

Appendix 6



Carbon Impacts of HS2

Prepared by Ian Thynne & JMP

6 CARBON IMPACTS OF HS2

Prepared by Ian Thynne & JMP

Overview

High speed rail is also an important part of our plans for a low carbon economy, helping us meet our climate change targets by encouraging millions out of their cars and off the planes onto the train. (Philip Hammond, Foreword to High Speed Rail: Investing in Britain's Future.)

- 6.1 DfT claims that HS2 will be broadly carbon neutral. The vagueness of the statement is commensurate with the standard of the Green House Gas report presented by DfT. Unfortunately this broad assessment fails to properly consider a number of factors that affect carbon emissions.
- 6.2 The DfT's own business plan for 2011 – 2015 states it will:
"Simplify transport funding and decision making, driving smarter investment to encourage low carbon transport and green growth".
- 6.3 HS2 will have a number of impacts on different factors which are considered in this appendix which will demonstrate that HS2 is not part of a low carbon future:
 - Consumption of electricity.
 - Change from domestic flights to medium and long haul flights.
 - Modal shift from domestic air to rail.
 - Assessment of operational and construction carbon.
 - Impacts on road transportation.
- 6.4 A review of the appraisal of the HS2 Greenhouse Gas Report shows that the assumptions of both HS2 and the DfT are inaccurate and misleading. It also demonstrates that based on the information provided, HS2 will not even be broadly carbon neutral, but is likely to increase the UK's carbon emissions. Thus support for HS2 appears to be in direct conflict with the Secretary of State's recent announcement on the changes to the project appraisal methodology which will give significantly greater emphasis and priority to projects which reduce carbon emissions.
- 6.5 One area of concern is the lack of clarity in the consultation material over what is being assessed and what is meant by the 'proposed route' in the

context of the Greenhouse Gas Report (the 'HS2 Ltd Report'), paragraph 1.1.2 of the report states:

"A full appraisal of the scheme between London and Manchester and Leeds would be undertaken during the course of 2011 to take account of the more detailed scheme proposals to Manchester and Leeds, as well as any policy revisions with respect to energy, carbon and transport that may have emerged by this stage. For this report, we have considered what the wider network might be in the longer term, up to and beyond Manchester and Leeds, in order to gain an understanding of what the full long term effects might be".

- 6.6 This could imply that the proposed route is actually different from the meaning used elsewhere in the Consultation documents, and that the Green House Gas Report assesses the 'Y' network and beyond (although no reference is made to the 'Y' network) or that benefits from the Y have been considered in the assessment of Phase 1 London – West Midlands.
- 6.7 However, if it is assumed that the Greenhouse Gas report does only relate to London – West Midlands then Phase 1 cannot possibly be even close to carbon neutral as the high construction and operational carbon impacts will not be offset by a reduction of domestic aviation. There are no domestic flights between London and Birmingham and the time savings from further north (Manchester and Scotland) are too marginal to create modal shift from air.

Consumption of Electricity

- 6.8 HS2 will have quite high CO2 emissions related to the consumption of electricity. The amount of emissions will be dependent on the carbon intensity of grid electricity and whether or not the UK moves to cleaner greener fuels in line with targets that have been set. The assumptions made about electricity consumption in the carbon report are broadly adequate and provide a range of results which are fair given the amount of information provided. It is therefore accepted that HS2 will have relatively high carbon emissions from its operations.
- 6.9 A further issue in relation to the carbon impact is that the HS2 trains will travel at speeds significantly greater than European high speed trains. HS2 Ltd's high speed (360kmh) trains have a 90% higher electricity demand than

regular (200kmh) trains. In recent months, Chinese high speed rail operators have reduced their high speed trains to 300km/hr to reduce the cost of energy. The UK's energy market is neither stable nor self reliant. With reliance on overseas supplies and the decommissioning of several domestic power stations without any permitted replacements, there is no agreed strategy in place to provide a more stable energy market in the UK to date. Consequently HS2's enormous consumption, upto 18 high speed trains per hour on the section between London and Birmingham for the complete Y, is highly vulnerable (both in terms of the level of emissions and price).

