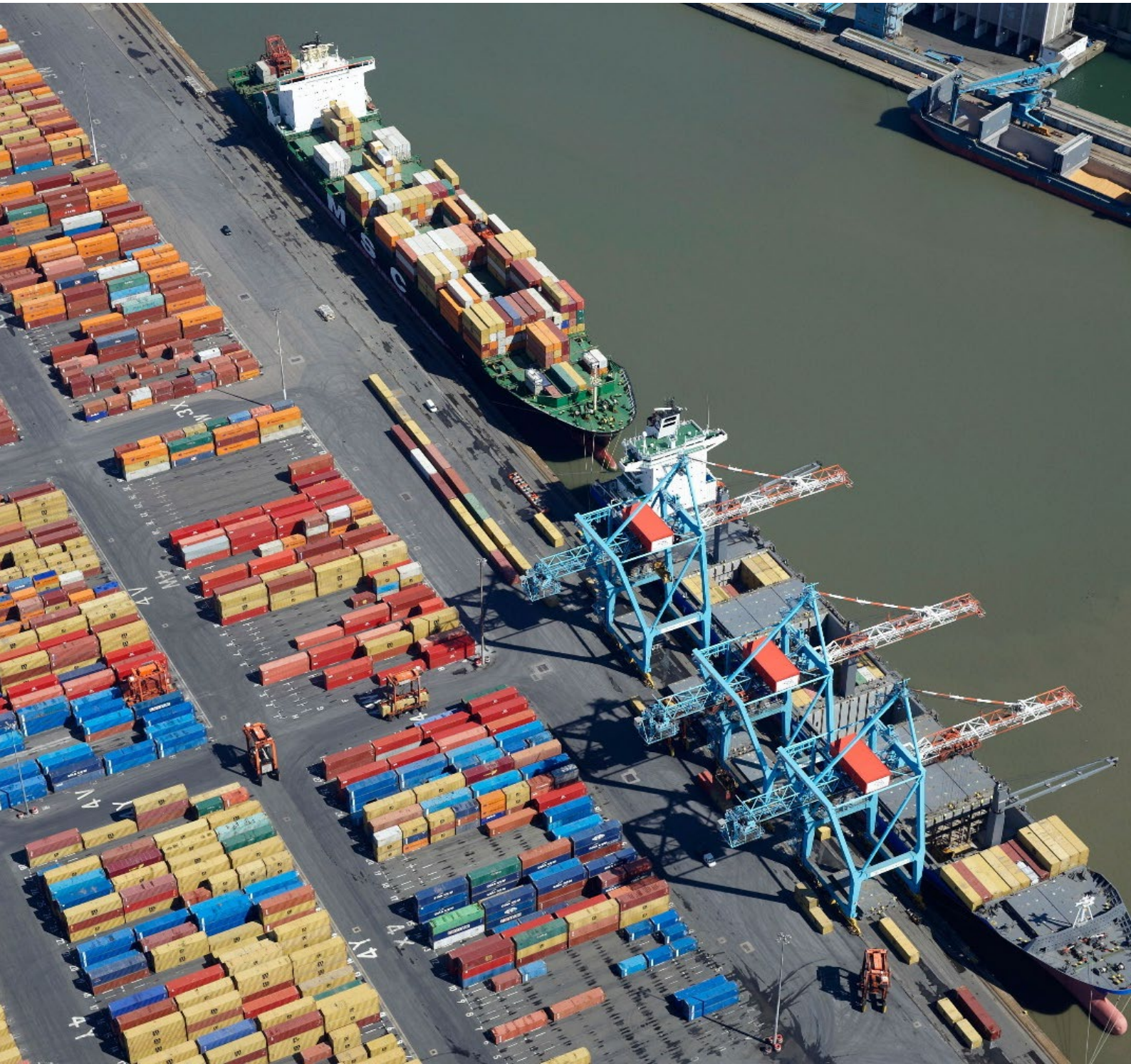
Department for Transport

UK Port Freight Traffic
2024 Forecasts

Moving Britain Ahead



The Department for Transport has actively considered the needs of blind and partially sighted people in accessing this document. The text will be made available in full on the Department's website. The text may be freely downloaded and translated by individuals or organisations for conversion into other accessible formats. If you have other needs in this regard, please contact the Department.

Department for Transport
Great Minster House
33 Horseferry Road
London SW1P 4DR
Telephone 0300 330 3000
Website www.gov.uk/dft
General enquiries: https://forms.dft.gov.uk

Contents

Executive Summary

Introduction

1 This document sets out the Department for Transport (DfT) 2024 forecasts for freight traffic at UK ports, covering the years 2024 to 2050. The primary purpose of these port traffic forecasts is to inform long-term strategic thinking for the future direction of the UK ports sector. They supersede the previous set of forecasts that were produced by DfT in January 2019[1].

2 It is important to recognise that projections about the future of a particular sector are inherently uncertain. The performance of the UK ports sector is dependent on the performance of other sectors of the economy, which introduces a high level of uncertainty. To recognise this uncertainty, the forecasts use scenarios of different economic, population, and energy outlooks. It should also be noted that these are long-term forecasts which aim to predict the overall trend of port traffic and not the exact movements in individual years.

3 The forecasts presented in this document update and build on in-house forecasting models built by DfT. The previous forecasts, published in 2019, used historical data up to and including 2016. The current version uses data up to and including 2023. The general forecasting approach taken for each cargo category is in line with the previous version. In some cases, though, the drivers or/and the estimation period or/and the model specification differ.

4 DfT will review and consider updating the forecasting models further over time. We are keen to invite views on the forecasts themselves, the methodology and on how people will use these forecasts, to inform how we will produce future forecasts.

Principles of the model

5 The port traffic forecast model looks at 14 categories of cargo, matching the cargo categories used in port freight statistics published by DfT, which can be grouped into four broad types reflecting how they are transported: unitised freight, liquid bulk, dry bulk, and general cargo.

6 The general approach taken for each cargo category is as follows:

- Use existing drivers (i.e., from the previous version) and identify new potential drivers that could have a causal effect on the amount of freight traffic transported through UK ports. The selection of drivers has been informed by economic theory, existing literature, and research into available data and forecasts.

[1] UK port freight traffic:2019 forecasts, DfT

- Use historical data to estimate and test the empirical relationships between the drivers and port traffic and identify the key drivers with the greatest predictive power under different model specifications.
- Calculate short-term port freight traffic forecasts (i.e., 2024-2035) by applying the estimated model to the forecast values of the drivers.
- Depending on the economics of the relevant sector and the statistical features of the data, long-term forecasts (i.e., 2036-2050) are produced either using the same approach as for short-term forecasts or extrapolating the cumulative annual growth rate up to 2035 or assuming that traffic will remain constant after 2035.
- In the cases where a statistically significant driver cannot be identified, historical trend projections are used for the entire forecasting horizon (i.e. 2024-2050).

7 The forecasts are given at a national level and assume unconstrained growth. They do not take into account ports' existing or planned capacity or any potential future events that could limit capacity.

8 The forecasts are based on freight traffic data for major UK ports only and do not include freight passing through minor ports. Minor ports account for around 2% of all port freight tonnage[2].

9 The forecasting model does not consider any interaction or substitution with air traffic forecasts as the markets for air freight and sea freight are treated as separate.

10 The forecasts for unitised freight do not consider the contents of container/Lift on-Lift off and Roll on-Roll off units, only the number of twenty-foot equivalent units and Roll on-Roll off units (and their corresponding weight, in tonnes) that are transported via vessels.

11 The forecasts do not explicitly model cargo types for which there are no available data (e.g. offshore wind turbines and hydrogen). Furthermore, they do not explicitly account for recent announcements as for e.g. the Cumbria deep-mine and the Port Talbot and Scunthorpe Electric Arc Furnace.

Inputs and assumptions

12 The port forecasts are mainly based on forecasts of the key drivers produced by other organisations. These include forecasts for real gross domestic product (GDP) and population from the Office for Budget Responsibility (OBR) and Office for National Statistics (ONS) which are included in the DfT TAG Data Book[3], Department for Energy Security and Net Zero (DESNZ) Digest of UK Energy Statistics (DUKES) Energy and Emissions Projections of coal power plant capacity[4], and North Sea Transition Authority (NSTA) Production and Expenditure Projections of crude oil production and UK oil products demand[5].

13 External forecasts were not available for some of the key drivers. In these cases, the model either uses forecasts of alternative statistically significant drivers or produces forecasts of the drivers, e.g. using its historical trends. Where it has not been possible to identify statistically significant drivers for a cargo category, future traffic is assumed to follow the trend/patterns indicated by the historical data.

[2] UK Port Freight Statistics, Table PORT0101, DfT
[3] TAG data book, 17 October 2024, DfT
[4] Energy and emissions projections, October 2023, DESNZ
[5] Oil and gas production projections and DESNZ and CCC demand projections, March 2024, NSTA

14 The main forecasts are for a central scenario, based, in most cases, on central projections of the key drivers. As estimation over such long horizons is subject to considerable uncertainty, most forecasts also provide low and high scenarios. To that end, either projections of the key drivers under different scenarios have been used or alternative model specifications have been developed. In the former case, the alternative scenarios also give an indication of the impact that a change in the key drivers could have on the freight forecasts.

15 For most cargoes, low and high real GDP projections and/or population projections have been used to produce the low and high scenario forecasts. Overall, different cargo forecasts use different drivers and some do not use any drivers with alternative scenario forecasts. As a result, the scenarios are not directly comparable across cargo categories.

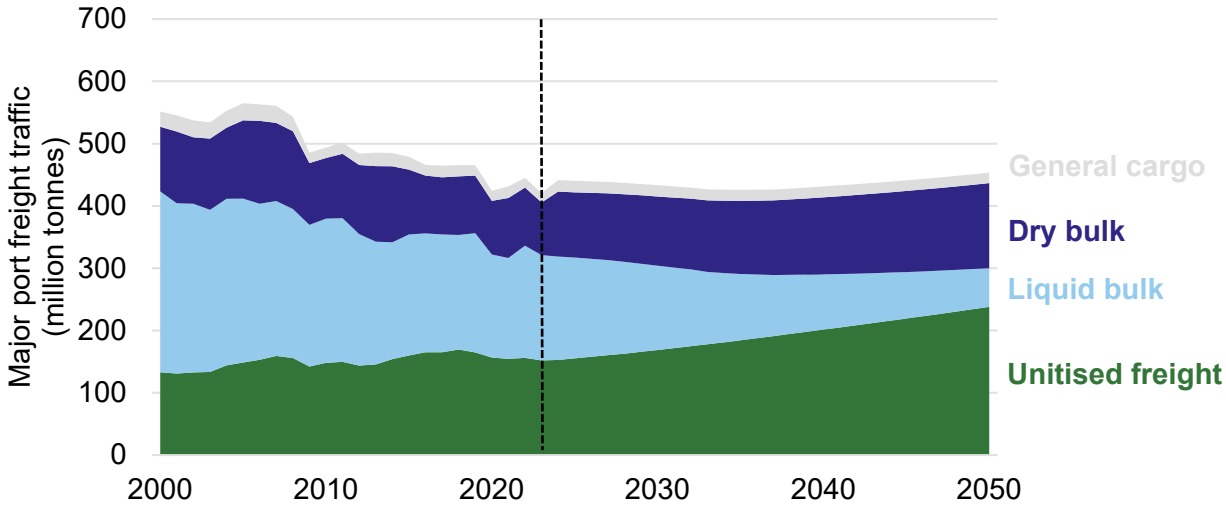
Forecasts

16 Compared to 2023, total[6] UK port traffic is forecast to grow by 1.2% in 2035 and by 7.8% in 2050, that is from 420.6 million (M) tonnes in 2023 to 425.8M in 2035 and to 453.5M in 2050.

17 The long-term growth, by 2050, is driven by significant increases in unitised and dry bulk freight (56.7% and 61.7%, respectively). The former is forecast to increase from 151.9M tonnes in 2023 to 237.9M tonnes in 2050 and the latter from 84.4M tonnes in 2023 to 136.5M tonnes in 2050.

18 General cargo freight is also forecast to increase but at the lower rate of 12.1%, that is from 15.0M tonnes in 2023 to 16.9M tonnes in 2050. This relatively smaller growth can probably be attributed to an expected decline in forestry products cargo and the increased containerisation of goods, i.e. shipments previously carried as break-bulk being moved through containers instead.

Figure 1. Total port freight tonnage, 2000-2050.



19 On the other hand, liquid bulk traffic is forecast to realise a significant decrease, by 63.3%, from 169.3M tonnes in 2023 to 62.1M tonnes in 2050. This is mainly due to the acceleration of the net zero transition which will mostly affect crude oil and oil products. This decrease, especially for other liquid bulk cargoes, can also be attributed to the

[6] Motor vehicles are not included in these figures as their forecasts are only expressed in unit terms.

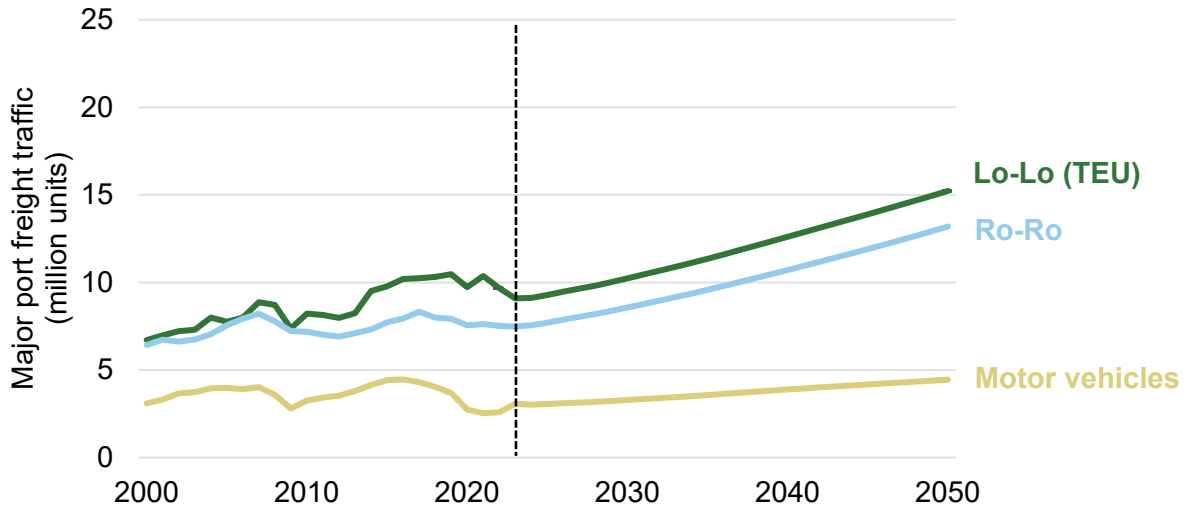
shift from liquid bulk to tank containers for some shipments. Liquefied gases are also forecast to decrease, although at a lesser degree, which can be due to the use of natural gas as a transition fuel towards net zero.

20 As a result, while liquid bulk accounted for the largest proportion of port freight traffic in 2023 (38.1%), it is forecast to drop to 13.7% in 2050. In contrast, unitised cargo is forecast to have the highest relative importance (52.5% in 2050 versus 34.1% in 2023) followed by dry bulk (30.1% in 2050 versus 19.0% in 2023). Finally, general cargo's relative importance is forecast to marginally increase from 3.4% in 2023 to 3.7% in 2050.

21 In the short term, that is by 2035, unitised, dry bulk, and general cargo freight are forecast to increase by 21.3% (184.2M tonnes in 2035), 38.9% (117.3M tonnes in 2035), and 17.6% (17.7M tonnes in 2035), respectively, while liquid bulk is forecast to decrease by 37.0% (106.6M tonnes in 2035).

22 The twenty-foot equivalent unit (TEU) forecast for Lo-Lo suggests that port freight will increase by 24.8% by 2035 and by 67.4% by 2050, that is from 9.1M units in 2023 to 11.3M units in 2035 to 15.2M units in 2050. The unit forecast for Ro-Ro suggests that port freight will increase by 27.9% by 2035 and by 76.3% by 2050, that is from 7.5M units in 2023 to 9.6M units in 2035 to 13.2M units in 2050. Motor vehicles freight is also expected to increase but at the smaller rates of 16.4% by 2035 and 45.0% by 2050, that is from 3.1M units in 2023 to 3.6M units in 2035 to 4.4M units in 2050. All these increases are driven by the forecast economic growth.

