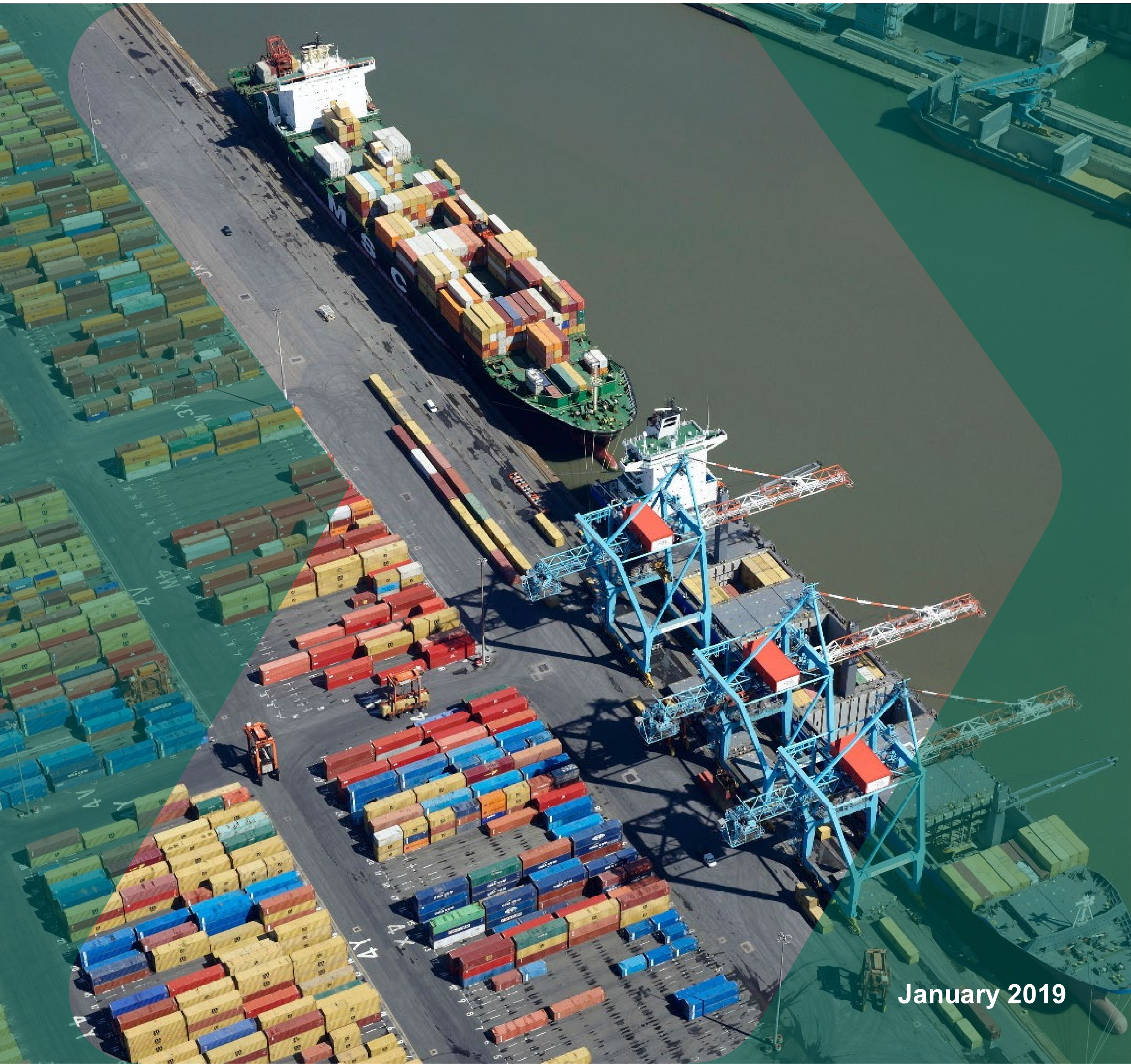
Department
for Transport

UK Port Freight Traffic
2019 Forecasts

Moving Britain Ahead



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Introduction

1 This document sets out the Department for Transport (DfT) 2019 forecasts for freight traffic at UK ports, covering the years 2017-2050. 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 MDS Transmodal for DfT in May 2006.

