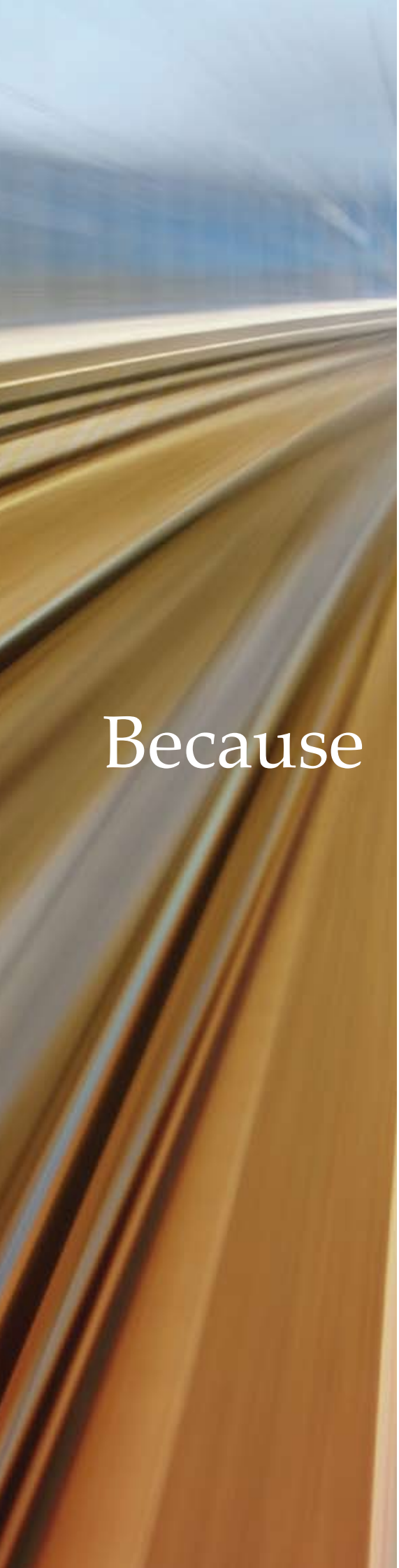
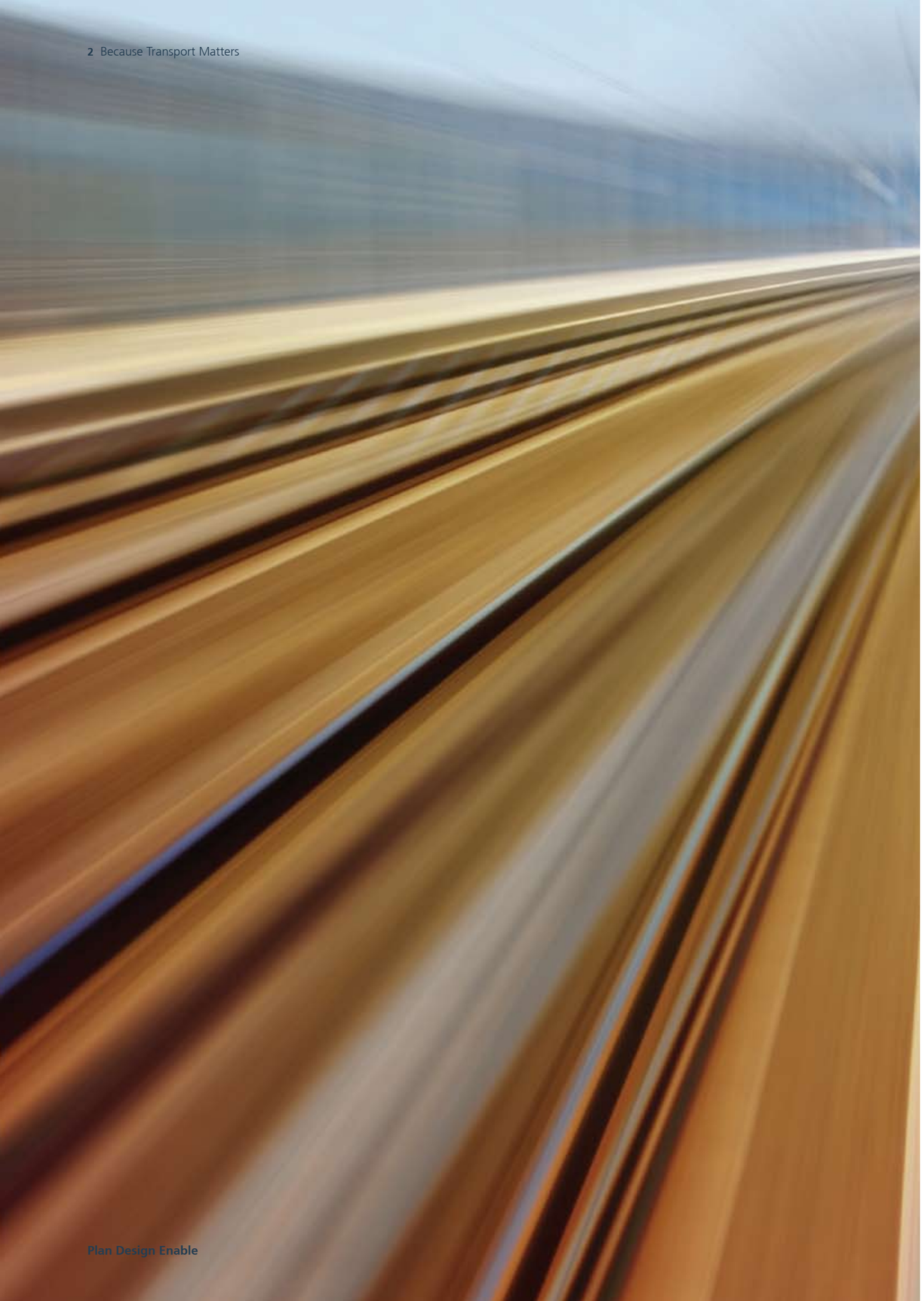


ATKINS

Because Transport Matters

High Speed Rail

Plan Design Enable



ATKINS

Contents

List of Tables

List of Figures

Foreword

John McSheen

Project Director for the North - South
High Speed Line Study (2001 - 2003)

Head of Project Development
Atkins

The debate around High Speed Rail (HSR) has seemingly taken on a life of its own over recent years. The success of "High Speed One" is rightfully being celebrated and has added further weight to the lobby for more high speed lines, with corridors being suggested and proposals offered for domestic high speed lines across the country.

Government is understandably taking a more cautious position. Following Sir Rod Eddington's report it has produced a number of sensible proposals for increasing the capacity of the existing conventional network over the next ten years or so before looking at any new lines.

In the light of all this, Atkins has undertaken some research of its own to update the business case for a North - South high speed line, building on the work we undertook for the Strategic Rail Authority (SRA) between 2001 and 2003, and more recently in support of the Eddington study.

We wanted to see if the original business case still stood up given the capacity and journey time improvements being presented in the current High Level Output Specification and the 2007 Rail White Paper. We tested options for East Coast and West Coast and for a 'Full' Network as before but against a situation in which the network had been significantly improved. Would the Government's current commitments and forward strategy take us through for the next 20 years - or not?

We wanted to compare high speed against a conventional rail alternative, acknowledging the sustainability and energy arguments being put forward. Five years on from the original work and the climate debate has moved on almost unrecognisably.

And would high speed be good for the whole country: not just for London, but for the major cities and regions outside of the capital? Does high speed rail make sound economics for the whole country? Lest we forget, it is a very expensive proposition with a potentially significant impact on the landscape it passes through.

With all this in mind, we offer the following update. No doodling with lines on a plan, but hopefully a thoughtful contribution to the wider debate. It is the first of a series of publications by Atkins on transport and associated issues which are not only exercising the minds of those engaged in the sector but anyone who has an interest in it or is affected by it.

Because Transport Matters.

ATKINS

Executive Summary

Background

The intense publicity surrounding the opening of St Pancras International and the launch of Eurostar services on the "High Speed One" line in November 2007 highlighted High Speed Rail (HSR) as a sustainable modern transport mode and the obvious choice for long distance travel between major urban centres. As such, attention has shifted back to the question of whether the UK could, or indeed should, be looking to construct its own high speed line to connect the major cities in the North of England and Scotland to London, and potentially on to Europe, providing passenger services capable of travelling at 300km/h or faster.

In 2001, Atkins was commissioned by the Strategic Rail Authority (SRA) to study the feasibility of a North - South High Speed Line (HSL). Atkins and its partner organisations presented their recommendations in 2003, concluding that strong transport and business cases existed for a range of High Speed Line (HSL) alignment options.

The winding up of the SRA in late 2005 gave the Department for Transport (DfT) a chance to review rail strategy to identify medium and long term priorities for rail investment. Reflecting the recommendations of the Stern Review on climate change and the Eddington Study on the links between transport and the economy, the focus of the subsequent 2007 Rail White Paper and High Level Output Specification (HLOS) for 2009 to 2014 is on addressing the current and forecast capacity problems of the rail network over the next 20 years.

In the months since HLOS, however, debate has once again returned to whether the longer-term strategy can deliver the necessary improvements to the rail network and how transport investment could support sustainable economic growth, not least to address the problems posed by increased rail usage, which has exceeded forecasts. There is a growing awareness of climate change and an increasing acceptance of the need to move away from fossil fuel (especially oil) dependence, with greater emphasis on encouraging modal shift to more sustainable froms of travel, such as rail.

At the same time, continuing concern over differentials in economic growth between the North and the South raises the question of whether major improvements in journey times (either between London and Northern England and Scotland, or between northern cities) could achieve the desired regeneration and economic benefits in the regions without holding back economic growth in London and the South East.

ATKINS

The case for High Speed

To inform the ongoing debate, Atkins has refreshed and expanded its 2003 HSR research work, exploring the case for a new North - South HSL by re-examining some of the preferred options, taking into account committed and likely upgrades planned on the network over the next 20 years as set out in the 2007 Rail White Paper and HLOS. Our horizon date for HSR introduction is 2026.