Figure 2. Unitised freight traffic, 2000-2050.



23 The individual cargo category forecasts are discussed in Chapter 4 and the figures can be found in the accompanying data tables.

Next phase

24 This document represents the conclusion of the second version of the forecasting model for UK port traffic. Future developments involve:

- Collecting user feedback on the structure and format of outputs and the model.
- Regularly updating the forecasts with the latest data.

25 If you have any feedback on the forecasts, please get in touch at MaritimeForecasts@dft.gov.uk.

1. Introduction

Summary

1.1 This document sets out the Department for Transport (DfT) 2024 forecasts for freight traffic at UK ports[7]. The forecasts cover the years 2024 to 2050[8]. As such, unless otherwise stated, the reference year throughout the document for all growth rates and comparisons is 2023.

1.2 The forecasts supersede the previous set of forecasts that were produced by DfT in January 2019 and were covering the period 2017-2050[9].

1.3 We will continue to refine and develop the forecasting model and are keen to invite views on how people will use these forecasts, to inform how we will produce future reports in this area.

Nature and purpose of forecasts

1.4 The primary purpose of these port traffic forecasts is to inform long-term strategic thinking for the future direction of the UK ports sector. The *National Policy Statement for Ports* (NPSP), currently under review, highlights the importance of the ports sector to the UK economy[10]. It also emphasises the need for new infrastructure in the ports sector to meet the demand forecasts last published in 2019. Page 14 of the NPS states *"The Government may from time to time commission new port freight demand forecasts to be published on its behalf. These new forecasts would then replace the 2006-07 MDS forecasts, and the commentary in [the NPS] may be subject to some change in the light of them."* This document presents the findings of these new port freight demand forecasts.

1.5 It is important to recognise that predictions about the future of a particular sector are inherently uncertain. Given the nature of the UK ports sector as a means of moving passengers and freight from land to sea, the sector is heavily reliant on the performance of other sectors of the economy, such as the steel industry and the construction and energy sectors. To explore this uncertainty, the forecasts use scenarios of different economic, population and/or energy outlooks.

1.6 It should also be noted that port traffic levels can be volatile and vary greatly from year to year. As such, instead of focussing on year-to-year movements, the forecasts aim to predict the overall, long-term trend of port freight traffic.

[7] The forecasts do not include passengers/cruises as port infrastructure required for freight is much more substantial compared to that for passengers/cruises. Furthermore, the drivers of passenger movements (except population and real gross domestic product [GDP]) can be significantly different from the ones for freight, e.g. uncertain behavioural shifts and substitutability with other transport modes.
[8] The 2050 horizon is in line with DfT's Maritime 2050: navigating the future and the 2023 IMO Strategy on reduction of GHG emissions from ships (as well as other DfT projects, e.g. the UK Maritime Emissions Model).
[9] The previous to the 2019 set of forecasts were produced by MDS Transmodal in May 2006. UK Port Demand Forecasts to 2030, MDS Transmodal.
[10] National Policy Statement for Ports, February 2012

1.7 The forecasts are given at a national level (i.e. there is no territorial or regional disaggregation of port freight) and assume unconstrained growth, that is they do not take into account ports' existing or planned capacity to handle freight or any potential future events that could limit capacity[11]. The DfT believes it is the responsibility of the ports sector to meet the changes in demand.

1.8 The forecasts are based on freight traffic data for major UK ports only (i.e. ports that handle over one million tonnes per year and/or are strategically important) and do not include freight passing through minor ports, as cargo category breakdowns are not available for the latter. Minor ports account for around 2% of all port freight tonnage[12].

1.9 The direction of these national forecasts may differ from individual port level forecasts. The latter may be produced for different purposes and may be informed by specific commercial and local information, such as capacity constraints, the shift of demand between ports, and other factors affecting specific shipping routes. They may also be more focussed on short-term changes than these long-term forecasts. As these national forecasts do not take into account local information, they cannot be disaggregated to port level without introducing a large amount of uncertainty.

1.10 The forecasting model does not consider any interaction or substitution with air traffic forecasts. The markets for air freight and sea freight are treated as separate because of the scale of the sea freight market (more than 80% of the volume of global international trade in goods is facilitated by sea[13] and around 95% for the UK[14]), the high costs of transporting freight by air, and the fact that, very largely, different types of cargo are transported by air and sea.

1.11 The forecasts for unitised freight do not consider the contents of container/Lift on-Lift off (Lo-Lo) and Roll on-Roll off (Ro-Ro) units, only the number of twenty-foot equivalent units (TEU)[15] and Ro-Ro units (and their corresponding weight, in tonnes) that are transported via this method. This is because the infrastructure required to transport that freight is primarily for standard, International Organization for Standardization (ISO), containers, irrespective of contents, apart from the secondary cases of refrigerated containers (‘reefers’) and hazardous goods[16].

1.12 The forecasts do not explicitly model cargo types for which there are no available data (e.g. offshore wind turbines and hydrogen). Furthermore, they do not explicitly account for recent announcements as for e.g. the Cumbria deep-mine and the Port Talbot and Scunthorpe Electric Arc Furnace.

1.13 Point forecasts are generally reported throughout this document and in the accompanying data tables. This is done for the sake of transparency of the modelling outputs. However, it must be stressed that the reporting of point forecasts does not reflect a greater level of certainty with the forecast estimates.

1.14 The forecasts presented in this document are based on a framework that has been used for the second time by DfT. It has been validated and verified by independent peer reviewers and the results have also been presented to a group of stakeholders in

[11] There might exist cases where, if the UK’s productivity of a commodity does not increase in line with the domestic demand for it (e.g. offshore wind), the residual demand could be met through international imports of this commodity or substitutes of it. In such cases, the constraints to UK ports’ capacity might be indirect, that is net imports substantially increasing the associated port expansion costs.
[12] UK Port Freight Statistics, Table PORT0101, DfT
[13] Review of Maritime Transport 2022, UNCTAD
[14] Transport Statistics Great Britain: 2022 International Travel and Freight, 15 December 2022, DfT
[15] TEU is a standardised measure to allow for the different sizes of containers. As the name suggests, it is based on the length of containers, so a 20ft long container is measured as 1 TEU and a 40ft long container is measured as 2 TEUs.
[16] For instance, it is possible that forestry products can be put in a containerised unit and transported on a container ship. In this case, the unit of measurement is the container, not the forestry products per se.

the ports sector. We expect to continue to develop and build on the forecasting tools in future years and publish new forecasts accordingly.

Document structure

1.15 The rest of this document is structured as follows:

- **Chapter 2** covers the principles of the port forecasting model.
- **Chapter 3** covers the inputs and assumptions that we use in the models.
- **Chapter 4** shows the forecasts themselves.
- **Chapter 5** discusses the next phase of this model.

1.16 The Annexes provide full technical details of the model. This report is supplemented by electronic versions of the data tables.

2. Principles of the DfT Port Freight Forecasting Model

Overview

2.1 This section describes the methodology for producing port freight traffic forecasts. It also covers general principles for how we have approached the forecasting work.

2.2 The port traffic forecast model looks at 14 categories of cargo, matching the cargo categories used in port freight statistics published by DfT[17]. These categories are listed in Table 1 and more details can be found in the published statistics.

Table 1. Cargo categories used in the model.

Cargo group	Cargo category	Metric
Unitised freight	Ro-Ro traffic	Tonnes and units
	Containers / Lo-Lo traffic	Tonnes and TEU
	Motor vehicles (as freight)	Units
Liquid Bulk	Crude oil	Tonnes
	Oil products	Tonnes
	Liquefied gases	Tonnes
	Other liquid bulk	Tonnes
Dry bulk	Agricultural products	Tonnes
	Coal	Tonnes
	Ores	Tonnes
	Other dry bulk	Tonnes
General cargo	Forestry products	Tonnes
	Iron and steel products	Tonnes
	Other general cargo	Tonnes

[17] Maritime and shipping statistics, 6 December 2023, DfT

Review of previous forecasts

2.3 Previous port freight traffic forecasts were produced and published by DfT in January 2019, covering the period 2017-2050[18].

2.4 This was the first bespoke forecasting model for UK port freight traffic, developed in-house by DfT[19].

2.5 Before producing these latest forecasts, we assessed how the 2019 projections performed against actual port traffic to identify positive features but also weaknesses and challenges in the previous methodology so that we could avoid them in the new model.

2.6 The results of this assessment are reflected in the forecasting approach and principles described below.

Forecasting approach

2.7 The general approach taken for each cargo market is as follows:

- Use existing drivers[20] (i.e. from the previous version of the forecasts) and identify new potential drivers that could have a causal effect on the amount of freight traffic transported through UK ports. The selection of drivers has been informed by economic theory, existing literature, and research into available data and forecasts. In bulk markets, drivers principally focus on the UK's demand for bulk products and also the UK's own production of the products. Other types of traffic rely more on generic economic or demographic factors, such as real GDP and population.
- Use historical data to estimate and test the empirical relationships between the drivers and port traffic and identify the key drivers with the greatest predictive power under different model specifications. The forecasts in this model generally use an Ordinary Least Squares (OLS) regression, although we have also tested in various cases the Autoregressive Integrated Moving Average (ARIMA), Autoregressive Integrated Moving Average with Explanatory Variable (ARIMAX), and Exponential Smoothing (ETS) frameworks.
- Calculate port traffic forecasts by applying the estimated model to the forecast values of the drivers. For instance, if there is a statistically significant relationship between port traffic and real GDP, then port forecasts can be calculated using real GDP forecasts from the DfT Transport Analysis Guide (TAG) Data Book[21]. Depending on the economics of the relevant cargo category and the statistical features of the data, these forecasts and approach are used either for the entire horizon (i.e. 2024-2050), or just for the short term (i.e. 2024-2035).
- In the latter case, long-term forecasts (i.e. 2036-2050) are produced through extrapolating the cumulative annual growth rate up to 2035 or assuming that traffic will remain constant after 2035.
- In the cases where a statistically significant driver cannot be identified, historical trend projections are used for the entire forecasting horizon (i.e. 2024-2050).

[18] UK port freight traffic:2019 forecasts, DfT
[19] The previous (to the 2019) version of port freight traffic forecasts was produced for DfT by MDS Transmodal in May 2006 covering the period 2005-2030. UK Port Demand Forecasts to 2030, MDS Transmodal.
[20] The terms driver, independent variable and explanatory variable are used interchangeably throughout the document.
[21] TAG data book, 17 October 2024, DfT

2.8 The details for each model are given in Annex A.

Forecasting principles

2.9 The following section covers come general principles and rules that we have adopted in building the new version of the forecasting model.

2.10 Forecasts are based on unconstrained growth, i.e. they do not take into account ports' existing or planned capacity to handle freight or any potential future events that could limit capacity.

2.11 There is no regional disaggregation of port traffic forecasts. We have not done this as feedback from stakeholders indicated that it is not needed but also because it risks adding further inherent uncertainty into the forecasting process.

2.12 Forecasts use historical freight traffic data for major UK ports only[22] and do not include freight passing through minor ports, as cargo category breakdowns are not available for the latter. Minor ports account for around 2% of all port freight tonnage.

2.13 The approach to forecasting port traffic is parsimonious, that is we begin with a basic forecasting model and only add complexity if it will improve the model performance. It is on this basis that the list of key drivers may appear to be small and also why an OLS estimation approach has been mainly used.

2.14 This report presents forecasts in 5-year gaps, but the forecasting tools produce annual forecasts up to year 2050. Annual forecasts can be found in the supplementary data files.

2.15 The forecasts build on forecasts produced by other Government bodies. For instance, on real GDP and population forecasts included in the DfT TAG Data Book.

2.16 The port freight traffic forecasting model does not consider any interaction or substitution with air traffic forecasts. We consider the market for air freight and sea freight to be separate and independent because of the scale of the sea freight market, the high costs of transporting freight by air, and the fact that different types of cargo are transported by air and sea.

2.17 The forecasts do not explicitly model cargo types for which there are no available data (e.g. offshore wind turbines and hydrogen). Furthermore, they do not explicitly account for recent announcements as for e.g. the Cumbria deep-mine and the Port Talbot and Scunthorpe Electric Arc Furnace.

2.18 Lastly, the forecasts for unitised freight do not consider the contents of container/Lo-Lo and Ro-Ro units, only the number of units (and their corresponding weight, in tonnes) that are transported by that method. This is because the infrastructure required to transport the freight is for standard containers and not dry bulk. For instance, it is possible that forestry products can be put in a containerised unit and transported via ports on a containership. In this case, the unit of measurement is the container (i.e. TEU), not the weight of the forestry products inside them.

Engagement with others

2.19 Throughout the process of developing a methodology for new port freight traffic forecasts, in addition to presenting emerging findings, we have engaged with industry,

[22] Major ports are the ones that handle over one million tonnes per year and/or are strategically important. A full list can be found in the published port freight statistics (see next footnote).

academia, and other stakeholders to check that the forecasts in this report are reasonable. This engagement has been useful in ensuring that the forecasts are credible and realistic without pre-judging the solution.

2.20 Separately, within Government, we have worked with colleagues in the Department for Transport (DfT), Department for Business and Trade (DBT), the Department for Environment, Food & Rural Affairs (DEFRA), and the Department for Energy Security and Net Zero (DESNZ) to understand how our forecasts will fit alongside their own forecasting capabilities. Some bodies rely on the DfT 2019 estimates in their forecasting, so we now encourage the use of the forecasts in this document in the future.

3. Inputs and Assumptions

Overview

3.1 This chapter outlines the inputs and assumptions for the port freight traffic forecasting model. The assumptions that feed into this model are designed to reduce the complexity that is inherent in forecasting port traffic.

Forecasts from other organisations

3.2 An important principle of the port freight traffic forecasting model is that it is mainly built on forecasts produced by other organisations. This means that the port traffic forecasts must also account for the uncertainty of other forecasts as well as the uncertainty generated within the model.

3.3 The following forecasts from other organisations are used in the model:

UK Real Gross Domestic Product

3.4 Economic theory suggests that there is a strong positive relationship between real Gross Domestic Product (GDP) and international trade. Therefore, UK real GDP is a key feature of the port freight traffic forecasting model.

3.5 UK Real GDP is used in the Ro-Ro, Lo-Lo, motor vehicles, crude oil, and forestry products forecasts.

3.6 Both historical and forecast UK real GDP estimates come from the DfT TAG Data Book.

UK Population

3.7 Economic theory suggests that there is a strong positive relationship between population and imports and exports of goods. Namely, one would expect port traffic to increase as the UK population increases.

3.8 Population is used in Ro-Ro, Lo-Lo, motor vehicles, crude oil, agricultural products, forestry products, and iron and steel products forecasts. It also feeds into the ores forecast via the iron and steel products forecast.

3.9 Both historical and forecast population estimates come from the DfT TAG Data Dook.

3.10 In the cases of unitised freight and crude oil, we scale real GDP by population as this appears to have higher explanatory power compared to real GDP on its own.

Cargo specific drivers

3.11 Other drivers are specific to certain cargoes:

- UK liquefied natural gas (LNG) imports forecasts from the Digest of UK Energy Statistics (DUKES) are used in the liquefied gases forecast.

- UK crude oil production forecasts from the North Sea Transition Authority (NSTA) Production and Expenditure Projections are used in the crude oil forecast.
- UK oil products demand forecasts from NSTA Production and Expenditure Projections are used in the oil products forecast.
- Coal power plant capacity forecasts from DESNZ Energy and Emissions Projections are used in the coal forecast.

Other assumptions

3.12 External forecasts were not available for some of the key drivers or others with strong explanatory power. In these cases, we have produced the forecasts for the driver through extrapolating the trend of the historical data. For instance, for the UK LNG imports which are used for the liquefied gases forecast.

3.13 For the other liquid bulk, other dry bulk, and other general cargo categories, it was not possible to identify a statistically significant driver. In these cases, we have assumed that traffic will follow the historical trend of the data.

Scenarios

3.14 The main forecasts are for a central scenario or, in other words, based on central case projections of the key drivers. Since freight forecasts over this horizon are always subject to considerable uncertainty, alternative scenarios have been produced for most cargo categories.

3.15 Namely, for the cargoes where alternative projections of the key drivers have been available, we have produced low and high scenarios in addition to the central one.