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 or population 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 use an in-house forecasting model built by DfT for the first time. As work continues to refine and develop the forecasting model further, we are keen to invite views on the forecasts themselves, the methodology and how people will use these forecasts, to inform how we will produce future forecasts.

Principles of the model

4 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.

5 The general approach taken to each cargo category is as follows:

- Identify potential drivers that could have a causal effect on the amount of traffic transported through UK ports, using existing literature and research.
- Use historical data to calculate and test the numerical relationships between the drivers and port traffic and identify the key drivers with the greatest predictive power.
- Calculate short-term port traffic forecasts (2017-2035) by applying the numerical relationships to forecasts of the key drivers.
- Produce long-term port traffic forecasts (2036-2050) using the average annual growth rate of the short-term forecasts.

6 The forecasts are given at a national level and are for unconstrained growth (they do not take into account ports' existing or planned capacity, or any potential future

events that could limit capacity). They are based on freight traffic data for major UK ports and do not include freight passing through minor ports, which accounted for 2% of total port freight traffic in 2016.

Inputs and assumptions

7 The port forecasts are based on forecasts of the key drivers produced by other organisations. Namely, these are OBR GDP forecasts, ONS population projections, National Grid gas supply projections, OGA oil production and demand forecasts, BEIS coal power plant capacity, US EIA Brent price forecasts.

8 External forecasts were not available for some of the key drivers. In these cases we have made assumptions about future trends, based on historic levels and patterns. Additionally, it was not possible to identify key drivers for some cargo categories, so for these categories we have also assumed that traffic will follow the trend seen in historic data.

9 The main forecasts are for a central case, in other words based on central projections for the key drivers. In addition to this central case, we have produced low and high scenarios where projections of the key drivers under different scenarios were available. These scenarios have been produced to give an indication of the impact that a change in the outturn of the key drivers could have on the forecasts.

10 For most cargoes, we have used either low and high growth GDP projections, or low and high population projections for the scenario forecasts, depending on the key drivers. For some cargoes, the scenarios reflect uncertainty around specific assumptions.

11 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 and the lack of scenarios for any cargo category does not indicate a higher level of certainty in that forecast. The scenarios, and the general treatment of uncertainty in the forecasts, is something that we will work to refine in future forecasts.

Forecasts

12 Overall, port traffic is forecast to remain relatively flat in the short term, but grow in the long-term, with tonnage 39% higher in 2050 compared to 2016. The long-term growth in port traffic is driven by increases in unitised freight traffic. In the short-term, this growth in unitised traffic is offset by decreases in the other categories.

