fast forward

A HIGH-SPEED RAIL STRATEGY FOR BRITAIN

GREENGAUGE21
PUBLIC INTEREST GROUP

In Summer 2008, *Greengauge 21* formed a Public Interest Group to develop a greater understanding of what high-speed rail could do for Britain. This unique Public Interest Group brought together the largest city councils in England and Scotland, the regional development agencies, key rail industry organisations, passenger transport authorities and other regional and transport agencies across the country. This report presents *Greengauge 21*'s conclusions from the major work programme funded by the Group in the public interest: a high-speed rail strategy for Britain.

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fast forward

A HIGH-SPEED RAIL STRATEGY FOR BRITAIN

executive summary

Across the nation, there is support for the creation of a high-speed rail network, linking together our major cities. This report shows, for the first time, what a national high-speed rail network would look like, what its value to the nation would be, and what it might cost.

The report has been prepared by *Greengauge 21*, using the evidence developed in a work programme funded by a widely-drawn Public Interest Group. When the work programme started, Government was dragging its feet on high-speed rail. This is no longer the case.

With Government at the start of this year establishing its own company to plan high-speed rail (HSR) between London and the West Midlands, and potentially beyond, our work provides a longer term plan for a national HSR network within which a first route needs to be considered.

HSR is needed to help address two fundamental challenges facing the country: supporting and enhancing economic competitiveness across the nation, and improving the environmental sustainability of our transport systems.

The economic challenge

Our national transport systems are filling up, even taking into account the effects of the current recession, and there is a risk that the capacity crunch created will constrain business efficiency, productivity growth and investment. Capacity is needed to cater for long-term economic growth.

In the last forty years, growth in business activity and in population has been greatest in the wider south east. Elsewhere there is a continuing sense of frustration: development is welcome, but is slow to get established when ready access to decision-makers in London, to the national gateway airports and to Europe via the Channel Tunnel is so poor.

With the transformational journey times and reliability offered by HSR, decisions on business location and on where people would prefer to live will change, allowing better balanced and more sustainable development across the country.

	Typical current rail journey time	Typical journey time on high-speed rail	Journey time saving
London » Edinburgh	4h30	2h40	1h50
London » Glasgow	4h30	2h40	1h50
London » Newcastle	2h55	1h45	1h10
London » Leeds	2h25	1h25	1h00
London » Manchester	2h10	1h15	0h55
London » Birmingham	1h25	0h45	0h40
London » Bristol	1h45	1h25	0h20
London » Cardiff	2h05	1h45	0h20
Birmingham » Paris	4h30	3h00	1h30
Manchester » Newcastle	2h35	1h35	1h00

The carbon challenge

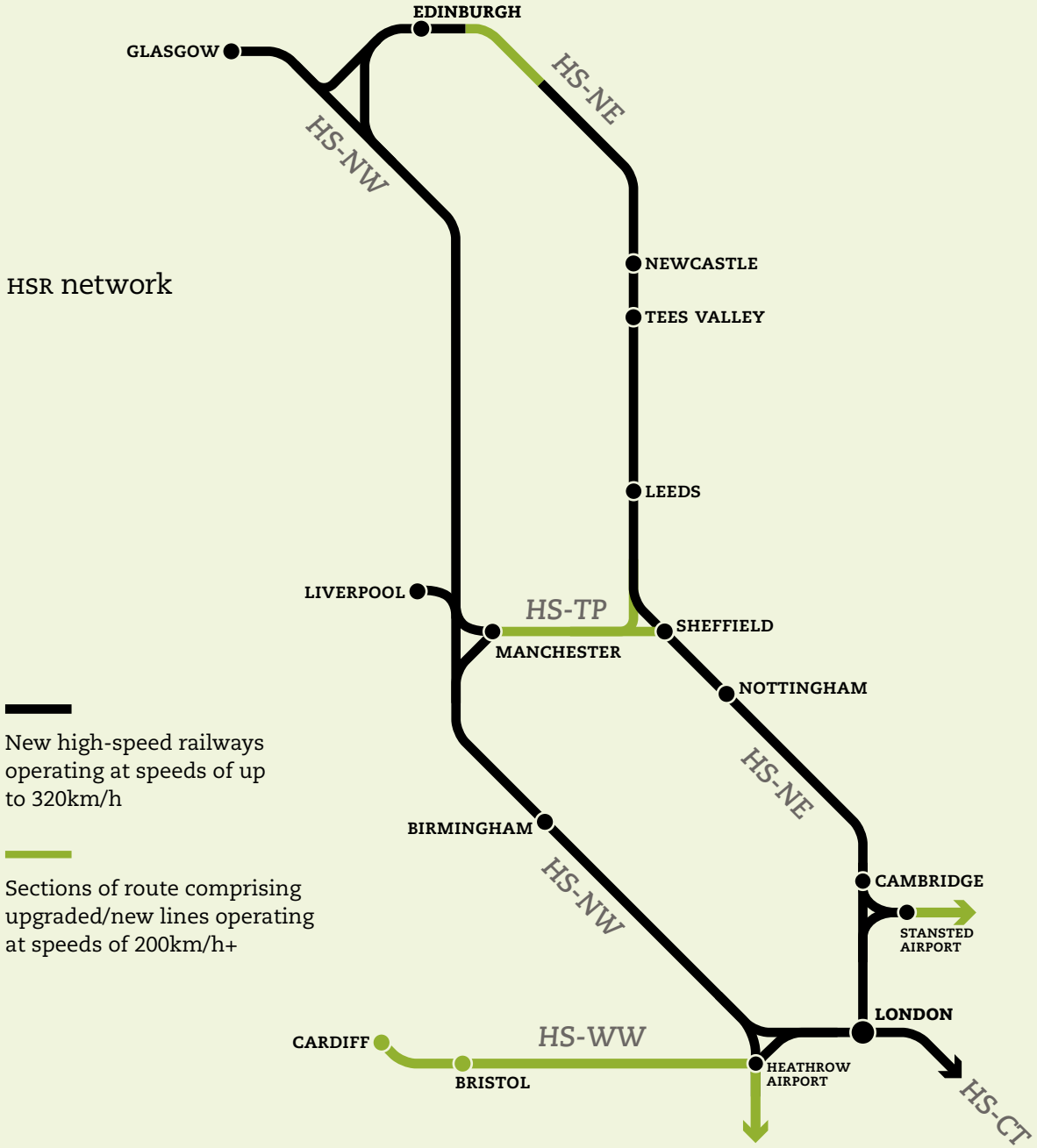
Alongside the economic benefits, high-speed rail can help to address the second major challenge facing Britain, by providing an attractive alternative to short-haul aviation and long-distance car use, transport modes that depend on fossil-based fuels. This report shows how, when operational, a national HSR network would reduce carbon emissions by one million tonnes a year. It is the green option for our national transport system. It will complement low-carbon initiatives in transport at a local level and support an evolution from the previous age of motorway building. It can act as a stimulus to complementary improvements in local public transport, as part of a joined up strategy. There are of course other environmental challenges to address, not least in the construction of new infrastructure, and these will need to be considered fully in the more detailed stages of planning.

A vision for high-speed rail in Britain

Greengauge 21 proposes a 25 year programme to create a national HSR network which can transform the travel experience in Britain. It offers large-scale time savings and provides a new, high-quality, super-reliable way to travel in safety, providing customer service fit for the 21st century. This provides benefits to business, to tourism, to the wider public and to the economy at large worth £125bn, exceeding costs by a ratio of over 3:1.

International experience shows that the appeal of high-speed rail will be wide, not just for business travel – which continues to grow even in this electronic age – but also for individuals, groups and families travelling to see friends and relatives, to get to university, to sports and cultural events or to go on holiday. It will free up space on the existing railway for more services to expand commuter capacity and to grow freight traffic on the rail network.

These plans for a national HSR network are designed to have broad appeal. The strategy does not rely on premium fares. Stations and services would be designed to offer access for all. *Greengauge 21* and the stakeholders we consulted believe that investment in the existing network should not be neglected to pay for HSR. The challenges we are addressing are the economy and climate change, not a narrower question of better transport, however desirable that may be.


HSR network
New high-speed railways operating at speeds of up to 320km/h
Sections of route comprising upgraded/new lines operating at speeds of 200km/h+
EDINBURGH
GLASGOW
HS-NE
HS-NW
NEWCASTLE
TEES VALLEY
LEEDS
LIVERPOOL
HS-TP
SHEFFIELD
MANCHESTER
NOTTINGHAM
HS-NE
BIRMINGHAM
HS-NW
CAMBRIDGE
STANSTED AIRPORT
LONDON
CARDIFF
HS-WW
BRISTOL
HEATHROW AIRPORT
HS-CT

The national HSR network comprises two north-south routes, one on each side of the country. It has three key east-west connections too, in central Scotland, across the Pennines and between London and Bristol/South Wales. These routes are inter-connected with one another, with the existing line to the Channel Tunnel, and with new connections at Heathrow Airport. They are also fully integrated with the existing rail network so that high-speed services can be provided to all of the major cities across Britain. A full range of network scenarios was developed and appraised before this preferred strategy was identified.

This 1,500km-long network of high-speed routes would carry 178 million passengers a year. The cost of the first national HSR line is estimated to be £19 billion, including allowances for risk and contingency.

We hope that this piece of work, setting out for the first time what a national HSR network will look like, together with the case for funding it, will add to Government resolve to move forwards to implementation.

***Greengauge 21* Public Interest Group**

- Association of North East Councils
- Association of Train Operating Companies (ATOC)
- BAA plc
- Birmingham City Council
- City of Edinburgh Council
- City of London Corporation
- English Regional Development Agencies
- Glasgow City Council
- Greater Manchester Passenger Transport Executive
- Network Rail
- Newcastle City Council
- The Northern Way
- Passenger Transport Executive Group (representing all six PTEs)
- Railway Industry Association
- South East of Scotland Transport Partnership (SEStran)
- Strathclyde Partnership for Transport
- Sheffield City Region
- Transport for London

Associate members

- Channel Tunnel Initiative
- Rail Freight Group

"78% of people in Britain believe high speed rail is essential for our future."

"Every £1 spent on a high speed rail network will provide £3.50 of economic benefit."

contents »

Both the Japanese and the French set out a long-term plan for their HSR networks—as we did for our motorway network back in the 1930s.

1 introduction »

The *Greengauge 21* Public Interest Group, established in 2008, represents a unique grouping of organisations that came together to develop a high-speed rail strategy for Britain.

The prospect of a high-speed rail network for Britain is a tremendously appealing and exciting one. But however attractive the vision, the challenges of developing such a major new transport infrastructure programme are enormous. Clarity and consensus on what this high-speed rail network might look like and the benefits it could deliver across the country are therefore essential.

In Summer 2008, *Greengauge 21* formed a Public Interest Group to develop a greater understanding of what high-speed rail could do for Britain. This unique Public Interest Group brought together the largest city councils in England and Scotland, the regional development agencies, key rail industry organisations, passenger transport authorities and other regional and transport agencies across the country. This report presents *Greengauge 21*'s conclusions from the major work programme funded by the Group in the public interest: a high-speed rail strategy for Britain.

At the time the Public Interest Group was established, interest in high-speed rail was building, stimulated in part by the successful opening of 'High Speed 1' and St Pancras International Station in Autumn 2007. However, little active planning was underway in Government. Since the Public Interest Group started work, a commitment has been made by the Conservative Party, if elected to form the next Government, to fund a high-speed railway line linking London, Birmingham, Manchester and Leeds. The Liberal Democrats have also reaffirmed their proposals for a priority programme for high-speed rail. Over the course of the last year, Network Rail carried out and has now reported on its 'New Lines Study'. And in January 2009, the Government set up a company, High Speed Two (HS2 Ltd), to develop a proposal by the end of 2009 for a high-speed line from London to West Midlands, and potentially beyond.

The work of the *Greengauge 21* Public Interest Group, in looking at the wider network strategy for high-speed rail, meshes well with the in-depth work being undertaken by HS2 on its specific corridor scheme. The aim of the *Greengauge 21* work programme is to look beyond a first line to the long-term vision for high-speed rail.

This summary report sets out why we need a high-speed rail network, what it might look like, its economic benefits and environmental impacts, what it will cost, how it might be delivered, and its sustainability implications. It draws on detailed analysis carried out over the last year by *Greengauge 21*'s advisers. The detailed reports are available on the *Greengauge 21* website (www.greengauge21.net/hsr-development-programme.html).

Learning from experience

Other countries have demonstrated the value of setting out a long-term network strategy early on. In Japan, a masterplan for the Shinkansen network was drawn up in the 1970s following the opening of the Tokaido Shinkansen, the first Japanese high-speed railway line. This ambitious masterplan was designed with the intention that everyone would be able to access Shinkansen within one to two hours. It was also integrated with airport planning. This masterplan still forms the basis of current authorisation of new lines or extensions to existing lines. In the case of Japan and also France, it is notable that a network strategy was developed *after* the first line had proved its success, which is where the UK now finds itself following completion of the Channel Tunnel Rail Link.

In this country, there is a parallel with the creation of Britain's national motorway network. The motorway concept and plans for a network were initially put forward in the 1930s and '40s by associations of highway engineers, as a solution to an inadequate road network and in the light of what had been achieved in Germany. Implementing the new technology in the 1950s required Government to develop consistent standards and regulations, although the real push came from local authorities, in particular from the County Surveyor in Lancashire. An objective assessment of inter-urban traffic needs was not carried out by Government until the 1960s, in recognition that "effective networks rather than [...] individual roads" were needed.

The Shinkansen below Mount Fuji, Japan

The Gare do Oriente Station, Lisbon, Portugal. One of the world's largest transport interchanges with over 75 million passengers per year.

Photo: Jonas Tesch

The Frankfurt Flughafen Fernbahnhof Station, Germany

2 *why HSR is needed… and why it's needed now* »

High-speed rail is not just another transport project: it provides a means of supporting long-term economic development in Britain and doing so in a sustainable way.

The economic imperative

A high-speed rail network is needed to form a key part of the nation's economic *infrastructure*. By offering a step-change in accessibility, it delivers regional economic benefits, provides a stimulus for tourism, supports inward investment and helps improve economic competitiveness.

A modern diversified economy has certain features. It is generally agreed that it will need to be focused on the creative and knowledge-based industries, using a highly skilled work-force to generate competitive advantage. It is characteristic of such an economy that it:

- is best built on existing business clusters;
- operates in an international market-place; and
- requires face-to-face contact (as well as excellent telecommunications) to work successfully[1].

As was made clear in the Eddington Transport Study of 2006 "a comprehensive and high-performing transport system is an important enabler of sustained economic prosperity". However, we lack the quality of national transport system needed to support our economy[2]. The rail network is filling up and congestion on the highway network will continue to hold back Britain's economic competitiveness. There is a requirement for investment to redress the balance.

