Phase 2b Western Leg Information Paper

E27: Carbon

This paper outlines the carbon footprint and greenhouse gas assessment for the Proposed Scheme.

It will be of particular interest to those potentially affected by the Government's proposals for high speed rail.

This paper was prepared in relation to the promotion of the High Speed Rail (Crewe - Manchester) Bill. Content will be maintained and updated as considered appropriate during the passage of the Bill.

If you have any queries about this paper or about how it might apply to you, please contact the HS2 Helpdesk in the first instance.

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1 Introduction

1.1 High Speed Two (HS2) is the Government's scheme for a new, high speed north-south railway, which is being taken forward in a number of phases. Phase One will connect London with Birmingham and the West Midlands. Phase 2a will extend the route from the West Midlands to Crewe. The Phase 2b Western Leg will connect Crewe to Manchester. As set out in the Integrated Rail Plan, published in November 2021, HS2 East is proposed to deliver a new high speed line from the West Midlands to East Midlands Parkway.

1.2 HS2 Ltd is the non-departmental public body responsible for developing and promoting these proposals. The company works under the terms of a Development Agreement entered into with the Secretary of State for Transport.

1.3 The construction and operation of Phase One of HS2 is authorised by the High Speed Rail (London – West Midlands) Act 2017 and Phase 2a by the High Speed Rail (West Midlands – Crewe) Act 2021.

1.4 In January 2022, the Government introduced a hybrid Bill to Parliament (hereafter referred to as 'the Bill'), to seek powers for the construction and operation of the Phase 2b Western Leg (the Proposed Scheme), which is called the High Speed Rail (Crewe – Manchester) Bill. The Proposed Scheme comprises the Phase 2b Western Leg from Crewe to Manchester and several off-route works. It also facilitates the delivery of Northern Powerhouse Rail by providing the Crewe Northern Connection and junctions and other infrastructure to be used in future schemes.

1.5 The work to produce the Bill includes an Equalities Impact Assessment and an Environmental Impact Assessment (EIA), the results of which are reported in an Environmental Statement (ES) submitted alongside the Bill. The Secretary of State has also published draft Environmental Minimum Requirements (EMRs), which set out the environmental and sustainability commitments that will be observed in the construction of the Proposed

Scheme. For more information on the EMRs please see Information Paper E1: Control of environmental impacts.

1.6 The Secretary of State for Transport is the Promoter of the Bill through Parliament. The Promoter will also appoint a body responsible for delivering the Proposed Scheme under the powers granted by the Bill. This body is known as the 'nominated undertaker'. There may be more than one nominated undertaker. However, any and all nominated undertakers will be bound by the obligations contained in the Bill, the policies established in the EMRs and any commitments provided in the information papers.

1.7 These information papers have been produced to explain the commitments made in the Bill and the EMRs and how they will be applied to the design and construction of the Proposed Scheme. They also provide information about the Proposed Scheme itself, the powers contained in the Bill and how particular decisions about the Proposed Scheme have been reached.

2 Overview

2.1 This Information Paper outlines the carbon footprint and greenhouse gas assessment for the Proposed Scheme.

3 HS2 and climate change

3.1 Volume 3 of the ES includes a greenhouse gas assessment. This paper outlines HS2 Ltd's approach to quantifying and assessing the greenhouse gas emission impact of the Proposed Scheme. It also reports the greenhouse gas emission impact in the form of the 'carbon footprint' of the Proposed Scheme and includes a discussion of its potential significance.

3.2 A carbon footprint is the total greenhouse gas emissions associated with a particular scheme, policy or development. The greenhouse gas emissions are converted into tonnes of carbon dioxide equivalent (tCO_2e)

which standardises the global warming potential of the main greenhouse gases into one index based on the global warming potential of CO_2.

3.3 Further detail on how the combined impact of the Proposed Scheme and potential climate change on the receiving environment and community has been assessed; and how the Proposed Scheme's resilience and capacity to cope with potential climate change impacts has been assessed is available in Information Paper E26: Climate change adaptation and resilience.

4 Policy background

4.1 The Proposed Scheme has developed against a background of emerging concern about climate change. The Kyoto Protocol of 1997 took the lead in converting this concern into action at an international level. The Paris Agreement – which was ratified and entered into force in November 2016 – sought to strengthen the global response to climate change. A central aim of the Paris Agreement is to limit global temperature increase this century to below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

4.2 In the UK, the Climate Change Act 2008 sets statutory targets for carbon reduction. The Climate Change Act 2008 requires at least an 100% reduction in carbon emissions from 1990 levels by 2050. To ensure that regular progress is made towards the target, the Climate Change Act 2008 also established a system of carbon budgets. The first six carbon budgets, leading to 2035, have been set in law. Meeting the fourth (2023-27), fifth (2028-2032) and sixth (2033-37) carbon budgets will require that carbon emissions are reduced by 50% (by 2025), 57% (by 2030) and 78% (by 2035) respectively relative to 1990 levels.