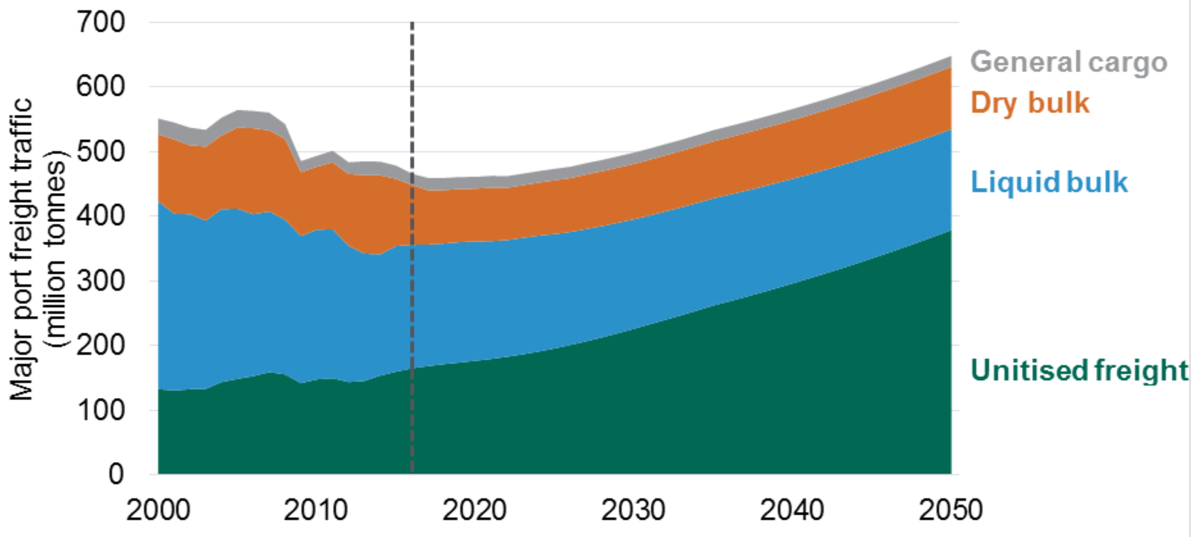
13 Liquid bulk traffic has the largest forecasted decreases. This is almost entirely due to falls in crude oil traffic, in line with the decreases which have been seen historically. It is likely that the projected decrease in other liquid bulk traffic is partly due to the shift from liquid bulk to tank containers for some shipments.

14 Similarly, general cargo is also forecast to decrease, in line with the historic decreasing trend, which is also likely to be partly driven by increased containerisation of goods.

15 Dry bulk traffic is forecast to have a relatively large decrease in the short-term, driven primarily by demand for coal being projected to fall. However, in the long-term, dry bulk traffic is forecast to increase, with other dry bulk, the largest category, continuing to increase as it has done historically. This historical increase is linked to the

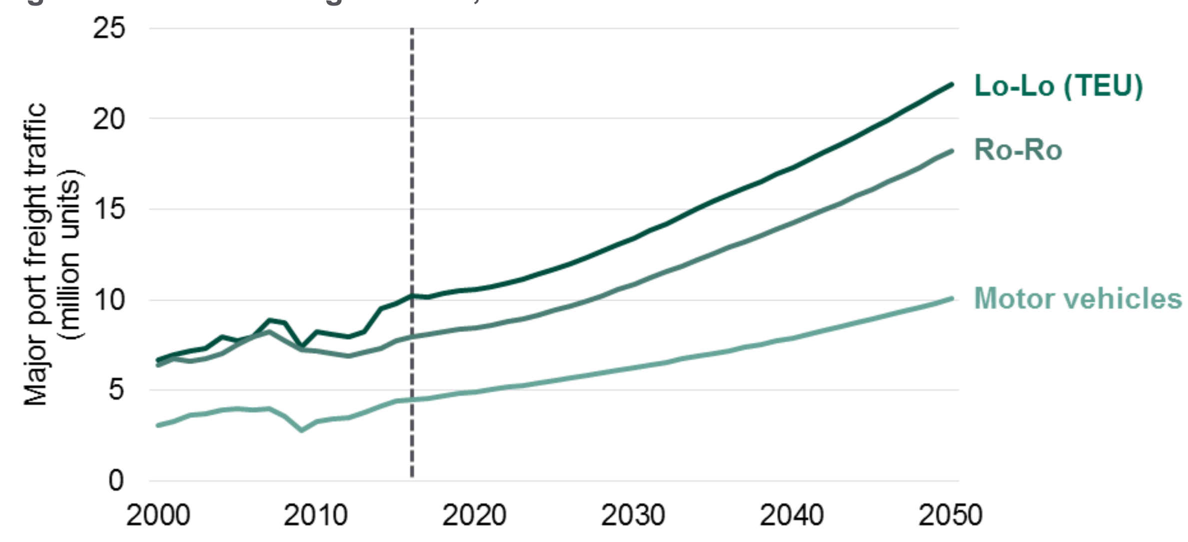
increase in the trade of biomass.