The UK rail network in 2026

Building on the analysis Atkins undertook to support the Eddington Study, we projected passenger growth on long-distance inter-urban routes to 2026, using standard rail industry forecasting guidelines.

On this basis we found that expected overall crowding conditions on long-distance, high-speed services would be broadly similar in 2026 as they are today, even assuming a full implementation of the Government's indicative list of upgrade and capacity enhancement schemes.

If recent higher growth trends continue, however, it is likely that the additional long-distance capacity improvements identified by HLOS/2007 Rail White Paper will become inadequate much earlier, possibly within the next ten years.

This is reinforced by strong growth in demand for long-distance passenger and freight travel by all modes, particularly by air. While proposals for travel demand management and road pricing structures may constrain growth and encourage the use of less congested routes at peak times, the UK's transport network will remain under strain for many years to come.

HSR - The rail industry perspective

A growing consensus has developed in the rail industry that HSR should be considered as the long-term solution for addressing capacity problems on the southern section of the West Coast Main Line (WCML). However, it has been unclear whether the capacity and other route improvement proposals included in the 2007 Rail White Paper may render HSR proposals poor value for money.

A new review of options

To explore whether the original case for HSR remains valid, in Autumn 2007 Atkins reviewed the business cases for constructing a North - South HSL on the three main alignments recommended for further review in 2003:

- A West Coast alignment from London to near-Birmingham, replacing most WCML long-distance services south of Rugby;
- An alternative East Coast alignment from London to near-Leeds, replacing most East Coast Main Line (ECML) long-distance services to Leeds, Newcastle and Edinburgh, but also running services to Sheffield and Nottingham;
- A Full Network option serving both the east and west sides of the country and going as far north as Glasgow and Edinburgh, representing the possible full extent of a network.

For comparison, a Conventional Speed West Coast option was examined, which would only operate at 200km/h. This has been put forward as a potentially cheaper and more environmentally friendly alternative to full high speed operation.

The findings

Our review shows that both the West and East Coast options result in financially viable load factors on HSR and existing services, whilst also providing major crowding relief:

- At a cost of around £9bn, the West Coast option generates a benefit-cost ratio (BCR) of around 1.7 - a slight reduction from the 2003 benefits assessment (which gave a BCR of 2.0), reflecting the much improved service on the WCML route together with the ongoing improvements planned over the next 10 years;
- The East Coast option generates economic benefits of around £29bn, compared with costs of around £12bn, equivalent to a BCR of about 2.5 as compared to the 2003 assessment of a BCR of 2.0. Given the relatively limited enhancements planned on the ECML and Midland Main Line (MML) routes, this result is unsurprising.

Both the West and East coast routes also offer the opportunity to increase overall service levels substantially beyond 2026 as demand continues to grow, potentially by providing extensions to Manchester and Newcastle, respectively.

Additional refinement would improve benefits further, including indirect gains from capacity release on the rest of the network and the ability to improve local and regional passenger, and freight, services to meet local needs.

It is clear that strong business cases continue to exist for the East and, to a somewhat lesser degree, West Coast options, even when taking into account planned enhancements to the rail network over the next 10 to 20 years.

The Full Network option generates the highest economic benefits of the three, at around £63bn. With costs in the order of £31bn, a BCR of around 2.0 is achieved, unchanged overall since the 2003 assessment. However, this option is likely to require additional capacity on the southern core section of route relatively quickly, reiterating our conclusion that no single HSR trunk connection to London will solve capacity problems on all North - South rail routes.

Compared to the high speed West Coast option, the business case for a Conventional Speed West Coast option is relatively poor, with a BCR of around 0.7 - even assuming 30% lower operating and construction costs. Cost savings would occur through lower energy demands and less onerous engineering requirements, though more rolling stock would be required to operate the same level of service because of longer end-to-end journey times.

This demonstrates that high speed operation is required to attract sufficient passengers to switch from road and air to make construction of a new line economically or financially worthwhile.

Heathrow expansion

Atkins has not assessed the potential market for switching of domestic-international interlining passengers at Heathrow to using HSR services rather than domestic services. However, any expansion of Heathrow would be likely to reinforce its national hub status, increasing the demand for travel from outside London and the South East to the airport. In turn, this would increase the potential for further mode-switch to rail if an HSL were connected to the airport.

ATKINS

HSR to support regeneration

Our review suggests that HSR could provide a significant boost to economic growth. Following DfT methodology guidelines, we have estimated the GDP productivity benefits of each of the three HSR options. Over a 60 year period these total around:

- £16bn for the West Coast option;
- £20bn for East Coast;
- £44bn for the Full Network option.

These estimates do not take into account effects associated with the improvements to regional / local rail services enabled by HSR introduction, which would increase the benefits significantly.

Effects on productivity

It is clear from Eddington, and the Government's response, that the priority for transport investment is schemes which improve UK productivity as a whole. This inevitably leads to a focus on improving transport in areas where the prospects for economic growth are already strong, particularly in London. At the same time, there is a realisation that the UK will benefit from strengthening the economies of its city regions. The most successful transport investments - in terms of boosting overall GDP growth across the UK - will deliver benefits to both London and the rest of the country.

Our analysis of the distribution of productivity benefits shows that a North - South HSL is equally effective at boosting productivity growth in the London area as well as in the regions served by the HSL alignments. In particular, the East Coast option benefits the East of England through faster services to Peterborough and more services to Cambridge using the released capacity on the ECML route. The South East region benefits indirectly from boosting the accessibility of Heathrow Airport in the West Coast option and increased services to Milton Keynes and Northampton.

Further expansion of the HSR network would increase both the size and spread of productivity benefits across the country, particularly for the North and Scotland as the length of dedicated track increases and journey times reduce.

HSR vs. other transport options

The Eddington report highlighted that addressing congestion problems for commuters and business users in a sustainable way is the main priority for transport policy; addressing local transport problems and improving wider connectivity are both important. In many urban areas outside London, congestion on rail and local roads is less severe while regional and national connectivity are more important factors for business.

Alternative ways to improve wider accessibility through enhancements to the road or air networks seem unlikely to achieve equivalent benefits:

- A major expansion of the road network may lead to some reductions in journey times, although these are likely to be marginal outside peak hours;
- The expansion of domestic air services from regional airports to Heathrow will not improve end-to-end journey times significantly, even if sufficient new airport capacity is provided.

In the long-term, the need to reduce carbon emissions suggests that, if restrictions on aviation are imposed, high-speed rail links may be vital to sustain transport connectivity.

HSR and economic development policy

Our 2003 study highlighted the need for HSR stations to be sited in city centre locations to maximise agglomeration benefits and support the higher value business development outside London.

The need for joined up thinking

While railway capacity analysis or strategic economic analysis might suggest a particular route or location of stations, real benefits can only be achieved if cities or regions are willing to change their economic development, planning and transport policies to take full advantage of the improved wider connectivity of HSR.

Such a commitment from regions and cities will require a commensurate degree of commitment from government on the chosen HSR strategy.

HSR to support local transport

Perhaps the greatest potential for HSR exists in releasing additional rail capacity on the existing rail network, particularly where long-distance, high speed, local commuter and freight services share the same tracks - we found that the potential capacity released often multiplied because of the corresponding removal of speed differential effects.

Strengthening local and regional transport links

Introducing a North - South HSL would create a step-change in the robustness of the rail network, where service patterns can be adapted easily to meet local and regional needs. Segregated high speed routes could relieve capacity constrained routes and release capacity for additional local services in rapidly expanding areas.

This offers a huge opportunity to regional and local government to shape their local transport policy and include rail as a key mode. The constraints of planning around long-distance services can be removed, giving genuine freedom to local and regional authorities to customise services through stopping patterns, train frequencies or the addition of new stations.

HSR to support sustainability and energy policy

The need to reduce CO_2 emissions has resulted in a shift towards a more sustainable energy policy, with emphasis on producing electricity from renewable energy sources and reducing dependence on carbon-based fuels. This is coupled with the rising costs of oil and gas and the security of fuel sources.

The 2007 Rail White Paper makes reference to the relatively poor performance of trains running at 300km/h or 350km/h compared with current 200km/h operations, in accordance with the fundamental rule that energy consumption increases with speed, with all other factors remaining equal. There is ongoing debate as to whether the figures provided are realistic, as they assume lower load factors for HSR services than are currently achieved and higher energy consumption figures than for equivalent new high speed trains.

Even if the 2007 Rail White Paper figures are taken at face value, there is evidence to suggest that the net carbon effect of HSR services improves if they can achieve a significant modal shift in travel from air and, to a lesser extent, road.

Using evidence produced by the Rail Safety and Standards Board, we may expect a saving of around 140g per passenger km in CO_2 emissions for each passenger trip switching from air to HSR, compared with a loss of 25g for each passenger switching from conventional rail to HSR. On this basis, a new HSL which gives rise to at least one passenger switching from air for every five to six passengers switching from conventional rail services could potentially contribute to a net balance in CO_2 emissions.

Promoting modal shift

Our outline results, based on relatively conservative air-rail modal shift assumptions, suggest that air : rail modal shift ratios fall slightly short of this level for the Full Network (1 : 7) and East Coast options (1 : 6), and the ratio is significantly weaker for the West Coast option (1 : 18).

However, these results ignore the significant effects of mode switch from road to rail, whether directly to HSR services or indirectly to replacement services on the existing network where capacity has been released. These effects could be significant, especially where they provide alternative access to congested urban road corridors.

