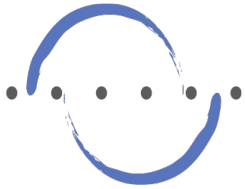
DRAFT – For Discussion



BLUESPACE THINKING

Bluespace Thinking Ltd.

A Review of High Speed Rail - HS2 proposals.
April 2010

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1. Introduction

Effective and affordable transportation systems are crucial to economic development and make a major contribution to the quality of life

However, transportation also makes a major contribution to UK CO_2 emissions, contributing 24% of the total in 2007. Over the last 10 years the public and Governments' worries about Global climate change have become evident, it is not clear how a balance between economic development and the reduction of harmful emissions can be achieved.

Transportation policy is a major lever to achieve this balance. The extent and purpose of our travel and the type of transport we use will dictate if we can avoid further harmful CO2 emissions from the transport sector and also how the UK can move out of the current recession to re establish economic growth.

The DfT HSR and HS2 documents leave us unclear whether the Governments position is to encourage or discourage travel. There is clearly a campaign to decrease road travel demonstrated by TV advertising encouraging car users to reduce car use by 5 miles /week. There is also clear direction to reduce car commuting and educational (school run) and social car use. There is a desire to transfer air travel and long distance road travel to train. However HS2 gives rise to a large addition of business and leisure travel.

It would appear to us that the key objectives, in the context of enhancing economic growth while reducing emissions, would be:-

- To enhance business to business and business to customer communications and to reduce unproductive time wasted during travel.
- To reduce commuting (including school journeys) wasted time, congestion and cost.
- To provide for leisure/private travellers convenient and accessible low emission travel options at affordable prices.

This paper takes the HS2 High Speed Rail proposals issued by the UK Department of Transport (DfT) -11th March 2010, and reviews the economic benefit expected and the impact on CO2 emissions.

2. High Speed rail – The HS2 proposals

The HS2 initial proposals are to build a £25bn, 100 mile long High Speed Rail (HSR) line between London and Birmingham capable of carrying 28 trains/hour. The trains will be capable of 220-250mph, and sufficient new rolling stock will be acquired to service the long distance destinations north of Birmingham, so as to allow journey times to be reduced by 30 minutes from London (Euston) to the West Midlands, the North West and Scotland. The rail line is planned to start operation in 2026.

HS2 and their consultants have prepared a series of reports that explain and evaluate their proposals. These are available at the DfT website www.dft.gov.uk/pgr/rail/pi/highspeedrail/

Passenger demand predictions, the costs in comparison with similar European schemes, the economic benefit calculations, predicted revenues and CO_2 emissions are areas that we studied in our review.

3. Key findings

We started our investigations with an open mind, like others we had the presumption that High Speed Rail was probably good for the economy and good for the environment. Having reviewed the proposal we do not consider that either the economic benefit case or any suggestion that the proposals will reduces emissions are sound.

HS2's economic case is unsound because:

- it depends on implausibly high rates of growth in transport demands.
    - it involves rapid increases in demand for travel that are out of line with the experience of the last 15 years.
    - it relies on considerable further demand growth created by HS2's own existence.
    - globalisation and internet based communications and business are making physical proximity of co-workers and face to face meeting less important for many businesses.
- the benefits will not be as large as claimed
    - the benefits of over crowding reduction are dependant on the high demand forecast, they evaporate as demand decreases.
    - the large savings in business travel time value are inconsistent with how business travels use trains and the valuation of business travellers time does not reflect the current salary profile of train business travellers.
    - the increases in the real value of fares are inconsistent with competing successfully with air or coach.
- to provide additional transportation capacity there are cheaper and far less risky alternatives that are not exposed to long term forecasts being wrong.
    - HS2's analysis shows that alternative transport system improvements can deliver half of HS2's total benefits at one fifth of the cost. There are also better means of addressing congestion arising from commuting.
    - the alternatives can be implemented more quickly, so that they relieve congestion and deliver benefits more rapidly
    - they are incremental, and can be adjusted to accommodate changes in social and working patterns not requiring speculation on transport requirements over an 80 year time horizon.

We consider that many of the assumption and implicit assumptions in the analysis are flawed particularly:-

- The demand forecasts are probably almost double that which can be evidenced by recent (last 15 years) travel trends.
- The benefit case is probably overstated by 40% to 150%
- That 30% of HS2 passengers will be business passengers as the usage triples over the next 20 years and the assumption that these passengers are unable to do productive work on trains are both unrealistic.
- That fares will increase by RPI+1% for the next 60-80 years, doubling in real terms, while rail demand grows at the expense of road and air. If the fares increase is only RPI fare revenue present value is reduced by 30%
- That road and rail improvements identified in the analysis will not be carried out allowing congestion and significant increases in car journey times over the next 20 years are, hopefully, not consistent with Government travel policy. Once these improvements are made the benefits of HS2 probably diminish considerably
- That HS2 will reduce transport emissions given the increases as a result of a) construction, b) the generation of 24 million additional journeys (that only occur because of HSR) and c) because HSR creates about twice the emissions /passenger Km of trains travelling at 125-140 mph.

We are disappointed that no alternative ways to improve UK business communications and reduce business travel have been evaluated. We consider that the £25bn first phase of proposed Government grants (equivalent to about £1600/ UK tax payer) can be spent more prudently. Support given to the UK regions for low emission public transport and improved communication are examples, providing greater economic benefits with a much lower impact on the environment. Subsequent extensions of HSR as proposed by HS2 to a total subsidy of £88 billion are unlikely to occur, if the first phase is built the true demand for the line will be made transparent.
(Ref. Office of rail Regulator ORR – National Rail Trends year book 2007-2008. DfT Transport Statistics Bulletin – National Travel Survey 2008)

4. Background - UK Transportation, the last 10 to 15 years

The DfT Transport Statistics Bulletin – National Travel Survey 2008 provides the changes in travel patterns over the last 10 years.

Table 1 Travel trends 1998- 2008

Miles / person	Miles/person 2008	Annual rate of change 1998-2008
Walk & Cycle	235	-0.15%
Car/van/Motor cycle	5560	-0.46%
Private coach	110	-1.80%
Local bus/Underground	387	1.60%
Long distance coach	56	-4.85%
Surface rail	495	2.70%
Air/Ferry/Light rail	80	8.80%
All modes	6923	-0.18%

The overall distance travelled per person has remained about 7,000 miles/year over the last 15 years. The dominant mode, car travel, is down but the reduction is partly off set by increases in rail travel. The population increased at about 0.5% per year during the period so overall travel is up in line with the population growth rate. GDP growth has been about 30% in real terms over the last 10 years.

