Lower Thames Crossing

7.19 Carbon and Energy Management Plan (Tracked changes version)

APFP Regulation 5(2)(q)

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7.19 Carbon and Energy Management Plan (Tracked changes version)

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1 Executive summary

1.1.1 The Applicant's plan to become a net zero business is described in 'Net zero highways: our 2030 / 2040 / 2050 plan' (National Highways, 2021a)[1].

1.1.2 This Carbon and Energy Management Plan sets out the Applicant's carbon ambitions for the Project and the mechanisms that it will use to deliver them.

1.1.3 The Applicant has designated the Project as a 'pathfinder' for low carbon construction and set the following ambitions:

a. To construct it for the lowest practicable carbon emissions

b. To test low carbon innovation and approaches

c. To leave a legacy that enables future projects to decarbonise, in line with National Highways' ambition for net zero construction emissions by 2040

1.1.4 The Applicant's approach is as follows:

a. **Select the right partners:** The procurement process has been designed to select Contractors who are committed to net zero and ready to work with the Applicant to design and build the Project for the lowest practicable carbon emissions. The Applicant has been actively engaging with the market to ensure that the future supply chain understands what will be required of them.

b. **Set minimum standards:** The three main construction contracts will include a set of minimum requirements for the adoption of low carbon materials and methods. Contracts will include a carbon limit, which will be the maximum level of emissions permissible in delivering the contract. The procurement process was designed to set a carbon limit for each contract consistent with an overall carbon limit of 1.763 million tonnes of carbon dioxide equivalent (tCO_2e). The tender submissions The Applicant received demonstrated that the market was prepared to commit to a lower carbon limit. Therefore, the Applicant has reset this best practice level of emissions as its maximum and has committed to not exceeding it.

c. **Reward carbon reduction:** The Applicant is focused on moving beyond current best practice and will pay a financial incentive for every tonne of carbon reduced below this current best practice level.

d. **Invest in low carbon innovation:** The Applicant is already engaging with the market to target low carbon technologies that can be brought to commercial scale to support construction of the Project. The Applicant intends to award the main contracts early, relative to the planned start of

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[1] Net zero means achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere

works, to maximise the opportunity to collaboratively incorporate low carbon innovation during the pre-construction phase. Contracts will include a contractual mechanism to pay Contractors the additional cost of implementing carbon reduction technologies, together with an incentive payment to further encourage their identification and adoption.

e. **Adopt a best practice carbon management approach:** Organisation and management arrangements on the Project will be designed to support successful delivery of the carbon ambitions. The Applicant's management system for the Project will be independently verified to the latest PAS 2080: Carbon Management in Infrastructure (British Standards Institution, 2023). This will also be mandatory for Contractors' management systems[2]. To develop a carbon-literate workforce, the Applicant, its Contractors and subcontractors will achieve at least silver level certification from the Carbon Literacy Project[3]. The Applicant will publish an annual carbon report, with independently verified carbon data and a progress update on the Project's carbon aims. The reports will form part of the learning legacy for the Project so that the whole industry can benefit from the pathfinding activity undertaken.

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[2] In this plan, Contractors refers to the Contractors providing the main works (Roads North, Tunnels and Approaches, and Kent Roads)
[3] In this plan, subcontractors refers to the subcontractors that are directly engaged by the Contractors providing the mains works (Roads North, Tunnels and Approaches, and Kent Roads)

2 Introduction

2.1 Background

2.1.1 This section provides a description of the A122 Lower Thames Crossing (the Project) and outlines the purpose of this plan. Appendix A explains the key terminology used in this plan.

2.2 The Project

2.2.1 The Project would provide a connection between the A2 and M2 in Kent and the M25 south of junction 29, crossing under the River Thames through a tunnel. The Project route is presented in Plate 2.1.

2.2.2 The A122 would be approximately 23km long, 4.25km of which would be in tunnel. On the south side of the River Thames, the Project route would link the tunnel to the A2 and M2. On the north side, it would link to the A13, M25 junction 29 and the M25 south of junction 29. The tunnel portals would be located to the east of the village of Chalk on the south of the River Thames and to the west of East Tilbury on the north side.

2.2.3 Junctions are proposed at the following locations:

a. New junction with the A2 to the south-east of Gravesend

b. Modified junction with the A13/A1089 in Thurrock

c. New junction with the M25 between junctions 29 and 30

2.2.4 To align with the National Policy Statement for National Networks (Department for Transport, 2014) and to help the Project meet the Scheme Objectives, it is proposed that road user charges would be levied in line with the Dartford Crossing. Vehicles would be charged for using the new tunnel.

2.2.5 The Project route would be three lanes in both directions, except for:

a. link roads

b. stretches of the carriageway through junctions

c. the southbound carriageway from the M25 to the junction with the A13/A1089, which would be two lanes

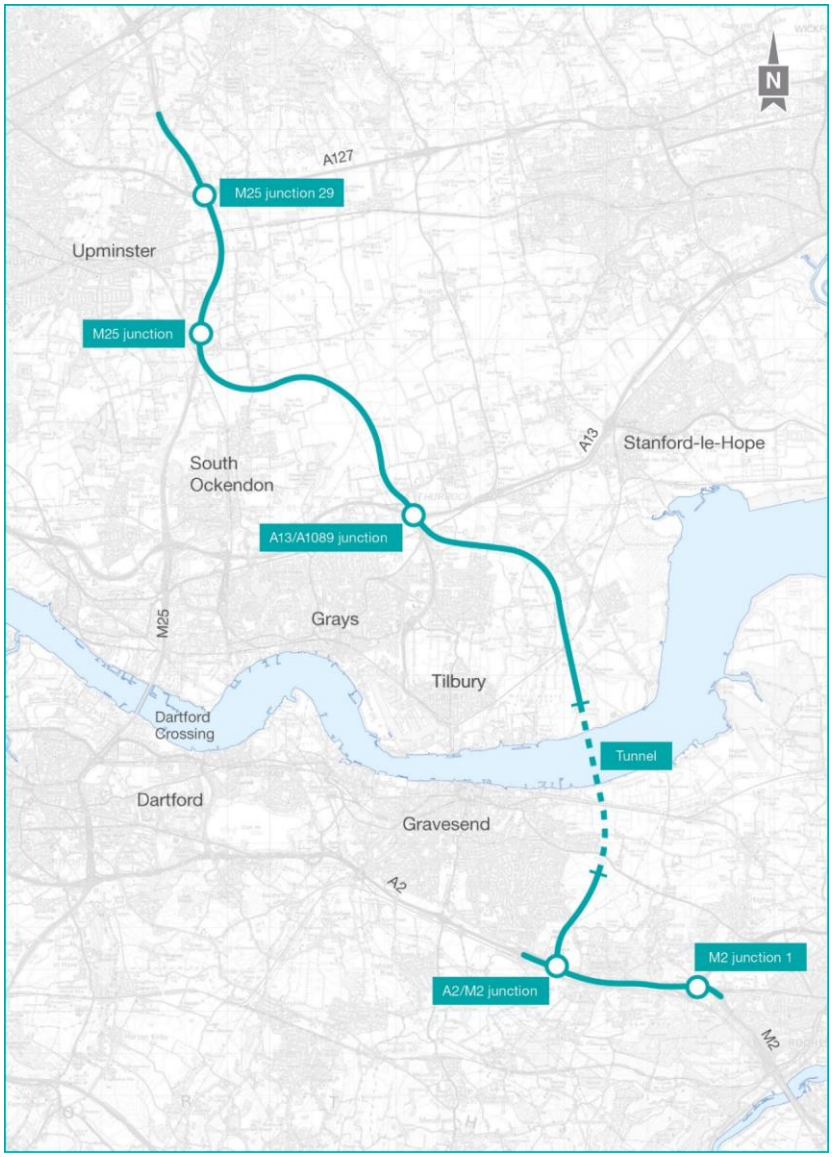
2.2.6 In common with most A-roads, the A122 would operate with no hard shoulder but would feature a 1m hard strip on either side of the carriageway. It would also feature technology including stopped vehicle and incident detection, lane control, variable speed limits and electronic signage and signalling. The A122 design outside the tunnel would include emergency areas. The tunnel would include a range of enhanced systems and response measures instead of emergency areas.

2.2.7 The A122 would be classified as an ‘all-purpose trunk road’ with green signs. For safety reasons, walkers, cyclists, horse riders and slow-moving vehicles would be prohibited from using it.

2.2.8 The Project would include adjustment to a number of local roads. There would also be changes to a number of Public Rights of Way, used by walkers, cyclists and horse riders. Construction of the Project would also require the installation and diversion of a number of utilities, including gas pipelines, overhead electricity powerlines and underground electricity cables, as well as water supplies and telecommunications assets and associated infrastructure.

2.2.9 The Project has been developed to avoid or minimise significant effects on the environment. The measures adopted include landscaping, noise mitigation, green bridges, floodplain compensation, new areas of ecological habitat and two new parks.

Plate 2.1 Lower Thames Crossing route



2.3 Purpose of this plan

2.3.1 This Carbon and Energy Management Plan sets out the Applicant's carbon ambitions for the Project and the mechanisms that it will use to deliver them.

2.3.2 This plan focuses on construction and maintenance emissions as these are under its control[4]. It also covers emissions from energy, water and waste in the operational phase.

2.3.3 The Environmental Statement (ES) Chapter 15: Climate [APP-153] assesses the Project's impact on greenhouse gas emissions during both the construction and operational phases. ES Chapter 15: Climate should be read with reference to the latest version of the ES Addendum [Document Reference 9.8]. The Combined Modelling and Appraisal Report, Appendix D - Economic Appraisal Report [APP-526] monetises the emissions and provides an explanation of the carbon emissions from road users. The Sustainability Statement [APP-544] covers wider aspects of sustainability including energy efficiency and water efficiency.

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[4] In line with the PAS 2080: 2016 Carbon management in infrastructure (British Standards Institute, 2016) principle of control and influence

2.4 Iterations of this plan

2.4.1 Three iterations of this Carbon and Energy Management Plan will be produced. This document is the first iteration and two further iterations will need to be prepared for approval following any decision to grant the DCO, as set out in Table 2.1.

