



HIGH SPEED TWO

PHASE 2a 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 (West Midlands-Crewe) 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.

The Helpdesk can be contacted:

by email: HS2enquiries@hs2.org.uk

by phone (24hrs): 08081 434 434
08081 456 472 (minicom)

or by post: High Speed Two (HS2) Limited
2 Snowhill, Queensway
Birmingham
B4 6GA

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1. Introduction

- 1.1. High Speed Two (HS2) is the Government's proposal for a new, high speed north-south railway. The proposal is being taken forward in phases: Phase One will connect London with Birmingham and the West Midlands. Phase 2a will extend the route to Crewe. Phase 2b will extend the route to Manchester, Leeds and beyond. The construction and operation of Phase One of HS2 is authorised by the High Speed Rail (London – West Midlands) Act 2017.
- 1.2. HS2 Ltd is the non-departmental public body responsible for developing and promoting these proposals. The company works to a Development Agreement made with the Secretary of State for Transport.
- 1.3. In July 2017, the Government introduced a hybrid Bill¹ to Parliament to seek powers for the construction and operation of Phase 2a of HS2 (the Proposed Scheme). The Proposed Scheme is a railway starting at Fradley at its southern end. At the northern end it connects with the West Coast Main Line (WCML) south of Crewe to allow HS2 services to join the WCML and call at Crewe Station. North of this junction with the WCML, the Proposed Scheme continues to a tunnel portal south of Crewe.
- 1.4. The work to produce the Bill includes 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)², which set out the environmental and sustainability commitments that will be observed in the construction of the Proposed Scheme.
- 1.5. 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'. The nominated undertaker will be bound by the obligations contained in the Bill and the policies established in the EMRs. There may be more than one nominated undertaker.
- 1.6. While the UK has notified its intention to withdraw from the European Union, the UK remains a member until withdrawal, meaning that rights and obligations under EU law apply until the date of departure. The European Union (Withdrawal) Act 2018 converts the body of existing EU law into domestic law and preserves the laws we have made in the UK to implement our EU obligations, once the UK exits the EU, so that the same rules and laws will apply

¹ The High Speed Rail (West Midlands – Crewe) Bill, hereafter 'the Bill'.

² For more information on the EMRs, please see Information Paper E1: Control of Environmental Impacts.

on the day after exit as on the day before. It will then be for Parliament to decide on any changes to that law.

- 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 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 emissions impact in the form of the 'carbon footprint'³ of the Proposed Scheme and includes a discussion of its potential significance.
- 3.2. Information Paper E26: Climate Change Adaptation and Resilience outlines:
 - 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.

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 2008⁴ sets statutory targets for carbon reduction. The Climate Change Act 2008 requires at least an 100% reduction in

³ 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 (tCO₂e) which standardises the global warming potential of the main greenhouse gases into one index based on the global warming potential of CO₂.

⁴ Her Majesty's Stationery Office (2008) *Climate Change Act 2008*, London. Available online at: <http://www.legislation.gov.uk/ukpga/2008/27/contents>

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 five carbon budgets, leading to 2032, have been set in law. Meeting the fourth (2023-27) and fifth (2028-2032) carbon budgets will require that carbon emissions are reduced by 50% (by 2025) and 57% (by 2030) respectively relative to 1990 levels.

5. HS2 Ltd Policy

- 5.1. HS2 Ltd's Environmental Policy⁵ states an aim to "minimise the carbon footprint of HS2 and deliver low carbon, long distance journeys that are supported by low carbon energy".
- 5.2. Accordingly 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, if reasonably practicable;
 - use and/or generate low carbon energy, if reasonably practicable; and
 - sequester carbon, if reasonably practicable.
- 5.3. This approach forms a hierarchy of actions, with avoidance 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

The greenhouse gas assessment takes a life cycle assessment approach consistent with the principles set out in BS EN 15978⁶, BS EN 15804⁷ and PAS 2080⁸ standards. The scope of the greenhouse gas assessment is outlined in

Table 1.

⁵ HS2 Ltd. Environmental Policy. <https://www.gov.uk/government/publications/hs2-environmental-policy>

⁶ British Standards Institution (2011), *Sustainability of Construction Works – Assessment of environmental performance of buildings – Calculation method*. BSI Limited, London, UK.

⁷ British Standards Institution (2012), *Sustainability of Construction Works – Environmental Products Declarations. Core Rules for the product category of construction products*. BSI Limited, London, UK.

