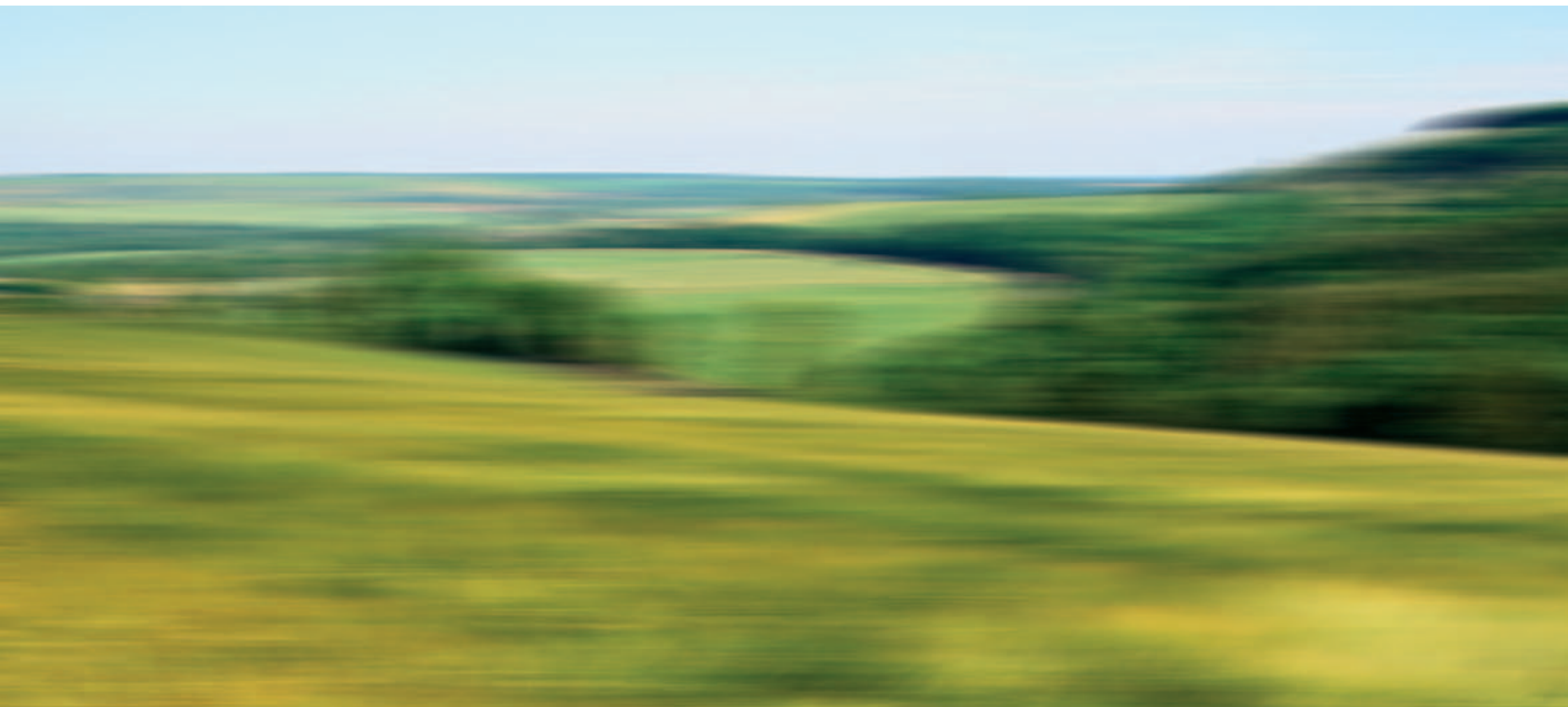
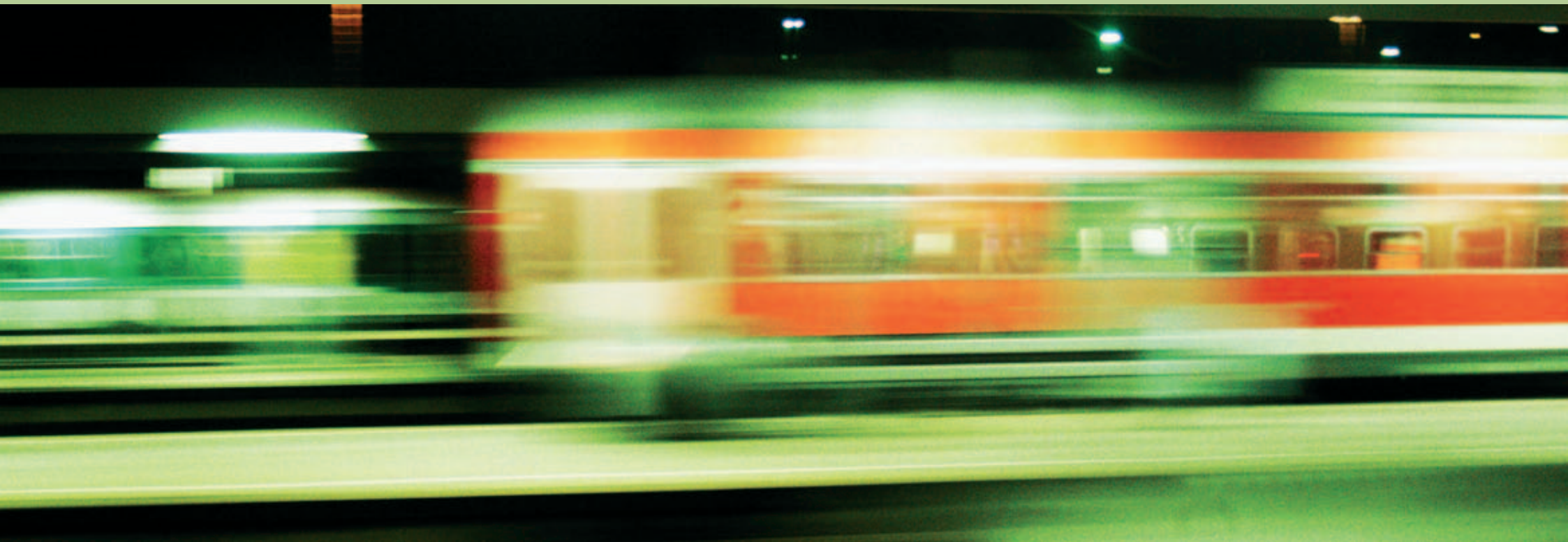