Change from Domestic Slots to Medium and Long Haul Flights

- 6.10 The Green House Gas report (Chapter 6) sets out the impacts on carbon emissions as a result of a switch in domestic flights to HS2 using two methodologies.
- 6.11 The first methodology provides a theoretical best case reduction of 23.2 MtCO₂, although this relies on a complete switch of domestic flights to HS2 and no reuse of these slots. A much more realistic best case scenario suggests no change in emissions based on the assumption of no change in domestic flights.
- 6.12 The second methodology sets out the worst case scenario but cannot quantify what it is. The uncertainty relates to the subsequent impacts of freed up domestic flights slots being switched to international flights e.g. HS2 Ltd do not know if a domestic slot will then be taken up by a medium haul flight to Europe or a long haul flight to America. The report therefore does not try to quantify and instead opts to base its broad conclusion on emissions on a scenario that does not see the re-use of domestic flight slots.
- 6.13 International flights are more commercially viable for airport operators and Heathrow's domestic flights have continued to reduce in recent years (see appendix 11). Furthermore, DFT has publicly claimed that the HS2 Heathrow spur is about enhancing international connectivity. DFT claim the Heathrow Link will:

"Bring Manchester and Leeds city centres within 70 and 75 minutes respectively of the country's main hub airport and transforming its accessibility from the Midlands and the North release runway capacity so that Heathrow could enhance its operational resilience and potentially

develop its route network” (DfT Exhibition Banner, The case for high speed rail)

- 6.14 However, in order to enhance international connectivity more use has to be made of the constrained capacity at Heathrow. Colin Matthews, BAA’s Chief Executive is quoted as saying:

“...BAA would like more passengers to arrive [at Heathrow] by train. High Speed rail would attract people who currently arrive by short-haul flights, freeing slots for more long-haul flights”

- 6.15 And Nigel Milton, Director of Policy and Political Relations at Heathrow told the ENDS Report (an environmental website):

*“No sensible, well-informed person still seriously pretends HS2 is a green alternative to a third runway. The question now is given no third runway, how we can maximise the effectiveness of our limited capacity at Heathrow. **That means more long-haul flights...**every time BMI or British Airways have cancelled a domestic route in the past, they’ve replaced it with a more profitable medium- or long- haul route. That’s exactly what will happen when HS2 comes and more domestic routes get cut”.*

- 6.16 DfT appears to be relying on the EU Emissions Trading Scheme (EU ETS) to control the likelihood of domestic slots going international, and therefore reduce HS2 impacts on carbon. No assessment of this has been carried out and HS2 Ltd would appear to be ‘hoping’ this has the desired effect. However, the aviation industry led by BAA would suggest that this control is highly unlikely to be effective. This assumption is supported by an academic study by Dr Elena Ares for the House of Commons Library, Science and Environment section which concludes:

“According to the EU Commission’s estimates the theoretical impact of inclusion is that emissions reductions of 183 millions tonnes of CO₂, a 46% reduction compared to business as usual will be achieved by aviation as they will be capped at 2004-06 levels. However as the Commission points out the option of purchasing credits from within the EU ETS and the Kyoto schemes mean that other options are available to the aviation industry and actual cuts are not likely to be anything as significant.” (Dr Elena Ares, 27 April 2011, House of Commons Library, Science and Environment Section).

- 6.17 HS2 Ltd has not done the work to enable a proper assessment of what effect the EU ETS would have on the freed up domestic slots switching to international. There is no inclination within the aviation industry,

particularly at BAA to freeze domestic slots for the good of the environment and the EU ETS is untried, untested and is currently considered to be relatively ineffective. Therefore, the HS2 claim that it will be “broadly carbon neutral” is based on the hope that freed up domestic slots will not be used for international purposes and HS2 Ltd’s own report acknowledges that the impacts could be negative if this were not to happen. The case presented by the aviation industry reduces this hope to a highly unlikely scenario.