The no emissions modes of walking and car passenger travel are both down as is coach travel (probably the least CO_2 emitting form of mechanised travel), contributing a reduction of 164 miles / person. This is offset by train, local bus and other means of public transport which are up by 187 miles /person.

Long distance travel (journeys over 100 miles) is also showing no signs of increase. While there is evidence to show that train travel for journeys over 100 miles has increased, total long distance travel / person remains constant. Of the 12 million (UK wide) additional train passengers/year it is likely that about 8 million passengers have transferred from coach with the remainder coming predominantly from car.

Table 2 Change in UK Journeys over 100 miles

Trips over 100 miles	Million Trips 2000	Million Trips 2006- 2008	Annual rate of change 2000-2008
Car/van	337	317	-0.9%
Private coach	14	11	-3.4%
Long distance coach	17	11	-6.2%
Surface rail	39	51	3.9%
Air	7	11	7.0%
Other (Ferry)	3	4	7.0%
All modes	416	405	-0.4%

Data from National Travel Survey 2008 Table 3.2

We have been unable to separate the 2000 air and other trips, however air has increased, in the event all current air trips were to switch to long distance rail there would be a one off increase in rail of about 20%.

Travel on the West Coast Main Line (WCML), the HS2 route, has increased over the last 12 years. Rather than an underlying travel demand, GDP linked increase, we believe that the reasons are population growth, switching from car and coach users as the train service has improved, and very competitive off peak prices. The Virgin brand may have enhanced the growth.

Over the last 4 years Virgin trains have improved the level of service, the number of trains had increased by over 40% with the number of long distance peak fast trains to and from London rising from 8 to 11 an hour, from December 2009 Virgin have provided trains every 20 minutes to both Birmingham and Manchester.

A report commissioned by Virgin Trains reported in 2007 that British Chamber of Commerce work showed that improving punctuality and reliability was business travellers highest priority (with 69% ranking this the highest or second highest factor, while only 18% ranking speed improvements as first or second priority. Virgin Trains reliability has greatly improved from 76.3% of trains arriving within 10 minutes of scheduled arrival in 2004/05 to 87.3% in 2007/08.

The change in ticket type for passengers arriving and departing through Euston, the London terminus of the line has also changed. Season ticket (regular commuters) have increased by 9.5% standard fare tickets have decreased by 35% , discount tickets (from £7/ journey) have increased by 47%. Business travel accounted for 24% of Virgin Trains journeys (Passenger Focus Autumn 2009).
This dramatic increase in low cost tickets combined with the evident decrease in coach travel supports the view that much of the passenger increase on the West Coast Main Line trains has come from coach passengers switching.

(Ref. ORR National Rail Trends year book 2007-2008. Dec 8 2009 Press release "New Virgin Trains" PR Newswire Europe Ltd.) Virgin Trains time table and ticket sales)

5. HS2 Demand forecasts

The HS2 demand projections are that long distance train travel involving the London to Birmingham route will increase three to four times during the next 23 years.

The HS2 demand forecast is made up of two parts, exogenous, the underlying demand that will take place generally for long distance travel and endogenous, demand that comes as a result of actions taken to increase or decrease use of a particular mode of transport.

We conclude that the estimates of exogenous travel increase are based on correlations/ elasticities of long distance travel with GDP growth established or heavily influenced by the period prior to 1995 before demand flattened. The elasticities being used suggest that long distance travel will increase 1.5 to 2 times the rate of GDP growth resulting an an annual forecast growth rate of about 4%.

The National Travel Survey 2008 shows that since 1995 there has been no discernible increase in long distance travel per person although in real terms GDP has grown 35% over the period. Population growth has been about 0.5 %/year (World Bank and OECD Statistics) based on this information, it would appear that the demand growth for domestic long distance travel is about 0.5%, 2% below GDP rather than 1.5% above.

If Train travel has increased over the last 10-15 years at the expense of other travel modes its growth has been endogenous. On behalf of HS2, Atkins have used a detailed and complex model to predict the further endogenous growth that will occur. It works by assessing the extent existing passengers will switch and new passengers choose train for their journey however if the exogenous growth assumptions are wrong the endogenous predictions will also be wrong in absolute terms, even if they accurately reflect travel type choice for

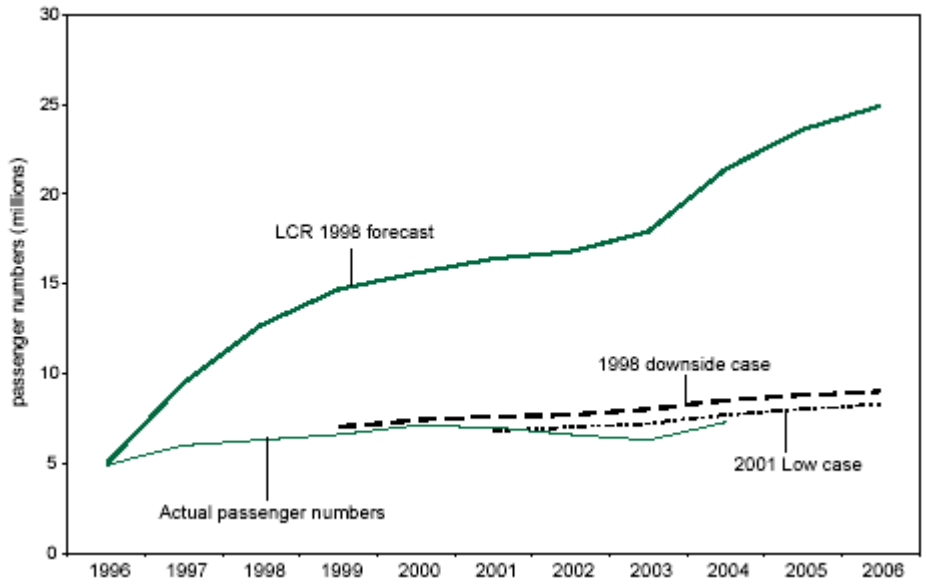
individual passenger circumstances.

Having completed the recognised (although in our view erroneous) forecasting calculations HS2 decided that in addition further demand growth would come from a desire by individuals to use the train simply because it exists and goes at 220mph rather than the 125-140mph of conventional fast trains.

In summary our reading of the HS2 reports suggest that they start by assuming 45,000 passengers/day used the route in 2008, they increase this at 4%/year to 2033 (rather than 2026 in accordance with DfT guidance) to 105,000 passengers/day, they acknowledge that many of these passengers (20,000) will choose other train services, giving an exogenous growth forecast of 85,000 passengers/day. To this they add 24,000 passengers from endogenous growth, switching from other modes, and then add a further 36,000 passengers/day of passengers that would not have travelled but will do so because it is a very fast train. Giving a total of 145,000 passengers the base case assumption used in the economic evaluation.