The missing link
A report on high-speed rail links in the UK



01	Introduction
02	1 Standing Still The UK's north/south transport jam
04	2 Moving Forward A high-speed railway for the UK
05	What is high-speed rail?
05	Rapid returns: the case for investment
06	Freight: a vital element
06	Safer for people, safer for the planet
07	Case study: Taiwan's high-speed railway
08	The cost – and how it can be contained
10	Delivering a high-speed railway
10	All new or renewal?
12	3 An Agenda for Delivery



Imagine a railway that could get you from Glasgow to London in three hours instead of the five and a half it takes now. Or one that could take an hour off the journey time from London to Manchester.

A railway that connected with a freight and passenger rail network that covers all of Europe. One that carried you in total comfort on the world's latest high-speed trains, running on a brand new line, without any fuss or delay. No weekend closures, no overnight engineering works. Stations that were new, clean, modern and totally accessible, and frequent, fast links into city centres en route. And imagine less congestion and delay on roads and the existing rail network; more room for travellers and freight to get from A to B...

This report brings together the insight and independent opinions of ICE's High-Speed Rail Expert Group: a 16-strong panel comprising many of the country's most experienced rail industry figures, including former and current rail company executives, senior engineers, rail economists and academics. It is a summary of their views on how best to tackle the UK's shortage of transport capacity, and on whether a high-speed, north-south railway really can provide the missing link.