Figure 1 Total port freight tonnage, 2000-2050



16 The unitised freight tonnage forecasts do not include motor vehicles, which are forecast in units and are also forecast to strongly grow, as is the twenty-foot equivalent units (TEU) forecast for Load-on/Load-off (Lo-Lo) traffic and the units forecast for Roll-on/Roll-off (Ro-Ro) traffic. These are all driven by economic growth.

Figure 2 Unitised freight traffic, 2000-2050



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

Next phase

18 While this document represents the conclusion of a project to build a bespoke forecasting model for UK port traffic, future developments are lined up in this project. This will involve:

- Collecting user feedback on the structure and format of outputs;
- Testing the accuracy of the models and investigating the use of alternative methods for producing the short and long term forecasts;

- Reviewing the tools that go in the forecasting model, such as the treatment of uncertainty, taking into account user feedback; and
- Regularly updating the forecasts with the latest data.

19 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) 2019 forecasts for freight traffic at UK ports. The forecasts cover the years 2017 through to 2050. These forecasts supersede the previous set of forecasts that were produced by MDS Transmodal in May 2006.[1]

1.2 The forecasts presented in this document use an in-house forecasting model built by DfT for the first time. We will continue to refine and develop the forecasting model further 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

1.3 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* (NPS) highlights the importance of the ports sector to the UK economy[2]. It also emphasises the need for new infrastructure in the ports sector to meet the demand forecasts last published in 2006. 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.

1.4 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 sector. To explore this uncertainty the forecasts use scenarios of different economic or population outlooks.

1.5 It should also be noted that these forecasts are long-term forecasts which aim to predict the overall trend of port traffic and not the exact movements in individual years. Port traffic levels can be volatile and vary greatly from year to year. We are not modelling those individual year movements and instead looking at the overall direction traffic is heading, averaging out the peaks and troughs that will occur along the way.

1.6 An important characteristic of these forecasts is that they consider an 'unconstrained demand' approach. That is, the forecasts do not take into consideration ports' existing

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1 UK Port Demand Forecasts to 2030, MDS Transmodal
http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/consultations/archive/2006/ppr/ukportdemandforecaststo2030.pdf

2 National Policy Statement for Ports, February 2012
https://www.gov.uk/government/publications/national-policy-statement-for-ports

or future capacity to handle freight. The DfT believes it is the responsibility of the ports sector to meet the changes in demand. They also do not take into account any future events that could limit capacity, for example any impact on ports of the UK's departure from the EU.

1.7 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.

1.8 Unrounded 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 unrounded forecasts does not reflect a greater level of certainty with the forecast estimates.

1.9 The forecasts presented in this document use a forecasting model that has been used for the first time. It has been validated and verified by external consultants and the results have also been sense-checked against a working group of stakeholders in the ports sector, who have confirmed that the forecasts seem reasonable. We will continue to develop and build on the forecasting tools in future years and publish new forecasts accordingly.

Document structure

1.10 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

1.11 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 forecasting model

Overview

2.1 This section describes the methodology for producing port 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[3]. These categories are listed in Table 1 below 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	Roll-on, roll-off traffic (Ro-Ro)	Tonnes and units
	Containers / Load-on, load-off traffic (Lo-Lo)	Tonnes and twenty-foot equivalent units (TEU)[4]
	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

[3] Maritime and shipping statistics, DfT
https://www.gov.uk/government/collections/maritime-and-shipping-statistics

[4] TEU is a standardised measure to allow for the different sizes for 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 TEU.

Review of previous forecasts

2.3 Previous port freight traffic forecasts were produced for DfT by MDS Transmodal in May 2006 covering the period 2005-2030[5].

2.4 Before producing these latest forecasts, we assessed how the 2006 projections compared against actual port traffic to identify weaknesses and flaws in the previous methodology so that we could avoid them in the new model.

