ARE HIGH-SPEED RAILWAYS GOOD FOR THE ENVIRONMENT?

A Discussion Paper

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TRANS*form* Scotland
the campaign for sustainable transport

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BACKGROUND TO THIS PAPER

The Author:

David Spaven has been the Chair of TRANS*form* Scotland, the campaign for sustainable transport, since its launch in 1997, and retires from the position in October 2006.

He has spent his working life in and around the rail industry, initially over an 18-year professional career with British Rail, most of it in freight marketing management in the bulk and intermodal sectors. Since 1993 he has worked in the consultancy business, specialising in multi-modal freight studies, currently with his Edinburgh-based company, Deltix Transport Consulting.

Over and above his involvement with TRANS*form* Scotland, his other spare-time activities have included membership of the Rail Passengers Committee Scotland from 1997 to 2005, and serving as a Trustee of the Waverley Route Trust since 2002.

David is a regular user of high-speed rail services in mainland Europe, on business and leisure train journeys from Edinburgh to Germany. He has made an air trip only once in the last 18 months, and has recently "taken the pledge" by signing up with the Flight Pledge Union, promising not to travel by plane in the next year, except in an emergency.[1]

This Discussion Paper:

This paper reflects the views of the author but does not necessarily reflect the views of TRANS*form* Scotland, whose definitive policy on high-speed railways will be determined in light of the paper and the discussion which follows.

CONTENTS

EXECUTIVE SUMMARY

Proposals for building a High-Speed Railway ('HSR') from Central Scotland to London – with trains running at speeds of 300 kph (186 mph) or more – have moved fast up the political agenda over the last year. While primarily driven by economic development and congestion considerations, there has also been an explicit assumption that HSR would bring significant environmental benefits, including reductions in greenhouse gas emissions, through modal shift from the plane and the car.

TRANS*form* Scotland, the campaign for sustainable transport, has backed greater priority for rail services over road and air since its inception in 1997.

More recently, in the face of an explosion of low-priced air travel, which imposes monumental environmental costs on the world at large, TRANS*form* has called specifically for air-rail substitution for short-haul aviation within Europe.

Rail transport generally produces much lower CO_2 emissions per passenger kilometre travelled than air (and the impact of CO_2 at ground level is much less than at aircraft cruising heights). However, comparisons of the performance of HSR with other modes, including conventional rail services, are fraught with underlying difficulties associated with the assumptions made – including load factors, sources of electricity generation, and taking account of the CO_2 impacts of HSR construction and maintenance.

Nine recent HSR studies and commentaries have been reviewed in this Discussion Paper in order to assess the depth of their environmental analyses. While the case argued for HSR to Scotland routinely invokes 'green' benefits, this review has found that a majority of these studies appear to have undertaken little more than a cursory analysis of the environmental implications.

The two studies that have involved substantive analysis of energy and environmental impacts – Atkins consultants for the Strategic Rail Authority in 2004 and Professor Roger Kemp of Lancaster University over a number of years – drew largely negative conclusions.

The £1m *High Speed Line Study* by Atkins concluded that HSR's "key weakness is in its environmental impact" and that "emissions from air transport are unlikely to be affected" because the number of passengers switching from air would be insufficient to reduce the number of flights – in part reflecting premium fares chargeable for HSR journeys.[2]

Comparing HSR environmental impacts to alternative transport options, Atkins concluded that HSR "is potentially more damaging than other rail-based schemes [i.e. a new conventional railway or upgrades of the existing conventional railway], but is likely to be better than a road investment programme. The environmental case…vs air travel is unproven".

Kemp argues that HSR construction is so energy intensive that, unless the infrastructure is fully exploited, it dwarfs any energy saving achieved by modal switch of passengers from car and plane. On a route like Edinburgh/Glasgow- London, even if all air passengers switched mode, there would still be massive over-capacity on the HSR, pushing rail operators to generate more long-distance travel, which could lead to an *absolute* increase in CO_2.

He has noted also that switching existing rail passengers to HSR would increase the CO_2 impact per passenger, because of the significantly higher energy consumption of high-speed trains operating well above the typical 140 mph maximum on conventional rail routes. Kemp urges us not to get fixated with finding exact CO_2 emissions comparisons, and instead insists that "the most important issue in this debate is how to reverse the growth in the overall amount of travel, rather than to worry too much about the fine detail of the relative [energy] consumption of different transport modes."[3]

There is no dispute that building an Anglo-Scottish HSR would be very expensive. Estimates vary from £11bn-£14bn by Network Rail to £32bn for a Maglev / Ultraspeed 'magnetic levitation' network. A further concern, as voiced by the Passenger Focus watchdog, is that substantial expenditure on HSR could drastically reduce the budget for crucial local and regional rail improvements throughout the country.

Compared to HSR, a better range of sustainable transport benefits could be secured by alternative investments. Just 23% of Scotland's rail network is electrified, one of the lowest shares in Europe, yet

current rail electrification costs are running at £1m or less per double-track mile, compared to (at best) £25m per mile for HSR construction.

The potential components of a sustainable solution and alternative to HSR broadly fall into two categories – sustainable transport investment (the carrot) and management of unsustainable demand (the stick).

A key element of the package would be to **upgrade the East Coast Main Line** to secure a fastest Edinburgh-London journey time of 3 hours 30 minutes, based on measures such as:

- Raising line speed to 140 mph (the capability of the existing 225 electric trains)
- Doubling the busiest double-track sections to four-track
- Providing by-passes of the most sharply curved pinchpoints e.g. Morpeth
- Providing enhanced local ScotRail feeder services to improve door-to-door Anglo-Scottish timings (with enhanced through ticketing).

In parallel would be a **further West Coast Main Line upgrade** – as mooted by Virgin Trains – to secure a fastest Glasgow-London journey time of 3 hours 45 minutes, based on measures such as:

- Raising line speed to 135 mph (the capability of the existing Pendolino tilting electric trains within the existing signalling system)
- Doubling the busiest double-track sections to four-track (this is already happening in the Trent Valley area)
- Providing bypasses of Stafford and other pinchpoints.

Perceptions, of course, are critical, and rail may have been failing to get across the message that, for example, the largely uninterrupted continuity of movement by train represents 'quality time' available for work – compared to air travel's increasingly fragmented process through check-in, security, departure lounge and flight itself.

Speed is not the only factor in modal choice, and HSR might actually be constrained by premium pricing and lower service frequency than air. Currently there are around 100 flights daily from Scotland to London, but GNER and Virgin together offer less than 30 trains a day.

To complement and facilitate ECML and WCML upgrades, long-haul freight would be shifted off these inter-city routes to a **freight-prioritised rail route from West Central Scotland to London**, as proposed by the EuroRail Freight Group. This would predominantly use existing rail lines and some closed formations, with just 4 miles of entirely new construction. The new route would potentially remove 5m lorries a year from Britain's roads and, given that rail freight can generate as little as one eighth of the CO_2 per tonne kilometre of road haulage, there are major environmental benefits to be secured from these proposals.

To spread the benefits of rail investment more widely and sustainably than HSR, a **major programme of rail electrification** would improve speeds, capacity and environmental performance on the key internal Scottish inter-city routes, linking Edinburgh, Glasgow, Dundee, Aberdeen and Inverness.

If transport is to make a fair contribution towards deep cuts in the UK's CO_2 emissions, then serious action is required to constrain the unsustainable growth of demand for transport. This will need to include **aviation taxation** to internalise external costs (in line with European Union objectives) and **a moratorium on airport expansion** in London and Edinburgh.

On the basis of the review undertaken by this paper in response to the question "Are high-speed railways good for the environment?", the fairest answer is probably: "Yes, in the right circumstances, compared to short-haul air transport".

However, more detailed research is clearly needed – but what now seems beyond dispute is that there is no basis for sustainable transport campaigners to voice unequivocal support for the construction of a high-speed railway from Scotland to London. There are other more sustainable and potentially better value-for-money alternatives which demand serious consideration by Government.

Contrary to what some proponents have implied, we are not faced with a stark choice between High-Speed Rail or 'do nothing'.

1. INTRODUCTION

Proposals for building a High-Speed Railway ('HSR') from Central Scotland to London have moved fast up the political agenda over the last year. While primarily driven by economic development and congestion considerations, there has also been an explicit assumption that HSR would bring significant environmental benefits through modal shift from the plane and the car.