1 Standing Still

The UK's north/south transport jam

The state of a nation's transport systems is a good sign of its medium to long-term economic prospects. Road, rail and airport systems that can anticipate growth in their use, and respond dynamically and effectively, indicate a country that is prepared for future prosperity.

Glasgow to
London in

3 hrs



Congested highways, crowded railways and over-used runways betray a country that is prepared to gamble on its continued growth.

British cities such as Leeds, Liverpool, Birmingham, Manchester, Newcastle, Edinburgh and Glasgow have enjoyed a renaissance in the past 20 years. Improvements to local and regional transport infrastructure have played an important part in sustaining the transformations of these urban areas, allowing goods and people to move with greater ease, and adding in each case to a renewed sense of identity and purpose.

Studies around the world have shown investment in transport infrastructure to have a more powerful effect on a region's growth than other types of investment. But the improvements made to the UK's existing roads, railways and airports, can only take things so far. Urban regenerations have stoked up demand for long-distance transport between the south east and cities in the north of England and in Scotland. The road and rail networks are now struggling to cope, with sections fast approaching overload.

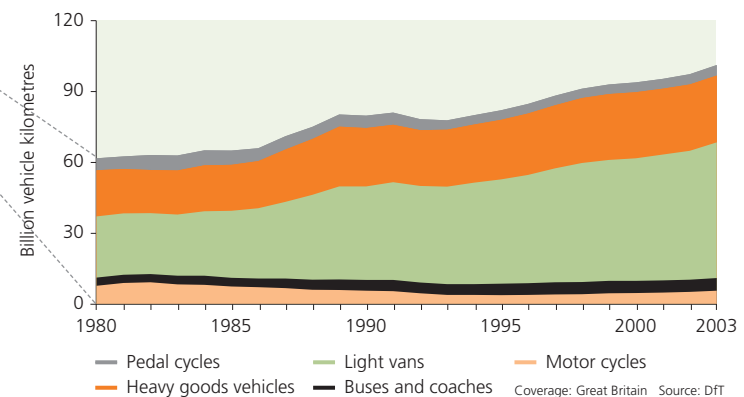
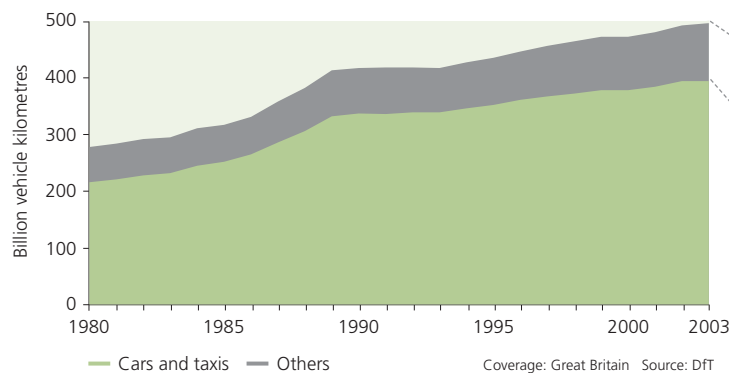
How often are we told that tailbacks on trunk roads and motorways are due to the 'sheer weight of traffic'? Car use has soared by 70% in the last 20 years. Congestion on local road systems, trunk roads and motorways costs British business £20 billion every year. Tailbacks and delays on north-south routes such as the M6 are routine and expected.

Short-haul air services have soaked up some of the increased demand for north-south travel and have eaten into airport capacity, particularly in the south east. Southern sections of key north-south rail routes – the West Coast Main Line, East Coast Main Line and Midland Main Line – are operating at 90% capacity, and networks in and around regional cities are also at full stretch.

The connectivity of towns and cities outside the south east is a central issue for businesses looking to relocate, both from within the UK and outside it. Long-term, continued congestion and a lack of reliability in transport drives up the cost of moving goods and products, and squeezes margins. Freight traffic, so vital to business, is running out of options. The demand for freight by rail has surged dramatically.

There comes a point when a step-change is needed. Even with modest annual economic growth of 2.5%, forecasters predict that capacity on north-south transport links will be unable to meet demand. Simply upgrading existing networks is not a long-term, sustainable option. Where does the UK go from here?