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

Forecasting approach

2.6 The general approach taken to each cargo market is as follows:

- **Identify potential drivers that could have a causal effect on the amount of traffic transported through UK ports.** 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 GDP and population. The selection of drivers was informed by existing literature and research on these topics.
- **Use historical data to calculate and test the numerical relationships between the drivers and port traffic and identify the key drivers with the greatest predictive power.** The forecasts in this model generally use an Ordinary Least Squares (OLS) approach, however future forecasting developments will consider if this is an appropriate technique to use.
- **Calculate short-term port traffic forecasts by applying the numerical formula to other forecasted data.** For instance, if there is a relationship between port traffic and GDP, then port forecasts can be calculated using GDP forecasts from the OBR. These forecasts are used for years up to and including 2035.
- **Produce long-term port traffic forecasts using the average annual growth rate of the short-term forecasts.** It was considered inappropriate to use regression models for long-term forecasts due to the relatively short periods of data available to build the models and the uncertainty surrounding the key drivers in the long-term. In the lack of any strong evidence for long-term traffic forecasts, simple trend projections are used instead.

2.7 The details of each model are given in Annex A.

Forecasting principles

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

2.9 Forecasts are based on <u>unconstrained growth</u> i.e. no consideration of actual capacity is taken on board.

[5] UK Port Demand Forecasts to 2030, MDS Transmodal
http://webarchive.nationalarchives.gov.uk/+/http:/www.dft.gov.uk/consultations/archive/2006/ppr/ukportdemandforecaststo2030.pdf

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

2.11 Forecasts use historic freight traffic data for major UK ports only[6], as cargo category breakdowns are not available for minor ports. In 2016, minor ports accounted for 3% of bulk freight traffic and less than 1% of unitised freight traffic.

2.12 The approach to forecasting port traffic is parsimonious, that is, we begin with a basic forecasting model and only add complexity into it if we feel it will improve 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 used to start with.

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

2.14 The forecasts build on forecasts produced by other Government bodies. For instance, these forecasts build upon GDP forecasts by the OBR and population forecasts produced by the ONS.

2.15 The port 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 completely separate 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.

2.16 Lastly, the forecasts for unitised freight do not consider the contents of the container, only the number of units that are transported by that method. This is because the infrastructure required to transport the freight is for container vessels, not dry bulk. For instance, it is possible that forestry products can be put in a containerised unit and transported via ports on a container ship. In this case, the unit of measurement is the container, not the weight of the forestry products inside them.

Engagement with others

2.17 Throughout the process of developing a methodology for new port traffic forecasts, in addition to presenting emerging findings, we have engaged with industry and other stakeholders to check the forecasts in this report are reasonable. This engagement has been useful in ensuring the forecasts are credible and realistic without pre-judging the solution.

2.18 Separately, within Government we have worked with colleagues in BEIS, DEFRA, the CCC and the Home Office to understand how our forecasts will fit alongside their own forecasting capabilities. Some bodies rely on the MDS 2006 estimates in their forecasting, so now we encourage the use of the forecasts in this document in the future.

[6] Major ports are ports handling over one million tonnes per year and a small number of other key ports. A full list can be found in the published port freight statistics.

3. Inputs and assumptions

Overview

3.1 This chapter outlines the inputs and assumptions that go into the port traffic forecasting model. The assumptions that feed into this model are designed to reduce complexity inherent in forecasting port traffic, however there is a risk that if the assumptions are too extreme they will not represent real life situations.

Forecasts from other organisations

3.2 One important principle of the port traffic forecasting model is that it is built on forecasts produced by other organisations. This means the port traffic forecasts must also consider the uncertainty of other forecasts as well as the uncertainty generated in the model.

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

Gross Domestic Product (GDP)

3.4 Economic theory explains that GDP is linked to aggregate demand, in which net exports are included as a measure of a nation's production. There is a strong relationship between GDP and international trade, so it is not surprising that this will be a key feature of the port traffic forecasting model.

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

3.6 The historical GDP estimates in this model come from the Office for National Statistics (ONS). GDP forecasts come from applying growth rates forecast by the Office for Budget Responsibility (OBR) to the historic ONS data.