Conclusions and way forward

Our latest modelling and research work re-emphasises the strong business case for a North - South HSL within the next 20 years. Our main findings are that:

- The business case for a North - South HSL remains robust, even when taking into account the planned improvements to the rail network set out in HLOS and the 2007 Rail White Paper over the next 20 years;
- The greater time-savings possible to cities in the East Midlands, Yorkshire and the North East would favour an East Coast HSL option. However, further development of both East and West Coast options could allow significantly improved benefits for both options, particularly when considering re-use of capacity released on the existing rail network;
- Better access to London through HSR connections benefits the whole of the UK economy, providing a boost to the strong London area while strengthening city regions. It also allows much greater flexibility for regions and major cities to expand and customise local rail services to meet their own needs;
- High speed operation is essential to make the case for a new, segregated railway alignment economically and financially worthwhile. Any increased energy consumption resulting from running at higher speeds could be balanced by reductions in use of less efficient air or road transport. This effect is reinforced by the potential for modal shift away from cars in urban areas through re-use of the rail capacity released for local rail services.

HSR options must not be developed on rail capacity considerations alone. HSR needs to be viewed less as a rail project, and more as a national transport, economic and environmental project, as the benefits and costs go far beyond the rail industry. Accordingly, the significant costs associated with HSR development need to be viewed as a long-term investment in UK productivity, rather than as part of the existing or future rail spending allocations. Given planning gestation periods, starting planning for high speed lines now is unlikely to draw down significantly on existing funding allocations to 2018/19.

DfT's response to Eddington sets out the prospect of one or more transport studies on a number of national corridors, particularly for the London - Birmingham - Manchester axis. Further development of HSR options on a corridor-by-corridor basis should be progressed to support this analysis, with greater clarity on the capacity release benefits and how they could be used by major cities and regions to support their own transport needs.

Regions across England, as well as Scotland, need to develop firmer views as to how HSR could contribute towards their strategic economic development. Buy-in is vital from those areas affected by the environmental effects of construction but for whom the benefits may not be so readily visible. Further development work needs to show how options for a North - South HSL integrate into economic, environmental and transport planning needs at local, regional and national levels.

An HSL is likely to be needed from a capacity perspective within 15-20 years, possibly sooner if growth in rail passenger demand continues on current trends. Major economic and environmental benefits could be realised within 10 years if detailed planning starts soon. Consensus between the rail industry, central government, the regions and Scotland is the only way for development to move forward. The next stage of detailed analysis by DfT will reveal whether that consensus can be achieved.

Introduction

The idea of a North - South HSL has been around for many years, notably as part of Virgin Rail's proposals for the Inter City East Coast (ICEC) franchise in 1999/2000. The SRA commissioned a study into the feasibility of a North - South HSL in 2001, as the rapid passenger growth post-privatisation suggested that rail capacity would need to be enhanced in the medium term. Huge cost-overruns in upgrading the West Coast Main Line (WCML) and the massive disruption to services while the line was being upgraded prompted government and industry to think twice about undertaking a similar scale of on-line upgrade of the East Coast Main Line (ECML) route.

Atkins and its partner organisations reported on the study in 2003 concluding that a business case existed for construction of a North - South HSL, although noting its landscape impacts would need to be carefully mitigated and that major government funding would be required. A summary of this report is on page 14.

Since 2003, progress on developing proposals any further has been limited. The collapse of Railtrack and need to improve both the financial and operational performance of the existing network meant that planning for longer term passenger growth fell down the priority list. The need for major rail investment to provide additional network capacity was challenged, with emphasis on making better use of the capacity already available through a series of Route Utilisation Studies (RUS).

The winding up of the SRA in late 2005 gave the DfT, now responsible for setting overall railway strategy, a chance to review medium and long term priorities for rail investment. Research work by Stern[1] on the effects of climate change and Eddington[2] on the link between transport and economic development informed development of a long term rail strategy, as set out in the 2007 Rail White Paper[3], together with more specific schemes proposed in the High Level Output Specification (HLOS) for Network Rail to implement between 2009 and 2014.

The 2007 Rail White Paper notably neither rules in, nor rules out, High Speed Rail (HSR) as a long term option, but focus has shifted towards short and medium projects spread across the whole rail network that can deliver benefits for existing capacity problems. This, in turn, perhaps reflects Eddington/Stern recommendations on maximising efficient use of the existing transport networks to reduce carbon footprint, and achieve maximum wider economic benefits without the potential distraction of "mega-schemes".

The 2007 Rail White Paper and HLOS proposals make a clear attempt to address the current and forecast capacity problems of the rail network. Proposals include: major rolling stock increases; continued WCML upgrades; some improvements to ECML and Midland Main Line (MML) routes; go-ahead for major capacity enhancement schemes including re-signalling of Reading; Thameslink Programme and Crossrail; lengthening of commuter services; and a longer term commitment to investigating new technologies to increase the capacity of the rail network through new signalling and operating technologies.

In the months since HLOS, focus has once again returned to what the long-term strategy should be for improving the rail network - coping with both passenger and freight growth.

[1] "Stern Review: The Economics of Climate Change", HM Treasury October 2006

[2] "The Eddington Transport Study", HM Treasury & Department for Transport, December 2006

[3] "Delivering a Sustainable Railway", White Paper CM7176, July 2007

[4] "Review of sub-national economic development and regeneration", HM Treasury et al, July 2007

Rail passenger demand continues to grow faster than the standard industry forecasts predicted. The reasons for the continued high levels of growth are subject to ongoing research, but three factors seem to be clear:

- Alternative modes are becoming more expensive and less convenient: travel by air continues to be affected by increased security requirements and airport congestion, and travel by car continues to be made less attractive due to rapidly increasing fuel costs;
- The revival of city centres across the UK as employment, business and leisure locations means that, in many cases, rail is the quickest and cheapest option for more and more trips. As major cities across the Midlands, North and Scotland move more towards financial and professional/technical service industries, there becomes a much greater propensity to use rail for business trips;
- Despite ongoing adverse media coverage, the quality of rail services in the UK has improved massively, with new rolling stock, better performance and the benefits of the WCML upgrade finally being seen by passengers.

Beyond the situation on the rail network, there is continuing concern over differentials in economic growth between the North and the South, highlighted in the Government's review of sub-national economic development[4], and an interest in how transport investment can assist in closing that gap. Funding announcements for the Thameslink and Crossrail schemes demonstrate a commitment to improve connectivity in London and the South East to support economic development. This raises the question of whether major improvement in journey times, either between London and Northern England and Scotland, or between cities in Northern England, could achieve the same kind of regeneration and economic benefits as Crossrail would achieve in East London.

Finally, continuing rises in the cost of oil and the effects of global warming have given greater focus on national energy policy. There is an increasing acceptance of the need to move away from fossil fuel (especially oil) dependence, with greater emphasis on encouraging modal shift to more sustainable means of travel. Recent debates over further electrification of the rail network are inextricably tied with wider energy policy debates.

ATKINS

Summary of the Atkins 2003 High Speed Line Report for the SRA

Between 2001 and 2003, a consortium led by Atkins undertook a strategic feasibility study to establish whether a transport and business case existed for constructing a new North - South high speed railway line in the UK.

The work was commissioned by the Strategic Rail Authority (SRA) as demand forecasts showed that over the next 15 to 30 years, unless action was taken, there would be substantial overcrowding problems on the strategic rail network. This was set against a background of increasing congestion on the road network, and whilst these problems could be deferred or managed to a degree by capacity allocation or pricing mechanisms, this would be likely to secure only short-term relief. The analysis was undertaken prior to the significant increases in passenger demand seen on the railways across Britain in the last five years.

The main objective of the study was to examine whether realistic and robust business and transport cases for a North - South High Speed Line (HSL) could be developed. Atkins was also tasked with determining the level of support for HSR throughout the country and with providing a vision for taking HSR forward, together with the most realistic way of doing so.

From the start it was established that the study would look at the strategic issues and appraisals rather than detailed design and testing. The study focused on railway/guided transit system technologies (Maglev) and the North - South market only, excluding at that stage the corridors to the West of England, Wales and East Anglia. A range of tasks was undertaken to ensure that the broadest consideration was given to the potential capabilities and the impacts of HSR:

- Option development and costing, including rail engineering and operations;
- Demand modelling and forecasting, and passenger surveys;
- Economic analysis, incorporating cost-benefit analysis and the consideration of wider economic impacts;
- Environmental assessment;
- Financial modelling and project structuring advice;
- Risk management;
- Stakeholder consultation.

The study concluded that there was both a business and transport case for HSR and that in economic, safety and accessibility terms:

- HSR is capable of delivering substantial economic benefits to the UK, covering costs by a ratio of between 1.9 and 2.8 to 1;
- A reduction in transport-related accidents could be expected, arising from the forecast modal shift from road to rail;
- Accessibility to the public transport network could be substantially widened by HSR, as it would be capable of delivering a step-change in service frequency, population catchment and journey speeds;
- HSR has a good fit with transport and land use policy as long as the services that use it serve city centres. If road user charging is introduced, the net benefits of HSR are increased.

The study identified some challenging issues that would need to be addressed. It is difficult to construct a new railway without adverse effects upon the natural and built environment. These would need to be carefully managed and appropriate actions taken to minimise and mitigate adverse impacts where possible - as successfully shown with the recently opened "High Speed One" line.

Secondly, the nature of the scheme and its high capital cost means that a very large public sector financial contribution would be required to support construction and/or operation. In terms of delivery, a Hybrid Bill was recommended, as it would have considerable advantages in terms of practicality and timing. This option however would only be practicable for the first and most important phase of an HSR network: it is vital to secure a strong statement of government support for the HSR concept as a whole.