Road traffic by mode:
Cars/taxis and other modes 1980 – 2003



2 Moving Forward

A high-speed railway for the UK

ICE believes that a new, world-class, high-speed railway running between London and Scotland would revolutionise transport in the UK, taking pressure off motorway bottlenecks, releasing terminal and runway capacity at airports and freeing up capacity on the existing rail network for passengers and freight.

A blurred image of a high-speed train in motion, overlaid with large white text. The background is a teal-green color.

300-350
km/h

London to Manchester or Leeds in less than 90 mins

What is high-speed rail?

Is high-speed rail an answer to the UK's transport woes? Before that question can be addressed, we should establish exactly what is meant by the term 'high-speed rail'.

High-speed rail systems consist of trains with onboard engines and steel wheels travelling on steel rails, usually at top speeds of 300 to 350 kilometres per hour. The vast majority of the world's high-speed trains, including those in France, Japan, Spain, Germany and Italy, are of this kind.

To allow trains to reach and maintain such speeds safely, high-speed railways must be designed along different lines – literally – to those carrying conventional rolling stock. They need straighter, stronger track, wider tunnels, longer trains, longer platforms, higher power provision, and installation and maintenance systems of the highest standard.

The alternative technology is magnetic levitation, or maglev, which involves trains that float on, and are propelled by, the guideway's own powerful magnetic field. As a technology, maglev is still in its infancy, and only viable if trains are not needed to also run on the existing, conventional steel rail network.

Technically, as defined in an EU Directive on the matter, a high-speed railway is one on which the maximum speed is at least 250 km/h (155 mph) if the track is new, and at least 200 km/h (125 mph) if it is refurbished. In this country, the Health & Safety Executive has set 200 km/h as the point above which a step change is required in the safety rules for design, construction and operation.

The UK's first truly high-speed railway – the Channel Tunnel Rail Link – will open on schedule in 2007. It's not just top speeds that have moved on since the Intercity 125. The modern high-speed railway is designed to minimise maintenance and environmental impact, and maximise reliability, safety, performance and comfort.

Rapid returns: the case for investment

A system that can transform journey times and compete with short-haul air travel would present a good investment, for the UK and for business.

In the years to come, if development policy remains committed to creating more independent, less car-reliant communities within urban areas, it is likely that movement between cities will become concentrated on a few core, high demand corridors. The intercity rail

system would offer a more natural fit with this pattern than the highway network.

Importantly, the emphasis on a small number of key routes – including a high-speed north-south spine route – would also be strongly conducive to investment. Increases in the cost of petrol and the introduction of demand management in the form of road user charging during the next decade will only strengthen the argument for investment in intercity rail services as the key for community regeneration.

If UK transport policy is to encourage a modal shift of road users to rail, it needs a step-change solution. At present, public perceptions of intercity train services are dominated by poor reliability, unimpressive journey times and weekend closures caused by renewal works. A significant injection of new north-south capacity would transform the image of intercity services, ease congestion on the existing rail network, improve reliability and attract motorway drivers back onto trains.

A new high-speed line serving major cities between London and Scotland would also provide a real alternative for travellers who currently choose to fly short-haul between the capital and the north.

Trains capable of 300 km/h or more could be expected to cut the journey time from London to Manchester or Leeds to below 90 minutes. The benefit would be even greater on longer distances, to Newcastle or Glasgow, for instance. No check-in, no queuing for take-off, no getting to and from terminals and airports. Just pure, direct travel, in comfort, from city centre to city centre.

High-speed intercity travel is what rail does best. And it is a sound investment offering long-term economic benefits, as all of the world's other major economies have recognised. Regular, dependable services on a new line, with the most modern high-speed trains running on their dedicated track, would dominate the market for north-south travel in the UK.

Freight: a vital element

Freight traffic is reaching gridlock. A high-speed rail route could assist the solution.