Population

3.7 Most bulk cargoes transported through ports are raw materials which will be manufactured into goods that the UK population will consume. Therefore including the UK population as a key driver can be interpreted as a proxy for overall consumer demand. We would expect port traffic to increase as the UK population increases.

3.8 Population is used in forestry products and iron/steel forecasts. It also feeds into the ores forecast, via the iron/steel forecast.

3.9 Both historic and forecast population estimates come from the ONS.

Cargo specific drivers

3.10 Other drivers are specific to certain cargoes:

- LNG import forecasts from National Grid are used in the liquefied gases forecast.
- Oil production forecasts from the Oil & Gas Authority (OGA) are used in the crude oil forecast.

- Oil product demand forecasts from OGA are used in the oil products forecast.
- Coal power plant capacity forecasts from BEIS are used in the coal forecast.
- Brent price forecasts from the US Energy Information Administration (EIA) are used in the Lo-Lo TEU forecasts.

Other assumptions

3.11 External forecasts were not available for some of the key drivers. In these cases we have made assumptions about future trends, based on historic levels and patterns. For example, the coal forecast uses coal production figures, which we have projected based on the trend seen historically.

3.12 Additionally, it was not possible to identify key drivers for some cargo categories, namely the other liquid bulk, other dry bulk, and other general cargo categories. For these categories we have also assumed that traffic will follow the trend seen in historic data.

Scenarios

3.13 The main forecasts are for a central case, in other words based on central case projections for the key drivers. In addition to this central case, we have produced low and high scenarios where alternative projections of the key drivers have been available.

3.14 These scenarios have been produced to give an indication of the impact that a change in the outturn of the key drivers could have on the forecasts and to highlight the uncertainty in the inputs we are using.

3.15 For most cargoes, we have used either low and high growth GDP projections, or projections for other drivers which correspond to low and high growth projections. We have also used low and high population projections for the cargo forecasts which used population.

3.16 For liquefied gases, the scenarios reflect uncertainty around the supply of gas and how this will be split between continental gas and LNG in the future.

3.17 For coal, the scenarios use low and high energy price projections of coal power plant capacity.

3.18 For Ro-Ro units, the scenarios reflect uncertainty around the conversion from tonnage to units, in addition to low and high growth GDP.

Table 2 Projections of key drivers used in scenarios

Driver	Central case	Low scenario	High scenario
GDP	OBR central projection	OBR central projection with growth decreased by 0.5pp	OBR central projection with growth increased by 0.5pp
Population	ONS principal projection	ONS low migration projection	ONS high migration projection
Brent price	US EIA reference case projection	US EIA low economic growth projection	US EIA high economic growth projection

Driver	Central case	Low scenario	High scenario
Generic gas imports supplied by LNG	50%	20%	80%
Oil products demand	OGA projection	OGA projection reduced in-line with BEIS low growth projection of energy consumption	OGA projection uplifted in-line with BEIS high growth projection of energy consumption
Coal power plant capacity	BEIS reference scenario projection	BEIS low price scenario projection	BEIS high price scenario projection
Tonnes per Ro-Ro unit	Average of historic data	95% confidence interval around historic average	

3.19 It is important to note that not all of the forecasts use drivers with alternative scenario forecasts. For example, the crude oil forecast only uses a projection of oil production, for which there are no alternative forecasts. The lack of scenarios for any cargo category does not indicate a higher level of certainty in that forecast and instead is just a reflection of the model's structure and the input data available.

3.20 Also, as different cargo forecasts use different drivers, the scenarios are not directly comparable across cargo categories. For example, the iron and steel forecast uses population, so the scenarios for this cargo are high and low population scenarios, whereas the forestry products forecast uses GDP, so the scenarios are high and low GDP scenarios.

3.21 The scenarios, and the general treatment of uncertainty in the forecasts, is something that we will work to refine in future forecasts.