3.16 These scenarios also give an indication of the impact that a change in the value of the key drivers could have on the forecasts and highlights the uncertainty in the inputs used.

3.17 For most cargoes, we have used low and high growth real GDP and/or population projections or projections of other drivers which correspond to low and high real GPD and/or population projections.

3.18 For some of the cargoes where central or/and alternative projections of the key drivers have not been available, we have used different model specifications (for extrapolating the historical trends) to produce the alternative scenarios.

3.19 For unitised freight, that is Lo-Lo, Ro-Ro, and motor vehicles, the scenarios reflect alternative projections of real GDP and population.

3.20 For liquefied gases, the scenarios reflect either alternative projections of UK LNG imports or projections of liquefied gases through extrapolating the historical data.

3.21 For crude oil, the scenarios reflect alternative projections of real GDP and population.

3.22 For oil products, the low scenario is based on the forecasts for the Climate Change Committee (CCC) Balanced Net Zero Pathway Scenario for oil products demand (due to no availability of high projections of the driver, there is no high scenario in this case)[23].

[23] Oil and gas production projections and DESNZ and CCC demand projections, March 2024, NSTA

3.23 For other liquid bulk, the scenarios are based on extrapolating the historical trend using alternative model specifications.

3.24 For agricultural products, the scenarios reflect alternative projections of population.

3.25 For coal, there are no scenarios as DESNZ's Energy and Emissions Projections alternative scenarios no longer exist.

3.26 For ores, the scenarios reflect alternative projections of population.

3.27 For other dry bulk, the scenarios are based on extrapolating the historical trend using alternative model specifications .

3.28 For forestry products, the scenarios reflect alternative projections of real GDP and population.

3.29 For iron and steel products, the scenarios reflect alternative projections of population.

3.30 For other general cargo, the scenarios are based on extrapolating the historical trend using alternative model specifications .

Table 2. Projections of key drivers used in scenarios.

Driver	Central case	Low scenario	High scenario
UK real GDP	DfT TAG Data Book, Annual Parameters	DfT TAG Data Book, Annual Parameters – with growth decreased by 0.5pp	DfT TAG Data Book, Annual Parameters – with growth increased by 0.5pp
UK population	DfT TAG Data Book, Annual Parameters	DfT TAG Data Book, Annual Parameters – low growth	DfT TAG Data Book, Annual Parameters – high growth
UK oil products demand	NSTA Production and Expenditure Projections, DESNZ Reference Scenario	NSTA Production and Expenditure Projections, CCC Balanced Net Zero Pathway Scenario	There is no high scenario

3.31 It is important to note that not all cargo categories have two alternative scenarios forecasts (i.e. oil products do not have a high scenario and coal has neither a low nor a high one). The lack of scenarios for any cargo category does not indicate a higher level of certainty in that forecast, it is only a reflection of the model's structure and the input data available.

3.32 Also, as different cargo forecasts use different drivers or/and methodologies, the scenarios are not directly comparable across cargo categories. For example, the iron and steel forecast uses population as a driver, so this cargo type incorporates high and low population scenarios, whereas, for other liquid bulk, the scenarios are based on extrapolating the historical trend using alternative model specifications.

4. Forecasts

Introduction

4.1 This chapter provides the results of the port freight traffic forecasting model. First, for the entire ports sector; second, for the broader cargo categories; and third, for each specific cargo type.

4.2 Further details and full forecasts for each specific cargo type can be found in the supplementary tables accompanying this report.

Headline forecasts

Total port freight

4.3 Overall, total UK port traffic is forecast to grow by 1.2% in 2035 and by 7.8% in 2050, that is from 420.6M tonnes in 2023 to 425.8M in 2035 and to 453.5M in 2050.

4.4 The long-term growth, by 2050, is driven by significant increases in unitised and dry bulk freight, that is 56.7% and 61.7%, respectively. The former is forecast to increase from 151.9M tonnes in 2023 to 237.9M tonnes in 2050 and the latter from 84.4M tonnes in 2023 to 136.5M tonnes in 2050.

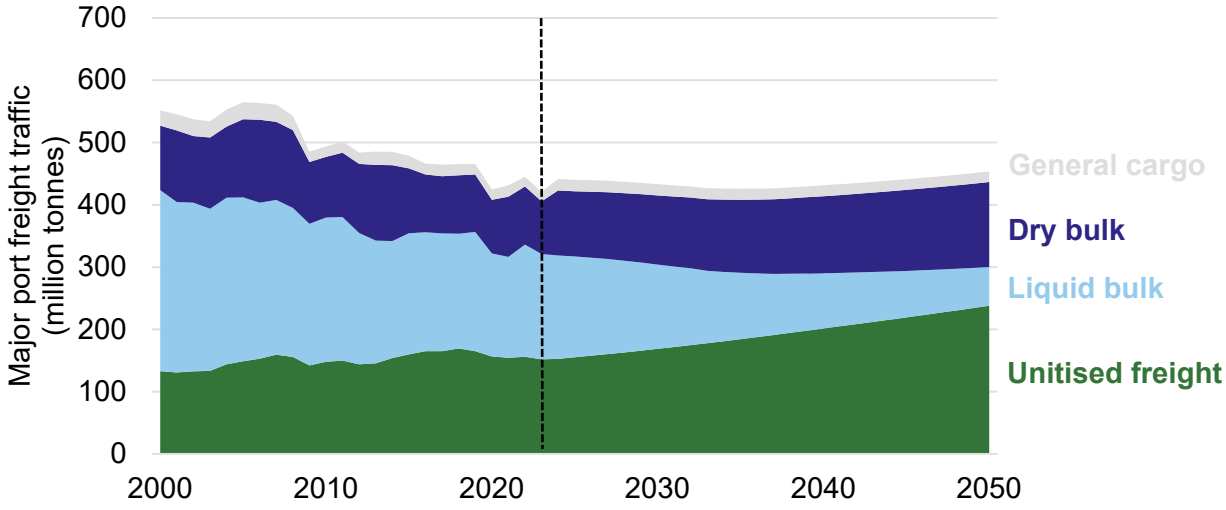
4.5 General cargo freight is also forecast to increase but at the lower rate of 12.1%, that is from 15.0M tonnes in 2023 to 16.9M tonnes in 2050. This relatively smaller growth can probably be attributed to an expected decline in forestry products cargo and the increased containerisation of goods, i.e. shipments previously carried as break-bulk being moved through containers instead.

4.6 On the other hand, liquid bulk traffic is forecast to realise a significant decrease, by 63.3%, from 169.3M tonnes in 2023 to 62.1M tonnes in 2050. This is mainly due to the acceleration of the net zero transition which will mostly affect crude oil and oil products. This decrease, especially for other liquid bulk cargoes, can also be attributed to the shift from liquid bulk to tank containers for some shipments. Liquefied gases are also forecast to decrease, although at a lesser degree, which can be due to the use of natural gas as a transition fuel towards net zero.

4.7 As a result, while liquid bulk accounted for the largest proportion of port freight traffic in 2023 (38.1%), it is forecast to drop to 13.7% in 2050. In contrast, unitised cargo is forecast to have the highest relative importance (52.5% in 2050 versus 34.1% in 2023) followed by dry bulk (30.1% in 2050 versus 19.0% in 2023). Finally, general cargo's relative importance is forecast to marginally increase from 3.4% in 2023 to 3.7% in 2050.

4.8 In the short term, that is by 2035, unitised, dry bulk, and general cargo freight are forecast to increase by 21.3% (184.2M tonnes in 2035), 38.9% (117.3M tonnes in 2035), and 17.6% (17.7M tonnes in 2035), respectively, while liquid bulk is forecast to decrease by 37.0% (106.6M tonnes in 2035).

Figure 3. Total port freight tonnage, 2000-2050.

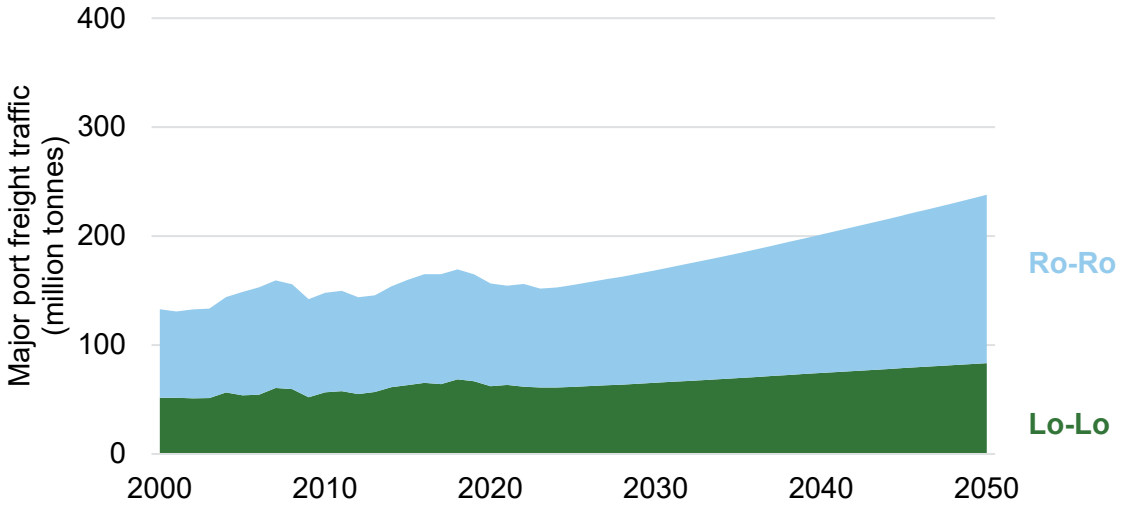


Unitised freight

4.9 Unitised freight traffic is forecast to strongly grow. In terms of tonnes[24], Lo-Lo freight is expected to increase by 14.3% by 2035 and by 36.7% by 2050, both compared to 2023 (i.e. from 61.0M tonnes in 2023 to 69.7M tonnes in 2035 to 83.4M tonnes in 2050). Ro-Ro tonnage is forecast to increase by 26.1% by 2035 and by 70.1% by 2050 (from 90.9M tonnes in 2023 to 114.5M tonnes in 2035 to 154.6M tonnes in 2050).

4.10 This will result in unitised cargoes becoming the largest cargo category in 2050 (even without accounting for motor vehicles in terms of tonnes) from second largest in 2023 (52.5% of total freight in 2050 versus 34.1% in 2023).

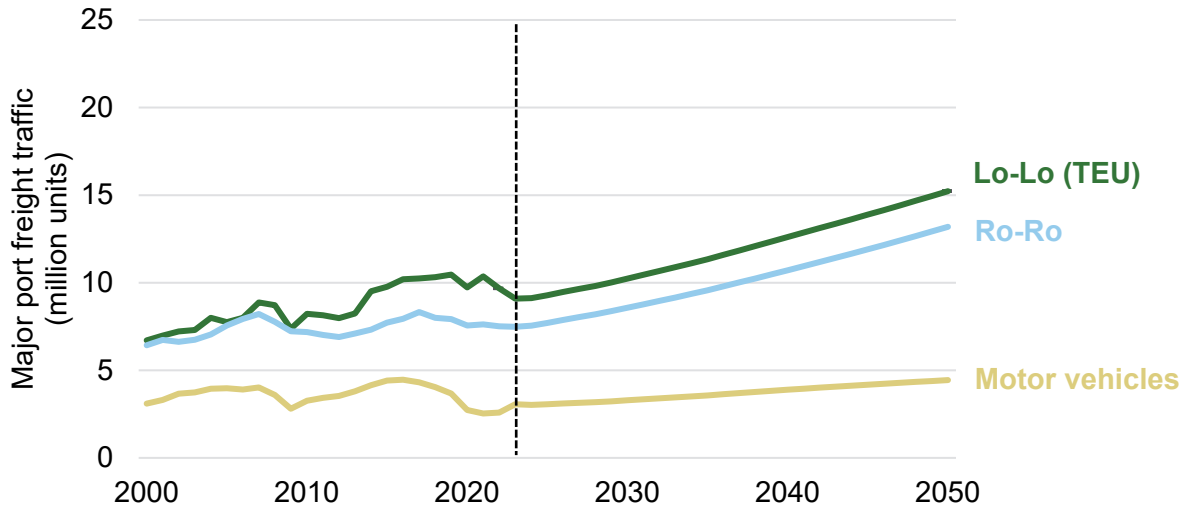
Figure 4. Lo-Lo and Ro-Ro freight traffic (tonnage), 2000-2050.



[24] It should be noted that unitised freight tonnage forecasts do not include motor vehicles, which are only modelled in terms of units. This is in line with the 2019 version of the forecasts.

4.11 The twenty-foot equivalent unit (TEU) forecast for Lo-Lo suggests that port freight will increase by 24.8% by 2035 and by 67.4% by 2050, that is from 9.1M units in 2023 to 11.3M units in 2035 to 15.2M units in 2050. The unit forecast for Ro-Ro suggests that port freight will increase by 27.9% by 2035 and by 76.3% by 2050, that is from 7.5M units in 2023 to 9.6M units in 2035 to 13.2M units in 2050. Motor vehicles freight is also expected to increase but at the smaller rates of 16.4% by 2035 and 45.0% by 2050, that is from 3.1M units in 2023 to 3.6M units in 2035 to 4.4M units in 2050. All these increases are driven by the forecast economic growth.

Figure 5. Unitised freight traffic, 2000-2050.

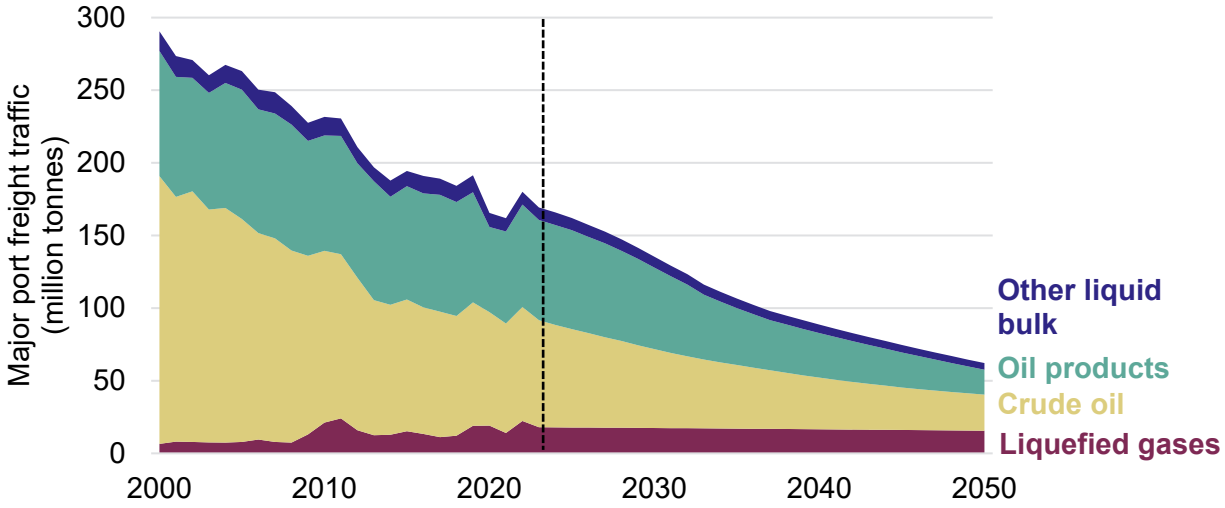


Liquid bulk

4.12 Liquid bulk freight traffic is forecast to decrease by 37.0% by 2035 and by 63.3% by 2050, that is from 169.3M tonnes in 2023 to 106.6M tonnes in 2035 to 62.1M tonnes in 2050. This is mainly due to the acceleration of the net zero transition which will heavily affect crude oil (-66.3% by 2050 compared to 2023) and oil products (-75.2% by 2050 compared to 2023). The decrease, especially for other liquid bulk cargoes (-46.5% compared to 2023), can also be attributed to the shift from liquid bulk to tank containers for some shipments. While liquefied gases are also forecast to decrease, this will be at a lesser degree (-13.1% compared to 2023), which can be due to the use of natural gas as a transition fuel towards net zero.

4.13 As a result, while liquid bulk accounted for the largest proportion of port freight traffic in 2023 (38.1%), it is forecast to drop to 13.7% in 2050, becoming the third biggest cargo category.

Figure 6. Liquid bulk freight traffic, 2000-2050.



