PORT OF
TILBURY
LONDON

PLANNING ACT 2008
INFRASTRUCTURE PLANNING
(APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009
REGULATION 5(2) (q)

PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

TILBURY2

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VOLUME 6

CARBON AND ENERGY REPORT

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TILBURY2

PORT OF TILBURY

PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION 'TILBURY2'

CARBON AND ENERGY REPORT

CONTENTS

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TILBURY2 PROJECT TEAM
PORT OF TILBURY LONDON LIMITED
Leslie Ford House
Port of Tilbury
Tilbury
Essex
RM18 7EH

www.tilbury2.co.uk

LIST OF FIGURES

LIST OF TABLES

1.0 EXECUTIVE SUMMARY

PURPOSE OF THE CARBON AND ENERGY REPORT

1.1 This Carbon and Energy Report has been prepared as part of the application by Port of Tilbury London Limited (PoTLL) for a Development Consent Order (DCO) for its proposed new port terminal project, referred to as "Tilbury2".

OUTLINE OF THE APPROACH

1.2 Thurrock Council has a vision for the region which considers social, economic and environmental issues that are facing Thurrock now and in the future. In Thurrock's Local Development Framework[1], the Council has set out a detailed plan of policies focussing on various sectors which impact the community. The policies involving the environment provide strategies on delivering green infrastructure, maintaining the region's biodiversity, protecting the land, and reducing carbon emissions.

1.3 The strategy on carbon and energy is set out in the Local Development Framework which identifies how the borough will address the overarching issues for mitigating and adapting to climate change. Specifically, the Framework sets out targets for carbon emissions which should be met by each sector by 2020. The policies and targets set out by Thurrock Council set the context for the importance of assessing the carbon emissions and developing a carbon and energy footprint for the Tilbury2 proposal.

1.4 PoTLL have prepared a carbon and energy footprint and supporting narrative report for the Tilbury2 proposals on the basis of design information currently available. This has included an allowance for flexibility in future design, captured within what is known as the Rochdale envelope. This approach enables the carbon and energy footprint to be a realistic worst-case.

1.5 A 'carbon and energy footprint' (herein referred to as 'footprint') refers to the collective consideration of Greenhouse Gas (GHG) emissions arising from an activity or set of activities. The significance of climate change emphasises the importance of accounting for emissions in an accurate and methodical manner; fundamental in understanding our contribution to GHGs in the atmosphere and the way in which we can minimise and account for climate change impacts.

[1] Thurrock, (2015), Local Development Framework (LDF): Core Strategy and Policies for Management of Development.

1.6 When developing a footprint it is important to define the scope and structure. The scope and structure of the footprint for the Tilbury2 proposal was defined by its 'physical scope', which included the built aspects of the proposals within the red line boundary of the Works Plans[2], and as detailed within the Masterplanning Statement[3], and its 'temporal scope,' which included the associated construction and operational phases. The physical scope was further sub-divided into themes of materials, transportation, energy use, water use and waste to allocate the quantified impacts.

1.7 The footprint was developed using supplied design data and information regarding the proposal, contained within relevant published documents, studies and plans (e.g. the Environmental Statement). The Atkins Carbon Knowledgebase (CKB) footprinting tool was used to quantify the footprint, which contains a large range of carbon factors suitable for a variety of activities and situations.

1.8 In undertaking the assessment, details were provided regarding the proposals' main sources of GHG emissions. The assessment concluded with a summary of the key impact areas for the Tilbury2 proposals.

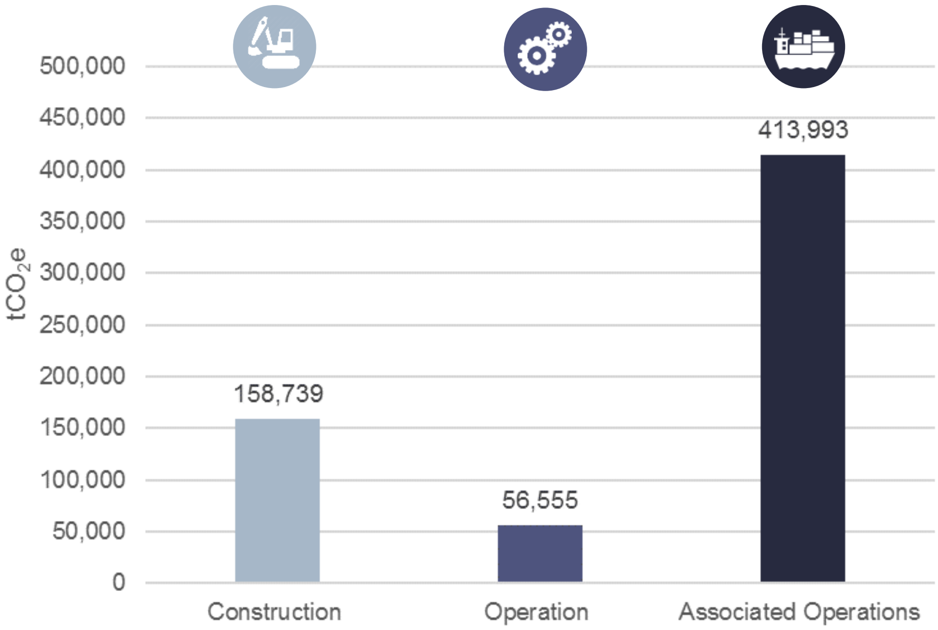
PRINCIPAL FINDINGS

1.9 The assessment has found that the proposals is anticipated to result in total carbon dioxide equivalent (CO_2e) emissions of circa 160,000 tCO_2e from the construction phase, across the 22-month programme, and average annual emissions from operations of approximately 57,000 tCO_2e. Associated operations, which takes into account the indirect emissions from transport, including the import and export of goods from shipping and their onward conveyance around the United Kingdom (UK), amounted to annual emissions of 410,000 tCO_2e. This largely relates to the high number of shipping, road and rail movements, the distances travelled and the tonnage of freight transported. Collectively this is less than 0.2% of the 466 $MtCO_2e$ emissions reported for the UK in 2016, and less than 0.6% of the 119 $MtCO_2e$ reported for the transport sector (which includes emissions from aviation, road transport, railways, shipping, fishing and aircraft support vehicles)[4].

1.10 A breakdown of the key elements is detailed in Figure 1.1. The operational impact is expressed on an annual basis.

[2] Port of Tilbury, (2017), Work Plan Regulations 5(2)(i), Ref: 5153187-ATK-ZZ-XX-DR-IR-1561; 5153187-ATK-ZZ-XX-DR-IR-1562; 5153187-ATK-ZZ-XX-DR-IR-1563.
[3] Port of Tilbury, (2017), Proposed Port Terminal at Former Tilbury Power Station, Masterplanning Statement. Ref: 6.2 5.A
[4] Department for Business, Energy and Industrial Strategy, (2017), 'Provisional UK Greenhouse Gas Emissions National Statistics 2016.'

Figure 1.1 Footprint Summary (tCO_2e)



1.11 Though the emissions from associated operations were the largest in the assessment given the nature of Tilbury2 as a port, it should be considered that such emissions may occur regardless of the proposals. In the absence of the propsoals, the movement of goods which Tilbury2 will facilitate, may otherwise use different access points and means into, out of, and across the UK.

1.12 Furthermore, the ownership of these will fall under the shipping and freight companies, who will have the most control over potential emissions reductions, rather than PoTLL. It will be the responsibility of these companies to ensure they utilise the best means possible to reduce their emissions impact when conveying goods, such as through using more efficient and modern forms of transport whether by sea, road, or rail.

1.13 Whilst the footprint presented a worst-case approach in quantifying these associated values, such considerations are likely to be increasingly adopted as sectors seek to meet the ambitious carbon reduction targets of the Climate Change Act (2008), and develop decarbonisation strategies for logistics operations. As a result it was noted that over the project's lifespan these emissions are likely to decrease as future improvements in areas such as fuel efficiency are progressed, driven by initiatives such as EURO VI engine emissions standards and the mandatory energy efficiency requirements for ships under the Energy Efficiency Design Index (EEDI), embedded in the International Convention for the Prevention of Pollution from Ships (MARPOL) regulations.

2.0 INTRODUCTION

2.1 A 'carbon and energy footprint' (herein referred to as a 'footprint') commonly refers to the collective consideration of Greenhouse Gas (GHG) emissions arising from an activity or set of activities. The significance of climate change emphasises the importance of accounting for GHG emissions in an accurate and methodical manner; fundamental in understanding our contribution to GHGs in the atmosphere and the way in which we can minimise and account for climate change impacts.

2.2 Footprints typically report the total mass of expected GHG emissions from a project, using predefined boundaries, and in kilograms (kg) or tonnes of carbon dioxide equivalent (CO_2e). Such information is useful as it can then be used in context with similar developments or other proposals to gauge the relative level of sustainability or potential carbon emissions for a given development from a climate change perspective, informing design enhancements or eventual decision making. The lower the perceived GHG emissions, the more preferential a development may be in this context.

DRIVERS FOR THE CARBON AND ENERGY REPORT

2.3 Thurrock Council has a vision for the region which considers social, economic and environmental issues that are facing Thurrock now and are anticipated in the future.

2.4 In Thurrock's Local Development Framework[5], the Council has set out a detailed plan of policies focussing on various sectors which impact the community. The policies involving the environment provide detailed strategies on delivering green infrastructure, maintaining the region's biodiversity, protecting the land, and reducing carbon emissions.

2.5 With regards to climate change, the Climate Change Policies of the Framework set out how the borough will address the overarching issues for mitigating and adapting to climate change. Specifically, the Framework sets out reduction targets for carbon emissions by sector, which include:

- Domestic (CO_2 per household): 4% by 2015 and 5.8% by 2020;
- Road Transport (CO_2 per Annual Average Daily Traffic): 6% by 2015 and 6.5% by 2020; and
- Business (CO_2 per job): 9% by 2015 and 11.3% by 2020.

2.6 The policies and targets set out by Thurrock Council set the context for the importance of developing a footprint to quantify the carbon emissions of the Tilbury2 proposals.

[5] Thurrock, (2015), Local Development Framework (LDF): Core Strategy and Policies for Management of Development.

2.7 The precedent for the inclusion of a Carbon and Energy Report (or similar) within DCO applications has been set by National Infrastructure Projects (NSIPs) such as Hinckley Point C, Silvertown Tunnel and Thames Tideway. Carbon and Energy Reports for these developments have been used to document the potential carbon and energy emissions associated with each proposal's activities. Though there are no required prescriptive requirements for the preparation of Carbon and Energy Reports (or similar) to be submitted in support of planning applications (DCO applications or Town and Country Planning Act (TCPA) applications).

2.8 The footprint and this narrative Carbon and Energy Report for Tilbury2 are based on the design information currently available. This includes an allowance for flexibility in future design, captured within what is known as the Rochdale envelope. This is an approach established by UK planning case law which permits a project description to be broadly defined, within a number of agreed parameters, for the purposes of a DCO application. This allows a certain level of flexibility while a project proposal is in the early stages of development but enables the footprint to be a realistic worst-case.

2.9 Chapter 4 of this document describes the methodology that was developed to undertake the footprint and prepare this Carbon and Energy Report.

Purpose

2.10 This Carbon and Energy Report has the following key objectives:

- To provide a summary of the policies and plans which have been reviewed to set the context for the footprint;
- To describe the methodology used for the development of the footprint;
- To publish the footprint; and
- To assess the results and outline the key findings of the footprint.

STRUCTURE

2.11 The structure of this Carbon and Energy Report is as follows:

Table 2.1: Structure of the Carbon and Energy Report

Chapter	Title	Content
1	Executive Summary	Provides a summary of the context to the project, the work undertaken and the results of the footprint.
2	Introduction	Provides the introduction, context and structure of the Tilbury2 proposals and the Carbon and Energy Report.

Chapter	Title	Content
3	Legislation and Policy Context	Describes the applicable UK legislation and UK, regional and local policies reviewed to set the context for the Tilbury2 Carbon and Energy Report.
4	Carbon and Energy Footprinting Methodology	Provides information on the approach (scope and structure) and methodology for the footprint for the Tilbury2 proposal. Assumptions, exclusions and limitations of the footprint are also provided.
5	Carbon and Energy Footprint	Summarises the results, key findings and hotspots of the Tilbury2 footprint.
6	Conclusion	Summarises the overall purpose of the Carbon and Energy Report and draws together the key findings.
Appendix A	Footprinting Standards and Associated Guidance	Summarises the generic carbon and energy footprint standards and associated guidance assessed as part of this Carbon and Energy Report.
Appendix B	Carbon and Energy Footprint	Provides the full details of the footprint.
Appendix C	Glossary	Provides details for the terms and definitions used throughout the Carbon and Energy Report.

TILBURY2

2.12 PoTLL is proposing a new port terminal on the north bank of the River Thames at Tilbury, a short distance to the east of its existing Port. The proposed port terminal will be constructed on largely previously developed land that formed the western part of the redundant Tilbury Power Station.

2.13 The proposal is known as Tilbury2 and the main uses on the site will be a Roll-on/ Roll-off (Ro-Ro) terminal and a Construction Materials and Aggregates terminal (CMAT), and associated infrastructure including rail and road facilities and revisions to the existing marine infrastructure. An 'infrastructure corridor' is proposed that will accommodate road and rail links to the existing rail and road network. The CMAT will include stockpiling of construction materials and some processing of aggregates for the production of asphalt and concrete products.

2.14 The proposals will require works including, but not limited to:

- Creation of hard surfaced pavements;

- Improvement of and extensions to the existing jetty including creation of a new Ro-Ro berth;
- Associated dredging of berth pockets around the proposed and extended jetty and their approaches;
- New and improved conveyors;
- Erection of welfare buildings;
- Erection of a single 10,200 m^2 warehouse;
- Storage and production structures associated with the CMAT;
- Construction of a new link road from Ferry Road to Fort Road; and
- Formation of a rail spur and sidings.

2.15 The proposed volumes of import/ export of Ro-Ro units for the terminal exceed the threshold of 250,000 units stated in the Planning Act 2008 for throughput per annum. The Tilbury2 proposal therefore constitutes a NSIP.

3.0 LEGISLATION AND POLICY

3.1 This Chapter summarises the legislation and policies which have been reviewed to set the context for the Tilbury2 Carbon and Energy Report. The policies included below are not seen as a requirement but as industry standards and best practice which have been considered in the report.

3.2 The legislation and policy summaries have been sub-divided into legislation (Table 3.1), national policies (Table 3.2) and regional (the county of Essex) and local (the borough of Thurrock) policies (Table 3.3). Neighbouring borough and/ or council policies are not considered applicable.

Table 3.1: Legislation

Legislation	Summary
Climate Change Act (2008)[6]	This Act sets targets for reducing the UK's impacts on climate change and the need to prepare for its impacts. The Act sets a target of 80% CO_2 emissions reduction by 2050 (against a 1990 baseline) and sets interim targets to ensure progress towards this target. The Act also requires a Climate Change Risk Assessment to be used to assess the risks from the impact of climate change to the UK.
Energy Act (2011)[7]	This Act provides key elements of the UK energy programme, including a step change in the provision of energy efficiency measures to homes and businesses. It also makes improvements for enabling and securing low carbon energy supplies and fair competition in the energy markets.
Climate Change and Sustainable Energy Act (2006)[8]	This Act focusses on the contribution that can be made by the UK to combat climate change and the importance of securing a diverse and feasible long-term energy supply. It aims to increase the number of heat and electricity microgeneration installations (local production of electricity from low energy sources) in the UK to help cut carbon emissions.
Carbon Budgets (2016)[9]	Carbon budgets place restrictions on the amount of GHGs the UK can emit over a five-year period. The UK is the first country to set legally binding carbon budgets. Every tonne of GHGs emitted between now and 2050 will be counted towards the budget. If emissions rise in one sector, the UK will have to reduce emissions in another sector to balance the budget.

[6] HM Government, (2008), Climate Change Act (c. 27).
[7] HM Government, (2011), Energy Act (c.16).
[8] HM Government, (2006), Climate Change and Sustainable Energy Act (c. 19).
[9] Department for Business, Energy & Industrial Strategy, (2016), Carbon Budgets.

Table 3.2: National Policies

Policy	Summary of Requirements
National Policy Statement for Ports (2012)[10]	The Statement encourages sustainable port development for long-term forecast growths in sea imports/ exports, allows the Port industry to decide the location of such developments based on commercial factors and ensures all developments meet legal, environment and social requirements and constraints. The Statement considers a range of potential environmental impacts, and sets a number of tests that must be met by projects in these areas. In order to help meet the requirements of the Government's policies on sustainable development, it requires that new port infrastructure should minimise emissions of GHGs from port related development amongst other requirements. Issues are also highlighted which are particularly relevant to port facilities and should be assessed, including the impact on climate change.
National Planning Policy Framework (2012)[11]	The Framework sets out planning policies for England and how these should be applied. The Framework's objective of sustainable development focusses on three main items: Economic, Social and Environmental planning objectives. The Framework states that sustainable development should support the transition to a low carbon future and help reduce GHG emissions and use of renewable resources.
Securing the Future - The UK Government Sustainable Development Strategy (2005)[12]	The Strategy establishes five principles to be used to achieve sustainable development, agreed by the UK Government, Scottish Executive, Welsh Assembly Government and the Northern Ireland Administration. The principles include: - Living within our environmental limits; - Ensuring a strong, healthy and just society; - Achieve a sustainable economy; - Promoting good governance; and - Using sound science responsibly. The Strategy also sets out the following four priorities for UK action on sustainable development: - Sustainable consumption and production; - Climate change and energy; - Natural resource protection and environmental enhancement; and - Sustainable communities.

[10] Department for Transport, (2012), National Policy Statement for Ports.
[11] Department for Communities and Local Government, (2012), National Planning Policy Framework.
[12] HM Government, (2005), Securing the Future - The UK Government Sustainable Development Strategy.