Freight plays a vital part in any strategy to increase transport capacity in the UK. Late deliveries are unacceptable in today's tightly structured supply-chains, so extra resources are deployed to overcome unreliability, resulting in higher costs for all. On the railways, freight traffic has grown by 40% in the last decade since recent increases in imports of coal have brought new flows from ports to power stations.

Although only 8% of freight is by rail, the major north-south lines are approaching capacity in some sections. Freight traffic is generally slower than passenger trains and is therefore usually more suited to night operations when the main line is not dominated by high speed passenger traffic.

There is now a clear and pressing need for more freight transport capacity. A new high-speed, passenger-only rail line would make more room on the existing network for freight and slower traffic. Passenger-only lines, running on new track, are more efficient and profitable – passengers typically pay ten times as much as freight customers – but this may only partially address the freight issue. The alternative is to run mixed traffic – passenger and freight – on the new line. With the exception of France, European countries with high-speed lines run mixed systems, providing a fast and reliable alternative for transporting freight.

Whether they carry freight or simply free up space for it on the existing network, high-speed lines can form an element of an effective, long-term strategy to get the country's freight moving smoothly.

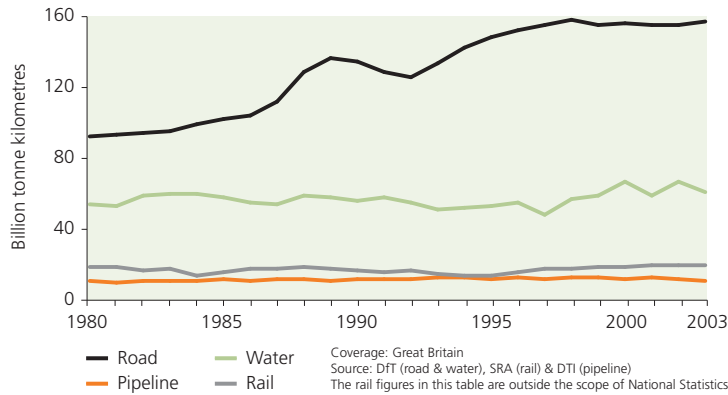
Safer for people, safer for the planet

As a means of expanding the transport system, a high-speed railway offers a safe, sustainable option.

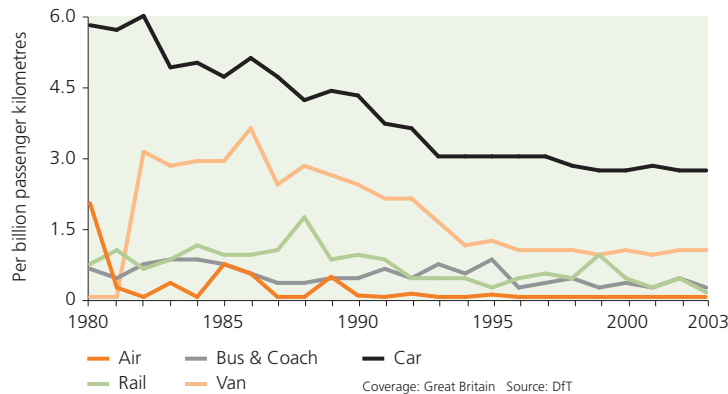
Taking rail generally, accidents are few and far between, and the industry is working hard to improve its safety record still further. When they do happen, collisions and derailments are rightly the focus of public attention. Fatal road accidents, on the other hand, are a daily occurrence garnering little in the way of press coverage. In 2003 alone, 3,508 people died on the UK's roads. In the same year, there were 252 fatalities on the railways, of which 179 were suicides (or suspected suicides).

A new, dedicated high-speed line could be built to the latest standards and with the most sophisticated modern safety technologies incorporated. It would be one of the safest pieces of transport infrastructure the country has ever constructed. And, by taking traffic off the road and the existing rail network, it would improve safety for both motorists and train users as a whole.