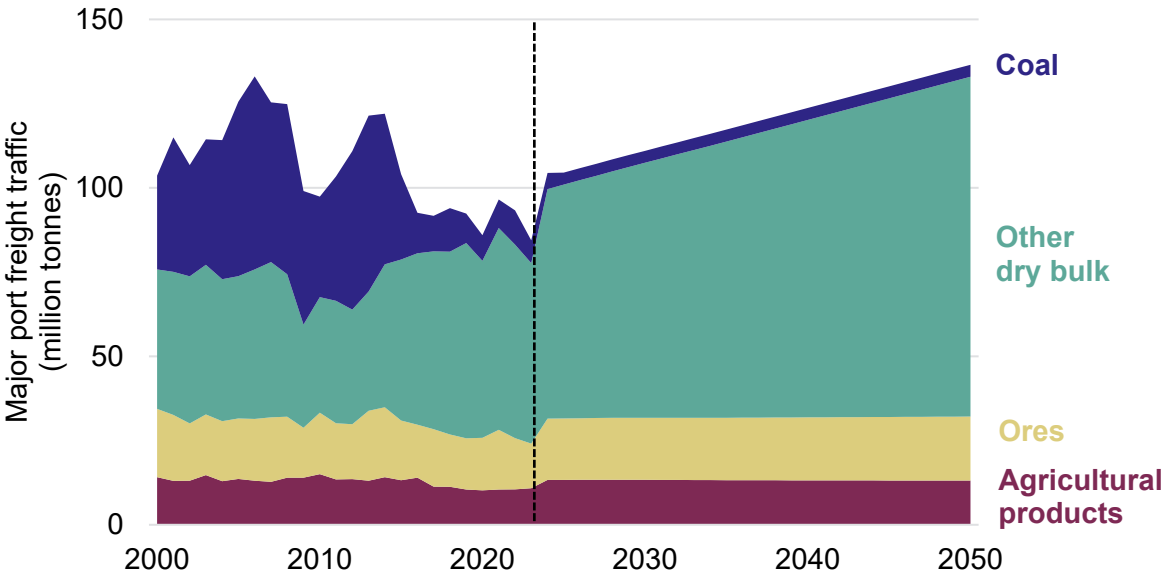
Dry bulk

4.14 Dry bulk freight traffic is forecast to increase by 38.9% by 2035 and by 61.7% by 2050, that is from 84.4M tonnes in 2023 to 117.3M tonnes in 2035 to 136.5M tonnes in 2050.

4.15 Consistent with the net zero transition, coal is expected to decrease by 47.2% by 2050 compared to 2023. However, the strong growth of other dry bulk cargoes (88.2%) drives an increase in the dry bulk category overall. Agricultural products are forecast to grow by 21.0% and ores by 43.4%. There is additional uncertainty around the outlook for ores at this time in light of the confirmation by Tata Steel (January 2024) that the blast furnaces at their Port Talbot works will close by the end of 2024.

4.16 As such, dry bulk cargoes are expected to become the second largest cargo category in 2050, from third largest in 2023 (30.1% of total freight in 2050 versus 19.0% in 2023).

Figure 7. Dry bulk freight traffic, 2000-2050.

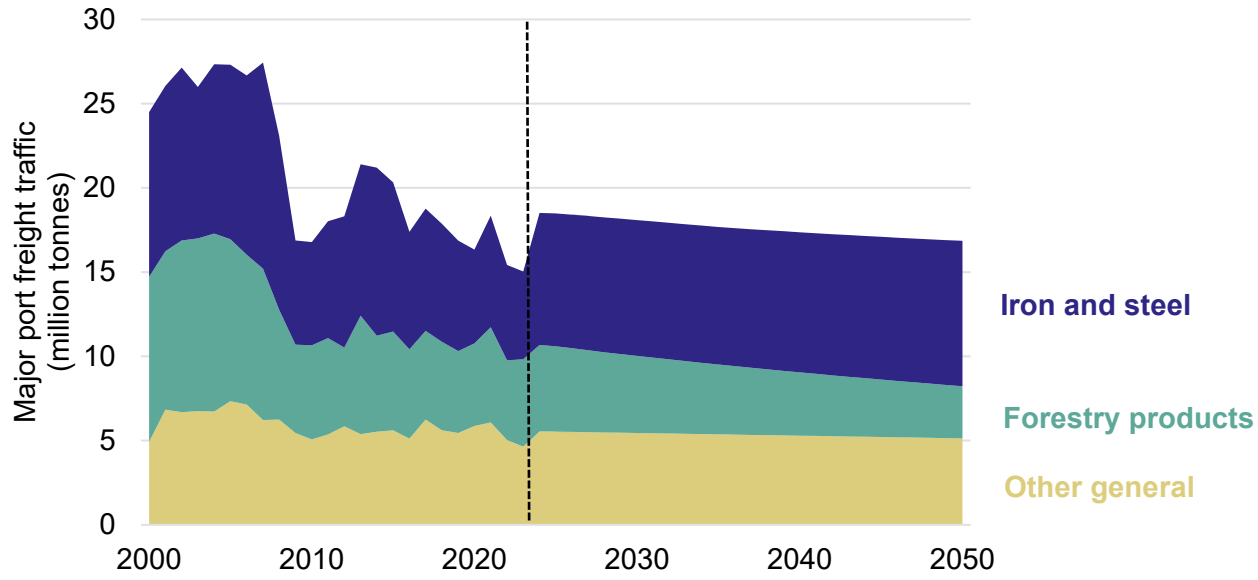


General cargo

4.17 General cargo freight traffic is forecast to increase by 17.6% by 2035 compared to 2023 but by 12.1% for the whole period 2023-2050. Namely, it will increase from 15.0M tonnes in 2023 to 17.7M tonnes in 2035 and then drop to 16.9M tonnes in 2050. While iron and steel and other general cargo freight traffic are forecast to increase (by 65.8% and 10.7%, respectively), the significant drop in forestry products (-40.4%) is expected to result in a rather moderate overall growth of general cargo.

4.18 This moderate growth compared to unitised cargoes can probably be attributed to the increased containerisation of goods – or, in other words, some of the general cargo goods counting as unitised traffic. As such, general cargo is expected to remain the smallest cargo category (3.7% of total freight in 2050 versus 3.4% in 2023).

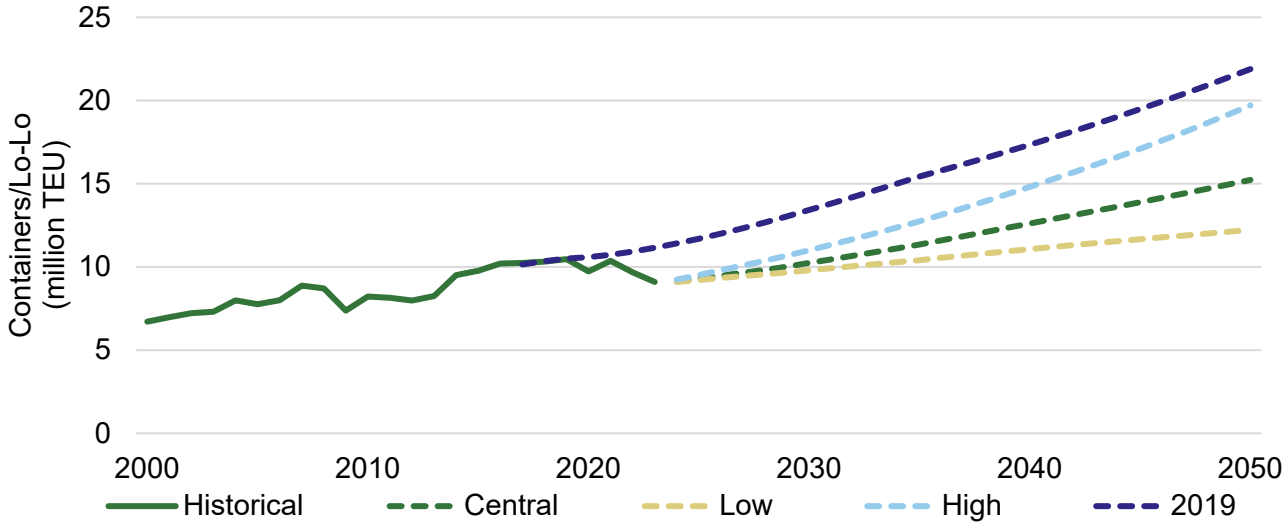
Figure 8. General cargo freight traffic, 2000-2050.



Detailed forecasts

4.19 Forecasts for each individual cargo category are given on the following pages.

Unitised freight: Containers/Lo-Lo



Notes:

A tonnage forecast has also been produced and the corresponding figures can be found in the accompanying tables.

Key drivers

Real GDP per capita

Commentary

The forecasts show significant growth of Lo-Lo traffic. In terms of tonnes, the forecasts suggest an increase from 61.0M tonnes in 2023 to 69.7M in 2035 to 83.4M tonnes in 2050, that is at a compound annual growth rate of 1.2% and a total growth rate of 36.7% over the period 2023-2050. In terms of units, the forecasts suggest an increase from 9.1M TEUs in 2023 to 11.3M TEUs in 2035 to 15.2M TEUs in 2050, that is at a compound annual growth rate of 1.9% and a total growth rate of 67.4% over the whole period. A reason for the discrepancy in the growth rates between the two units of measurement could be the decrease in the weight of the average container, e.g. due to empty containers (as was the case during COVID-19). In all three scenarios, the forecasts are below the central scenario of the previous forecasts.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million TEU	10.47	9.09	9.3	10.2	11.3	12.6	13.9	15.2
Growth from 2023	-	-	+2.1%	+12.6%	+24.8%	+38.7%	+52.7%	+67.4%
Growth from 2019	-	-13.1%	-11.3%	-2.2%	+8.4%	+20.4%	+32.7%	+45.4%
Million tonnes	66.77	60.98	61.62	65.39	69.67	74.37	78.87	83.36
Growth from 2023	-	-	+1.0%	+7.2%	+14.3%	+22.0%	+29.3%	+36.7%
Growth from 2019	-	-8.7%	-7.7%	-2.1%	+4.4%	+11.4%	+18.1%	+24.9%

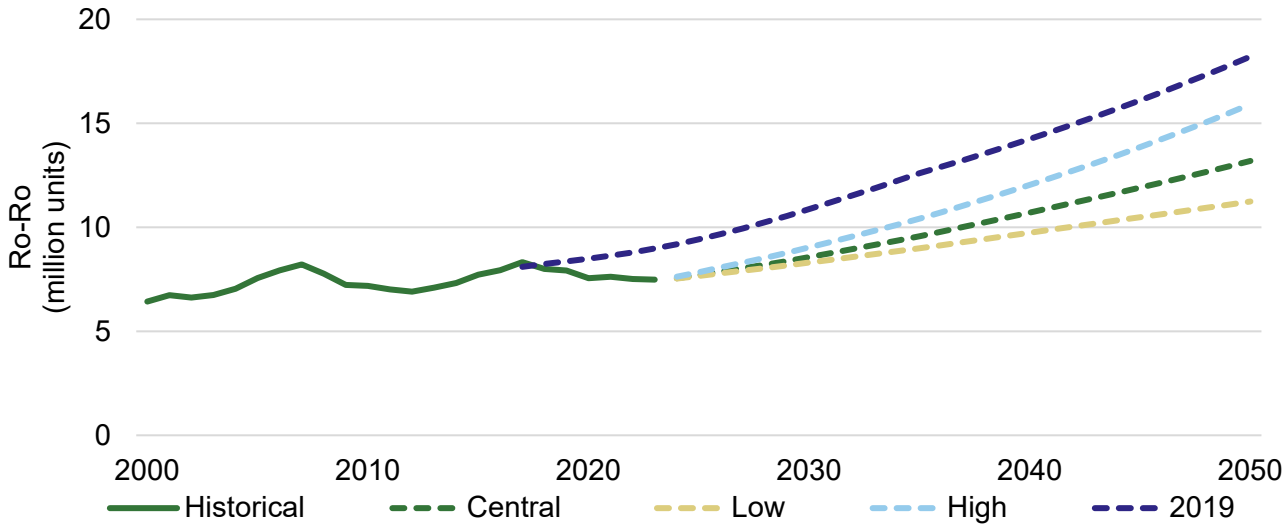
Scenarios

The low and high scenarios reflect alternative projections of real GDP growth and population growth, which result in alternative real GDP per capita projections.

1. In a low real GDP growth and high population growth scenario (i.e. low real GDP per capita growth), Lo-Lo traffic still grows but less significantly compared to the central scenario, at a compound annual growth rate of 0.6% for tonnage (71.0M tonnes in 2050) and 1.1% for TEU (12.2M TEUs in 2050), for the period 2023-2050.

2. In a high real GDP growth and low population growth scenario (i.e. high real GDP per capita growth), Lo-Lo traffic grows more strongly compared to the central scenario, at a compound annual growth rate of 1.9% for tonnage (100.6M tonnes in 2050) and 2.9% for TEU (19.7M TEUs in 2050), for the period 2023-2050.

Unitised freight: Ro-Ro



Notes:

A tonnage forecast has also been produced and the corresponding figures can be found in the accompanying tables.

Key drivers

Real GDP per capita

Commentary

The forecasts show significant growth of Ro-Ro traffic (similar to Lo-Lo traffic). In terms of tonnes, the forecasts suggest an increase from 90.9M tonnes in 2023 to 114.5M tonnes in 2035 to 154.6M tonnes in 2050, that is at a compound annual growth rate of 2.0% and a total growth rate of 70.1% over the period 2023-2050. In terms of units, the forecasts suggest an increase from 7.5M units in 2023 to 9.6M units in 2035 to 13.2M units in 2050, that is at a compound annual growth rate of 2.1% and a total growth rate of 76.3% over the whole period. In all three scenarios, the forecasts are below the central scenario of the previous forecasts.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million units	7.92	7.48	7.71	8.57	9.57	10.71	11.91	13.19
Growth from 2023	-	-	+3.0%	+14.5%	+27.9%	+43.1%	+59.1%	+76.3%
Growth from 2019	-	-5.6%	-2.7%	+8.2%	+20.8%	+35.2%	+50.3%	+66.5%
Million tonnes	98.12	90.87	93.56	103.36	114.55	127.13	140.37	154.57
Growth from 2023	-	-	+3.0%	+13.7%	+26.1%	+39.9%	+54.5%	+70.1%
Growth from 2019	-	-7.4%	-4.6%	+5.3%	+16.7%	+29.6%	+43.1%	+57.5%

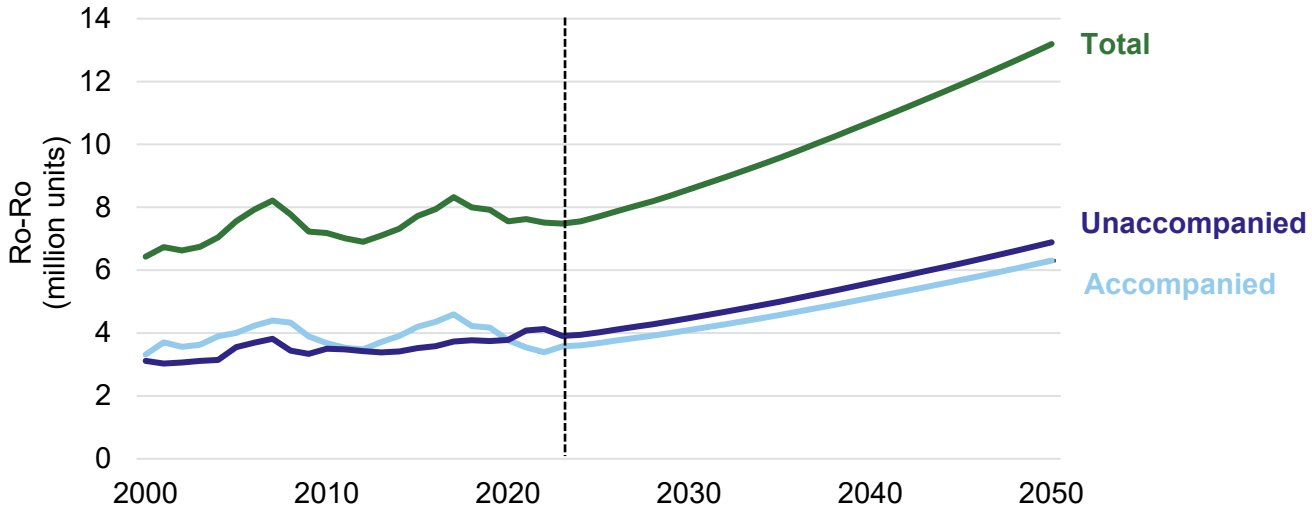
Scenarios

The low and high scenarios reflect alternative projections of real GDP growth and population growth, which result in alternative real GDP per capita projections.