Policy	Summary of Requirements
The UK Low Carbon Transition Plan (2009)[13]	The Plan sets out the UK's low carbon transition plan to 2020 through measures such as emission cuts of 18% on 2008 levels, obtaining 40% of electricity from low carbon sources, producing 30% of electricity from renewables, introducing clean energy cash-back schemes, increasing investment to clean energy and cutting CO_2 emissions from new cars by 40%.
Our Energy Future - Creating a Low Carbon Economy (2003)[14]	This Energy White Paper provides a long-term strategy for energy policy which combines environmental, security of supply, competitiveness and social goals. The Paper identifies challenges that are faced with the environment and how these can be mitigated through new or updated infrastructure and policies.
The Carbon Plan: Delivering Our Low Carbon Future (2011)[15]	The Plan sets out how the UK will achieve the emissions reductions commitment of 80% reduction by 2050, made in the Climate Change Act (2008). It sets out how the UK will make the transition to a low carbon economy, maintain energy security and minimise costs to consumers.

Table 3.3: Regional and Local Policies

Policy	Summary of Requirements
Energy Planning - Greater London Authority Guidance on Preparing Energy Assessment (2015)[16]	The Guidance provides details on how to prepare an energy assessment for strategic planning applications in order to demonstrate how climate change mitigations measures comply with the energy policies within the London Plan. The update to the guidance helps clarify energy targets and baselines regarding zero carbon policy, helps developers and planning officers identify and address overheating risks and clarifies the hierarchy in the London Plan.
Sustainable Design and Construction Supplementary Planning Guidance (2014)[17]	The Guidance provides ways on how to achieve the goals within the London Plan which are easy and cost effective. It provides measures which can be used by developers in their designs and operations to achieve the CO_2 and water consumption targets in the London Plan. In addition, provides guidance to boroughs on how to implement the new approaches to off-set CO_2 emissions.
Essex County Council Green House Gas Emissions Report (2016)[18]	The report sets out requirements for local councils to measure and report their GHG emissions in line with the GHG Protocol. It provides an annual overview of carbon emissions from activities and progress made to date. The report states the following progress:

[13] HM Government, (2009), The UK Low Carbon Transition Plan.
[14] Department for Transport and Defra (2003), Our Energy Future - Creating a Low Carbon Economy.
[15] HM Government, (2011), The Carbon Plan: Delivering Our Low Carbon Future.
[16] Mayor of London, (2015), Energy Planning - Greater London Authority Guidance on Preparing Energy Assessment.
[17] Mayor of London, (2014), Sustainable Design and Construction Supplementary Planning Guidance.
[18] Essex County Council, (2016), Green House Gas Emissions Report.

Policy	Summary of Requirements
	- Scope 1 (direct emissions from fuel combustion): The amount of natural gas used in the period 2015/ 16 has decreased. - Scope 2 (indirect emissions): The amount of purchased electricity has decreased for the reporting period 2015/ 16. The amount of electricity used for Street lighting has also decreased. - Scope 3 (indirect emissions from other activities): Emissions from business travel have fallen due to monitoring of business travel claims and the ongoing promotion and support of the Authority's Sustainable Travel Plan.
Thurrock Local Development Framework: Core Strategy and Policies for Management of Development (2015)[19]	The Thurrock Local Development Framework is a strategic document which provides guidance on the scale and distribution of development and the provision of supporting infrastructure throughout Thurrock to 2026. The Framework contains several core strategy thematic policies (CSTPs) which focus on carbon and energy: - CSTP25 Addressing Climate Change: The Council will require new and existing development and associated activities to adhere to local, regional and national targets for reducing carbon emissions. The Council has also set reduction of CO_2 targets for 2020 (5.8% for domestic sector, 6.5% for road transport and 11.3% for business) - CSTP26 Renewable or Low-Carbon Energy Generation: the Council will encourage opportunities to generate energy from non-fossil fuel and low-carbon sources. The Framework also contains policies for management of development (PMDs) which focus on carbon: - PMD13 Decentralised, Renewable and Low-Carbon Energy Generation: new developments of 5 or more residential dwellings or 1,000 m^2 of non-residential floor space must secure energy from decentralised and renewable or low-carbon sources. Targets are 10% from 2010, 15% from 2015 and 20% from 2020. - PMD14 Carbon Neutral Development: The Council requires developers to demonstrate that all viable energy efficiency measures and renewable or low-carbon technology opportunities have been utilised to minimise emissions. Any development that would lead to a net increase in CO_2 emissions above existing emissions for the development site will be required to make contributions to the Thurrock Carbon Offset Fund.

[19] Thurrock Council, (2015), Local Development Framework: Core Strategy and Policies for Management of Development.

4.0 CARBON AND ENERGY FOOTPRINT METHODOLOGY

4.1 This Chapter explains the scope, structure and methodology for the Tilbury2 footprint, including the assumptions, exclusions and any noted limitations.

APPROACH

4.2 The overall approach for defining the footprint has been influenced by a combination of aspects, including:

- The level of design detail for the Tilbury2 proposals;
- The common and consistent principles of published footprinting standards and guidance documents, including the modular structure for footprint quantification outlined in the PAS 2080: 2016 and BS EN 15978: 2012 technical standards;
- The physical scope of the proposals (physical scope);
- The time boundary of the proposals (temporal scope); and
- The scope of GHG emissions (GHG emissions scope).

4.3 Details regarding each of the aspects referenced above are provided throughout this Chapter.

CARBON AND ENERGY FOOTPRINT CALCULATIONS

4.4 The most common method for calculating a footprint is using emission factors. A given set of data such as kilowatt hours of electricity use can be translated to its equivalent kg or tonnes of carbon dioxide equivalent (CO_2e) using an appropriate value reflective of the data source (for example gas, oil or coal generated electricity). This can be represented by the following equation:

$$Cf = a \text{ x } f$$

Cf = carbon footprint (as kg of CO_2e)

a = activity data (various units, e.g. gigajoules of energy, litres of fuel, etc.)

f = carbon factor (various units, e.g. $kgCO_2e$/ kilowatt, $kgCO_2e$/ litre, etc.)

4.5 Many organisations publish emission factors and the choice of these affect the outcome of a footprint. Details of the carbon factors used for the footprint are provided in subsequent paragraphs.

4.6 In measurement terms, footprints are generally expressed as CO_2e given in kg or tonnes. They can, however, incorporate any number of parameters with 'carbon intensity' measurements ranging from mass of CO_2 per product and capital spent to unit of energy used.

4.7 To quantify and integrate the effect of known gases additional to CO_2 into the footprint, the gases must be converted into their CO_2e. This is achieved using the global warming potential, a measure of a gases contribution to global warming (over a specified time), relative to the same mass of CO_2. By multiplying an emission of a gas by its global warming potential, commonly considered over a 100-year period, its equivalent CO_2 emissions can be given. The global warming potential is the standard method for comparing emissions of different GHGs. By way of example, the emissions of 1 kg of methane (CH_4) are 25 times more potent than the emissions of 1 kg of CO_2.

4.8 The footprint for the Tilbury2 proposals has utilised CO_2e factors (which incorporate the emissions of other climate influencing gases) and where possible those which reflect the 'cradle-to-gate' or 'well-to-wheel' emissions, from manufacture to use. For example, for a given material this includes the embodied GHGs which may result from its extraction and manufacture.

FOOTPRINTING STANDARDS AND ASSOCIATED GUIDANCE

4.9 Although there is a lack of a specific methodology for carbon and energy footprinting and reporting for port projects in the UK, a review of generic footprinting standards and associated guidance has been undertaken (as summarised in Appendix A). These include:

- GHG Protocol (2001, as amended)[20]:
  - Corporate Accounting and Reporting Standard;
  - Value Chain (Scope 3) Accounting and Reporting Standard;
  - Product Life Cycle Accounting and Reporting Standard; and
  - GHG Protocol for Project Accounting.
- ISO 14064:2006, Part 1: Greenhouse Gases - Part 1: Specification with Guidance at the Organisation Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals[21];
- ISO/ TS 14067:2014: Greenhouse Gases. Carbon Footprint of Products. Requirements and Guidelines for Quantification and Communication[22];
- PAS 2050:2011: Specification for the Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services[23];

[20] World Business Council for Sustainable Development and World Resources Institute, (2001) (as amended), GHG Protocol.
[21] International Organization for Standardisation, (2006), ISO 14064:2006, Part 1: Greenhouse Gases - Part 1: Specification with Guidance at the Organisation Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals.
[22] International Organization for Standardisation, (2014), ISO/TS 14067:2014: Greenhouse Gases. Carbon Footprint of Products. Requirements and Guidelines for Quantification and Communication.

- PAS 2060:2014: Specification for the Demonstration of Carbon Neutrality[24];
- PAS 2080:2016: Carbon Management in Infrastructure[25];
- BS EN 15978:2011: Sustainability of Construction Works. Assessment of Environmental Performance of Buildings. Calculation Method[26]; and
- BS EN ISO 14044:2006: Environmental Management. Life Cycle Assessment. Requirements and Guidelines[27].

4.10 The standards and guidance documents identified above include extensive technical detail, however, the overall principles are common and consistent throughout. For the purposes of the assessment the carbon model has been based on the structure and categories outlined within Section 7 of the PAS 2080:2016 Carbon Management in Infrastructure technical standard. The structure outlined within PAS 2080:2016 has been adapted from BS EN 15978:2011 for infrastructure projects. However it should be noted that the assessment uses the modular approach from PAS 2080:2016 only for the purposes of quantifying the footprint, and does not attempt to follow other approaches within the standard i.e. those associated with monitoring, reporting and improvement, which are not applicable for this DCO submission.

4.11 PAS 2080:2016 builds on the Infrastructure Carbon Review (published by HM Treasury in 2013) to provide guidance on development of low carbon infrastructure projects. BS EN 15978:2011 provides the basis for the modular assessment approach. Developed to support decision-making processes, it provides emphasis on the calculation method, outlining a life cycle based approach for the quantitative evaluation of environmental performance in new and existing buildings, including reporting and communication methods.

SCOPE

4.12 Footprints can encompass an array of emission sources; from direct processes, such as energy use, transportation and waste disposal to indirect sources further down or up the supply chain. The exact emissions quantified (CO_2 or other GHGs) and the extent to which the emission sources within these categories are included in the footprint is defined by the scope.

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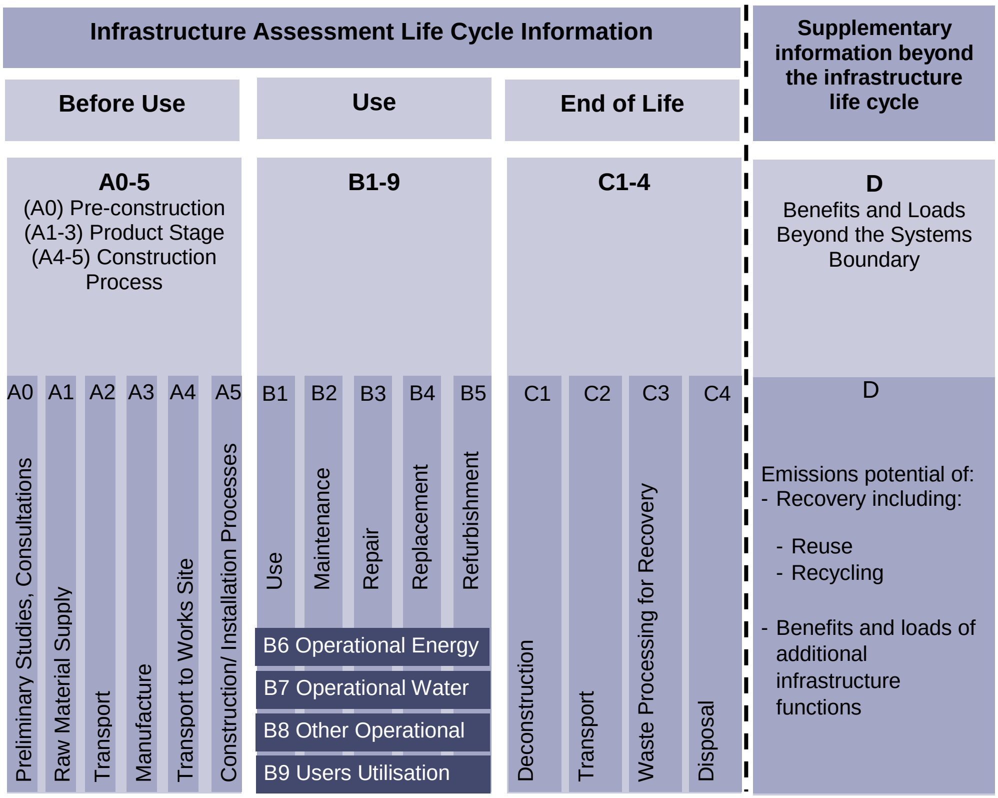
[23] Publicly Available Specification, (2011), PAS 2050:2011: Specification for the Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services.
[24] Publicly Available Specification, (2014), PAS 2060:2014: Specification for the Demonstration of Carbon Neutrality.
[25] Publicly Available Specification, (2016), PAS 2080:2016: Carbon Management in Infrastructure.
[26] British Standards Institute, (2011), BS EN 15978:2011: Sustainability of Construction Works. Assessment of Environmental Performance of Buildings. Calculation Method.
[27] British Standards Institute, (2006), BS EN ISO 14044:2006: Environmental Management. Life Cycle Assessment. Requirements and Guidelines.

4.13 The scope of the footprint for the proposals and the associated GHG emissions is defined based on the physical aspects of the project (i.e. the built development) and the timescales over which they will occur (i.e. construction and operation), in accordance with the principles of the standards and associated guidance outlined above.

4.14 The modular structure presented within PAS 2080:2016 (adapted from BS EN 15978:2011) and which has been used as the basis for the assessment is outlined in Figure 4.1. This provides a framework for the quantification of GHG emissions for construction products, processes and services and follows a structure consistent with the principles set out in BS EN 15798:2011. Categories for the Tilbury2 footprint have been adapted from this approach.

Figure 4.1: PAS 2080:2016 Modular Approach



PHYSICAL SCOPE

4.15 The physical scope comprises of the built aspects of the proposals, within the boundaries of the DCO application which includes the RoRo Terminal, CMAT, rail facilities, highways and other associated ancillary buildings.

4.16 Whilst details on each individual aspect of the site were not always available (e.g. water use was not available on a per building basis), where possible every effort has been made to report individual elements separately so emissions can be more specifically assessed. However, where this has not been possible, a site wide approach has been used.

4.17 Assumptions have been made on the basis of all design information currently available. As previously noted, this included an allowance for flexibility in future design captured within what is known as the Rochdale envelope.

TEMPORAL SCOPE

4.18 The temporal scope of the assessment included the construction (before use) and operational (use) phases of the Tilbury2 proposals, defined within the boundaries of the DCO application.

4.19 The construction phase included all construction, demolition and excavation activities within the remit of the physical scope, across the expected 22-month programme.

4.20 The operational phase accounted for the site's energy and water use during operation as well as waste disposal. Given the nature of the development as a port this also included the associated operational impacts (users utilisation of infrastructure) from the indirect shipping and movement of freight.

4.21 The footprint has been structured into a number of categories, based on these activities, and following the principles of the modules outlined in PAS 2080:2016. Each module is denoted by a letter and number which defines its stage.

4.22 For the purposes of this assessment these included the A - Before Use Stage; which includes the stages prior to operation such as material extraction, processing, transportation, and associated energy and water use, and the emissions from the construction stage, and the B - Use Stage, which covers the associated carbon emissions when the site is in use.

4.23 Descriptions of the modules which were considered and included as part of the calculations are outlined in Table 4.1. Note that this only includes the aspects which have been applied to the carbon model.

4.24 Excluded modules included those associated with ad hoc, planned and response maintenance (B1- B5), as such information is not available at this point, and those relating to decommissioning (C1 - C4), as the site is expected to undergo upgrading, rather than decommissioning or deconstruction in the longer term. D is not considered applicable for this assessment.

Table 4.1: PAS2080:2016 Modules Applied in the Assessment

Boundary Stage	Description
A - Before Use Stage (Construction)	
Boundary of Product Stage (Modules A1 - A3)	Applies to the material used in the infrastructure. Represents raw material extraction, processing, the final product manufacture, its energy use, and waste management. Transportation of materials and goods up to the point of final factory gate.
Boundary of Construction Process Stage (Module A4)	Represents transportation of products/ materials to the infrastructure site.
Boundary of Construction Process Stage (Module A5)	Represents construction site works activities such as: • Temporary works, ground works, and landscaping; • Materials storage; • Transport of materials and equipment on site; • Installation of materials and products; • Emissions associated with site water demand; • Waste management activities;
B - Use Stage (Operation)	
Boundary of Use Stage - Operational Energy (Modules B6)	Represents the carbon emissions resulting from the energy used by infrastructure to enable it to deliver its service during operation. Both direct and indirect energy sources might be used including the combustion of fuels in plant and equipment and the consumption of electricity from energy grids.
Boundary of Use Stage - Operational Water (Modules B7)	Represents the carbon emissions resulting from the consumption of water required by the infrastructure to enable it to operate and deliver its service, including all water used and its treatment (pre- and post-use).
Boundary of Use Stage - Other Operational Processes (Module B8)	Represents other process carbon emissions arising from infrastructure to enable it to operate and deliver its service including management of operational waste.
Boundary of Use Stage - User's Utilisation (Module B9)	Represents the activities associated with the user's utilisation of the infrastructure during the use stage. This is defined by the principle of control and influence where by the carbon emissions are when they arise from an activity that the user has control over.

METHODOLOGY

4.25 The footprint has been developed using the Carbon Knowledgebase (CKB). The CKB is a web-based tool developed by Atkins for the building and construction industry that can be used to calculate footprints with an extensive database of GHG emissions data. The CKB provides the ability to develop and structure effective footprints for projects through its ability to:

- Flexibly develop unique structures for footprints optimal to specific projects;
- Efficiently develop footprints through a wide range of intuitive functions;
- Access a large database of carbon factors; and
- Easily extract outputs to facilitate analysis.

4.26 The CKB has a proven track record on infrastructure projects, including NSIPs (e.g., Thames Tideway Tunnel), and was considered to be the most effective means to develop the footprint for the proposals.