In *absolute* terms, high-speed trains (or indeed any trains) are clearly bad for the environment – in the sense that they virtually all generate carbon dioxide or use nuclear electricity, they're noisy and they intrude on the landscape. However, in *relative* terms, there is clear evidence over many years of comparative analysis that conventional rail travel can offer substantial environmental advantages (in energy consumption, greenhouse gas emissions and toxic air pollution) over road and air transport, for both passenger and freight traffic.

New high-speed rail routes along busy corridors linking major cities at the heart of mainland Europe, such as Paris-Brussels-Cologne-Frankfurt, have typically involved sections with very dramatic improvements in rail journey times through by-passing relatively slow conventional routes along river valleys or across significant mountain ranges. These routes offer substantial environmental benefits through large-scale air-rail substitution, and they link some of the most heavily populated metropolitan regions in Europe, including Paris (11m), Rhine-Ruhr (11m) and Greater Frankfurt (2.5m)

By contrast, one of the two principal Anglo-Scottish passenger routes, the East Coast Main Line, has a generally good route alignment with few significant speed restrictions. While London has the second largest metropolitan region in Europe, the population of Central Scotland is very small by comparison with mainland European HSR corridors – Glasgow's metropolitan region has a population of 1.7m, and Edinburgh around 1m.

It is therefore evident that developing a case for HSR to Scotland involves assessment of substantially different circumstances from HSR in mainland Europe, and analysis of a complex range of technical, operational, business, political and environmental issues.

2. THE TRANSFORM SCOTLAND POSITION

TRANS*form* Scotland, the campaign for sustainable transport, has backed greater priority for rail services over road and air since its inception in 1997.

More recently, in the face of an explosion of low-priced air travel,[4] which imposes monumental environmental costs on the world at large, TRANS*form* has called specifically for the shift to rail of journeys by short-haul aviation within Europe ("air-rail substitution"). However, our policy position has not been prescriptive as to what type and level of high-speed rail service would be optimum in terms of air-rail modal switch and avoiding major stimulation of new journeys, which could lead to an absolute increase in carbon dioxide emissions and other environmental impacts.

To address this topic, and help inform a more detailed TRANS*form* Scotland policy on HSR, a seminar was held in Edinburgh on 6th September 2006, attended by more than 30 delegates representing member organisations.

The seminar presentation[5] was made by David Spaven, Chair of TRANS*form* Scotland, based on research into recent business and academic studies which to a greater or lesser degree have touched on the environmental impacts of HSR. This, the discussion which followed, and subsequent research, form the basis of the discussion paper.

3. DISCUSSION PAPER OBJECTIVES

The principal objectives of this Discussion Paper are to:

- Compare CO_2 emissions across the modes
- Review energy/environmental conclusions of key HSR studies and commentators
- Consider alternatives to HSR
- Encourage a deeper and wider debate
- Raise key questions for Government
- Inform TRANS*form* Scotland policy.

This paper (and the 6th September 2006 seminar) are explicitly concerned with energy and environmental impacts – in particular in the context of the policy need for transport to contribute deep cuts in CO_2 emissions.

The paper has not sought to address in any detail the other outcomes of HSR – financial, economic, rail congestion relief, etc – that normally dominate the case made by HSR proponents. However, environmental aspects cannot be treated in isolation, and the paper therefore inevitably makes reference to related and overlapping topics such as claimed economic benefits, value for money, and travel capacity created versus existing and projected demand.

4. HIGH-SPEED RAIL – DEFINITIONS AND RATIONALES

4.1 Definitions

For the purposes of this paper, 'High Speed' does not mean the existing diesel High Speed Trains (InterCity 125) or Voyager trains which operate in Britain, nor the electric 225 / Mallard or Pendolino trains which operate at 125 mph on the East and West Coast Main Lines respectively.

HSR across Europe is typically understood as dedicated routes with electric trains operating at 186 mph (300 kph) and more – such as Eurostar from London to Paris/Brussels, the TGV in France, Thalys from Paris/Brussels to Cologne, Ave in Spain and Deutsche Bahn's InterCityExpress operating throughout Germany and into Austria, Belgium and Holland.

Although all these operations involve train services over dedicated high-speed routes built over the last 20 years or so, it is important to bear in mind that they are integrated with existing conventional rail networks, principally to allow access to city centre stations and other locations where dedicated routes would be exorbitantly expensive and/or destructive.

4.2 Rationales

Although there are a number of different 'competing' concepts for an Anglo-Scottish HSR, there is a high degree of commonality in the rationales advanced to justify the substantial cost and disruption involved. These can be summarised as:

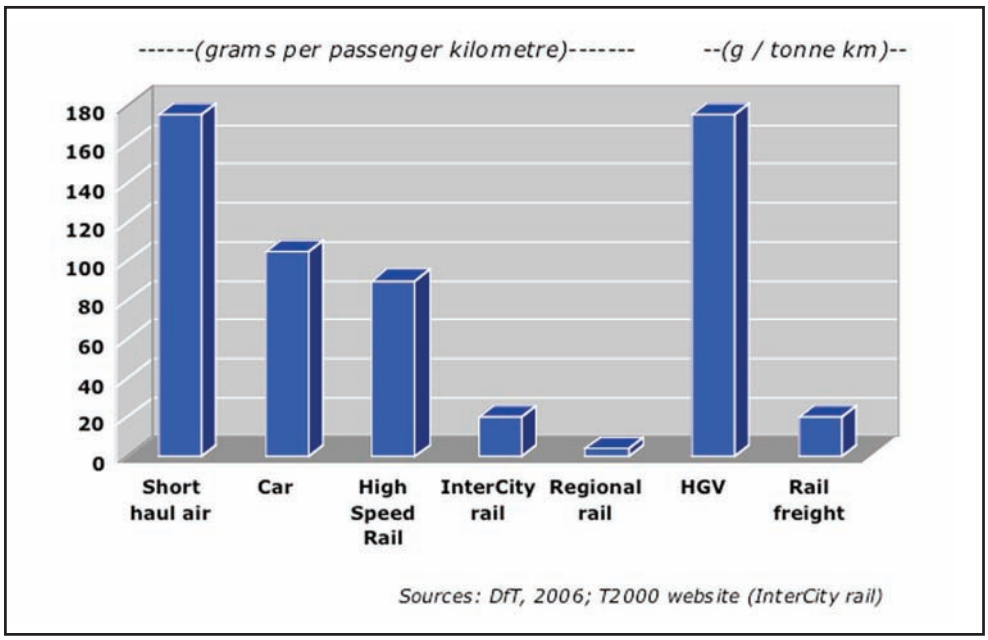
- Relief of current and projected rail network congestion
- Provision of quality rail alternatives to congested roads and airports
- Boosting national and regional economies, including regeneration of particular localities
- Reduction of environmental impacts of transport through modal switch from air and road to rail.

5. CROSS-MODAL CO_2 EMISSIONS COMPARISONS

A useful starting point for assessment of the potential energy and environmental benefits of HSR is to compare the relative CO_2 emissions of the different modes of transport per passenger kilometre travelled (or per tonne kilometre moved in the case of freight transport).

Table 1 below provides an order-of-magnitude comparison of the relative CO_2 impacts of the different modes. However, it is crucial to bear in mind that comparisons are fraught with underlying difficulties associated with the assumptions made, as discussed later in this section.

Table 1: Cross-modal CO2 emissions comparisons



The comparisons above highlight the very poor environmental performance of short-haul air services, contrasting with much lower CO_2 consumption for rail travel, particularly in the case of the less energy-intensive conventional inter-city rail services. Virgin Trains have calculated that on a tilting electric Pendolino train between London Euston and Manchester Piccadilly, the CO_2 emissions per passenger journey equate to 4.19kg, compared to 40kg for a Boeing 737 between London Heathrow and Manchester Airport (excluding emissions from local travel to/from airports/stations).[6]

Interestingly, consultants working for Eurostar have recently calculated that their carbon dioxide emissions per HSR passenger journey from London to Paris are one tenth of the comparable short-haul airline journey,[7] a much greater contrast than that suggested by Table 1. This illustrates the point made by Professor Roger Kemp of Lancaster University[8] and others, that comparisons are fraught – the Eurostar statistic in part reflects the unusually high share of nuclear sources for electricity (with zero direct CO_2 emissions) in France. It is unlikely that the research included allowance for indirect $C0_2$ emissions from uranium mining and the storage of nuclear waste for thousands of years.