Of course there are choices. But, aside from high-speed rail, these fail for a variety of reasons:

- Expanding the motorway network, with its lack of a price mechanism to regulate demand, can achieve short term gains but only at the price of a surge in demand that means even greater levels of congestion and unreliability in the future than exist today.

- Expanding the network of domestic air services and the airport capacity needed to handle them cannot achieve the connectivity a rail network offers and cannot keep up with expected demand increases even if all of the proposals for runway expansion are adopted to a tight schedule[3].

[1] See for example, *New Industry New Jobs*, DBIS, July 2009.

[2] See *The Congestion Question: A Business Transport Survey*, British Chambers of Commerce, November 2008, in which just 18% of businesses surveyed considered that the UK's transport infrastructure meets their business needs fully and 62% claimed that the transport system inhibits inward investment in their region.

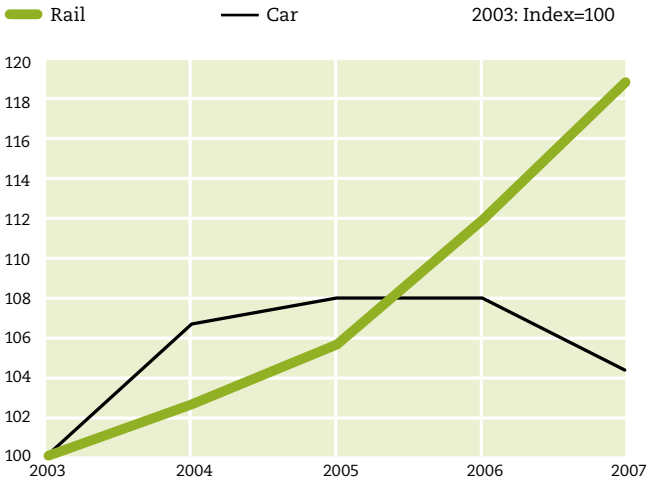
[3] Capacity in the South East will remain unable to handle the forecast demand from 2030 onwards according to the Aviation White Paper, DfT 2003.

» Expanding the existing rail network only through upgrades that address known pinch-points is to consign rail users to lengthy periods of disruption, and without any prospect of the step-change in journey times and reliability that would encourage transfer from less sustainable modes.

Each of these options has already been examined, and, when set alongside the investment case for high-speed rail, found to be inferior[4]. The choice remains for Government to decide, of course, and *Developing a Sustainable Transport System* is a process currently underway at the Department for Transport (DfT) to provide the necessary evidence: it would be surprising if it developed different conclusions to these.

In recent years, use of the national rail network has grown faster than road use. While short-haul air travel experienced an uplift in demand following the introduction of low-cost airlines, the effects of the recession have been particularly severe with a fall-off in usage of 13% in the first quarter of 2009[5]. Especially in the south east, runway capacity limitations will start to bite once the economy is in recovery mode .

Passenger-kilometres travelled by mode



[4] *High Speed Line Study: Summary Report*, Atkins *et al*, 2003.

[5] Aviation Trends, Quarter 1 2009, Civil Aviation Authority.

As the economy recovers the relatively high growth in rail demand is expected to resume. While there are plans in the short term to ensure that overcrowding, especially on commuter services, remains at acceptable levels, there are only limited plans beyond 2014. This is where high-speed rail, despite its focus on longer distance inter-city travel, brings across the board benefits. By removing express non-stop trains from today's network, the capacity that can be released is significant, and can be used for commuter and rail freight services.

An expanding economy, with a growing population, needs the infrastructure capacity and capability to support it. High-speed rail is what is needed from the transport sector to support economic competitiveness. A commitment now would fill a void in current policy: the absence of firm plans after 2014 to address the transport capacity short-fall.

The broad set of public sector and transport industry stakeholders that we consulted believe that HSR is not primarily about addressing a transport problem (less still, a rail network problem) so much as a wider economic problem[6]. The important implication is that the funding of HSR must be considered more broadly than simply as part of the transport budget.

In addition, that while the capacity of our national transport networks is a foreseeable problem, we need to have a solution that addresses the quality of travel, as well as the quantum; we are looking for a system with very high levels of traveller safety, comfort and security, easily accessed and affordable, and reliable. The uncertainty of travel times is as injurious to business efficiency as the intrinsic slowness of journeys.

HSR has the track record to deliver reliable reductions in journey times and offer a step-change in reliability over today's rail services. This is precisely what the Department for Transport called for in launching its *Towards a Sustainable Transport System* approach in November 2007[7].

Sustainability

There is also an important question about the nature of economic recovery and expansion.

Economic prudence would suggest that alongside a re-invigorated world-leading financial service sector centred in London there is a need to build across a wider base of industries. This will help achieve a further, desirable, outcome: less development pressure on the wider south east, which has experienced the lion's share of population growth over the last 40 years, and support to those regions which are eager for regeneration and growth.

[6] Stakeholder Consultation Report, Bircham Dyson Bell LLP and ComRes, February 2009.

[7] Towards a Sustainable Transport System Cm7226, Department for Transport, October 2007.

The reliability of high-speed rail

On the AVE high-speed line from Madrid to Seville, passengers are guaranteed arrival within five minutes of the advertised time, and are offered a full refund if the train is delayed further. So far, only 0.16% of trains have been delayed beyond five minutes. When Eurostar services switched from using the existing Southern Region rail network to using the new high-speed link to reach the Channel Tunnel, punctuality improved from 79% of services on time to 92%.

The AVE on the Jalon Viaduct between Madrid and Barcelona, Spain *Photo: Spanish Rail*

The economic performance of the regions remote from London is markedly lower. The three northern English regions have an *annual* under-performance of over £30bn against the English national average. The benefit of reducing the north-south gap in terms of economic productivity is huge. And London too will benefit from radically improved links with the rest of the country, links which, set alongside those it has with the major economic centres in other countries, are relatively poor.

Better, faster connectivity between the major cities will help foster the economies of scale that can attract businesses; better connections from across the nation to the financial markets in London will help encourage investment outside the south east (where the venture capital industry prefers to invest because of its accessibility); fast direct links to the nation's dominant international airport at Heathrow will help businesses located outside the south east to compete in world markets.

This is a much more sustainable pattern of economic development across the English regions, Wales and Scotland. It would be reinforced further by ensuring that the greatest accessibility boost is in city centres, helping to reinforce existing urban areas and enhancing the value of development within them. This can be achieved by high-speed rail, in stark contrast to the effects of both aviation and roads-oriented expansion which encourages peri-urban sprawl and development on rural land, adding to the wider environmental consequences of transport. The wider economic gains of a high-speed rail network – as illustrated in chapter 6 – are balanced across Britain and are not simply focused on London and the south east.

The need to reduce carbon emissions is now reflected in government targets. Plans to de-carbonise private cars require a wholesale switch away from current engine technologies, which is going to take several decades to achieve[8]. Plans to reduce the greenhouse gas emissions from aircraft, along with the use of larger planes, will improve their performance in terms of emissions per passenger carried. But as we show in the next chapter, this is nowhere near enough to offer a good alternative to rail and to high-speed rail travel.

Achieving a substantial reduction in carbon from the transport sector, where greenhouse gas emissions are still growing, requires a change in the use of the different transport modes. For local travel, this will mean an emphasis on walk, cycle, bus and tram, in preference to car travel. But longer distance travel has a disproportionate effect on carbon emissions. For example, long-distance car trips of over 25 miles account for 44% of all car travel in Britain, measured by distance travelled: the relatively small number of longer car journeys therefore creates over one-third of the carbon emissions from travel by private car[9].

High-speed rail can positively attract people from their cars to use a more environmentally benign way of travelling.

[8] The King Review of Low Carbon Cars, October 2007.

[9] Carbon Pathways Analysis – Informing Development of a Carbon Reduction Strategy for the Transport Sector, Department for Transport, July 2008.


Stockholm
Gothenburg
Glasgow
Edinburgh
Copenhagen
Dublin
Hamburg
Amsterdam
Hannover
Berlin
Poznań
Warsaw
Bristol
London
Brussels
Köln
Luxembourg
Frankfurt
Nuremberg
Kraków
Paris
Strasbourg
Munich
Nantes
Zürich
Lyon
Milan
Bordeaux
Turin
Bologna
Coruña
Nice
Vitoria
Toulouse
Marseille
Vigo
Zaragoza
Rome
Porto
Valladolid
Barcelona
Madrid
Naples
Valencia
Lisbon
Alicante
Seville
Málaga
European high-speed network, 2008
≥ 250km/h
≥ 250km/h (planned)

There needs to be a change in the balance of the use of the transport modes, and high-speed rail could lead to an overall reduction of carbon from the 2020s onwards, when the production of electricity that will power the services will itself necessarily be well-progressed down the path of de-carbonisation.

The urgency in all of this stems from the lead times. It takes time to achieve a switch to renewables-based electricity, to renew the nuclear-based proportion of the national energy supply and to adopt cleaner coal technology; time which parallels the planning and construction timescale for high-speed rail which will enable the greener energy supply to be put to good use offering the consumer an alternative to private car or short haul aviation powered using fossil fuels.

Why high-speed rail is needed now

The need for high-speed rail is three-fold:

- to provide sufficient higher quality transport capacity across the nation
- to stimulate a more efficient economy
- to reduce carbon emissions.

There is a need now to develop plans to provide sufficient long term capacity on our national transport infrastructure. The next five years can be used to develop and obtain consents for specific plans for HSR which can add capacity for both person travel and freight in a manageable and sustainable way. The longer a decision to proceed is deferred, the longer we shall need to spend inefficiently on a make-do and mend basis on an overcrowded transport network.

The economic and carbon requirements are both urgent matters where we know delay is expensive.

This report calls for more than a decision to progress a single scheme, welcome though that would be. Without a longer term strategy for HSR and the existing main lines there is a risk that:

(a) wider benefits may be squandered

(b) with a piecemeal approach, costs may be higher than necessary

(c) the pan-regional support that the Public Interest Group has started to foster will dissipate, extending the planning timescales before construction of the first national HSR line is even started.

The AVE at Zaragoza Delicias Station, Spain

Photo: Thealx

3 *what will HSR offer the travelling public?* »

Customers' needs must be paramount in designing and planning high-speed rail. A high-quality service accessible to all is essential to ensuring that high-speed rail is the first choice for long-distance travel in Britain.

A new high-speed rail service will offer a transformation from the travelling experience we know today. It will be easy to book and easy to use. It will be designed with customers in mind – families, holiday-makers, students, business travellers. Trains will be modern, well-laid out and highly reliable, and there will be no standing in the aisles – passengers will be guaranteed a seat, not just when booking in advance but also with last-minute seat-allocation for turn-up-and-go. All of this is essential to make sure we can deliver the policy objectives outlined in chapter 2.

What markets is HSR serving?

HSR services will be aimed primarily at passengers making long-distance journeys – in this market the railway already plays an important role, accounting for over 60 per cent of city to city trips from London to destinations such as Birmingham, Manchester and Leeds. In other markets, particularly for connections between cities outside London or for travel beyond city centres, rail currently has a relatively low mode share and considerable potential to expand.

The market research carried out for *Greengauge 21*[1] shows that train travel for long-distance journeys can be a great way to make good use of travel time and travel from city centre to city centre. But there remain barriers to greater use of the rail network, such as the perceived cost and complexity of rail fares and overcrowding – which the rail industry is aware of and beginning to address. In comparison, the appeal of other modes of transport is no longer as strong as it once was. Travel by car may present the ultimate in terms of freedom, but it is an increasingly frustrating experience in the light of ever-increasing congestion. And while passengers see air travel as having an aura of glamour attached to it and value the low-cost options available these days, air travel is losing its shine too, from the increasing irritations of security controls, baggage restrictions and flight delays.

Arriving at St Pancras.

[1] Project Bullet, *The Leading Edge*, July 2009.

The Avignon TGV Station, France

Photo: Gordon Joly

What does HSR need to deliver?

The HSR concept described here is based in large part on what has been delivered by other high-speed railway systems across the world, and has been refined through our own market research. A high-speed railway network for Britain will offer a new high-quality travel experience for the public, providing an attractive alternative to other modes of transport. It needs to address the varying needs of rail travellers in the way that car travel allows us to do now.

The key features of the HSR service

- ***Modern easy booking systems***, allowing passengers to book in advance, take advantage of frequent traveller programmes, print out their own tickets and plan their whole end-to-end journey effectively;
- ***Easy ways to access HSR***, with dedicated platforms at modern stations, new interchanges with other modes of transport;
- ***High-levels of customer service*** at stations and on trains, with staff on hand at all times providing attention to the details that count;
- ***Sleek modern and clean new trains***, with communication and entertainment facilities on board to make good use of travelling time;
- ***Dramatically reduced journey times*** compared with today, providing a competitive alternative to short-haul air travel;
- ***Express limited-stop rail services*** between Britain's major towns and cities;
- ***Ultra-high levels of punctuality***, beating delays on the congested road network.

Our market research reveals that, in addition to the huge benefits that reduced journey times will deliver, passengers place particular value on:

- ***A consistent and readily-understandable pricing structure***. In contrast to the national rail network, Eurostar has a memorable £59 price point for return journeys to Paris/Brussels, although a range of more flexible and more expensive fares are offered which help keep up average yields. An equivalent lowest promotional price point for domestic high-speed rail services could be £39 for a return trip – offering such fares, even if limited to less busy trains, will help ensure that HSR is affordable to all.
- ***Information and arrangements for before the journey and for onward travel to the ultimate destination***. To reduce hassle and increase the ease of travel, reflecting the point that the rail trip is normally only one part of a longer journey and many users are not regular rail travellers.

- ***A service that runs 7 days a week, without weekend closures for engineering works***. On Japan's Shinkansen network, all engineering work is carried out at night, avoiding the need for any line closures in the daytime. Sunday is the busiest day of the week at Heathrow: an indicator that this is often chosen as a good day for longer distance trips; unfortunately, Sunday travel on today's rail network can be a chancy affair.

- ***Modern standards of accessibility, including for the mobility-impaired***. In part, this can be enhanced through excellent customer service, but building new infrastructure and trains provides the opportunity to provide from the start facilities that allow for easy access by all.

It is also clear from the market research that there is great support for HSR: of those we surveyed, 78% believe that HSR is essential for Britain in the future. However, while there is a reasonable appreciation of the concept of high-speed rail, some people are confused over how this differs from today's rail product and concerned over how it will be delivered and paid for. This report will help start the process of winning public confidence in the deliverability of HSR by building consensus on what it's all about and what kind of experience it will provide.

Facilities for wheelchairs on the high-speed trains in Taiwan.

Getting it right for the customer

In both Japan and France, the first high-speed line was designed to address the greatest available market to secure the maximum economic and financial benefits early on. While this was not the case in Britain with the development of the Channel Tunnel Rail Link, there is now an opportunity to focus on the significant travel markets between London, the Midlands, the North and Scotland, which will be considerably larger than the flows to Paris and Brussels.