4.27 Contained within the CKB is a detailed library of carbon factors. The library includes factors from a variety of sources such as the Inventory of Carbon and Energy (ICE) (versions 1.6(a) and 2.0), published by Bath University, the Department for Environment, Food and Rural Affairs (DEFRA) Greenhouse Gas Reporting Conversion Factors, and the EMEP/ CORINAIR Emission Inventory Guidebook.

4.28 The ICE factors have predominantly been used for calculating the embodied (cradle-to-gate) GHG emissions for materials, whereas the DEFRA and EMEP/ CORINAIR carbon conversion factors have predominantly been used to calculate GHG emissions associated with energy and fuel use. These databases are currently some of the industry's most comprehensive publicly available sources of carbon conversion factors and are consequently the most widely used. The factors used in the footprint for the Project are primarily from these sources.

4.29 As previously noted the footprint has been structured based on the PAS 2080:2016 modular approach and lifecyle stages. These have been arranged to best fit the proposals with headline (top-level) folders adapted from the PAS 2080:2016 categories. These included Construction (A1 - A5), Operation (B6 - B8), and Associated Operations (B9), as headline (top-level) folders. Within the headline folders, there is a further sub-structure of folders which further defines the impacts considered for the project and where the embodied carbon and GHG emissions have been captured. Broadly this consists of Materials, Transport to Site, Energy Use, Water Use and Waste.

4.30 Design and construction methodology and operational information was analysed and interpreted to obtain the required information for use in the CKB, as shown in Table 4.2, to generate the footprint and thus the CO_2e values.

Table 4.2: Footprint Information Gathered and Interpreted

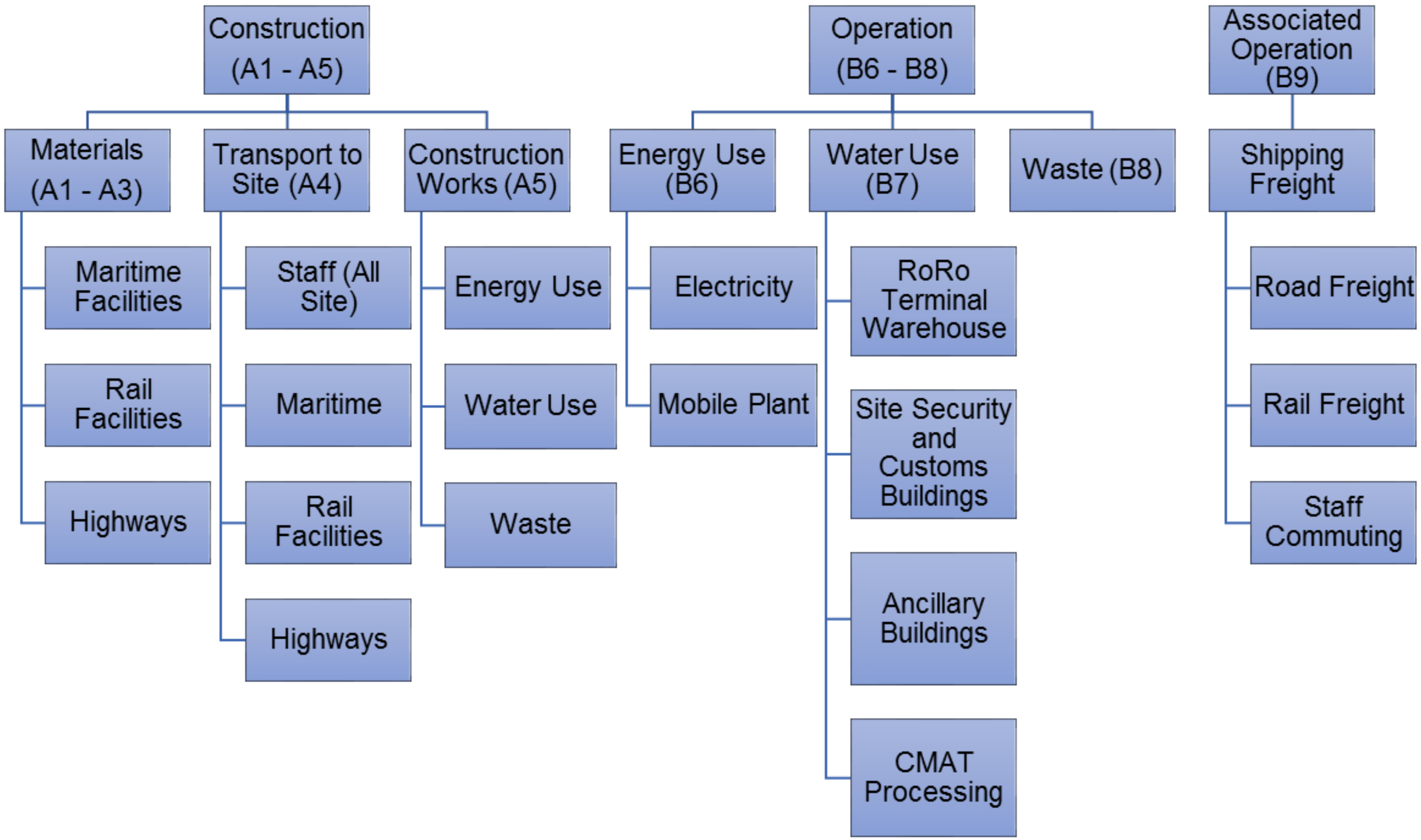
Activity	Information Gathered/ Interpreted	Unit for CKB
Construction (A1 - A4)		
Materials (A1 - A3)	Quantity and type of materials used during construction.	Kg and type of materials used.
Transport to Site (A4)	Number of vehicle movements for the transport of staff, materials used and waste generated during construction and the anticipated travel distance of the movements.	Vehicle movements and travel distance.
Construction Works (A5)		
Energy Use (A5)	Type and operating hours of construction plant.	Type and operating hours of plants used.
Water Use (A5)	Quantity of water consumption and waste water generated during construction.	Litres of water consumption and waste water treatment.
Waste (A5)	Quantity and type of waste generated during construction.	Kg and type of waste generated.
Operation (B6 - B8)		
Energy Use (B6)	Electricity consumption and fuel use during operation.	Kilowatt hour usage.
Water Use (B7)	Quantity of water consumption and waste water generated during construction.	Litres of water consumption and waste water treatment.
Waste (B8)	Quantity and type of waste generated during operation.	Kg and type of waste generated.
Associated Operation (B9)		
Associated Operations (B9)	Number of vehicle movements for the transport of materials and waste during the operation of the port and the anticipated travel distance of the movements.	Vehicle movements and travel distance.

4.31 Project information, once interpreted to obtain the units shown above, was included in the CKB to generate the footprint and thus the CO_2e emissions. References and assumptions, where necessary, were included within the appropriate CKB section.

4.32 Appropriate factors were selected in the CKB based on the suitability and robustness of the factors and to ensure consistency across the footprint. Results and analysis of the footprint are presented within Chapter 5 and a full breakdown of the footprint is provided in Appendix 2.

4.33 The footprint structure is outlined in Figure 4.2.

Figure 4.2: Footprint Structure

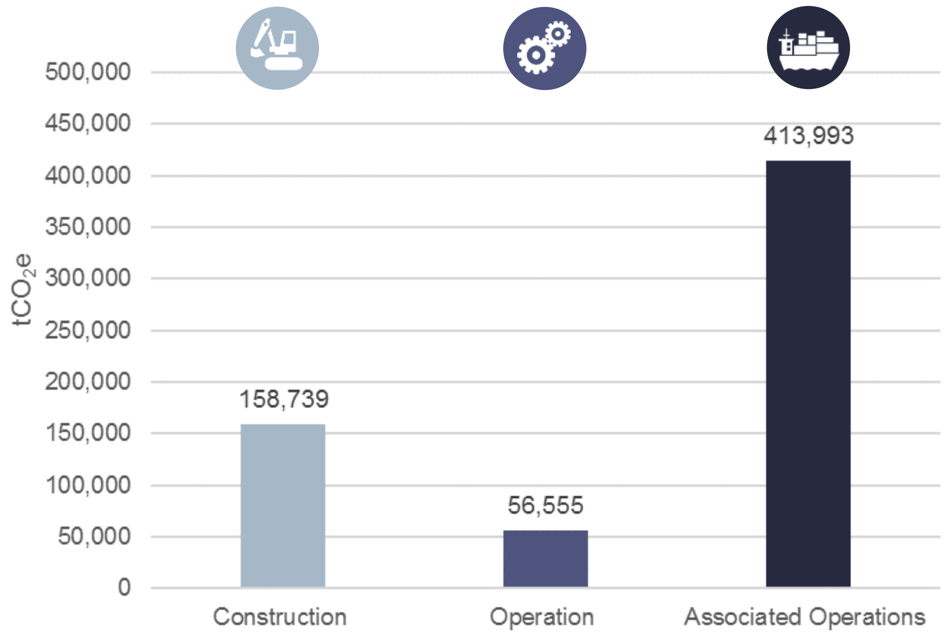


5.0 CARBON AND ENERGY FOOTPRINT

5.1 The proposals will result in total CO_2e emissions of circa 159,000 tCO_2e from Construction, across the 22 month programme, and an annual emissions impact from Operations of approximately 57,000 tCO_2e. Associated Operations, which takes into account the indirect emissions from transport, including the import and export of goods from shipping and their conveyance around the UK, amounted to annual emissions of 410,000 tCO_2e. This is largely related to the high number of movements from shipping, road and rail, the distances travelled and the tonnage of freight transported.

5.2 A breakdown of the key elements is detailed in Figure 5.1. The operational emissions are expressed on an annual basis.

Figure 5.1 Footprint Summary (tCO_2e)



5.3 A more detailed examination of the proposals' expected emissions from the construction and operational phases is contained in the following sections.

CONSTRUCTION (A1 - A5)

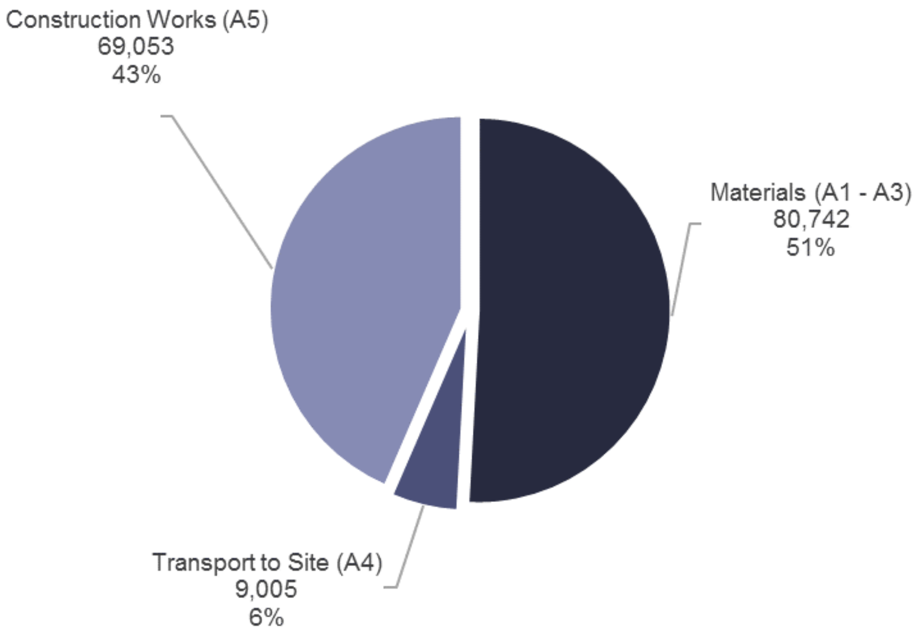
5.4 The proposals will result in CO_2e emissions of circa 159,000 tCO_2e from Construction.

5.5 Given the significant quantity of materials required for developing the project, the Materials category, unsurprisingly resulted in the highest emissions from this phase, amounting to approximately 51% of the total CO_2e emissions produced.

5.6 This was followed by Construction Works, at just over 43%, which was broken down into the fuel and energy use associated with the construction plant, at 42%, and water use and waste disposal which collectively amounted to less than 2% of the total construction emissions. Transport to Site, which included the movement of staff, materials and goods to the site, was 6% of the total.

5.7 The CO_2e emissions of the main activities are detailed in Figure 5.2. Further details on each activity type are contained in the subsequent sections. The assumptions used for each specific element are contained within the footprint within the CKB.

Figure 5.2 Construction Emissions by Activity (tCO_2e)



Materials (A1 - A3)

5.8 Some 68% of the total emissions from construction materials was attributable to the maritime elements of the project i.e. the RoRo and CMAT berths and associated infrastructure being the most significant aspects of the development, with 19% associated with the rail facilities and 13% the highways.

5.9 The emissions associated with material usage reflected the 'cradle-to-gate' emissions, including aspects such as material extraction and processing to use. This was variable according to both material type and the intensity of its associated carbon factor, as well as the quantity of each material as per the supplied information within the Project bill of quantities.

5.10 The greatest overall impact to the footprint in terms of CO_2e emissions was from steel, which amounted to almost 38% of material emissions. Some 15,800 tonnes of steel resulted in over 31,000 tCO_2e with a carbon factor of 1.95 $kgCO_2e$/ kg. This was followed by concrete which amounted to some 22,000 tCO_2e, with a carbon factor of 0.107 $kgCO_2e$/ kg, and which had a significant impact due to the large quantity of material expected at over 200,000 tonnes.

5.11 Of all the materials assessed the most carbon intensive was rubber. It was estimated that 120 tonnes of material would be used during the construction phase, resulting in total emissions of 330 tCO_2e with embodied (cradle-to-gate) GHG emissions of 2.85 $kgCO_2e$/ kg.

5.12 A detailed breakdown of the emissions for all materials is shown in Figure 5.3 and Figure 5.4.

Figure 5.3 Material Emissions by Type and Quantity (tCO_2e)

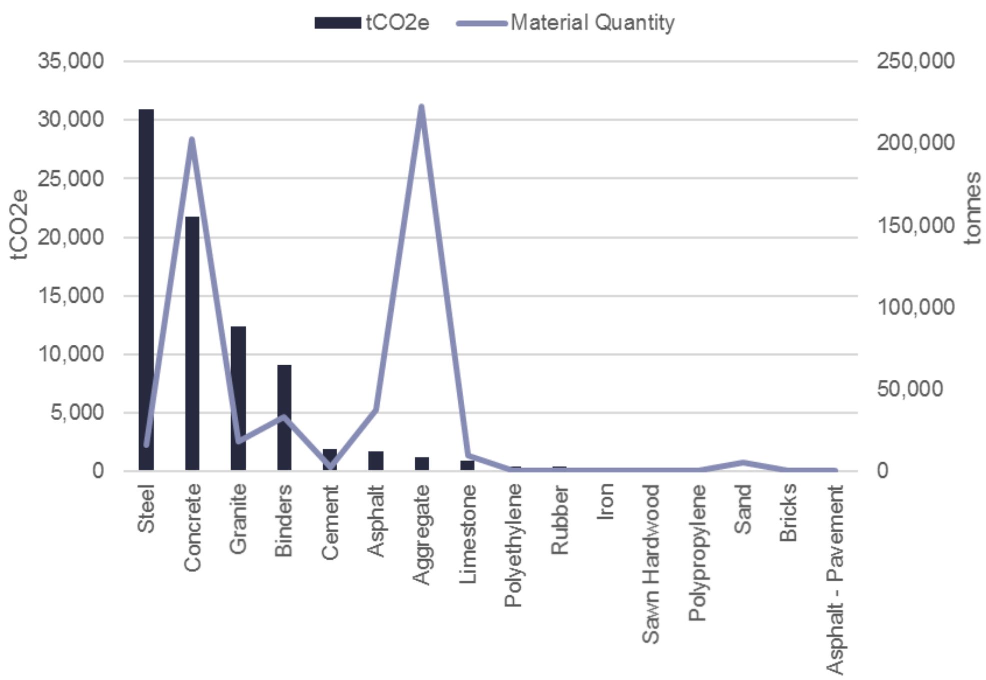
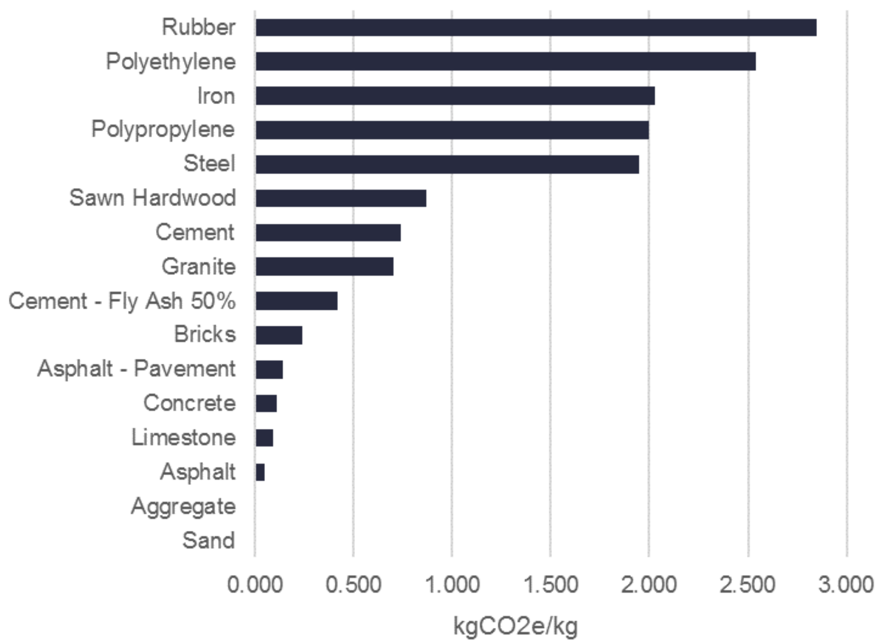


Figure 5.4 Carbon Factor by Type and Intensity ($kgCO_2e$/ kg)



Transport to Site (A4)

5.13 The transportation emissions for the construction phase has been based on the landside transportation chapter (ES Chapter 13). This is understood to include all expected landside material movements to and from the site, including delivery of materials, removal of waste and travel by staff. Two key modes were identified; transfer by heavy goods vehicle (HGV), and transport by car. The expected movements used as the basis for this assessment are outlined in Table 5.1.