North - South High Speed Line Study: 2008 Update

We have focused on updating the business case and examining the wider economic benefits for three HSL options from our 2003 work:

- A **West Coast** alignment from London to near-Birmingham. This is broadly similar to options put forward by Network Rail and Greengauge21's "Manifesto" (although exact alignments differ), and would replace most WCML long-distance services south of Rugby. The service patterns mostly correspond to Option 1 in the previous HSL study, with additional services running from London to Milton Keynes and Northampton using some of the capacity released on the southern section of the WCML;
- An alternative **East Coast** alignment from London to near-Leeds, replacing most ECML long-distance services to Leeds, Newcastle and Edinburgh, but also running services to Sheffield and Nottingham (Option 16 in previous HSL work). This would perform a broadly similar role on the eastern side of the country. Some additional services from Kings Cross to Cambridge would use some of the capacity released on the southern section of the route;
- A **Full Network** option (Option 8 in previous HSL work), serving both the east and west sides of the country, and going as far north as Glasgow and Edinburgh, representing the possible full extent of a network. HSR services would generally replace existing most ECML and WCML services.

For comparison, a **Conventional Speed West Coast** option was examined, which would only operate at 200km/h, the current maximum speed on the existing UK rail network. This has been put forward as a potentially cheaper and more environmentally friendly alternative to full high speed operation.

Our work has also examined the wider economic regeneration benefits of a North - South HSL on Northern England, Scotland and the UK as a whole, using methods of analysis similar to those used to support Atkins' research work for the Eddington Review[5], showing how effective HSR could be in reducing the North - South productivity gap.

Finally, we have reviewed how HSR fits into a wider policy perspective, particularly in enabling improvements in local transport and its fit with the sustainability and energy policy agenda.

[5] "Inter-Urban Rail Forecasts: Final Report", Atkins (on behalf of Department for Transport), December 2006

ATKINS

Figure 1.1 - West Coast option

Figure 1.2 - East Coast option

Figure.1.3 - Full Network option

The UK rail network in 2026

Growth in rail passenger travel has continued to be strong since rail privatisation, with growth of some 45% in passenger trips over the last ten years[6]. The last three years have seen the long-distance rail operators experience growth of around 20%, mostly driven by the completion of the first phases of upgrade work on the WCML route.

There are few signs that the driving factors behind recent rail growth are likely to reduce. Cities across the UK continue to move towards service-sector, centre-based economies, and are developing packages of transport schemes to allow sustainable development to continue without the threat of congestion stifling growth. As such, both central government and regional stakeholders recognise the need to plan for growth in rail travel, although there are differing views of the levels of rail demand that will need to be accommodated.

Over the last two years, the rail industry has been examining options for coping with both existing demand and future demand. This culminated in the production of the 2007 Rail White Paper which set out the Government's long term rail strategy, together with more definite plans for enhancement schemes through to 2014, contained in the High Level Output Specification (HLOS).

Detailed plans for the period 2014-2019 will be developed over the next three to five years, although given the long lead times involved in many rail projects, the Government has given a strong steer as to the types of schemes it would like to see.

For long-distance passenger services, government has set out an indicative list of upgrade and capacity enhancement schemes, including:

- Continuing upgrades of the WCML with increased services and reduced journey times from December 2008. Further major schemes in the Stafford/Crewe area and lengthening of trains by two carriages can reasonably be expected in the next five to ten years;
- On the ECML, power supply upgrades, timetable changes and reconfiguration of junctions near Hitchin and Doncaster are planned, enabling increases in peak and off-peak services (including those to Lincoln) and some limited journey time improvements. Introduction of new Inter-City Express Programme (IEP) trains will increase carrying capacity of trains by up to 20%;
- Train lengthening on the MML route, possibly followed by introduction of IEP trains, will provide significant additional capacity; provision of lengthened Thameslink services will also give some relief to long-distance trains on the critical southern section of the route;
- Platform reconfigurations and re-signalling at Paddington and Reading will enable additional long-distance services to operate on the Great Western Main Line (GWML). Introduction of IEP trains will also increase carrying capacity significantly;
- On non-London inter-urban routes (such as the Cross-Country services through Birmingham and Trans-Pennine services through Manchester and Leeds), a combination of train lengthening and some journey time improvement schemes is likely, although the schemes are at a relatively early stage of planning.

Atkins refreshed the analysis that we undertook to support the Eddington Study, forecasting passenger growth on long-distance inter-urban routes, using standard rail industry Passenger Demand Forecasting Handbook guidelines[7].

[6] Source: National Rail Trends Chart 1.2b, Office of Rail Regulation

[7] Passenger Demand Forecasting Handbook ("PDFH"), guidelines developed by the Passenger Demand Forecasting Council, part of the Association for Train Operating Companies.

Table 1.1 shows the forecast passenger km increases for each of the main inter-urban routes from London.

Table 1.1 - Forecast rail passenger demand increases 2006 - 2026[8]

Route	Forecast demand increase (pass km) 2006-2026
East Coast Main Line	69%
Midland Main Line	84%
West Coast Main Line	104%
Great Western Main Line	80%

At the highest level, our independent forecasts show that expected passenger growth can be accommodated on long distance rail services, when combined with planned improvements to peak commuter services into London. Figure 1.4 and Figure 1.5 show the forecast impact of the 2007 Rail White Paper proposals on crowding on London-based long-distance services in 2026 compared with current (2006) levels.

Capacity problems shown in Figure 1.5 between Birmingham and Coventry would be expected to be addressed by lengthening local services, and between Reading and London by Crossrail and enhancements enabled by re-signalling at Reading Station (it is not possible to include these schemes within our modelling work). Overall, we expect crowding conditions on long-distance, high-speed services would be broadly similar in 2026 to current (2006) levels, assuming full implementation of the schemes outlined above, on the basis of the standard rail industry forecasts used in this analysis.

If recent growth trends continue, however, it is likely that the additional long-distance capacity improvements identified by HLOS/2007 Rail White Paper will become inadequate much earlier, possibly within the next ten years if we see the particularly rapid rates of growth maintained.

In some senses, the rail industry continues to be a victim of its own success: achieving this level of modal shift is a major achievement for a largely car-dependent European nation, with focus on tackling existing network bottlenecks and train lengthening and relatively little large-scale investment required beyond that already undertaken on the WCML upgrade. Continued investment in rolling stock and stations increases the attractiveness of rail, making it more than just a "distress purchase" for frustrated air and road travellers.

Rail forms just one part of the UK's transport system. Use of air and road still dominate for longer and non-London based trips. Road travel, measured by vehicle-kms, is forecast to increase by around 30% between 2006 and 2025, with congestion[9] rising by a similar amount[10]. National air forecasts suggest a near-doubling of travel between regional and London airports over a similar period. However, taking into account the relative maturity of the market, and the recent slow-down in domestic air travel growth, perhaps some caution needs to be exercised in considering these projections.

Overall however, a picture is painted of robust growth in demand for long-distance travel by all modes, across the UK. While proposals for travel demand management may be able to reduce growth, and pricing structures used to encourage use of less congested routes and times, there appears to be an ongoing background of strain on the UK's transport network for many years to come.

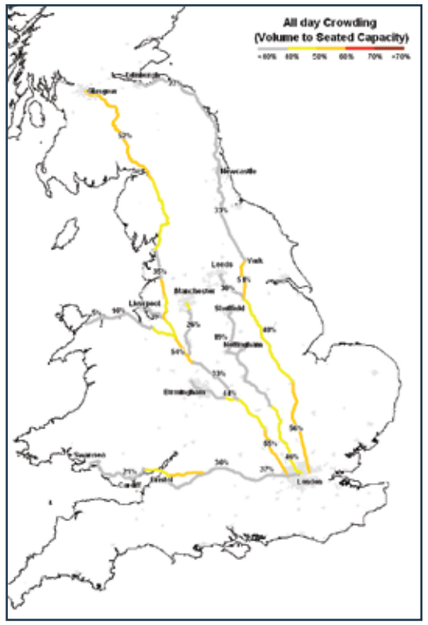


Figure 1.4 - Long distance crowding (2006)

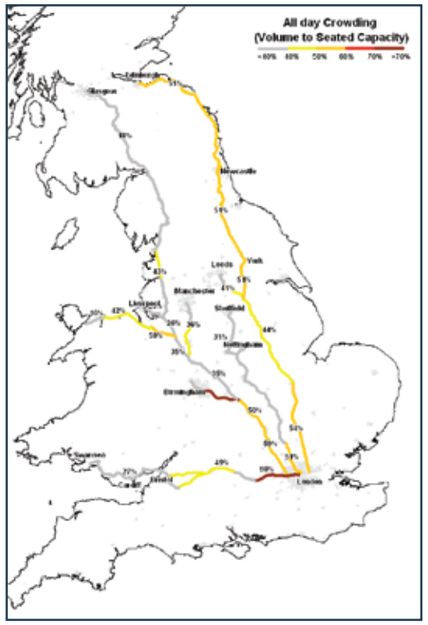


Figure 1.5 - Long distance crowding (2026)

[9] Source: "Inter-Urban Rail Forecasts: Final Report", Atkins, December 2006

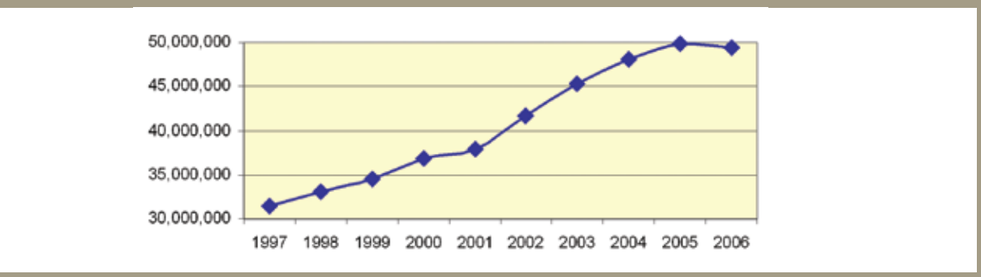
[10] Lost time per vehicle km relative to free-flow conditions.

[11] Source: National Transport Model (from Eddington Transport Study)

UK air travel

Over the past 30 years demand for air travel has increased five-fold and the expectation is that air travel will continue to grow, from 200 million passenger journeys nationally in 2003 to between 400 and 600 million passenger journeys in 2030. The 2003 Aviation White Paper, 'The Future of Air Transport', predicted that domestic traffic would grow on average by 3.5 percent per annum, with the 'No Frills' carriers growing by 6.6 percent per annum from 1998 to 2020.