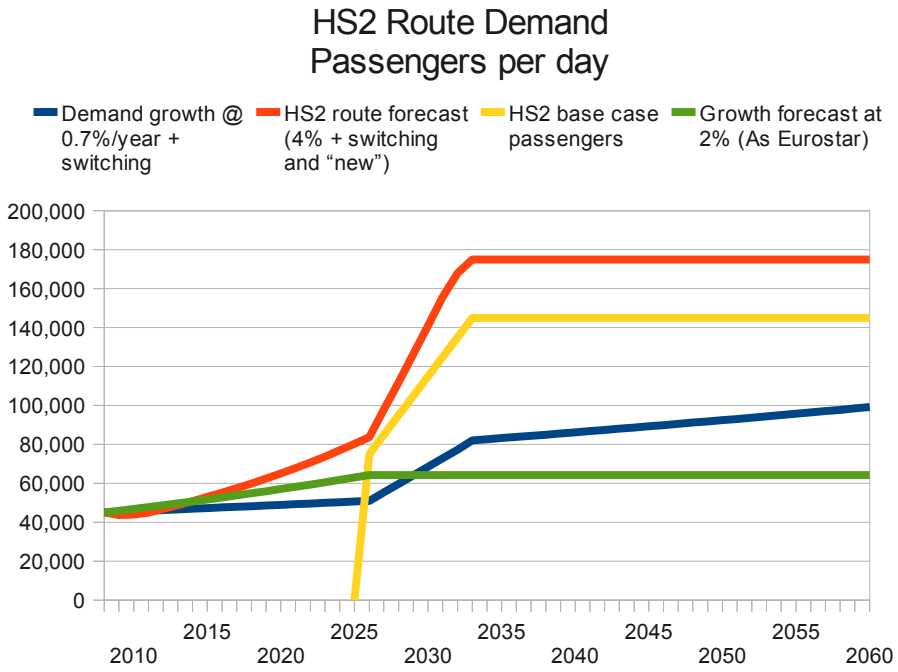
The forecasts are not limited to rail travel, the exogenous forecast impacts road travel showing extreme congestion and road over crowding the HS2 benefit case then takes credit for reducing, to a very small extent, this "forecast situation" that is not supported by current travel trends.

The HS2 demand forecasts remind us of the original Channel Tunnel forecasting where similar, extreme assumptions were made but in practice did not materialise. In Appendix B we include an abstract from the Select committee for Public Accounts investigation into the erroneous forecasting. It seems that there is precedent for DfT substantially overestimating demand for high speed rail projects..



Source: C&AG's Reports (HC 302 of Session 2000-01, Figure 6 and HC 77 of Session 2005-06, Figure 8)

The graph below shows the HS2 route forecast and base case planned HS2 usage. We have added a forecast based on 2.0% growth curtailed in 2026 in accordance with DfT guidance this approximates to GDP growth and is consistent with the current forecast for the Eurostar demand growth. We also show a more realistic growth at the predicted population growth rate (0.7%) plus the HS2 assumption for growth due to switching.



(Ref HS2 Proposals and Reports– Demand and Appraisal Atkins - Baseline forecasting report)

6. HS2 Economic benefit case

Time saving and over crowding reduction:

Of the £27billion of economic benefits from the HS2 project £17billion are from business travel time saved and over crowding reduction, £10bn is from savings in commuting and private travel time.

Over crowding is directly a result of demand forecasting and comparison with the alternative arrangements that may exist. As a consequence it is difficult to assess the extent to which the HS2 forecast maybe overstated although from our assessment of alternatives identified, but not pursued by HS2, it is possible there are no over crowding benefits. Overcrowding is also we understand a function of seats filled and that the increased density of seats per metre envisaged in HSR trains is not considered.

We think that £2billion of benefits identified comes from a reduction by 2% of the road traffic flows at the southern end of the M1 and adjacent M25. The model shows that the actual increase in car loading between 2007/08 and 2033 in this location is predicted to be about 76%, after the impact of proposed improvement schemes is taken into account. The demand forecasts predict that overall traffic growth in the HS2 study area is estimated at 44%. If correct, this indicates that congestion on UK roads is going to get considerable worse over the coming years and that the problem will not be addressed. Atkins reports identifies schemes with Net Benefit Ratios much higher than HS2 that could directly address the problems. We also noticed that shorter distance business and commuter car journeys represent 56% of all road journeys in the study area highlighting their importance in finding a solution to the problems of continued increased travel infrastructure needs.

For business travellers, train journeys are not totally lost time. On longer train journeys business people will usually read or work via laptop or mobile phone. The provision of WiFi allows the train to serve as a mobile office. The Virgin Trains commissioned study reported that 86% of business travellers said they had work that could be easily done on the train, and the National Passenger Survey found that 58% of business travellers felt they had made some use of their time and 27% felt they had made very worthwhile use of their time. Given the time taken to set up and pack up, work journeys over 1 hour are probably more productive. In all probability only half the time saved by faster journeys is actually avoiding wasted or unproductive time.

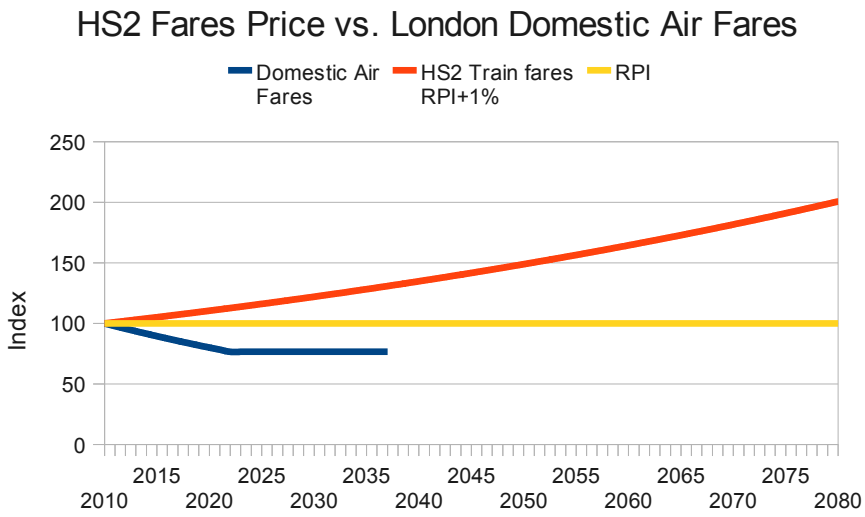
The DfT (webtag) guidance on the value to be attributed to lost business time was set in 2002. As far as we can tell it has been inflated at GDP/capita growth rate rather than the earnings growth rate and has not been adjusted to reflect the increase in train usage that has occurred, lowering significantly the average salary of a business train user. The assumption suggests that in 2010 the average business train traveller earns £70,000, we think this very unlikely and not consistent with the predicted increase in usage.