Table 2.1 Iterations of the Carbon and Energy Management Plan

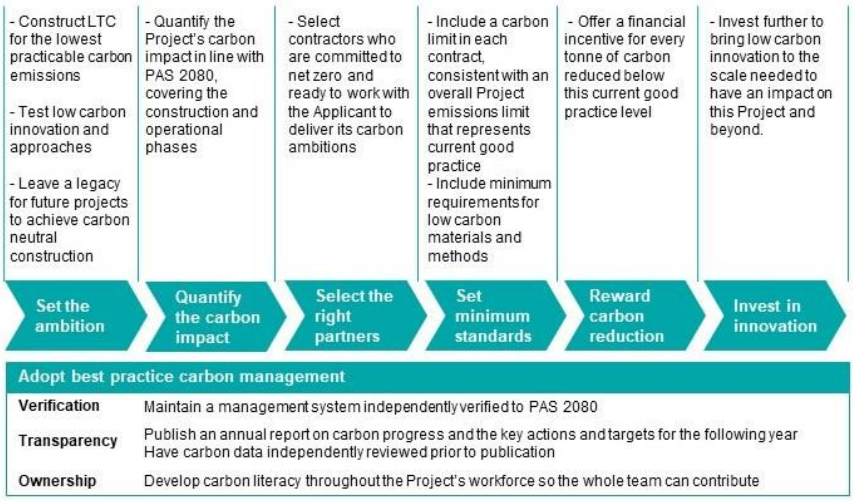
Iteration	Status	Contents	Approval process
First	• Secured document pursuant to Requirement 16 of Schedule 2 (Requirements) of the draft Development Consent Order (DCO) (Application Document 3.1)	• Relates to the construction and operational phases and provides the overarching approach to reducing emissions • Sets out a process for reducing construction emissions below the maximum level described above, so that the Project is constructed for the lowest practicable carbon emissions • Identifies commitments covering both the construction and operational phases, listed in this plan with the prefix CBN	• Secured control plan under Requirement 16 of the draft Development Consent Order and would therefore form part of any decision to approve the DCO by the Secretary of State
Second	• Would follow the grant of the DCO and must be approved by the Secretary of State before the relevant part of the authorised development commences (Requirement 16). • Must be substantially in accordance with the first iteration of the plan, under Requirement 16	• Relates to the construction phase and provides the detailed approach to reducing emissions including (a) how the Contractors will comply with the maximum level of emissions secured as part of the first iteration and (b) the further measures and proposals Contractors will deploy during the construction phase to reduce emissions below this maximum level • Commitments in the first iteration which relate to the construction of the authorised development will need to be reflected in the second iteration	• Submitted to the Secretary of State for approval prior to commencement of the relevant part of the authorised development • The authorised development must then be carried out in accordance with the approved Carbon and Energy Management Plan (Second Iteration)
Third	• Must be submitted for the approval of the Secretary of State by the end of the	• Must address the matters set out in the Carbon and Energy Management Plan (First Iteration) which are	• Submitted to the Secretary of State for approval by the end of the construction, commissioning

Iteration	Status	Contents	Approval process
	construction, commissioning and handover stage of any part of the authorised development	relevant to the operation and maintenance of the authorised development • Must explain how carbon emissions will be managed and minimised during the operation and maintenance of the authorised development, with an emphasis on continuous improvement and compliance with evolving best practice • Must support the Applicant's carbon policies, plans and strategies	and handover stage of any part of the authorised development. • The authorised development must then be operated and maintained in accordance with approved Carbon and Energy Management Plan (Third Iteration)

3 The Project's carbon plan

3.1 Summary

Plate 3.1 The Project's carbon plan



3.1.1 Plate 3.1 summarises the Applicant's plan to achieve its carbon ambitions. Each element is presented in more detail below.

3.2 Set the ambition

3.2.1 The Applicant published 'Net zero highways: Our 2030 / 2040 / 2050 plan' in July 2021. The document describes how the Applicant plans to become a net zero business and sets a pathway for achieving net zero:

a. for its own corporate operations, by 2030

b. for the construction and maintenance of its network, by 2040

c. for travel on its roads, by 2050

3.2.2 The document also highlights the Applicant's intention to 'use our Lower Thames Crossing scheme as a key project to test low carbon innovation and approaches'.

3.2.3 The Applicant has designated the Project as a 'pathfinder' for low carbon construction and set the following ambitions:

a. To construct it for the lowest practicable carbon emissions

b. To test low carbon innovation and approaches

c. To leave a legacy that enables future projects to achieve carbon neutral construction

3.3 Quantify the carbon impact

3.3.1 The Applicant has quantified its carbon impact in line with PAS 2080, covering the construction and operational phases.

3.3.2 Appendix B outlines the scope of the Applicant's carbon management approach. Appendix C explains how emissions were quantified and Appendix D presents the results of that quantification.

3.3.3 The forecast carbon emissions from the construction of the Project are estimated to be 1.44 million tCO_2e. Forecast emissions from its maintenance are estimated to be 0.031 million tCO_2e (Table 3.1). Emissions from energy consumption during the operational phase are zero, in line with the Net zero highways plan (National Highways, 2021a).

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Table 3.1 Construction and maintenance emissions

Emission type	Emissions (million tCO_2e)
Construction	1.44
Maintenance	0.03
Total	1. 47

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3.3.4 The Project's carbon emissions, including emissions from road users, are also presented in ES Chapter 15: Climate (Application Document 6.1) and are monetised in the Combined Modelling and Appraisal Report, Appendix D - Economic Appraisal Report (Application Document 7.7).

3.4 Select the right partners

3.4.1 The Project is the first publicly procured, major UK infrastructure project to include carbon as a key part of the procurement process.

3.4.2 The Applicant has already engaged with the market to confirm that its carbon ambition is understood throughout the potential supply chain and to explore the technologies and approaches that the market can provide.

3.4.3 The Applicant is procuring for three design and build contracts (Roads North, Tunnels and Approaches, and Kent Roads) and has designed the procurement process to select partners who are committed to net zero and are ready to work with the Applicant to deliver its carbon ambitions.

3.4.4 The Applicant has allocated a significant proportion of the evaluation marks for the tenderers' carbon responses (CBN01, Appendix E).

3.4.5 The scope of works that the Applicant has issued to tenderers requires Contractors to:

a. demonstrate commitment to net zero with corporate net zero plans setting out how they will reach a net zero position that aligns with the 1.5°C reduction of the Paris Agreement (United Nations, 2015) and the UK's commitment to be net zero by 2050 (CBN02, Appendix E). The plans must include science-based targets for emissions reduction.

b. collaborate with each other and with the Applicant, through formal regular carbon reduction workshops (CBN03, Appendix E) intended to support the sharing of:

i. opportunities for collaboration

ii. proposals for innovations or low carbon investments

iii. current best practice

iv. potential issues and opportunities for improvement

3.5 Set minimum standards

3.5.1 The procurement process was designed to set a carbon limit, for each of the three design and build contracts, consistent with an overall level of emissions for the construction phase of the Project of 1.763 million tCO_2e. The Applicant considered that level to represent best practice for low carbon construction because it could only be delivered by incorporating an extensive range of commercially available, low carbon technologies and approaches. Table D.3 (Appendix D) illustrates these technologies and approaches.

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3.5.2 During the procurement of design and build contracts, the Applicant presented bidders with a carbon limit aligned to the Project-wide maximum level of construction emissions of 1.763 million tCO_2e, asked them to commit to this or a lower limit and asked them to explain how they would go beyond this and construct the Project for the lowest practicable carbon emissions.

3.5.3 The tender submissions the Applicant received demonstrated that the market was prepared to commit to a lower carbon limit. Therefore, The Applicant has reset this best practice level of emissions as its maximum and has committed to not exceeding it. This is reflected in the updated limit of 1.44 million tCO_2e for construction emissions (CBN04, Appendix E).

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3.5.4 Contractors will be contractually required to not exceed their carbon limit (CBN05, Appendix E).

3.5.5 Prior to commencing construction, Contractors will produce a second iteration of this plan (Table 2.1), setting out:

a. the actions they will take to ensure they do not exceed their carbon limit

b. the further technologies and measures they will deploy during the construction phase to reduce emissions below this maximum level

3.5.6 The three design and build contracts will also include a set of minimum requirements, all of which are being committed to within this plan:

a. Contractors will be required to provide Environmental Product Declarations for their top ten emitting products and to demonstrate that these have an emission factor below the European average (CBN06, Appendix E).

b. All the mains electricity that Contractors use for the construction of the Project must come from certified renewable sources, with at least 20% of

the energy demand for site compounds and offices expected to be from on-site renewables (CBN07, Appendix E).

c. Contractors will be required to provide and maintain electric vehicle charging facilities, using zero carbon electricity, for 30% of parking capacity in each compound, increasing this as necessary to satisfy demand (CBN08, Appendix E). Contractors will use zero tailpipe emission vehicles for all staff movements within working areas and to and from public transport hubs (CBN09, Appendix E). Contractors will promote the use of active transport for personnel to and from the compounds and provide managed electric charging facilities for e-bikes at each compound, in covered cycle parking areas, to satisfy demand (CBN10, Appendix E).

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3.6 Reward carbon reduction

3.6.1 The primary purpose of the contractual carbon limit is to provide the basis for incentivising Contractors to work with the Applicant to construct the Project for the lowest practicable carbon. The Applicant will pay Contractors a financial incentive for every tonne of carbon reduced below the carbon limit (CBN11, Appendix E).

3.7 Invest in innovation

3.7.1 Alongside rewarding carbon reduction, the Applicant will facilitate and invest in commercial scale, low carbon innovation, focusing on technologies that are likely to have an affordable medium to long-term role in taking the construction industry to net zero. The aim is to bring forward low carbon innovation and further reduce the Project's emissions.

3.7.2 The Applicant is using the following mechanisms to facilitate innovation:

a. The Applicant is already engaging with the market to target low carbon technologies that can be brought to commercial scale to support construction of the Project. The Applicant is looking at partnering or contracting with others in the likely supply chain, ahead of or in parallel to the procurement of Contractors. It is also considering how to involve its broader portfolio of construction projects to bring economies of scale.

b. The Applicant will award contracts early, relative to the planned start of works, to maximise the opportunity to collaboratively incorporate low carbon innovation during the pre-construction phase.

c. The Applicant will include a contractual mechanism to pay Contractors the additional cost of implementing agreed carbon-reducing technologies, together with an incentive payment to further encourage their identification and adoption (CBN12, Appendix E).

3.8 Adopt best practice carbon management

3.8.1 The Applicant will adopt a best practice carbon management approach on the Project, encompassing the following themes:

Verification

3.8.2 The Applicant has identified the attainment of PAS 2080 (a global standard for managing infrastructure carbon) as a critical step in ensuring effective carbon management and has therefore committed to obtaining certification to PAS 2080 for the Project, verified by an independent, third-party certification body by 2023 (CBN13, Appendix E). It has also committed to annual reverification against this standard.

3.8.3 The Applicant has achieved PAS 2080 certification from an independent, third-party certification body. The Applicant is currently undergoing certification against the latest update to PAS 2080 (PAS 2080:2023 Carbon Management in Infrastructure (British Standards Institution, 2023)). To align with the updated PAS 2080 guidance, the Applicant has updated Appendix B, Appendix C and Appendix D.

3.8.4 The Applicant will also require Contractors to obtain PAS 2080 certification from an independent, third-party certification body within 52 weeks of the starting date of each contract (CBN14, Appendix E).

3.8.5 The Applicant will require subcontractors to obtain PAS 2080 certification within 52 weeks of appointment, through self-certification or third-party certification, unless otherwise agreed (CBN15, Appendix E).

Transparency

3.8.6 The Applicant recognises the importance of transparent quantification of its carbon impact. It will publish an annual carbon report (CBN16, Appendix E). The report will include:

a. carbon emissions data (emissions incurred and emissions forecast)

b. an update on progress in meeting the Project's carbon ambitions

c. key actions and targets for the following year.