1. In a low real GDP growth and high population growth scenario (i.e. low real GDP per capita growth), Ro-Ro traffic still grows but less significantly compared to the central scenario, at a compound annual growth rate of 1.5% for both tonnage (136.0M tonnes in 2050) and units (11.2M units in 2050), for the period 2023-2050.

2. In a high real GDP growth and low population growth scenario (i.e. high real GDP per capita growth), Ro-Ro traffic grows more strongly compared to the central scenario, at a compound annual growth rate of 2.6% for tonnage (179.6M tonnes in 2050) and 2.8% for units (15.9M units in 2050), for the period 2023-2050.

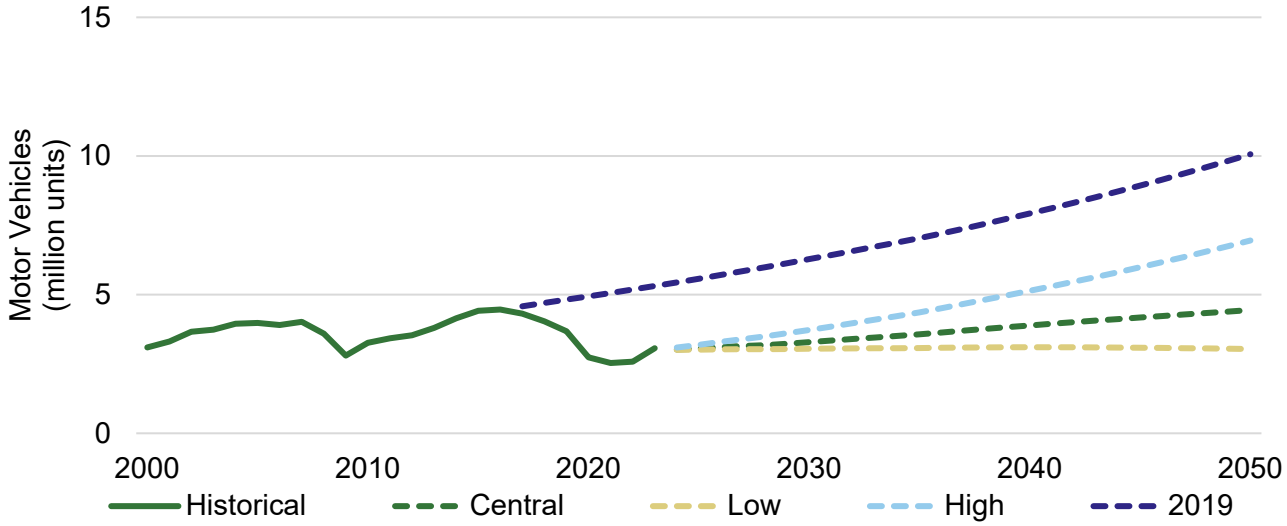
Accompanied and unaccompanied Ro-Ro freight



In line with discussions with external stakeholders, also disaggregated forecasts for Ro-Ro freight (in terms of units) have been produced. To distinguish between accompanied and unaccompanied Ro-Ro freight, the total Ro-Ro freight forecast for each year (analysed above) was multiplied by the percentage share of each type based on the 2023 share figures (i.e. 47.8% for accompanied and 52.2% for unaccompanied freight). As such, unaccompanied freight is forecast to be constantly above the accompanied one.

The figure above shows the forecasts for each type based on the central scenario for total Ro-Ro freight. In terms of accompanied cargo, the forecasts suggest an increase from 3.6M units in 2023 to 4.6M units in 2035 to 6.3M units in 2050. In terms of unaccompanied cargo, the forecasts suggest an increase from 3.9M units in 2023 to 5.0M units in 2035 to 6.9M units in 2050. In both cases, the compound annual growth rate and the total annual growth rate over the period 2023-2050 are as for the total Ro-Ro freight, i.e. 2.3% and 89.6%, respectively.

Unitised freight: Motor vehicles



Notes:

Motor vehicles freight traffic is only forecast in terms of units and not tonnes. This is in line with the previous version of the forecasts and discussions with stakeholders.

Key drivers

Real GDP per capita

Commentary

The forecasts show significant growth of motor vehicles traffic, with a compound annual growth rate of 1.4% and a total growth rate of 45.0% over the period 2023-2050. Namely, from 3.1M units in 2023 to 3.6M units in 2035 to 4.4M units in 2050. This growth seems to be in line with the DfT's National Road Traffic Projections 2022 where the increase in traffic from 2025 to 2060 is forecast to be within the range of 8%-54%, depending on the modelled scenario[25]. In all three scenarios, the forecasts are substantially below the central scenario of the previous forecasts. A potential explanation for that are behavioural changes in conjunction with the acceleration of the transition towards net zero.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million units	3.68	3.07	3.06	3.29	3.57	3.89	4.18	4.45
Growth from 2023	-	-	-0.3%	+7.2%	+16.4%	+26.8%	+36.2%	+45.0%
Growth from 2019	-	-16.6%	-16.8%	-10.6%	-3.0%	5.8%	13.5%	20.9%

Scenarios

The low and high scenarios reflect alternative projections of real GDP growth and population growth, which result in alternative real GDP per capita projections.

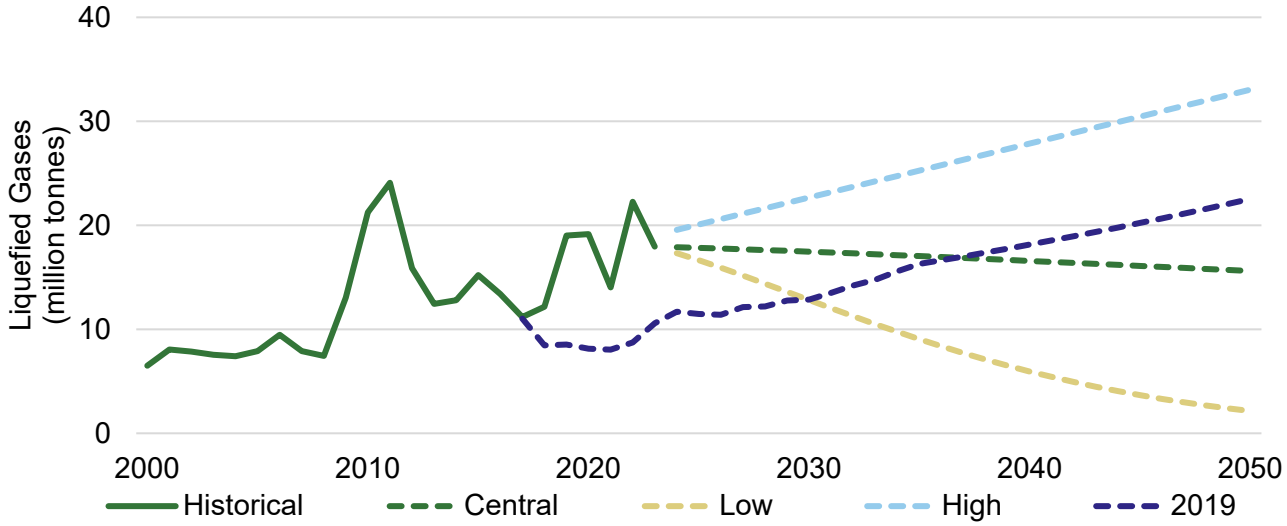
1. In a low real GDP growth and high population growth scenario (i.e. low real GDP per capita growth), motor vehicles traffic marginally decreases at a

[25] National Road Traffic Projections 2022, DfT

compound annual growth rate of -0.04% (3.0M units in 2050), for the period 2023-2050.

2. In a high real GDP growth and low population growth scenario (i.e. high real GDP per capita growth), motor vehicles traffic grows much more strongly compared to the central scenario, at a compound annual growth rate of 3.1% (7.0M units in 2050), for the period 2023-2050.

Liquid bulk: Liquefied gases



Key drivers

UK LNG imports

Commentary

Liquefied gases freight has exhibited high volatility in the last fifteen years with large swings. The forecasts suggest a moderate decrease, that is at a compound annual growth rate of -0.5% and a total growth rate of -13.1% over the period 2023-2050. Namely, from 17.9M tonnes in 2023 to 17.0M tonnes in 2035 to 15.6M tonnes in 2050. It was not possible to identify drivers with strong statistical power for which there were available external forecasts. As such, for UK LNG imports, i.e. the driver with the strongest explanatory power, forecasts are produced through extrapolating the (logarithmic) trend of the historical data. The forecasts in the central scenario are much higher than the ones produced in 2019 until 2036, after which point, they become significantly lower. The fact that liquified gases are forecast to exhibit a moderate decrease until 2050 is in line with their current and expected use as a transition fuel towards net zero (as opposed to crude oil and oil products that are forecast to significantly decrease until 2050).

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	19.01	17.95	17.83	17.47	17.04	16.58	16.09	15.61
Growth from 2023		-	-0.7%	-2.7%	-5.1%	-7.6%	-10.3%	-13.1%
Growth from 2019	-	-5.6%	-6.2%	-8.1%	-10.4%	-12.8%	-15.3%	-17.9%

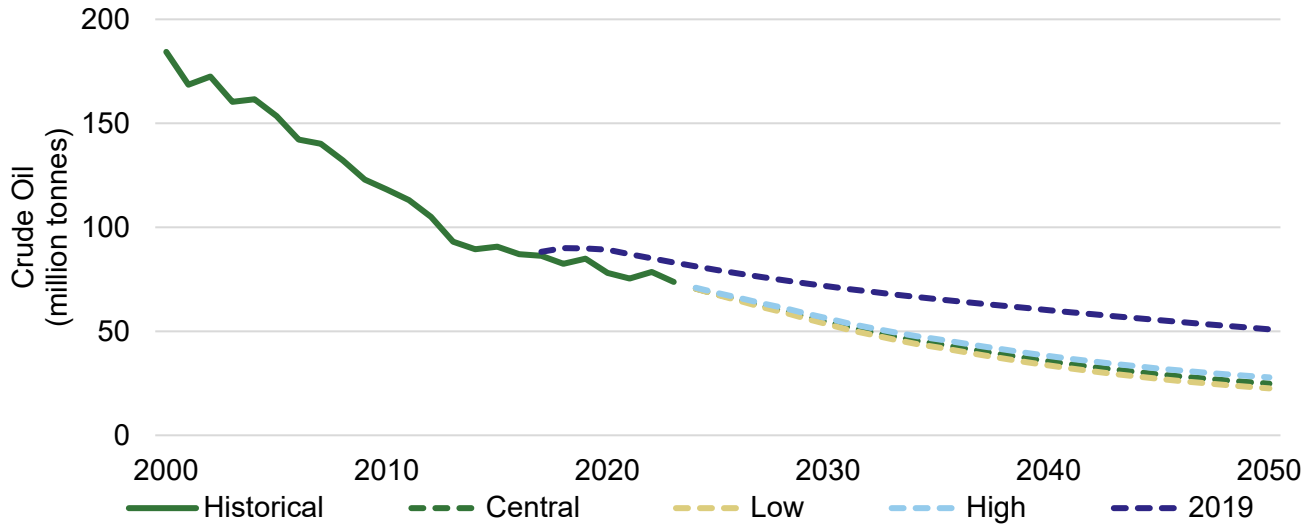
Scenarios

The low and high scenarios reflect either alternative projections of UK LNG imports or projections of liquefied gases through extrapolating the historical data.

1. The low scenario corresponds to the case where the growth rate of UK LNG imports is extrapolated through a logarithmic trend. In this scenario, there is a very strong decrease in liquefied gases freight, at a compound annual growth rate of -7.6% (2.1M tonnes in 2050), for the period 2023-2050.

2. The high scenario corresponds to the case where liquefied gases freight is extrapolated through a linear trend. In this scenario, there is a significant increase in liquefied gases freight, at a compound annual growth rate of 2.3% (33.0M tonnes in 2050), for the period 2023-2050.

Liquid bulk: Crude oil



Key drivers

UK crude oil production, real GDP per capita

Commentary

The forecasts suggest a strong annual decrease of crude oil traffic, at a compound annual growth rate of -3.9% and a total growth rate of -66.3% over the period 2023-2050. Namely, freight is forecast to decrease from 73.7M tonnes in 2023 to 43.8M tonnes in 2035 to 24.8M tonnes in 2050. Real GDP per capita seems to contribute twice as much crude oil production does to the variability of crude oil traffic. In all three scenarios, the forecasts are substantially below the central scenario of the previous forecasts. This projected strong decrease seems to be in line with the acceleration of the net zero transition and the phasing out of oil fuels.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	84.95	73.75	67.69	54.35	43.82	35.56	29.29	24.85
Growth from 2023		-	-8.2%	-26.3%	-40.6%	-51.8%	-60.3%	-66.3%
Growth from 2019	-	-13.2%	-20.3%	-36.0%	-48.4%	-58.1%	-65.5%	-70.8%

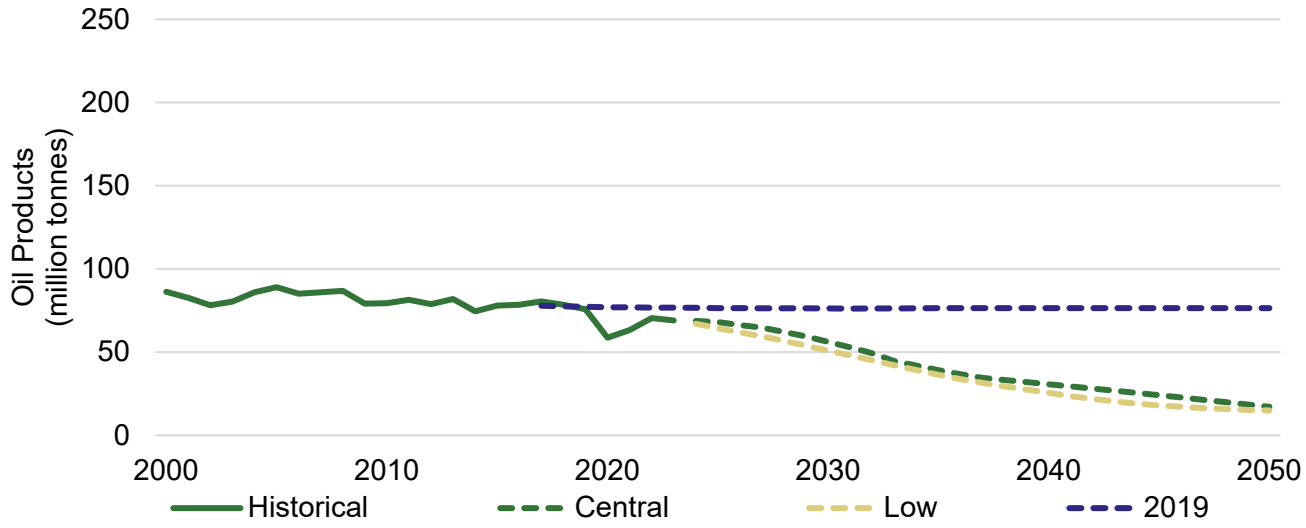
Scenarios

The scenarios reflect alternative projections of real GDP growth and population growth, which result in low and high real GDP per capita projections.

1. In a low real GDP growth and high population growth scenario (i.e. low real GDP per capita growth), crude oil traffic decreases even more significantly compared to the central scenario, at a compound annual growth rate of -4.3% (22.6M tonnes in 2050), for the period 2023-2050.

2. In a high real GDP growth and low population growth scenario (i.e. high real GDP per capita growth), crude oil traffic still decreases significantly, although at a lesser degree compared to the central scenario, that is at a compound annual growth rate of -3.5% (27.8M tonnes in 2050), for the period 2023-2050.