HS2 assume that business journeys will account for 30% of the HS2 total. This contrasts to recent surveys which suggest 24% for Virgin Trains. It is not clear why this increase in proportion is anticipated.

Fares income

The HS2 reports show that £15 billion of present value of the project is attributable to ticket revenues. We calculate that £5 billion of this value comes from the assumption that ticket prices will rise 1% above RPI rather than at RPI, which causes ticket prices to double over the evaluation period in real terms.

Over the time period from 2010 to 2030 the Atkins Baseline Forecasting Reports quotes the DfT predicted cost of domestic air travel as reducing by 30% in real terms. As has proved the case with Eurostar, either prices will be set below that assumed in the evaluation of the line, or HS2 will be less competitive against air travel, making modal shift and any positive contribution to reducing emissions unlikely. The price assumptions might also lead to HS2 being significantly less competitive against coach, conventional north-south rail lines or cars.



Other revenue lost

During our review we noticed that while the benefits, costs, Governments grants, revenues and reduced taxes are taken into account in the NBR calculation it would appear that no allowance has been made for the reduced revenue to the Government for the reduction in usage fees on the current WCML. We calculate that the PV of this reduction is about £4 billion (assuming it escalates in line with fares).

Wider economic benefits

On behalf of HS2 The Imperial College did some work to assess if there were wider economic benefits as a result of the HS2 line. The work concludes that the wider economic benefits of agglomeration are very small, probably valued at about £8 Million per year. However HS2 quote the text of the report but attribute £3.6 billion Present Value to wider economic benefits. We have been unable to find any rigorous academic support for the HS2 view.

7. Alternatives: Road and rail

The proper basis for assessing HS2, according the the Government's Green Book evaluation process, is against the alternatives.

Were HS2 not built, on HS2's own assumptions, most of the rail journeys and the fares revenue from this would occur in any event. Immediately before the opening of HS2 all the projected growth to 2026 is carried on the existing WCML.

Atkins have carried out a study of the rail and road improvements that can be made to provide similar benefits to that achieved by HS2. The reports highlight that if the underlying travel growth assumptions are correct then congestion on roads and rail routes will increase significantly before HS2 is able to come into operation.

If some of the improvements identified in the Atkins Strategic Alternatives study were made in the next 23 years then the benefits attributable to HS2 would be substantially diminished.

Of the options Atkins analyse (*High Speed 2 Strategic Alternatives Study Strategic Outline Case Appendices D and E*) , Rail Alternative 2 and Road Alternative 2 both have substantially better Net Benefit Ratios (NBR) than HS2. In addition Rail Alternative 1, which involves longer trains and platform lengthening, is not properly analysed. Typically longer trains and platform lengthening is the cheapest way to provide additional rail capacity. Also while rail alternative 2 assumes new rolling stock it presumably does not include the denser seat packing implicit in the HS2 assumption that trains will have 551 seats but be 200m long, this solution while degrading the passenger experience presumably could reduce the length of platform extensions required to implement Alternative 1.

Table 3 Impact of Alternative Rail and Road solutions

Road and Rail Alternatives to HS2 Present Values £million	HS2 base case	Road Alternative 2	Rail Alternative 2	Assumed impact on HS2	Residual H case
Business user time benefits	£17,407	£1,996	£4,557	£6,553	
Consumer time benefits	£10,299	£3,135	£2,526	£5,661	
Other benefits	£1,000			£441	
Present Value of benefits	£28,706	£5,131	£7,349	£12,655	£16,051
Gross Government funding	£25,400	£1,403	£2,581		£25,400
Revenues (reduce with benefit reduction)	£15,010			£6,617	£8,393
Reduced Taxes	£1,486			£655	£831
Central Government funding	£11,876	£1,403	£2,581		£17,838
NBR	2.42	3.66	2.85		0.9

On the basis of the alternatives presented, Road Alternative 2 in Combination with Rail Alternative 2 would have a cost of £3.6 billion but would capture almost 50% of the benefits of HS2. On a wholly government funded basis the rail option would be less costly (rolling stock leasing costs would not arise).

If we assume that these benefits then are unavailable to HS2, HS2 is left half the benefits but all the costs. In practice the benefits would not entirely overlap, but they would seriously reduce the available benefit. It is plausible that some lengthening of long distance trains would also add capacity at relatively modest additional cost.

Virgin Trains' current (2010 timetable) shows 11 fast long distance trains on the WCML at peak times. Alternate trains case 2 shows how this can be increased to 13 which is two more than the number proposed in the full HS2 scheme in 2026. The alternative scheme also improves journey times and can be implemented as required typically 2018 in the event the HS2 demand predicted materialises.

Currently Virgins trains carry 447 passengers versus HS2 single trains 551 passengers. However the Alternative 2 case includes money for new running stock so if similar platform extensions as required by HS2 at Euston and Birmingham were carried out the Alternate case 2 can provide equal carrying capacity and train frequency.

Trains/hour	Virgin (2010)		Alternative 2 (2018)		HS2 (2026)	
	Peak	Day	Peak	Day	Peak	Day
Birmingham	3	3	4	3	4	3
Manchester	3	3	4	3	3	3
Liverpool	2	1	2	1	2	1
Preston	2	1	2	1	1	0
Glasgow	1	1	1	1	1	1

Alternative case 2 provides journey times between 6-8 minutes faster than current times, the further improvement created by HS2 is therefore about 22 minutes rather than the 30 minutes quoted.

A major advantage of these alternatives is that they deliver benefits more quickly, reducing congestion and crowding well before HS2 can have any benefit. They are also less dependent on needing to project high level of demand growth, naturally forming part of a suite of shorter lead-time developments that can be tailored to meet how demand actually develops. This avoids the risk of building a railway that is never needed, with the massive waste of resources this involves.