Table 5.1: Landside Construction Transport Two-Way Movements

Activity	Spoil Removal (HGV)	Construction of Facilities (HGV)	Staff (Car)
Staff Commuting	-	-	241,910
Maritime Facilities	9,864	38,620	-
Rail Facilities	2,928	2,468	-
Highways	1,800	3,295	-
Total	**14,592**	**44,383**	**241,910**

5.14 Note that movement of goods to the site will also occur by barge. This is considered under Construction Works and the energy use associated with the fuel consumption of the marine plant.

5.15 Carbon factors were taken from Defra's 2017 Government Emission Conversion Factors[28]. These accounted for the well-to-tank emissions associated with upstream extraction, refining and transportation of the raw fuels, as well as those generated during use, collectively referred to as well-to-wheel emissions.

5.16 HGVs were considered to be equivalent to large diesel fuelled articulated trucks of between 3.5 to 33 tonnes, with an average UK vehicle load, equating to 1.04251 $kgCO_2e$ per vehicle kilometre. Other vehicles were considered as petrol driven cars, of average size, and which will predominantly be used by staff, equating to 0.23619 $kgCO_2e$ per vehicle kilometre.

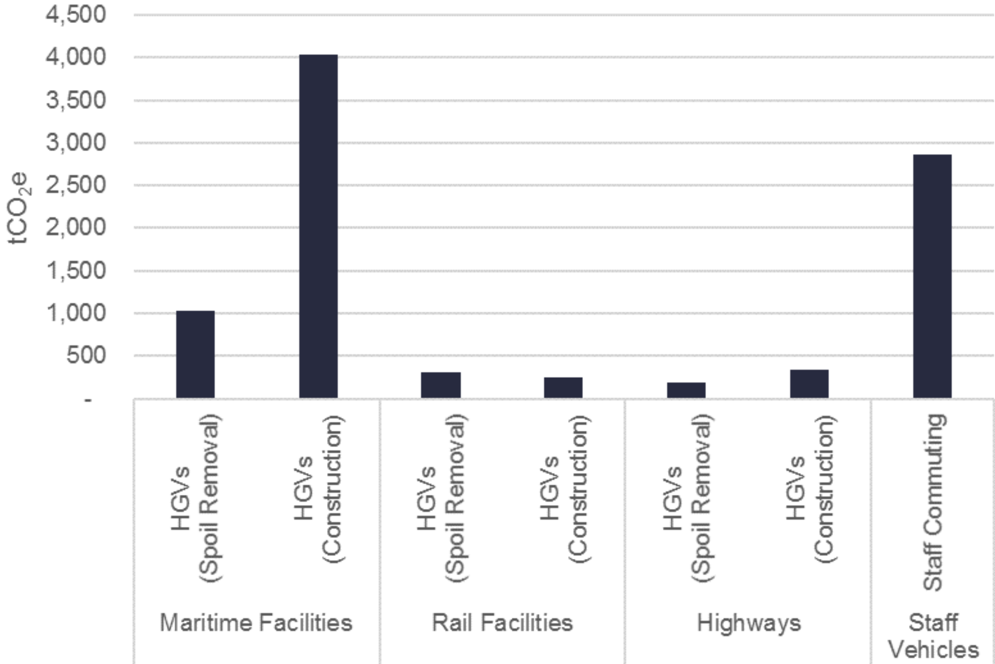
5.17 Note that as there is likely to be a mix of vehicle efficiencies and some staff may drive higher emission executive type cars, or lower emission, hybrid or electric cars, emissions may be higher or lower depending on the balance of vehicle types.

[28] Defra (2017) Government Emission Conversion Factors.

5.18 An average two-way travel distance (i.e. total of inward and outward journey) of 200 km was assumed for spoil removal and construction transportation, and which considered local sourcing of materials (within Greater London). An average two-way travel distance of 50 km was assumed for staff commuting, based on local travel from the Tilbury and Gravesend areas. This equated to total emissions of circa 9,000 tCO_2e, with 17% originating from spoil removal, 51% from construction, and 32% from staff.

5.19 A breakdown of the emissions associated with transport is shown in Figure 5.5, according to the respective development elements.

Figure 5.5 Transport Emissions by Type and Quantity (tCO_2e)



Construction Works (A5)

Energy Use

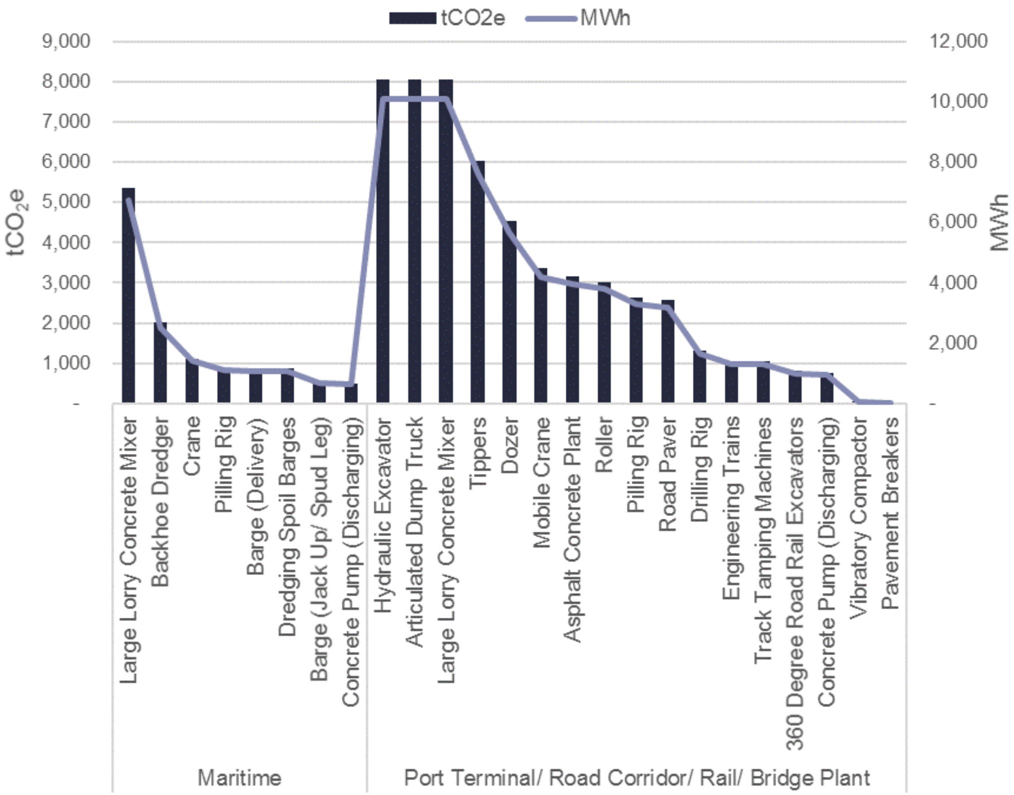
5.20 Assessment of the energy and fuel consumption during the construction phase considered the diesel and electrical plant, such as excavators, piling rigs and articulated dump trucks etc. associated with the development of the maritime, road and rail elements of the project. Whilst an impact will also occur from site lighting, no specific details were available for this to be quantified so this was excluded from the assessment, though the overall impact of this upon the footprint was considered to be minor. Any electrical plant was considered to be powered using diesel generators.

5.21 Collectively construction plant amounted to emissions of some 66,000 tCO_2e. Variable engine sizes (and carbon factors) were considered based on either the expected vehicle type, and appropriate manufacturer specifications, or supplied Project information. This was applied to the programme of works and an estimate of the expected working hours and utilisation of each type of plant, across the construction period.

5.22 Larger engines are associated with higher CO_2e emissions, with the most significant estimated to come from the use of a backhoe dredger associated with the maritime works which had a collective engine power of 2,100 kW (based on a NordicGiant dredger with a Liebherr P955 excavator).

5.23 A breakdown of the CO_2e emissions from the different items of plant is shown in Figure 5.6, including the total megawatt hours (MWh), as determined based on the engine sizes and operational hours.

Figure 5.6 Mobile Plant Fuel Emissions by Type and MWh (tCO_2e)

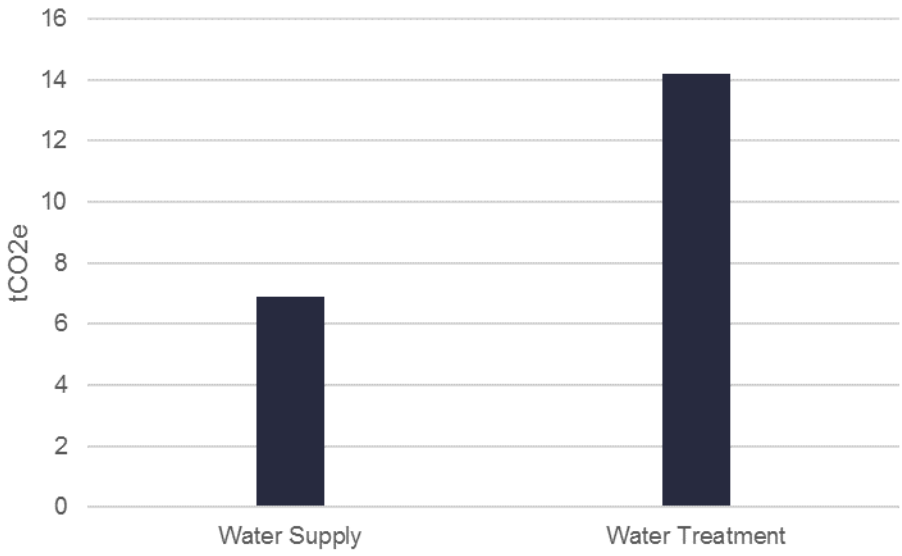


Water Use

5.24 The construction water emissions for the Tilbury2 project considered both water consumption and offsite waste water disposal. Usage was estimated based on the expected daily number of 300 construction workers, and an assumed water flow rate of 100 litres per worker per day, expanded over the course of the 22-month programme. Waste water was considered to be equal to water consumption.

5.25 Some 20 million litres of water was estimated and which amounted to emissions of 21 tCO_2e, one of the lowest impacts across the footprint. This was based on an assumed impact of 344 $kgCO_2e$/ million litres for water use and 708 $kgCO_2e$/ million litres for waste water treatment, as per the latest Defra 2017 Government Emission Conversion Factors[29]. A breakdown is shown in the Figure below.

Figure 5.7 Water Emissions by Type and Quantity (tCO_2e)



Waste

5.26 The waste associated emissions for the construction phase were based on information contained within the Waste and Materials Chapter of the Environmental Statement (ES Chapter 19). This included a summary of a wide range of different wastes which may arise from the construction, demolition and excavation (CD&E) works associated with the development.

5.27 Processing of waste has considered the worst-case scenario, that all waste would be disposed of, either to landfill, or recovered using waste to energy, (the latter being considered applicable for hazardous wastes only). This included dredging material. Carbon factors were taken from the Defra (2017) Government Emission Conversion Factors[29] as appropriate for each material type and end destination.

5.28 From the calculations the total emissions amounted to some 2,400 tCO_2e with carbon factors for disposal to landfill ranging between 1.4 $kgCO_2e$ for every tonne of inert waste, to 588.9 $kgCO_2e$ for every tonne of municipal waste, and at the highest level 819.1 $kgCO_2e$ for every tonne of wood. The increased carbon intensity from wood and municipal waste can be associated with the organic content and the generation of the potent GHG methane as they decay.

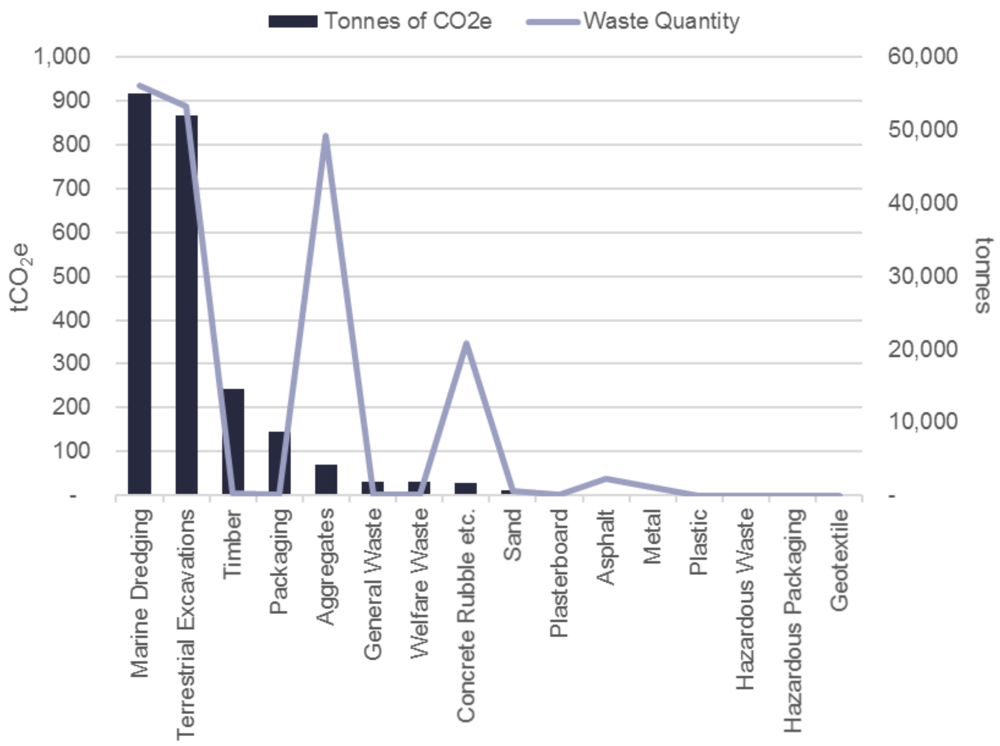
[29] Defra (2017) Government Emission Conversion Factors.

5.29 By far the largest impact was from marine dredging and terrestrial excavations due to the quantity of material expected. Collectively over 100,000 tonnes of material was estimated from the site works. Several options are being considered for its reuse. However, as no definitive decisions have yet been made, the worst-case scenario has been assumed (i.e. total disposal offsite).

5.30 This was a similar case for other waste streams such as aggregates and some municipal wastes. The footprint has been modelled on a worst-case scenario, though it is likely that some wastes will be reused, and recycled, in accordance with good practice construction waste management, and therefore in reality the emissions from waste may be reduced.

5.31 A breakdown of CO_2e emissions from the different wastes expected from the development is shown in Figure 5.8, including the estimated quantity.

Figure 5.8 Waste Emissions by Type and Quantity (tCO_2e)



OPERATIONS (B6 - B8)

5.32 The proposals will result in annual CO_2e emissions of circa 57,000 tCO_2e from the operational phase, excluding Associated Operations, which takes into account indirect emissions, such as the movement of freight, and is considered in more detail below.

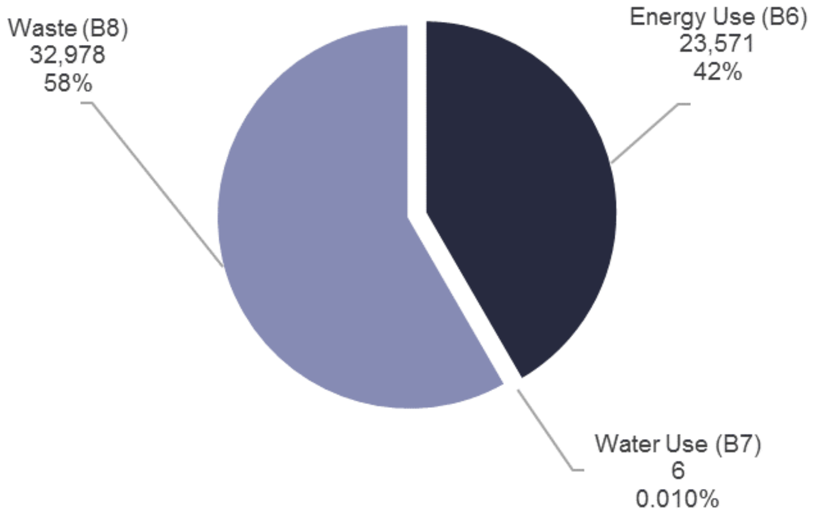
5.33 Details on maintenance activities were not available for the operational phase so have not been included as part of the footprint. However, the impact of this was considered likely to be minimal, and therefore unlikely to result in a significant impact to the overall results.

5.34 When the results from this phase are broken down by activity type, Waste is the most significant source of emissions, at 58% of the overall CO_2e, associated with disposal of municipal wastes to landfill. This is followed by Energy Use at 42%. The majority of this can be associated with the use of operational plant such as reach stackers, forklifts and RoRo tractors, as well as the use of grid electricity to operate the facility. Water use had the lowest emissions impact at less than 1% of the total.

5.35 In viewing the results it should be considered that over the course of the lifespan of the proposals it is likely that efficiencies will be gained in many areas, particularly in the generation of electricity, and the fuel consumption of vehicles/ mobile plant. As far as is possible the latest available carbon factors have been utilised in the calculations but it should be considered that these are likely to improve in the future as technologies change or become more developed. As a result the average emissions across the project would likely be lower in future years, for example, if the UK energy mix used a greater proportion of cleaner or renewable technologies. In this case some consideration of future electricity emissions has been used, and this is explained in more detail below.

5.36 The CO_2e emissions of the main activities are detailed in Figure 5.9. Further details on each activity type are contained in the subsequent sections.

Figure 5.9 Operational Emissions by Activity (tCO_2e)



Energy Use (B6)

5.37 The most significant burden on energy and fuel consumption during the operational phase is from the mobile plant which will be operating on the site and consuming fuel, and to a lesser extent the electricity which will be consumed to run onsite buildings, including offices and facilities.