4.3 The Department for Transport (DfT) Transport Decarbonisation Plan (TDP), published in July of 2021, sets out how the Government intends to decarbonise the transport sector in line with the legally binding carbon budgets and delivering net zero by 2050. HS2 is one of several major

infrastructure projects that is fundamental to this. The Government intends to achieve this by prioritising key areas including: accelerating modal shift to public and active transport; and decarbonising how we get our goods.

5 HS2 Ltd policy

5.1 HS2 Ltd's Environmental Policy states an aim to "minimise the carbon footprint of HS2 towards a goal of net-zero carbon emissions, build a network that is climate resilient for the long term and deliver zero carbon journeys from day one of operation".

5.2 HS2 Ltd will apply the following carbon minimisation hierarchy:

- calculate the carbon footprint of the Proposed Scheme and use this as a tool to assess the potential to reduce carbon across the design, construction and operational phase;
- consider low carbon options in developing the detailed design of the Proposed Scheme;
- reduce embedded carbon in construction materials and carbon emissions from construction works, where practicable;
- reduce energy requirements of the Proposed Scheme and maximise the energy efficiency of operations, where reasonably practicable;
- use and/or generate low carbon energy, where reasonably practicable; and
- sequester carbon, where reasonably practicable.

5.3 This approach forms a hierarchy of actions, with avoidance of carbon-emitting actions generally being the most preferable option. The carbon footprint will be calculated at appropriate intervals to determine progress in carbon reduction.

6 Assessment of greenhouse gas emissions

6.1 The greenhouse gas assessment takes a life cycle assessment approach consistent with the principles set out in the following standards:

- BS EN 15978: 2011 – Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method;
- BS EN 15804: 2012+A1:2013 – Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products; and
- PAS 2080 – Carbon management in infrastructure.

6.2 The scope of the greenhouse gas assessment is outlined in Table 1 in Appendix A.

6.3 The greenhouse gas assessment covers carbon emissions from construction and 120 years of operation to align with the assumed design life of the Proposed Scheme. The assessment is based on early design information and a number of assumptions. As a result, the greenhouse gas assessment adopts a 'reasonable worst case scenario'. For example, it is assumed that there will be no carbon emissions reduction improvements within the cement and steel industries between the time of this assessment and the construction of the Proposed Scheme, and that the carbon intensity of UK grid electricity will reduce in accordance with HM Treasury's Green Book Guidance.

6.4 The greenhouse gas assessment establishes a benchmark for the Proposed Scheme and will be used as a tool to assess the potential to reduce carbon across the design, construction and operational phase.

6.5 The greenhouse gas assessment covers a long timescale and as such requires a number of assumptions to be made. This includes the rate of replacement of fossil fuel generation capacity with low carbon alternatives, the ability of the steel and cement industries to implement greater efficiencies and the rate of uptake of electric cars.

7 Carbon footprint

7.1 Table 2 in Appendix A summarises the Proposed Scheme's carbon footprint.

7.2 Table 3 in Appendix A reports the projected carbon emissions – in grams of CO_2e per passenger-km (gCO_2e/pkm) – in 2039 (opening year), and for 2050 and beyond.

7.3 The significant passenger capacity of the Proposed Scheme, combined with its ability to draw power from an increasingly decarbonised national grid, means that it will be an effective low carbon transport solution for travel from Crewe to Manchester in 2039. In terms of emissions per passenger kilometre, the Proposed Scheme will emit 0.81 gCO_2e/pkm, compared to the average of petrol and diesel cars (94 gCO_2e/pkm), electric cars (1.8 gCO_2e/pkm), intercity rail (25.5 gCO_2e/pkm) and UK domestic flights (91.9 gCO_2e/pkm), based on projected carbon emissions in 2039. It should be noted that the intercity rail forecast is for the entire conventional rail network, including the predicted mix of both diesel and electric trains in 2039, as well as decarbonisation of the grid for the electrified portion of the network.