There is of course a big difference between, on the one hand, advocating maximum mode switch from short-haul aviation to an existing HSR (where construction-phase CO_2 has long ago been emitted), and on the other hand, choosing whether or not to build an Anglo-Scottish HSR and incur future CO_2 emissions for construction, operation and maintenance.

It is also interesting to note that the biggest contrast in road-rail CO_2 performance in Table 1 lies in the freight sector, supporting longstanding research evidence that rail freight's potential environmental advantages over road are significantly greater than passenger rail's environmental advantages over the road competition. This is relevant to consideration of alternatives to HSR, as explored in Section 8.

At one level, Table 1 significantly under-rates the disastrous environmental impact of short-haul aviation, since it does not reflect the fact that CO_2's climate changing impact is **2.5 times worse at 10 kms altitude**.

Assumptions on **load factors** can make a substantial difference to relative performance. While a full 18-coach Eurostar train will have a dramatically better CO_2 performance than a full short-haul air service, the low-priced airlines in practice rely on achieving very high average load factors (80% plus)

which are significantly higher than those generally achieved by rail operators. Readers will be well aware of the large quantities of 'fresh air' routinely transported north of Preston and Newcastle on the West and East Coast Main Lines respectively. While 'yield management' approaches to pricing (e.g. very low fares) can help to fill up the empty spaces, the critical issue from an environmental perspective is the balance between passengers switching mode and those making entirely new journeys generating additional *absolute* quantities of CO_2.

CO_2 impacts of HSR will also vary significantly in relation to the **source of electric train power**, which can be coal, oil, gas, nuclear, hydro or other renewables. In France, for example, the majority of electricity is generated by nuclear which superficially causes no CO_2 emissions (if one discounts the impacts of uranium mining and storing waste for thousands of years), but sustainable transport campaigners are unlikely to regard this as an environmentally-friendly source of energy. By contrast, Norway makes substantial use of hydro power, so high-speed rail operations could have a virtually zero direct CO_2 impact.

During periods of oil shortage in recent years (such as the truckers' blockades of refineries in protest against the Fuel Duty Escalator) it was noted that **different styles of driving** can make a substantial difference to car fuel efficiency. A similar principle applies to train driving, and Professor Roger Kemp has noted that more sustainable styles of driving, such as cruising into intermediate stations (rather than heavy braking) can yield fuel efficiency benefits of 20%-30%.[9]

Comparisons of air, rail and road journeys can also be distorted because one mode (the car) is **'door-to-door'** while others involve additional transport to start or complete the through journey. Network Rail Deputy Chief Executive Iain Coucher recently commented[10] that the principal beneficiaries of high-speed rail would be commuters into the West Coast Main Line's big cities, taking up capacity released by HSR construction. This implies either expensive HSR tunnelling into city centres, or, as Coucher notes "it could be that parkway stations are the only way". The danger, of course, with edge-of-city parkway stations is that they will be far more readily accessible by car than by public transport, and will therefore stimulate local modal shift to car, generating yet more CO_2.

The temptation for HSR operators to opt for financially lucrative but environmentally damaging station locations is illustrated by Eurostar's recent decision to slash the number of trains that call at Ashford International, and replace these largely with stops at a 9,000 parking space station at out-of-town Ebbsfleet, 34 miles to the north. Ashford International interchanges with conventional rail lines from five different directions, but Ebbsfleet is located on a single conventional rail route. The encouragement of car-based feeder traffic is illustrated by the comment of Eurostar's Chief Executive, Richard Brown, that "We…believe that it will be an attractive option for a number of our current users at Waterloo International, who drive to their local stations to come to London but may prefer to stay in their car a little longer and drive to Ebbsfleet International." [11]

A narrow focus on CO_2 emissions caused by transport *operations* can lose sight of the important CO_2 impacts of **transport infrastructure construction and maintenance**. While infrastructure CO_2 emissions from air transport are relatively low – since the route infrastructure (i.e. the sky) is a 'free' good provided by nature – the same is not true of HSR, with very substantial requirements for concrete and steel manufacture for track and structures. Ongoing maintenance also involves CO_2 emissions, and it is understood, for example, that ventilation of the Channel Tunnel alone requires the equivalent of a small power station.

6. THE HIGH-SPEED RAIL STUDIES REVIEWED

A range of recent HSR studies and commentaries has been reviewed to assess the depth of their environmental analyses. They are:

- Atkins – for the SRA, 2004
- Steer Davies Gleave – for CfIT, 2004
- Institution of Civil Engineers, 2005
- Greengauge21, 2006
- Jim Steer – for Transport 2000 Trust, 2006
- Network Rail, 2006
- The Railway Forum, 2006
- Maglev / Ultraspeed, 2006
- Professor Roger Kemp, Lancaster University, 2006

It should be emphasised that these studies / commentaries have been reviewed for their environmental content, and only some aspects of the financial and economic cases are touched on in this paper. Summaries of environmental conclusions and supporting evidence are listed below.

6.1 Atkins / SRA

This £1m *High Speed Line Study* for the Strategic Rail Authority was completed in 2004,[12] and backed the business case for a North-South high-speed line ('HSL') against a number of alternative transport options.

However, in assessing HSL performance against the Government's key criteria for transport schemes (environment, safety, economy, accessibility and integration) Atkins concluded that "HSL's key weakness is in its environmental impact", citing "significant negative landscape, biodiversity and heritage impacts" and "relatively small benefits to air quality.

Most fundamentally, in terms of the debate about climate change impacts, Atkins concluded that "Although the modal shift from air travel to HSL is expected to reduce passenger kilometres travelled by air, the reduction is likely to be insufficient to reduce the number of flights; hence emissions from air transport are unlikely to be affected by HSL." The relatively modest scale of modal switch in part reflects Atkins' assumption that HSR would apply premium pricing to fares for the speed and quality of service provided.

Comparing HSR environmental impacts to alternative transport options, Atkins concluded that "HSL is potentially more damaging than other rail-based schemes [i.e. a new conventional railway or upgrades of the existing conventional railway], but is likely to be better than a road investment programme. The environmental case for HSL vs air travel is unproven".

6.2 Steer Davies Gleave / Commission for Integrated Transport

Consultants Steer Davies Gleave produced their *High Speed Rail: International Comparisons* report for the Commission for Integrated Transport in 2004,[13] primarily focusing on appraisal systems that had been used in mainland European countries to help justify HSR construction.

In their commentary on the report CfIT states that HSR "has a role to play in the future British transport mix, but the cost must be right", and notes that "The existence of very good conventional rail lines reduces the case for high speed rail."

There appears to have been little or no environmental analysis undertaken, with CfIT saying not much more than "High-speed rail will reduce congestion as well as bring environmental and safety gains".

6.3 Institution of Civil Engineers

In 2005, the Institution of Civil Engineers ('ICE') published *The Missing Link*,[14] focusing overwhelmingly on HSR transport and economic impacts. There are only a few mentions of the environment, such as "increases in the cost of petrol…will only strengthen the argument for investment in intercity rail services" and "the environmental cost of the alternatives [road / air] would make a mockery of the UK's attempts to address climate change".

The report concludes that a high-speed line "might" reduce emissions, but there is no evidence of serious environmental analysis having been undertaken to reach this conclusion.

6.4 Greengauge21

The lobby group Greengauge21 was launched in early 2006,[15] with its aim to "develop the concept of a high speed rail (HSR) network, and to promote its implementation as a national economic priority". A key player is Jim Steer, formerly (and once again) of Steer Davies Gleave prior to his work with the SRA.

The Scotsman reported on 29 January 2006 that 'Jim Steer… said the group has been launched to combat competing schemes, such as magnetic levitation trains, and to maintain pressure on ministers. He said its name was devised to reflect the "green" credentials of the "21st-century rail project"'.

Strangely, for a group whose very name implies the environmental benefits of HSR, Greengauge21 advances little environmental evidence. The positive business aspects of the 2004 Atkins report for the SRA are discussed in the group's manifesto, but there is no mention of the negative environmental conclusions or of the low air-rail substitution projections.