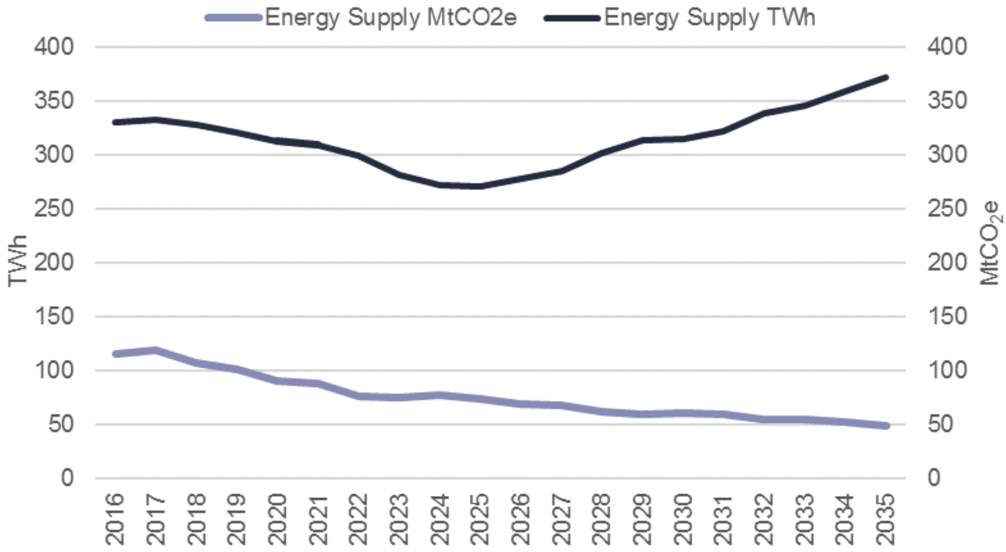
5.38 Information on the expected mobile plant (e.g. reach stackers, forklifts and RoRo Tractors etc.), including quantity and operating hours, was provided by PoTLL on the basis of the operations at the existing port of Tilbury, whilst electricity consumption was estimated based on provided data from the existing Tilbury port facilities (i.e. Norway House, Briggs Workshop, LCT Canopy, Main Gatehouse, Warehousing etc.). For the purposes of the assessment this was quantified on a kwh/ m^2 basis and applied to the estimated site areas and facilities within the Tilbury2 site.

5.39 As noted previously it is likely that over time the UK energy mix (i.e. the source of electricity generation such as oil, gas, wind etc.), as well as the respective generating efficiencies, may change as the energy market is likely to develop over the period that the proposals are in operation. Therefore, the sources of electricity which Tilbury2 would use for consumption of electricity, and the associated emissions which would be generated, are likely to be greater during the early years of its operation, than towards its end, when the energy mix may be made up of a greater proportion of more efficient, cleaner and renewable energy technologies.

This has been factored into the model using the projected energy supply and carbon impact for the UK, published by the Department for Business, Energy & Industrial Strategy (BEIS) up to 2035[30]. An average of values from the years 2021 (assumed project operation) to the end of the available projection in 2035 was taken as representative for the purposes of this assessment (0.234 kg CO_2e/ kWh) and including a 9% uplift for transmission and distribution losses as per typical UK performance. With an inherently uncertain future and over such long timescales this was considered suitable for the purposes of the calculations, as it is not possible to draw overly precise conclusions in this respect. The BEIS projections are detailed in Figure 5.10 below.

[30] Department for Business, Energy & Industrial Strategy, (2016), 'Updated Energy and Emissions Projections: 2016'.

Figure 5.10 Energy and Emissions Projections



5.40 In terms of emissions, energy and fuel use collectively amounted to some 24,000 tCO_2e. The vast majority was associated with fuel consumption from mobile plant with 168 tCO_2e (less than 1%), attributable to electricity consumption. A breakdown of the emissions, is shown in Figure 5.11 and 5.12 below.

Figure 5.11 Mobile Plant Fuel Emissions by Type and MWh (tCO_2e)

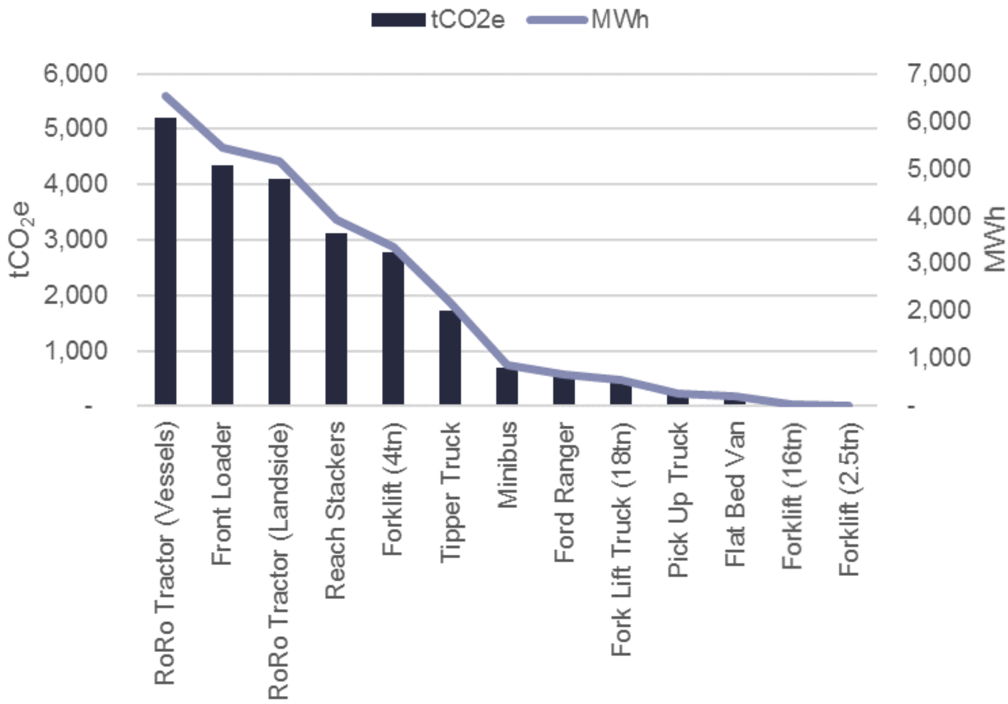
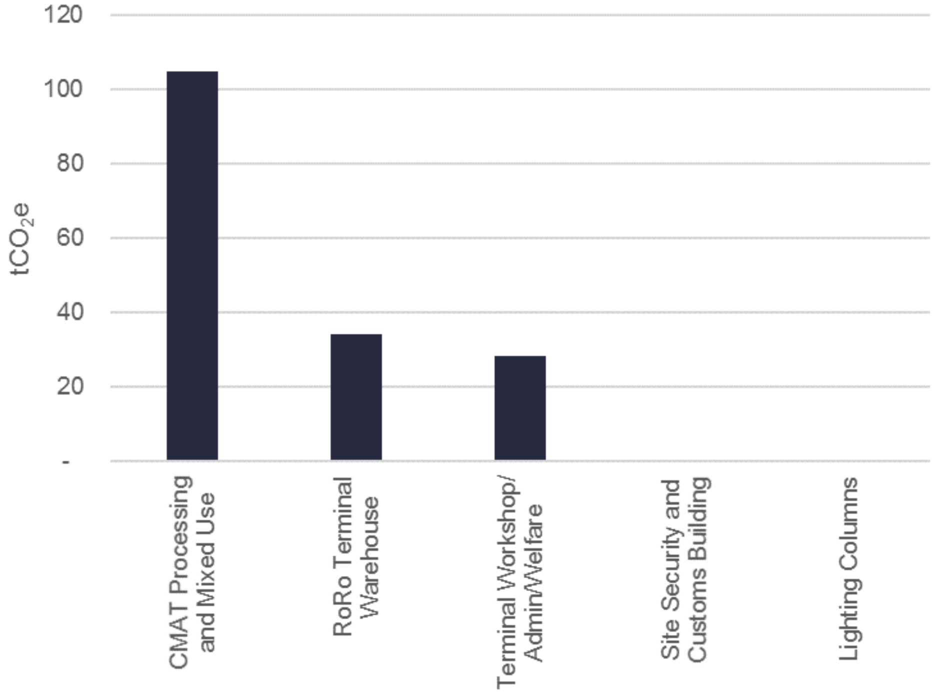


Figure 5.12 Electricity Consumption Emissions (tCO_2e)



Water Use (B7)

5.41 The operational water emissions for the Tilbury2 project considered both water consumption and offsite waste water disposal. Data for the calculations was taken from the Drainage Strategy (Document Ref: 6.2 16.E) which estimated usage based on the expected 166 daily site workers, and a maximum daily total flow rate of 90 litres per person per day, as determined from the Flows and Loads Code of Practice[31]. The rate assumed an industrial landuse and full-time day staff. As per the construction estimates, water disposal was considered to be equal to water consumption.

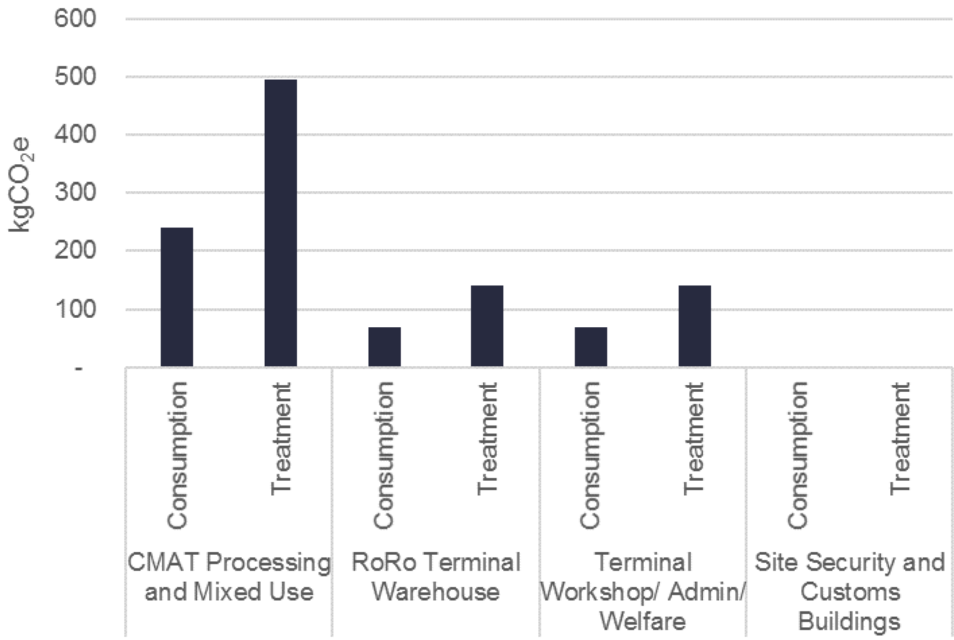
5.42 The foul water drainage system is proposed (through the Drainage Strategy) to discharge to the adjacent Anglian Water Tilbury waste water treatment works, via the existing drainage connection. It is anticipated that there will be a decrease in foul water flows compared to the baseline, as a result of the development, due to a reduction in full time employees working on the site.

5.43 Based on these calculations annual water consumption and disposal was estimated collectively as some 5.5 million litres over 363 operational days per annum. This equated to emissions of circa 6 tCO_2e per annum, the lowest across the footprint. As per the construction calculations this was based on the latest Defra 2017 Government Emission Conversion Factors and 344 $kgCO_2e$/million litres for water use and 708 $kgCO_2e$/million litres for water treatment.

5.44 A breakdown of the water emissions, according to the development features, is shown in Figure 5.13 below.

[31] British Water (2017), 'Flows and Loads: Sizing Criteria, Treatment Capacity for Sewage Treatment Systems.'

Figure 5.13 Water Use Emissions by Type and Quantity ($kgCO_2e$)



Waste (B8)

5.45 The waste emissions for the operational phase were based on the information contained within the Waste and Materials Chapter of the Environmental Statement (ES Chapter 19). This included a summary of the expected quantity of waste which may arise from the operation of the development, considered to be municipal in nature (i.e. comprising of organic wastes, paper and cardboard, plastics etc.).

5.46 Processing of waste considered the worst-case scenario, that all waste would be disposed of to landfill. As per the calculations undertaken for the construction phase, carbon factors were taken from the Defra (2017) Government Emission Conversion Factors[32], as appropriate for each material type and end destination.

5.47 From the calculations the total waste associated emissions amounted to some 33,000 tCO_2e with a carbon factor of 588.9 $kgCO_2e$ applied per tonne waste, applicable for disposal of municipal waste to landfill.

[32] Defra (2017) 'Government Emission Conversion Factors.'

Associated Operation (B9)

5.48 The emissions from associated operation focuses on indirect emissions, attributable to the users of the port facilities but beyond the control of PoTLL. This included the movement of staff to and from the site, shipping movements as vessels convey goods to and from Tilbury2, and movement of freight by rail and road.

Road

5.49 Road Movements were based on the landside transportation study (ES Chapter 13). Employee travel was noted as 271,925 two-way movements across a year, considering Annual Average Daily Traffic (AADT). An average two-way travel distance of 100 km was assumed for staff commuting, based on local travel to and from the Tilbury and Gravesend areas.

5.50 Vehicles were assumed to be equivalent to petrol driven, average size cars and a carbon factor of 0.23619 kgCO_2e was applied per tonne kilometre, which incorporated well-to-wheel emissions. As noted previously emissions may be higher or lower depending on the mix of vehicles and whether staff drive higher emission executive type cars, or lower emission, hybrid or electric cars, as there is likely to be a range in vehicle types. This equated to total CO_2e emissions of circa 3,200 tCO_2e (two-way movements).

5.51 GVs will be used to convey freight from Tilbury2 across the UK. Associated traffic movements were noted to be 713,210 two-way movements across a year, considering AADT. In the absence of specific information regarding their destinations a nominal 800 km two-way travel distance was assumed, based on an average distance to and from central Great Britain. For the purposes of selecting an appropriate carbon factor for the assessment, HGVs were considered to be equivalent to large diesel fuelled articulated trucks of between 3.5 to 33 tonnes, with an average UK vehicle load. This equated to a carbon factor of 1.04251 kgCO_2e per tonne kilometre travelled, and total CO_2e emissions of circa 300,000 tCO_2e (two-way movements).

5.52 In viewing the results it should be considered that over the period of the project’s operation improvements in technology and tighter regulation of emissions in the future are likely to drive a reduction in associated emissions from vehicles. In the past five years for example, the stated carbon factors have decreased by up to 4%. As a result it is likely that the emissions from transport will be lower in the future.

Rail

5.53 Rail will also be used to convey freight from Tilbury2 across the UK. Project information for daily rail traffic assumed a total of five movements per day, conveying approximately 8,000 tonnes of freight (at maximum laden weight). Though minimal information on expected destinations was available, some containers were noted to travel from the current Tilbury port to Birch Coppice Intermodal Freight Terminal in the West Midlands, at an approximate distance of 200 km. It was also understood that the Port are seeking to undertake regular intermodal services to Scotland. Assuming the trains will run to Glasgow, i.e. worst-case, this equates to an approximate journey distance of 550 km.

5.54 For the purposes of this assessment a nominal average figure between the known destinations was taken, rounded to 400 km for a one-way trip, and 800 km two-ways. This accounted for a train running empty to Tilbury2, then picking up freight, and conveying it back to the origin. A carbon factor equivalent to rail freight was applied, equivalent to 0.04168 kgCO_2e/tkm. This equated to total CO_2e emissions of circa 85,000 tCO_2e (two-way movements).

Shipping

5.55 Ships will be used to convey freight to Tilbury2. Relevant data was obtained from the ES and from information provided by PoTLL based on operations at the existing port of Tilbury. The expected movements and associated assumptions are outlined as follows:

- RoRo vessels:
  - 1,452 two-way movements per annum. Note that no additional movements will occur because of Tilbury2 but the expansion will allow for larger vessels than those which currently access the existing port.
  - Assumed capacity of 7,675 tonnes per ship with 90% utilised, equivalent to 6,906 tonnes per incoming journey.
  - An average travel distance of 382 km two-ways based on the expected travel routes and destinations.
  - Assumed equivalent to a General Cargo vessel, 5000-9999 tonnes dead weight for shipping freight, which equated to a carbon factor of 0.01892 kgCO_2e/tkm in the Defra 2017 Government Emission Conversion Factors[33]. As per previous and subsequent factors this included well-to-tank emissions and those associated with operation.

[33] Defra (2017) Government Emission Conversion Factors.

- Bulk carriers:
  - 40 two-way movements per annum.
  - Assumed capacity of 100,000 tonnes per ship with 90% utilized or 90,000 tonnes per incoming journey.
  - An average travel distance of 2,686 km two-way as based on the expected travel routes and destinations.
  - Assumed equivalent to a Bulk Carrier vessel, 100,000-199,999 tonnes dead weight for shipping freight, which equated to a carbon factor of 0.00359 kgCO_2e/tkm in the Defra 2017 carbon emissions factors[33].
- Barges (non-self-propelling) towed by tugs:
  - 300 two-way movements per annum.
  - Barges will deliver to various destinations along the Thames. Expected movements have been evenly distributed between frequent London destinations and an average of the quantified distances taken. This equated to a 67 km two-way journey which assumes that barges arrive empty to Tilbury then leave full.
  - Based on an engine power of 450 kW, as determined from the specification of a tug operating at Tilbury1, and its expected hours of operation. A maximum speed of 9.7 knots or 18 km/h, was assumed and applied to the travel distances expected, including some contingency for maneuvering and travelling at slower speeds. A carbon factor of 358.6 kgCO_2e/hr was assumed, equivalent to the stated engine size.

5.56 It was noted that the larger RoRo vessels and Bulk Carriers may also require towing to and from Tilbury2 via tug. PoTLL expect a maximum number of three tugs per vessel, though whether any would be required at all will be variable according to the wind conditions at any given time. For the purposes of the assessment two tugs per vessel was assumed to be a realistic worst-case. These would be required to meet vessels 9 km from Tilbury before leading them back. This equated to a total two-way trip of 18 km. To quantify the emissions attributed to these movements the same tug assumptions as outlined above were applied, based on maximum possible speed, distance, time and an engine power of 450 kW.