3.8.7 The carbon data will be independently reviewed prior to publication (CBN17, Appendix E).

3.8.8 Individually and collectively, the published carbon reports will form part of the learning legacy for the Project so that the whole industry can benefit from the pathfinding activity undertaken.

Ownership

3.8.9 The Applicant has committed to developing the carbon knowledge of its staff by delivering carbon literacy training and achieving silver certification from the Carbon Literacy Project by 2023 (CBN18, Appendix E). It will also require both

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Contractors and subcontractors to achieve silver certification within 52 weeks of starting date and engagement respectively (CBN19 and CBN20, Appendix E)[5].

3.8.10 Contractors will be required to appoint a director responsible for carbon (CBN21, Appendix E) who will:

a. develop and implement carbon management processes to reduce emissions to the lowest practicable level

b. provide adequate personnel for the development and implementation of the carbon management process

c. demonstrate a commitment to continuous improvement through the sharing of current best practice and collaboration with the other Contractors

3.9 Reduce emissions during the operational phase

3.9.1 The Applicant will continue to engage with industry partners to seek to reduce carbon emissions during the operation of the Project.

3.9.2 The Applicant has included a requirement in the draft Development Consent Order, which would require it to prepare and submit for the approval of the Secretary of State a third iteration of the Carbon and Energy Management Plan.

3.9.3 The third iteration will explain how carbon emissions will be managed and minimised during the operation and maintenance of the Project, to support the Applicant's carbon policies, plans and strategies (CBN22, Appendix E).

[5] Starting date is the Contract Date which is defined in the NEC4 ECC as the date when the contract came into existence. Engagement is the earlier of the date when the relevant sub-contractor commenced providing its works and the date it entered into a subcontract with the Contractor.

4 Conclusion

4.1.1 The Applicant has designated the Project as a 'pathfinder' for low carbon construction and set the following ambitions:

a. To construct it for the lowest practicable carbon emissions

b. To test low carbon innovation and approaches

c. To leave a legacy that enables future projects to decarbonise, in line with National Highways' ambition for net zero construction emissions by 2040

4.1.2 This Carbon and Energy Management Plan sets out the mechanisms and management arrangements that the Applicant will use to deliver its carbon ambitions for the Project.

4.1.3 This is the first time that a Carbon and Energy Management Plan has been incorporated into a highways DCO. The Applicant considers its approach to be industry leading and one that will accelerate the transition to net zero.

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Glossary

Term	Abbreviation	Explanation
A122		The new A122 trunk road to be constructed as part of the Lower Thames Crossing project, including links, as defined in Part 2, Schedule 5 (Classification of Roads) in the draft DCO (Application Document 3.1)
A122 Lower Thames Crossing	**Project**	A proposed new crossing of the Thames Estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
A122 Lower Thames Crossing/M25 junction		New junction with north-facing slip roads on the M25 between M25 junctions 29 and 30, near North Ockendon.
A13/A1089/A122 Lower Thames Crossing junction		Alteration of the existing junction between the A13 and the A1089, and construction of a new junction between the A122 Lower Thames Crossing and the A13 and A1089, comprising the following link roads: • Improved A13 westbound to A122 Lower Thames Crossing southbound • Improved A13 westbound to A122 Lower Thames Crossing northbound • Improved A13 westbound to A1089 southbound • A122 Lower Thames Crossing southbound to improved A13 eastbound and Orsett Cock roundabout • A122 Lower Thames Crossing northbound to improved A13 eastbound and Orsett Cock roundabout • Orsett Cock roundabout to the improved A13 westbound • Improved A13 eastbound to Orsett Cock roundabout • Improved A1089 northbound to A122 Lower Thames Crossing northbound • Improved A1089 northbound to A122 Lower Thames Crossing southbound
A2		A major road in south-east England, connecting London with the English Channel port of Dover in Kent.
Application Document		In the context of the Project, a document submitted to the Planning Inspectorate as part of the application for development consent.
Approved Carbon and Energy Management Plan		A Carbon and Energy Management Plan that has been approved by the Secretary of State
Bill of Quantities		A document prepared by a quantity surveyor or cost consultant which defines the quantity of works that the main contractor will need to undertake to complete a project
Carbon Literate Organisation	**CLO**	An organisation that has been accredited by The Carbon Literacy Project as having a substantial commitment to Carbon Literacy
Construction		Activity on and/or offsite required to implement the Project. The construction phase is considered to commence with the first activity on site (e.g. creation of site access), and ends with demobilisation.

Term	Abbreviation	Explanation
Design Manual for Roads and Bridges	**DMRB**	A comprehensive manual containing requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (National Highways, Transport Scotland, the Welsh Government or the Department for Regional Development (Northern Ireland)) is highway authority. For the A122 Lower Thames Crossing the Overseeing Organisation is National Highways.
Development Consent Order	**DCO**	Means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects (NSIP) under the Planning Act 2008.
Development Consent Order application	**DCO application**	The Project Application Documents, collectively known as the 'DCO application'.
Environmental Impact Assessment	**EIA**	A process by which information about environmental effects of a proposed development is collected, assessed and used to inform decision making. For certain projects, EIA is a statutory requirement, reported an Environmental Statement.
Environmental Statement	**ES**	A document produced to support an application for development consent that is subject to Environmental Impact Assessment (EIA), which sets out the likely impacts on the environment arising from the proposed development.
Ground Granulated Blast Furnace Slag	**GGBS**	GGBS is a by-product from the manufacture of iron and steel. It can be used to replace Ordinary Portland Cement and so reduce the carbon impact of both cement.
Heavy Goods Vehicle	**HGV**	A large, heavy motor vehicle used for transporting cargo.
Highways England		Former name of National Highways.
Intergovernmental Panel on Climate Change	**IPCC**	The IPCC is the international body for assessing the science related to climate change.
Inventory of Carbon and Energy	**ICE**	A database of information on the embodied carbon content of building materials.
M2 junction 1		The M2 will be widened from three lanes to four in both directions through M2 junction 1.
M2/A2/Lower Thames Crossing junction		New junction proposed as part of the Project to the east of Gravesend between the A2 and the new A122 Lower Thames Crossing with connections to the M2.
M25 junction 29		Improvement works to M25 junction 29 and to the M25 north of junction 29. The M25 through junction 29 will be widened from three lanes to four in both directions with hard shoulders.
National Highways		A UK government-owned company with responsibility for managing the motorways and major roads in England. Formerly known as Highways England.
National Planning Policy Framework	**NPPF**	A framework published in March 2012 by the UK's Department of Communities and Local Government, consolidating previously issued documents called Planning Policy Statements (PPS) and Planning Practice Guidance Notes (PPG) for use in England. The NPPF was updated in February 2019 and again in July 2021 by the Ministry of Housing, Communities and Local Government.

Term	Abbreviation	Explanation
National Policy Statement	**NPS**	Set out UK government policy on different types of national infrastructure development, including energy, transport, water and waste. There are 12 NPSs, providing the framework within which Examining Authorities make their recommendations to the Secretary of State.
National Policy Statement for National Networks	**NPSNN**	Sets out the need for, and Government's policies to deliver, development of Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England. It provides planning guidance for promoters of NSIPs on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
Nationally Significant Infrastructure Project	**NSIP**	Major infrastructure developments in England and Wales, such as proposals for power plants, large renewable energy projects, new airports and airport extensions, major road projects etc that require a development consent under the Planning Act 2008.
Operation		Describes the operational phase of a completed development and is considered to commence at the end of the construction phase, after demobilisation.
Order Limits		The outermost extent of the Project, indicated on the Plans by a red line. This is the Limit of Land to be Acquired or Used (LLAU) by the Project. This is the area in which the DCO would apply.
Ordinary Portland cement	**OPC**	This is the most common type of cement.
Planning Act 2008		The primary legislation that establishes the legal framework for applying for, examining and determining Development Consent Order applications for Nationally Significant Infrastructure Projects.
Project road		The new A122 trunk road, the improved A2 trunk road, and the improved M25 and M2 special roads, as defined in Parts 1 and 2, Schedule 5 (Classification of Roads) in the draft DCO (Application Document 3.1).
Project route		The horizontal and vertical alignment taken by the Project road.
Register of Environmental Actions and Commitments	**REAC**	The REAC identifies the environmental commitments that would be implemented during the construction and operational phases of the Project if the Development Consent Order is granted, and forms part of the Code of Construction Practice (Application Document 6.3, ES Appendix 2.2).
Renewable Energy Guarantee of Origin	**REGO**	A certificate that shows electricity has been generated from renewable sources. REGOs are administered by Ofgem (the energy regulator).
Science Based Targets Initiative	**SBTi**	The SBTi is a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF). It approves science-based targets set by organisations.
Steel Fibre Reinforced Concrete	**SFRC**	Concrete that is reinforced with steel fibres as opposed to conventional steel bars.
Transport Analysis Guidance	**TAG**	National guidance document produced by the Department for Transport.

Term	Abbreviation	Explanation
The tunnel		Proposed 4.25km (2.5 miles) road tunnel beneath the River Thames, comprising two bores, one for northbound traffic and one for southbound traffic. Cross-passages connecting each bore would be provided for emergency incident response and tunnel user evacuation. Tunnel portal structures would accommodate service buildings for control operations, mechanical and electrical equipment, drainage and maintenance operations. Emergency access and vehicle turn-around facilities would also be provided at the tunnel portals.
Tonnes of carbon dioxide equivalent	**tCO_2e**	A metric relating to emissions of carbon dioxide and the resultant climate change impact adopted by the UN.
United Nations Framework Convention on Climate Change	**UNFCC**	An international environmental treaty which seeks to reduce atmospheric concentrations of greenhouse gases.

Appendix A Key terms

A.1 Greenhouse gas emissions (GHG)

A.1.1 Greenhouse gases are gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation. The increased quantity of greenhouse gases in the atmosphere is causing warming throughout the climate system.

A.1.2 The United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol (2008) identifies seven main greenhouse gases:

a. Carbon dioxide (CO2)

b. Methane (CH4)

c. Nitrous oxide (N2O)

d. Hydrofluorocarbons (HFCs)

e. Perfluorocarbons (PCFs)

f. Sulphur hexafluoride (SF6)

g. Nitrogen trifluoride (NF3)

A.2 Carbon

A.2.1 This plan uses the term ‘carbon’ as shorthand for the above greenhouse gases.