More recently (in *Transport Times*, 10 February 2006) under the strapline "Jim Steer reckons the sustainable environment lobby has got the argument over commuting wrong", he backs the case for long distance rail commuting, which HSR would facilitate and encourage.

6.5 The Railway Forum

The Railway Forum is the strategic lobby group and think tank for the privatised rail industry. In March 2006 its Chairman, Chris Green, made the case for HSR at a national rail conference in London.[16] Further aspects of the Railway Forum's thinking were revealed in a *Modern Railways* magazine article by Green published in October 2006.[17]

There is no mention of environmental issues beyond the conference reference that: "A high speed railway offers the most sustainable way of expanding transport capacity. A two-track railway equals a three-lane motorway, but only needs a quarter of the land-take. An electric railway also leaves the nation free to choose future energy sources – this is particularly important in an era where the use and cost of both oil and coal are increasingly in doubt."

The latter two sentences are uncontroversial, but the opening sentence is at odds with Atkins' 2004 conclusions that a new conventional railway or upgrades of the existing conventional railway would be potentially less environmentally damaging than HSR.

The Railway Forum highlights the rail capacity and regional economic benefits of HSR. Much reference is made to the economic regeneration of Lille following HSR construction, but no evidence is advanced as to the net overall economic impact of HSR across the regions of North East France (where Amiens is understood to have suffered from the bypassing of the traditional route from Paris to the Channel Ports).

As sustainable transport campaigners have long encountered with major road infrastructure projects, promoters love to emphasise the positive local economic outcomes but are reluctant to acknowledge that there can also be negative outcomes, with jobs shifting away from less favoured locations.

A rare example of research into the impact of a major new transport investment on the spatial distribution of economic activities followed the introduction of the TGV between Paris and Lyons, and was quoted in a 1994 report.[18] The research concluded that: "transport infrastructure does not automatically have positive effects on local development; second, the effects are themselves conditioned by the development measures implemented by the local actors." It suggested that a major investment producing considerable savings in time and money had not been reflected in a change in the pattern of economic activities, i.e. that people, not activities, move.

Whilst this produced some advantages for firms in Lyons wishing to penetrate the Paris market, economic actors in the Paris region were starting to consider Lyons as a remote suburb and in the long term the two economic areas might merge, increasing the peripheral status of the Lyons area. It would be interesting to identify whether any follow-up research has been undertaken.

The same 1994 report quoted other research which showed that Nagoya in Japan, formerly an important regional centre, had lost 20% of its employment since being bypassed by the opening of the high speed railway line between Tokyo and Osaka.

A useful revelation of the unsubstantiated and sweeping nature of economic claims typically made for new transport infrastructure projects in this country is provided by the conclusions reached by the Public Local Inquiry Reporter into the proposed M74 Northern Extension in Glasgow, Britain's biggest urban motorway project:[19]

"The most optimistic conclusion that can be drawn from these two reports in relation to the economic benefit of the M74 is that 20,000 jobs would be drawn to the area at the expense of other parts of Scotland, and that 5,000 jobs (at the most) might be genuinely new jobs for Scotland…Thus the overall economic impact of the proposed road in terms of employment appears to be largely a redistribution of jobs from other parts of central Scotland to the areas in closest proximity to the corridor of the new road".

This kind of critical analysis should be applied to economic claims for HSR.

6.6 Jim Steer / Transport 2000 Trust

The Transport 2000 Trust published Jim Steer's short *Fog on the Runway* report in May 2006.[20] This was primarily focused on a North-South HSR route via Heathrow Airport providing a substitute for short-haul air services (and a third runway), with associated local and global environmental benefits.

Much of the environmental discussion is focused on local air quality benefits around airports. The 2004 Atkins report is referred to, but again there is no mention of the negative environmental conclusions or of the low air-rail substitution projections.

Bizarrely, for a report produced for a sustainable transport group, *Fog on the Runway* accepts future international air travel growth and sees HSR as "a way to allow Heathrow to grow"!

6.7 Network Rail

Network Rail ('NR') did not substantively enter the HSR debate until a presentation by Deputy Chief Executive Iain Coucher at an HSR conference in London in May 2006.[21] Further aspects of NR's thinking were revealed in a *Modern Railways* article in October 2006.[22]

In his opening remarks to the conference, Coucher said, "I want to start with a note of caution; the rail industry must not fall into the trap of concluding the answer is a high speed rail link, now what is the question? If the question is 'how do we address the issues of capacity on the existing railway?' the answer may not be a high speed rail link – there are many other things we could do to accommodate growth."

There is little mention of environmental issues, although the *Modern Railways* article states that "A new line to Scotland could cover its costs by taking traffic away from domestic airlines, with the added 'green' benefit of reducing high-level CO_2 emissions." This looks very laudable, but in the next sentence it is reported that a consequence would be that "Capacity would be freed up at airports for long-distance traffic", so any CO_2 benefits secured domestically would be frittered away in a 'predict and provide' approach to highly polluting international air travel!

As noted earlier, Coucher believes that the principal beneficiaries of high-speed rail would be commuters into the West Coast Main Line's big cities, taking up capacity released by HSR construction. This implies either expensive HSR tunnelling into city centres, or diversion of HSR services away from traditional city centre stations to unsustainable edge-of-city locations, favouring the car over public transport.

The *Modern Railways* article poses the question "What is the point in flashing past a bunch of sheep on the northern fells at great expense, when Pendolinos already run virtually empty north of Preston?" Coucher's answer is that "we've got to go all the way to Scotland, because it is by capturing today's Scottish air traffic for rail that the revenue comes in to make the line wash its face…With a time of two to two and a quarter hours to Scotland, we would capture the vast majority of the air market." This

conclusion sits somewhat uneasily with the 2004 Atkins study conclusion on air-rail modal shift.

In conclusion, however, it would appear that Network Rail is keeping an open mind on the best way to improve rail capacity and speed, but appears not to have spent much time undertaking environmental analyses of HSR impacts.

With regard to the ECML specifically, Network Rail believes the ideal solution is a six-track railway over 100 miles, made by refurbishing under-used parallel routes to the ECML in England.[23]

6.8 Maglev / Ultraspeed

The origins of futuristic high-speed travel systems lie deep in the folk memory – the ill-fated Bennie Railplane entered brief service at Milngavie in 1930. The concept of trains operated by an elevated magnetic levitation ('Maglev') system has been around for many years, and a proposal ('Ultraspeed') for a North-South high-speed route in Britain was relaunched in 2006, attracting support from the Conservative party's transport spokesman despite its £32 bn price tag.

Maglev would attain speeds of up to 500 kph (311 mph), using technology already operational on the Shanghai airport link, the only commercially operational example. Ultraspeed claim that their system would require just 20% of emissions of short-haul air, but the basis of this conclusion is not clear. The British rail industry is highly sceptical about Ultraspeed, Iain Coucher of Network Rail stating in his May 2006 conference address that "I remain suspicious of claims that the energy required to [operate Maglev] is minimal." [24]

The principal criticism of Maglev is that it cannot – unlike Eurostar, TGV, ICE, etc – use the existing rail network. This presents major difficulties in serving the major cities – either through highly destructive and expensive construction of elevated tracks through densely built-up areas, or relying on edge-of-city stations with all the interchange penalties and stimulation of feeder car traffic which these imply. Interestingly, some 75% of TGV train mileage is understood to be operated over conventional tracks as opposed to dedicated HSR tracks.

As Professor Roger Kemp has noted,[25] Maglev would probably also fall foul of EU rules on interoperability of trains between different networks, and it might prove difficult to separate accounting for infrastructure and train operations as required by EU Directive.

As noted on the Deutsche Bahn website,[26] the 1990s' idea of a Maglev route from Hamburg to Berlin was part of "the euphoric thinking in the immediate post-unification period. But the ridership forecasts made at the time were not very realistic. In reality, operation of the line would not have made economic sense." The scheme was finally abandoned after years of delay, due to financial and operational difficulties, and an upgrade of the existing conventional DB railway was undertaken instead.

The line was initially electrified and developed for 160 kph operation. This alone made rail so attractive for passengers that airlines discontinued the service between Hamburg and Berlin due to lack of demand. Line speeds were raised to 230 kph (143 mph) in 2004, and ICE trains now cover the 180 mile distance in just 90 minutes.