Liquid bulk: Oil products



Key drivers

UK oil products demand

Commentary

The forecasts based on the DESNZ Reference Scenario for oil products demand is considered as the central scenario. In this case, the forecasts show a strong decrease until 2050, at a compound annual growth rate of -5.0% and a total growth rate of -75.2% over the period 2023-2050. Namely, freight is forecast to decrease from 69.0M tonnes in 2023 to 39.1M tonnes in 2035 to 17.1M tonnes in 2050. In both scenarios, the forecasts are substantially below the central scenario of the previous forecasts. This projected strong decrease seems to be in line with the crude oil forecasts and the acceleration of the net zero transition and phasing out of oil fuels.

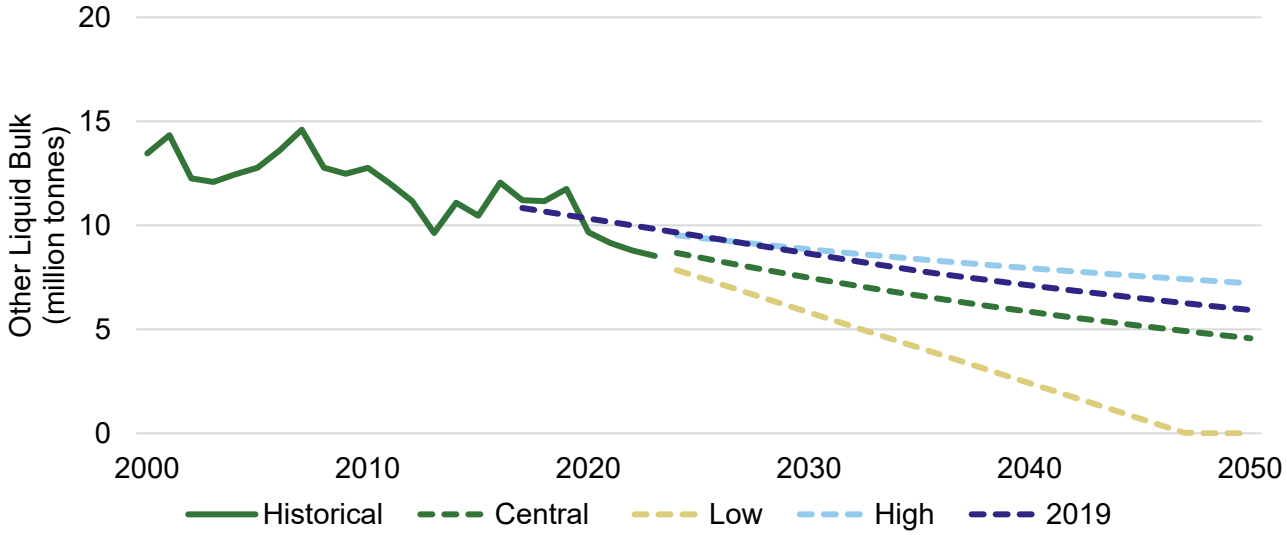
Summary figures

	Year	2019	2023	2025	2030	2035	2040	2045	2050
DESNZ Reference Scenario (Central)	**Million tonnes**	75.77	69.04	68.09	56.08	39.14	30.68	24.08	17.13
	Growth from 2023	-	-	-1.4%	-18.8%	-43.3%	-55.6%	-65.1%	-75.2%
	Growth from 2019	-	-8.9%	-10.1%	-26.0%	-48.3%	-59.5%	-68.2%	-77.4%
CCC Balanced Net Zero Pathway (low)	**Million tonnes**	75.77	69.04	64.29	50.84	36.35	25.53	17.92	14.90
	Growth from 2023	-	-	-6.9%	-26.4%	-47.4%	-63.0%	-74.0%	-78.4%
	Growth from 2019	-	-8.9%	-15.1%	-32.9%	-52.0%	-66.3%	-76.3%	-80.3%

Scenarios

The low scenario is based on the forecasts for the CCC Balanced Net Zero Pathway Scenario for oil products demand. In this case, the forecasts suggest a slightly stronger decrease until 2050, at a compound annual growth rate of -5.5% and a total growth rate of -80.3% (14.9M tonnes in 2050) over the period 2023-2050. This is consistent with an even faster net zero transition. Since there are no other external forecasts for the driver, only one alternative scenario is produced for this cargo type.

Liquid bulk: Other



Key drivers

Historical trend

Commentary

Other liquid bulk includes a wide range of non-petrochemical products which cover various industries. As a result, it was not possible to identify external key drivers for the whole group and the forecasts for other liquid bulk freight are solely based on extrapolating the historical downward trend (using an exponential function). This trend implies a compound annual growth rate of -2.3% and a total growth rate of -46.5% over the period 2023-2050. Namely, freight is forecast to decrease from 8.5M tonnes in 2023 to 6.6M tonnes in 2035 to 4.6M tonnes in 2050. It is likely that this decrease is partly driven by the shift from liquid bulk to tank containers for some shipments. It remains to be seen how the increase of alternative (net zero) fuels, such as biofuels, can affect this trend. In the low and central scenarios, the forecasts are below the central scenario of the previous forecasts but they are above it in the high scenario.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	11.74	8.53	8.46	7.48	6.61	5.84	5.17	4.57
Growth from 2023	-	-	-0.8%	-12.3%	-22.5%	-31.5%	-39.4%	-46.5%
Growth from 2019	-	-27.4%	-28.0%	-36.3%	-43.7%	-50.2%	-56.0%	-61.1%

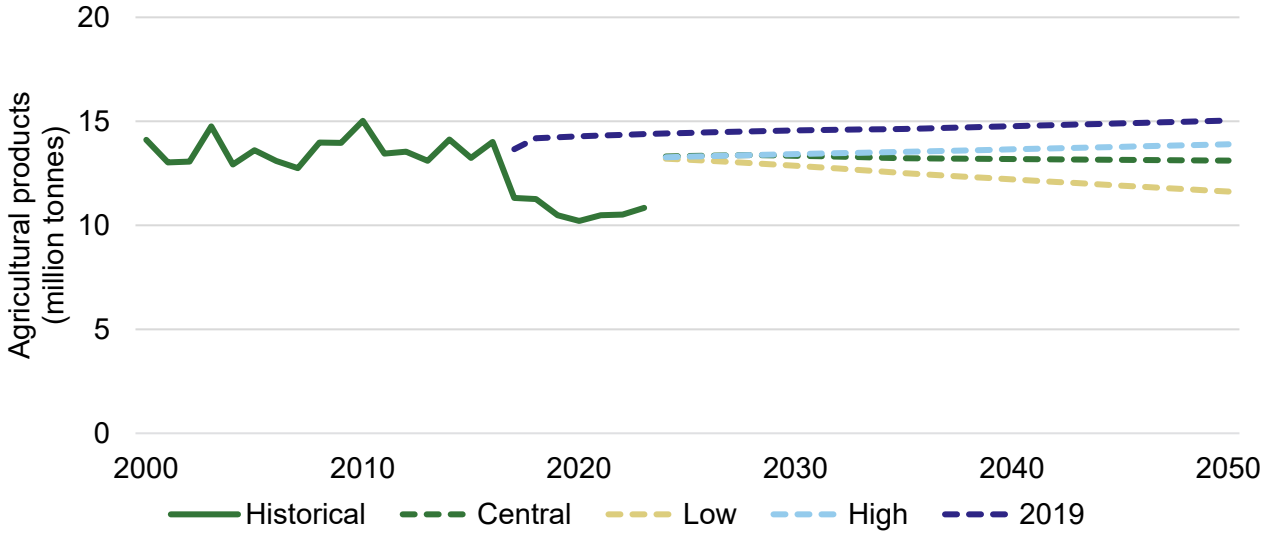
Scenarios

The alternative scenarios are based on extrapolating the historical downward trend using a linear and a logarithmic function.

1. In the linear trend case (i.e. low scenario), the forecasts show a very high decrease compared to the central scenario, that is at a compound annual growth rate of -21.2% up to 2047, after which year, tonnage reaches zero.

2. In the logarithmic trend case (i.e. high scenario), the forecasts show a smaller decrease compared to the central scenario, that is at a compound annual growth rate of -0.6% (7.2M tonnes in 2050), for the period 2023-2050.

Dry bulk: Agricultural products



Key drivers

Population, trends in cereal production, cereal trade

Commentary

The previous forecasts significantly overestimated agricultural products port freight traffic (compared to the actual figures for the period 2017-2023). This can be attributed to a series of shocks (adverse weather, changes in trading arrangements, COVID-19, and the Russia-Ukraine war). The new forecasts suggest that agricultural products freight traffic will rebound in 2024, after which point, it will follow a steady decrease, with a compound annual growth rate of -0.1% over the period 2024-2050 and a total growth rate of 21.0% over the period 2023-2050. Namely, freight is forecast to increase from 10.8M tonnes in 2023 to 13.3M tonnes in 2023 and then to decrease to 13.2M tonnes in 2035 and to 13.1M tonnes in 2050. In all three scenarios, the forecasts are well below the central scenario of the previous forecasts. The updated forecasts seem to be in line with the large and sustained drop in agricultural products UK port freight traffic since 2017.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	10.48	10.84	13.33	13.34	13.22	13.19	13.15	13.11
Growth from 2023	-	-	+23.0%	+23.1%	+22.0%	+21.7%	+21.3%	+21.0%
Growth from 2019	-	+3.4%	+27.2%	+27.3%	+26.2%	+25.8%	+25.4%	+25.1%

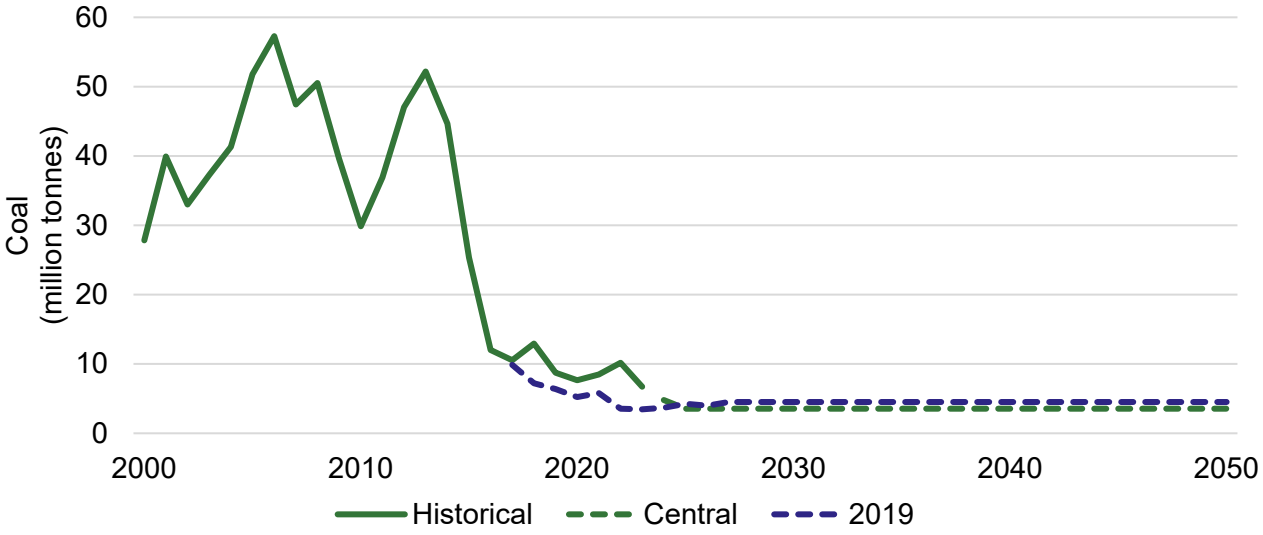
Scenarios

The low and high scenarios reflect alternative projections of population growth and different degrees of persistence of the recent adverse shocks.

1. In a low scenario, which assumes low population growth and long-term persistence of the recent adverse shocks, the forecasts suggest a more significant annual decrease over the period 2024-2050 compared to the central scenario, that is at a compound annual growth rate of -0.5%. In this scenario, freight is forecast to reach 11.6M tonnes in 2050.

2. In a high scenario, which assumes high population growth and that the recent adverse shocks will only have a temporary impact, the forecasts suggest a marginal annual increase over the period 2024-2050, that is at a compound annual growth rate of 0.2%. In this scenario, freight is forecast to reach 13.9M tonnes in 2050.

Dry bulk: Coal



Key drivers

Coal power plant capacity, trends in coal production

Commentary

There was a significant drop in coal freight traffic from 2013 to 2016, after which point, it became relatively stable. Coal power plant capacity is set to drop to zero by 2027, which will result in a further decrease in coal traffic from 2023 to 2027. After that, coal traffic is forecast to stabilise to meet the residual level of demand for other purposes such as coke manufacture and blast furnaces. Overall, coal freight is forecast to exhibit a compound annual growth rate of -2.3% and a total growth rate of -47.2% over the period 2023-2050. Namely, freight is forecast to decrease from 6.7M tonnes in 2023 to 3.6M tonnes in 2025 and remain close to this level for the entire period 2025-2050. The new central scenario forecasts are above the 2019 ones for 2024 but then become roughly 1 million tonnes lower.

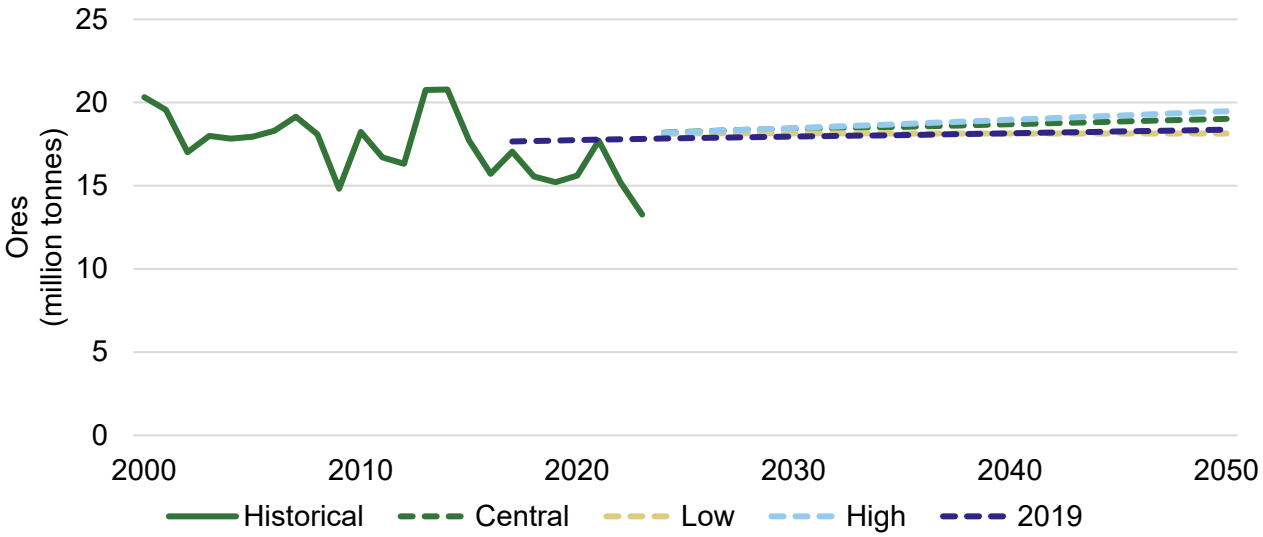
Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	8.74	6.72	3.56	3.55	3.55	3.55	3.55	3.55
Growth from 2023	-	-	-47.1%	-47.2%	-47.2%	-47.2%	-47.2%	-47.2%
Growth from 2019	-	-23.1%	-59.3%	-59.4%	-59.4%	-59.4%	-59.4%	-59.4%

Scenarios

There are no low and high scenarios for this cargo type as DESNZ's Energy and Emissions Projections alternative scenarios for coal power plant capacity no longer exist.