4. Forecasts

Introduction

4.1 This chapter provides the results of the port traffic forecasting model. It gives forecasts for the entire ports sector, then breaks down forecasts into cargo categories.

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

Headline forecasts

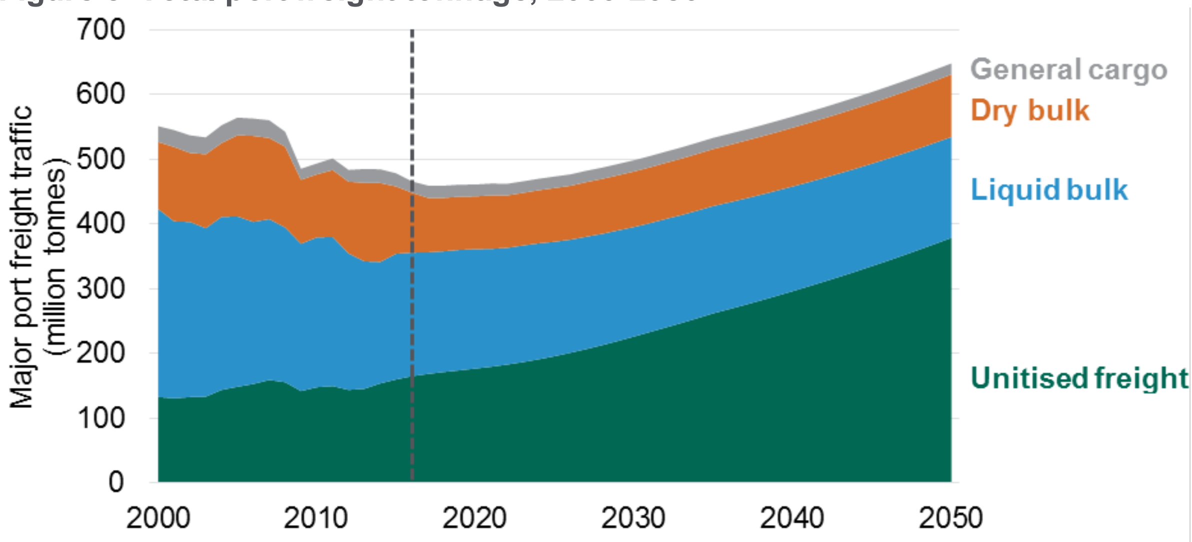
Total port freight

4.3 Overall, port traffic is forecast to remain relatively flat in the short term, but grow in the long-term, with tonnage 39% higher in 2050 compared to 2016.

4.4 The long-term growth in port traffic is driven by increases in unitised freight traffic. In the short-term, this growth in unitised traffic is offset by decreases in the other categories.

4.5 It is worth noting that some of the decrease in non-unitised freight is due to the increased containerisation of goods, for example the decline in general cargo is partially due to some of these goods becoming unitised traffic.