The determination of SNCF to succeed in France with the TGV service launched in 1981 was partly a response to the perceived threat of the *Aerotrain*, an elevated new technology system, the rusting remains of which can still be seen alongside the main road from Paris to Orléans. But it was also driven by a sense that the railway would continue to lose market share to the private car and to domestic airlines unless its offer could be radically improved.

The TGV represented a step change in terms of rolling stock technology, with purpose-built infrastructure, but attention was paid to the customer and market base from the outset. It was decided to make a striking break in the very appearance of the train and the new design was intentionally meant *not* to resemble existing trains; its bright orange colour was intended to reinforce this aim of differentiation.

The marketing breakthrough was that, unlike on every previous railway, all seats had to be reserved, so there could be no risk of having to stand or suffer travel in an over-crowded train. Right from the outset, a system was established that allowed this to be achieved booking seats at home (through the Minitel system – the Internet hadn't yet been invented), with the ability to cancel and change reservations up to a few minutes before departure at the relevant station.

This same system lends itself to yield management techniques and the fulfilment of one of SNCF's key aims which is that all TGV services should be profitable and run without subsidy.

The Frankfurt Flughafen Fernbahnhof Station, Germany

Photo: Heiko Dassow

4 HSR's carbon credentials and sustainability »

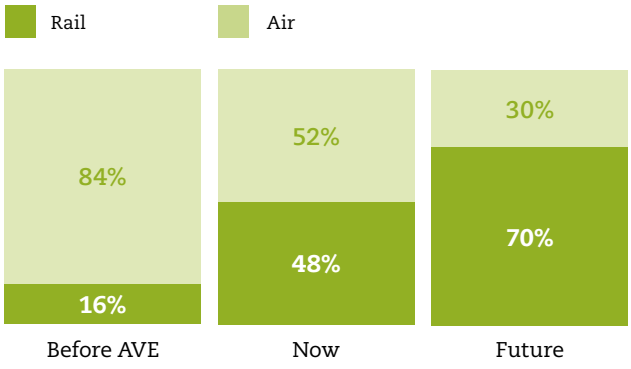
High-speed rail has great potential to reduce our dependence on car and air travel and could make a contribution to reducing the nation's CO_2 emissions. Experience has also shown that adverse environmental impacts can be minimised through careful planning.

Impact of HSR on car and air travel

By dramatically speeding up rail journey times, high-speed rail offers a competitive and attractive alternative to other modes of transport, shifting people out of planes and cars. This is borne out by international experience: the reduction in air travel on corridors now served by high-speed rail has been substantial across Europe.

The effect of the Spanish high-speed railway network, AVE, has been dramatic in reducing air travel from Madrid to Barcelona.

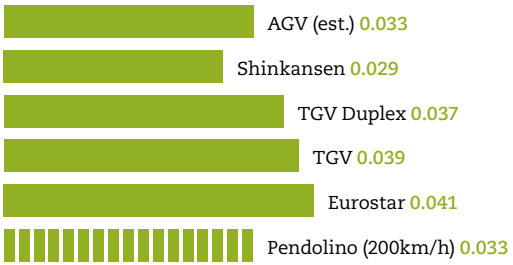
Madrid – Barcelona
The effect of AVE on rail's market share



Carbon efficiency of HSR

Operating trains at higher speeds might be thought to increase energy consumption, but in practice this is offset by factors such as the efficiency of aerodynamic rolling stock design, the high capacity of trains and high load factors. Evidence prepared for this programme[1] demonstrates that high-speed trains can be as efficient as today's 200 km/hour Pendolino trains operating on the West Coast Main Line.

Energy consumption of high-speed trains
kWh/seat-km



Source: ATOC

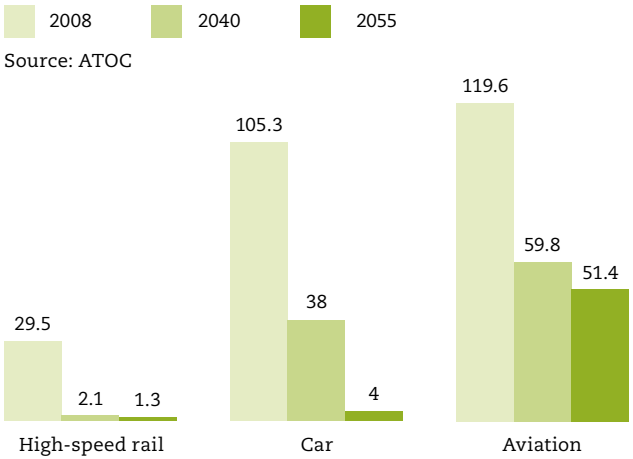
Note: Pendolinos are conventional speed trains, operating at 200 km/h on today's railway; all the other train types are high-speed trains operating (or planned to operate) at 300km/h or above in other countries.

[1] *Energy consumption and CO_2 impacts of High Speed Rail*, ATOC analysis for Greengauge 21, April 2009.

The result is that travel by high-speed rail currently produces one-third of the carbon emissions of car travel and one-quarter of the emissions of an equivalent trip by air, when taking into account the average loadings typically achieved on each mode of transport. Looking to the future, operating on electric traction, high-speed rail will further improve its environmental performance as our electricity supply becomes gradually decarbonised. Air travel, even if it becomes more efficient, is likely to continue to be restricted to petroleum-based fuel sources. And even if we see a shift in the future to electric cars, the carbon advantage of high-speed rail travel will be as great if not better.

Travel by high-speed rail produces significantly less carbon emissions than car and air travel.

Carbon emissions per passenger-km



Source: ATOC

Forecasts of carbon emissions

The relative carbon performance for a theoretical passenger journey is useful to know, but more importantly, how might this play out in practice for a high-speed rail network in Britain?

Forecasts prepared for this study[2] suggest that a full HSR network would result in an annual reduction in CO_2 emissions by 2055 of one million tonnes.

1,000,000

This is a valuable contribution from the long-distance domestic market to the carbon reductions that all sectors need to deliver. This is based on the expected reductions in car and air travel, but also takes into account the forecast carbon emissions arising from passengers travelling on high-speed rail services. By far the biggest benefit is secured from the forecast reduction in air travel.

[2] High Speed Rail Development Programme. Principal Consultant Final Report, SYSTRA-MVA, August 2009.

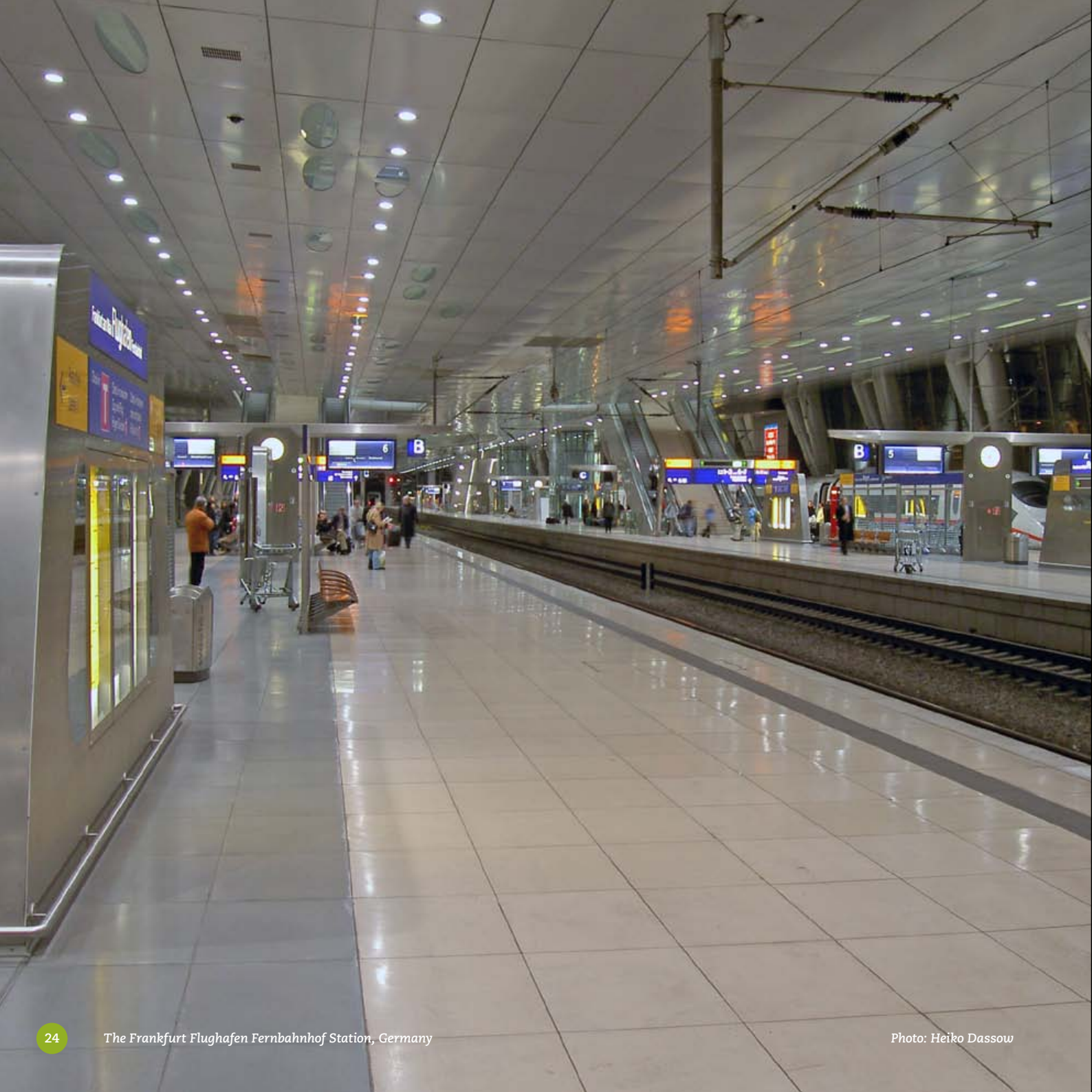
These projections focus on the carbon impacts from the operation of high-speed rail services; the carbon impact of construction of new railway lines is also an important issue to be considered. This is a complex area and it is difficult to assemble clear evidence on the carbon content of railway construction. Analysis carried out by Network Rail[3] suggests that the carbon emissions from infrastructure construction and train production add around 25% to the direct carbon emissions arising from train operation at today's levels of carbon emissions. However, given that we expect electricity generation to decarbonise significantly in the future, over the lifetime of a high-speed railway line, the infrastructure carbon impact will be proportionately much greater, at 70% of the total carbon emissions over a 30-year period. Carbon costs are a factor in the construction or renewal of any new infrastructure and it is acknowledged that we need to develop less carbon-intensive methods of construction across the board.

Other environmental impacts

There are of course other environmental impacts that will arise from the construction and operation of a high-speed railway, although experience from other countries shows that these can be mitigated or managed. Land-take from new infrastructure development is inevitable, but the environmental impacts can be minimised by building alongside existing transport corridors, tunnelling through particularly sensitive or built-up areas or other means of environmental protection. Construction of new railway is much less costly, in terms of land-take, than building new roads: a two-track high-speed railway can carry over 16,000 passengers an hour and requires 40% less land-take per passenger than a three lane motorway.

To make the most of a new rail corridor, it may be worth investigating the case for providing for other utilities within the HSR construction envelope, including for a "super-grid" and to provide additional water supply for the south east – although this should not compromise the design or delivery of the high-speed railway network.

[3] Comparing environmental impact of conventional and high speed rail, Network Rail, August 2009.



The Frankfurt Flughafen Fernbahnhof Station, Germany

Photo: Heiko Dassow

5 *what would a national HSR network look like?* »

A high-speed rail network could provide dramatically improved rail services to all major urban areas in Britain. This will be achieved through the phased development of a network of north-south and east-west lines.

The rationale for developing high-speed rail in Britain applies across the nation as a whole. With the ability to operate high-speed trains over the existing rail network as well as over newly constructed HSR lines, it is realistic to expect that, in the fullness of time, all major urban areas will be served by high-speed rail.

In practice, the high-speed rail network will need to be developed in stages. Priorities will have to be set with phasing taking into account affordability constraints. But there is immense value in having an outline of how the overall network is likely to evolve.

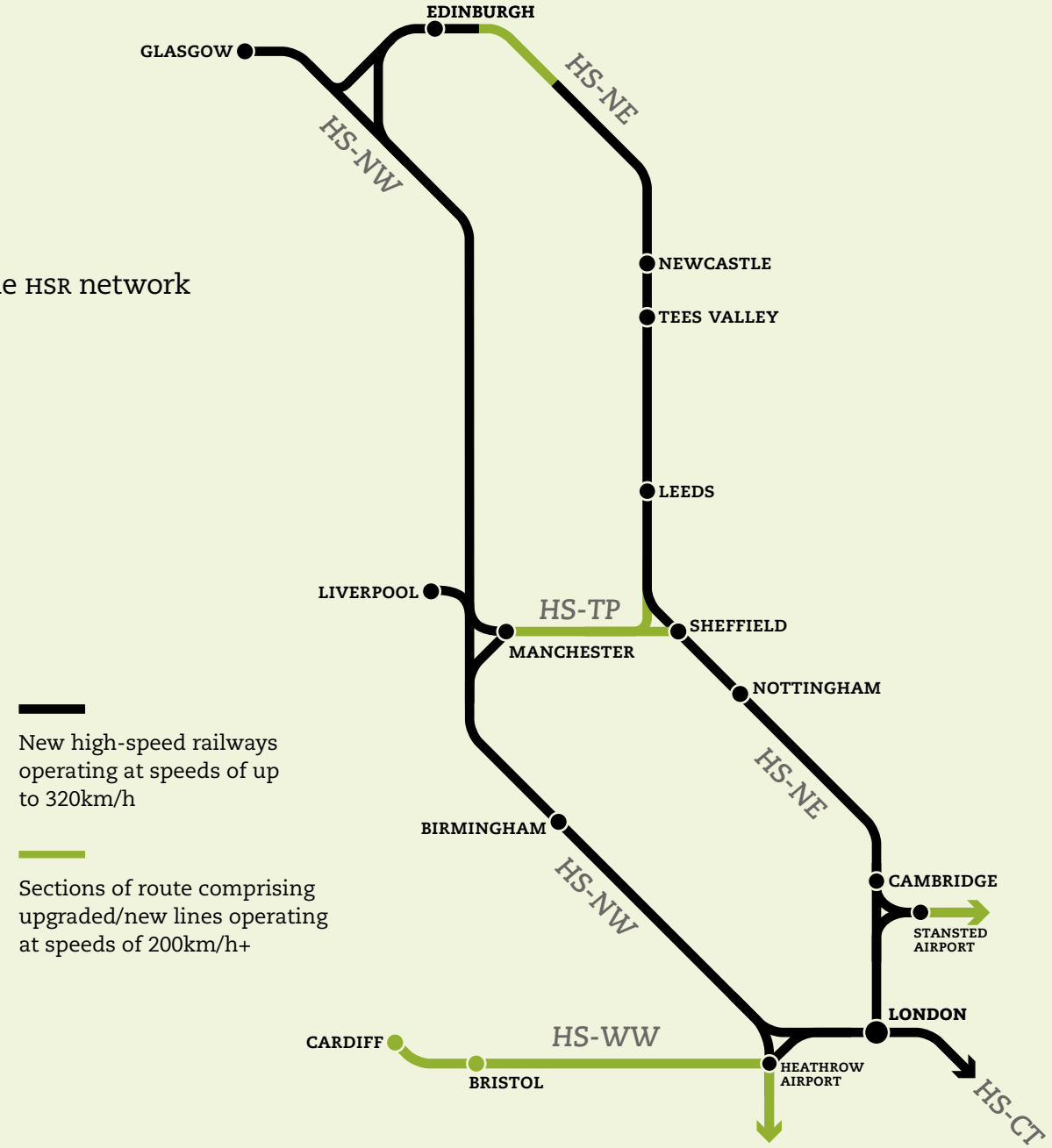
The national HSR network

The national HSR network comprises two north-south routes, one on the east, one on the west side of the country. There are important, shorter, east-west links, from London to Bristol/South Wales, across the Pennines and between Edinburgh and Glasgow. Heathrow Airport is on this network, comprehensively connected into high-speed and conventional rail routes. There is a connection to the existing high-speed route to Kent and the Channel Tunnel which will allow the operation of through high-speed services from places other than London to European cities[1].Not shown on the diagram, but of great importance, will be a series of connections to the existing network so that high-speed services can reach further key centres.