⁸ Construction Leadership Council & the Green Construction Board (2016), *PAS 2080: 2016: Carbon Management in Infrastructure*. BSI Limited, London, UK.

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
Use stage	Carbon sequestration from tree planting Replacement of infrastructure Operation of infrastructure Operation of rolling stock
Benefits and loads beyond the system boundary	Benefits and loads associated with modal shift of passenger and freight journeys

- 6.1. 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 greenhouse gas 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'⁹.
- 6.2. 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 summarises the Proposed Scheme's carbon footprint.

Table 2: The Proposed Scheme's carbon footprint from construction and over 60 and 120 year operational periods.

Work stage	Life cycle stage	Tonnes CO ₂ e	
		60 years	120 years
Construction	Before use stage	1,451,000	

⁹ 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 Government projections.

Work stage	Life cycle stage	Tonnes CO ₂ e	
		60 years	120 years
Operation	Use stage ¹⁰	141,000	315,000
	Benefits and loads beyond project boundaries ¹¹	-159,000	-307,000
	Total residual carbon emissions	1,433,000	1,459,000

- 7.2. Table 3 reports the projected carbon emissions – in grams of CO₂e per passenger-km (gCO₂e/pkm) – in 2027 (opening year), 2041 (full capacity) and 2087 (60 years after the opening year).

Table 3: The Proposed Scheme's projected carbon emissions per passenger kilometre (gCO₂e/pkm)

Year	2027	2041	2087
gCO ₂ e/pkm	13.64	2.93	1.64

- 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 between the West Midlands and Crewe in 2030. In terms of emissions per passenger kilometre, the Proposed Scheme will emit 10 gCO₂e/pkm as compared to interurban cars (67 gCO₂e/pkm); intercity rail (22 gCO₂e/pkm¹²) and UK domestic flights (170 gCO₂e/pkm), based on projected carbon emissions in 2030.
- 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 1,451,000 tCO₂e. The Proposed Scheme's operational emissions are anticipated to result in 8,000 tCO₂e over the 120 year operational assessment period, once modal shift, carbon sequestration from tree planting and freight benefits from released capacity on the conventional network are taken into account. When the operational and construction carbon footprints of the Proposed Scheme are combined, the residual carbon emissions are estimated to be 1,459,000 tCO₂e.

¹⁰ The use stage is a net carbon emission figure, which includes a carbon sequestration benefit from tree planting estimated to be -144,000 tCO₂e over 60 years and -174,000 tCO₂e over 120 years.

¹¹ 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.

¹² It should be noted that the intercity rail forecast is for the entire classic network, including the predicted mix of both diesel and electric trains in 2030.

- 7.5. The Proposed Scheme's annualised construction emissions against the Green Construction Board's 2026 projected UK construction sector as a whole shows that the Proposed Scheme's contribution is less than 1% of the projected 2026 total UK construction carbon emissions. Carbon emissions from the construction of Phase One of HS2 and the Proposed Scheme are estimated to account for 0.17% of the UK's combined third (2018-2022) and fourth (2023-2027) carbon budgets. Operational carbon emissions are projected to be less than 0.01% of UK total transport emissions in 2027 (the Proposed Scheme's opening year).
- 7.6. The European Union Emissions Trading System (ETS), a cap and-trade system with a decreasing cap over time, is a significant policy tool available to the UK to meet its carbon reduction targets. The emissions of the UK's electricity generation sector used to power the Proposed Scheme are regulated by the EU ETS, as are EU cement and steel industries which are likely to be used in the construction of the Proposed Scheme. The carbon emissions associated with the construction and operation of the Proposed Scheme will therefore be largely regulated through the EU ETS. This means that, overall, most of Proposed Scheme's carbon emissions will not contribute to an increase in Europe-wide carbon emissions.
- 7.7. Carbon emissions from journeys made by road and classic diesel rail are currently not traded within the EU ETS cap. However, those journeys, which, as a result of modal shift, will be taken on the Proposed Scheme, will give rise to carbon emissions that will become tradable within the EU ETS cap.
- 7.8. Carbon emissions not regulated by the EU ETS, predominantly those arising from construction, will be managed through other policy tools as part of the Climate Change Act target. Nevertheless HS2 Ltd is committed to minimising, insofar as is reasonably practicable, carbon emissions both in the traded and non-traded sectors 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.

8. More information

- 8.1. More detail on the Bill and related documents can be found at: www.gov.uk/HS2