A.3 Carbon dioxide equivalent (CO_2e)

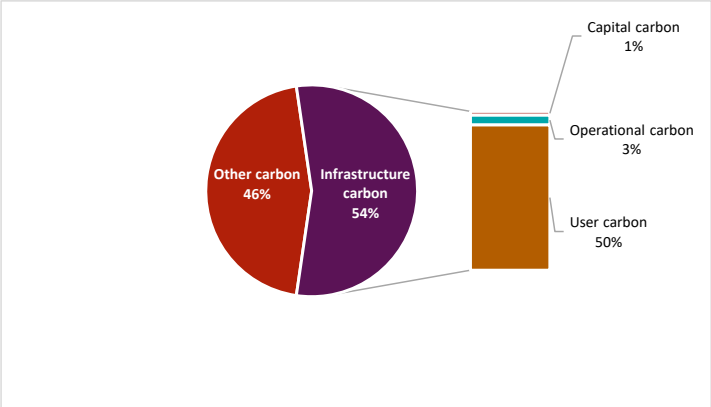
A.3.1 To take account of the different climate impact of each greenhouse gas, this plan quantifies emissions in tonnes of carbon dioxide equivalent (tCO_2e). The tCO_2e for each greenhouse gas is calculated by multiplying the quantity of the greenhouse gas by its global warming potential. The global warming potential depends on the amount of energy the greenhouse gas can absorb and how long it remains active in the atmosphere.

A.4 Carbon management

A.4.1 Carbon management is a process by which organisations or projects quantify, monitor, reduce and report their carbon impact.

A.4.2 Carbon management is crucial in the infrastructure industry because infrastructure accounts for 55% of the UK's total emissions (based on 2018 data) (Curd, 2020).

Plate A.1 Carbon emissions in the infrastructure sector



A.4.3 As presented in Plate A.1, infrastructure emissions consist of:

a. Capital carbon. For this Project, capital carbon consists of emissions from construction, maintenance and replacement[6]

b. Operational carbon. For this Project, operational carbon consists of emissions from operational energy and water consumption[7]

c. User carbon. For this Project, user carbon consists of emissions resulting from the change in traffic on the road network caused by the Project[8]

A.5 PAS 2080

A.5.1 PAS 2080:2023 Carbon management in infrastructure (British Standards Institute, 2023) is a global standard for the management of carbon in infrastructure. It covers the whole life cycle of carbon used in projects and consists of six key steps (blue boxes in Plate A.2):

a. Target setting: Set appropriate carbon reduction targets

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[6] PAS 2080 defines capital carbon as GHG emissions that can be associated with the creation, refurbishment and end of life treatment of an asset. This includes the emission or sequestration of carbon that occurs due to land use change.
[7] PAS 2080 defines operational carbon as GHG emissions associated with the operation of an asset.
[8] PAS 2080 defines user carbon as GHG emissions associated with the users' utilisation of infrastructure (i.e. emissions arising from the user utilising infrastructure services).

b. Baselines: Determine baselines against which carbon reduction performance is assessed

c. Monitoring: Establish metrics, e.g. key performance indicators, for monitoring carbon performance

d. Quantification: Quantify emissions including selecting the method, defining boundaries and applying cut-off rules

e. Reporting: Report carbon performance at appropriate infrastructure work stages

f. Continual improvement: Continually improve carbon management and performance

Plate A.2 PAS 2080:2023 Carbon Management Process (British Standards Institution, 2023)

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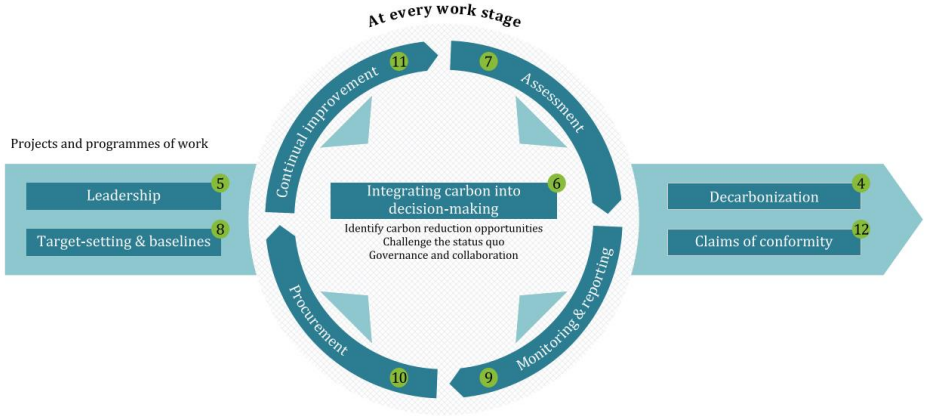


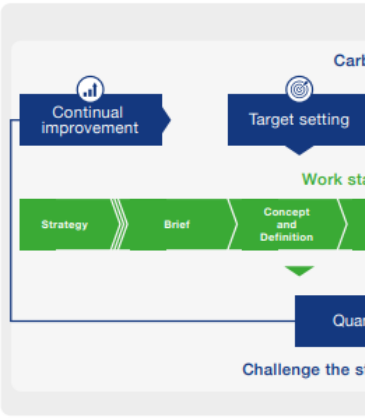
A.5.2 PAS 2080 helps organisations reduce whole life carbon emissions on projects by:

a. providing a common framework for the infrastructure sector and supply chain

b. encouraging a more integrated value chain

c. facilitating clear and consistent communications on carbon

d. fostering a culture of collaboration and innovation



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A.6 Net zero

A.6.1 Net zero means achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere. Net zero can be achieved by reducing existing emissions and/or actively removing greenhouse gases (Institute for Government, 2020). The UK is legally committed to achieving a 78% reduction by 2035 and net zero by 2050, with interim binding reduction targets to that date through five-year progressive carbon budgets.

A.6.2 Net zero requires a commitment to:

a. reduce emissions, with the scale of reduction being consistent with the 1.5°C goal of the Paris Agreement (United Nations, 2015)

b. neutralise the impact of residual emissions by permanently removing an equivalent amount of atmospheric carbon dioxide, through carbon removal credits (Science Based Targets initiative (SBTi), 2021)

A.7 Carbon hotspot

A.7.1 A carbon hotspot is an area or activity with a high concentration of carbon emissions.

A.8 Environmental Product Declaration

A.8.1 An Environmental Product Declaration is a transparent, objective report detailing what a product is made of and calculating its environment impact across its entire life cycle. It is based on third-party verified data so can be used to compare different products and services.

A.9 Contractors and subcontractors

A.9.1 In this plan, 'Contractors' refers to the Contractors providing the main works (i.e. the three design and build contracts: Roads North, Tunnels and Approaches, and Kent Roads).

A.9.2 In this plan, 'subcontractors' refers to the subcontractors that are directly engaged by the Contractors providing the main works (Roads North, Tunnels and Approaches, and Kent Roads).

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Appendix B Scope

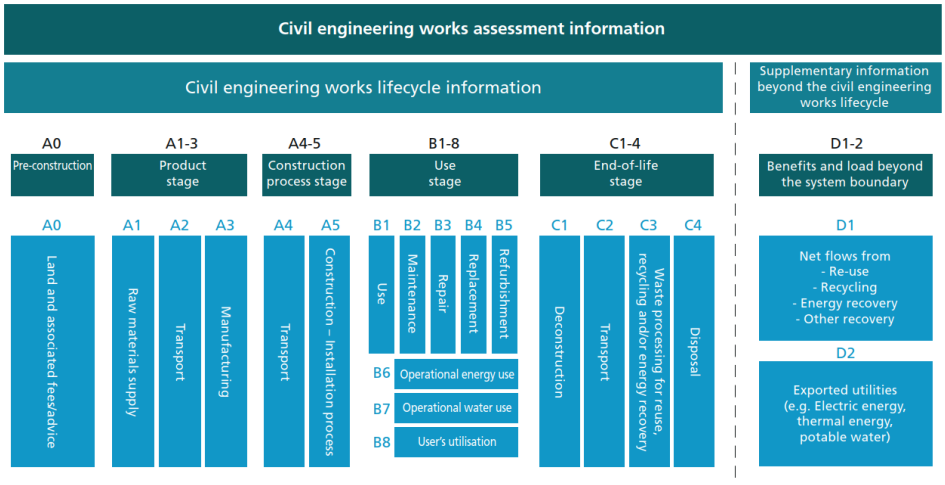
B.1.1 This section sets out the parameters of the Project's carbon quantification and carbon management approach.

B.2 Emissions quantification

Life cycle boundary

B.2.1 PAS 2080:2023 divides an infrastructure project into lifecycle stages (Plate B.1).

Plate B.1 PAS 2080:2023 Lifecycle stages (British Standards Institution, 2023)



B.2.2 The Applicant has quantified the carbon impact of the Project across the whole life cycle, in line with PAS 2080. Appendix C outlines which modules have been included and justifies any exclusions.

Temporal boundary

B.2.3 The temporal boundary includes:

a. The complete construction phase

b. A sixty-year operational phase as this is the timescale set out in the Department for Transport's Transport Analysis Guidance (TAG) (2013).

Spatial boundary

B.2.4 The Project does not apply a spatial boundary and instead includes emissions irrespective of the geographic location in which they occur. The exception to this

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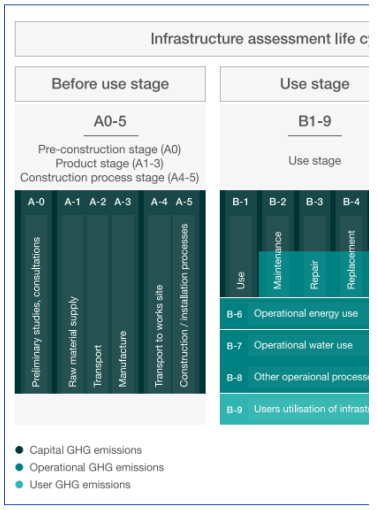

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is the road-user emissions, whose study area is defined by the Project's transport model, as set out in the Combined Modelling and Appraisal Report (ComMA) (Application Document 7.7). This study area is appropriate as it captures the change in user emissions from the Project, those arising from the outlying road network, and vehicle movements that would be indirectly influenced by the Project (positively and negatively).

B.3 Carbon management approach

B.3.1 In line with PAS 2080, the Project has applied the principle of control and influence and has focused on emissions under its control (Table B.1).

Table B.1 Application of the control and influence principle on the Project's carbon management approach

Control vs. influence	Emission sources	Carbon management approach
Emissions under the Project's control	• Capital carbon (construction and maintenance) • Operational carbon (operational energy, water and waste)	• The Applicant has sought to identify and implement measures to reduce emissions over which it has control.
Emissions which the Project can influence but not control	• User carbon (user traffic)	• The Applicant can influence but not control the emissions from user carbon (i.e. user traffic). Policies to drive reductions in road user emissions are set out in wider Government policy, principally the Transport Decarbonisation Plan.

Appendix C Emissions quantification

C.1 Goal of emissions quantification

C.1.1 The goal in quantifying the Project's carbon emissions is to report forecast emissions and identify the main contributors (emissions hotspots) where reduction efforts should be focused.

C.2 Alignment with PAS 2080

C.2.1 The Applicant has quantified its emissions in line with PAS 2080. Table C.1 shows which modules are included and justifies any that have been excluded.