Travel between locations linked by the HS2 proposal currently represent 0.8% of all rail journeys in the UK, all rail journeys represent 7% of all distance travelled, government funding for HS2 first phase is estimated at £25bn with subsequent extension the total grant rises to £88 billion. The identified alternate schemes could be implemented leaving money for the UK regions for low emission public transport and communication solutions which we believe would provide far greater economic benefits with a much lower impact on the environment.
(Ref Office of rail Regulator ORR – National Rail Trends year book 2007-2008. DfT Transport Statistics Bulletin – national Travel survey 2008)

8. Alternative option Virtual meetings and Coach.

We can not find within the HS2 proposals any mention of how technology could help reduce the need for business travel, or indeed why they conclude that it would be ineffective. We consider that the reason business travel has not grown for the last 10-15 years is in part due to the growth of the internet and other technologies. If Government were to increase funding in non transport technologies, to improve directly business communications, this may restrict travel growth further at no dis-benefit to business and deliver far greater benefits to the economy.

In Appendix C we discuss the use of Internet based technology to allow business meeting to take place between remote location. This is not new technology and many businesses have reduced cost and lost working time by employing these methods.

27% of all trips and 23% of all miles travelled are for commuting and the school runs. which of necessity occur during the 6 hours of peak travel time. While these activities may not be addressed by HS2, the economic benefit case for HSR includes the benefits that come from minor reductions in lost time associated with commuting. Reducing congestion from these activities is a real alternative, as it frees capacity in the road system.

Again in Appendix C we outline how subsidised coach travel may help solve some of the difficult issues associated with road and rail peak time congestion.

HM Treasury Green Book is the overarching guidance on Appraisal and Evaluation in Central Government. In Chapter 5 Box 8 it provides a check list to help establish a broad range of options. This includes “Consider the full range of issues likely to effect the objective”, Identify the full range of policy instruments or projects that maybe used to meet the objectives”, “Develop and consider radical options”. We do not consider that this broader development of options to address the underlying transport and business objectives has been evidenced in the HS2 HSR proposals.

9. HS2 Cost comparisons and financing

The table below shows the comparative costs of HSR in the UK compared to other European countries. That the UK is so much more costly per unit distance shows that it will need a much higher level of utilisation to be economically viable and that it is inherently less well suited to UK conditions of relatively high population density and topography. The right hand column expresses the unit cost as a multiple of the European average.

The HS2 figures exclude any allowance for the cost of environmental damage, CO2 emissions, or for compensation to business, agriculture, tourism and individuals for the loss of value, amenity and damage to adjoining property.

Current European HSR Projects		Investment Euro Billion	Length (km)	Million Euro/Km	UK Cost vs. European average
UK	HS2	18.6	176	106 €	4.6
UK	HS1	5.8	108	54 €	2.3
TGV, France	LGV Est	3.1	300	10 €	0.4
	Rhine-Rhone	2.5	425	6 €	0.3
	Sud Atlantique	7	300	23 €	1.0
	Brittany - Loire	3.4	182	19 €	0.8
TAV, Italy	Rome – Milan	35	900	39 €	1.7
RAVE	Portugal Lisbon-Madrid	2.5	206	12 €	0.5

The assumptions for financing the line are that it will be totally Government funded with no provision for private financing or leasing of the rolling stock. Any such financing will reduce the present value of the project, we calculate that interest charges would be about £3billion per 1% of interest charged via external finance. *Ref HS2 reports Delivery and Funding*

10. Global climate change – Emissions

HS2 have not yet issued the technical details of the emissions that they estimate will be caused by HS2 during construction and operation. HS2 that their plans will either increase emissions by 26.5 Million Tonnes CO_2 or decrease emissions by 25 Million Tonnes.

In 2007 Booze Allen Hamilton /Temple issued an indicative assessment of the emissions for HSR construction however it was to compare HSR alternatives and did not accurately assess emissions. They allowed for the emissions involved in the steel, concrete and ballast components but did not appear to allow for the considerable earth works and tunnelling with the need for the large quantities of spoil to be transported and compacted and the temporary works required to divert roads and traffic during the construction period.

In operation, the emissions per passenger km will be heavily dependant on passenger demand and utilisation rates. If the demand is half that forecast, unless HS2 cut services, CO2/passenger km will be twice that predicted, unlike car, coach and to some extent air, train travel does not easily allow emission levels to be cut if passengers travel demand on a particular line are not met.

HS2 explain that HSR trains use 25kwh/km versus current conventional fast trains which they estimate at 14.3kwh/km, given the improvements possible with the next generation of conventional fast trains it is likely that HSR will emit twice the emissions/ passenger Km as 125mph trains for the same utilisation rates.

The biggest uncertainty in CO2 emissions cited by HS2 would appear to be the fuel mix for future power generation. We think that their low emissions case is consistent with a rapid UK move to totally nuclear and wind powered generation. In Appendix D we discuss this in more detail and draw comparisons with emissions from other transport types. We conclude that in the event the passenger forecasts are met, emission from HS2 travel will be about twice that of conventional rail, four times that of long distance coach and comparable with car travel based on an average car with 1.6 passenger (the UK norm). Unfortunately the level of switching from air calculated by HS2 and the comparatively limited extent of total domestic air travel mean the reduction from air switching is minimal.

When the detailed HS2 assessments are issued we will review in further detail.

11. Bluespace economic comparison

Besides the key deficiencies notes in the key finding, we have raised a number of other concerns about the analysis of the HS2 proposals:-

- An assumption that the scheme will be totally government funded with no allowance for private finance or leasing.
- No allowance for the reduction in benefits due to rail and road improvements identified as having better NBRs than HS2 taking place in the next 23 years.

Based on the key issues and these concerns we have prepared 3 sets of Present Value and Net Benefit Ratio calculations. Case A is based on the HS2 usage assumptions, Case B has an annual increase in demand of 2.5%/year to 2026 (as webtag guidance) plus the switched passengers but without the 36,000 “extra” passengers/day, and Case C has the increase set at population growth (0.7%/annum) plus the HS2 assumed switching of passengers.

Table 6 A Economic Assessment - HS2 base case Case A with Bluespace sensitivities

HS2 –Base case – Bluespace sensitivities £000s	Business benefits	Consumer benefits	Revenues	Reduced taxes	Other benefits	NBR
HS2 Economic Case	£17,407	£10,299	£15,010	£1,486	£1,000	2.41
Business value of time	£12,595	£10,299	£15,010	£1,486	£1,000	2.00
25% business traveller	£10,495	£11,034	£15,010	£1,592	£1,072	1.88
Fare price increase RPI after 20 years	£10,495	£11,034	£12,331	£1,592	£1,072	1.54
Lose of WCML track access fees	£10,495	£11,034	£9,411	£1,592	£1,072	1.28
Cost of funding 50% capital @ 1%	£10,495	£11,034	£7,985	£1,592	£1,072	1.19
50% lose of benefit attributable to road/rail schemes	£8,219	£8,204	£7,985	£1,183	£797	0.87

Table 6 B Bluespace Case B Demand increase 2.5%/year to 2026 (as webtag guidance) with HS2 assumptions for switching from road and air.