In the context of a proposed Anglo-Scottish HSR, it is interesting to note that Berlin and Hamburg are, respectively, the 10th largest and 17th largest metropolitan regions in Europe. London is the 2nd largest, but Glasgow comes 44th and Edinburgh does not figure in the top 78 in Europe.[27]

6.9 Professor Roger Kemp

Professor Roger Kemp of the Department of Engineering at Lancaster University has attracted attention in recent years for his academic critiques of HSR, with particular emphasis on the environmental disbenefits. Formerly Technical Director of the GEC team for development of the Class 91 electric locomotive for the East Coast Main Line electrification, and subsequently part of the Eurostar development team for the Channel Tunnel, he is now a regular technical source for Roger Ford's 'Informed Sources' column in Modern Railways magazine.

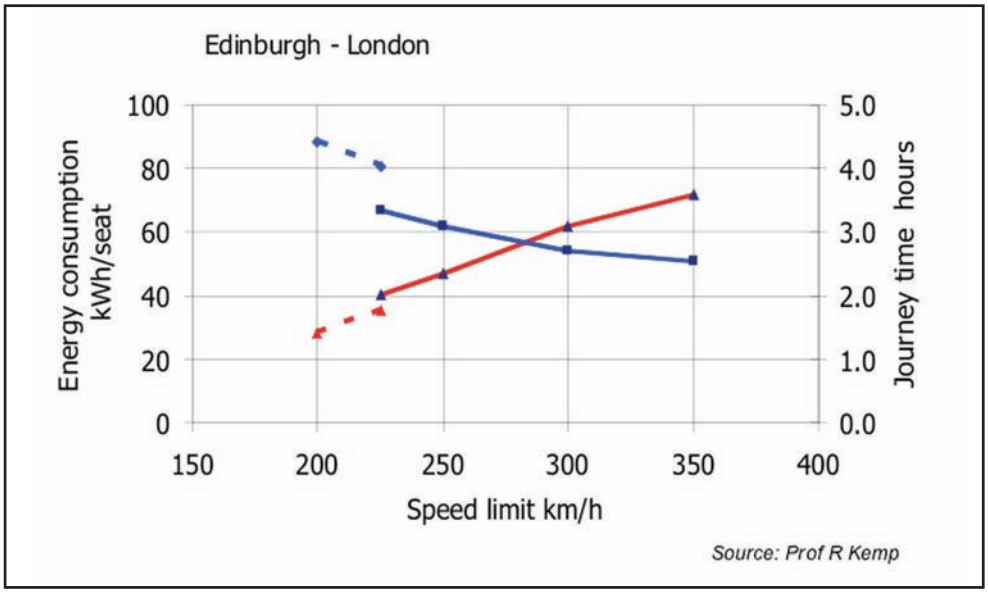
In May 2006 he addressed TRANS*form* Scotland's *Facing the Flood* Edinburgh conference on transport and climate change,[28] challenging many of the conventional wisdoms on HSR which sustainable transport campaigners have long taken for granted. Much of this Discussion Paper is informed by his analysis, including the Section 5 commentary on problems of cross-modal CO2 comparisons.

Kemp's view is that the essential dilemma of HSR is that it can be seen as "a good thing" in climate

change terms – particularly so in countries like France where the vast majority of electricity comes from non-fossil fuel sources – but the construction is so energy intensive that, unless the infrastructure is fully exploited, it dwarfs any energy saving achieved by modal switch of passengers from car and plane. On a route like Edinburgh/Glasgow- London, even in the highly unlikely event (bearing in mind inter-lining to international flights in London) of all air passengers switching mode, there would still be massive over-capacity over the northern half of an Anglo-Scottish HSR (as well as a likely financial shortfall), pushing rail operators to generate more long-distance commuting and entirely new journeys. The net effect of this could well be an *absolute* increase in CO_2.

Kemp's conference slide comparing energy use and journey times at different rail speeds between Edinburgh and London is reproduced in Table 2 below, contrasting existing track and trains performance (the dotted lines) with projected HSR and Eurostar equivalent trains (the solid lines). The red line shows how energy consumption (the left-hand vertical axis) rises with increased speed (the horizontal axis). The blue line illustrates how journey times (the right hand axis) are reduced with increased speed.

Table 2: Rail journey times and energy consumption v speed



Kemp urges us not to get fixated with finding exact CO_2 emissions comparisons, and instead insists that "the most important issue in this debate is how to reverse the growth in the overall amount of travel, rather than to worry too much about the fine detail of the relative [energy] consumption of different transport modes." [29]

6.10 Conclusions on the studies' environmental analyses

While the case argued for HSR to Scotland routinely invokes 'green' benefits, this review of nine recent HSR studies / commentaries has found that a majority of these appear to have undertaken little more than a cursory analysis of the environmental implications.

The two studies that have involved substantive analysis of energy and environmental impacts – Atkins for the SRA in 2004 and Professor Roger Kemp over a number of years – drew largely negative conclusions. This suggests that sustainable transport campaigners need to develop a more refined position on HSR and potential alternatives, and that the case for HSR to Scotland requires much more critical analysis than has been applied to date by most HSR proponents and promoters.

7. SUPPLY & DEMAND FOR AN HIGH-SPEED RAILWAY NORTH OF NEWCASTLE

Section 6 has demonstrated a lack of evidence to support environmental arguments in favour of HSR, and Professor Roger Kemp's analyses have highlighted the potential mismatch between the capacity supply of an HSR and the practical demand. While a variety of Anglo-Scottish routeings have been mooted for HSR, it is useful to look at supply and demand for the circumstances of an HSR north of Newcastle, broadly paralleling the existing ECML.

It should be borne in mind that, while currently the fastest train journey from Edinburgh to London (the 05.50 from Waverley) is scheduled to take 4 hours 16 minutes (with 3 intermediate stops), when the ECML was first electrified in 1991 this took 3 hours 59 minutes. A test run later in 1991 did Edinburgh-London in just 3 hours 29 minutes. GNER's current services average around 4 hrs 42 mins, in part because of the large number of intermediate stops. A split service – with expresses making very few calls, and smaller intermediate stations served by a 'semi-fast' service – would help to reduce average rail journey times.

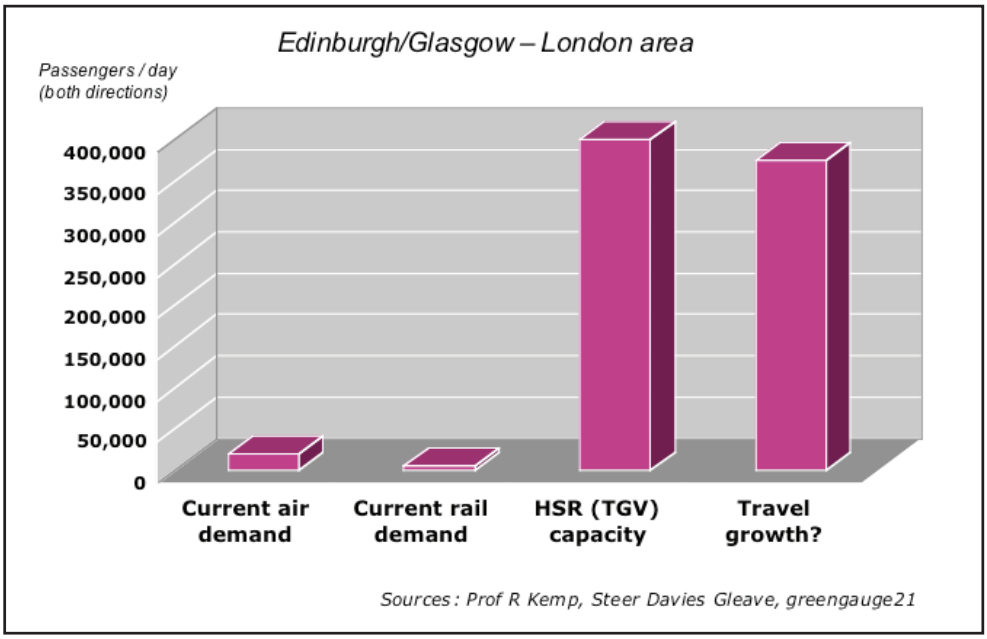
Network Rail's Strategic Business Plan[30] indicates that, but for the immediate environs of Edinburgh, between 30% and 70% of available train path capacity on the ECML between Edinburgh and Newcastle is used at present. The typical maximum number of trains per hour in each direction between Portobello Junction and Morpeth is around five, i.e. two GNER trains, one Virgin train, one ScotRail train as far as Drem and one freight train. Inter-city passenger trains virtually every five minutes can be accommodated by the signalling system, but local stopping trains and slower-moving freight trains (in particular coal) take up the equivalent of just over two passenger paths each.