Domestic freight transport by mode: goods moved



Passenger fatality rates: air, rail, motor vehicles



maximum speed of
300 km/h

Case study: Taiwan's high-speed railway

Many leading economies now enjoy high-speed, long-distance intercity travel by train. Taiwan will soon be the latest on the list. The project to build the new 350 km long Taipei-to-Kaohsiung line has been fast-track in every sense.

The first plans for Taiwan's high-speed rail line were drawn up in the early 1990s. It was to link Taiwan's two largest cities, which stand at opposite ends of the densely-populated island, roughly the same distance apart as London and Middlesbrough. Just four years after the award of the design-and-build contracts, the railway is close to completion, at a cost very close to the original contract price of £11 billion.

The line is completely new and, incredibly, no less than 90% of its length has been built in tunnel or on viaducts. It will take trains running at a maximum speed of 300 km/h, which will reduce the journey time between Taipei and Kaohsiung to 90 minutes, including a single three minute intermediate stop at Taichung. Slower trains with four intermediate stops will complete the 350 km trip in a level two hours.

The decision to go ahead with the high-speed plan, despite the discouraging downturn in Far Eastern economies in the late 1990s, rested on the fact that Taiwan's road, rail and air networks had reached capacity.

The expectation was that passenger travel by road and on the existing rail system would be reduced, thereby making more room for rail freight which would in turn relieve the congested road network of some of its freight burden.

One of the cornerstones of the project has been the sustained open support for it from both the government and opposition. The Taiwanese population, supportive of any new enhancement of their nation and enticed by forecasts that the new line would grow the GNP by 8%, also got behind the project, en masse.

The corridor for the route was acquired by the government prior to the start of the project, which undoubtedly smoothed its path. But to meet such demanding design and construction programmes for one of the world's largest civil engineering projects – and be virtually certain of achieving them from the outset – underlines the value of unfettered greenfield construction. It has been a remarkable journey, and faster than anyone might have expected.

cost close to original of

£11 bn

Its environmental impact would also be low in comparison with an expansion of the motorway network. There would inevitably be some loss of environmental quality with the construction of a new long-distance line. However, the land-take would be less than that for a new motorway. In use, high-speed electric trains would offer clean, energy-efficient, long-distance mass transport and, presented as such, might be the least problematic in terms of gaining public support and approvals.

The environmental cost of either of the alternatives – more traffic on new roads or more passenger aircraft in the sky – would make a mockery of the UK's attempts to address climate change. A high-speed line would support the country's line on tackling emissions and might, in fact, reduce them by cutting the number of long journeys made by road and air.

The cost – and how it can be contained

The financial sums involved in realising a high-speed rail route are formidable. How can we reach a realistic figure – and then make sure it is stuck to?

Research shows a very wide range of costs for high-speed rail routes around the world, from £2 million per kilometre to £140 million per kilometre. The Channel Tunnel Rail Link, running 109 km through densely populated south east England, will have cost under £50 million per kilometre to build when it is complete in 2007. A new London-to-Scotland high-speed line would be at least six times the length of the Channel Tunnel Rail Link but could run through far less densely developed terrain for most of its course.

The cost of developing a high-speed railway between London and Glasgow or Edinburgh, whether it predominantly involved the enhancement of existing track, or the construction of a completely

new line, would run into many billions of pounds. To create such an asset of long-term national value would demand the very highest standards of design, construction and operation, which would mean that the procurement process would need to focus on performance criteria such as reliability, maintenance and environmental factors.

The appraisal of any proposed project would have to take a balanced view of the costs and risks involved. Considerable caution is, of course, needed. But the evaluation framework created after the 2003 revision of the Treasury's 'Green Book' (Appraisal and Evaluation in Central Government) and implemented through the Strategic Rail Authority's Appraisal Criteria shows signs of being over-conservative in its initial assessments.

Its focus is on the impact and changes in levels of revenue support for rail services, rather than the capital investment. One element of the approach is the 'optimism bias'. Once all of a project's major risks have been identified, costs are then inflated (by up to 66% in the case of the Crossrail project and by 30-40%, typically, for lesser schemes) to cover perceived weaknesses in forecasts and schedule.