Total Domestic Passengers

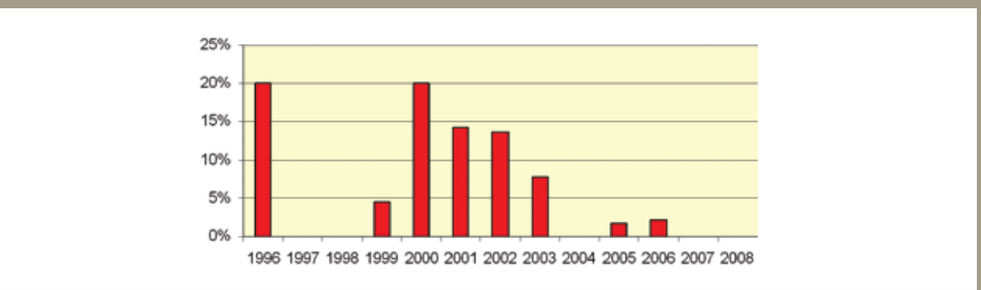


Source: CAA Statistics Table 10.2

Domestic air travel in the UK has traditionally only had a fairly small market share of overall trips compared to that for road or rail. Levels of domestic air travel have steadily been increasing from around 31 million passengers per annum in 1997 to approximately 50 million in 2005, although the rate of growth slowed last year. There is evidence of a response to the slow down in growth by the traditional airlines (BA and BMI), who have reduced frequencies and/or capacity through the use of smaller aircraft on domestic routes.

Most of the recent growth has been through the 'No Frills' carriers (e.g. easyJet, Ryanair) who now account for around two thirds of all domestic airline flights, although their expansion has also slowed significantly. The graph below shows the proportion of current easyJet domestic routes opening in each year since the airline started operations.

Percentage of Routes opened (Domestic)



This slow down is perhaps unsurprising, as demand is being satisfied, airports are becoming congested (leading to longer overall journey times), and the reliability of the railway network is improving. There have also been several incidents that have made air travel more restrictive and time consuming such as security alerts, industrial action and severe weather.

ATKINS

The case for HSR - rail industry perspective

The policy background to our previous study was a growing awareness that capacity on the main North - South routes was running out: a decision needed to be made whether or not to consider constructing new high speed alignments to obviate ongoing and relatively costly upgrades of existing routes.

Building a segregated high speed route has several advantages over incremental enhancements of existing lines:

- Speed differentials between long-distance, high-speed, commuter and freight services are drastically reduced, increasing the overall capacity of the existing network (e.g. the Peterborough - Doncaster section of route has an effective limit of 8 trains per hour (tph) freight or passenger trains due to speed differentials between services sharing the two-track section, far lower than the 16tph level operating on some other sections of the route); [11]
- Since construction is generally on new alignments, impacts on existing services are minimised, removing the need for disruptive route closures as experienced on WCML;
- Faster, segregated services have much greater reliability and are more attractive to passengers, increasing revenue for train operators. This has been demonstrated on Eurostar, where the use of the first section of the HS1 route increased reliability by 11% and passengers by 15%; [12]
- Because of the complex interactions of operations on routes, incremental capacity enhancements become increasingly costly for marginal benefits. For example, benefits from improvements to the ECML through Hitchin are still limited by existing capacity constraints at Kings Cross, Welwyn and north of Peterborough. In the long term, the value for money of short-term fixes has to be questioned.

Atkins' 2003 HSL Study demonstrated that strong transport and business cases existed for a range of HSL options. It also acknowledged the large impact of construction on the local environment, and the major funding requirements from government.

Some opposition to the concept of a new HSL has come from parts of the rail industry where there have been concerns that building a new route would divert investment and attention to the needs of other parts of the network. Such fears may have been developed during the WCML upgrade when plans for improvements to other parts of the network were scaled back or delayed. Lessons must be learnt to ensure that attention (or investment) is not diverted away from other local, regional and national rail needs to support a single "mega" rail network project.

As a result of the 2007 Rail White Paper, clear direction has been given to addressing capacity problems across the network. The DfT has adopted a strategy of carrying out smaller-scale enhancements across the network which can provide capacity relief over a wider geographic area. Acknowledging, however, that there may well be a case for considering HSR in order to address capacity problems. [13]

While there may be some caution expressed over high speed rail in some quarters of the rail industry, nonetheless there is a broad and growing consensus, supported by work from Network Rail[14], that HSR should be considered as the long term solution for addressing capacity problems. However, it has been unclear whether the capacity and other route improvement proposals included in the 2007 Rail White Paper might have rendered HSR proposals poor value for money

[11] Draft ECML RUS (page 11), Network Rail. June 2007

[12] Eurostar Press Release 17/01/05

[13] Towards a Sustainable Transport System, page 66. Department for Transport. October 2007

[14] Speech delivered by Iain Coucher "A high-speed rail strategy for railway network enhancement" at High-Speed Rail in the UK conference, ICE Conferences 8th May 2006

During Autumn 2007, Atkins reviewed the business cases for constructing a North - South HSL on the three main alignments recommended for further review in the 2003 report, assuming opening in 2026. The updated business cases took into account the capacity and route capability enhancements proposed in the 2007 Rail White Paper and revised passenger growth forecasts based on latest rail industry guidance, as well as revisions to DfT appraisal guidance.

The results of the refreshed modelling and business case work are summarised below for each of the options:

- The West Coast option accrues economic benefits over 60 years of around £16bn compared to costs of around £9bn, equivalent to a benefit - cost ratio (BCR) of about 1.7. This represents a slight reduction from the 2003 benefits assessment of a BCR of 2.0, reflecting the much improved service on the WCML route since 2003 together with the ongoing improvements planned over the next 10 years;
- The East Coast option generates economic benefits of around £29bn, compared with costs of around £12bn, equivalent to a BCR of about 2.5 - compared to the 2003 assessment of a BCR of 2.0. Again, this is unsurprising given the relatively limited enhancements planned on the ECML and MML routes - a new HSL continues to provide much substantial journey time improvements, particularly to Nottingham, Sheffield and Leeds;
- The Full Network option generates the highest economic benefits of the three, at around £63bn. With costs of around £31bn, a BCR of around 2.0 is achieved, unchanged overall since the 2003 assessment.

Figure 2.1 - HSL crowding (West Coast)

As in the 2003 HSL study, both the West Coast and East Coast options result in financially viable load factors on HSL (Figure 2.1 and Figure 2.2) and existing services, but also provide major crowding relief. In addition, they offer the opportunity to increase overall service levels substantially beyond 2026 as demand continues to grow, potentially by providing extensions to Manchester and Newcastle, respectively.

By contrast, the Full Network option is likely to require additional capacity on the southern core section of route relatively quickly (Figure 2.3). This reiterates the conclusion that a single HSR trunk connection to London is unlikely to provide the necessary capacity.

Figure 2.2 - HSL crowding (East Coast)

Figure 2.3 - HSL crowding (Full Network)

Compared to the high speed West Coast option, the business case for a conventional speed West Coast option is relatively poor. Cost savings would occur through lower energy and less onerous engineering requirements, although more rolling stock would be required to operate the same level of service because of longer end-to-end journey times. Even on the assumption of 30% lower operating and construction costs, the BCR of this option is far lower than for high speed line operation, at around 0.7. This demonstrates that high speed operation is necessary to attract sufficient passengers to switch from road and air to make construction of a new line economically or financially worthwhile.

Both the West and East Coast options can be refined to improve their benefits, including indirect benefits from capacity release on the rest of the network and the ability to improve local and regional passenger services to meet local needs, as well as freight services. In any case, it is clear that strong business cases continue to exist, even when taking into account planned enhancements to the rail network over the next 10 to 20 years.

Heathrow expansion

The Government has recently released a consultation on plans to expand Heathrow Airport, including construction of a third runway and sixth terminal. Around 15% to 20% of capacity at the airport is currently used for domestic flights, although this proportion is likely to fall as the capacity provided by Terminal 5 starts to become available. In the long-term, it is unclear how significantly the development of an HSR connection to Heathrow and release of capacity from corresponding reduction in domestic flights will affect the case for expanding Heathrow.

Our modelling does not include assessment of the potential market for switching of domestic-international interlining passengers at Heathrow to using HSR services rather than domestic services. Any expansion of Heathrow would be likely to reinforce its national hub status, increasing the demand for travel from outside London and the South East to the airport. In turn, this would increase the potential for further modal-switch to rail if an HSL were connected to the airport.

ATKINS

The case for HSR - regeneration

Successive governments have attempted to tackle the gap in productivity and wealth between the north and south of the country. Improving connectivity to London through an HSL could contribute towards narrowing this gap significantly.

One of Eddington's recommendations is to prioritise small-scale, congestion reducing improvements to the road and rail networks, which can improve the efficiency of the existing network without the major cost associated with large national transport schemes. The Government and rail industry have committed to address several major bottlenecks on the national rail network over the next ten years. However, many others will remain and will be far more costly to resolve, limiting the improvements in connectivity between the north and the south.

Effects on productivity

How much could HSR contribute towards productivity growth across the UK? For each of the three main options, Atkins estimated GDP productivity benefits following DfT methodology guidelines.

Productivity impacts total around £16bn for the West Coast option, £20bn for the East Coast option and £44bn for the Full Network option over 60 years.[15] These figures do not take into account more local effects associated with improving regional and local services, which would increase the benefits significantly.