It is clear that there is spare capacity for additional inter-city trains on this section of the ECML, particularly if some or all coal trains were re-routed to other Anglo-Scottish lines (see Section 8.3 below). Most of the route is designed for 110-125 mph operation, and there are only a few significant speed constraints, at Penmanshiel and Morpeth – the 55 mph curve at the latter is described as "the severest curve on any main line in Britain",[31] and has been the cause of three fatal accidents in the last 40 years.

To the spare paths capacity available to accommodate potential higher speed operation and additional Edinburgh-London passengers must be added the spare capacity within existing passenger trains, which on average probably have a load factor of 50% or less between Edinburgh and Newcastle.

Table 3 below seeks to illustrate the enormous mismatch between supply and demand which an HSR north of Newcastle would create. It uses current estimates of 20,000 air passengers daily (in both directions combined) between Edinburgh / Glasgow and London, and 5,000 rail passengers. The capacity of a double-track HSR like the Channel Tunnel Rail Link is between 6,000 and 24,000 passengers per hour in each direction, and the Tokaido Shinkansen 'bullet train' from Tokyo to Osaka carries a 1,200-seat train every 3 minutes.[32]

Table 3: notional HSR capacity v demand north of Newcastle



The current GNER service comprises 18 trains a day from Edinburgh to London, each with a capacity of around 500 passengers. In contrast, in the case of Table 3 the HSR capacity projection is based on a TGV Duplex-type (double-decker) train with 1,000 seats departing every 5 minutes over a 16-hour day. It is not of course envisaged that such an intensive service would ever conceivably be justified, but the comparison is made to illustrate the massive over-capacity that an expensively-constructed HSR north of Newcastle would be saddled with.

This table is intended to illustrate order-of-magnitude only, and it does not include allowance for existing rail passengers between Edinburgh and Newcastle (and other main intermediate points en route to London) switching to HSR. However HSR is not needed to give rail a competitive edge between Edinburgh and Newcastle or points as far south as Leeds (now served hourly by Virgin) – it is already a much faster service than by road and there is no substantive air service, with rail having a high market share.

Furthermore, if existing rail passengers switch from the ECML, additional spare capacity will be created on the latter, further stretching the gap between rail supply and demand. Professor Kemp has noted also that switching existing rail passengers to HSR would increase the CO_2 impact per passenger (see Table 2), because of the significantly higher energy consumption of high-speed trains operating well above the typical 140 mph maximum on conventional rail routes.

Overall it is hard to see a public investment justification for HSR north of Newcastle. It would appear that a privately financed line could only be viable with massive stimulation of new travel, i.e. potentially generating higher *absolute* levels of transport CO_2.

8. ALTERNATIVES TO HIGH-SPEED RAIL

8.1 Virgin Trains' 'alternatives' to HSR

In their (unsuccessful) 1999/2000 bid for the InterCity East Coast franchise, Virgin Trains proposed a major ECML upgrade to improve speed and capacity, based on:

- A £6bn new line over the 120 miles from Peterborough to York, designed for 220 kph (138 mph) operation
- Re-opening the Darlington/Leamside/Newcastle line
- A Morpeth bypass

At the *Facing the Flood* conference in May 2006, Virgin Trains outlined its aspirations for enhanced service over the WCML. While not opposed to HSR, Virgin are keen to avoid medium-term inaction on the existing railway caused by awaiting the possibility of long-term HSR construction, which might never happen.

Virgin thinks there should be continuing investment in the existing railway network to cope with rising demand (especially for modal shift from road and air). Based on increasing train speeds to 135 mph within the existing signalling system, constructing a Stafford bypass, etc., it believes a 3 hrs 45 mins Glasgow-London journey time is feasible. A 3 hrs 55 mins non-stop test run was achieved in September 2006.

While 3 hours is traditionally seen as the critical 'turning point' for significant rail capture from air, this figure predates recent heightening of airport terrorist security alarms and associated lengthening of throughout journey times as a result of increased security checks on passengers. Based on the largely uninterrupted continuity of movement by train, and the associated 'quality time' available for work – compared to air travel's increasingly fragmented process through check-in, security, departure lounge and flight itself – Virgin reckon that 3 hrs 45 mins would be very competitive with air.

Perceptions, of course, are critical, and rail may have been failing to get across the message that in terms of total journey times there is not a great difference between rail and air, and that rail has a much superior provision of quality time, provided by such features as Quiet Coaches, wi-fi internet access and overnight Sleeper travel as an alternative to airport hotels or the "red-eye" shuttle. Anecdotal evidence does suggest that air passengers are becoming increasingly unhappy about air delays, interruptions and associated stress, but rail suffers from less user-friendly on-line booking systems than air, thought to be due to lack of website investment.

Virgin Trains recently announced a planned roll-out of onboard wi-fi in all its carriages, to be completed by 2007. This is part of the company's 'Most Valuable Travel Time' campaign, which emphasises the value of productive travel time. According to GNER, 22% of journeys that have shifted from air to rail are a result of wi-fi availability.[33]

Rail may be perceived as less reliable because delays are meticulously reported through the Passenger Charter, whereas airline passengers told to check in as normal can find the ensuing delay in take-off presented as a retail opportunity!

Interestingly, Professor Roger Kemp questions how large the genuinely time-sensitive market is between Edinburgh and London: "My guess is that only a minority [of air passengers on this route] are paying for speed, most of the rest chose air because it is convenient or cheaper than First Class on GNER, which they see as the alternative." [34]

The higher frequency of air services between Edinburgh/Glasgow and London, compared to the current Edinburgh ECML and Virgin WCML timetables, may also be a factor. Currently there are around 100 flights a day from Scotland to London, while GNER and Virgin together operate less than 30 trains daily.

Same-day through train travel from Scotland to the heart of mainland Europe via GNER and Eurostar is already perfectly feasible (e.g. 11 hours from Edinburgh to Germany), and will become even more practical next year, when St Pancras International Station and the Channel Tunnel Rail Link ('CTRL') are completed. However, through ticketing is not currently available readily, and it is not clear how this will change in 2007 and whether key connections between GNER trains arriving at Kings Cross and Eurostars departing from St Pancras will be guaranteed.

When the Channel Tunnel was being built, it was planned that an overnight Sleeper service would operate from Scotland to Paris. This plan was dropped a number of years ago on the grounds of allegedly insufficient demand, but with the completion of the CTRL next year it is surely time to reconsider the potential role of an international Sleeper as an alternative to short-haul aviation.

8.2 Professor Roger Kemp alternatives to HSR

In his presentation to the *Facing the Flood* conference[35] and on other occasions, Professor Roger Kemp has outlined what might constitute a 'green' high-speed railway.

A key element would be the upgrading of existing InterCity lines such as the ECML to accommodate higher speeds and capacity, and utilising non-carbon energy sources such as renewables and nuclear. He envisages a relatively modest top speed of around 200 – 250 kph as a compromise between higher speed demands and increased energy consumption, ideally using high-capacity, low weight, low drag trains. Interestingly, the existing ECML Class 91 locomotives, although currently limited to 200 kph operation because of signalling constraints, were designed to operate at 225 kph.

Kemp wants to discourage travel growth such as long distance commuting, and would target mode switch by the "one person per car" market, since this is where there is a clear benefit from rail in terms of emissions per passenger.

Kemp sees a limited role for new construction of rail bypasses, to avoid the worst speed restrictions, such as those through Morpeth and York. Transferring long-haul freight away to other freight-prioritised lines would also free up additional capacity to accommodate faster passenger trains.

8.3 The EuroRail Freight Group alternative to HSR

In April 2006 the EuroRail Freight Group launched their plan for a freight-prioritised rail route from West Central Scotland to the North of England, the Midlands, London and the Channel Tunnel.[36] Their route would predominantly use existing rail lines and some closed formations, with just 4 miles of entirely new construction.