5.57 Based on these assumptions associated operations equated to total emissions of 410,000 tCO_2e. Over 70% was applicable to road freight, with 20% from rail and less than 10% from shipping, associated with its greater transport efficiency. Less than 1% of the total emissions from associated operations derived from staff commuting. Note that all factors included well-to-tank emissions as well as those from operation.

5.58 Though these represent the largest numbers of the footprint it is important to note that these emissions are an indirect result of the development. They are beyond the control of the port, and are instead attributable to the freight companies and carriers conveying goods via its facilities. It is the responsibility of these companies as to the methods they use for moving goods, and whether they choose to use the most efficient and modern forms of transport available to reduce their emissions impact.

5.59 Such considerations are likely to be increasingly adopted as sectors seek to meet the ambitious carbon reduction targets of the Climate Change Act (2008), and develop decarbonisation strategies for their logistics operations. Over the project's lifespan the carbon emissions are therefore likely to decrease as future improvements in areas such as fuel efficiency are progressed.

5.60 By way of example in the EU road freight vehicles have become increasingly efficient in the terms of fuel usage and emissions since the introduction of Directive 88/77/EEC (1987) and its later amendments. The subsequent introduction of 'Euro' engine emissions standards resulted in the latest engines (Euro VI) emitting considerably less GHG emissions than the Euro I engines of 1993.

5.61 The Freight Carbon Review undertaken by the Department for Transport in 2017 identified a number of measures that the road freight industry are considering to further reduce emissions such as vehicle and in-cab modifications, efficient driving, alternative fuels and low/ zero emissions technologies. In addition, the European Commission has proposed that from 1st January 2019 HGV manufacturers will have to calculate the CO_2 emissions and fuel consumption of new vehicles produced for the EU market. These regulations are likely to act as a catalyst to drive technological development of HGV design helping to deliver potentially significant CO_2 emission reductions.

5.62 In terms of shipping, in 2013 the International Maritime Organisation (IMO) introduced the Energy Efficiency Design Index (EEDI) for all new ships and Ship Energy Efficiency Management Plans (SEEMP) for all existing ships, applying to those over 400 gross tonnes, as part of the International Convention for the Prevention of Pollution from Ships (MARPOL).

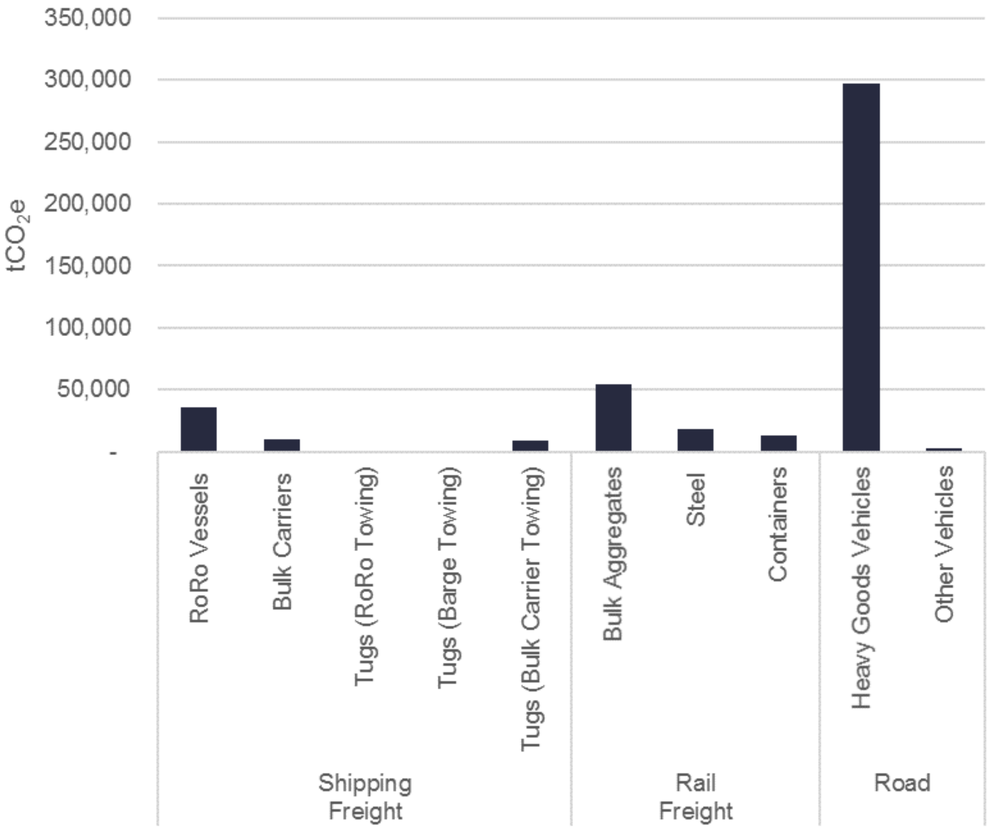
5.63 The mandatory EEDI set specific ship-class fuel efficiency targets with an initial 10% reduction in CO_2 from 2011 levels to be achieved in 2015, 20% by 2020 and 30% by 2025. If implemented according to schedule, it was estimated that up to 263 $MtCO_2$ could be reduced annually by 2030. The SEEMP established a mechanism for operators to improve energy efficiency of ships through monitoring emissions and consideration of best practice fuel efficient operation. A Roadmap has since been approved for developing a comprehensive IMO strategy on reduction of GHG emissions from ships, with initial CO_2 reduction commitments expected to be agreed by 2018.

5.64 Furthermore, in the EU, as of 2018 all ships passing through an EU port over a gross tonnage of 5,000 tonnes will be required to monitor and report their CO_2 emissions. The Shipping Monitoring, Reporting, Verification (MRV) Regulation (2015/757) entered into force in 2015. The Regulation aims to provide further insight into the sector's potential to reduce emissions and opportunities to agree efficiency standards for existing ships. It is expected to cut emissions by 2% from the baseline business as usual scenario.

5.65 It should also be considered that the emissions from shipping and movement of freight may occur regardless of the expansion of Tilbury2. In the absence of the project, movements of goods may otherwise use different access points and means into, out of, and across the UK.

5.66 A breakdown of the CO_2e emissions from associated operations is shown in Figure 5.14.

Figure 5.14 Associated Operations Emissions by Type (tCO_2e)



CONCLUSIONS

5.67 The proposals will result in total CO_2e emissions of circa 160,000 tCO_2e from the construction phase, across the 22-month programme, and annual emissions from operations of approximately 57,000 tCO_2e. Associated operations, which took into account the indirect emissions from transport, including the import and export of goods from shipping and their conveyance around the UK, amounted to annual emissions of 410,000 tCO_2e. This was largely related to the high number of vehicle movements, the distances travelled and the tonnage of freight which would be transported. Collectively this is less than 0.2% of the 466 $MtCO_2e$ emissions reported for the UK in 2016, and less than 0.6% of the 119 $MtCO_2e$ reported for the transport sector (which includes emissions from aviation, road transport, railways, shipping, fishing and aircraft support vehicles)[34].

5.68 Of the areas assessed the most significant emissions during construction were noted to be from materials use. This comprised of 51% of the total emissions from this stage. This was followed by energy use at 42% which was associated with the fuel consumption of mobile plant, such as excavators, dump trucks and piling rigs, and transport at 6%, which included the movements of goods to the site, transport from staff, and removal of waste.

5.69 The operational emissions of Tilbury2 were largely associated with the disposal of waste at 58% of the total. This is followed by energy use at 42% from the fuel consumption of mobile plant, such as reach stackers, forklifts and RoRo tractors, which will be used in general operations as ships are loaded and unloaded and goods are moved around the site. The lowest emissions were from water consumption and treatment, at less than 1% of the total.

5.70 The emissions from associated operations were overwhelmingly biased towards road freight at over 70% of the total. The remaining emissions were distributed as 20% for movements of freight by rail, 10% for movements of freight by ship and less than 1% for staff commuting.

5.71 Though the emissions from associated operations were the largest in the assessment given the nature of Tilbury2 as a port, it should be considered that such emissions may occur regardless of the proposals. In the absence of the project, the movement of goods which Tilbury2 will facilitate, may otherwise use different access points and means into, out of, and across the UK.

5.72 Furthermore, the ownership of these will largely fall under the shipping and freight companies, rather than PoTLL, who will have the most control over potential emissions reductions. It will be the responsibility of these companies to ensure they utilise the best means possible to reduce their emissions impact when conveying goods, such as through using more efficient and modern forms of transport whether by sea, road, or rail.

[34] Department for Business, Energy and Industrial Strategy, (2017), 'Provisional UK greenhouse gas emissions national statistics 2016.'

5.73 Whilst this footprint presents a worst-case approach in quantifying these associated values, such considerations are likely to be increasingly adopted as sectors seek to meet the ambitious carbon reduction targets of the Climate Change Act (2008), and develop decarbonisation strategies for their logistics operations. As a result over the project's lifespan this impact is likely to decrease as future improvements in areas such as fuel efficiency are progressed, driven by initiatives such as EURO VI engine emissions standards and the mandatory energy efficiency requirements for ships under the EEDI, embedded in the MARPOL regulations.

APPENDIX 1: CARBON FOOTPRINTING STANDARDS AND ASSOCIATED GUIDANCE

GREENHOUSE GAS PROTOCOL (2001)

The GHG Protocol (2001, as revised)[35] was developed by the World Resources Institute and World Business Council on Sustainable Development and set a global standard for how to measure, manage, and report GHG emissions. The specific standards are as follows:

- Corporate Accounting and Reporting Standard;
- Value Chain (Scope 3) Accounting and Reporting Standard;
- Product Life Cycle Accounting and Reporting Standard; and
- GHG Protocol for Project Accounting.

The Corporate Standard is for companies to quantify and report their direct and indirect operational GHG emissions, and the Scope 3 Standard is for companies to quantify and report their indirect emissions from their up and downstream supply chains. Consequently, together the Corporate and Scope 3 Standards provide the requirements and guidance for companies and other organizations to prepare and publicly report a GHG emissions inventory that includes the whole life cycle of their operations.

The Product Standard defines how to quantify and report GHG emissions and removals associated with individual products throughout their life cycle. The Project Accounting Protocol is a guide for quantifying reductions from GHG-mitigation projects.

ISO 14064:2006, PART 1: GREENHOUSE GASES - PART 1: SPECIFICATION WITH GUIDANCE AT THE ORGANISATION LEVEL FOR QUANTIFICATION AND REPORTING OF GREENHOUSE GAS EMISSIONS AND REMOVALS (2006)

ISO 14064:2006[36] was developed by the International Organization for Standardization (ISO) and sets an international standard for quantification and reporting of greenhouse gas emissions and removals. It is split into two parts and specifies principles and requirements for quantification and reporting of GHG emissions and removals, as follows:

- Part 1: For organisations; and
- Part 2: For individual GHG emission reductions activities (projects).

[35] World Business Council for Sustainable Development and World Resources Institute, 2001 (as amended), GHG Protocol.

[36] International Organization for Standardisation, 2006, ISO 14064:2006, Part 1: Greenhouse Gases - Part 1: Specification with Guidance at the Organisation Level for Quantification and Reporting of Greenhouse Gas Emissions and Removals.

ISO/ TS 14067:2014: GREENHOUSE GASES. CARBON FOOTPRINT OF PRODUCTS. REQUIREMENTS AND GUIDELINES FOR QUANTIFICATION AND COMMUNICATION (2014)

ISO/ TS 14067:2014[37] was prepared by the ISO and approved by European Committee for Standardization and sets the requirements and guidelines for quantification and communication of carbon footprints for products.

PAS 2050:2011: SPECIFICATION FOR THE ASSESSMENT OF THE LIFE CYCLE GREENHOUSE GAS EMISSIONS OF GOODS AND SERVICES AND PAS 2060:2014: SPECIFICATION FOR THE DEMONSTRATION OF CARBON NEUTRALITY (2014)

Publicly Available Specifications (PAS) are produced by the British Standards Institution (BSI), and PAS 2050 and 2060 are the two specifications that relate to carbon footprinting, as summarised below:

- PAS 2050:2011: for the assessment of the life cycle greenhouse gas emissions of goods and services38; and
- PAS 2060:2014: for demonstration of carbon neutrality[39].

PAS 2080:2016: CARBON MANAGEMENT IN INFRASTRUCTURE (2016)

The PAS 2080:2016 Carbon Management in Infrastructure[40] technical standard builds on the Infrastructure Carbon Review (published by HM Treasury in 2013) to provide guidance for all parties involved (as stated below) on development of low carbon infrastructure projects. It sets out a comprehensive carbon management process for infrastructure developments.

PAS 2080:2016[40] is intended to be applied to all parties across the supply (value) chain including: owner/ manager; designers; constructors; and product materials suppliers. Specifically, it requires that the asset owner/ manager set the carbon strategy for the project in question and all parties across the supply chain buy into the implementation of the strategy. Furthermore, it sets out requirements for all value chain members under a range of headings including:

- Section 5 - Leadership and Governance;
- Section 6 - Carbon Management Process;
- Section 7 - Quantification;
- Section 8 - Targets, Baseline and Monitoring;
- Section 9 - Reporting;

[37] International Organization for Standardisation, 2014, ISO/TS 14067:2014: Greenhouse Gases. Carbon Footprint of Products. Requirements and Guidelines for Quantification and Communication.
[38] Publicly Available Specification, 2011, PAS 2050:2011: Specification for the Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services.
[39] Publicly Available Specification, 2014, PAS 2060:2014: Specification for the Demonstration of Carbon Neutrality.
[40] Publicly Available Specification, 2016, PAS 2080:2016: Carbon Management in Infrastructure.

- Section 10 - Continual Improvement; and
- Section 11 - Assessment of Carbon Reductions.

BS EN 15978:2011: SUSTAINABILITY OF CONSTRUCTION WORKS. ASSESSMENT OF ENVIRONMENTAL PERFORMANCE OF BUILDINGS. CALCULATION METHOD (2011)

BS EN 15978:2011[41] is the calculation method for the assessment of environmental performance of buildings and was prepared by Technical Committee CEN/ TC 350 "Sustainability of Construction Works", the secretariat of which is held by AFNOR, and it was published by the BSI.

Specifically, it defines the calculation method, based on Life Cycle Assessment (LCA) and other quantified environmental information, to assess the environmental performance of a building, and gives the means for the reporting and communication of the outcome of the assessment. It is applicable to new and existing buildings and refurbishment projects.

BS EN ISO 14044:2006: ENVIRONMENTAL MANAGEMENT. LIFE CYCLE ASSESSMENT. REQUIREMENTS AND GUIDELINES (2006)

BS EN ISO 14044:2006[42] was developed by ISO and specifies generic requirements and guidelines for life cycle assessment (LCA) studies and inventories.

[41] British Standards Institute, 2011, BS EN 15978:2011: Sustainability of Construction Works. Assessment of Environmental Performance of Buildings. Calculation Method.
[42] British Standards Institute, 2006, BS EN ISO 14044:2006: Environmental Management. Life Cycle Assessment. Requirements and Guidelines.

APPENDIX 2: CARBON AND ENERGY FOOTPRINT

APPENDIX 3: GLOSSARY

Term	Acronym	Definition
Annual Average Daily Traffic	AADT	The total volume of vehicle traffic of a highway or road for a year divided by 365 days.
Application	--	The application by Port of Tilbury London Ltd for the proposals
Atkins Carbon Knowledgebase	CKB	A web-based tool developed by Atkins for the building and construction industry that can be used to calculate footprints with an extensive database of GHG emissions data.
Construction Materials and Aggregates Terminal	CMAT	Area of the site to be used for aggregate handling and processing
Core Strategy Thematic Policies	CSTPs	Set of strategies and policies which deal with important themes and set out in detail how the Council intends to ensure the best outcomes are delivered.
Carbon Dioxide Equivalent	CO_2e	Unit used to report total mass of greenhouse gas emissions in carbon and energy footprints. Usually reported as kilograms or tonnes of carbon dioxide equivalent.
Department for Business, Energy & Industrial Strategy	BEIS	UK government department which brings together responsibilities for business, industrial strategy, science, innovation, energy, and climate change
Department for Environment, Food and Rural Affairs	DEFRA	UK government department responsible for safeguarding the natural environment, supporting food and farming industry, and sustaining the rural economy.

Term	Acronym	Definition
Development Consent Order	DCO	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project
EMEP/ CORINAIR Emission Inventory Guidebook.	--	A recognised set of emission inventory estimation methods used in air pollution studies in Europe. The set of methodologies found in the guidebook help ensure comparable and consistent emissions data are reported by countries, and helps inform policymakers, the scientific community and the broader public.
Environmental Statement	ES	The document which reports the process, findings and recommendations of the EIA carried out to assess the environmental impacts of the Scheme.
Energy Efficiency Design Index	EEDI	As part of the MARPOL regulations. This mandatory measure sets specific ship-class fuel efficiency targets with an initial 10% reduction in CO2 from 2011 levels.
Footprint	--	Carbon and energy footprint refers to the collective consideration of Greenhouse Gas emissions arising from an activity or set of activities.
Greenhouse Gas Emission	GHG Emission	The direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources into air, water or onto land, e.g. pollution may be discharged into the atmosphere from a stack or vent.
Heavy Goods Vehicle	HGV	A truck that when laden has a total weight of more than 3500 kg.

Term	Acronym	Definition
Kilograms	Kg	Unit of mass.
International Convention for the Prevention of Pollution from Ships	MARPOL	MARPOL 73/78 is one of the most important international marine environmental conventions. It was developed by the International Maritime Organization in an effort to minimize pollution of the oceans and seas, including dumping, oil and air pollution.
International Maritime Organisation	IMO	Specialised agency of the United Nations responsible for regulating shipping
National Planning Policy Framework	NPPF	The National planning policy framework for England, dated March 2012.
National Policy Statements for Ports	NPSP	Overarching legislative policy concerning the planning and consenting of port NSIPs in the UK.
Nationally Significant Infrastructure Project	NSIP	As defined by the Planning Act 2008, which includes new harbour facilities that will be able to handle the embarkation or disembarkation of quantities of material exceeding: • 0.5 million Twenty Foot Equivalent Units (TEU) for a container terminal; • 250,000 movements for roll-on roll off (ro-ro); • 5 million tonnes for other (bulk and general) traffic; or • a weighted sum equivalent to these figures taken together.
Policies For Management Of Development	PMDs	The basis for the determination of planning applications for the development and use of land and buildings by Thurrock Council.

