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HS2

High Speed Rail (Crewe – Manchester) Environmental Statement

Volume 5: Appendix CL-003-00000

Climate change

Summary greenhouse gas calculation outputs

M73

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Department for Transport

High Speed Two (HS2) Limited has been tasked by the Department for Transport (DfT) with managing the delivery of a new national high speed rail network. It is a non-departmental public body wholly owned by the DfT.

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1 Introduction

1.1.1 This report is an appendix to the climate change assessment; it provides a summary of the greenhouse gas assessment results.

1.1.2 This appendix should be read alongside:

- Volume 3, Route-wide effects; and
- Volume 5, Appendices: CL-001-00000 Climate data and information, CL-002-00000 Results of climate change assessments, and CL-004-00000 Greenhouse gas calculation methodology.

2 Results

2.1 Overall results

2.1.1 Table 1 presents the Proposed Scheme's overall carbon emissions, from construction and operation, by life cycle stage, for the following time periods:

- from 2038 (opening year) to 2050 (UK carbon budget target year legislated by Government); and
- from 2038 (opening year) to 2157 representing the 120 year design life of the Proposed Scheme.

Table 1: The Proposed Scheme's total carbon emissions by life cycle stage

Life cycle stage	Module	Description	Up to 2050 (tCO_2e)	120 year design (tCO_2e)
Before use stage	A1 – A3	Product manufacturing	3,114,333	
	A4	Transport of construction material to work site	223,303	
	A5	Construction/ installation process	1,684,642	
Use stage	B1	Carbon sequestration	-101,528	-747,165
	B2 – B3	Repair and maintenance of infrastructure and rolling stock	60,287	588,954
	B4	Replacement of infrastructure and rolling stock	5,581	2,851,462
	B6	Operational energy consumption (infrastructure)	18,909	139,505
	B7	Operational water use (infrastructure)	738	7,375
	B9	Operational energy consumption (rolling stock)	407,242	2,928,936
End-of-life	C	End-of-life[1]	-	-
Benefits and loads beyond the system boundary	D	Conventional rail passengers	-6,160	-180,811
		Car passengers	-206,798	-1,538,273
		Surface access journeys	51,407	411,347
		Freight	-199,038	-785,670
		Aviation	-257,801	-1,794,428

[1] It is assumed that the Proposed Scheme is not demolished or decommissioned at end-of-life and therefore end-of-life emissions are zero.

2.2 Before use stage results (A1 – A5)

2.2.1 Table 2 presents the construction product manufacturing stage (A1 – A3) carbon emissions results broken down by asset. Table 3 presents the product manufacturing stage (A1 – A3) carbon emissions broken down by material.

2.2.2 Carbon emissions associated with the transport of materials to work site (A4) are as reported in Table 4.

2.2.3 Carbon emissions associated with construction and installation processes (A5), such as plant equipment use and temporary works, are presented in Table 5.

Table 2: The Proposed Scheme's product stage (A1 – A3) carbon emissions breakdown by asset

Element category	tCO_2e	%
Tunnel	565,897	18%
Viaduct	555,086	18%
Rolling stock	369,128	12%
Station	355,058	11%
Track and overhead systems	275,728	9%
Retaining wall	264,395	8%
Depot	209,988	7%
Ventilation shaft	101,320	3%
Overbridge	87,199	3%
Ground stabilisation	82,412	3%
Electricity distribution	60,586	2%
Highway work	60,228	2%
Tunnel portal	58,026	2%
Signalling and communication	29,180	1%
Underbridge	13,191	<1%
Culvert	9,192	<1%
Embankment	7,980	<1%
TBMs	6,524	<1%
Aqueduct	2,085	<1%
Balancing pond	1,130	<1%
Temporary compound	-	<1%
Total	**3,114,333**	**100%**
Total (rounded)	**3,114,000**	**100%**

Table 3: The Proposed Scheme's product stage (A1 – A3) carbon emissions breakdown by material

Element category	tCO_2e	%
Ferrous metals - steel	1,362,012	44%
Concrete	1,147,428	37%
Bulk aggregates sands and soils	175,138	6%