There is a sound business case for the whole network as shown, and also for each of the key elements within it.

[1] To avoid confusion, we have termed these new high-speed lines as shown: the route between London and the North West and Scotland is shown as HS-NW; the line on the east side of the country is shown as HS-NE. The trans-Pennine route is HS-TP, the route to South Wales and the South West is shown as HS-WW and the Channel Tunnel Rail Link is shown as HS-CT. The simpler numerical sequence (HS1, HS2 etc) is now used for *companies*, with HS1 currently Government-owned and expected to be sold, and the team working on a high-speed route between London and the West Midlands (and potentially beyond) called HS2.

The HSR network



New high-speed railways operating at speeds of up to 320km/h

Sections of route comprising upgraded/new lines operating at speeds of 200km/h+

Technical parameters

The high-speed rail network has been developed at this stage on the basis of operation at speeds of 320km/h. Above this speed, there is a trade-off with service frequency. We have planned on being able to operate up to 15 trains/hour on high-speed lines.

Trains would be 400 metres long, with some of them operated as two 200m sets in multiple. The half length trains may operate on services on the existing network, although such trains could be sensibly operated at up to 320m length.

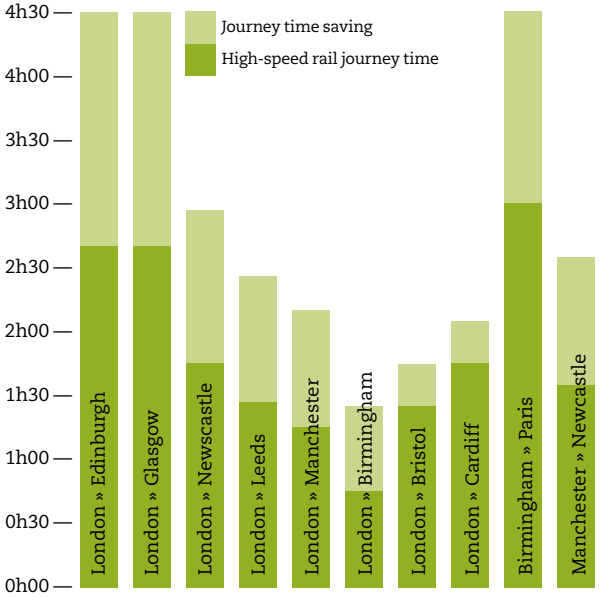
New lines would be built to UIC GC gauge[2] and EU-mandated standards for high-speed rail, compatible with operation over the Channel Tunnel Rail Link and the European network. This will allow the operation of duplex (double-deck) trains in due course, which offer a 40% uplift in capacity with no further infrastructure cost.

On three sections of the HSR network (shown in the network diagram coloured green) for differing reasons, the best way forward may turn out to be in part a line-of-route upgrade, and operating speeds would be lower, of the order of 200km/h. In such cases, as the HSR network of services expands, it would be desirable to adopt the larger UIC GC gauge (which will require works to over-bridges and an increased spacing between running tracks) to ensure capacity and comfort benefits of larger trains is not squandered.

HSR services

The HSR services will offer very substantial time savings over existing rail and road alternatives; when account is taken of airport access and check-in arrangements, in many cases they will be faster than air services too.

HSR services will typically offer journey time savings of 30–45% over today's rail journey



[2] UIC GC Gauge is an international standard for loading gauge that allows high-capacity double-deck rolling stock to operate.

The services will be addressing different markets so there is no reason why all of the high-speed services should be provided by a single operator. In practice, the best use of the HSR network may result from a mix of services, some running exclusively on high-speed lines, and therefore able to take advantage of contemporary design standards, with wider, roomier coaches; others will operate extension services, leaving the HSR network to reach their ultimate destinations without requiring passengers to change trains. Some services will operate over the national HSR network and onwards through the Channel Tunnel to Europe. Services from Heathrow Airport might be operated by airlines as a substitute for feeder services that would otherwise use scarce runway slots.

There are three reasons why high-speed rail is planned to run through to the heart of city centres:

- Truncating lines (and services) short at the edge of cities deters passengers and destroys the business case; the advantage over other travel modes is seriously compromised.

- We have an aim of encouraging sustainable development. The best way to achieve that with transport investment is to enhance the accessibility (and therefore the value of) city centre locations. This is where business and other activity is at its most intense and where international experience demonstrates high speed rail can best support economic growth.

- High-speed rail brings a huge injection of transport capacity (up to 16,000 seats/hour in each direction); dispersal of large volumes from HSR stations requires careful planning to avoid overloading sections of the public transport and road network. This challenge can be best met in city centres.

Those cities that are on the line of the high-speed route pose a particular challenge. A through HSR station on a busy line, to operate satisfactorily, needs to have a pair of platforms for each direction of travel and through lines without platforms for non-stopping services. There is a need for a four-track section of several kilometres length, and even then, speeds of through services will need to be reduced somewhat. With a city centre location, this inevitably points generally towards a need for underground construction. Overall this is an expensive solution, and not necessarily one with immense passenger appeal.

For this reason, approaches to city centres are generally better made over dedicated spurs from a high-speed line that passes around the city rather than through it[3]. In some cases this can make use of existing stations, suitably re-configured.

[3] This is *Greengauge 21's* view, based on the work of our Principal Consultants, SYSTRA-MVA. We note also the view of Network Rail in their New Lines study, August 2009.

There is scope for edge-of-city hub stations in addition to the city centre locations. We have identified several suitable sites to assure ourselves this is feasible. One option is to provide a HSR station at an existing airport where there is at least some of the requisite support infrastructure and access transport. This opportunity arises in several parts of the country. There is also the opportunity for air-rail interchange, but this would not be the dominant demand driver at such stations. What these stations may achieve, however, is an attraction for those who would need to use private car to access HSR services, as long as this can be achieved without adverse traffic impacts. One idea for a particularly attractive combination might be to use such stations to prioritise parking for electric vehicles, equipping them with suitable charging points. The limited range of electric vehicles helps to overcome one of the possible drawbacks of offering easy access by car, which is a tendency for some drivers to make excessively long access journeys when there are more local choices on offer.

Image: © SWNS

High Speed North West

The business case for High Speed North West is strong and is made even by stronger by the addition of the northern section from the Manchester area northwards to Glasgow and Edinburgh. It is possible to achieve 2h30min journey times between London and each of Glasgow and Edinburgh if HSR is built throughout and if there are no intermediate stops. A more likely scenario perhaps, is for such services to have a single intermediate stop (in the West Midlands or the North West) in which case journey tines would be around 2h40min. This would lead to a substantial switch of traffic from air travel, with the London to Glasgow/Edinburgh market share for rail projected to increase from 26% to 88%.

With intermediate station calls adding roughly 10 minutes to journey times, two points are apparent:

- A design that would have one high-speed line to Scotland serving intermediate cities such as Birmingham, Manchester, Leeds, and Newcastle would have a poor end-to end journey time (indeed not much quicker than can be achieved today, when the extended route length is also factored in).

- High-Speed North West should be designed largely around a spur concept to serve the major cities in the corridor. With carefully integrated planning, this can provide for excellent fast connections between all of the cities en route as well as to/from London.

High Speed North East

High Speed North East, also a north-south line, would serve the eastern side of the Pennines, providing services from London to the East Midlands, Yorkshire & the Humber, the North East and Scotland. It would be possible to have this line serve Stansted[4], and/or Cambridge and offer connections onwards to East Anglia destinations over the existing network.

With High Speed North West able to offer fast journey times to central Scotland, this line still has a case to be extended over the border to Edinburgh, because of the very high levels of connectivity between cities in England and Scotland this would offer. It would need to be assessed whether this would justify a full new HSR over the 125 mile section between Newcastle and Edinburgh, or whether the advantage of being able to accommodate higher gauge services could be secured partly by upgrading the existing line, as shown in the national network diagram.

[4] An eastwards extension of new line towards Colchester would mean that HSR services to Stansted would be able to serve a richer variety of travel markets across the East of England, assuming that a HSR station would not be on the line of route but on spurs from HS-NE.

Scotland

The need to access both Glasgow and Edinburgh creates an opportunity to fashion a modest HSR network within Scotland that can meet challenges identified by Transport Scotland as well as support north-south HSR services across the border.

In particular, it would be possible to operate services offering useful time savings over existing trains on the following routes, by using a combination of HSR built in the central belt and existing lines[5]:

- Edinburgh – Glasgow
- Glasgow – Edinburgh Airport – Dundee/Aberdeen and Perth/Inverness.

London and surrounds

The London area presents one of the more complex network challenges. The aims are:

- To access central London from High Speed North West and High Speed North East
- To link both of these lines to Heathrow and to the Channel Tunnel Rail Link
- To link Heathrow additionally to both High Speed Wales & West and the Channel Tunnel Rail Link.

[5] One further route worth considering would be a north-south HSR line across Fife, broadly following the M90 corridor. This will be a matter for the Scottish Executive to consider.

We have benefited from useful analysis undertaken by Transport for London on the question of suitable terminal locations. To avoid overloading the underground network, more than one terminus station would be needed for a national HSR network. We are confident that there is a good solution for High Speed North West and options have also been identified for a High Speed North East terminus. A HSR connection to Heathrow airport would broaden accessibility and take pressure off central London terminus capacity. Plans for Crossrail and Thameslink help provide significant additional access capacity, but, of course, were planned without regard to the possible development of a national HSR network.

London is the biggest single market for national HSR services, but it is also where inter-connections need to be fashioned if a lengthy new build M25-style line around London is to be avoided. In particular, there is a clear case for extending HSR services from the new national HSR network over HS1, making use of the existing HSR station at Stratford and extended as appropriate into Europe.

Our conclusion is that it may be possible to create the necessary linkages identified above and to do so at reasonable cost. There is a need for tunnelling works, but not for any underground stations or junctions, and none of the solutions leads to a continuous tunnel from central London to the edge of the built-up area (as was necessary with High Speed Channel Tunnel).

High Speed Wales & West

Our conclusions, reached in consultation with the Welsh Assembly Government, were that:

- Operation of HSR services requires electrification of the Great Western Main Line, which would allow through services from other HSR lines to operate over this high-quality line at speeds of 200km/h;
- A long-discussed connection from the potential HSR station at Heathrow would allow such services direct access to Heathrow from South Wales and South West England;
- The case for HSR development in this corridor is likely to be a lower priority because of the shorter distances and high-performance of the existing railway, but
- There will come a time when a HSR line could bring significant wider benefits, including the creation of a separate route across the Severn Estuary (which should be examined in connection with the Shoots barrage proposal, with which it could be co-aligned).

Heathrow

Looked at narrowly as a means to divert existing domestic air flows to HSR, the case for new connections to Heathrow is not strong. The HSR network strategy, however, sees a much broader functionality for HSR services at Heathrow.

We are fortunate in having the experience of SNCF at Paris Charles de Gaulle (CDG) Airport from which to learn. There, rather than seek to introduce TGV services as like for like replacements of domestic air services - recognising that travel volumes would not support a suitable service frequency with such a high-capacity product - a new approach has been very successfully introduced. Operating over the same radial high-speed lines into the capital, a new set of TGV services was created that bypass Paris, call at CDG Airport, and then continue onwards. The Airport stop is an important one on a set of long-distance routes that inter-connect provincial cities of France (but not central Paris itself). SNCF are now planning a similar service at Paris's second airport of Orly. We need to do the same thing in Britain, and the national strategy delivers this capability.

In Britain, our aim would be to locate a new HSR station at Heathrow on the confluence of routes:

- to the north, connecting to High Speed North West;
- to the east, including to Europe and High Speed North East;
- to the south, using a new connection to the south western main line routes which will also allow services to extend to Gatwick/Sussex; and
- to the west, by the use of new connection westwards from the airport to the Great Western line towards Reading and points west thereof.

The services that would run through Heathrow will connect places such as Southampton with Newcastle, Cardiff with Paris/Brussels and Gatwick with Glasgow.

At Heathrow itself, the expanding network of high-quality regional rail services will ensure that this becomes a superb surface transport hub, offering for many people a better means of accessing HSR than travelling into and across central London.


London
Brussels
Lille Europe
Arras
Douai
TGV Haute-Picardie
Cherbourg
Le Havre
Champage-Ardenne-TGV
Aéroport CDG-TGV
Mame-la-Vallée-Chessy TGV
Lorraine-TGV
Strasbourg
Massy TGV
Juvisy
Brest
Guingamp
Moraix
St Brieuc
Quimper
Rennes
Le Mans
Les Aubrais-Orléans
Auray
Lorient
Vannes
Redon
Montbard
Dijon
Besançon
St Nazaire
Angers
Vierzon
St Pierre-des-Corps
Nantes
Vierzon
Montbard
Le Creusot-TGV
Futuroscope
Châteroux
Poitiers
Mâcon-TGV
Annemasse
La Rochelle
Niort
La Souterraine
St Gervais-les-Bains
Lyon Part-Dieu
Lyon Saint-Expéry-TGV
Limoçes
Bourg St Maurice
Modane
Brive
Grenoble
Bordeaux
Mâcon-TGV
Libourne
Agen
Cannes
Nimes
Avignon-TGV
Nice
Antibes
Bayonne
Dax
Toulouse
Montpellier
Les Arcs
Draguignan
Cannes
St Jean-de-Luz
Biaritz
Marseille
Béziers
Sète
St Raphaèl
Hendaye
Agde
Carcassonne
Narbonne
Toulon
Pepignan
TGV lines
Shared lines

The resulting High Speed Wales & West scheme is included in the national network, recognising that it would in practice be developed in stages, starting with use of the electrified Great Western line as described. This route will be electrified following the Secretary of State's announcement of July 2009 and is also due for application of a new train control system. Consideration will need to be given to whether these investments should allow for operation over core sections at speeds higher than 200km/h.