Bluespace Case 1 (webtag base) £000s	Business benefits	Consumer benefits	Revenues	Reduced taxes	Other benefits	NBR
Demand 2.5% growth to 2026	£10,452	£6,209	£9,107	£896	£603	1.00
Business value of time adjusted (webtag case)	£7,563	£6,209	£9,107	£896	£603	0.83
25% business traveller	£6,302	£6,653	£9,107	£960	£646	0.79
Fare price increase RPI after 20 years	£6,302	£6,653	£7,572	£960	£646	0.72
Lose of WCML track access fees	£6,302	£6,653	£4,644	£960	£646	0.62
Cost of funding 50% capital @ 1%	£6,302	£6,653	£3,226	£960	£646	0.59
50% lose of benefit attributable to road/rail schemes	£3,026	£3,823	£3,226	£551	£371	0.32

Table 6 C Bluespace Case C Demand increase 0.7%/year with no cut off, with HS2 assumptions for switching from road and air.

Bluespace case 2 0.7% growth £000s	Business benefits	Consumer benefits	Revenues	Reduced taxes	Other benefits	NBR
Revised Demand forecast 0.7% growth to 145,0	£11,644	£6,765	£9,909	£976	£660	1.14
Business value of time	£8,425	£6,765	£9,909	£976	£660	0.94
25% business traveller	£7,021	£7,248	£9,909	£1,045	£660	0.88
Fare price increase RPI after 20 years	£7,021	£7,248	£8,031	£1,045	£535	0.79
Lose of WCML track access fees	£7,021	£7,248	£5,111	£1,045	£341	0.69
Additional cost of funding 50% @ 1% as a redu	£7,021	£7,248	£3,685	£1,045	£246	0.65
50% lose of benefit attributable to road/rail schemes	£3,745	£4,418	£3,685	£637	£429	0.37

As can be seen the NBRs drop considerably below the HS2 base case. We have not allowed for the case where business passengers work on the train, which substantially reduces the benefit of any time saved: this would reduce the NBR for all demand cases to below 1.

The impact of going ahead with alternative road and rail schemes are kept separate at the bottom of each table, we can not tell the extent to which they will detract from the benefit of HS2, we have modelled it at 50%. Implementing the alternatives is not really an uncertainty so much as a conscious government decision, which HS2 assume will be to leave the road and rail congestion in place until 2026 & beyond rather than addressing the problems earlier.

12. Conclusion

We do not consider that the HS2 project is economically viable and if it goes ahead it occurs to us that in 30 years time the Public Accounts Select Committee of the day will question why (particularly at a time of fragile economic recovery) £25.5 billion of government grants where spent in this way. If phase 1 does go ahead we think it unlikely that Phase 2 will proceed because we assume that the decision makers will learn from the experience of, at that time, two HSR projects.

In carrying out this assessment we have been surprised at the extent to which the generally held view that HSR will reduce emissions, create economic benefit and reduce congestion is not supported by the data.

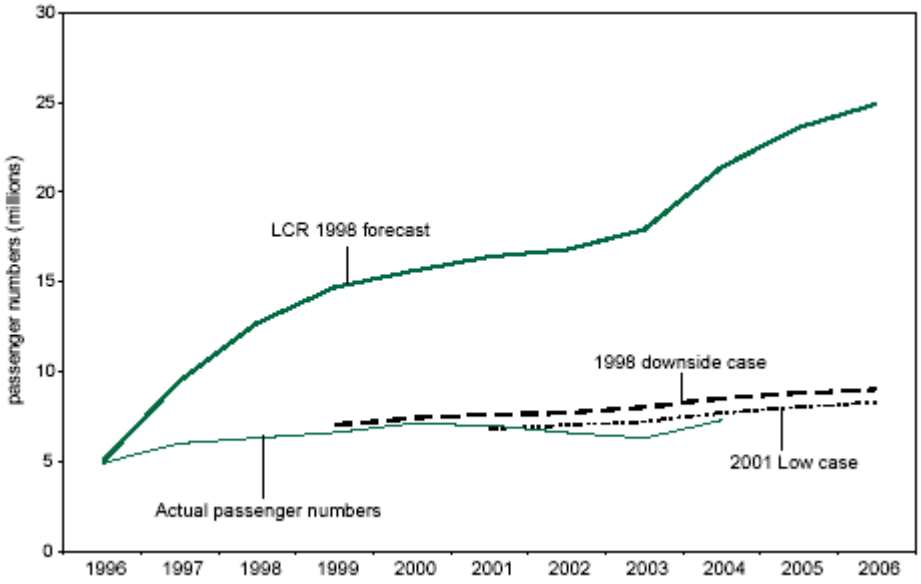
References

1. HM Treasury Green Book Appraisal and Evaluation in Central Government.
2. HS2 Proposals and Reports– Particularly the Demand and Appraisal Section
3. HS2 Reports Atkins - Baseline forecasting report
4. HS2 Reports Atkins – Road and Rail Alternative study
5. DfT Transport Statistics Bulletin – National Travel Survey 2008
6. Select Committee on Public accounts 2006 Thirty-Eighth Annual Report 1 Forecasting of passenger traffic.
7. DfT – Transport Analysis Guidance webtag unit 3.5 The Economic Objective.
8. DfT UK Air Passenger demand and CO2 Forecasts
9. Office of rail Regulator ORR – National Rail Trends year book 2007-2008.
10. ActonCO2 government web site.

Appendix A - Abstracts from the Select Committee on Public Accounts -Thirty Eighth Report
22nd Report from the Committee of Public Accounts, *The Channel Tunnel Rail Link*

1 Forecasting of Passenger Traffic

2. Estimates of passenger numbers have been progressively reduced. In bidding for the deal in 1996, LCR forecast that passenger numbers would reach 21.4 million by 2004 but actual numbers reached only 7. 3 million **(Figure 1)**. In 2004, passenger numbers and revenues were revised downwards and the central case numbers are now below the 1998 and 2001 low case forecasts.
Figure 1: Estimates of passenger numbers have been progressively reduced



Source: C&AG's Reports (HC 302 of Session 2000-01, Figure 6 and HC 77 of Session 2005-06, Figure 8)

3. Over optimistic forecasts of Eurostar's passenger numbers and revenues were produced when the project was first planned by British Rail and SNCF. Inaccurate forecasts were also produced ahead of the restructuring of the project in 1998 and, in 2001 and 2004, by the Department's advisers, …...