Element category	tCO_2e	%
Plastics	161,154	5%
Cement grout	136,682	4%
Asphalt and bitumen	68,355	2%
Rubber	11,253	<1%
Glass	8,148	<1%
TBMs	6,524	<1%
Timber	5,168	<1%
Paints and finishes	3,691	<1%
Bricks, blocks and pavers	3,454	<1%
Non-ferrous metals	3,249	<1%
Electrical items	1,407	<1%
Ferrous metals - iron	0.3	<1%
Insulation	0.2	<1%
Total	**3,114,333**	**100%**
Total (rounded)	**3,114,000**	**100%**

Table 4: The Proposed Scheme's construction process stage (A4) carbon emissions

Element category	tCO_2e
Material transport	223,303
Total	**223,303**
Total (rounded)	**223,000**

Table 5: The Proposed Scheme's construction process stage (A5) carbon emissions

Element category	tCO_2e	%
Construction plant	945,464	56%
Temporary works and construction compounds	457,081	27%
Land use change	177,498	11%
Tunnel boring machines	50,233	3%
Transport of excavated material	36,486	2%
Construction waste	14,319	1%
Compounds water use	2,839	<1%
Demolition waste transport and disposal	707	<1%
Construction worker accommodation waste	16	<1%
Total	**1,684,642**	**100%**
Total (rounded)	**1,685,000**	**100%**

2.3 Use stage results (B1 – B9)

2.3.1 Table 6 summarises the use stage (operational) carbon emissions of the Proposed Scheme.

Table 6: Use stage (B1 – B9) carbon emissions breakdown

Element category	Up to 2050 (tCO_2e)	120 year design life (tCO_2e)
Carbon sequestration (B1)	-101,528	-747,165
Repair and maintenance of infrastructure and rolling stock (B2 – B3)	60,287	588,954
Replacement of infrastructure and rolling stock (B4)	5,581	2,851,462
Operational energy consumption (infrastructure) (B6)	18,909	139,505
Operational water use (infrastructure) (B7)	738	7,375
Operational energy consumption (rolling stock) (B9)	407,242	2,928,936
Total	**391,228**	**5,769,067**
Total (rounded)	**391,000**	**5,769,000**

2.3.2 Table 7 summarises the sensitivity analysis applied to the use stage (B1 – B9) carbon emissions of the Proposed Scheme.

Table 7: Sensitivity analysis of use stage (B1 – B9) carbon emissions breakdown

Element category	Up to 2050 (tCO_2e)	120 year design life (tCO_2e)
Carbon sequestration (B1)	-101,528	-747,165
Repair and maintenance of infrastructure and rolling stock (B2 – B3)	57,114	565,178
Replacement of infrastructure and rolling stock (B4)	5,581	2,851,462
Operational energy consumption (infrastructure) (B6)	2,380	11,988
Operational water use (infrastructure) (B7)	738	7,375
Operational energy consumption (rolling stock) (B9)	49,963	251,698
Total	**14,247**	**2,940,536**
Total (rounded)	**14,000**	**2,941,000**

2.4 Benefits and loads beyond the project boundary (D)

2.4.1 Table 8 presents the carbon emissions results from passenger and freight mode shift and surface access journeys.

Table 8: Benefits and loads associated with mode shift carbon emissions breakdown

Element category	Up to 2050 (tCO_2e)	120 year design life (tCO_2e)
Conventional Rail Passengers	-6,160	-180,811
Car Passengers	-206,798	-1,538,273
Surface access journeys	51,407	411,347
Freight	-199,038	-785,670
Aviation	-257,801	-1,794,428
Total	**-618,390**	**-3,887,835**
Total (rounded)	**-618,000**	**-3,888,000**

2.4.2 Table 9 presents the sensitivity analysis carbon emission results from passenger and freight mode shift and surface access journeys. .

Table 9: Sensitivity analysis of benefits and loads associated with mode shift carbon emissions breakdown

Element category	Up to 2050 (tCO_2e)	120 year design life (tCO_2e)
Conventional Rail Passengers	18,851	4,667
Car Passengers	-33,376	-77,176
Surface access journeys	8,929	20,641
Freight	-176,477	-549,686
Aviation	-257,801	-1,794,428
Total	**-439,874**	**-2,395,982**
Total (rounded)	**-440,000**	**-2,396,000**

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