EuroRail Freight Group is an independent lobby group led by railway engineers Andy Berry and Tim Brown, Scottish haulier Ken Russell of the road/rail Russell logistics business, and Kelvin Hopkins MP (Luton North). The primary objectives of the scheme are to:

- Enhance the UK's freight infrastructure and link it more effectively with Continental Europe
- Provide a rail freight service capable of taking lorries on trains and container traffic, from Glasgow via London to the Channel Tunnel
- Promote modal shift of freight from road to rail in co-operation with road hauliers and the wider freight industry
- Maximise environmental benefits through reduced road congestion and lower greenhouse gas emissions.

The route would be designed primarily for freight, accommodating 750m long trains (compared to the current normal maximum of around 450m), with a top speed of 100 mph meeting freight industry requirements without inflating capital and operating costs. The northern end of the route would utilise the existing 'Glasgow & South Western' line from Glasgow via Kilmarnock and Dumfries to Carlisle, and then the 'Settle and Carlisle' line across the Pennines.

A capital cost of around £6bn has been estimated, although this in part reflects an ambitious specification for 'loading gauge' enabling not just 'piggyback' lorry trailers to be conveyed, but also double-stacked 9'6" high maritime containers, as is the practice in North America (where there are few road overbridges or tunnels).

The Group has researched the proposed route in detail and strategic terminal sites have been informally identified. They are continuing to consult and seek support for the scheme, to demonstrate how it can achieve an improvement in UK national transport efficiency.

A key claimed environmental benefit is the removal of 5m lorries a year from Britain's roads. Given that rail freight can generate as little as one-eighth of the CO_2 per tonne kilometre of road haulage (see Table 1), there are major potential CO_2 benefits to be secured from the EuroRail Freight Route proposals.

Of particular relevance to this paper is the fact that transferring long-haul freight from the ECML and WCML to this freight-prioritised route would create additional capacity for more and faster passenger trains on these routes, in line with Virgin aspirations and Professor Roger Kemp's ideas.

In the October 2006 issue of *Modern Railways*, Network Rail Deputy Chief Executive Iain Coucher confirmed that together with the Department for Transport it is examining a new freight-only line as a potential alternative to a dedicated high-speed line. Interestingly, the EuroRail Freight Group is not seeking to create an entirely new line, and it envisages shared freight and passenger usage, albeit with freight getting priority (as is typically the case in North America).

8.4 HSR and opportunity costs / value for money

There is no dispute that building an Anglo-Scottish HSR would be very expensive. Estimates vary from £11bn-£14bn by Network Rail[37] to £32bn for a Maglev / Ultraspeed network.

The Network Rail estimate is heavily caveated, and is based on bringing down construction costs from the £40m per mile for the rural Phase 1 of the Channel Tunnel Rail Link to just £25m-£30m per mile, as a result of a longer construction run, less tunnels and better construction techniques.
Developing a business case will depend on demonstrating that revenues and wider societal benefits justify the colossal cost of route construction and maintenance, and building and operating a fleet of new trains.

The question then arises as to whether a better range of benefits could be secured by alternative investments in transport or other sectors of the economy. Recent press reports suggested that: "A plan to build a 200 mph North-South rail line is expected to be abandoned because the Government's chief transport adviser has concluded that it would be too expensive and deliver too few benefits. Sir Rod Eddington has spent more than year studying the long-term needs of Britain's transport system and has decided that investment in rail should be focused on more modest schemes linking cities such as Liverpool, Manchester and Leeds. He also wants more road tolls." [38]

This view was supported by Passenger Focus, the rail watchdog, whose Chief Executive Anthony Smith said: "We are wary of big projects because they suck up all the resources for years to come. We want a series of smaller improvements."

Rail industry sources understand that the Department for Transport believes that better stopping patterns, with existing London (Euston) – Glasgow services running non-stop to Preston, in association with Trent Valley track quadrupling, may deliver most of what can be done for rail on the West Coast Main Line.

In the context of value-for-money, the economic and environmental case for extending rail electrification may be a useful comparator. Just 23% of Scotland's rail network is electrified, one of the lowest shares in Europe. Strategically however, with growing concerns about climate change and the imminent peaking of global oil production,[39] more widespread electrification – combined with further upgrades of the ECML and WCML – may represent a better value for money package and a more sustainable way forward for Scotland than HSR. Currently rail electrification costs are running at £1m or less per double-track mile,[40] compared to (at best) £25m per mile for HSR construction.

9. AIR-RAIL SUBSTITUTION – MARKET FORCES VS. REGULATION

Underlying the whole debate on HSR, and the associated scope for air-rail substitution, is the fundamental question of the extent to which Government regulation (and investment), as opposed to market forces, could or should deliver desired policy outcomes.

While the Atkins study posited relatively modest switches from air to HSR (in part because HSR would feature some premium pricing to reflect the market offer of very fast journeys, high quality of service, etc), it has been suggested that the study could have modelled the better business and cost/benefit outcomes of Government banning short-haul flights once HSR was in service. That indeed is a policy option, albeit one with politically difficulties in the current climate of opinion. Equally, however, an ECML/WCML upgrade giving journey times of, say, 3hrs 30 mins / 3 hrs 45 mins could be modelled for such a regulatory scenario.

A key question arises as to how far we have to take existing air travel patterns as the starting point for a programme of rail-air substitution. Should the massive growth in low-price air travel from Scotland to London over the last five years, based on an artificially cheap and distorted market, be the basis for colossal public investment and trying to replicate all or most of these journeys by another mode of transport? Much of the market is purely price-driven, with many consumers making very low-priced leisure journeys which would not happen by air (or any other mode) if the external costs of transport were properly internalised in ticket prices, and/or if the quoted price for air included the cost of getting to and from the airport.

This takes the discussion into deeper philosophical territory – do we assume we have to cater for ever growing demand for long-distance travel ('the hyper-mobile society'), or do we start planning for a different society where transport demand is better managed or even rationed to accommodate the global threats posed by climate change and 'Peak Oil'? Proponents and promoters of HSR largely fall into the former camp, but shouldn't sustainable transport campaigners be in the latter?

10. A 'SUSTAINABLE' SOLUTION?

While further detailed research is clearly needed, some of the potential components of a 'sustainable' solution and alternative to HSR are now evident. Broadly these fall into two categories – sustainable transport investment (the carrot) and management of unsustainable demand (the stick).

SUSTAINABLE TRANSPORT INVESTMENT:

A key element of the package would be to **upgrade the ECML** through measures such as:

- Raising line speed to 140 mph (the capability of the existing 225 electric trains), as in the successful DB upgrade of the Hamburg-Berlin line
- Doubling the busiest double-track sections to four-track
- Providing by-passes of the most sharply curved pinchpoints, where the terrain would enable this to be done cost-effectively, e.g. Morpeth, but not Penmanshiel
- Providing improved local ScotRail feeder services, for example through implementing the Network Rail Route Utilisation Strategy recommendation[41] that Fife calls on Aberdeen-Edinburgh services should be transferred to a separate hourly Dundee-Edinburgh service, with Perth-Edinburgh via Fife also becoming hourly
- Providing enhanced through ticketing from Scottish stations to London and mainland Europe
- Further improving existing stations such as Edinburgh Waverley (which is often compared unfavourably with Edinburgh Airport) and Motherwell
- Constructing new parkway stations (or perhaps 'hub and spoke' stations) only at carefully selected locations where public transport access can be maximised, local car growth minimised and worsened end-to-end journey times avoided e.g. Musselburgh, and in the longer term Livingston/Midcalder.

In parallel, would be a **WCML upgrade** through measures such as:

- Raising line speed to 135 mph (the capability of the existing Pendolino tilting electric trains within the existing signalling system)
- Doubling the busiest double-track sections to four-track (this is already happening in the Trent Valley area)
- Providing bypasses of Stafford, etc.
- Providing improved local ScotRail feeder services (with enhanced through ticketing).

To complement and facilitate ECML and WCML upgrades, a cross-country **EuroRail freight route, or variant** would be provided to shift long-haul freight off these inter-city routes, freeing up capacity for higher speed passenger trains and securing major modal switch of freight from road to rail.

To spread the benefits of rail investment more widely and sustainably than HSR, a **major programme of rail electrification** would improve speeds, capacity and environmental performance on the key internal Scottish inter-city routes, linking Edinburgh, Glasgow, Dundee, Aberdeen and Inverness.