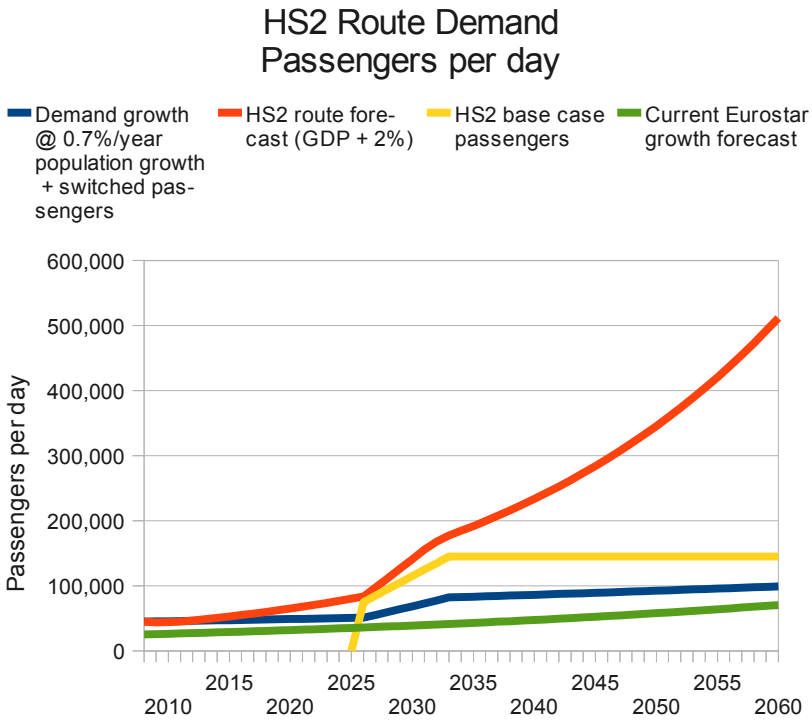
5. A further reason for the lower than expected passenger revenues is the success of the low-cost airlines in competing with Eurostar on price, and their much larger range of destinations. These events illustrate the difficulty of accurately forecasting revenues on novel major projects. The Link is moreover the only high speed railway in the country and the first new railway line for a hundred years, so there is no recent national experience with which to compare it.[5]

6. The Department told us that it has now learned from all this experience, and that the next time it considered undertaking a major transport project, it would factor more severe downside assumptions into its business case analysis.[6]

End of Abstracts.

Graph A1 HS2 Route Demand forecasts showing continued growth

For interest Bluespace prepared a graph showing the passenger demand if HS2 assumed demand elasticity with GDP continues to 2060, at this point over 0.5% of the population of the UK are travelling on the line every day.



Appendix B - An assessment of DfT webtag value of business travel

The DfT guidance for establishing the economic benefit of publicly funded projects is contained within Webtag www.dft.gov.uk/webtag/documents/expert/unit3.5.6.php

Hours saved and the valuation of saved travel time are the two key assumptions.

The hourly rate for train business time saved was set at £36.96 in 2002, this equates to a salary of about £70,000/year in 2010. For a bus business traveller the rate is set at £20.22, for commuters it is £5.04 and for personal travel £4.46 irrespective of the type of travel used.

The Webtag guidance recognises that if passengers move from one travel type to another the average cost of travel for the new travel type would need to be adjusted to get an accurate forecast of economic benefit. Between 2002 and 2026 when HS2 is due to commence operations it is forecast that train travel for this route will have increased by 3 to 4 times, the hourly rate should therefore be adjusted.

It is not plausible that there are sufficient high salaried business travellers to maintain the 2002 average hourly rate for the business travellers (30% of all travellers) assumed in the HS2 proposals. We calculate that a weighted hourly rate of £26.75 (2002) would reflect the use of train changes that have and are predicted to occur by 2026. We are also aware that a number of academics question the underlying basis of this form of valuation and we note that no other form of | Government expenditure evaluation uses this approach. The HS2 reports do not identify that they have made any correction in their assessments to update the valuation of time.

Business travellers that travel by train do so because they are able to work during the journey.

Jolin Warren in his paper The Railways mean Business, Attracting Business Travellers from Air to Rail , Published by Transform Scotland, November 2007 makes this point very clearly.

- “on a 4h40 train journey a dedicated traveller could work for 4h30 (allowing time to unpack and pack up)”
- “a rail traveller could accomplish over three hours of work and still have more than an hour to relax“
- “in the case of rail services with a longer journey time, the result is not additional lost work time but instead more time available to work on the train”.
- “Many attitudes to travel time are still stuck in the industrial mindset – travel is out with the working day because it happens away from the ‘place of work’. Yet when travelling by train, the journey can be a part of the working day”
- “It is vital to shift perception so that business travellers see the train as a type of mobile office, a place that can be part of the working day. ”

At Bluespace we think it maybe time that transport planners shift their perceptive and acknowledge that train time is not lost time.

The paper also details the problems of working on shorter trips, it is probable that in reducing travel time from 68 minutes to 38 minutes on the London to Birmingham route, 30 minutes of work time are lost rather than 30 minutes gained, we are doubtful that it is appropriate to credit time saved at the webtag rate. Clearly if this assumption were used in an economic assessment HS2 benefits would reduce to such an extent that the NBR would be less than 1 in most cases.

Finally, the HS2 analysis assumes that 30% of their passengers will be business passengers, we do not know the basis for this assumption. Based on Virgins passenger survey in 2008 & 2009, business travellers represent 24% of their passengers, in our analysis we will assess the impact of reducing this to 25%, still in our view a very high percentage.

Appendix C - Alternative options - Virtual meetings & high technology coaches.

In reviewing UK Transportation policy it is clear that for both economic and environmental reasons there are two key imperatives.

1) Reduction of the time business people spend travelling while increasing their internal and external, business to business and business to customer communications.
2) Reduction of road and rail overcrowding, congestion and cost as a result of commuting (including journeys to and from school).

The challenge is to make substantial improvements in these areas to increase the ease and convenience of personal travel without the need for added infrastructure, cost and an increase in CO2 emissions.

From the Travel survey data it is probable, given the declining trend in overall business travel, that with the development of the internet and the ability to have virtual meetings via the net businesses are already addressing the way they communicate. With the proposed increases in taxation for businesses that do not reduce their energy consumption there is added incentive to reduce travel.