Table C.1 PAS 2080 modules in the carbon quantification

Modules	Scope	Status
A: Before use stage (construction)		
A0: Pre-construction	• Preliminary studies and works such as strategy and brief development, architecture, design efforts, EIA and cost planning. These functions are largely office-based.	• Pre-enabling work and development phase work have been included. • Other aspects have been excluded due to a lack of data. Excluded emissions are less than 1% of the total construction emissions, based on professional judgement.
A1 – A3: Product stage	• Emissions associated with the extraction, processing and manufacturing of the construction material. The module includes energy consumption and waste management within these processes. • Emissions associated with the movement of materials and goods within the supply chain up to the point of final factory gate.	• Included
A4: Construction process stage: Transport to works sites	• Transport emissions associated with the delivery of construction material, construction equipment and construction workers to works sites.	• Included
A5: Construction process stage: Onsite stage	• Enabling works and ground works • Materials storage and any energy or otherwise needed to maintain necessary environmental conditions • Transport of materials and equipment onsite	• Included

Modules	Scope	Status
	• Installation of materials and products into the infrastructure asset • Emissions associated with site water demand • Waste management activities (transport, processing, final disposal) associated with waste arising from the construction site • Production, transportation and waste management of materials/products lost during works • Carbon emissions associated with land use change	
B: Use stage		
B1: Use	• Carbon emitted directly from the fabric of products and materials once they have been installed as part of the infrastructure, e.g. emissions from refrigerants • Carbon sequestration from planting of trees and vegetation	• sequestration from planting of trees and vegetation has been included. • No other relevant emissions identified.
B2 – B5: Maintenance, repair, replacement and refurbishment	• Works activities and new materials for the maintenance, repair, replacement and refurbishment of the infrastructure during the use stage	• Maintenance: The emissions associated with the day-to-day upkeep of the Project have been included. Maintenance includes plant equipment, materials and transport activities. Operational waste excluded due to low annual waste tonnages and high diversion from landfill. The Environmental Statement (ES) Chapter 11: Material Assets and Waste (Application Document 6.1) presents the commitments on minimising the impact of waste during the operational phase. • Repair: The repair of any fixed infrastructure assets is excluded as it is assumed the assets would be maintained to prevent failure and would be replaced at the end of their life. • Replacement: Some assets would need to be replaced over the sixty-year timescale of the carbon model and this has been included in the model.

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Modules	Scope	Status
		• Refurbishment: No refurbishment is expected to occur during the sixty-year operational period.
B6: Operational energy	• Emissions resulting from the energy used by infrastructure-integrated technical systems to enable it to deliver its service during operation. This might be to provide heating and cooling, ventilation, lighting, auxiliary energy for pumps, control and automation.	• Included
B7: Operational water	• Emissions resulting from the consumption of water required by the infrastructure to enable it to operate and deliver its service. It includes all water used and its treatment (pre- and post-use) during the normal operation of the infrastructure.	• Excluded as this module is expected to contribute less than 1% of total emissions, based on professional judgement. The main use would be by staff at the tunnel services buildings, fire incident response and tunnel washing.
B8: User's utilisation	• Activities associated with the user's utilisation of the infrastructure during the use stage	• Included. These are emissions from user traffic.
C: End of life stage		
C1: Deconstruction	• Onsite activities of deconstructing, dismantling and demolishing the infrastructure	• Excluded as the Project has no planned end of life and infrastructure assets are rarely decommissioned.
C2: Transport	• Emissions due to the transport to disposal and/or until the end-of-waste state of waste materials	• Excluded as above
C3: Waste processing for recovery	• Emissions due to the treatment and processing for recovery, reuse and recycling of waste materials arising from the infrastructure	• Excluded as above
C4: Disposal	• Emissions resulting from final disposal of demolition materials (neutralisation, incineration with or without utilisation of energy, landfilling with or without utilisation of landfill gases, etc.)	• Excluded as above

Deleted: B8: Other operational processes ...

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C.3 Data used in the carbon quantification

Data quality principles

C.3.1 The Applicant has used the best available data, in line with the data quality principles in Table C.2.

Table C.2 data quality principles

Data quality principle	Application to the Project
Age	The activity data and carbon emission factors used are applicable to the time period for construction or operation.
Geography	The activity data is specific to the Project and emission factors used are applicable to the UK.
Technology	The activity data and emission factors used are representative of the UK construction and transport sectors.
Methodology	The activity data is specific to the Project and has been provided by the Project's engineering and design teams.
Competency	The activity data is specific to the Project and has been provided by the Project's engineering and design teams. The emission factors used are from published sources. Data gaps have been filled using best available data, for example extrapolating existing data or using industry guidance documents.

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Activity data

C.3.2 Table C.3 lists the data sources used in the carbon quantification.

Table C.3 Data sources used in the carbon quantification

Module	Key activity data	Data source
A0	Pre-enabling works and development phase emissions	Actual data where available, otherwise reasonable estimates
A1 – A3: Product stage	Roads	Bill of Quantities except for any items not quantified in sufficient detail, in which case, professional judgement has been used. This mainly relates to temporary assets that have not yet been designed in detail.
	Tunnels	Bill of Quantities except for any items not quantified in sufficient detail, in which case, professional judgement has been used. This mainly relates to temporary assets that have not yet been designed in detail. Third-party data for tunnel boring machine and mechanical and ventilation plant in tunnel.
	Utilities works	Bill of Quantities
	Earthworks	Bill of Quantities
A4: Construction process stage: Transport to works sites	Transport of materials	Material quantities taken from data sources used for modules A1–A3 Assumed transport distance taken from the Royal Institution of Chartered Surveyors whole life carbon assessment for the built environment (November 2017).
A5: Construction process stage: Onsite stage	Construction waste	Bill of Quantities and assumed wastage rates and disposal routes
	Electricity consumption	Estimated maximum demand models for compounds
	Diesel consumption	Plant activity schedules
	Land use change	Baseline habitat mapping (ES Chapter 8: Terrestrial Biodiversity) Post development design models and information such as engineering and landscape plans. These identify the areas moving from one land use type to another.

Module	Key activity data	Data source
	Carbon associated with risk	Register of potential Project risks Project-specific calculation of emissions per million pounds of spend
B1: Use	Land use change	Baseline habitat mapping (ES Chapter 8: Terrestrial Biodiversity) Post development design models and information such as engineering and landscape plans. These identify the areas moving from one land use type to another.
B2 – B5: Maintenance, replacement, repair and refurbishment	Capital carbon	Renewal frequencies schedules
B6: Operational energy	Electricity consumption	Estimated energy demand loads
B8: User's utilisation	Emissions from traffic during the operational phase	TAG Greenhouse Gases Workbook (Department for Transport, 2022a). The assumptions and method used to calculate the user traffic emissions are set out in the Combined Modelling and Appraisal Report (Application Document 7.7).

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C.3.3 The activity data is based on early design information and generally uses forecast data rather than actual data, as actual data is not available at this stage[10]. The carbon quantification is therefore a reasonable estimate, calculated using the most representative, accurate and plausible data available.

Emission factors

C.3.4 The following sources have been used for emission factors:

a. National Highways Carbon Tool v2.4 (National Highways, 2021b)

b. Inventory of Carbon and Energy (ICE) v3.0 (Circular Ecology, 2019a)

c. ICE Cement, Mortar and Concrete Model – V1.1 Beta (Circular Ecology, 2019b)

d. Department for Business, Energy & Industrial Strategy (BEIS) Carbon Factors 2021

e. BEIS Electricity emissions factors to 2100 (in kgCO2e/kWh), last updated March 2019 (for future emission factors for grid electricity)

f. National Atmospheric Emissions Inventory (Ricardo Energy & Environment, 2014)

g. Emission Factors Toolkit (EFT) v11 (with London Adjustment) (DEFRA 2021)

h. Speed Banding Toolkit v4.3[11] (National Highways 2019)

i. Other third-party data sources: a limited number of emission factors were not available from the above sources so have been obtained from other sources, including the Carbon Trust

C.3.5 Where no emission factor was available for the exact material, the closest match has been used.

Calculation

C.3.6 Carbon emissions have been calculated using the equation:

activity data x carbon emissions factor = carbon emissions

[10] Actual data has been used for A0 emissions where available.
[11] National Highways speed band emission factors (set out in DMRB LA 105)

Appendix D Project emissions

D.1.1 This appendix:

a. presents the projected reasonable worst-case emissions for the Project[12]. These emissions represent the Project's maximum level of emissions (CBN04) and are a reasonable worst case because they do not take into account the impact of the carbon reductions actions set out in Section 3 (rewarding carbon reduction, investing in innovation and adopting a best practice carbon management approach)

b. breaks down emissions by PAS 2080 module, source and material

c. defines the carbon limit that Contractors will be required to meet, as a minimum, through the second iteration of the Carbon and Energy Management Plan

d. shows that the maximum level of construction emissions represents current best practice in the industry

D.2 Total emissions

D.2.1 The forecast carbon emissions from the construction of the Project are 1.44 million tCO_2e (Table D.1). Forecast emissions from the maintenance of the Project are 0.03 million tCO_2e[13]. Operational emissions are zero as the Applicant has assumed the use of certified renewable electricity during operations (Net zero highways plan, National Highways, 2021a) and emissions from water consumption and waste generation are excluded (as they are expected to be minimal, Table D.1)[14].

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Table D.1 Carbon emissions from construction and maintenance

Emission type	Emissions (million tCO_2e)
Construction	1.44
Maintenance	0.03
Total	1.47

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[12] Emissions are also presented in ES Chapter 15: Climate (Application Document 6.1) and are monetised in the Combined Modelling and Appraisal Report, Appendix D – Economic Appraisal Report (Application Document 7.7).
[13] Includes emissions from replacement of assets
[14] Operational emissions cover water consumption, energy consumption and waste generation. They do not include emissions from road users

D.3 Emissions by PAS 2080 module

D.3.1 The PAS 2080 module that accounts for the most construction emissions is A1–A3 (product stage), accounting for 54% (Plate D.1, Table D.2). Product stage emissions result from the extraction, processing and manufacturing of the construction material and the transportation of the material to the final factory gate.