Some rail schemes – including the Channel Tunnel Rail Link – that qualified under British Rail rules would not clear the current hurdles. Projects that offer the country

considerable economic, social and environmental benefits might appear too expensive on first inspection. A major high-speed rail project might be particularly vulnerable to over-hasty rejection. Research into high-speed rail schemes around the world in the last 40 years demonstrates that overall project costs are typically over-estimated in the pre-feasibility stages.

However, there is now good reason to believe that a high-speed railway can be built in the UK to a predictable cost and programme.

Let's look at recent civil engineering experience. The West Coast Route Modernisation (WCRM) project is likely to be completed four years late. The cost of the upgrade is expected to have mushroomed from the predicted £2.2 billion to £7.6 billion, and maximum speeds for its tilting trains will fall short of those originally envisaged: 200 km/h instead of 225 km/h. The Channel Tunnel Rail Link (CTRL), in contrast, which will carry trains at speeds of up to 300 km/h, will open on schedule in 2007 and on its £5.2 billion budget.

opportunity to create a
quantum
leap

future proofing

The reason why the CTRL promoters enjoy so much more certainty about their timetable and eventual costs, and why the project has been heralded as one of the UK's great civil engineering successes, is that the route consists of entirely new line. It has been purpose-built for today's high-speed trains and technologies and constructed along a string of greenfield sites with unrestricted site access.

The WCRM, on the other hand, is an enhancement of existing line – a genre of engineering project that, in recent years, has escalated in difficulty, risk and expense.

So intensively is the UK's existing rail infrastructure now used, that the job of reconstructing or realigning sections, while maintaining some kind of service for passengers, has become immensely complex and expensive. The costs of upgrading now bear no relation to those that convinced the UK to upgrade old line for its intercity trains rather than to follow the French TGV example and build new. Safety measures have increased and insurance costs for enhancement projects have spiralled whilst traffic on the railways has grown.

In 2005, the economy of working in a greenfield site, with its freedom of site access and easier contract letting, is greater than working on existing infrastructure. Determining the major costs for a new line of tunnelling and major civil engineering or environmental mitigation works is infinitely more straightforward than trying to predict the expense of working around an operating, ageing line with all its own unforeseen hazards.

Delivering a high-speed railway

The realisation of such an ambitious project would demand the very strongest commitment, both politically and financially. But it is within reach.

The headline cost may be daunting, and might never gain approval. However, construction of a high-speed link could be funded and carried out incrementally, thereby spreading the total cost over a longer timeframe. A more gradual, phased approach could utilise opportunities to enhance existing line as they occur, and build new sections – that could operate commercially on their own – until a complete high-speed railway is in place.

The cost of high-speed rolling stock is a considerable part of the overall investment. Once a route is identified and approved, discrete sections could be built that are then used by existing 200-240 km/h trains. When sufficient infrastructure has been created and connected, new, faster trains could be brought on line. It is possible to identify locations for short sections of new line that would ultimately form part of a high-speed route, but which could be justified now by the short-term speed and capacity improvements they would achieve. Costs could also be offset by the development gain arising around new stations en route.

Building new railways in the UK is never a straightforward or quick process. Obtaining permissions, acquiring land and property, and compensating for the impacts of new lines are major hurdles.

The first section (74 km) of the Channel Tunnel Rail Link – the UK's first high-speed railway – has been built on time and to budget. The scheme provides a model for the financing, planning and construction of a north-south route. It has shown that the UK has access to the engineering skills and construction expertise necessary to build new railways to the very highest standards. The country should build on that experience.

All new or renewal?

A high-speed line, built on new, dedicated infrastructure and serving city centres via frequent rapid transit branch lines would bring intercity travel in the UK up to 21st century standards.

Even without the difficulties of site access that make railway upgrade projects vulnerable to cost overruns, the physical and design limitations of Victorian railway lines often preclude their conversion into infrastructure capable of hosting modern high-speed trains at a reasonable cost. The step-change in service quality and journey times needed to stimulate a large-scale switch of intercity travellers from cars to trains would simply not be possible if the new service were shoe-horned into old tracks and tunnels.