While the need for business travel will always exist it is possible that the extent of travel could be held at or reduced below the population growth rate. In order to encourage this Government would need to ensure the development of high capacity broad band throughout the country and help small to medium businesses become familiar with the technology possibly through grants and training.

The more difficult problem would appear to be commuting and the school run. 27% of all trips and 23% of all miles travelled are for these purposes and by necessity they occur during the 6 hours of peak travel time. Home working and moving businesses out of city centres may be part of the solution but a more direct and practical approach is also required.

Current Public transport systems tend to be radial in direction, in and out of city or town centres, possibly requiring two or more changes to complete a journey. Commuter routes, bus or train, involve multiple stops losing time, using energy and causing congestion, getting to the start of a rail route may well require a car journey.

The internet can enable groups of people who regularly travel similar routes, at similar times, to be identified, forming pools of people for whom low cost (possibly free) coach transport could be provided. Occupancy targets would be above 75% rather than the current 30-40% for public service vehicles. Fleet route planning would use full logistics planning techniques rather than the current set time table approach

Transport could be by 20- 40 person coaches, the most energy efficient form of transport today and with the advent of battery, LPG/CNG, hydrogen or other technologies the most likely contender for further significant improvement. Initially they would be subject to congestion however for current car drivers they would be equally as fast and lower cost. Eventually by replacing 20-30 cars with one coach and reducing travel distances (direct routes) they can make significant reductions in congestion making travel more convenient for all.

We have not prepared a full analysis but if part of the £25 billion Government subsidy for HS2 were used in this way up to £500 million pounds / year could be made available to provide free or very

heavily subsidised travel to reduce car journeys by up to 5 billion miles or by 5% of all road journeys, if focused on congested routes a 15 -25% reduction in peak time travel may be achieved. This may well enable people to work who otherwise would not be able to afford the travel cost.

This approach would create the opportunity to reduce emissions by about 1 million Tonnes CO_2/year , 60 million Tonnes CO_2 over the evaluation period, twice the probable increase for HS2. The reduction would not be dependant on future power generation policy but would be dependant on a shift by individual car users to public transport however the risk of trying this approach is minimal versus that of building huge single route infrastructure projects.

Appendix D - Transportation CO_2 emissions

There is a presumption that HSR will reduce transportation emissions however if it generates new travel or switching from lower CO_2 emissions travel this may not be the case. The HS2 proposals suggest that a high speed rail line between London and Birmingham will either increase emissions by 26.5 Million Tonnes CO_2 or decrease emissions by 25 Million Tonnes the documents do not make clear against what base these assessments are made.
In order to get a general understanding of transport emissions we looked at the Government Act on CO2 web site.

Table 7. Transport Emission/passenger Km (Ref Act on Co2 www.actonco2.direct.gov.uk) .

CO2 Emissions	Kg/ passenger mile	Kg/ passenger mile	Kg/ passenger mil
	10 mile journey	100 mile journey	Adjusted see Note
Small car only	0.21	0.21	0.13
Large car only	0.41	0.41	0.26
Train only	0.09	0.09	0.11
Bus only	0.17	n/a	0.17
Coach only	n/a	0.05	0.07
Plane only	n/a	0.28	0.29

Note 1 - The adjustments reflect the mean 1.6 passengers /car and an addition for train, coach and air to allow for the added emissions to get to/from the station/airport.

For short journeys train is clearly the best form of travel, for mid length journeys not in a congested area a small car with the average 1.6 passengers has slightly more emissions than trains but coach travel has about 60% of the emissions. For longer distances coach is the least polluting form of transport followed by an average car with 3 or 4 passengers then train.

However High speed rail may have higher emissions than indicated in the Act for CO_2 guidance while we would think conventional fast trains 125mph maybe lower the additional speed doubles the CO2 emitted. HS2 provide a huge variance in their predictions, their upper limit probably reflects the growth in travel generated by HS2 itself, the higher CO_2 emissions for HSR versus lower speed trains and assumes improved power generation average fuel mix.

The HS2 forecast of a 25 Million Tonne reduction in CO_2 we think is based on the assumption that trains in the future run on zero polluting power generated solely by nuclear or renewable while the transport type it replaces stay with their current fuels and efficiencies. It maybe that by 2080 all energy will come from clean sources but if so it will be available to all land based transport.

We looked further at power generation fuel mix. (Ref Association of electricity producers www.aepuk.com/about-electricity/facts-figures/)

The government has plans to increase both nuclear and wind power however the current new

power stations with Section 36 consent (first step in the planning process) and the forecast closures would, given distribution losses and the interruptible nature of wind power, by our calculations ,indicate that by 2025 nuclear and wind may provide about 23% of the UK's needs.

We considered the extent to which the remaining supply comes from coal or gas. Currently UK gas production is in decline and it will be replaced by LNG and gas from East Russia or the Middle East. These sources will be more expensive, less reliable and have significantly greater transmission losses with associated CO_2 emissions. For the UK to become more reliant on gas will require substantially more storage with an additional cost and further energy losses.

For these reasons we estimate that gas will decrease to 42% of the supply and coal will increase to 35% and the CO_2/Gwh for gas will increase about 30%. If a radical decrease in energy usage overall could be achieved via transportation, housing and industrial policy then our estimates may be pessimistic.

Electricity is sold in 30 minutes segments, the price and fuel mix varies for each segment with day time peak use being more expensive and using higher CO_2 (hydrocarbon) emitting fuels. We calculated that for a typical 18 hour/day train usage profile a 5% CO_2 emission increase over the daily average fuel mix was appropriate. Note (2)

Table 8 UK Power Generation fuel mix (Ref AEP 2010, 2025 Bluespace)

UK Power generation CO2 emissions	2010 Reported Mix	Tonnes CO2 /Gwh	2025 Note (1)	Tonnes CO2 /Gwh
Coal	0.31	910	0.35	910
Gas	0.46	393	0.42	511
Nuclear	0.13		0.15	
Wind	0		0.08	
Other	0.1	350	0	
Mix (24 hours)		498		533
Mix 18 hours Note (2)		524		561

We think that HS2 have assumed a lower rate of CO2 then the current 498 Tonnes /Gwh which we consider might be optimistic.

The emissions involved in building new nuclear power stations and wind farms are considerable, due to the amount of concrete and steel involved, in practice it will be many years before the shift in generation mix actually show a real reduction in CO_2 emissions

When added to the substantial emissions during the construction phase which have not yet been published by HS2 we conclude that at start up HS2 emissions will be at or above the upper limit they have forecast. We will review the HS2 emissions in more detail when the HS2 Sustainability Technical Appendices are made available.