Term	Acronym	Definition
Port of Tilbury London Limited	PoTLL	Submitting the proposal for a new port terminal on the north bank of the River Thames at Tilbury.
Proposal	--	The development proposals as described in the PEIR
Red line boundary	--	The Order Limits for the Site.
Roll-on/ Roll-off	Ro-Ro	Area of the site which deal with a range of cargos including cars, ferry services and tracked and agricultural plant.
Site	--	• The Tilbury2 site • The infrastructure corridor; and • Sections of the tidal Thames required for the construction of expanded berthing capacity and associated dredging.
Thurrock's Local Development Framework	LDF	A spatial planning strategy introduced by the Planning and Compulsory Purchase Act 2004.
Tilbury2 site	--	The site of the proposed RoRo and CMAT terminals and associated infrastructure.
Town and Country Planning Act	TCPA	Established the requirement for planning permission to develop land, introduced in 1947.

Project Name: Tilbury2

Print Date: 20/10/2017

Project Notes: None

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Tilbury2				
Construction (A1 - A5)		158,739,418	158,739,418	158,739,418
Materials (A1 - A3)		80,742,004	80,742,004	80,742,004
Maritime Facilities		54,759,516	54,759,516	54,759,516
Aggregate Berth		11,030,055	11,030,055	11,030,055
Steel	5,621,060 kg	2.0	10,961,067	10,961,067
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	10,961,067
Concrete	644,750 kg	0.11	68,988	68,988
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	68,988
RoRo Berth and Approach Bridge		15,551,273	15,551,273	15,551,273
Steel	7,907,190 kg	2.0	15,419,021	15,419,021
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	15,419,021
Concrete	1,236,000 kg	0.11	132,252	132,252
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	132,252

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Trailer and Container Yard		15,555,905	15,555,905	15,555,905
Paving	119,600,000 kg	0.11	12,797,200	12,797,200
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	12,797,200
Aggregates	167,450,000 kg	0.01	870,740	870,740
Aggregate - General Carbon Factor Value: 0.0052 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.01	0.01	870,740
Polyethylene	96,720 kg	2.5	245,669	245,669
Polyethylene - General Carbon Factor Value: 2.54 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Europe Mass: 1 kg		2.5	2.5	245,669
Geotextile	21,060 kg	2.0	42,120	42,120
Polypropylene (PP) Carbon Factor Value: 2 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Plastics Europe EPD: Polypropylene (2008) Region: Europe Mass: 1 kg		2.0	2.0	42,120
Cement	2,162,400 kg	0.74	1,600,176	1,600,176
Cement - General (UK weighted average) Carbon Factor Value: 0.74 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.74	0.74	1,600,176
CMAT Processing and Mixed Use		2,737,726	2,737,726	2,737,726
Paving	21,275,000 kg	0.11	2,276,425	2,276,425
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	2,276,425

Name	Quantity	kgCO2e Single	Total	Project
Aggregates	25,160,000 kg	0.01	130,832	130,832
Aggregate - General Carbon Factor Value: 0.0052 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.01	0.01	130,832
Cement	377,400 kg	0.74	279,276	279,276
Cement - General (UK weighted average) Carbon Factor Value: 0.74 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.74	0.74	279,276
Polyethylene	17,205 kg	2.5	43,701	43,701
Polyethylene - General Carbon Factor Value: 2.54 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Europe Mass: 1 kg		2.5	2.5	43,701
Geotextile	3,746 kg	2.0	7,492	7,492
Polypropylene (PP) Carbon Factor Value: 2 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Plastics Europe EPD: Polypropylene (2008) Region: Europe Mass: 1 kg		2.0	2.0	7,492
RoRo Terminal Workshop/ Admin/ Welfare/ Parking		730,319	730,319	730,319
Paving	6,325,000 kg	0.11	676,775	676,775
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	676,775
Aggregates	7,370,000 kg	0.01	38,324	38,324
Aggregate - General Carbon Factor Value: 0.0052 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.01	0.01	38,324
Polyethylene	5,115 kg	2.5	12,992	12,992

Name	Quantity	kgCO2e Single	Total	Project
Polyethylene - General Carbon Factor Value: 2.54 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Europe Mass: 1 kg		2.5	2.5	12,992
Geotextile	1,114 kg	2.0	2,228	2,228
Polypropylene (PP) Carbon Factor Value: 2 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Plastics Europe EPD: Polypropylene (2008) Region: Europe Mass: 1 kg		2.0	2.0	2,228
RoRo Terminal Warehouse and Storage		4,446,411	4,446,411	4,446,411
Paving	40,145,000 kg	0.11	4,295,515	4,295,515
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	4,295,515
Aggregates	20,770,000 kg	0.01	108,004	108,004
Aggregate - General Carbon Factor Value: 0.0052 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.01	0.01	108,004
Polyethylene	14,415 kg	2.5	36,614	36,614
Polyethylene - General Carbon Factor Value: 2.54 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Europe Mass: 1 kg		2.5	2.5	36,614
Geotextile	3,139 kg	2.0	6,278	6,278
Polypropylene (PP) Carbon Factor Value: 2 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Plastics Europe EPD: Polypropylene (2008) Region: Europe Mass: 1 kg		2.0	2.0	6,278
Silo		806,392	806,392	806,392
Paving	2,070,000 kg	0.11	221,490	221,490

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	221,490
Concrete	5,466,371 kg	0.11	584,902	584,902
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	584,902
RoRo Terminal		2,136,303	2,136,303	2,136,303
Steel	1,095,540 kg	2.0	2,136,303	2,136,303
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	2,136,303
CMAT Corridor		757,178	757,178	757,178
Conveyor	232,500 kg	2.4	558,000	558,000
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass with percentage composition (Mass_kg * (Percentage_Composition / 100) * CF) Property Calculation: 0.5 kg Source: Bath ICE (2.0) Region: Global % Composition: 50 % Mass: 1 kg		0.98	0.98	226,688
Rubber - General Carbon Factor Value: 2.85 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass with percentage composition (Mass_kg * (Percentage_Composition / 100) * CF) Property Calculation: 0.5 kg Source: Bath ICE (2.0) Region: UK % Composition: 50 % Mass: 1 kg		1.4	1.4	331,313
Paving	1,725,000 kg	0.11	184,575	184,575
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	184,575
Aggregates	2,010,000 kg	0.01	10,452	10,452

Name	Quantity	kgCO2e Single	kgCO2e Total	kgCO2e Project
Aggregate - General Carbon Factor Value: 0.0052 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.01	0.01	10,452
Polyethylene	1,395 kg	2.5	3,543	3,543
Polyethylene - General Carbon Factor Value: 2.54 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Europe Mass: 1 kg		2.5	2.5	3,543
Geotextile	304 kg	2.0	608	608
Polypropylene (PP) Carbon Factor Value: 2 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Plastics Europe EPD: Polypropylene (2008) Region: Europe Mass: 1 kg		2.0	2.0	608
Site Security and Customs		1,926	1,926	1,926
Paving	18,000 kg	0.11	1,926	1,926
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	1,926
Terminal Workshop/ Admin/ Welfare		570,179	570,179	570,179
Wall	96,000 kg	0.24	23,040	23,040
Bricks - General Carbon Factor Value: 0.24 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.24	0.24	23,040
Cladding	1,584 kg	2.0	3,089	3,089
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	3,089
Steel	279,000 kg	2.0	544,050	544,050

Name	Quantity	Single ($kgCO_2e$)	Total ($kgCO_2e$)	Project ($kgCO_2e$)
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	544,050
Fences		194,573	194,573	194,573
Steel	99,781 kg	2.0	194,573	194,573
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	194,573
Lighting		205,838	205,838	205,838
Lighting Column	105,558 kg	2.0	205,838	205,838
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	205,838
Culverts		35,438	35,438	35,438
Concrete	331,200 kg	0.11	35,438	35,438
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	35,438
Rail Facilities		15,286,588	15,286,588	15,286,588
Permanent Way		14,960,757	14,960,757	14,960,757
Concrete	1,249,000 kg	0.11	133,643	133,643
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.11	0.11	133,643
Line Sleepers	99,914 kg	0.87	86,925	86,925

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Sawn Hardwood - General Carbon Factor Value: 0.87 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.87	0.87	86,925
Iron	107,601 kg	2.0	218,430	218,430
Iron - General Carbon Factor Value: 2.03 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		2.0	2.0	218,430
Steel	579,621 kg	2.0	1,130,261	1,130,261
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	1,130,261
Track Ballast	17,706,000 kg	0.70	12,394,200	12,394,200
Granite Carbon Factor Value: 0.7 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.70	0.70	12,394,200
Geotextile	13,130 kg	2.0	26,260	26,260
Polypropylene (PP) Carbon Factor Value: 2 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Plastics Europe EPD: Polypropylene (2008) Region: Europe Mass: 1 kg		2.0	2.0	26,260
Turnouts (Rail Junctions)	73,360 kg	1.4	103,438	103,438
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass with percentage composition (Mass_kg * (Percentage_Composition / 100) * CF) Property Calculation: 0.5 kg Source: Bath ICE (2.0) Region: Global % Composition: 50 % Mass: 1 kg		0.98	0.98	71,526
Sawn Hardwood - General Carbon Factor Value: 0.87 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass with percentage composition (Mass_kg * (Percentage_Composition / 100) * CF) Property Calculation: 0.5 kg Source: Bath ICE (2.0) Region: UK % Composition: 50 % Mass: 1 kg		0.44	0.44	31,912
Composite Panel (Level Crossing Surface)	15,000 kg	0.66	9,899	9,899

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Concrete - General Carbon Factor Value: 0.107 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass with percentage composition (Mass_kg * (Percentage_Composition / 100) * CF) Property Calculation: 0.7 kg Source: Bath ICE (2.0) Region: UK % Composition: 70 % Mass: 1 kg		0.07	0.07	1,124
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass with percentage composition (Mass_kg * (Percentage_Composition / 100) * CF) Property Calculation: 0.3 kg Source: Bath ICE (2.0) Region: Global % Composition: 30 % Mass: 1 kg		0.59	0.59	8,775
Limestone	9,239,040 kg	0.09	831,514	831,514
Limestone - General Carbon Factor Value: 0.09 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: United States Mass: 1 kg		0.09	0.09	831,514
Sand	5,135,000 kg	0.01	26,189	26,189
Sand - General Carbon Factor Value: 0.0051 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: UK Mass: 1 kg		0.01	0.01	26,189
Fort Road Bridge		325,831	325,831	325,831
Concrete	2,445,096 kg	0.13	317,862	317,862
Concrete - General Carbon Factor Value: 0.13 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (1.6a) Region: Global Mass: 1 kg		0.13	0.13	317,862
Paving (Asphalt)	31,147 kg	0.14	4,361	4,361
Asphalt - Road and Pavement Carbon Factor Value: 0.14 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (1.6a) Region: Global Mass: 1 kg		0.14	0.14	4,361
Steel	1,850 kg	2.0	3,608	3,608
Steel - General - World Average Recycled Content Carbon Factor Value: 1.95 kgCO2e/kg Lifecycle: Partial process Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (2.0) Region: Global Mass: 1 kg		2.0	2.0	3,608

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Highways		10,695,900	10,695,900	10,695,900
Link Road		3,380,700	3,380,700	3,380,700
Binders	17,700,000 kg	0.14	2,478,000	2,478,000
Cement - Soil Cement Carbon Factor Value: 0.14 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (1.6a) Region: UK Mass: 1 kg		0.14	0.14	2,478,000
Asphalt	20,060,000 kg	0.05	902,700	902,700
Asphalt - General Carbon Factor Value: 0.045 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (1.6a) Region: Global Mass: 1 kg		0.05	0.05	902,700
Internal Road		7,315,200	7,315,200	7,315,200
Binders	15,600,000 kg	0.42	6,552,000	6,552,000
Cement - General with Fly Ash Replacement 50% Carbon Factor Value: 0.42 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (1.6a) Region: UK Mass: 1 kg		0.42	0.42	6,552,000
Asphalt	16,960,000 kg	0.05	763,200	763,200
Asphalt - General Carbon Factor Value: 0.045 kgCO2e/kg Lifecycle: Cradle to Gate Calculation: Mass (Mass_kg * CF) Property Calculation: 1 kg Source: Bath ICE (1.6a) Region: Global Mass: 1 kg		0.05	0.05	763,200
Transport to Site (A4)		9,005,039	9,005,039	9,005,039
Staff (All Site)		2,856,836	2,856,836	2,856,836
Staff Commuting	241,910 no.	12	2,856,836	2,856,836
Car - Average - Petrol Carbon Factor Value: 0.23619 kgCO2e/km/ day Property Calculation: 50 km/ day Source: Defra: Cars. All Scope. (2017)	50 km/ day	0.24	12	2,856,836
Maritime Facilities		5,054,505	5,054,505	5,054,505

Name	Quantity	kgCO2e Single	Total	Project
Spoil Removal	9,864 no.	104	1,028,332	1,028,332
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 100 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 100 km		104	104	1,028,332
Construction of Maritime Facilities	38,620 no.	104	4,026,174	4,026,174
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 100 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 100 km		104	104	4,026,174
Rail Facilities		562,538	562,538	562,538
Spoil Removal	2,928 no.	104	305,247	305,247
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 100 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 100 km		104	104	305,247
Construction of Rail Facilities	2,468 no.	104	257,291	257,291
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 100 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 100 km		104	104	257,291
Highways		531,159	531,159	531,159
Spoil Removal	1,800 number	104	187,652	187,652
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 100 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 100 km		104	104	187,652
Construction of Highways	3,295 number	104	343,507	343,507

Name	Quantity	kgCO2e Single	Total	Project
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 100 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 100 km		104	104	343,507
Construction Works (A5)		68,992,376	68,992,376	68,992,376
Energy Use		66,620,448	66,620,448	66,620,448
Mobile Plant: Maritime Facilities		12,119,393	12,119,393	12,119,393
Barges (Jack Up/ Spud Leg)	1,201 hours	440	528,656	528,656
Barge Hydraulics Carbon Factor: Diesel Engine - 100kW / 135hp Value: 81.58 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		82	82	97,978
Barge Tug Carbon Factor: Diesel Engine - 450kW / 607.5hp Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	430,679
Barges (Delivery)	2,402 hours	359	861,357	861,357
Diesel Engine - 450kW / 607.5hp Carbon Factor Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	861,357
Pilling Rigs	2,002 hours	438	877,477	877,477
Diesel Engine - 550kW / 742.5hp Carbon Factor Value: 438.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		438	438	877,477
Cranes	5,606 hours	199	1,116,715	1,116,715
Diesel Engine - 250kW / 337.5hp Carbon Factor Value: 199.2 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		199	199	1,116,715
Large Lorry Concrete Mixers	33,634 hours	159	5,361,260	5,361,260

Name	Quantity	kgCO2e Single	kgCO2e Total	kgCO2e Project
Diesel Engine - 200kW / 270hp Carbon Factor Value: 159.4 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		159	159	5,361,260
Concrete Pumps	2,803 hours	179	502,578	502,578
Diesel Engine - 225kW / 303.75hp Carbon Factor Value: 179.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		179	179	502,578
Dredging Spoil Barges	2,402 hours	359	861,357	861,357
Diesel Engine - 450kW / 607.5hp Carbon Factor Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	861,357
Backhoe Dredgers	1,201 hours	1,674	2,009,994	2,009,994
Dredger Engine Carbon Factor: Diesel Engine - 1000kW / 1350hp Value: 796.9 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		797	797	957,077
Dredger Engine Carbon Factor: Diesel Engine - 600kW / 810hp Value: 478.2 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		478	478	574,318
Excavator Carbon Factor: Diesel Engine - 500kW / 675hp Value: 398.5 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		399	399	478,599
Mobile Plant: Port Terminal/ Road Corridor/ Rail/ Bridge		54,501,054	54,501,054	54,501,054
Dozers	37,885 hours	120	4,527,258	4,527,258
Diesel Engine - 150kW / 202.5hp Carbon Factor Value: 119.5 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		120	120	4,527,258
Hydraulic Excavators	25,257 hours	319	8,051,932	8,051,932

Name	Quantity	kgCO2e Single	Total	Project
Diesel Engine - 400kW / 540hp Carbon Factor Value: 318.8 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		319	319	8,051,932
Vibratory Compactors	16,838 hours	2.6	42,954	42,954
Diesel Engine - 3kW / 4.05hp Carbon Factor Value: 2.551 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		2.6	2.6	42,954
Large Lorry Concrete Mixers	50,513 hours	159	8,051,772	8,051,772
Diesel Engine - 200kW / 270hp Carbon Factor Value: 159.4 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		159	159	8,051,772
Concrete Pumps	4,209 hours	179	754,674	754,674
Diesel Engine - 225kW / 303.75hp Carbon Factor Value: 179.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		179	179	754,674
Mobile Cranes	16,838 hours	199	3,354,130	3,354,130
Diesel Engine - 250kW / 337.5hp Carbon Factor Value: 199.2 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		199	199	3,354,130
Rollers	25,257 hours	120	3,018,212	3,018,212
Diesel Engine - 150kW / 202.5hp Carbon Factor Value: 119.5 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		120	120	3,018,212
Road Pavers	25,257 hours	102	2,576,214	2,576,214
Diesel Engine - 125kW / 168.75hp Carbon Factor Value: 102 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		102	102	2,576,214