High Speed Trans-Pennine

We believe that there should be a mixed traffic new route across the Pennines, capable of operating at 200km/h and supporting additional regional services as well as a set of longer distance services that would run over this new link and High Speed North West/ North East. Such a route could support the operation of UIC GC gauge freight services too, but the case to do so has not been evaluated.

This route would link Sheffield and Manchester Airport, and support a wide range of services including routes such as Newcastle – Sheffield – Manchester Airport – Liverpool.

As noted below, the Manchester – Leeds corridor does not appear to be a suitable part of a through-route north-south HSR scheme. Journey times between London and Leeds, for example, would not be particularly attractive, and the cost and feasibility issues are a problem. This conclusion leaves open, of course, the potential early benefits of upgrading the existing north trans-Pennine route with electrification and higher speeds without delay. Such a route would have some limited role in supporting extension of high-speed services to/from High Speed North East.

The classic rail network

With a HSR network, we can refer to the existing rail system as the 'classic network', and its use can change substantially with the longer distance non-stop trains removed.

Additional services, offering better frequencies to intermediate stations, could be run over the following lines:

- West Coast Main Line
- East Coast Main Line
- Midland Main Line
- (parts of) Great Western Main Line
- West Anglia Main Line
- (possibly) Great Eastern Main Line.

This means more capacity would be available to provide additional train services for passengers commuting into a number of key stations including:

- Birmingham New Street
- Glasgow Central
- Leeds
- London Euston
- London Liverpool Street
- London Kings Cross
- London St Pancras
- Manchester Piccadilly.

The opportunities for railfreight are also significant. There are some locations where it may be possible to offer the new lines for freight operation, and we have identified the trans-Pennine route as a particular example; in general there would be insufficient capacity to seek to accommodate freight on the HSR network. In any event, there would be substantial capacity released on key routes such as the West and East Coast Main Lines[6].

For these main lines, it will be necessary to develop forward investment plans that reflect the likely phased implementation of new HSR lines. This will allow a re-prioritisation of renewal and enhancement expenditure, and with a greater degree of similarity in train operating speeds (passenger and freight), for better utilisation of track capacity.

[6] Although cross-London capacity will still be at a premium.

Phased implementation of the national network

The national network has been developed with the help and guidance of stakeholders through regional and corridor-level workshops. We have used the Guiding Principles described below and the work on business case as the core evidence base on which to reach conclusions.

It is very clear that the challenges we have identified, reflected in the Guiding Principles, cannot be met by the construction of a single HSR line. A single north-south route fails to provide sufficient capacity for a start, and is projected to be 'full' within about 20 years of opening. We have also found it to be extremely important to develop a set of connections to the two north-south lines to ensure that the full potential benefits of HSR can be captured.

Arriving at St Pancras from HS1.

One of the merits of an overall vision for the future high-speed network at a national level is that it creates options for how its implementation can be progressed in phases. In our earlier report in June 2007, we set out a rationale for having a first stage connecting London, the Channel Tunnel Rail Link, and Heathrow with the West Midlands and beyond[7]. Nothing in our work to date has suggested that this should not be the first stage of a national network and Network Rail appears to have reached the same conclusion[8]. However, the design of the early phases of the HSR network need to take into account the very significant benefits that HSR offers over longer distances and the way that the national network might evolve.

There are four reasons why High-Speed North West should form the first phase:

- it has the best business case[9]
- the West Coast Main Line which it will relieve directly is projected to be the closest of the national main rail lines to capacity

[7] *Greengauge 21: High Speed Two: a Greengauge 21 Proposition*, June 2007.

[8] Network Rail, *Meeting the Capacity Challenge – The Case for New Lines*, August 2009.

[9] The business case for HSR between London and Manchester (HS-NW) is stronger than between London and Newcastle (HS-NE).

- it can be developed in a way that spreads the benefits of a first construction phase beyond the regions of the South East, West Midlands and North West to reach Scotland, the East Midlands, Yorkshire and the North East

- it is relatively easy to add a connection to both Heathrow and to HS-CT from this route.

There is no prospect of a single north-south line being sufficient: it reaches the limit of its capacity by 2040/5. A second north-south route on the eastern side of the country has a very good business case in its own right. And a second route is demonstrably better than providing a four-track solution over the length of High Speed North West as a means to provide the necessary long-term capacity. A possible phased implementation sequence could be:

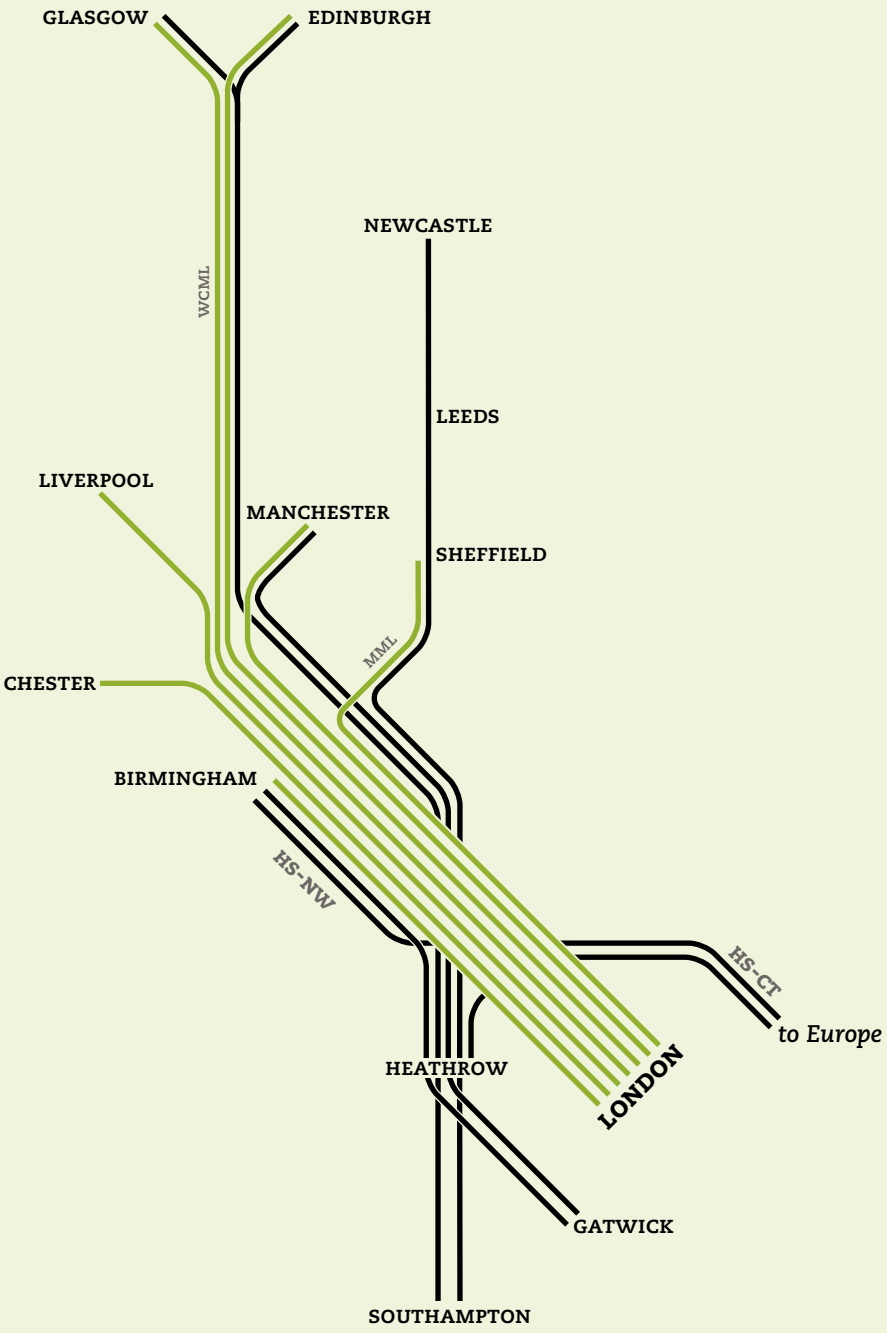
High Speed North West between London and the North West including the lines to the Channel Tunnel Rail Link and Heathrow[10]

1. High Speed North West between London and the North West including the lines to the Channel Tunnel Rail Link and Heathrow
2. i) High Speed North East between London and the North East
   ii) High Speed North West between North West England and Glasgow/EdinburghHigh Speed Trans-Pennine
3. i) High Speed Trans-Pennine
   ii) High Speed Wales & West.

The priorities for HSR services, and the benefits they will confer, differ across the regions. The suggested phasing takes these into account, as well as the evidence on value for money implications. Within each of the five HSR routes shown above (with High Speed North West split into two sections), there will be the possibility of sub-phases, in order to keep the procurement and delivery tasks manageable. But as can be seen in other European countries, there is no reason why progress cannot be achieved on more than a single corridor at any one time, and there is nothing to say that, for example, Scottish authorities should not make a start on HSR within Scotland earlier than implied above.

[10] With a western connection built to the HSR station at Heathrow, this would allow HSR services to reach Bristol/ South Wales and the West of England, potentially, operating over the existing (but electrified) Great Western Main Line.

Service plans for a first stage High Speed North West scheme to the West Midlands



central London

via Heathrow or HS-CT

Implications for a first line to the West Midlands

If Government decides, following the receipt of the report of its company, HS2, that it wishes to proceed with a first line between London and the West Midlands, then the evidence and analysis we have carried out suggests it is important that:

1. There is provision for high-speed trains to connect with the existing West Coast Main Line to the north so that Manchester, Liverpool, Glasgow and Edinburgh services can each gain from the improved journey times (and so that there is a substantial release of capacity over the southern West Coast Main Line)[11].

2. Connections are made to allow direct high-speed rail services to operate both to Heathrow and over the Channel Tunnel Rail Link to Europe.

3. There is a connection also made to the Birmingham – Derby line, and that the route northwards over the Midland Main Line to Sheffield and the North East is electrified so that this first line can support high-speed services between London/Heathrow and Yorkshire and the North East as well as the North West.

The services that could be provided by this first national high-speed line provide an excellent early spread of benefits across Britain, as illustrated.

There are some important points arising from this. First, there is going to be a need for interoperable rolling stock, to be able to run over the West Coast Main Line without losing the journey time advantages that the Pendolino fleet offers. This almost certainly means there is a need for a trainset capable of operating at 320 km/h over new high-speed lines *and* at 200km/h+ in tilt mode.

The second point concerns the Midland Main Line connection. Two of the four English regional air connections to Heathrow were abandoned earlier this year, from Durham Tees Valley and Leeds/Bradford. It would be possible, provided the connections are built into High Speed North West in the way described, to replace these lost connections, with a service connecting Heathrow with Newcastle and serving key centres such as Derby, Sheffield, Leeds, York and Darlington and Durham *en route*.

The connection to the Midland Main Line would also allow a transfer of Sheffield – London services to High Speed North West, releasing MML capacity for other services. It would also provide Sheffield with a very fast connection to London: 90 minutes compared with over two hours today.

[11] This is particularly important in order to improve services for commuters from Buckinghamshire, Bedfordshire and Northamptonshire and to free up line capacity for more rail freight services.

How the national high-speed network was developed

Clarity on what we want high-speed rail to deliver must be the starting point in developing a strategy. To provide a framework for the development programme, a set of Guiding Principles was established. These describe the purpose of a national high-speed rail network as being:

To provide the transport infrastructure and services needed to achieve sustainable economic competitiveness;

To increase the capacity of the national transport system, relieving pressure on existing networks, and creating scope for additional services for passengers and freight on the existing rail network;

To create an attractive alternative to the use of private cars and short-haul aviation, so that the market share of these modes – which have a much worse carbon/passenger-km performance than HSR – is diminished as the HSR network develops;

To stimulate regional economies in a way that takes development pressure off the wider south east, with a focus on city regeneration; and

To create a national HSR network that can be developed in stages with a wide appeal and relevance across social groups and travel markets

Greengauge 21 invited submissions of ideas and reviewed the work published to date on HSR in Britain. We also sought to learn the lessons of others' experience – and especially their mistakes (with the advantage of hindsight). Rather than see Britain's belated interest in high-speed rail as a disadvantage, we were determined to gain all we could.

A great deal is known about the demand for travel across Britain, by all modes of transport. We know, too, from our market research about how people in Britain regard high-speed rail and what its appeal will be. The task has been to assess how these travel markets will grow in future, and how they will respond to various configurations of high-speed rail service. Then we looked at the extent of the benefits across the economy, including those that arise from the release of capacity on existing networks, at the achievement of the five guiding principles and at the costs of building and operating each candidate configuration. Through an iterative process, formulating options and selecting those features which perform best, we arrived at the long term network plan shown here.

The five corridors selected for study

As part of the process of searching for the best network shape, consideration was given to various configurations. A single 'reverse S'-shaped north-south route was rejected, partly for the poor journey times to London from cities further north, and partly because of the cost and constraints of attempting to fashion a route north-eastwards from Manchester to Leeds. Such a scheme would entail the need to cross both cities with a HSR line and to cross the Pennines, for which a base tunnel would be needed. This would in practice need to be restricted to c.200 km/h operation (with a significant cost penalty of perhaps 35% if the higher speed was to be retained because of the increase in tunnel bore size needed to address air pressure effects. Such a speed restriction further detracts from such a north-south routing.

Other network shapes were considered and rejected for different reasons. A 'Y'-shaped network, dividing into easterly and westerly routes in the Midlands has the effect of placing great pressure on the trunk section of line, which would need to be four-tracked to accommodate the number of HSR services. This would prove costly, and offers no advantage over constructing two separate north-south routes throughout.

We also looked at 'reverse E'-shaped network, again with a single stem, this time on a central or easterly corridor with separate branches built westwards to serve Birmingham and Manchester. This has some attractions, but again would likely trigger in the long run a need for four-tracking. Its likely phasing, including the construction of a new route across the Pennines would make it harder to deliver early capacity relief to the West Coast Main Line.

One issue we considered was the value of integrating with the existing classic rail network, to provide through HSR services to a much wider range of destinations than would be possible with a fully segregated HSR network, particularly in the early phases of development. We concluded that connections between the HSR and classic networks were vital to the business case, and this has been reinforced by the findings of Network Rail's New Lines study[1].

