' – The Government's Initial Preferences For The High Speed Rail Route To Leeds, Manchester And Beyond For Phase Two Of The HS2 Project. https://www.Gov.Uk/Government/Publications/High-Speed-Rail-Investing-In-Britains-Future-Phase-Two-The-Route-To-Leeds-Manchester-And-Beyond

Laidlaw Review – Inquiry into the lessons learned for the Department for Transport from the InterCity West Coast competition https://www.gov.uk/government/publications/report-of-the-laidlaw-inquiry

London Gateway – One of the UK's largest container ports and Europe's largest logistics park.

Midland Main Line (MML) – A major mixed-traffic railway route linking London and Sheffield via Luton, Bedford, Kettering, Leicester, Derby, Nottingham and Chesterfield.

Mph – Miles per hour.

NAO – National Audit Office.

NOx emissions – mono nitrogen oxide emissions.

Network Rail – The company that runs, maintains and develops Britain's tracks, signalling system, rail bridges, tunnels, level crossings, viaducts and 18 key stations http://www.networkrail.co.uk/

OECD – The Organisation for Economic Cooperation and Development.

ONS – Office for National Statistics.

ORR – Office of Rail Regulation.

PAC – Public Accounts Committee.

Phase One – A line from London to the West Midlands, including stations in central London (Euston), West London (Old Oak Common), outer Birmingham (Birmingham Interchange) and central Birmingham (Curzon Street). It includes a connection onto the High Speed 1 line to the Channel Tunnel.

Phase Two – Lines from the West Midlands to Manchester and to Leeds, including stations in South Yorkshire and the East Midlands, and a direct link to Heathrow Airport.

PPM – Public Performance Measure.

Preparation Bill – Generally used when the Government needs Parliament's authority to spend money in a preparatory fashion on a new function or service that subsequent legislation is planned to provide fuller powers in order to implement.

PV – Present Value.

Released Capacity – Routes and services on the classic rail network that could be made available to franchise operators to develop new markets for passenger and freight services when HS2 becomes operational.

Risk and Optimism Bias – Allowances for risk and optimism bias are added to the appraisal costs of projects to take account of the tendency for appraisers to be over-optimistic about the costs and other key parameters of projects.

Section 61 of the Control of Pollution Act – Section 61 of the Control of Pollution Act 1974 allows developers and their contractors to apply for prior consent for noise generating activities during the construction phase of a development.

Thameslink – a 225 km (140 mi) north-south rail route through London from Bedford to Brighton.

Tph – Trains per hour.

Trans-Pennine electrification – the project to electrify the existing rail network across the Pennines.

VAT – Value Added Tax.

WEI (wider economic impacts) – Wider economic impacts refers to the benefits accruing from agglomeration, increased competition and improved labour market participation brought about by the scheme.

WebTag – Department for Transport's web-based guidance on appraising transport projects and proposals.

West Coast Main Line (WCML) – A major inter-city railway route in the United Kingdom linking Greater London, the West Midlands, the North West, North Wales and the Central Belt of Scotland. The West Coast Main Line, which is not a single railway but a network of routes which diverge and rejoin the central core between London and Glasgow, is the most important intercity rail passenger route in the United Kingdom.

51m – an alliance of councils that has come together to challenge the evidence base about the HS2 project.