Plate D.1 Construction emissions by PAS 2080 module

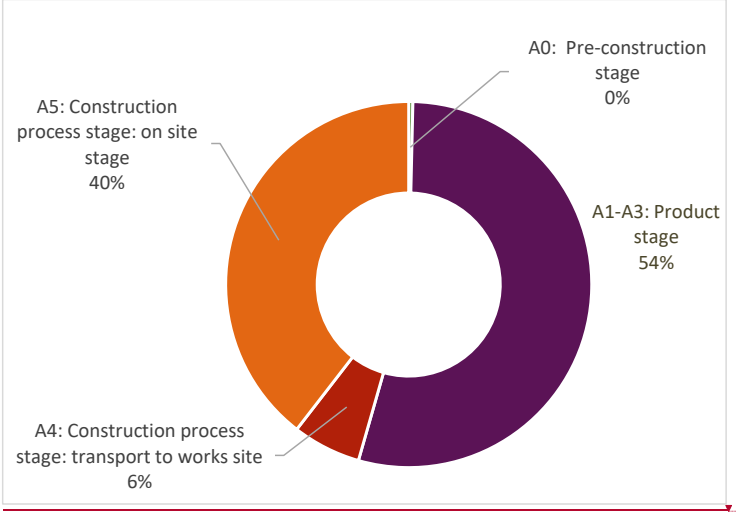

Table D.2 Construction emissions by PAS 2080 module

PAS 2080 module	Carbon emissions (million tCO_2e)	%
A0	0.005	<0.4%
A1-A3	0.781	54%
A4	0.087	6%
A5	0.571	40%
Total	1.445	100%

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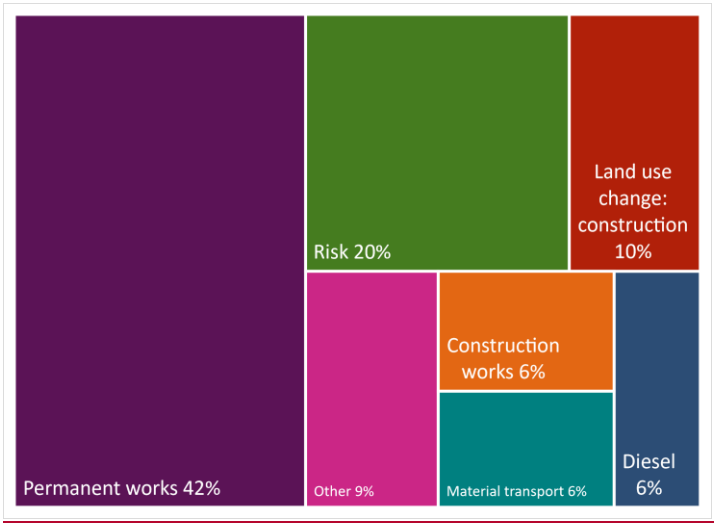
D.4 Construction emissions by source

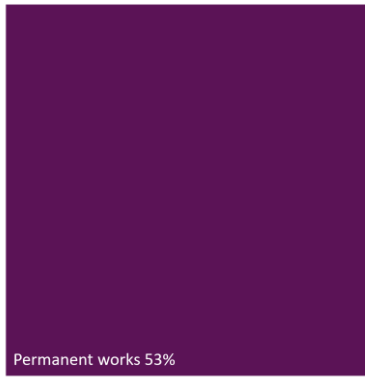
Plate D.2 Construction emissions by source



D.4.2 Forty-two percent of the Project's construction emissions arise from embodied carbon in the permanent works, 20% from carbon in risk items[15] and 10% from land use change (Plate D.2)[16].

D.5 Construction emissions by material

D.5.1 Steel, carbon in risk items and cement (including the cement in concrete) account for 57% of total construction emissions (0).



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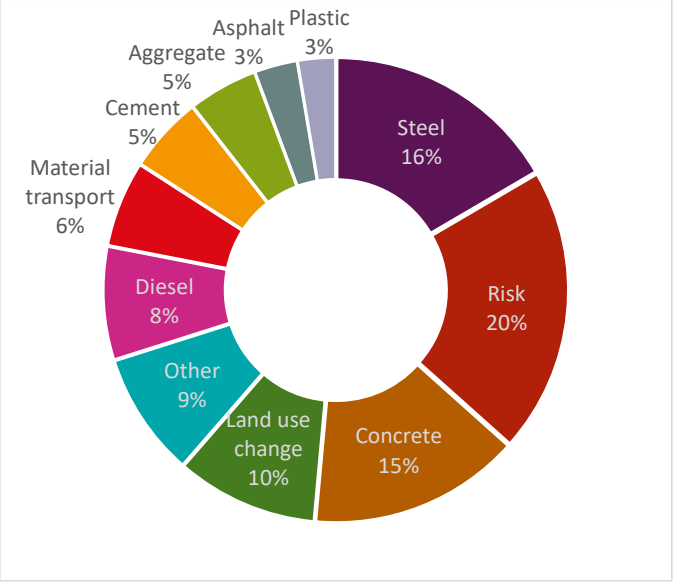
[15] Carbon impact if risks identified in the risk register were to materialise, for example the need for more ground improvement than was anticipated

[16] This covers emissions from land use change. The carbon sequestration from land use change is included in the operational phase emissions

Plate D.3 Construction emissions by material



Steel emissions

D.5.2 Most of the steel emissions arise from the use of steel bar and rod (30% of total steel emissions), followed by plate steel (20%) (Plate D.4).

D.5.3 Of the three design and build contracts, the Tunnels and Approaches contract accounts for 45% of steel emissions, followed by the Roads North contract (33%) and Kent Roads (22%).

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Construction emissions by material¶

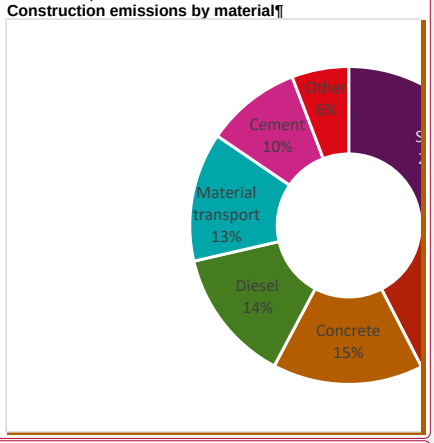

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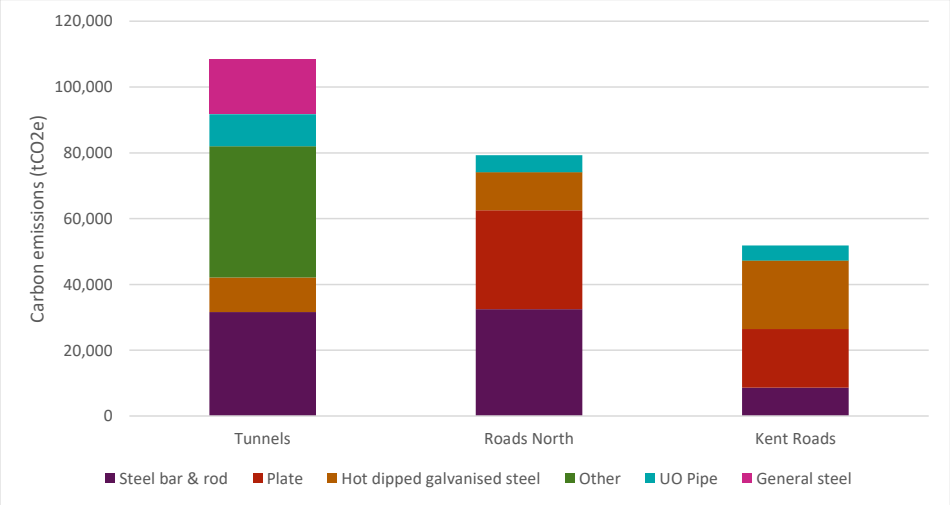
Plate D.4 Steel emissions by type and contract

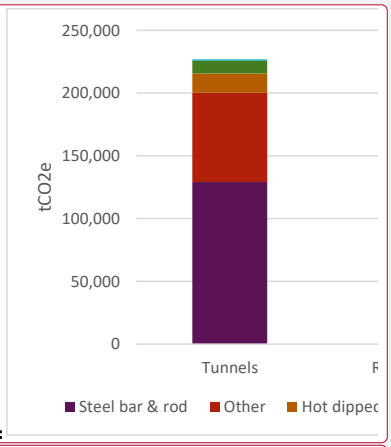


Cement and concrete emissions

D.5.4 Cement and concrete are grouped together because the embodied carbon in cement accounts for most of the carbon impact of concrete[17].

D.5.5 Concrete is categorised into different grades depending on its strength, with a higher number (e.g. C40/50) indicating a stronger concrete. Standalone cement and two types of concrete account for more than two-thirds of all cement and concrete emissions (Plate D.5).

D.5.6 The Tunnels contract accounts for 81% of all cement and concrete emissions, followed by Roads North and Kent Roads, at 13% and 6% respectively.



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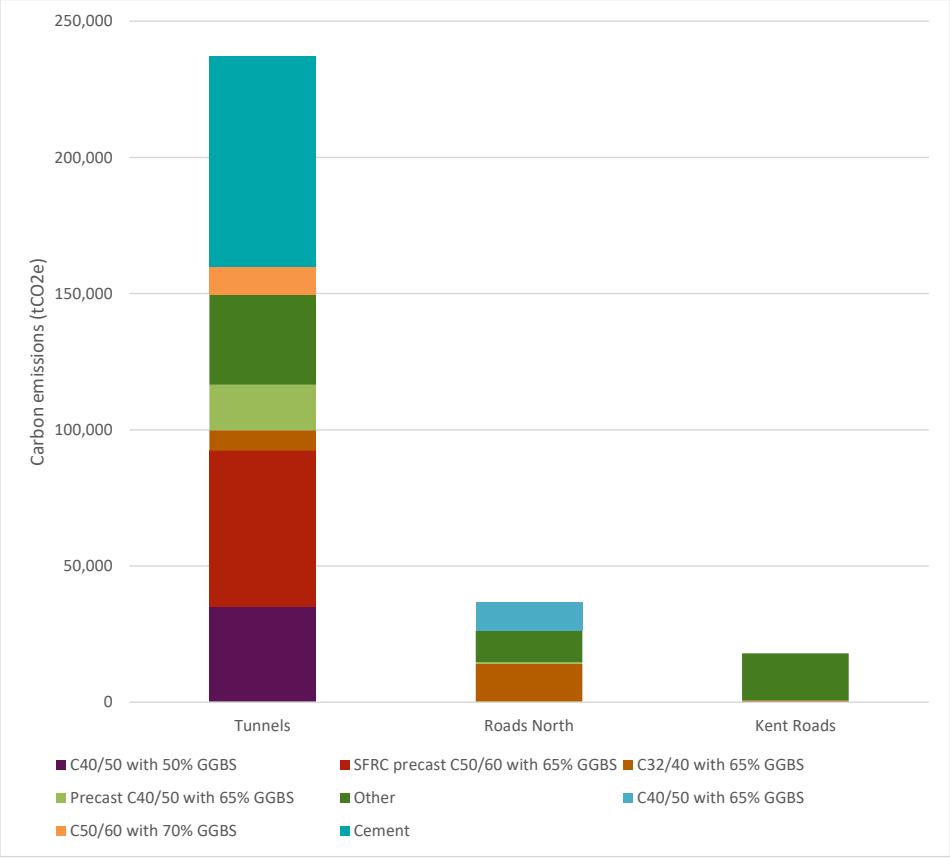
[17] The other components of concrete (aggregates, admixtures, transport of constituents and batching) have a lower carbon impact than that of cement (Astle, 2021). As well as being used in concrete, cement is also used on the Project for ground improvement.