The process developed with a series of workshops, carried out at 'super region' level and also for each of the five corridors that we had selected for study at the outset.

[1] Network Rail found that a self-contained HSR route serving only London, Birmingham and Manchester does not have a business case, but providing connections to Liverpool, Glasgow and Edinburgh, allowing HSR services to be extended over the northern parts of the West Coast Main Line, improved the benefit cost ratio from 0.9:1 to 1.9:1.

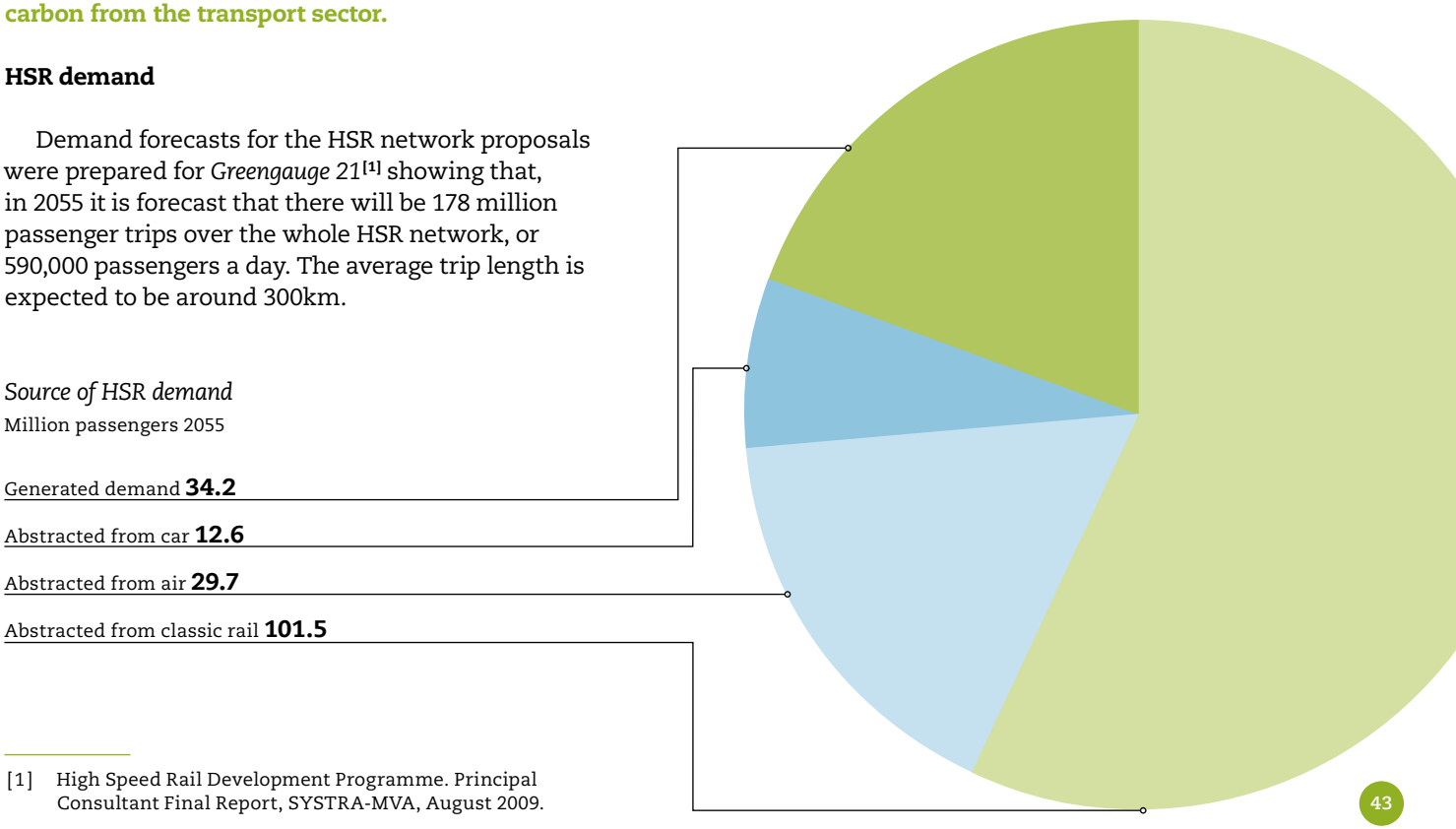
6 *evidence on value for money* »

Investing in a high-speed rail network will provide excellent value for money for Britain when measured in economic terms. It delivers in terms of providing additional capacity to the transport system, achieves substantial shift between the modes of transport, and provides wider economic benefits that favour the regions outside the greater south east. HSR also brings about a reduction in carbon from the transport sector.

HSR demand

Demand forecasts for the HSR network proposals were prepared for *Greengauge 21*[1] showing that, in 2055 it is forecast that there will be 178 million passenger trips over the whole HSR network, or 590,000 passengers a day. The average trip length is expected to be around 300km.

Source of HSR demand
Million passengers 2055



[1] High Speed Rail Development Programme. Principal Consultant Final Report, SYSTRA-MVA, August 2009.

Sources of HSR demand

Of course longer term demand projections out to 2055 cannot be certain. Our assessments use the best projections available, taking account of differing projections of growth across the various transport modes.

Over a period of 40-50 years, this leads to some very substantial increases in demand. But then longer distance travel in Britain has been growing strongly; rail demand, for instance, has increased by over 40% in the last ten years. And the evidence from those countries where HSR has been adopted is that demand continues to grow year-on-year as its relative advantage over other travel modes increases.

Of the 178 million passengers per annum (mppa) forecast for HSR in 2055, just over 100mppa would otherwise use conventional (slower) rail services, 30mppa would fly, 13mppa would use car and 34mppa would have not made the journey by any mode. The latter category is known as induced demand.

For air travel, we assumed that underlying demand growth would continue, at 2.3% per annum, and this leads to a near-trebling of air demand over the period in question. In practice, of course, such growth is dependent not only on the expansion of air services but also on the availability of runway capacity to handle them. This may well be unlikely in practice, and in which case the projected diversion from air needs to be recognised as being a forecast of the level of *potential* air demand that would switch to HSR; a significant part of this demand may not have been accommodated by the aviation sector over the years to 2055, but if so, the benefit of being able to accommodate it on HSR is just as valuable.

The benefits of a national HSR network

The direct benefits of the national high-speed rail network lead to enhanced productivity and greater economic efficiency. These effects are measured, following appraisal techniques that have been used for many years, in terms of:

- *Journey time savings* for passengers who have transferred from other modes, in this case private car, air or classic rail services. This is the largest single category of benefit and highlights the economic value of speeding up travel times. The forecasts include an estimate of the benefit of greater punctuality as well as planned shortening of journey times;

- *Reductions in crowding* on the rail network from the increased capacity provided – there are benefits to passengers using the HSR services and to those using classic rail services;
- *Benefits from capacity released* with an expanded set of local and regional rail services on the existing network;
- *Benefits for railfreight* also secured generally by freeing up capacity on routes that will otherwise be constrained and unable to accommodate growth in rail freight;
- *Less road congestion* – 13 million car trips are removed from the road network in 2055;
- *Reductions in carbon emissions* – estimated to total one million tonnes per annum, arising in part from the shift from air to rail, which is forecast to result in a reduction of 30 million air passenger trips by 2055. The shift from car to rail will also reduce carbon emissions.

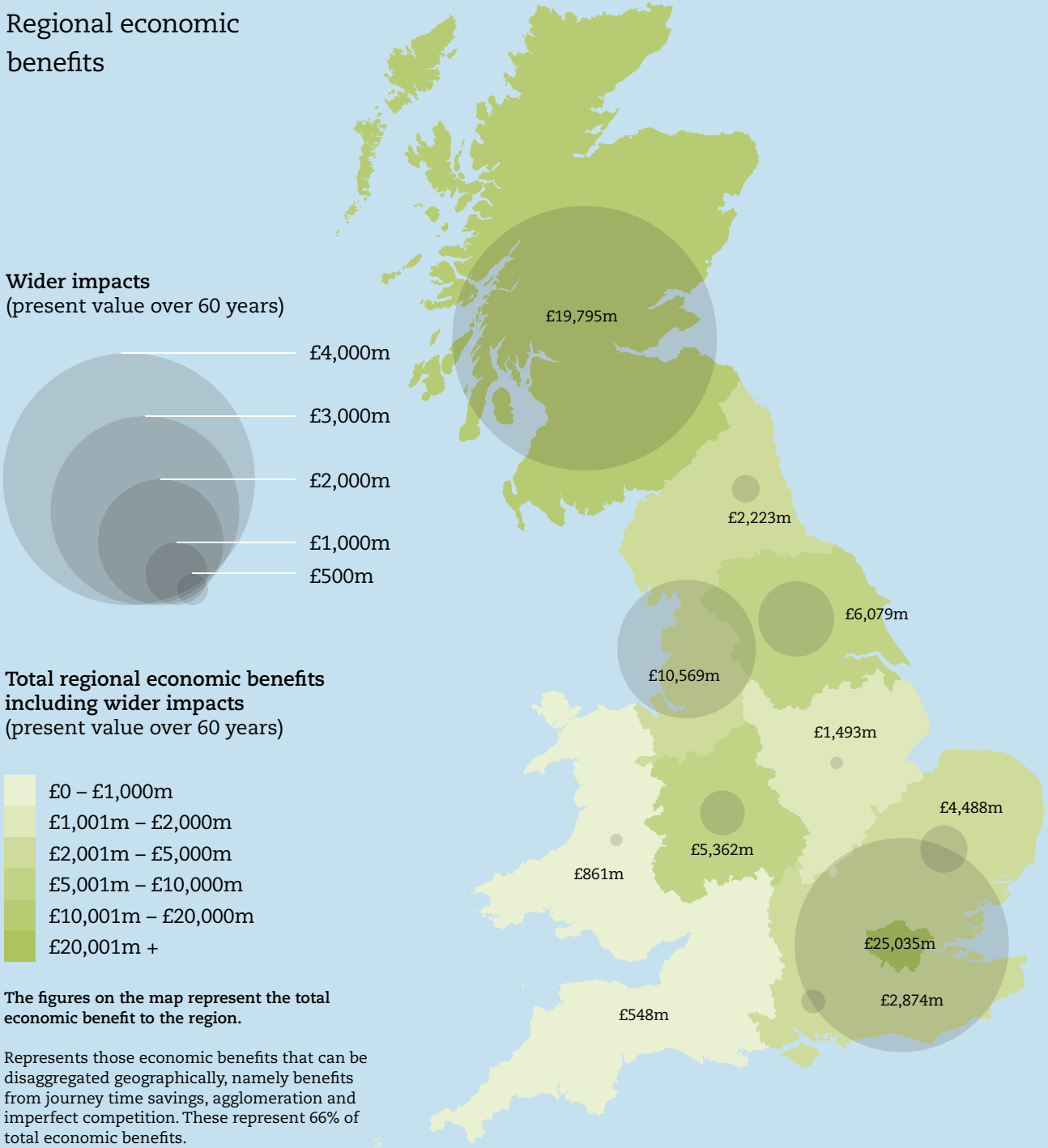
In addition to these 'conventional' benefits incorporated in the cost benefit figures presented in this chapter, the wider economic impacts have been estimated – these take into account the effects of changes in accessibility which can have a further beneficial effect on the productivity of businesses through changes in employment patterns and agglomeration effects. These wider impacts are estimated to add 13% or £14 billion to the transport benefits estimated in the conventional cost-benefit analysis below[2].

These wider economic benefits are well distributed across the regions: 36% to the Midlands and the North of England, 35% to the wider South East including London, and 26% to Scotland.

There will also be a significant number of jobs created for the construction and operation of a HSR network, although we have not yet attempted to quantify this effect. The increased economic activity will also provide new tax revenues to HM Treasury.

[2] The methodology for calculating these 'agglomeration' effects is relatively new. The estimates presented here follow current DfT guidance. But it may be that there are other wider effects that arise from what is, after all, a fundamental change to the national transport system – and one for which most of these appraisal tools are not designed to measure. In particular, if HSR leads to a substantial change in land use, and in the development pattern of the cities across the nation, then there could be very substantially greater wider economic impacts. There are just no agreed means to assess such effects at present.

Regional economic benefits



The figures on the map represent the total economic benefit to the region.

Represents those economic benefits that can be disaggregated geographically, namely benefits from journey time savings, agglomeration and imperfect competition. These represent 66% of total economic benefits.

HSR costs

Against these benefits need to be set the costs of constructing, maintaining and operating the high-speed rail network. The largest element of cost is, unsurprisingly, the construction cost of the new infrastructure. A first stage of High Speed North West, as far north as Manchester and including connections to the West Coast Main Line and Midland Main Line, with the link through Heathrow Airport and to High Speed Channel Tunnel, is estimated to cost approximately £19 billion in 2008 prices.

In practice, it is likely that this route would be built in a staged development over a number of years. The unit cost of this 385km HSR route is estimated at £50 million per route-km, similar to the costs of the Channel Tunnel Rail Link. This cost estimate includes the 66% adjustment for 'optimism bias' and so may be considered to be a relatively conservative estimate.

The proposed full high-speed rail network of over 1,500km would cost in the order of £69 billion but of course would be phased over a number of decades. Unit construction costs are slightly lower for a full network, at £45 million per route-km, as the costs of constructing terminus stations, particularly in London, are spread over a greater route distance. The costs could be offset in part by savings in long-term expenditure that would otherwise be required to upgrade the existing rail network.

Appraisal results: full HSR network

	£ million Present values, 2002 prices
Revenues	
HSR revenue	£50,860
Change in classic revenue	-£28,327
Net rail revenue	**£22,533**
Benefits: users	
Journey time	£68,380
Accident savings	£160
Crowding	£9,942
Total user benefits	**£78,482**
Benefits: non-users	
Highway decongestion	£1,733
Reduction in greenhouse gases	£1,757
Capacity released on classic rail	£6,914
Total non-user benefits	**£10,404**
Wider economic benefits	**£13,968**
Total benefits (excl. WEBs	**£111,420**
Costs	
Capital: infrastructure / rolling stock	£31,701
HSR maintenance / operations	£27,480
Classic rail operating costs	-£11,098
Total costs	**£48,083**
Economic indicators (excl.WEBs)	
Net Present Value (NPV)	£63,337
Benefit : Cost Ratio	3.48 : 1

Corridor	HS-NW		HS-NE		HS-TP	HS-WW	HSR Network
New HSR infrastructure	London–Birmingham / Manchester [a]	Manchester–Glasgow / Edinburgh	London–Leeds / Newcastle	Newcastle–Edinburgh	Manchester–Sheffield	West of Didcot (part)	**All**
Benefit : Cost Ratio	2.9 : 1	7.6 : 1	2.0 : 1	1 : 1	1.3 : 1	2.8 : 1	**3.5 : 1**
Net Present Value (£bn, 2002 prices)	£24bn	£23bn	£15bn	£0bn	£1bn	£3bn	**£63bn**

[a] This includes the costs and benefits of the connections to Heathrow and HS-CT.
Note: NPVs do not total because of phasing assumptions

Economic performance of the HSR network

The assessment of economic and other impacts of the HSR network proposals has demonstrated that there is a strong case for building the entire network described in this report. The benefits of the HSR network exceeding the costs of providing it by a ratio of over 3 to 1. The overall benefits of a high-speed rail network are expected to total £111 billion over 60 years, with a net benefit of £63 billion. Addition of benefits from so-called wider impacts adds a further £14bn to these two sums. This analysis has been carried out following Department for Transport appraisal guidelines and demonstrates that a national high-speed rail network offers very good value for money.