Modal Shift from Domestic Flights to HS2

- 6.18 HS2 acknowledges that the major competitor with High Speed Rail is air travel. This is also the area where any significant carbon savings are likely to exist as in theory the operational carbon generated by HSR (per passenger km) should be less than that for the equivalent journey by air.
- 6.19 HS2 Ltd has provided no modelling or flight information making it difficult to assess their appraisal. However, previous reports¹ have set out more comprehensive assessments and concluded that the only aviation competition for high speed rail is the London to Scotland links, because there are currently no Birmingham or Leeds flights to London and in 2008 rail had 80% of the rail/air market from Manchester to London. The domestic air market has declined in recent years as airlines have moved away from less profitable domestic flights. HS2 only predicts a 30min saving, on the current minimum 4hr rail journey time to Scotland², when the Y is completed. This is not sufficient to achieve any appreciable modal shift from air. Thus any real benefits in the Greenhouse gas report can only be assumed to come from if HSR links are made all the way to Scotland. However, even with a high speed rail link to Scotland there would still be a 38%³ aviation share of the London to Edinburgh route.
- 6.20 Any CO2 benefits would happen after 2033 and the completion of the ‘Y’. This means that HS2 would be in considerable carbon debt until the full benefits can be explored. With no supporting data, it is difficult to assess

¹ Steer Davies Gleave - Potential for modal shift from air to rail for UK aviation, 2009

² It is noticeable that the Consultation Document at fig 2 refers to current Edinburgh to London journey time of 4hr 30 mins. However, ECML have now introduced a 4 hour service 19 times per week. Therefore the correct comparison time should be 4 hours and not 4hrs 30 minutes.

³ Steer Davies Gleave - Potential for modal shift from air to rail for UK aviation, 2009

the information provided, and more importantly it is difficult for HS2 to be able to justify their conclusions.

- 6.21 In 2007 Booz Allen Hamilton's produced a report for DfT which assessed the carbon impacts of a possible new North-South rail line. The analysis included CO2 emissions from construction and operations over a period of 60 years. The 2007 report showed that carbon emissions parity could not be achieved for the London-Manchester route. The rail mode share required to offset additional emissions would exceed 100%, i.e. the entire carbon emissions generated by domestic flights is less than the increase in emissions from high speed rail.
- 6.22 JMP's analysis of HS2 for 51M uses assumptions on the rail services beyond the 'Y' network for the Scotland links because no information has been provided by HS2. The broad analysis shows that alongside the 100+% shift from Leeds and Manchester flights to HS2 that would be required for carbon neutrality, 88% of all flights from Glasgow would also need to switch to HS2. It must be acknowledged that this is only to make up for the impacts of the London to Birmingham route. The impacts of the whole 'Y' network are not yet known.
- 6.23 In simple terms, the modal shift needed to achieve even 'carbon neutrality' is impossible. For the London to Birmingham route to achieve parity, the whole 'Y' network has to be in operation, and more than 100% of flights need to be removed from the skies. Even in the unlikely situation of HS2 being the preferred mode for travel from Glasgow to London, there would still be a considerable amount of domestic flights with the intended purpose of interlining. This point is underlined by examples in Europe whereby airlines still fly regular services between cities connected by HSR (Madrid – Barcelona still has over 20 flights per day and Paris – Lyon up to 9 flights a day).

Operational and Construction Impacts

- 6.24 A summary of operational carbon in the Greenhouse Gas report is given in table 4 and using HS2's analysis one can only conclude that Phase 1 is hugely carbon negative. As described above, Phase 1 will not attract passengers from air and thus the most optimistic conclusion has to be that HS2 Phase 1 will have no impact on domestic aviation as eluded to in paragraph 6.1.3

“for the purposes of completing this appraisal, a zero net change in air travel related to carbon emissions was used as a mid point”.