Plate D.5 Cement and concrete emissions by type and contract



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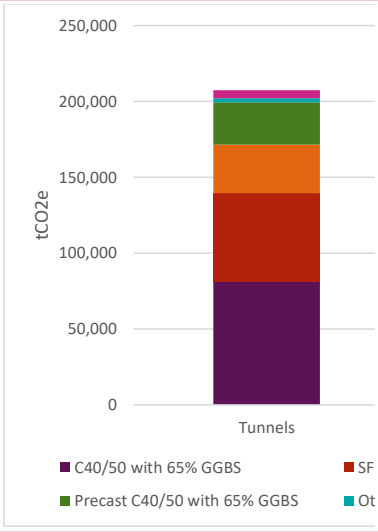

Plant emissions

D.5.7 Excavators and dumpers are the plant types accounting for the most carbon emissions at 27% and 26% respectively (Plate D.6).

D.5.8 The Roads North contract accounts for 82% of all plant emissions, followed by Tunnels and Kent Roads, accounting for 15% and 3% of plant emissions respectively.

D.5.9 Diesel accounts 94% of plant emissions and HVO (hydrogenated vegetable oil) accounts for 6%.

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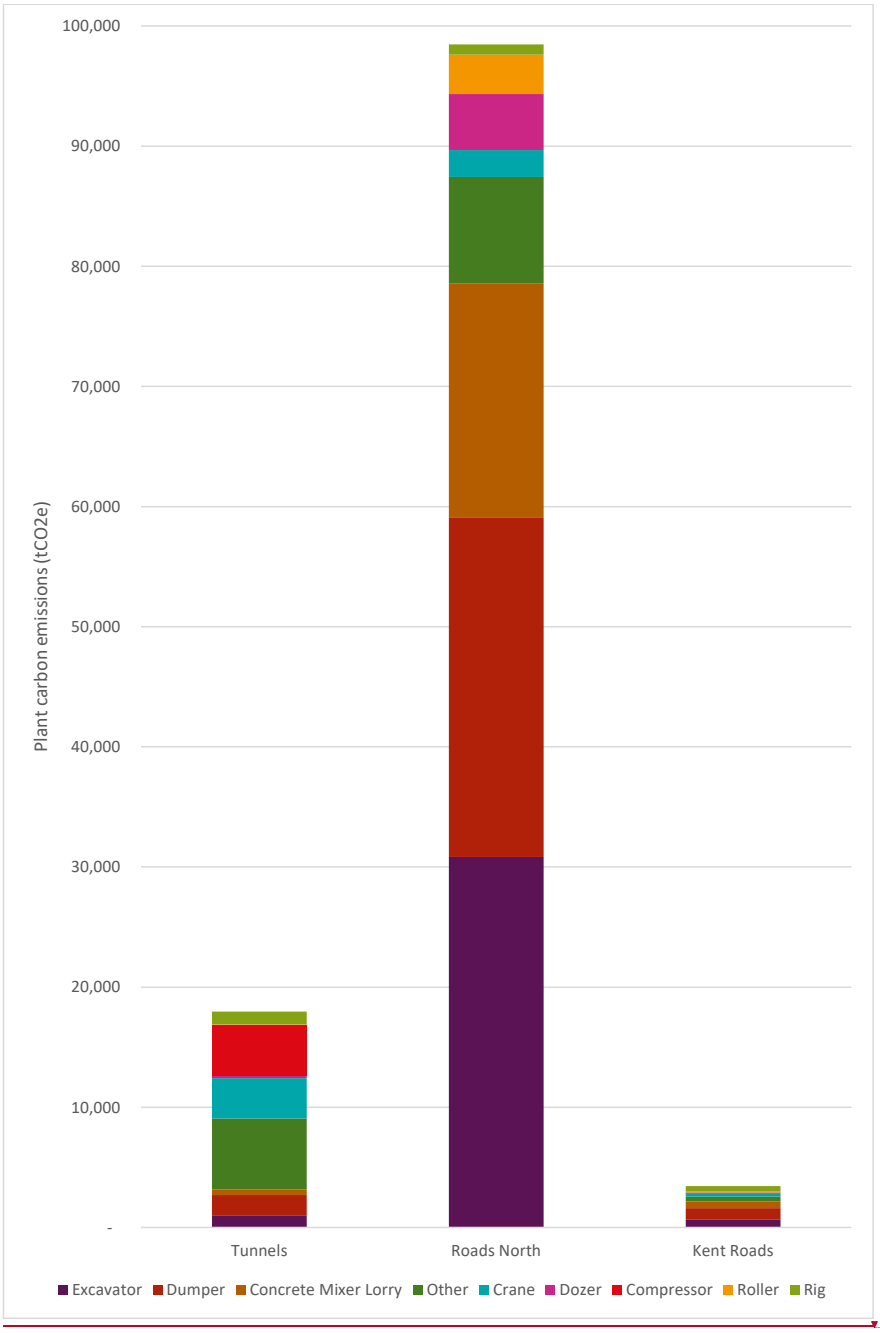
Plate D.6 Plant emissions by plant type and by contract



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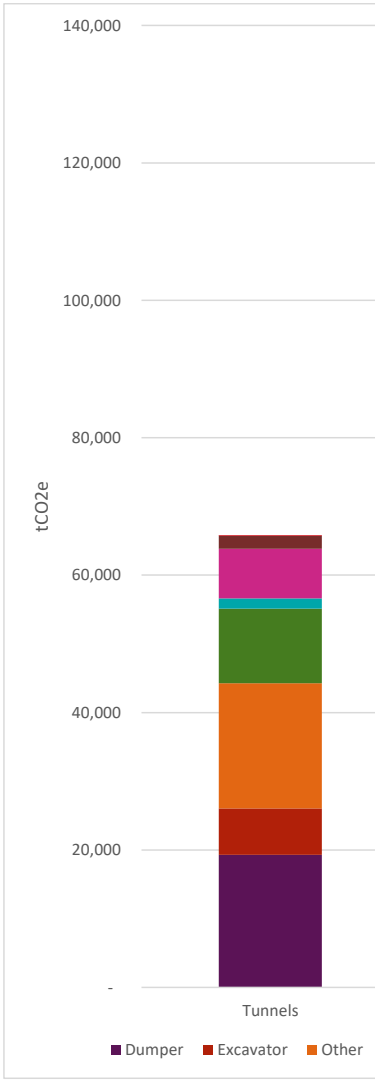

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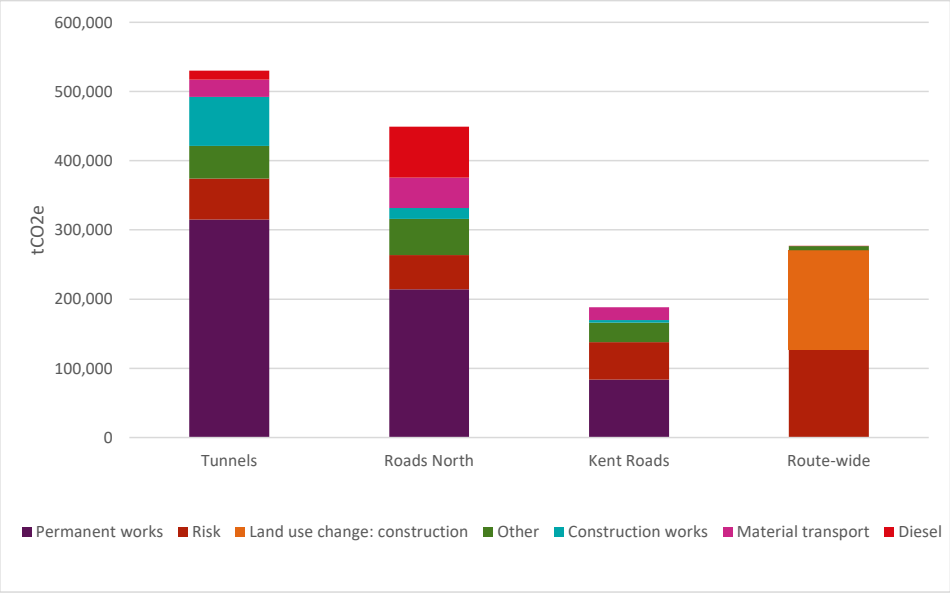
D.6 Construction emissions by contract

D.6.1 Construction emissions have been apportioned between the three design and build contracts and emissions that are route-wide (i.e. not contract-specific)[18]. The Tunnels contract accounts for 37% of total construction emissions, Roads North accounts for 31%, route-wide 19% and Kent Roads 13% (Plate D.7).

Plate D.7 Construction emissions by contract



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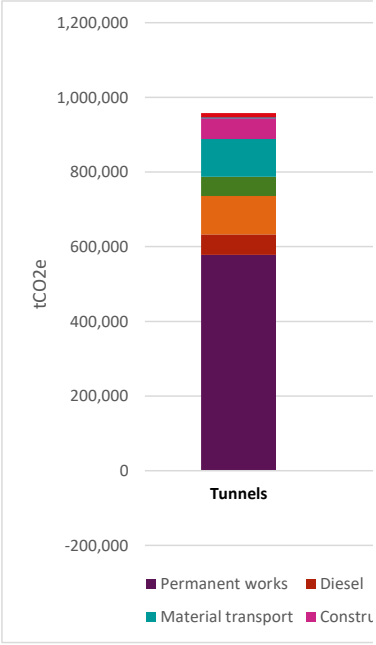

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[18] Route-wide emissions are mainly related to land use change and programme-level risk.

D.7 Construction emissions represent industry best practice

D.7.1 The Applicant initially set a construction emissions limit of 1.763 mtCO_2e which it considered to represent current best practice for low carbon construction because it could only be delivered by incorporating an extensive range of commercially available, low carbon technologies and approaches such as those shown in Table D.3.