Elements of the national HSR network

There is a case for each of the high-speed lines described in chapter 5. All of the constituent parts of the national HSR network with two possible exceptions discussed below have a benefit cost ratio that exceeds 2:1 (which qualifies an investment as being 'good' as far as DfT is concerned) even without consideration of the 'wider impacts'.

In cost-benefit terms, *High Speed North West*, from London to Birmingham and Manchester and with a connection to the East Midlands and Yorkshire/the North East, has the strongest case as the first national HSR line. Included in this corridor are links through Heathrow Airport and to High Speed Channel Tunnel, both of which add significantly to the core route, with incremental benefit cost ratios over 5:1. Extending High Speed North West to Edinburgh and Glasgow improves the economic return of the line considerably, as the journey time improvements trigger a large shift from air to rail.

There is also a good value for money case for *High Speed North East*, a high-speed line to Newcastle serving the East Midlands and Yorkshire/Humber, in order to provide the additional north-south capacity that will be needed. If constructed as a second north-south line between London and Newcastle, the BCR is around 2:1. The case for extending High Speed North East to Scotland currently looks relatively poor. However, this additional section of route would allow for many inter-city high-speed linkages, such as Glasgow – Newcastle that are not otherwise provided and would add to network resilience and flexibility for the cross-border routes. A mix of upgrade and new build over this section, as included in the network strategy, would have a significantly lower cost, at the price of some extension of journey times, and we believe should be examined as the candidate best way forward in the overall strategy.

High Speed Trans-Pennine would link High Speed North West and High Speed North East and, if constructed as a 200 km/h mixed traffic route, has a positive economic case, albeit a weaker one than the other routes. The results shown in the table above reflect only the HSR service element and do not take into account benefits of mixed use operation from being able to operate local/regional passenger and/or freight services. The economic return would therefore be better than this in practice. In addition, the wider impacts are proportionately large for this route and if they were included in the economic appraisal, the benefit cost ratio would improve significantly.

On *High Speed Wales & West*, the case for a full high-speed railway over the whole corridor is less strong than for other routes. However, the economic appraisal indicates that a staged upgrade of the route, progressively adding capacity and speeding up high-speed services from London to the South West and South Wales with a suitable mix of 200km/h and 320km/h operation, will provide substantial benefits.

In carrying out the appraisal of the national HSR network, we have had to make assumptions about its phasing. While our consultants were able to construct a clear evidence base for a phasing stratagem based on comparing benefit cost ratios for different network elements, our conclusions on phasing, as summarised at the end of the previous chapter, take into account in addition the question of whether a particular phasing sequence could have, during the interim stages, any adverse consequences for a particular region.

We found that there is some limited evidence that adverse consequences might occur, with an early construction of HSR to one region having a (very) small but negative 'wider economic impact' (agglomeration effect) on a region that does not so benefit. That is why we identify the second phase as needing to progress both the High Speed North East element and the extension of High Speed North West across the border to serve Glasgow/Edinburgh, despite the latter having a clearly stronger benefit cost ratio.

Risk and uncertainty

As with any forecasting and appraisal exercise, there is uncertainty over what the actual outcomes would be. This is particularly true when forecasting so far into the future and when assumptions on issues such as fare levels are dependent on policy decisions that have not yet been made. While the demand forecasts have been adjusted to take into account the likely effects of the current recession, there are other risks that may materialise and so we have carried out a number of sensitivity tests.

Reducing economic growth over the whole period of the forecasts understandably has a significant effect on the forecasts: reducing GDP growth by 0.5% a year results in 22% lower HSR demand by 2055. This reduces lifetime economic benefits by 21% , although the strong business case means that even under this scenario, the HSR network still delivers good value for money.

We also tested the effect of applying a 20% fare premium to HSR fares compared with rail fares on the existing network. This reduces HSR demand by 19% and total benefits by 13%, but again the scenario still represents good value for money. The net financial effect of the fare premium is 3% higher total rail network revenue because of the lower levels of abstraction from classic rail services.

There is also inherent risk and uncertainty in estimating capital, maintenance and operating costs at this stage of early project definition. To reflect this, in our central case we have made allowances for 'optimism bias' by increasing capital costs by 66% and operating costs by 41%, as recommended by the Department for Transport.

Fulfilment of Guiding Principles

The case for high-speed rail is not only about the economics – as outlined in chapter 5, a set of Guiding Principles was established early on in the study programme. The HSR network described here performs well against each of these guiding principles.

Guiding Principles	Evidence
To achieve sustainable economic competitiveness	The net economic value of a high-speed network to the national economy is £63bn. Most cities will be served by city centre stations, reinforcing sustainable patterns of development.
To increase the capacity of the national transport system, relieving the existing rail network	The two north-south high-speed lines would each provide capacity for 16,000 passengers an hour, providing benefits worth £10 billion from reduced crowding. The benefits arising from capacity released on the classic network are worth £7 billion. Additional passenger and freight services could be operated on existing rail lines, namely the West Coast, Midland, East Coast and West Anglia Main Lines, together with parts of the Great Western Main Line and possibly the Great Eastern Main Line too. Intensified local passenger services could be provided over existing lines in most major cities served by HSR where non-stopping longer distance services will be removed.
To provide an attractive alternative to the use of private cars and short-haul aviation	With a cautious modelling assumption, 13 million passengers per annum are forecast to transfer from the private car by 2055. 30 million passengers per annum are forecast to transfer from short haul air services in Britain and to Europe by 2055[a]. This will allow the use of scarce runway capacity, especially at Heathrow, for medium/long distance flights instead.
To stimulate regional economies	HSR will bring a very widely distributed set of benefits. The forecast wider economic benefits of £14 billion (2002 present values) are spread widely across Britain, with two-thirds of the projected GDP gains expected to be outside the wider south-east.
To create a national HSR network with wide appeal and relevance across social groups and travel markets	All regions and nations of Britain can be served by the national high-speed rail network There would be benefits to every English region and to Scotland and Wales if the first route was to be High Speed North West, taking advantage of the wide set of connections to the existing network planned for this line. The economic case for HSR has been demonstrated with no fares premium over existing rail services. Deeply discounted tickets will be available as well as higher fares for those who value flexibility and added customer services.

[a] This is with an assumption that air demand grows at 2.3% per annum, a slower rate than the period up to the current recession. Over the period to 2055, this leads to air travel growing by 193%. In practice, this level of increase is likely to be compromised by constraints on airport capacity. Insofar as this happens, recognising that the underlying potential demand would still exist, then a portion of the demand estimated to be diverted from air in the diagram would instead be new travel, generated by HSR.

The Lyon-Satolas TGV Station, Lyon, France

Photo by Nathan Tyler Jensen

7 how will it be funded? »

There are two important questions to be addressed here:

- **How much will HSR cost the public account?**
- **What should be the roles of the private and public sectors in funding, financing and implementing high-speed rail?**

Introduction

The appraisal tells us that high-speed rail services will earn in passenger revenues substantially more than they cost to operate. However, there is insufficient surplus to fund much of the infrastructure costs once account is taken of the worsening in the financial performance of the classic lines. Therefore significant public sector expenditure will be required to deliver the capital elements of the project.

The scale of the HSR investment means that it is not possible just to develop a Public Private Partnership (PPP) for HSR and expect it to work. Government has to be the driving force throughout, with the private sector providing the design and construction management expertise and taking appropriate risks on construction contracts.

The design development/consent stage of work for the next line and the preliminary development of future stages are likely to run from 2011 to 2015 and entail projected expenditure of roundly £80m – £120m per annum. Assuming a staged programme commences in 2015, this is when the major expenditure on capital programmes would start.

Step-by-step development

The HSR network will need to be developed in discrete stages, each conforming to common technical standards and within an overall planning framework. Arrangements for funding are needed for each stage, and they may evolve over time. This phasing will also need to consider the capacity of the market – in terms of construction and rolling stock, as well as private finance and the affordability constraints of the public sector.

Illustrative cost to the public account of a first national HSR line

The first stage of the High Speed North West scheme (London to Manchester) modelled for this programme illustrates the potential cost to Government of a single high-speed line.

The table overleaf shows the net cashflows required from Government to fund a new high-speed rail line over a 38-year concession, assuming high speed services commence from 2021. The infrastructure and rolling stock are each financed with a combination of debt finance (some of which is assumed to be underwritten by Government) and milestone payments paid by Government.

£bn	Total	2011 –2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026 –2053
Government payments in respect of HSR	**9.1**	(0.5)	(1.4)	(1.4)	(1.4)	(1.7)	(1.7)	(1.3)	0.4	0.4	0.1	0.2	17.2
Net impact on classic network	**(35.6)**	–	–	–	–	–	–	–	(0.3)	(0.4)	(0.5)	(0.6)	(33.7)
Total project costs to Government	**(26.5)**	**(0.5)**	**(1.4)**	**(1.4)**	**(1.4)**	**(1.7)**	**(1.7)**	**(1.3)**	**(0.1)**	–	**(0.4)**	**(0.4)**	**(16.5)**

Notes: Figures for years 2011 to 2015 and 2026 to 2053 show the total costs incurred over those years. The funding structure assumes a Design Build Finance Transfer contractual arrangement for the scheme (described later in this chapter). Payments and costs are in 2008 values.

High speed rail services are anticipated to generate more revenue than the costs of operating those services and therefore from 2022 the cashflows from high speed rail are positive. The financing structure assumes a high speed service operator, an infrastructure builder and maintainer and a rolling stock manufacturer and maintainer. The high speed operator pays access charges for use of the new infrastructure sufficient for the infrastructure manager to repay its financing costs and receive an economic return on its investment. The operator also pays an availability payment to the rolling stock provider for making the trains available. That payment is sufficient for the rolling stock company to pay its financing costs and to receive an economic return on its investment. The high speed operator is also assumed to earn an economic return on its operating franchise and pays any surplus revenues back to Government by way of a premium.

When high speed services commence in 2021, the fall in revenue on classic rail services is offset only partially by a fall in operating costs. The net financial impact of high speed services less the abstractive impact on the classic network results in a total cost to the public purse of £26.5bn.

Sources of funding

- A variety of funding sources could be available to fund a high-speed line. The beneficiaries of HSR extend well beyond HSR users and include freight as well as passenger, the short-haul air sector as well as road users and rail passengers on the existing network too. In addition to direct Government funding other sources might include:
- Farebox revenue from HSR users;
- hypothecated charges on road or aviation users, businesses rates and environmental charges;
- capital grants from strategic beneficiaries such as airports; and
- regional funding – but which is unlikely under current arrangements to stretch very far.

There is also likely to be some scope to realise major property value uplifts in the vicinity of HSR stations and these could be used to defray some of the capital cost. The extent to which property gains will materialise is largely dependent on the availability of developable land at station locations as well as economic recovery of the property sector. It should be realised that the values are unlikely to be on the scale available to HS1, which was developed to both serve and exploit the Thames Gateway.

For Government, funding levels will need to take into account investments and expenditures that can be foregone (for example upgrades or investments on the classic network and other transport modes and other regional regeneration projects) and reduced revenues on the adjacent classic network.

Delivery of the infrastructure

A Design Build Finance and Transfer-type ("DBFT") approach may be one of the appropriate structures to deliver the infrastructure and this is the assumption for illustrative modelling of the financial requirements of High Speed North West shown above. Under this approach a private sector construction consortium builds the infrastructure and then transfers it to an asset management company which maintains it either over a long concession period or in perpetuity. This is similar to the approach in place on High Speed 1 which is now being readied for sale. Service providers on the high-speed line would pay track access charges or availability payments to the infrastructure provider/maintainer. The asset manager could be financed based on a Regulated Asset Base in the same way as Network Rail, with periodic reviews of its outputs and charges or it could possibly be a PPP with longer term risk transfer to the private sector.

Role of public and private sectors: two examples from the Channel Tunnel Rail Link

Eurostar international services are run by a business which is owned jointly by the UK Government, SNCF and SNCB. The management of the company is free to make its own decisions on how to meet its shareholder aims (which include being profitable). Here, Government does not 'set the timetable' or decide on whether Eurostar services should or should not make calls at intermediate stations and indeed the Government may sell its stake in Eurostar to the private sector in due course.

For CTRL domestic services which primarily serve a commuter market, the DfT has awarded a single franchise to a private operator to include both services on the classic network and the new high speed services on CTRL so that the franchisee is in a position to manage the changeover. This also means that any shortfall in revenue from services using one network may be offset be a positive variance on the other. This would seem to be a sensible model to consider more generally at least for an initial stage of HSR service provision going forward. This might be combined with giving the operator the commercial flexibility that Eurostar has enjoyed, rather than applying the existing tightly-specified franchise regime, given the generally more commercial nature of intercity as opposed to commuter services.

Delivery of high-speed services

Existing models in relation to a franchise/concession for operations and leasing (or possibly a PPP arrangement) for rolling stock appear appropriate and have also been used for modelling the High-Speed North West scheme. These can efficiently allocate suitable risks to private sector partners, provided the concessions have a suitable duration and Government is prepared to take a position on the longer term risks beyond concession periods (residual values). Rolling stock can alternatively be left as a matter for the private sector concession-holder to procure and finance, with the role of the public sector authority being that of clearly specifying *the outcomes* that it wishes to obtain.

Integration risks

Infrastructure delivery and high speed services may be procured separately but this would introduce interface risk into the contractual structure which it may be better to avoid. Therefore another possible option is where the delivery of infrastructure and of the initial services is let under a single contract (with a hiving-off of the operating concession once its commercial operation has bedded in).

This could help address a key integration risk area – the systems interfaces that span track and train: the control/signalling systems; immunisation; overhead electric line equipment; gauging clearances, and interfaces with other railways.

A situation such as in the Netherlands where a new high-speed line has been built and available for several years before revenue will be earned from it has to be avoided[1].

The role of private finance

Private finance can play two important roles:

- bringing financial discipline to a project as lenders take risk and undertake due diligence on the project
- allowing Government to manage its national finances more efficiently as the cost to the public purse can be recognised when services are delivered, rather than earlier when assets are constructed.