Table 3.1 provides a breakdown of productivity benefits by region, representing the value added to existing industries by closer access to similar industries in other parts of the UK. The effects on productivity are shown graphically in Table 3.1.[16]

Most importantly, the distribution of benefits across the country shows that a North - South HSL is effective in boosting productivity growth both in the strong London and South East economy and the growing city regions. The East Coast option also benefits the East of England through faster services to Peterborough and more services to Cambridge using the released capacity on the ECML route, while the South East region benefits indirectly from boosting the accessibility of Heathrow Airport in the West Coast option and increased services to Milton Keynes and Northampton.

Further expansion of the HSR network would increase both the size and spread of productivity benefits across the country, particularly for the North and Scotland as the length of dedicated track increases.

Table 3.1 - Productivity increases - HSL options by region

Agglomeration benefits to productivity			
Region[17]	**West Coast Option**	**East Coast Option**	**Full Network Option**
East Midlands	-	£3.3bn	£3.8bn
West Midlands	£1.2bn	-	£2.1bn
North East	£0.1bn	£1.4bn	£3.1bn
North West	£4.4bn	£0.9bn	£7.4bn
Yorkshire & Humber	-	£3.2bn	£3.8bn
Scotland	£2.3bn	£1.2bn	£7.3bn
Midlands / North / Scotland (Total)	£7.8bn	£10.0bn	£27.4bn
South East / East (Total)	£3.0bn	£4.0bn	£5.0bn
London	£4.0bn	£6.1bn	£11.1bn

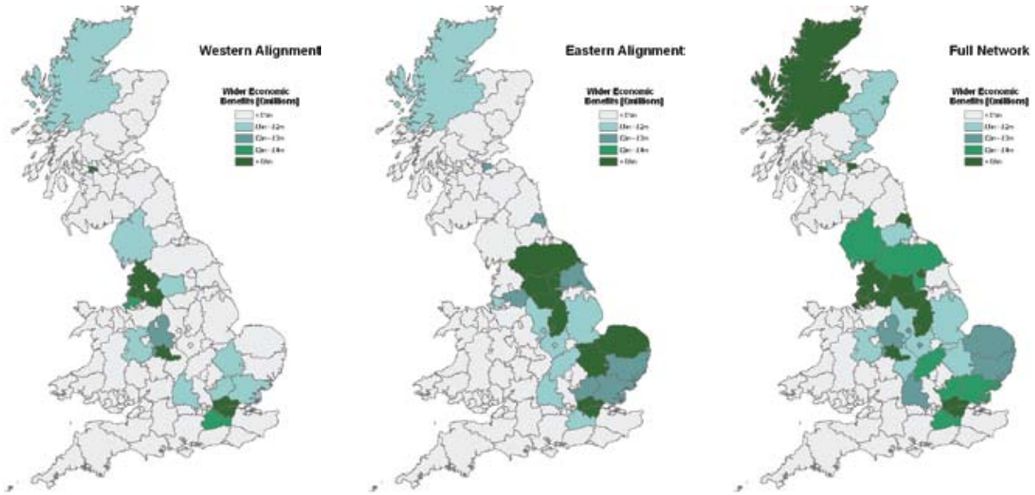


Figure 3.1 - HSL Agglomeration Benefits by Region

[15] Figures represent total discounted GDP impacts of the three options, based on 2002 values and prices, over 60 years.

[16] Graphics represent single year (2026) agglomeration benefit forecasts (WB1).

[17] Analysis excludes Wales and South West, largely unaffected by proposed HSL options. Figures based on 2002 prices & values, 60 year appraisal).

ATKINS

HSR or other transport schemes

Are there other transport schemes that could be more effective? The UK's largest urban conurbations all suffer from congestion problems - Eddington highlighted that addressing congestion problems for commuters and business users in a sustainable way is the main priority for transport policy. On the rail side, HLOS includes train lengthening as the main priority for addressing these problems. Some major cities are also developing Transport Innovation Fund (TIF) schemes which include packages of enhancements to rail networks as a complement to road pricing schemes.

It is clear that addressing local transport problems is important in supporting productivity growth, however, wider connectivity also has substantial economic effects. Congestion on rail and local roads is much less severe in many urban areas outside London, while regional and national connectivity are more important factors for business.

Alternative ways to improve wider accessibility through enhancements to the road or air networks seem unlikely to achieve equivalent benefits: major expansion of the road network may lead to some reductions in journey times, although these are likely to be marginal outside peak hours, especially for trips to and from central London.

Expansion of domestic air services from regional airports to Heathrow will not improve end-to-end journey times significantly, even if sufficient new airport capacity is provided. Recent improvements to the WCML between London and Manchester have resulted in a decisive shift away from use of air, suggesting that even improved air links have difficulty in competing with high quality, fast and frequent rail services. In the long term, the need to reduce carbon emissions suggests that high speed rail links may be vital to sustain transport connectivity in the future particularly if we see increasing restrictions on aviation.

HSR and economic development policy

Although improving North - South transport links is a necessary enabling factor in reducing the productivity gap, it is insufficient without other supporting economic development measures. Even before the Eddington study, our previous work highlighted the need for HSR stations to be sited in city centre locations to maximise agglomeration benefits and support the development of higher value business development outside London.

This highlights the critical linkage between HSR provision and a commitment required by regional and city agencies to development and local transport planning that supports city centre intensification and maximises the inward accessibility benefits of an HSR link.

The mix of economic activity will also affect the productivity impact of HSR. Cities with more extensive financial services and research sectors will benefit more quickly from an HSR connection than those without.

These issues raise difficult questions around a preferred North - South HSR route. While railway capacity or strategic economic analysis might suggest a particular route or location of stations, real benefits can only be achieved if cities or regions are willing to change their economic development, planning and transport policies, in order to take full advantage of the improved wider connectivity of HSR.

The case for HSR - local transport

Perhaps the greatest potential for HSR exists in releasing addition capacity on to the existing rail network, particularly where long-distance high speed, local commuter and freight services share the same tracks. The amount of capacity released by removing long-distance high-speed services from the existing, mixed-use network is often multiplied because of the corresponding removal of speed differential effects.

Introducing a North - South HSL would create a step-change in the robustness of the rail network, where service patterns can be easily adapted to meet local and regional needs. The complex interaction of long-distance high-speed services across the country means they take priority over the needs of local and regional services. Any improvements to local services often require expensive infrastructure to avoid changes to long-distance services.

Digswell Viaduct

Opened in 1850, the 475m long viaduct spans the valley over the River Mimram in Hertfordshire and represents a major engineering constraint to increasing the capacity of the southern section of the East Coast Main Line - the viaduct only carries two tracks while most of the rest of the route south of Peterborough carries four tracks.

Many different proposals have been put forward over the years for widening the ECML to four tracks along this section of route, including building a parallel viaduct, double-decking the existing viaduct, or building a completely separate bypass route. Even the cheapest option would cost several hundred million pounds to implement, and face concerted opposition from local residents.

In the meantime, services over the viaduct are seriously constrained to a total of 16 trains per hour at the height of the peak. Stopping patterns are arranged to maximise available capacity into London at the expense of local journeys. Even simple journeys such as Stevenage to Hatfield (both major sub-regional employment centres) cannot be made easily in peak periods.

Yet there is demonstrable potential for significant modal shift and increases in the accessibility of the sub-regional centres along the southern section of the ECML, with thousands of people commuting on the line to non-London employment centres such as Cambridge, Stevenage, Welwyn Garden City and Hatfield every day.

The extent of the capacity released depends on the amount of segregated route provided. Segregated high speed routes into Birmingham, Manchester and Leeds from London would relieve the capacity-constrained routes in from Coventry, Stoke-on-Trent and Doncaster respectively. Even the released capacity on main lines can be used to provide additional services to support the rapidly expanding areas near Milton Keynes, Peterborough and Cambridge by the paths released on the southern sections of the WCML and ECML.

The removal of high speed services to dedicated routes offers a huge opportunity for regional and local government to shape their local transport policy and include rail as a main mode. The constraints of planning around long-distance services can be removed and give genuine freedom to local and regional authorities to customise services whether through stopping patterns, train frequencies or addition of new stations.

It is essential that further development of HSR proposals involves an assessment and understanding of the amount of capacity released and the potential for more efficient use of the rail network by local and regional government, as it forms an integral part of the case for national investment in HSR. Instead of considering HSR as a single line proposal, it should be considered as part of a package of changes to a rail network corridor.

The case for HSR - sustainability and energy policy

Transport policy is not created in a vacuum. Its interaction with national energy policy and tackling climate change is clear. Transport is responsible for around 23% of the UK's energy-based CO_2 emissions, with rail producing an estimated 2% of the UK total.[18]

Estimates of rates of CO_2 emissions per passenger km for different modes vary depending on the age and type of vehicle, load factor and characteristics of the journey. For example, four people sharing a modern car using a motorway are more fuel efficient than the same four people using individual, older cars on stop-start urban journeys. Typical figures of CO_2 emissions per passenger km for the main alternative modes to rail were developed by the Rail Safety and Standards Board (RSSB), and are shown in Figure 5.1 below.

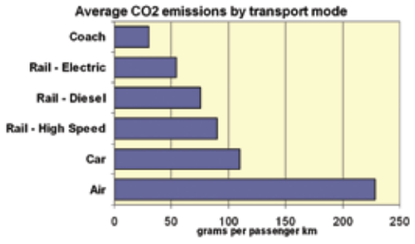


Figure 5.1 - CO_2 Emissions per Passenger km[19]

The 2007 Rail White Paper makes reference to the relatively poor performance of trains running at 300km/h or 350km/h compared with current 200km/h operations, according to fundamental rules of energy consumption increasing with speed, all other factors remaining equal. There is some debate over whether those factors would actually remain neutral: HSR services can achieve higher load factors through less frequent station stops. Efficiencies would also be increased through a reduction of differential operating speeds and patterns. Arguably, these features could also be achieved to a certain extent by a segregated conventional speed line.