Dry bulk: Ores



Key drivers

Iron and steel products freight traffic (which is, in turn, driven by steel use and population projections)

Commentary

The forecasts indicate a substantial rise in ores freight traffic from 2023 to 2024, followed by a small steady increase from 2024 to 2050, at a compound annual growth rate of 0.2%. This results in a total growth rate of 43.4% over the period 2023-2050. Namely, freight is forecast to increase from 13.3M tonnes in 2023 to 18.2M tonnes in 2024 and then to 19.0M tonnes in 2050. These forecasts are driven by the iron/steel products freight forecasts which are discussed later. The low, central, and high scenarios are relatively close to the respective scenarios of the previous forecasts.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	15.21	13.27	18.24	18.42	18.54	18.70	18.86	19.02
Growth from 2023	-	-	+37.5%	+38.9%	+39.7%	+40.9%	+42.1%	+43.4%
Growth from 2019	-	-12.8%	+19.9%	+21.1%	+21.9%	+22.9%	+24.0%	+25.0%

Scenarios

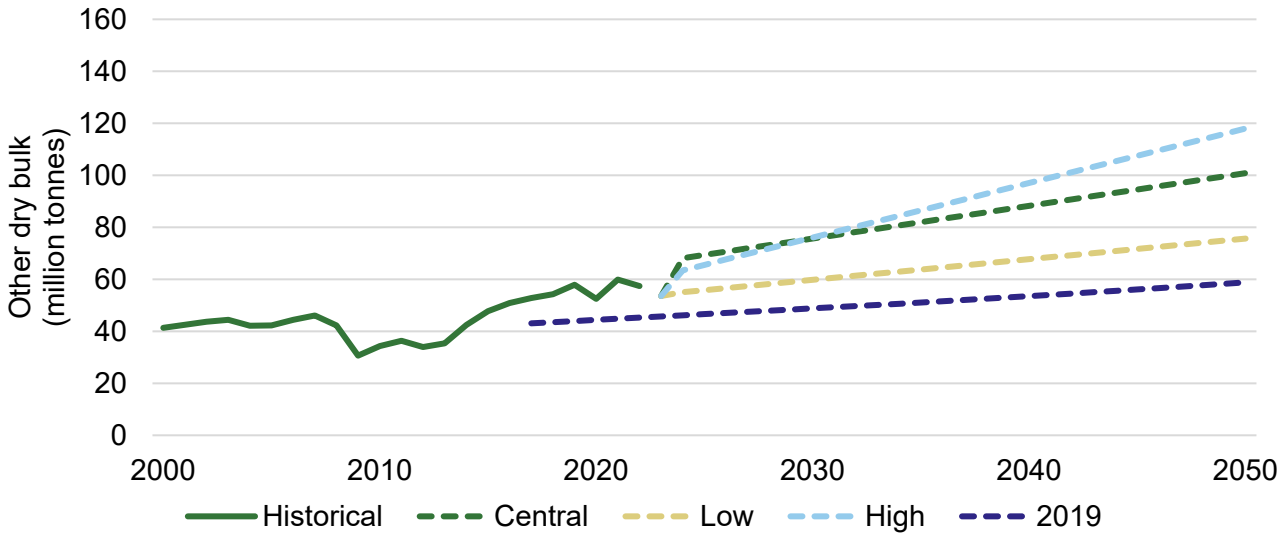
The low and high scenarios reflect alternative projections of population growth.

1. In a low population growth scenario, the forecasts suggest a total growth rate of 36.7% over the period 2023-2050 (reaching 18.1M tonnes in 2050) but a 0.002% compound annual growth rate from 2024 to 2050 (this is due to a substantial increase from 2023 to 2024). Those figures are lower than the respective ones in the central scenario.

2. In a high population growth scenario, the forecasts suggest a total growth rate of 46.8% over the period 2023-2050 (reaching 19.5M tonnes in 2050) but only a 0.3% compound annual growth rate from 2023 to 2050 (this is due to a

substantial increase from 2023 to 2024). Those figures are higher than the respective ones in the central scenario.

Dry bulk: Other



Key drivers

Historical trend

Commentary

As 'other dry bulk' includes a wide range of products (e.g. cement, aggregates, and wood pellets), it was not possible to identify external key drivers for the whole cargo group. HMRC trade data show that the amount of wood pellets traded with the UK has grown from zero in 2010 to over 6.4 million tonnes in 2023[26]. This corresponds almost entirely to imports to supply the Drax powerplant station with biomass. Extrapolating the historical trend from 1994 to 2007 (using a linear function), i.e. before biomass[27] (e.g. wood pellets) became a significant component of the 'other dry bulk' cargo type, results in an annual compound growth rate of 2.4% and a total growth rate of 88.2% over the period 2023-2050. Namely, freight is forecast to increase from 53.6M tonnes in 2023 to 82.0M tonnes in 2035 to 100.8M tonnes in 2050. In all three scenarios, the forecasts are above the central scenario of the previous forecasts.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	57.93	53.59	69.40	75.69	81.98	88.26	94.55	100.84
Growth from 2023	-	-	+29.5%	+41.2%	+53.0%	64.7%	+76.4%	+88.2%
Growth from 2019	-	-7.5%	+19.8%	+30.7%	+41.5%	+52.4%	+63.2%	+74.1%

Scenarios

The alternative scenarios are based on extrapolating the historical trend using different estimation periods.

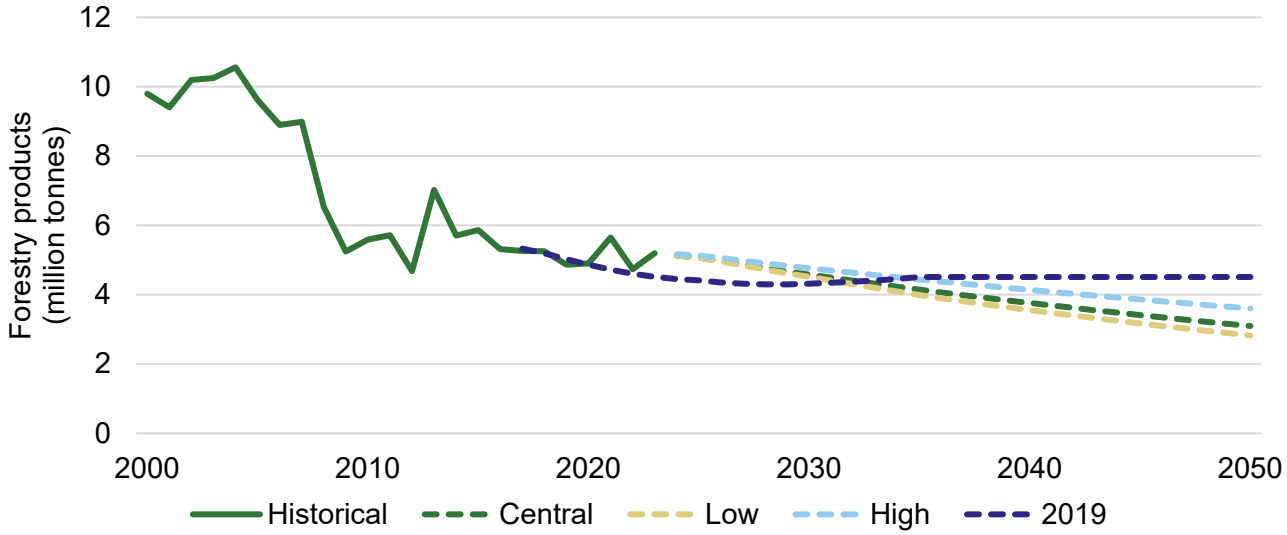
1. In a low scenario, all historical data (i.e. from 1994 to 2023) are used to extrapolate the trend (that is both the periods before and after biomass became a significant component of the 'other dry bulk' cargo type). This

[26] Forestry Statistics CH3_Trade 2024-3, Forest Research
[27] Biological material that can be used as fuel or for industrial production.

results in a lower compound annual growth rate of 1.3% (75.7M tonnes in 2050), for the period 2023-2050.

2. In a high scenario, only recent historical data (i.e. from 2009 to 2023) are used to extrapolate the trend (i.e. assuming that the trend in biomass growth continues). This results in a higher compound annual growth rate of 3.0% (118.0M tonnes in 2050), for the period 2023-2050.

General Cargo: Forestry products



Key drivers

Real GDP, population

Commentary

Forestry products freight traffic is forecast to decrease, following the historical downward trend, at a compound annual growth rate of -1.9% and a total growth rate of -40.4% over the period 2023-2050. Namely, freight is forecast to decrease from 5.2M tonnes in 2023 to 4.1M tonnes in 2035 to 3.1M tonnes in 2050. This decrease is mainly driven by the decline in newsprint, which is generally expected to continue. From 2035, the forecasts in all three scenarios are below the central scenario of the previous forecasts. From 2036 to 2050, the compound annual growth rate from 2024 to 2035 is used, whereas the previous forecast model assumed no growth after 2035.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	4.87	5.19	5.07	4.58	4.14	3.76	3.41	3.10
Growth from 2023	-	-	-2.5%	-11.9%	-20.3%	-27.6%	-34.3%	-40.4%
Growth from 2019	-	6.7%	4.1%	-5.9%	-14.9%	-22.8%	-29.9%	-36.4%

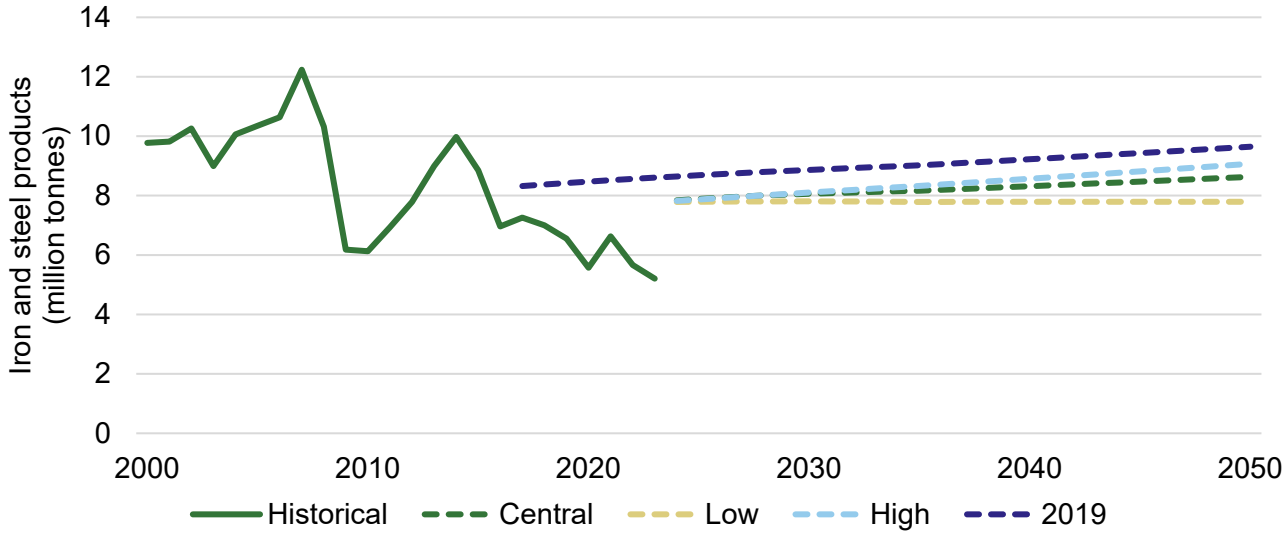
Scenarios

The low and high scenarios reflect alternative projections of real GDP and population growth.

1. In a low real GDP and population growth scenario, forestry products freight traffic decreases more sharply than in the central scenario, at a compound annual growth rate of -2.2% (2.8M tonnes in 2050), for the period 2023-2050.

2. In a high real GDP and population growth scenario, forestry products freight traffic still decreases significantly – although less than in the central scenario – that is at a compound annual growth rate of -1.3% (3.6M tonnes in 2050), for the period 2023-2050.

General Cargo: Iron and steel products



Key drivers

Steel use, population

Commentary

Historically, steel use has been related to the performance of other industries, such as construction and automotive, and has exhibited significant fluctuation due to this dependence. Assuming that steel use per capita will remain constant in the future, iron and steel products traffic is forecast to sharply increase in 2024, reverting to its long-run trend, and then steadily grow at a much lower rate. Overall, this will result in a compound annual growth rate of 1.9% and a total growth rate of 65.8% over the period 2023-2050. Namely, freight is forecast to increase from 5.2M tonnes in 2023 to 8.2M tonnes in 2035 to 8.6M tonnes in 2050. In all three scenarios, the forecasts are below the central scenario of the previous forecasts.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	6.55	5.21	7.89	8.06	8.16	8.32	8.47	8.63
Growth from 2023	-	-	+51.5%	+54.8%	+56.8%	+59.8%	+62.7%	+65.8%
Growth from 2019	-	-20.6%	+20.4%	+23.0%	+24.6%	+26.9%	+29.3%	+31.7%

Scenarios

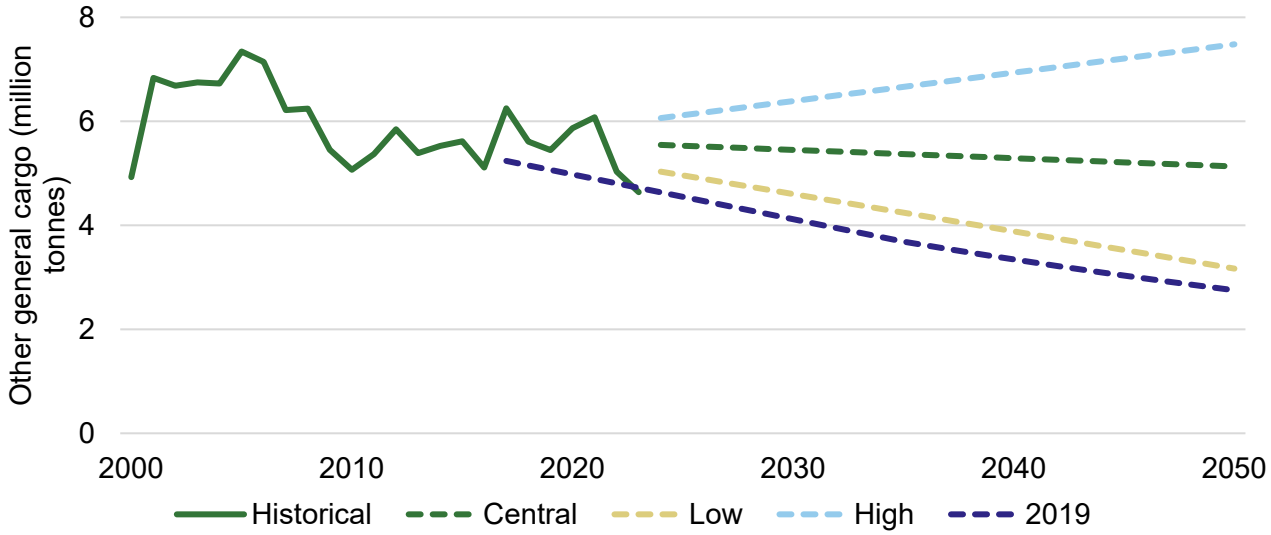
The low and high scenarios reflect alternative projections of population growth.

1. In a low population growth scenario, iron and steel products freight traffic is forecast to significantly increase until 2029 and then exhibit a marginal decrease for the remaining years. This results in a compound annual growth rate of 1.5% (7.8M tonnes in 2050) from 2023 to 2050, which is lower than the one in the central scenario.

2. In a high population growth scenario, iron and steel products freight traffic is forecast to increase at a faster pace than in the central scenario, that is at a

compound annual growth rate of 2.1% (9.1M tonnes in 2050), for the period 2023 to 2050.

General Cargo: Other



Key drivers

Historical trend

Commentary

Other general cargo includes break-bulk cargo (e.g. pipes and cable reels) and containers less than 20ft in length. Due to this wide range of products, it was not possible to identify external key drivers for the whole group. As such, the forecasts are produced by extrapolating the historical trend (from 1994 to 2023). This results in a compound annual growth rate of 0.4% (and a total growth rate of 10.7%) from 2023 to 2050 but in a -0.3% rate from 2024 to 2050. Namely, freight is forecast to reach 5.4M tonnes in 2035 (from 4.6M tonnes in 2023) and then decrease to 5.1M tonnes in 2050.This marginally downward trend could be partly attributed to increased containerisation of goods, i.e. shipments previously carried as break-bulk being moved through containers instead. In all three scenarios, the forecasts are above the central scenario of the previous forecasts.

Summary figures

Year	2019	2023	2025	2030	2035	2040	2045	2050
Million tonnes	5.45	4.64	5.53	5.45	5.37	5.29	5.21	5.13
Growth from 2023	-	-	+19.3%	+17.5%	+15.8%	+14.1%	+12.4%	+10.7%
Growth from 2019	-	-14.9%	+1.5%	+0.1%	-1.4%	-2.9%	-4.3%	-5.8%

Scenarios

The alternative scenarios are based on extrapolating the historical trend using different estimation periods.