Using HS2’s own figures this results in an increase in carbon emissions of some 15.7MtCO₂e.

- 6.25 There is also a serious concern that the carbon emissions assumed for the construction impacts are flawed. HS2 Ltd has used a methodology that fails to consider Government endorsed approaches set out in the Greenhouse Gas Guidelines for Business (2010 Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting). JMP (Sustainable Transport Consultants) has used this approved methodology to assess the impacts of emissions associated with the construction impacts of HS2. The findings are considerably different from HS2 Ltd whose assessment is based on a more simple CO₂ / £ equation. Using the approved methodology above, JMP has assessed the likely emissions for construction as being in the region of 13.6MtCO₂e compared with HS2 Ltd’s assessment of 1.2 MtCO₂e
- 6.26 In support of this view, a high level comparison has been made with Crossrail. This suggests that the HS2 assessment is a significant underestimate of the true impact. Crossrail embedded carbon emissions have been assessed at 1.7MtCO₂e⁴ and the major generation of these emissions is from the 22km of tunnelling. In contrast, HS2 embedded carbon emissions are assessed to be only 1.2MtCO₂e, although the route length is some 180km and like Crossrail it has some 20km of tunnelling. Even this basic comparison suggests a significant under estimate of embedded carbon.
- 6.27 In addition HS2 Ltd have accepted that their assessment of construction spoil of 700,00m tonnes is a major underestimate. A very high level assessment by 51m indicates that the actual spoil quantity is likely to be at least 10 times more than the figure stated by HS2 Ltd. This will result in a significant increase in embedded carbon and further supports 51m view that the embedded carbon estimate are underestimated by some magnitude.
- 6.28 Even only taking HS2 Ltd own figures for the operational (15.7MtCO₂e) and embedded (1.2MtCO₂e) carbon impacts results in an increase in carbon emissions of a minimum of some 17MtCO₂e and thus HS2 is hugely carbon

⁴ Crossrail factsheet - www.crossrail.co.uk

negative and would lead to an increase in UK GHG emissions. This is a serious problem which needs to be properly examined in the context of international and domestic obligations to reduce the UK's emissions. Plainly to proceed with the project on the assumption that it is "green" would be wrong.

6.29 Due to the lack of data shown, it is not possible to critically appraise the cost of carbon. Nevertheless, HS2 has costed it at somewhere between +£1.37billion (i.e. the value of carbon savings) and -£4.6billion (the value of additional carbon used). However, they acknowledge this could be worse if freed up domestic slots become international flights. Again, no figures have been provided or a proper assessment been made. Using the same conclusion as for operational carbon above, table 8 of the Green House gas emissions report, calculate the cost to be -£2billion. If the aspirations of the aviation industry are realised, and freed domestic slots are switched to long haul flights, then the cost could rise further. We are concerned that the business case does not include a figure for the cost of carbon, nor is there any supplementary business/economic case which does so. This results in no proper consideration of the carbon impacts of HS2 having been undertaken.

6.30 The report fails to provide an adequate timeline of emissions. The construction and operation of Phase 1 will be highly carbon negative. Only when the 'Y' network is constructed and operated will there be any limited competition with air travel, and even then for the reasons set out above carbon benefits are highly unlikely as any relinquished domestic slots will be used for medium or long haul flights. HS2 would have to provide a direct link to Scotland before any noticeable impact on aviation is made. Therefore HS2 will rack up considerable carbon deficits prior to any noticeable impacts on domestic aviation. It is misleading to portray the carbon impacts of a fully operational 'Y' network with links to Scotland without considering the 30+ years of carbon deficit.