The 'new wine in old bottles' analogy is entirely appropriate. Present rail routes were constructed for entirely different kinds of traffic and speeds. The alignments and separation distances of track, the widths of tunnels, loading restrictions and the lengths of platforms all limit the size and speed of rolling stock.

The civil engineering works required to bring long sections of infrastructure up to the standards of a modern high-speed railway would be immense, complex and hugely disruptive. There would also need to be work done on the fleet sharing the line with the new trains to make it compatible with high-speed signalling technology. And the lack of 'redundancy' – spare space – on the old network would render future expansion a non-starter.

A new railway, even if it ran parallel to old lines and were only separated from them by a matter of yards, would offer a much higher degree of cost certainty and the opportunity to create a quantum leap in the experience of intercity travel.

Only new lines can truly be said to be 100% fit for purpose. Their paths, foundations, track, tunnels, embankments, bridges and stations maximise the advantages of high-speed rolling stock. They are designed, constructed, tested and operated to the most modern standards. They can be 'future-proofed' by laying two tracks initially but building room for four.

Power supplies and signalling can be installed with production-line efficiency.

The main issue with the new-build route is city centre access. High speed services would need to use existing termini at either end of the route but would also have to serve centres of demand en route without diversions that would significantly reduce their overall speed.

The difficulty of running high-speed trains on old track have already been mentioned, so a possible way of planning the new railway would be to stick to greenfield land, taking the most direct route that passed close to major conurbations. New out-of-town stations could provide links to city centres such as Birmingham and Manchester with frequent rapid transit services in the mould of Heathrow Express, utilising existing, refurbished tracks.

As well as maximising the benefits of high-speed infrastructure, this approach would allow the new line to stimulate development and regeneration in city fringe areas, with the development gain around the new stations being captured to offset costs on the project. The downside of this is that the benefits of direct city centre to city centre travel is lost, reducing some of the route's advantage over air. A compromise should be considered. Intermediate conurbations could be served by out-of-town interchanges for through trains, with certain services running over existing infrastructure to end at city centre termini.



the Channel Tunnel
Rail Link cost under

£50m

per kilometre

3 An Agenda for Delivery

The challenges and rewards of building a north-south high-speed railway have been set out. The challenges are great but the rewards – for the economy, for the environment and for the people of the UK – are greater.

So, what next? We believe the arguments made here amount to a clear case for further work on the feasibility of creating the missing link in our transport infrastructure. Such a study, commissioned by Government, would need to encompass:

- Detailed forecasts and analysis of transport demand and growth.
- Study into the need for additional present and future capacity in other transport modes as a result of a large shift in demand towards rail travel.
- An examination of how a new high-speed rail line would be integrated with those modes and other parts of the transport network eg. motorways, airports, Channel Tunnel Rail Link.
- Research into the potential economic impacts of a new north-south railway.
- Study of the skills implications of the project – what the demand would be and whether it could be met.
- An action plan and preliminary timetable for the project, including financing, route development, design, public consultation and construction.

Undertaking an enterprise of such scale, with such a potential impact on people's lives, would demand the support of the public and cross-party backing in Parliament. Strong public approval would encourage local or regional authorities to compete for connections to the new railway and facilitate the programme of land acquisitions.

It would be important to develop the idea of a high-speed north-south railway in the national consciousness, and to persuade the public of the industry's ability to plan, finance, design and build the system, on time and budget. It would position the project as a long-term investment with short-term costs, and as a solution to the problems of congestion, delay and pollution that blight British people's daily travel experience.

ice

Institution of Civil Engineers

One Great George Street

Westminster

London SW1P 3AA

t +44 (0)20 7222 7722

f +44 (0)20 7222 7500

ice.org.uk

Published December 2005.

Registered charity no. 210252

This paper is made from elemental chlorine-free pulp from sustainable forests.