Table D.3 Some of the Carbon reduction measures included in the construction emissions calculation

Carbon reduction measure	Detail	Carbon impact (tCO_2e)
65% GGBS replacement for OPC in concrete[20]	GGBS is a by-product from manufacturing iron and steel. It can be used to replace OPC. GGBS has less than a fifteenth of the embodied carbon dioxide emissions of OPC so replacing OPC with GGBS reduces the carbon impact of the concrete used. The Applicant has assumed 65% GGBS replacement for OPC in all main concrete grades used on the Project (accounting for 97% of total quantity of concrete used)[21]. The saving has been calculated by comparing emissions with 65% GGBS replacement to emissions if UK average cement was used (from ICE database (Circular Ecology, 2019a)), except for steel fibre reinforced C50/60 precast concrete where UK average data was not available so the comparison was made against standard (CEM I) cement.	-275,000
Reuse of excavated material	The Project will reuse over 20 million tonnes of material excavated from the construction of the roads and tunnels. This saves carbon by reducing: a. the need to transport material offsite b. the need to import material for landscaping (embodied carbon in the material) c. the need to transport new material onsite for landscaping The saving has been calculated by quantifying the carbon reduction from these three changes.	-227,000

[20] Concrete has a wide variation of cement contents for the same strength class of concrete so this carbon impact is an estimate modelled using the ICE Cement, Concrete & Mortar mode (Circular Ecology, 2019b).
[21] 65% GGBS replacement for OPC was used for the following grades: C32/40 *in situ* concrete, C40/50 *in situ* concrete, SFRC C50/60 precast concrete, C40/50 precast concrete and C28/35 *in situ* concrete

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Carbon reduction measure	Detail	Carbon impact (tCO_2e)
50% GGBS replacement for OPC in cement	The Project uses cement in concrete and in ground improvement. For cement in concrete, it has assumed 65% GGBS replacement of OPC (see row 1 of this table). For cement in ground improvement, it has assumed 50% GGBS replacement of OPC. The saving has been calculated by comparing emissions with 50% GGBS replacement to emissions if UK average cement was used (from ICE database (Circular Ecology, 2019a)).	-127,000
Renewable electricity for construction	The Project will use renewable electricity for construction which results in lower carbon emissions than if the grid-average electricity was used. The saving has been calculated by quantifying what emissions would have been if grid-average electricity had been used. This was done using predicted electricity consumption and forecast grid electricity factors which consider future decarbonisation of the grid.	-67,000
Concrete grade optimisation	The Applicant has reviewed the assumed strength grade of the key concretes used during construction and has reduced the grade where possible. The saving has been calculated by comparing emissions of the new concrete grade with those of the original assumed concrete grade.	-53,000
Use of steel fibre reinforced concrete	The Applicant has assumed the use of SFRC for most of the concrete segments in the bored tunnels which has a lower emission factor than steel bar reinforced concrete. The saving has been calculated by comparing emissions with SFRC to emissions if steel rebar was used.	-31,000
Reduced disposal of other material offsite	The Applicant has identified measures to reduce offsite disposal for the following materials: a. Clean surplus material b. contaminated Materials (Class U1B – non-hazardous) c. Contaminated Materials (Class U2 – hazardous) d. Topsoil surplus Reducing the amount of offsite disposal saves carbon by reducing the need to transport material offsite and the need to process materials offsite. The saving has been calculated by quantifying carbon reduction from these changes.	-28,000

Carbon reduction measure	Detail	Carbon impact (tCO_2e)
Design efficiency	The Applicant has proposed a more carbon-efficient design for the north portal, changing from a large rectangular box to a caterpillar design. The saving has been calculated by quantifying the embodied carbon in the caterpillar design and comparing it to the large rectangular box design.	-27,000
Other	The Applicant has: a. identified measures to reduce the amount of aggregate that needs to be imported b. assumed zero tailpipe emission generators are used instead of diesel generators c. reduced the extent of planned utility diversions d. assumed that current good practice level of hybrid and electric plant will be used e. assumed warm mix asphalt will be used on the base and binder courses f. reduced the average onsite haul distance and the amount of double handling and stockpiling of materials g. recycled a proportion of its hazardous waste rather than sending it to landfill.	-63,000
Total carbon impact		**-898,000**

D.7.2 The tender submissions the Applicant received during the procurement of the three design and build contracts demonstrated the market was prepared to commit to a lower carbon limit, so the Applicant has reset this best practice level of construction emissions as its maximum (CBN04, Appendix E). Tenderers have shown the lower limit could be achieved through measures such as:

a. Using lower carbon steel compared with the steel assumed in the original carbon model

b. Using lower carbon concrete compared with the concrete assumed in the original carbon model

c. Reducing distances and changing mode for material transport

d. Using more hybrid plant, electric plant and biofuels and using telematics to optimise efficiency

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D.8 Operational phase emissions

D.8.1 Emissions in the operational phase consist of:

a. Emissions from the change in user traffic, which the Applicant can influence but not control (Table B.1). Emissions from road users presented in the Environmental Statement (ES) Chapter 15: Climate (Application Document 6.1) and the Combined Modelling and Appraisal Report, Appendix D - Economic Appraisal Report (Application Document 7.7).

b. Emissions from maintenance and replacement. Forecast emissions from the maintenance of the Project between 2030 and 2040 are 0.031 million tCO_2e[22]. From 2040, the Applicant has assumed zero carbon maintenance in line with the Net zero highways plan (National Highways, 2021a).

c. Emissions from operational energy consumption. The Applicant has assumed zero carbon operations throughout the operational phase of the Project, in line with the Net zero highways plan (National Highways, 2021a).

[22] This includes emissions from the replacement of assets

Appendix E Register of carbon commitments

E.1.1 The Applicant's carbon commitments are set out in Table E.1.

Table E.1 Register of carbon commitments

ID	Commitment	Iteration of C&EMP
CBN01	The Applicant will include carbon as a key criterion in the evaluation of tenders for the three design and build contracts.	First
CBN02	The Applicant will require Contractors to have corporate net zero plans setting out how they will reach a net zero position that aligns with the 1.5°C reduction of the Paris Agreement (United Nations, 2015) and the UK's commitment to be net zero by 2050. The plans must include science-based targets for emissions reduction.	First
CBN03	The Applicant will ensure that formal regular collaborative carbon reduction workshops are held with representatives of all Contractors present.	First & second
CBN04	The Applicant will develop and, where appropriate, implement measures to avoid / prevent, reduce and remediate emissions arising from the construction of the Project to ensure that net construction emissions do not exceed 1.44 million tCO_2e.	First & second
CBN05	Contractors will be required not to exceed a carbon limit which is aligned to the level set out in CBN04	First
CBN06	The Applicant will require Contractors to provide Environmental Product Declarations for the ten construction products contributing the most to carbon emissions in their contract. The Environmental Product Declarations must show that the emission factor for the product being used is better than European average.	First & second
CBN07	The Applicant will require Contractors to procure renewable electricity throughout construction, to meet any demand that is not met through onsite renewables and will provide Renewable Energy Guarantee of Origin (REGO) certificates covering the total amount of electricity consumed.	First & second
CBN08	The Applicant will require Contractors to provide and maintain electric vehicle charging facilities, using zero carbon electricity, for 30% of parking capacity in each compound, increasing this as necessary to satisfy demand.	First & second
CBN09	The Applicant will require Contractors to use zero tailpipe emission vehicles for all staff movements within working areas and to and from public transport hubs.	First & second
CBN10	The Applicant will require Contractors to promote the use of active transport for personnel to and from the compounds and to provide managed electric charging facilities for e-bikes at each compound, in covered cycle parking areas, to satisfy demand.	First & second
CBN11	The Applicant will provide commercial incentives for Contractors to reduce emissions below their carbon limit.	First

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ID	Commitment	Iteration of C&EMP
CBN12	The Applicant will include a contractual mechanism that allows Contractors to be paid the additional costs of implementing agreed carbon reduction technologies, together with an incentive payment to further encourage their identification and adoption.	First
CBN13	The Applicant will obtain PAS 2080 certification for the Project from an independent, third-party certification body by the end of 2023 and will maintain the certification annually.	First
CBN14	The Applicant will require Contractors to obtain PAS 2080 certification from an independent, third-party certification body within 52 weeks of the contract starting date and will maintain the certification annually[1].	First & second
CBN15	The Applicant will require Subcontractors to obtain PAS 2080 certification within 52 weeks of appointment, unless otherwise agreed by the Applicant[2].	First & second
CBN16	The Applicant will publish an annual carbon report that will include information on forecast life cycle carbon emissions, carbon reductions and progress against carbon commitments as well as key actions and targets for the following year.	First & second
CBN17	Carbon data published by the Applicant in the annual carbon performance report will be independently reviewed prior to publication.	First & second
CBN18	The Applicant will deliver carbon literacy training and achieve silver certification from the Carbon Literacy Project by the end of 2023.	First
CBN19	The Applicant will require Contractors to develop the carbon literacy of their workforce working on the Project to Carbon Literacy Project level silver within 52 weeks of the contract starting date[3].	First & second
CBN20	The Applicant will require Subcontractors to develop the carbon literacy of their workforce working on the Project to Carbon Literacy Project level silver within 52 weeks of their engagement[4].	First & second
CBN21	The Applicant will require Contractors to appoint a director responsible for carbon.	First & second
CBN22	The Applicant will publish a third iteration of this Carbon and Energy Management Plan explaining how carbon emissions will be managed and minimised during the operation and maintenance of the Project, to support the Applicant's carbon policies, plans and strategies. This would include measures such as the use of low energy lights.	First & third

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Moved up [3]: more hybrid plant, electric plant and biofuels and using telematics to optimise efficiency

Moved up [1]: The Applicant is currently undergoing certification against the latest update to PAS 2080 (PAS 2080:2023 Carbon Management in Infrastructure (British Standards Institution, 2023)).

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Updated carbon emissions data and commitments¶
Updated carbon emissions data and commitments¶
For ease of reference, the Applicant has restricted all updates to this appendix and an amendment to CBN04 in Appendix E. The remainder of this plan is unchanged.¶
Since this Plan was submitted in October 2022, the Applicant has continued to drive down carbon emissions. The Applicant has embedded carbon in the procurement of its three design and build contracts. ¶
During the procurement of design and build contracts, the Applicant included carbon as a key criterion in the tender evaluation (CBN01). The Applicant presented bidders with a carbon limit aligned to the Project-wide maximum level of construction emissions (1.763 million tCO_2e, CBN04), asked them to commit to this limit or a lower limit and asked them to explain how they would go beyond this and construct the Project for the lowest practicable carbon emissions. ¶
The tender submissions the Applicant received demonstrated that the market was prepared to commit to a lower carbon limit and therefore the Applicant has updated CBN04 to reflect this. Tenderers have shown this could be achieved through measures such as:¶
Using lower carbon steel compared with the steel assumed in the Project's carbon model¶
Using lower carbon concrete compared with the concrete assumed in the Project's carbon model¶

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The Applicant has continued to implement its best practice approach to carbon management by:¶
Achieving PAS 2080 certification from an independent, third-party certification body. This demonstrates the Applicant's commitment to carbon reduction and provides assurance of its carbon management approach.¶
Initiating Carbon Literacy training across the Project workforce with 135 people now independently certified as being carbon literate.¶

Deleted: To align with the updated PAS 2080 guidance, the Applicant has reallocated the carbon sequestration from land use change to the operational phase, whereas previously this was allocated to the construction phase. This is represented as "*Reallocation of land use change emissions*" in Plate F.1 and shows a net contribution to the construction phase carbon emissions due to their movement to the operational phase (Table F.1). ¶
The combined effect of these two changes is presented in Plate F.1 and has enabled the Applicant to reduce the Project's maximum level of construction carbon emissions (CBN04) to 1.44 million tCO_2e (Appendix E). This reduction provides demonstrable evidence of the successful implementation of steps three and four of this Plan (to select the right partners and set minimum standards). ¶
Change in construction emissions¶ ...

[1] Starting date is the Contract Date which is defined in the NEC4 Engineering and Construction Contract as the date when the contract came into existence
[2] Appointment is the earlier of the date when the relevant sub-contractor commenced providing its works and the date it entered into a subcontract with the Contractor
[3] Starting date is the Contract Date which is defined in the NEC4 ECC as the date when the contract came into existence
[4] Engagement is the earlier of the date when the relevant sub-contractor commenced providing its works and the date it entered into a subcontract with the Contractor

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