Name	Quantity	kgCO2e Single	Total	Project
Asphalt Concrete Plants	26,510 hours	120	3,167,945	3,167,945
Diesel Engine - 150kW / 202.5hp Carbon Factor Value: 119.5 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		120	120	3,167,945
Pavement Breakers	8,419 hours	2.6	21,477	21,477
Diesel Engine - 3kW / 4.05hp Carbon Factor Value: 2.551 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		2.6	2.6	21,477
Articulated Dump Trucks	33,676 hours	239	8,051,932	8,051,932
Diesel Engine - 300kW / 405hp Carbon Factor Value: 239.1 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		239	239	8,051,932
Tippers	16,838 hours	359	6,038,107	6,038,107
Diesel Engine - 450kW / 607.5hp Carbon Factor Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	6,038,107
Pilling Rigs	6,014 hours	438	2,635,936	2,635,936
Diesel Engine - 550kW / 742.5hp Carbon Factor Value: 438.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		438	438	2,635,936
Drilling Rigs	3,007 hours	438	1,317,968	1,317,968
Diesel Engine - 550kW / 742.5hp Carbon Factor Value: 438.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		438	438	1,317,968
360 Degree Road Rail Excavators	9,828 hours	82	801,768	801,768

Name	Quantity	kgCO2e Single	Total	Project
Diesel Engine - 100kW / 135hp Carbon Factor Value: 81.58 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		82	82	801,768
Engineering Trains	3,276 hours	319	1,044,389	1,044,389
Diesel Engine - 400kW / 540hp Carbon Factor Value: 318.8 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		319	319	1,044,389
Track Tamping Machines	3,276 hours	319	1,044,389	1,044,389
Diesel Engine - 400kW / 540hp Carbon Factor Value: 318.8 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		319	319	1,044,389
Water Use		21,119	21,119	21,119
Water Consumption	20.075 m/litres	344	6,906	6,906
Water Supply Carbon Factor Value: 344 kgCO2e/million litres Lifecycle: Partial process Calculation: Water - Million Litres (Water_million_litres * CF) Property Calculation: 1 million litres Source: Defra: Water Supply. Scope 3. (2017) Region: UK Water: 1 Million Litres		344	344	6,906
Waste Water Treatment	20.075 m/litres	708	14,213	14,213
Water Treatment Carbon Factor Value: 708 kgCO2e/million litres Lifecycle: Partial process Calculation: Water - Million Litres (Water_million_litres * CF) Property Calculation: 1 million litres Source: Defra: Water Treatment. Scope 3. (2017) Region: UK Water: 1 Million Litres		708	708	14,213
Waste		2,350,809	2,350,809	2,350,809
Aggregates	49,200,000 kg	< 0.01	68,880	68,880
Landfill (Aggregates) Carbon Factor Value: 0.0014 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	< 0.01	< 0.01	68,880
Asphalt	2,190,000 kg	< 0.01	3,066	3,066

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Landfill (Asphalt) Carbon Factor Value: 0.0014 kgCO2e/kg Property Calculation: 1 kg	1 kg	< 0.01	< 0.01	3,066
Concrete, Cement, Rubble, Bricks, Tiles and Glass etc.	20,758,000 kg	< 0.01	29,061	29,061
Landfill (Bricks) Carbon Factor Value: 0.0014 kgCO2e/kg Property Calculation: 1 kg	1 kg	< 0.01	< 0.01	29,061
Geotextile	1,000 kg	0.01	9.3	9.3
Landfill (Plastic: Average Plastics) Carbon Factor Value: 0.0093 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.01	0.01	9.3
Plasterboard	56,000 kg	0.07	4,032	4,032
Landfill (Plasterboard) Carbon Factor Value: 0.072 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.07	0.07	4,032
Plastic	5,000 kg	0.01	47	47
Landfill (Plastic: Average Plastics) Carbon Factor Value: 0.0093 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.01	0.01	47
Sand	645,000 kg	0.02	10,514	10,514
Landfill (Aggregates) Carbon Factor Value: 0.0163 kgCO2e/kg Property Calculation: 1 kg	1 kg	0.02	0.02	10,514
Metal	1,099,000 kg	< 0.01	1,539	1,539
Landfill (Metal) Carbon Factor Value: 0.0014 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	< 0.01	< 0.01	1,539
Timber	297,000 kg	0.82	243,273	243,273
Landfill (Wood) Carbon Factor Value: 0.8191 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.82	0.82	243,273
Marine Dredging	56,200,000 kg	0.02	916,060	916,060
Landfill (Soil) Carbon Factor Value: 0.0163 kgCO2e/kg Property Calculation: 1 kg	1 kg	0.02	0.02	916,060

Name	Quantity	kgCO2e Single	Total	Project
Terrestrial Excavations	53,200,000 kg	0.02	867,160	867,160
Landfill (Soil) Carbon Factor Value: 0.0163 kgCO2e/kg Property Calculation: 1 kg	1 kg	0.02	0.02	867,160
General Waste	52,000 kg	0.59	30,623	30,623
Landfill (Municipal Waste) Carbon Factor Value: 0.5889 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.59	0.59	30,623
Hazardous Waste	1,000 kg	0.02	22	22
Incineration (Commercial and Industrial Waste) Carbon Factor Value: 0.0218 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.02	0.02	22
Welfare Waste	52,000 kg	0.59	30,623	30,623
Landfill (Municipal Waste) Carbon Factor Value: 0.5889 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.59	0.59	30,623
Packaging	140,000 kg	1.0	145,880	145,880
Landfill (Paper and Board: Mixed) Carbon Factor Value: 1.042 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	1.0	1.0	145,880
Hazardous Packaging	1,000 kg	0.02	22	22
Incineration (Commercial and Industrial Waste) Carbon Factor Value: 0.0218 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	0.02	0.02	22
Operation (B6 - B8)		56,555,369	56,555,369	56,555,369
Energy Use (B6)		23,571,264	23,571,264	23,571,264
Electricity		167,782	167,782	167,782
RoRo Terminal Warehouse	1 years	34,398	34,398	34,398
Electricity Carbon Factor Value: 0.234 kgCO2e/kWh/ year Property Calculation: 147,000 kWh/ year Source: A New Source	147,000 kWh/ year	0.23	34,398	34,398
Site Security and Customs Building	1 years	211	211	211

Name	Quantity	kgCO2e Single	Total	Project
Electricity Carbon Factor Value: 0.234 kgCO2e/kWh/ year Property Calculation: 900 kWh/ year Source: A New Source	900 kWh/ year	0.23	211	211
Terminal Workshop/Admin/Welfare	1 years	28,314	28,314	28,314
Electricity Carbon Factor Value: 0.234 kgCO2e/kWh/ year Property Calculation: 121,000 kWh/ year Source: A New Source	121,000 kWh/ year	0.23	28,314	28,314
Lighting Columns	1 years	28	28	28
Electricity Carbon Factor Value: 0.234 kgCO2e/kWh/ year Property Calculation: 119 kWh/ year Source: A New Source	119 kWh/ year	0.23	28	28
CMAT Processing and Mixed Use	1 years	104,832	104,832	104,832
Electricity Carbon Factor Value: 0.234 kgCO2e/kWh/ year Property Calculation: 448,000 kWh/ year Source: A New Source	448,000 kWh/ year	0.23	104,832	104,832
Mobile Plant		23,403,481	23,403,481	23,403,481
Reach Stackers	1 years	3,124,123	3,124,123	3,124,123
Diesel Engine - 225kW / 303.75hp Carbon Factor Value: 179.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 17,424 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 17,424 hr		3,124,123	3,124,123	3,124,123
Forklift (16tn)	1 years	37,026	37,026	37,026
Diesel Engine - 125kW / 168.75hp Carbon Factor Value: 102 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 363 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 363 hr		37,026	37,026	37,026
Forklift (2.5tn)	1 years	13,583	13,583	13,583
Diesel Engine - 45kW / 60.75hp Carbon Factor Value: 37.42 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 363 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 363 hr		13,583	13,583	13,583
RoRo Tractor (Vessels)	1 years	5,206,872	5,206,872	5,206,872

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Diesel Engine - 225kW / 303.75hp Carbon Factor Value: 179.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 29,040 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 29,040 hr		5,206,872	5,206,872	5,206,872
RoRo Tractor (Landside)	1 years	4,100,412	4,100,412	4,100,412
Diesel Engine - 225kW / 303.75hp Carbon Factor Value: 179.3 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 22,869 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 22,869 hr		4,100,412	4,100,412	4,100,412
Front Loader	1 years	4,338,576	4,338,576	4,338,576
Diesel Engine - 250kW / 337.5hp Carbon Factor Value: 199.2 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 21,780 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 21,780 hr		4,338,576	4,338,576	4,338,576
Tipper Truck	1 years	1,735,430	1,735,430	1,735,430
Diesel Engine - 250kW / 337.5hp Carbon Factor Value: 199.2 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 8,712 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 8,712 hr		1,735,430	1,735,430	1,735,430
Forklift (4tn)	1 years	2,788,711	2,788,711	2,788,711
Diesel Engine - 70kW / 94.5hp Carbon Factor Value: 58.2 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 47,916 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 47,916 hr		2,788,711	2,788,711	2,788,711
Fork Lift Truck (18tn)	1 years	444,312	444,312	444,312
Diesel Engine - 125kW / 168.75hp Carbon Factor Value: 102 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 4,356 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 4,356 hr		444,312	444,312	444,312
Ancillary Vehicles (Ford Pick Up Truck - Ford Transit)	1 years	222,156	222,156	222,156
Diesel Engine - 125kW / 168.75hp Carbon Factor Value: 102 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 2,178 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 2,178 hr		222,156	222,156	222,156

Name	Quantity	kgCO2e Single	Total	Project
Ancillary Vehicles (Minibus - Ford Transit)	1 years	694,056	694,056	694,056
Diesel Engine - 150kW / 202.5hp Carbon Factor Value: 119.5 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 5,808 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 5,808 hr		694,056	694,056	694,056
Ancillary Vehicles (Ford Ranger)	1 years	520,542	520,542	520,542
Diesel Engine - 150kW / 202.5hp Carbon Factor Value: 119.5 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 4,356 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 4,356 hr		520,542	520,542	520,542
Ancillary Vehicles (Flat Bed Van - Ford Transit)	1 years	177,681	177,681	177,681
Diesel Engine - 100kW / 135hp Carbon Factor Value: 81.58 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 2,178 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 2,178 hr		177,681	177,681	177,681
Water Use (B7)		5,705	5,705	5,705
Water Consumption	1 years	1,866	1,866	1,866
Water Supply Carbon Factor Value: 344 kgCO2e/million litres Lifecycle: Partial process Calculation: Water - Million Litres (Water_million_litres * CF) Property Calculation: 5.42322 million litres Source: Defra: Water Supply. Scope 3. (2017) Region: UK Water: 5.42322 Million Litres		1,866	1,866	1,866
Waste Water Treatment	1 years	3,840	3,840	3,840
Water Treatment Carbon Factor Value: 708 kgCO2e/million litres Lifecycle: Partial process Calculation: Water - Million Litres (Water_million_litres * CF) Property Calculation: 5.42322 million litres Source: Defra: Water Treatment. Scope 3. (2017) Region: UK Water: 5.42322 Million Litres		3,840	3,840	3,840
Waste (B8)		32,978,400	32,978,400	32,978,400
Municipal Waste	1 years	32,978,400	32,978,400	32,978,400
Total Waste	56,000 kg	589	32,978,400	32,978,400
Landfill (Municipal Waste) Carbon Factor Value: 588.9 kgCO2e/kg Property Calculation: 1 kg Source: A New Source	1 kg	589	589	32,978,400

Name	Quantity	kgCO2e Single	kgCO2e Total	kgCO2e Project
Associated Operation (B9)		413,992,968	413,992,968	413,992,968
Shipping Freight		28,703,662	28,703,662	28,703,662
RoRo Terminal		19,686,223	19,686,223	19,686,223
RoRo Vessels (Incoming)	1 years	18,118,310	18,118,310	18,118,310
Movements	726 number/ year	24,956	18,118,310	18,118,310
Sea Freight: General Cargo. 5,000-9,999 dwt. Carbon Factor Value: 0.01892 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 1,319,046 tkm Source: Defra: Cargo Ship. All Scope. (2017) Region: UK Distance: 191 km Weight: 6,906 tonne		24,956	24,956	18,118,310
RoRo Vessels (Outgoing)	1 years	2,624	2,624	2,624
Movements	726 number/ year	3.6	2,624	2,624
Sea Freight: General Cargo. 5,000-9,999 dwt. Carbon Factor Value: 0.01892 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 191 tkm Source: Defra: Cargo Ship. All Scope. (2017) Region: UK Distance: 191 km Weight: 1 tonne		3.6	3.6	2,624
Tugs (RoRo Towing)	1 years	1,565,289	1,565,289	1,565,289
Hours	4,365 hours/ year	359	1,565,289	1,565,289
Diesel Engine - 450kW / 607.5hp Carbon Factor Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	1,565,289
CMAT Terminal		9,017,439	9,017,439	9,017,439
Bulk Carriers (Incoming)	1 years	8,678,466	8,678,466	8,678,466
Movements	20 number/ year	433,923	8,678,466	8,678,466
Sea Freight: Bulk Carrier. 100,000-199,999 dwt. Carbon Factor Value: 0.00359 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 120,870,000 tkm Source: Defra: Cargo Ship. All Scope. (2017) Region: UK Distance: 1,343 km Weight: 90,000 tonne		433,923	433,923	8,678,466
Bulk Carriers (Outgoing)	1 years	96	96	96

Name	Quantity	Single (kgCO2e)	Total (kgCO2e)	Project (kgCO2e)
Movements	20 number/ year	4.8	96	96
Sea Freight: Bulk Carrier. 100,000-199,999 dwt. Carbon Factor Value: 0.00359 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 1,343 tkm Source: Defra: Cargo Ship. All Scope. (2017) Region: UK Distance: 1,343 km Weight: 1 tonne		4.8	4.8	96
Tugs (Bulk Carrier Towing)	1 years	39,805	39,805	39,805
Hours	111 hours/ year	359	39,805	39,805
Diesel Engine - 450kW / 607.5hp Carbon Factor Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	39,805
Tugs (Barge Towing)	1 years	299,072	299,072	299,072
Hours	834 hours/ year	359	299,072	299,072
Diesel Engine - 450kW / 607.5hp Carbon Factor Value: 358.6 kgCO2e/hr Lifecycle: Partial process Calculation: Hours of Combustion Engine Operation (Hours_of_Operation_hr * CF) Property Calculation: 1 hr Source: CORINAIR - Diesel Engine (T8-5) (2006) Region: Europe Hours of Operation: 1 hr		359	359	299,072
Road Freight		297,411,423	297,411,423	297,411,423
Heavy Goods Vehicles	1 years	297,411,423	297,411,423	297,411,423
Movements	713,210 number/ year	417	297,411,423	297,411,423
Road Freight: Articulated HGV. 3.5 - 33t. Average Load Carbon Factor Value: 1.04251 kgCO2e/vkm Lifecycle: Cradle to Gate Calculation: Vehicle Use - Vehicle Kilometre (Distance_km * CF) Property Calculation: 400 vkm Source: Defra: HGV. All Scope. (2017) Region: UK Distance: 400 km		417	417	297,411,423
Rail Freight		84,666,585	84,666,585	84,666,585
Steel (Incoming)	1 years	6,052	6,052	6,052
Trains	363 number/ year	17	6,052	6,052

Name	Quantity	kgCO2e Single	Total	Project
Rail - Freight Carbon Factor: Rail Freight Value: 0.04168 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 400 tkm Source: Defra: Rail Freight. All Scope. (2017) Region: UK Distance: 400 km Weight: 1 tonne		17	17	6,052
Steel Outgoing	1 years	17,913,731	17,913,731	17,913,731
Trains	363 number/ year	49,349	17,913,731	17,913,731
Rail - Freight Carbon Factor: Rail Freight Value: 0.04168 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 1,184,000 tkm Source: Defra: Rail Freight. All Scope. (2017) Region: UK Distance: 400 km Weight: 2,960 tonne		49,349	49,349	17,913,731
Containers (Incoming)	1 years	6,052	6,052	6,052
Trains	363 number/ year	17	6,052	6,052
Rail - Freight Carbon Factor: Rail Freight Value: 0.04168 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 400 tkm Source: Defra: Rail Freight. All Scope. (2017) Region: UK Distance: 400 km Weight: 1 tonne		17	17	6,052
Containers (Outgoing)	1 years	12,709,066	12,709,066	12,709,066
Trains	363 number/ year	35,011	12,709,066	12,709,066
Rail - Freight Carbon Factor: Rail Freight Value: 0.04168 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 840,000 tkm Source: Defra: Rail Freight. All Scope. (2017) Region: UK Distance: 400 km Weight: 2,100 tonne		35,011	35,011	12,709,066
Bulk Aggregates (Incoming)	1 years	18,156	18,156	18,156
Trains	1,089 number/ year	17	18,156	18,156
Rail - Freight Carbon Factor: Rail Freight Value: 0.04168 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 400 tkm Source: Defra: Rail Freight. All Scope. (2017) Region: UK Distance: 400 km Weight: 1 tonne		17	17	18,156
Bulk Aggregates (Outgoing)	1 years	54,013,529	54,013,529	54,013,529
Trains	1,089 number/ year	49,599	54,013,529	54,013,529

Name	Quantity	kgCO2e Single	Total	Project
Rail - Freight Carbon Factor: Rail Freight Value: 0.04168 kgCO2e/tkm Lifecycle: Cradle to Gate Calculation: Freight - Tonne Kilometre (Weight_tonne * Distance_km * CF) Property Calculation: 1,190,000 tkm Source: Defra: Rail Freight. All Scope. (2017) Region: UK Distance: 400 km Weight: 2,975 tonne		49,599	49,599	54,013,529
Staff Communting		3,211,298	3,211,298	3,211,298
Other Vehicles	1 years	3,211,298	3,211,298	3,211,298
2 Way Movements/ Year	271,925 no.	12	3,211,298	3,211,298
Car - Average - Petrol Carbon Factor Value: 0.23619 kgCO2e/km/ day Property Calculation: 50 km/ day Source: Defra: Cars. All Scope. (2017)	50 km/ day	0.24	12	3,211,298

knowledgebase_support@atkinsglobal.com

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