Impacts on Road Transportation

6.31 Rail is normally considered to be a cleaner more efficient alternative to road transportation. However, HS2 acknowledge that this multi billion pound rail scheme will have minimal impact on road. Only 7% of HS2 passengers will have left their cars at home or the Birmingham Interchange (HS2 Demand for Long Distance Travel April 2011). This has an almost negligible impact on road emissions as set out in HS2 Ltd's report.

- 6.32 Table 4 of the HS2 Ltd report states the scheme will achieve a reduction of between 0.8MtCO₂ and 2.2 MtCO₂ as a result of removing cars from the road. The report uses a reasonable best case estimate of 1MtCO₂ reduction in road emissions over 60 years as a result of HS2. In 2009 the DfT reported that the UK's annual road transport emissions were 113MtCO₂.
- 6.33 There is no reason to doubt the figures presented by HS2 Ltd, but there is a more important issue to be considered. The single largest public transport intervention for the foreseeable future will have no noticeable impact on the UK's transport emissions. This is highly concerning given that road transportation provides a quarter of the UK's emissions which should make this a prime area for helping to meet the overall 2050 reduction goal of 80%.
- 6.34 HS2 relies on satisfying a latent demand in travel, (people who are only making the journey because of HS2) with a 100% increase over and above the demand growth for the classic network. The report makes no acknowledgement of the number of additional passengers generated by HS2, and the additional emissions caused by these new journeys. It is likely that the increased demand of energy intensive rail (HS2) will outweigh any potential reduction in domestic aviation
- 6.35 There is a further omission within the carbon report related to the impacts on road transportation. The report fails to acknowledge any effect the opening of a new station near the Birmingham NEC would have on road trips.
- 6.36 Paragraph 3.10.1 of the Appraisal of Sustainability (Main Report 1) states:
"A new HS2 station would be constructed adjacent to the NEC and just to the east of the M42. And It is likely that some 7,000 car parking spaces also would be required and that this would be provided in multi-storey accommodation."
- 6.37 HS2 proposes to have city centre stations and then upto 3 parkway stations for the full Y. This is in direct contrast to the classic network which serves numerous station/cities directly in the London to Manchester/Leeds corridors. The result of the small number of HS2 stations will be that a significant number of its passengers will have to drive to catch HS2, eg Birmingham Interchange has 7000 parking spaces. The impact of these additional car journeys does not appear to have been taken into account in the evaluation, either in relation to CO₂ or in relation to air quality.

Conclusions

- 6.38 The first thing to notice about the HS2 Ltd report is the amount of assumptions and incompleteness of the supporting data. The report acknowledges that:
- “During the later stages of preparing the AoS it became apparent that a full set of results from the HS2 Demand Model would not be available. Subsequently, the approach agreed with HS2 Ltd was to adapt the detailed methodology to reflect current availability of the HS2 Demand Model results.”* (para 5.1.1 of Greenhouse Gas Report)
- 6.39 This lack of a robust report makes it very difficult to fully determine the impacts on carbon. It also means that the conclusions are just as vague, which results in the claim that HS2 is ‘broadly carbon neutral’. This claim deliberately ignores some significant impacts which would otherwise overturn the statement to read ‘highly carbon negative’. The information provided on the modal shift from air to rail is not clearly presented in the report. Further studies suggest the modal shift from to rail on the proposed route would not be enough to outweigh the operational and construction emissions. The most damaging omission for the report is a failure to acknowledge that any freed up domestic slots would be used for international slots. When a proper assessment of the carbon impacts is undertaken that factors in a shift of domestic slots to international, it is impossible to conclude that HS2 would be ‘broadly carbon neutral’. Given that HS2 has little or no impact on road emissions this multi billion pound ‘green’ transport scheme fails comprehensively to meet the green rhetoric of Phillip Hammond and the only part it plays in reducing UK’s ambitious emissions targets is a highly negative one.
- 6.40 In reality HS2 will increase the UK’s carbon emissions and will have a damaging affect on the UK’s attempts to meet an 80% reduction in CO2 emissions by 2050.