1. In a low scenario, historical data from 2005 to 2023 are extrapolated (i.e. the period 1994-2004 is excluded to assign more weight to the strong downward trend over the years 2005-2010), resulting in a compound annual growth rate of -1.4% (3.2M tonnes in 2050), for the period 2023 to 2050.

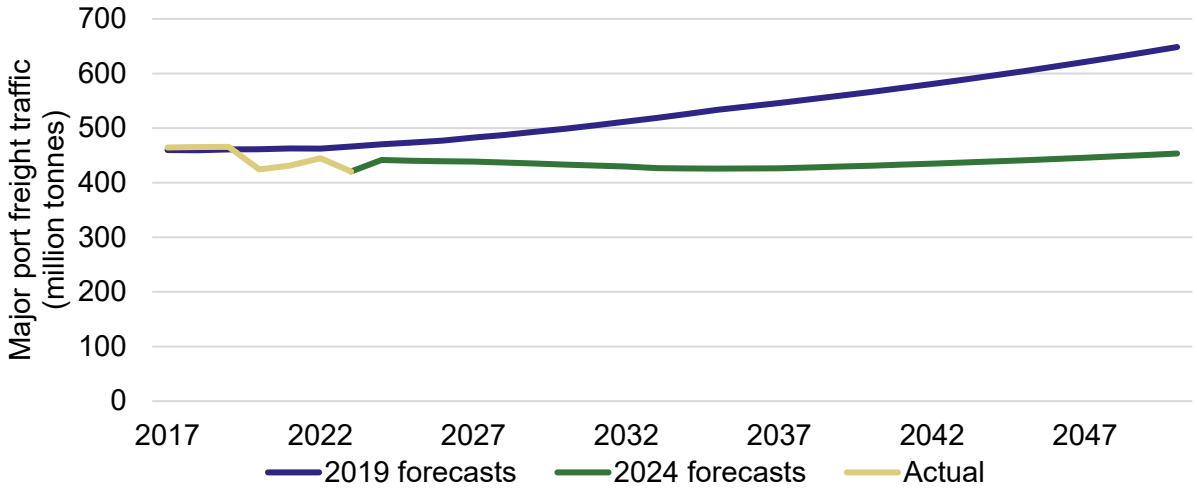
2. In a high scenario, historical data only from 2010 to 2021 are extrapolated (that is to exclude the significant downward trends from 2005 to 2010 and from 2021 to 2023), resulting in a compound annual growth rate of 1.8% (7.5M tonnes in 2050), for the period 2023 to 2050.

Comparison with previous forecasts

4.20 The previous port freight traffic forecasts produced in 2019 were based on 2016 data (and forecast in annual intervals up to 2050). While in some freight categories these forecasts performed relatively well, especially up to 2019, they significantly deviated from actual port freight traffic in several others (Table 3 and Figure 9). Namely, for 2023, the 2019 forecasts suggested that total freight would reach 466.3M tonnes, while the actual figure was 420.6M tonnes.

4.21 This overall overestimation of the previous forecasts can be attributed to various reasons, including the COVID-19 pandemic and the war in Ukraine. In addition, structural changes in various economic sectors (e.g. as a result of the acceleration of the transition towards net zero) have led to shifts in long-term trends for different cargo categories.

Figure 9. Comparison of 2019 and 2024 forecasts (excluding motor vehicles).



4.22 Looking at the projected percentage changes for the period 2023-2050, the 2019 forecasts suggest much higher overall growth of port freight traffic compared to the new ones. In other words, driven by the factors mentioned in the previous paragraph, the new forecasts are less optimistic than the 2019 ones. Namely, while the 2019 forecasts indicate that total freight will reach 533.5M tonnes by 2035 and 648.4M tonnes by 2050, the new forecasts suggest much lower figures, that is 425.8M tonnes by 2035 and 453.5M tonnes by 2050.

4.23 Regarding the four main cargo categories, compared to the 2019 forecasts, the new ones suggest significantly smaller growth in unitised freight, significantly larger decrease in liquid bulk freight, a much larger increase in dry bulk freight, and a relatively smaller increase in general cargo freight.

Table 3. Comparison of percentage changes in 2019 and 2024 forecasts (in tonnage terms and excluding motor vehicles).

	Percentage change 2016-2023		Percentage change 2023-2050	
	2019 forecasts	Actual	2019 forecasts	2024 forecasts
Lo-Lo	13%	-7%	144%	37%
Ro-Ro	14%	-9%	153%	70%
Unitised freight	13%	-8%	150%	57%
Liquefied gas	-21%	34%	26%	-13%
Crude oil	-5%	-15%	-31%	-66%
Oil products	-2%	-12%	11%	-75%
Other liquid bulk	-19%	-29%	-31%	-47%
Liquid bulk	-6%	-11%	-8%	-63%
Agriproducts	3%	-23%	39%	21%
Coal	-71%	-44%	-33%	-47%
Ores	13%	-16%	38%	43%
Other dry bulk	-10%	5%	10%	88%
Dry bulk	-12%	-9%	15%	62%
Forestry products	-15%	-2%	-13%	-40%
Iron and steel	24%	-25%	85%	66%
Other general cargo	-8%	-9%	-41%	11%
General cargo	3%	-9%	12%	8%
Total	0%	-14%	54%	8%

5. Next Phase

5.1 This report represents the conclusion of the second version (following the 2019 version) of a bespoke forecasting model for UK port freight traffic and constitutes the second step in an iterative process of engaging with industry, academia, and other users and developing the forecasts. This section sets out the next phase of work.

Collecting feedback from users and stakeholders

5.2 A next step will be to engage with people who use this report and the forecasts to understand how they utilise them. This will allow us to consider whether to change the structure and format of outputs from the model to further account for the needs of the end user.

5.3 If you have any feedback on the forecasts, please get in touch at MaritimeForecasts@dft.gov.uk.

Future review

5.4 In light of feedback and new data we will review and may update port freight forecasts in future. We expect to review the accuracy and predictive power of the forecasting model. We may consider the use of alternative methods for identifying the relationship between historical port traffic and historical key drivers. While various modelling approaches were tested for this version, there might be further frameworks with stronger predictive power.

Products in the forecasting model

5.5 We may also review the inputs into the forecasting model itself, based on user feedback and data availability. This will likely include the treatment of uncertainty, for example refining the scenarios using new, publicly available data (e.g. alternative scenarios for key drivers corresponding to the net zero transition).

New data points

5.6 There will be a process of periodically updating all the datasets to cover the latest historical data points and also to include revised versions of other forecasts. The assumptions used in the model will also need reviewing and updating as more information becomes available and in the light of user feedback.

Annex A: Model Details

Short-term forecasts methodology

A.1 Each of the cargo categories has its own model, which is unrelated to the other forecasts (apart from using the same key drivers in many cases). The only exception is the ores forecasts which use iron and steel products freight traffic forecasts as inputs.

A.2 The following sections detail the methodology used for each cargo category to produce forecasts up to 2050.

Tonnage models

A.3 **Lo-Lo** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with real UK GDP per capita. In line with the economics of this sector, the estimation period has been reduced to 2000-2023 to account for the time-varying relationship between container trade and real GDP.

A.4 **Ro-Ro** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with real UK GDP per capita.

A.5 **Liquefied gases** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with UK LNG imports. The forecasts of the driver are produced through extrapolating the (logarithmic) trend of the historical data.

A.6 **Crude oil** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with UK crude oil production and real GDP per capita.

A.7 **Oil products** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with UK oil products demand. Since DESNZ provide forecasts for the driver only until 2040, it is assumed that the annual growth rate of the driver for the period 2041-2050 will be equal to the annual growth rate for the period 2039-2040.

A.8 **Other liquid bulk** traffic is forecast through extrapolating the historical downward trend using an exponential function.

A.9 **Agricultural products** traffic is forecast using a regression model with cereal trade. To produce a projection of cereal trade:

1. The area of land used for cereal production is projected based on the compound annual growth rate of the period 1984-2023.
2. The volume of cereal produced is forecast using a regression model with cereal production area.

3 Change in cereal stock is projected as the average value from the period 2008-2023.

4 Domestic use of cereal is forecast using a regression model with population.

5 Cereal exports are projected based on the trend for the period 2000-2023.

6 $Cereal\ imports = domestic\ use + exports + change\ in\ stock - production$[28]

A.10 **Coal** traffic is forecast using a regression model with coal trade. To produce a projection of coal trade:

1 Coal production is projected by source:

   a. Surface-mined coal production is projected using the trend seen in the period 1996-2023.

   b. Deep-mined and other sources of coal production is projected as a flat line from 2023 onwards.

2 Coal demand is projected by type:

   a. Heat generation, coke manufacture, and blast furnaces demand is projected as a flat line from 2023 onwards.
   b. Electricity generation demand is projected using the projected percentage change in coal power plant capacity.

3 Coal exports are forecast as the average value for the period 2017-2023.

4 $Coal\ imports = demand + exports - production$[29]

A.11 **Iron and steel** traffic is forecast using a regression model with steel use (which, in turn, is forecast based on population projections and the average steel use per capita during the period 2010-2023).

A.12 **Ores** traffic is forecast using a regression model with iron and steel traffic.

A.13 **Forestry products** traffic is forecast using a regression model on first order differences (to ensure stationarity of the dependent and independent variables) with:

- Trade in wood in rough, which is projected using a regression model on first order differences with GDP per capita.
- Trade in pulp, which is projected using a regression model on first order differences with GDP.
- Trade in newsprint, which is projected using the trend for the period 2009-2022.

A.14 **Other dry bulk** and **other general cargo** are forecast using the trends in historical data. For other dry bulk, the trend for the period 1994-2007 is used. For other general cargo, the trend for the period 1994-2023 is used.

Unitised models

A.15 **Lo-Lo** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with real UK GDP per capita. In line with the economics of this sector, the estimation period has been reduced to 2000-2023 to account for the time-varying relationship between container trade and real GDP.

[28] The alternative text for the equation is: Cereal imports equal domestic use plus exports plus change in stock minus production.
[29] The alternative text for the equation is: Coal imports equal demand plus exports minus production.

A.16 **Ro-Ro** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with real UK GDP per capita.

A.17 **Motor vehicles** traffic is forecast using an OLS regression model on first order differences (to ensure stationarity of the dependent and independent variables) with real UK GDP per capita.

Long-term forecasts methodology

A.18 For some cargo categories, it was considered inappropriate to use regression models for long-term forecasts due to the relatively short periods of data used to build the models and the uncertainty surrounding the key drivers in the long-term. In the absence of any strong evidence for long-term traffic forecasts, simple trend projections or flat-line projections are used.

A.19 The trend projections incorporate the compound annual growth rate of the short-term forecast to project beyond 2035 and are used for all dry bulk and general cargo categories except for coal (Table 4). This forecast is instead held constant from 2035 onwards. This approach was followed because there was insufficient evidence to infer about which direction the forecasts would move in.

Table 4. Long-term growth rates in the central case forecasts (only includes the cargo categories that have incorporated this approach).

Cargo group	Cargo category	Long-term growth rate
Dry bulk (tonnage)	Agricultural products	-0.06%
	Coal	0.00%
	Ores	0.17%
	Other dry bulks	1.69%
General cargo (tonnage)	Forestry products	-1.92%
	Iron and Steel	0.37%
	Other general cargo	-0.29%

Annex B: Data Sources

B.1 Data on port freight were retrieved from DfT's published port statistics.

B.2 The table below shows the years of freight data used in the models.

Table 5. Time periods of port freight data used in models.

Cargo group	Cargo category	Time period used
Unitised freight	Ro-Ro (tonnage)	1990-2023
	Ro-Ro (units)	1990-2023
	Lo-Lo (tonnage)	2000-2023
	Lo-Lo (TEU)	2000-2023
	Motor vehicles (units)	1993-2023
Liquid Bulk	Crude oil	1998-2023
	Oil products	1998-2023
	Liquefied gases	2000-2023
	Other liquid bulk	1994-2023
Dry bulk	Agricultural products	1994-2023
	Coal	1994-2023
	Ores	1995-2023
	Other dry bulk	1994-2023
General cargo	Forestry products	1996-2023
	Iron and steel products	1995-2023
	Other general cargo	1994-2023

B.3 Sources for all other data used are listed in the table below. Unless otherwise stated, the data used cover the UK.

Table 6. Data sources.

Name	Historical data source	Central projection source	Scenario projections
UK real GDP	ONS AMBI series (1970-2023)	DfT TAG Data Book, Annual Parameters	Central projection with growth decreased/increased by 0.5pp
UK population	ONS mid-year population estimates (1971-2022)	DfT TAG Data Book, Annual Parameters	DfT TAG Data Book, Annual Parameters with low/high growth
UK LNG imports	DUKES: natural gas (2005-2023)	DUKES: natural gas Historical data are extrapolated using the logarithmic trend (in level terms)	DUKES: natural gas Historical data are extrapolated using the logarithmic trend (in growth terms)
UK crude oil production	NSTA (1998-2023)	NSTA	No data for alternative scenarios were available from NSTA
UK oil products demand	NSTA (1998-2023)	NSTA DESNZ Reference Scenario	NSTA, CCC Balanced Net Zero Pathway Scenario
Wood in rough, pulp, and newsprint trade	HMRC - Trade statistics (1996-2023)	Produced in model	Produced in model based on GDP and population scenarios
Coal power plant capacity	Not used	BEIS - Energy & emissions projections (reference scenario)	Low/high energy price projections
Coal demand, imports, exports, and production	BEIS - Digest of UK Energy statistics (DUKES) (1996-2023)	Produced in model	Demand linked to coal power plant capacity scenarios
Steel use	World Steel Association - Apparent steel use (1995-2023)	Produced in model	Produced in model based on population scenarios
Cereal production area, production volume, change in stock, imports, exports, and domestic use	DEFRA - UK agriculture statistics (1984-2023)	Produced in model	Produced in model based on population scenarios

Annex C: Econometric Methods

C.1 The empirical framework on which most forecasts are based is an Ordinary Least Squares regression model of dependent and independent (i.e. explanatory) variables. Depending on the case, either a univariate (i.e. with one explanatory variable) or a multivariate (i.e. with more than one explanatory variable) regression model has been used. This quantifies the time-series relationship between historical port freight traffic and the set of explanatory variables defined in Annex A.

C.2 The general form of the OLS regression model for a given cargo type is described below:

$$y_t = \alpha + \beta_1 x_{1t} + \beta_{2t} x_{2t} + \cdots + \beta_{nt} x_{nt} + \varepsilon_t$$

Alternative text for the equation: y with subscript t equals α plus β with subscript 1t times x with subscript 1t plus β with subscript 2t times x with subscript 2t plus three dots plus β with subscript nt times x with subscript nt plus ε with subscript t.

where:

y_t : port freight traffic at time t

Alternative text for the mathematical expression: y with subscript t denotes port freight traffic at time t.

$x_{it}, i \in [1, n]$: explanatory variable i at time t

Alternative text for the mathematical expression: x with subscript it (where i belongs to the closed interval from 1 to n) denotes the explanatory variable i at time t.

ε_t : error in prediction at time t

Alternative text for the mathematical expression: ε with subscript t denotes the error in prediction at time t.

$\alpha, \beta_i, i \in [1, n]$: unknown parameters to be estimated

Alternative text for the mathematical expression: α and β with subscript i (where i belongs to the closed interval from 1 to n) denote unknown parameters to be estimated.

C.3 The explanatory variables (drivers) that are used for forecasting are selected after assessing the performance of various regression models by considering:

- Measures of model fit, such as the R-squared (in univariate regressions), the adjusted R-squared (in multivariate regressions), and the F-test.
- t-statistics to assess the statistical significance of individual explanatory variables.
- The sign of the individual explanatory variables. For instance, if real GDP per capita increases, economic theory would suggest port freight traffic to go up. We would expect, therefore, the respective slope coefficient in the regression output to be positive. If the regression estimate is negative, this would be a cause for concern.

- Various other tests, including ones for stationarity, heteroskedasticity, autocorrelation, normality of residuals, to ensure that the OLS estimation produces non-biased, efficient parameters.

C.4 For the cargo types where an OLS regression model has not been used, the forecasts are based on extrapolating the trends from the port freight historical data. When this is the case, it is mentioned in the respective parts of Section 4 and Annex A.