Even taking the 2007 Rail White Paper emissions figures at face value, the net carbon effect of HSR services improves if it can achieve significant shift in travel from air and, to a lesser extent, road modes. Under this assumption that each passenger trip switched from air to HSR saves around 130-140g per passenger km compared with a loss of 25g for each passenger switching from conventional rail to HSR. A simple calculation shows that if a new HSL gives rise to at least one passenger switching from air for every five to six passengers switching from conventional rail services, then the operation of HSR services could result in a net balance in CO_2 emissions. It is unclear how ongoing efficiency improvements will change the relative environmental performance of rail and air in the future - additional research is required in this area.

Outline results from our modelling suggests the air-rail modal shift ratio is between 1:6 and 1:7 for the Full Network and East Coast options, dropping to around 1:18 for a West Coast option. We emphasise that these results are outline only: our modelling does not take into full account the potential for mode-shift from domestic to international interlining passengers at Heathrow, particularly affecting the West Coast option, nor the relatively conservative air-rail modal shift assumptions used in the forecasting model, and ignore effects of generated (or destination-switched) travel.

These headline figures also ignore the significant effects of mode switch from road to rail, whether directly to HSR services or indirectly to replacement services on the existing network where capacity has been released - these effects could be highly significant, especially where they provide alternative access to congested urban road corridors. This again emphasises the importance of viewing HSR not in isolation, but as part of a wider solution for improving local and regional rail networks.

Energy policy

The need to reduce national (and global) CO_2 emissions has resulted in a shift towards a more sustainable energy policy, with emphasis on producing electricity from renewable sources. When combined with rising costs of oil and gas, this has led to renewed calls for further electrification of the rail network, with or without construction of HSR.

Notwithstanding ongoing technological development to increase efficiency of air and road travel, development of the rail network reduces or has the potential to reduce the UK's dependence on carbon based travel - essential for maintaining competitiveness in an environment of rising fuel costs. Again, this particularly affects long-distance travel where the impact of rapidly increasing costs of travelling by domestic air services - and potential reduction in their economic viability on some routes - will directly impact on the competitiveness of northern England and Scotland.

[18] Source: "Transport and Climate Change", CfIT, 2007 p18 & p22

[19] Source: RSSB Report "The case for rail 2007: The first sustainable development review of the mainline railways of Great Britain". 25/06/07

ATKINS

The way forward

Our latest modelling and research work re-emphasises the strong business case for the implementation of a North - South HSL within the next 20 years. Our main findings are that:

- The business case for a North - South HSL remains robust, even when taking into account the planned improvements for the rail network set out in HLOS and the 2007 Rail White Paper over the next 20 years;
- Greater time-savings to cities in the East Midlands, Yorkshire and the North East would favour an East Coast option, however further development of both East and West Coast options could allow significantly improved benefits for both alignments, particularly when considering re-use of capacity released on the existing rail network;
- Better access to London through an HSL connection would contribute towards closing the productivity gap between Northern England and London, without holding back the economic development of London. It also allows much greater flexibility for regions and major cities to expand and customise local rail services to meet their own needs, especially for the East and South-East regions;
- High speed operation is essential to make the case for a new, segregated railway alignment economically and financially worthwhile. Any increased energy consumption resulting from running at higher speeds could be balanced by reductions in use of less efficient air or road transport. This effect is reinforced by the potential for modal shift away from cars in urban areas through re-use of the rail capacity released for local rail services.

Improving transport, whether rail or other modes, is not an end in itself, but enables more tangible gains in economic development, energy and environmental performance, and social inclusion. HSR needs to be viewed less as a rail project, and more as a national transport, economic and environmental project, as the benefits and costs go far beyond the rail industry. Accordingly, the significant costs associated with HSR development need to be viewed as a long-term investment in UK productivity, rather than as part of the existing or future rail spending allocations. Given planning gestation periods, starting planning for HSR now is unlikely to draw down on existing funding allocations to 2018/19 significantly.

The DfT's response to Eddington sets out the prospect of one or more transport studies on a number of national corridors, particularly for the London - Birmingham - Manchester axis. These studies will examine in more detail how a number of options, ranging from road-pricing to construction of major projects such as an HSL, could assist in meeting transport and other government policy objectives. They will also update and develop the forecasting and modelling work used for the original HSL study and this update.

Further development of HSL options should be progressed to support the national corridor analysis. Greater clarity is needed on the capacity release benefits and how they could be used by major cities and regions to support their own transport needs. Regions across England, as well as Scotland, also need to develop firmer views as to how HSR could contribute towards their strategic economic development. Buy-in is vital from those areas affected by the environmental effects of construction and operation but for whom the benefits may not be so readily visible. Further development work needs to show how options for a North - South HSL integrate into economic, environmental and transport planning needs at a local, regional and national level. HSL options must not be developed on rail capacity considerations alone.

Depending on growth forecasts and the planned capacity improvements, an HSL is likely to be needed from a capacity perspective within 15-20 years, possibly sooner if growth in rail passenger demand continues on current trends. Major economic and environmental benefits could be realised within 10 years if detailed planning starts soon. Consensus between the rail industry, central government, the regions and Scotland is the only way for development to move forward. The next stage of detailed analysis by DfT will reveal whether that consensus can be achieved.

Modelling approach

Our work used an extended version of the PLANET Strategic Model (PSM), the same forecasting model developed by Atkins for the 2003 High Speed Line study.

PSM is a multi-modal incremental mode choice model, representing air, car and rail modes for long-distance passenger movements, as well as a separate mode for high speed rail. The original model was to represent long-distance passenger movements on a typical weekday during 2000.[20] Rail data was developed from the National Transport Model, highway data from a series of multi-modal studies and domestic aviation movements from Civil Aviation Authority data.

The model was developed specifically to look at the business case for constructing an HSL along a number of North - South alignments, with functionality of the model focussed around testing HSL and other long distance rail upgrade options. The travel choice model was constructed from analysis of a series of stated preference surveys of existing rail, air and car travellers on North - South corridors, cross-checked against revealed preference information.

In itself, PSM does not forecast future rail demand, but uses and combines unconstrained mode-specific forecasts. It then calculates the impacts of congestion on the strategic highway network and crowding on long distance rail services on relative mode shares going forward.

Since its development in 2002, PSM has been used to support strategic level rail passenger forecasting exercises, including most recently the Eddington Study in 2006.

Atkins' 2008 HSR work included updating the base year data for the model from 2000 to 2006, using observed rail, highway and air growth figures. The methodology used to update the base year data was identical to that used in the Eddington Study. We also refreshed rail demand forecasts for 2026, using standard rail industry PDFH-based forecasts and planning data from TEMPRO, NTEM forecasts of road traffic growth and SPASM forecasts of air travel growth.

[20] Represents passenger movements in 2000 prior to the Hatfield Accident.

Assumed rail upgrade schemes

A number of rail upgrade schemes were assumed to have been implemented in full by 2026, based our interpretation of HLOS and the 2007 Rail White Paper, listed below. The list of schemes and their impact on journey times and rail capacity are inherently uncertain, and have been developed as a best estimate of the likely capability of long-distance rail services in 2026.

East Coast Main Line

- Draft ECML RUS and National Express East Coast proposals for faster trains to Leeds and York (journey times reduced proportionately), introduction of bi-hourly services to Lincoln and York and Grand Central services to Sunderland. Replacement of existing IC225 and HST rolling stock with "IEP"-style trains, providing around 100 additional seats per set.

West Coast Main Line

- Introduction of December 2008 timetable, increasing frequency to Manchester and Birmingham, stations along the Trent Valley and faster journey times to most destinations from London. Lengthening of Pendolino trains by two carriages, adding around 150 seats per set.

Cross-country routes

- Introduction of December 2008 timetable, with services on Newcastle - Plymouth corridor operated by higher-density HST sets (around 550 seats per train). Other trains assumed to be either 2x4-car length or 5-car length on former Virgin Cross Country routes, or 3-car Class 170 sets on former Central Trains routes.

Midland Main Line

- Introduction of enhanced East Midlands timetable, with 5tph operating in off-peak hours from Kettering to London, and reductions of around 12 minutes in Sheffield - London journey times. Lengthening of all services to capacity equivalent to "IEP"-style formations, of around 700 seats.

Great Western Main Line

- Replacement of HST fleet with "IEP"-style trains, providing between 100 and 200 additional seats per set. No increases in train frequencies or journey times have been assumed through reconstruction of Reading station area, as insufficient information on scheme outputs was available.

Trans-Pennine routes

- Reduction in journey times: Leeds to Manchester reduced to 43 minutes, Liverpool to Manchester reduced to 40 minutes on fast services. Lengthening of all services by one carriage (equivalent to around 70 seats).

Other capacity enhancement schemes such as the Thameslink Programme and Crossrail were not included in coding, as PSM does not model crowding on local services approaching London in detail.

HSR option tests

Three options from the 2003 HSL study were re-tested against the new base case scenario. To maintain consistency with the previous HSR work, generally options were left unchanged, including premium fares on HSR services (20% higher). Where upgrades to the WCML and ECML allowed greater service frequencies (e.g. increases in services to Leeds, Manchester and Birmingham), HSR service frequencies were increased correspondingly. Assumptions on residual services on the classic rail network were also updated where appropriate. An additional lower speed West Coast option was also tested to improve the understanding of the trade-off between environmental and economic impacts of high speed vs conventional speed running.

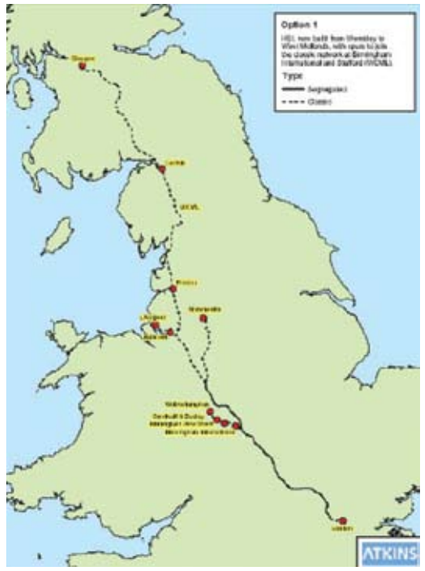
As referred to in the main report, further option development work could be undertaken to improve the performance of all options tested: these tests represent likely options rather than specific proposals.