The most likely sources of private finance are infrastructure and PPP equity funds and commercial banks, with the possibility of support from the European Investment Bank. Public subscription for shares or bonds might also be considered though there is little recent precedent, and the appetite would be limited unless the project captures the imagination of small investors in the way that the privatisations of the 1980s did. Publicly issued bonds might need to be underwritten by Government to some degree.

[1] Services are due to start operation in September 2009.

Infrastructure expenditures on HSR, however, are expected largely to fall to the public sector account. This point has already been recognised by the Conservative Party, which committed to £15.6bn public sector funding over the period 2015–27 for high-speed rail in September 2008.

Regulatory issues

The Third Package (the European rail directive which regulates international high speed operations in Europe) requires infrastructure to be open to international passenger operators. This is not currently a requirement for national high speed networks, but clearly might become so. UK law for the classic network makes access to the network subject to the supervision of the independent Office of Rail Regulation (ORR) which has established policies concerning access to the network by open access operators.

The nature of the access regime will be important to the economics of high speed rail. Open access may have the beneficial effect of encouraging competition, thereby leading to improved and cheaper services. It needn't necessarily reduce the operating surplus (premia) available through a single franchise if the access charge regime is designed to capture the surpluses back from all operators over the HSR network1. But clearly, the open access system creates a risk to achievement of forecasts and therefore to certainty on getting the planned benefits of the investment. The pros and cons of open access will therefore need to be considered alongside the funding of the project. There may be a case for limiting access in the early years of operation. The relationship between the access regime on the high speed network and that on the classic network will also need to be considered.

Building Lièges Guillemin Station, Liège, Belgium

We have had helpful discussions with ORR on the challenges of regulating a new high-speed railway. As well as the rules governing access these include:

- Setting access charges so as to incentivise efficiency, together with a focus on the needs of customers, while enabling the infrastructure manager and train operators to plan their businesses with a reasonable degree of assurance and secure appropriate remuneration of investment;
- In support of this, periodic reviews of access charges;
- Providing assurance for users of the network and Government about the quality and capability of the infrastructure;
- Securing efficient management of the interface between the high speed and classic networks.

These issues, and the appropriate regulatory mechanisms for dealing with them, will need to be considered as part of the further development of the programme.

Lille Europe Station, France

8 *integrating with regional and city plans* »

Planning a high-speed rail network cannot be done in isolation. Fulfilling its potential will need integration of the high-speed rail strategy with wider national, city and regional plans for transport, the economy and spatial development This will ensure that the sustainable economic growth that high-speed rail delivers extends from the city centres across the regions. HSR also needs to be an integral part of a 20-30 year development programme for the whole rail network. This is needed to ensure joined-up plans and efficiency of investment and to ensure that necessary upgrades to the existing railway are not over-looked.

Co-ordinated transport strategy

Developing a long-term investment plan for high-speed rail will need integration with investment plans across the transport sector. This is the way to make best use of limited public funds.

The existing rail network may require reconfiguration and investment in certain locations to facilitate HSR, in particular at shared stations to provide new dedicated HSR platforms or on sections of the classic network where HSR services are envisaged to operate, in order to upgrade line speeds, or to provide gauge clearance, for example.

HSR can be a valuable catalyst to investment in complementary public transport schemes. The concentrated demand patterns it engenders can enhance the value of otherwise marginal public transport investment cases. These would include tram and bus programmes, and city region-wide rail service enhancements.

Complementary measures of this type will help ensure that benefits are spread beyond the immediate vicinity of HSR stations.

The long-term strategy for the national rail network should be re-assessed. In some cases, there will be scope for savings on what would become unnecessary and costly short-term investments. Falling into this category would be further investment in the southern section of the West Coast Main Line, for example. On other routes, such as the East Coast Main Line, a new strategy is needed that combines shorter term investment that will remain of future value, together with a longer term strategy identifying how high-speed rail can be introduced progressively to meet the challenges that will be faced in this eastern corridor. In other cases, investments such as the recently announced plans for electrification of the Great Western Main Line can be exploited to introduce extensions of HSR services (for instance, in this case, from HS-CT and across Heathrow, that would otherwise be impossible).

Experience from France: Local economic impact of high-speed rail

The success of Lille is often cited as a good example of the economic stimulus that can be delivered through the introduction of high-speed rail services. Lille traditionally depended on manufacturing industries but was suffering economic decline and high levels of unemployment by the 1970s. It prepared plans to develop into the service sector and lobbied hard to position itself at the node of the TGV Nord line between Paris, Brussels and London. The urban area between Lille Europe, the new station served by TGV and Eurostar services, and Lille Flandres, the old principal station, was redeveloped and is now transformed, to great success, into a major commercial centre. Complementary programmes of regeneration have taken place in other parts of the conurbation.

Similar successes have been seen across France, in Germany, Belgium, Spain and Italy. However, there are examples of towns and cities where local development plans have not been integrated with HSR stations or pursued with as much vigour, or where the new stations have been located outside the urban area dependent on road access. In several of these cases, the introduction of high-speed rail services has not had the desired transformational effect.

HSR stations at the heart of urban redevelopment

A key lesson from international experience is that the local economic benefits from a new high-speed rail station are much greater if the station development is integrated within a visionary city masterplan that provides for and encourages complementary urban development, particularly if this is based on an economy that relies on personal contact: the major knowledge-based industries that make up the broadly-defined service sector. The engineering analysis carried out for this study programme has shown that it is possible to construct HSR stations in city centres and thus provide a catalyst to local development plans.

Regional economic development

Our analysis of the economic impacts of high-speed rail suggests that it could make a positive contribution to re-balancing economic development in Britain. While it is right that all regions should be aiming to fulfil their economic potential, improving connections between cities should provide companies with the confidence to carry out more business activity outside the congested wider south-east.

It cannot be taken as a given that improving accessibility to a relatively remote region with better links to a strong economic centre such as London will automatically have a beneficial impact on a more remote region's economy[1].

Instead it needs to be recognised that HSR – with associated planning and policy measures – creates the *opportunity* to achieve growth and development outside the wider south-east, ending the trend of the last 50 years when population and employment growth has been seriously imbalanced.

Without HSR, investment to the north and west is often seen as unappealing: remote, not well-connected into Europe's leading financial centre or to the main international airport; and with cities poorly connected with one another, making it hard to serve the substantial market that exists outside the wider south east. *With* a national HSR network, it will be for businesses to exploit the new opportunities created.

Bringing together the relevant planning bodies to achieve this level of collaborative integrated planning has already started through the work of the Public Interest Group. However, this has been only the start of that process; there is a considerable way to go yet to develop co-ordinated plans that work across sectors and across geographical boundaries.

[1] *Greengauge 21* commissioned independent research on this area. See: *Complementary Measures to Facilitate Regional Economic Benefits from High-Speed Rail*, *Urban & Regional Policy*, June 2009.

9 *implementation* »

As a nation, we need to do something a little out of character. To implement high-speed rail, we need long-term cross-party and cross-Government commitment to a long-term strategy. This is needed to rebuild a resilient and diverse economy, and to create a path for reducing carbon from the transport sector.

Alongside the arrangements to implement the first national HSR line, there is a need to develop the overall strategy and translate it into firm plans. This will help build confidence across the economy.

Greengauge 21 has sought through its work to build consensus and cross-party support. We have identified a national strategy for HSR and the way its introduction could be phased. This all needs to be converted into firm plans.

Government has introduced new arrangements for major projects such as high-speed rail through the 2008 Planning Act although there still exists a choice over which procedural route to take towards planning consent. Powers could be sought under the processes of the new Act or through the traditional route of the Hybrid Bill process.

In either case, it will be very important to ensure that the upcoming National Policy Statement on national transport networks reflect the case that has been identified for a national high-speed rail network. It would be a mistake to presume either that this statement is not necessarily relevant or to believe that it would be acceptable to miss the first version of the National Policy Statement and re-visit the policy later.

Implementing the first national HSR line

Government has established a company, HS2, largely staffed by personnel seconded from the Department for Transport and Network Rail, to develop a scheme for the first line. Ministers have promised to respond promptly to their end-of-year report.

The critical decisions on implementation are likely to be taken by Government following the next General Election. This will be at a time when there will be very considerable constraints on public finances. But the HSR funding requirement is unlikely to be substantial until powers are gained. The critical challenge will be finding the funds for the period from 2015 onwards.

The path through the planning consent process has been well-trodden for the Channel Tunnel Rail Link, Thameslink and Crossrail. None of these has gone smoothly. All offer critical lessons to be learned.

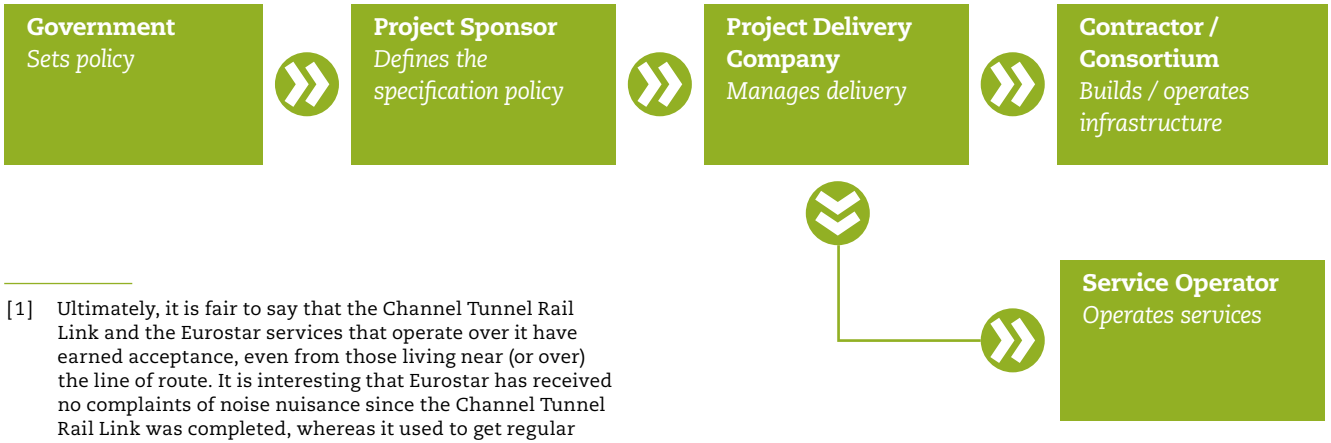
In moving forward from the initial work of HS2, it will be necessary to ensure that the implications of wider network thinking are taken on-board. The aim is not just to optimise the first line, but also to ensure that it creates the platform for a successful national network. For this we need a Project Sponsor, a custodian of the objectives of the project and controller of its budget.

A Project Sponsor could be formed by joining the existing expertise in HS2 with expertise from the private sector to create an efficient vehicle for establishing a clear output/service delivery specification that meets national, regional and local objectives, progressing planning consents and negotiating funding. The Project Sponsor will need to remain accountable to Ministers.

Other approaches have been tried. One involves issuing an early call for tender to contract this planning work, or even to invite ideas on alternative routes. But this is not a stage when the private sector is able to assume risk or fund the work itself on a prospective basis. We need to avoid the unfortunate experience suffered by Kent during the planning of the Channel Tunnel Rail Link with rival schemes emerging and affecting an unnecessarily wide swathe of the county. Far better that there is an agreed planning process to follow, with absolute clarity on objectives[1].

While there has to be an emphasis on infrastructure planning by the High Speed Rail Sponsor, it is essential that there is a clear customer and market focus from the outset.

The structure required for the first national line is outlined below. The relationships with suppliers need to be established at an early stage, so that the service operator, for instance, is afforded a 'seat at the table' when specifications are developed. Of course, this could take the form of a representative or shadow presence. The key point is to avoid the project being seen as an infrastructure-led scheme: it isn't. It is no less than the vehicle by which the national transport system will start to be transformed to deliver the wider benefits that this work programme has identified. And it has to deliver a transformation of service offer designed to meet people's real journey needs, not just offer sufficient capacity. This is why we suggest the desirability for the Procuring Authority – the sponsor – to be broadened from the current structure of HS2.



[1] Ultimately, it is fair to say that the Channel Tunnel Rail Link and the Eurostar services that operate over it have earned acceptance, even from those living near (or over) the line of route. It is interesting that Eurostar has received no complaints of noise nuisance since the Channel Tunnel Rail Link was completed, whereas it used to get regular complaints when the Eurostar trains has to operate over existing lines through South London.

Remit for the High Speed North West Sponsor

- Establish technical specifications and standards for a British HSR system, covering new HSR lines and operation of high-speed trains over the existing railway network.
- Confirm a long-term national HSR strategy and integrate with future plans for the classic rail network.
- Obtain planning consent and funding for a first national line linking central London and the West Midlands and beyond to:
  - the West Coast Main Line
  - the Birmingham – Derby line
- Obtain planning consent and funding for new connections from this line to HS-CT and to Heathrow Airport, the latter designed with onward connections to the classic network to the west and south
- Identify and procure any necessary works to ensure that new HSR services can be operated not only over the new line (High-Speed North West) but also over existing lines, improved and upgraded as necessary, with high levels of reliability to Manchester, Liverpool, Glasgow and Edinburgh and other key locations (via the West Coast Main Line) and to Derby, Sheffield, Leeds and Newcastle (via the Midland and East Coast Main Lines)
- Ensure that the high-speed rolling stock procured to operate over the first national HSR line is compatible with services operated over the existing network by ensuring, for example, that the relevant rolling stock has (separate) capabilities for tilting and high-speed operation.
- Ensure that the design remains compatible with plans for the national network and makes the necessary passive provision to allow future connections with minimised disruption to service.

Planning the national network

Thus far, it has been a Public Interest Group, formed by *Greengauge 21*, that has progressed thinking on the longer term, national network. When this group was formed, Ministers were supportive, but not intent on progressing high-speed rail themselves. Governments (both Westminster and Edinburgh[2]) have been 'observers' through attendance at its Steering Group, but not members. Of course, the level of interest has changed significantly over the last 12 months.

We believe that there has been proven to be great virtue in the Public Interest Group and that the engagement of those with regional and local responsibilities and with specialist know-how in the rail sector should be built into the next stage of national network planning.

The strategy outlined here needs to be subject to critical review and wider consultation and worked up into a clear set of specifications that can be integrated into other pre-existing planning processes at a national, regional and local level. This is the way to maximise value and minimise objection, by thoughtful accommodation into devolved planning.

This type of planning process needs skills that are in scarce supply. We need a framework approach that can progressively deliver clear specifications for subsequent stages of implementation through the type of specific route delivery vehicles described above. *Greengauge 21* is committed to help in this process.

[2] And the Welsh Assembly Government through a separate dialogue and engagement.

Greengauge 21 Public Interest Group

Associate Members

Channel Tunnel Initiative

Technical input to the HSR Development Programme provided by:

Principal Consultants: SYSTRA/MVA Consultancy
Consultation Advisers: Bircham Dyson Bell
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