MANAGEMENT OF UNSUSTAINABLE DEMAND:

If transport is to make a fair contribution towards deep cuts in the UK's CO_2 emissions, and if we are to prepare ourselves wisely for Peak Oil, then serious action is required to constrain the unsustainable growth of demand for transport.

A number of action areas are possible, with **aviation taxation** to internalise external costs (in line with European Union objectives) being a key potential tool, albeit one which is fraught with problems of achieving international agreement.

As George Monbiot as noted,[42] an obvious area where Government can manage the growth in air travel demand without recourse to international agreement is by placing **a moratorium on airport**

expansion in London, Edinburgh, etc.

Given that the objectives of managing unsustainable demand are to secure overall reductions in transport CO_2, action will be required across all modes. A key element of any national policy will have to be either **road user charging** or **increased fuel taxation**.

Clearly there is a role for the use of **alternative fuels** and **more fuel-efficient vehicles**, but such 'techno-fix' measures are often invoked as a means of avoiding taking the fundamental action that is required to constrain and reduce unsustainable demand. If nothing serious is done to cut demand in line with global and local environmental imperatives, then techno-fix benefits will quickly be swamped by the overall growth in traffic.

11. SEMINAR DISCUSSION

A lively and wide-ranging discussion followed the presentation at TRANS*form* Scotland's 6th September seminar. A number of key points from that discussion have been taken on board in the preceding sections of this paper.

The most fundamental debate was around the issue of whether we continue to provide additional transport infrastructure and services for more frequent and increasingly longer distance travel, in line with predictions of what people will demand in a hyper-mobile society (in response to a distorted market which keeps transport prices artificially low), or instead do we move towards a more sustainable society where a fair price is paid for travel, there is less need for travel, and more facilities and services are closer to where people live and work.

'Softer' issues such as perceptions of journey times and the need for politicians to set an example were also aired. The rail industry may well have failed to get across the message that through rail journey times from city centre to city centre can be close to what air offers in practice, and may offer significantly more 'quality time', in line with Sir Rod Eddington's reported view that an uninterrupted three hours of rail travel is equivalent to an hour in the air.[43] The seminar heard that a number of MSPs have insisted on air travel from Edinburgh to Inverness and Manchester – despite the through journey being no quicker than rail – because that is what they consider befits their perceived status. Some rail industry managers are also understood to see travelling by air as a reflection of their prestige.

It was suggested that the opposition of sustainable transport campaigners to HSR risked them being labelled as "don't want anything", i.e. being seen as negative on progress. The response to that was that people should be asked to pay a fair price for transport, and that the overarching policy objective should be emphasised as reducing CO_2 emissions if future climate change disaster is to be avoided. In other words, transport investment should be focused where it is most efficient in energy terms.

One delegate described HSR as a "vanity project", and he and others expressed concern that the enormous cost of HSR would jeopardise a more valuable programme of smaller and more widespread investments in the national rail network.

It was also noted that, in any event, HSR would be a long time coming and that waiting for a long-term development that might never happen could seriously prejudice cheaper and potentially more valuable short and medium term upgrading of the existing rail network.

12. CONCLUSIONS – 'JUST ENOUGH' TRANSPORT

On the basis of the review undertaken by this paper in response to the question "Are high-speed railways good for the environment?", the fairest answer is probably: "Yes, in the right circumstances, compared to short-haul air transport".

However, more detailed research is clearly needed – but what now seems beyond dispute is that there is no basis for sustainable transport campaigners to voice unequivocal support for the construction of a High-Speed Railway from Scotland to London. There are other more sustainable and potentially better value-for-money alternatives which demand serious consideration by Government. Contrary to what some proponents have implied, we are not faced with a stark choice between High-Speed Rail or 'do nothing'.

A further concern, as voiced by the Passenger Focus watchdog, is that substantial expenditure on HSR could drastically reduce the budget for crucial local and regional rail improvements throughout the country. A better range of sustainable transport benefits could be secured by alternative investments.

Future Government decisions on HSR will be taken not just on the basis of environmental issues but also the other four criteria used for transport project appraisal (safety, economy, accessibility and integration), plus of course the unmentioned criterion – political expediency.

However, sustainable transport campaigners may take the view that the scale of the global environmental challenges we face – climate change and perhaps increasingly Peak Oil – are such that all other decision-making considerations should be subordinate to energy and environmental policy objectives.

Fundamentally, this comes down to a choice between artificially prolonging the life of the 'predict and provide' hyper-mobile society, which particularly benefits the better-off, or recognising the limits to growth and the need to manage transport demand down to a sustainable level.

Over the last decade or more the freight logistics industry has got well used to the concept of 'just-in-time' transport. In the emerging 21st century we will all instead have to adjust to the need for 'just enough' transport.

13. KEY QUESTIONS FOR GOVERNMENT & OTHER STAKEHOLDERS

This paper has demonstrated that searching energy and environmental questions are required of the concept of a dedicated new high-speed rail route from Scotland to London. Some key questions for Government, at both Westminster and Holyrood, and other stakeholders are:

SHORT- TO MEDIUM-TERM:

1. How will ongoing **airport delays** (including those brought about by security fears) impact on the competitivity of conventional inter-city rail services?

2. How can the **perception of rail travel** be improved by introducing better on-line booking and promoting appreciation of the quality time provided on rail by Quiet Coaches, wi-fi internet access and overnight Sleeper services?

3. How can **local rail feeders** to Anglo-Scottish rail (and through ticketing from Scottish stations to London and mainland Europe) be improved to enhance the through travel experience?

4. By how much could the average rail journey time from Edinburgh to London be reduced by a split service, with **expresses making very few calls**, and smaller intermediate stations served by a 'semi-fast' service?

5. How can **existing stations** such as Edinburgh Waverley and Motherwell be further improved to help create a high-quality seamless journey experience?

6. Can a **new 'parkway' (or perhaps 'hub and spoke') station** at Musselburgh, and in the longer term at Livingston/Midcalder, be designed to reduce door-to-door journey times to London without generating unacceptable levels of car feeder traffic or worsening end-to-end journey times?

MEDIUM- TO LONG-TERM:

7. How can a EuroRail **freight route** contribute to economic and environmental objectives?

8. How can a rolling programme of rail **electrification** assist with policy aims?

9. Compared to HSR, how will **an alternative package** (based on ECML / WCML upgrade) perform in terms of cost-benefit, value-for-money and contribution to energy and environmental policy objectives?

10. What needs to be done to create a less distorted market place for transport, **getting the prices right** (to reflect true costs) for the different modes, so that rail fares are not artificially inflated above air?

INTERNATIONAL AND STRATEGIC:

11. What can be done by the rail operators (principally Eurostar and GNER) to ensure that through ticketing and connections at St Pancras International / Kings Cross are optimised to facilitate convenient and seamless **day-time travel from Scotland to mainland Europe**, following the completion of the Channel Tunnel Rail Link in 2007?

12. What role could an **international overnight Sleeper service** from Scotland to mainland Europe play in providing a sustainable alternative to short-haul aviation?

13. How can Government lead and promote the **management of demand** for air travel?

14. How can Government ensure that policies and programmes deliver **an absolute reduction** in levels of transport CO_2?

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About this paper

Proposals for building a High-Speed Railway from London to Central Scotland – with trains running at speeds of 300 kph or more – have moved fast up the political agenda over the last year.

While primarily driven by economic development and congestion considerations, the case argued for High-Speed Rail routinely invokes 'green' benefits – but do these environmental claims stand up to scrutiny? Are we really faced with a stark choice between a High-Speed Railway or 'do nothing' for Anglo-Scottish transport?

This discussion paper examines CO2 emissions from different modes of transport, reviews nine recent studies on High-Speed Rail, and sets out some potential alternatives, before concluding with key questions for Government and other stakeholders to consider as part of the ongoing debate.

About TRANS*form* Scotland

TRANS*form* Scotland is the national sustainable transport alliance, campaigning for a more sustainable and more socially-just transport system. Our membership includes bus, rail and shipping operators, local authorities, national environment and conservation groups, consultancies and local transport campaigns.

"The most important issue in this debate is how to reverse the growth in the overall amount of travel, rather than to worry too much about the fine detail of the relative [energy] consumption of different transport modes."

Professor Roger Kemp, Lancaster University