West Coast option (2003 HSL option 1)

The core network would consist of new build track from north west London to Staffordshire. Connections join the classic network for services to Birmingham, Manchester, Liverpool and the northwest via the existing WCML route.

The pattern of HSR services in Option 1 was altered to reflect current long-distance WCML services:

- 1tph London to Glasgow (232 min);
- 2tph London to Liverpool (104 min);
- 2tph London to Manchester (96 min);
- 1tph London to Wolverhampton (80 min);
- 2tph London to Birmingham (60 min);
- 1tph Heathrow to Birmingham (60 min);
- 1tph Heathrow to Manchester (96 min).



Changes to classic rail

All WCML services (to Glasgow, Liverpool, Birmingham and Manchester) were removed, apart from those to North Wales. In turn, they were replaced by three slow classic trains an hour from London to Birmingham and two slow trains per hour from London to Manchester via Stoke were also provided, as well as one train per hour between London and Crewe, stopping at stations which would not be served by an HSL, including Watford and Milton Keynes. An additional 2tph fast service to Northampton and Milton Keynes was also added to make use of capacity released on the existing WCML route.

Reduced speed West Coast option

To test the business case for services operating at 200km/h instead of 300km/h, the West Coast option was also re-run with services modelled to take 20 minutes longer on the HSL part of their journey. This corresponds to reduced speed running over an average of 120 miles of dedicated track.

East Coast option (2003 HSL option 16)

An easterly alignment from London to Yorkshire, connecting to the ECML between Leeds and York. Services would run via Peterborough and Nottingham, with spurs to serve Hull via the existing ECML route, Sheffield and Leeds.

Some changes were made to the original HSL specification to reflect expected ECML RUS changes to stopping patterns and journey times to Leeds, York and Edinburgh.

HSR services would be as follows:

- 1tph London to Sheffield (79 min);
- 1tph London to Hull (108 min);
- 2tph London to Leeds (82-98 min);
- 1tph London to Newcastle (168 min);
- 2tph London to Glasgow via Edinburgh (268 min).

Changes to classic rail

All long-distance, London-based ECML services on electric routes are removed (however services to non-electrified destinations such as the north of Scotland were retained). They were replaced by stopping services to Leeds (2tph) and faster services to Newcastle (1tph) and Sunderland (1tph). An additional 2tph fast services from London to Cambridge were modelled, using capacity released on the existing ECML route.

ATKINS

Full Network option (2003 HSL option 8)

An extension of the West Coast Option into central Manchester, with a separate branch from south of Birmingham to Nottingham, then following an easterly alignment to Yorkshire, the North East and Scotland.

Service patterns were altered slightly to reflect existing ECML and WCML service levels: however, a maximum of 12tph operating on the core section into London was assumed.

HSR services would be as follows:

- 1tph London to Wolverhampton (76 min);
- 1tph London to Birmingham (60 min);
- 1tph London to Sheffield (80 min);
- 1tph London to Leeds (86 min);
- 2tph London to Manchester (74-79 min);
- 1tph London to Liverpool (96 min);
- 3tph London to Glasgow via Newcastle (169-186 min);
- 1tph London to Newcastle (131 min);
- 1tph Birmingham to Glasgow via Newcastle (176 min);
- 1tph to Carlisle via Preston (158 min).

Changes to classic rail

Similar to the East Coast and West Coast options, all long-distance, London-based ECML and WCML services on electric routes are removed, except with services to non-electrified destinations retained. Residual services on the ECML and WCML routes were as described for the West Coast and East Coast options described above.

Appraisal

Guidance on how benefits and costs of rail and other transport schemes should be considered has changed considerably since the 2003 HSL Study. Where possible, we have used current guidance.

The underlying assumptions for the preparation of cost benefit analysis is based upon DfT Appraisal Guidance which is has been developed in line with the requirements of HM Treasury's Green Book for the appraisal and evaluation of public sector investment projects.

PSM was used to assess both the social benefits of the scheme such as journey time savings and perceived benefits through crowding reduction. The model was also used to assess the net revenue generated on the rail network, taking into account both the extra revenue generated by the HSR service and the revenue extracted from existing franchises for journeys which the HSL will directly compete with.

The scheme operating costs were based upon those developed for the original HSL study work, but updated to reflect changes in services assumed for the base case and each option. Consistent with the approach taken for the revenue assessment, net operating costs have been used which capture the cost of running the HSL, less any operating cost reductions on existing franchises through changes in service levels as a result of HSR being introduced. Capital costs from the original study were updated to reflect the observed increases in construction and land prices between the time of the original study and the present day costs faced using indices published by the Department for Business, Enterprise and Regulatory Reform.

Options have been assessed based on an assumed opening date of 2026 with a 60-year appraisal period from the scheme opening. Social and financial benefits have been discounted based on a discount rate of 3.5% for the next 30 years and 3% thereafter using a 2002 price and discount base year, consistent with current DfT appraisal guidance. Standard WebTag values of time were used to monetise time-savings for users of each mode.

Productivity impacts

Although the theoretical and evidence base for productivity assessment is still emerging, the guidance suggests impacts can be estimated by valuing business time savings and a number of wider benefits that are omitted from conventional appraisal because real economic and market conditions differ from the theoretical assumptions underlying the conventional appraisal approach.[21]

We have adopted the same approach towards estimating productivity benefits as used to support our work for the Eddington Study in 2006. This is based on DfT guidance[22], which outlines an approach for assessing the performance of transport schemes in terms of their productivity impacts. Estimates of the value of the productivity impacts of each HSL option were made in line with the detailed methodologies provided in the guidance document, focussing on the following effects:

- **Business time savings**: When the journey time for an employee's trip during working time is reduced, the time saved can be directly linked to increased economic output for their employer. The productivity impacts of time saved can therefore be estimated by multiplying the number of hours saved by a monetary value of time reflecting average wages;
- **Impacts of imperfect competition**: In perfectly competitive markets, the benefits of increased economic activity (increased provision of products or services) exactly match the costs involved. In this case the value of business time savings described above would fully capture the productivity impacts of time saved. However, in reality firms operate in imperfectly competitive markets and can usually charge prices for additional output that exceed the costs they incur. This means that the value of productivity gained is greater than the value of time saved through faster journeys. Research suggests that the additional loss associated with this effect can be estimated as 10% of the value of business time and reliability savings;
- **Agglomeration benefits**: The productivity of firms often increases with their degree of clustering with other firms and employees. Clustering is assessed through the measure of 'effective density' which identifies the degree of accessibility (in travel cost terms) of firms to other firms and to workers. The greater the density or clustering levels, the greater the agglomeration productivity benefits they receive from effects such as improved information transfer between firms, access to wider input markets and improvement in the quality of markets near the clustered firms. Improved accessibility to employees also provides access to a wider, deeper labour market improving productivity through better matching of employees with vacancies;
- **Labour market effects**: changes in commuting costs can influence the labour market choices and productivity of the work force in a number of ways including encouraging non-workers to participate in the labour market or workers to relocate to more productive locations. The first effect has been estimated for each HSL option but has a very limited value. The latter effect has the potential for a much larger scale effect but is beyond the scope of this study as estimation would depend upon detailed knowledge of the landuse impacts of each option and other local influences on employment location.

The key inputs to the calculations of each of the effects outlined were details of travel costs and economic characteristics across the country. Details on the costs of long distance journeys and the impact of the HSL upon them were extracted from PSM scenarios run for each option for the forecast year 2026. Local travel cost information was collated from the National Transport and Trip End models and the National Travel Survey. The majority of the economic data was provided by the DfT, including employment and GDP levels by district and sector (originally derived from the Annual Business Enquiry) and elasticity of productivity to effective density for given districts and sectors. Supporting information on detailed spatial employment distribution and employment growth was obtained from TEMPRO.

National benefits were estimated for 2026 and assumed to remain constant for the full 60 year appraisal period to enable a net present value of the effects to be estimated. The benefits presented are likely to be conservative as they exclude the impacts of the relocation of jobs and only consider the direct impacts of the HSL, excluding the local and regional rail improvements that would be made possible by the capacity freed by the transfer of long-distance, high-speed journeys to the HSL. These measures would also bring considerable productivity improvements through reduced local commuting and business journey times and improved connectivity between employment areas, other local employment centres and their potential workforce.

An estimate of the disaggregation of the national productivity benefits between regions was also made. Agglomeration and labour market effects are estimated by district and were therefore simply aggregated to the relevant regions. However, business time savings are estimated for individual journeys and it was therefore necessary to allocate benefits between trip origins and destinations. For transparency and simplicity, it was assumed that time savings on business trips generally increase productivity at the production of the trip (i.e. employer's location) and that the directional flow of trips on the HSL would be balanced with equal numbers of trips on a given route produced in and attracted to the north. However, it is likely that this approach underestimates the productivity impacts in the north and overestimates those attributed to the south as the model suggests that more than half of the trips using the HSL would be produced in the north.

[21] Conventional assessment is based on the assumption that transport using markets behave in a theoretically perfect manner with the implication that the economic impacts of schemes can be fully quantified by estimating the direct impacts of the scheme on transport users and providers. In reality, markets are imperfect and consequently the conventional approach omits some scheme impacts, termed the 'wider economic benefits'.

[22] Transport, Wider Economic Benefits, and Impacts on GDP, DfT, 2005

ATKINS

The manufacturing mill is producing Zanders Mega matt and gloss products with up to 50% recovered fibre from pre and post consumer waste and the remaining pulp source is totally chlorine free sourced from fully sustainable sources. The manufacturing mill has also been accredited with the internationally recognised standard ISO 14001.