7.4 The carbon emissions associated with the construction of the Proposed Scheme are substantial, as might be expected from a national level infrastructure scheme. The construction carbon footprint is estimated to be 4,758,000 tCO_2e. The Proposed Scheme's operational emissions are anticipated to result in 1,325,000 tCO_2e over the 120 year operational assessment period. The benefits and loads of the Proposed Scheme (modal shift) are anticipated to result in a saving of -511,000 tCO_2e over the 120 years.

7.5 The Proposed Scheme's construction programme is expected to run from 2025 to 2038 and will therefore intersect the fourth (2023-27), fifth (2028-32), and sixth (2033-37) carbon budgets. Construction carbon emissions from the Proposed Scheme are expected to contribute approximately 0.1% of the UK's total carbon budget between 2025 and 2038. Operational carbon emissions are projected to be less than 0.01% of UK total transport emissions in 2039 (the Proposed Scheme's opening year).

7.6 On the 1st January 2021 the UK's participation in the European Union's Emissions Trading System (EU ETS) was replaced by the UK Emissions Trading Scheme (UK ETS) covering England, Scotland, Wales and Northern Ireland. The UK ETS operates in a similar manner to the EU ETS. It is a cap-and-trade mechanism whereby a limit on GHG emissions is set for energy intensive sectors such as electricity generation, cement and steel production, and commercial flights within the EU. Organisations covered by the cap are allowed to trade emission allowances with one another.

7.7 The greenhouse gas assessment is sensitive to a number of assumptions and there is a level of uncertainty around the assessment of GHG emissions when projecting into the future. Accordingly, sensitivity analyses have been undertaken looking at different scenarios and assumptions that would affect the Proposed Scheme's emissions in the future.

7.8 HS2 Ltd is committed to minimising the carbon footprint of HS2 towards a goal of net-zero carbon emissions by implementation of its Environmental Policy. A carbon minimisation approach has been set for Phase One of HS2, which will set a precedent for the Proposed Scheme to continue and build upon. Best practice carbon management in infrastructure guidance from the Construction Leadership Council and the Green Construction Board has also been adopted.

7.9 HS2 Ltd's Net Zero Carbon Plan seeks to accelerate the ambition of the construction industry to realise net zero during the construction phase of the Proposed Scheme and also to procure zero carbon electricity from day one of operation. These aspirations have not driven the main results of this assessment but have been considered as part of the sensitivity analysis.

8 More information

8.1 More detail on the Bill and related documents can be found at www.gov.uk/hs2-phase2b-crewe-manchester.

Appendix A:

Table 1: Scope of the greenhouse gas assessment

Life cycle stage	Activities included
Before use stage	• Product manufacturing • Transport of construction materials from the factory gate to the construction site • Construction processes including water use • Emissions and removals from land use change during construction
Use stage	• Emissions and removals from land use change during operation • Repairs and maintenance • Replacement • Refurbishment • Operation of infrastructure including energy and water use • Operation of HS2 rolling stock
End of life	• 'End of life' deconstruction, transport, waste processing and disposal
Benefits and loads beyond the system boundary	• Benefits and loads associated with modal shift of passenger and freight journeys. • Emissions resulting from construction works to third party assets impacted by the Proposed Scheme.

Table 2: The Proposed Scheme's carbon footprint from construction and operation up to 2050 and over 120 years

	Tonnes CO_2e		
Work stage	**Life cycle stage**	**Up to 2050**	**120 years**
Construction	Before use stage	4,758,000	
Operation	Use stage	56,000	1,325,000
	Benefits and loads beyond project boundaries	-62,000	-511,000

Table notes

The use stage is a net carbon emission figure, which includes a carbon sequestration benefit from tree planting and new habitat creation estimated to be -14,000 tCO_2e up to 2050 and -207,000 tCO_2e over 120 years.

The benefits and loads stage is the net carbon emission figure, which includes loads (i.e. increase in carbon emissions) from additional surface access journeys to access the Proposed Scheme, and benefits (i.e. reduction in carbon emissions) from freight and passenger modal shift.

Table 3: The Proposed Scheme's operational greenhouse gas emissions per passenger kilometre (gCO_2e/pkm) for 2039 (opening year) and 2050 and beyond

	2039	2050 and beyond
gCO_2e/p.km	0.81	0.29

References

Climate Change Act 2008

https://www.legislation.gov.uk/ukpga/2008/27/pdfs/ukpga_20080027_en.pdf

HS2 Environmental Policy:

https://www.gov.uk/government/publications/hs2-environmental-policy

Department for Transport (2021), Decarbonising Transport: A Better, Greener Britain:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1002285/decarbonising-transport-a-better-greener-britain.pdf