Figure 3 Total port freight tonnage, 2000-2050

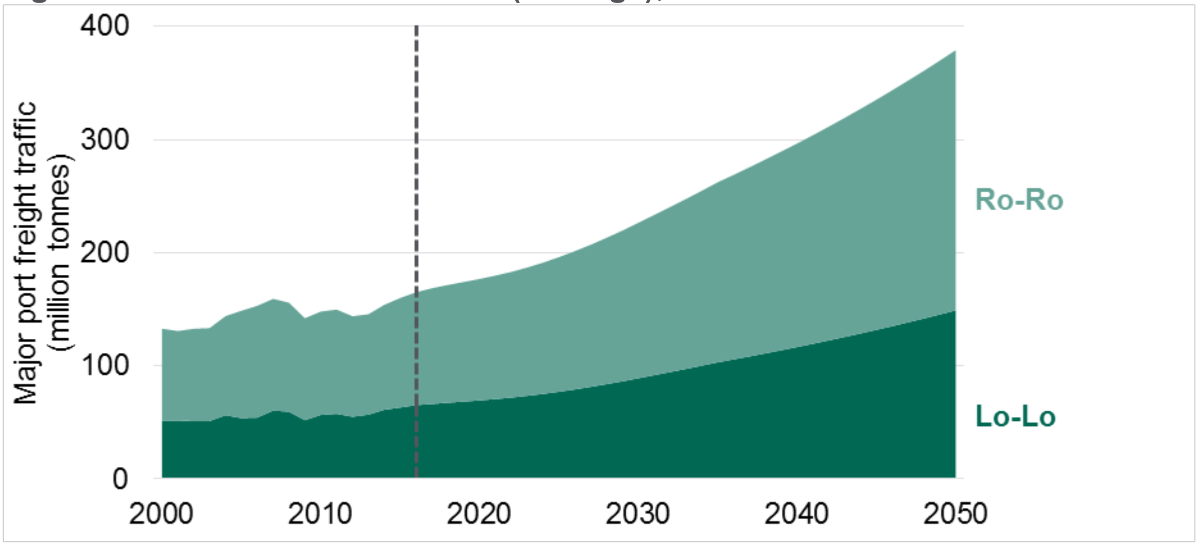


Unitised freight

4.6 Unitised freight traffic is forecast to strongly grow, with all categories of unitised freight more than doubling by 2050.

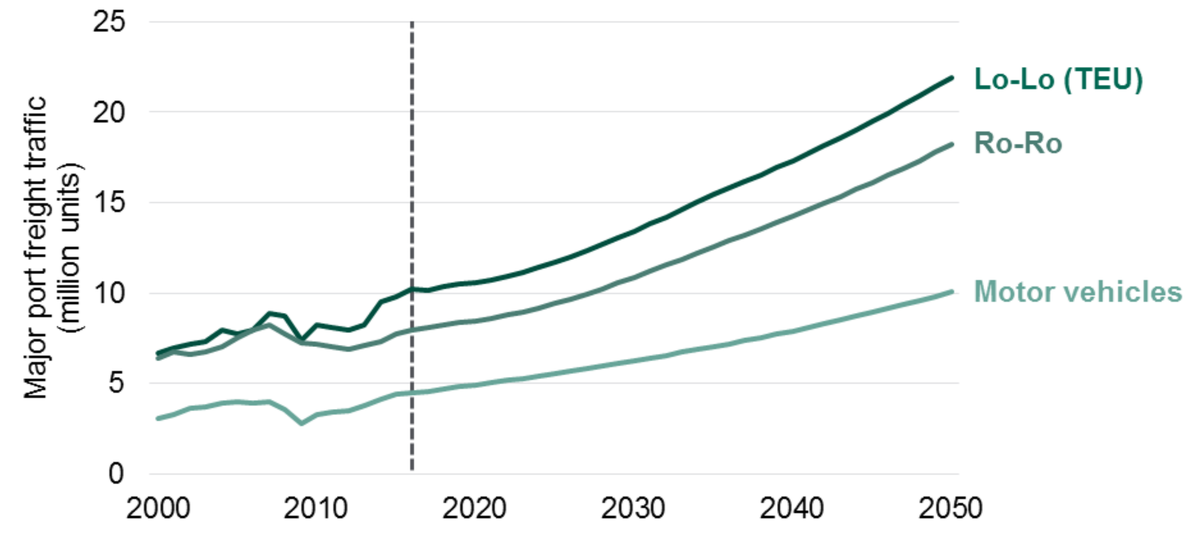
4.7 For Lo-Lo and Ro-Ro tonnage forecasts, we have assumed that the split between the two categories will be similar to the split seen historically, which has been fairly consistent over time. We have used the average split of 1988-2016 freight for the forecasts, which has 39% of unitised tonnage being transported as Lo-Lo.

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



4.8 It should be noted that unitised freight tonnage forecasts do not include motor vehicles, which are forecast separately in units and are also forecast to strongly grow, as is the TEU forecast for Lo-Lo and the unit forecast for Ro-Ro.

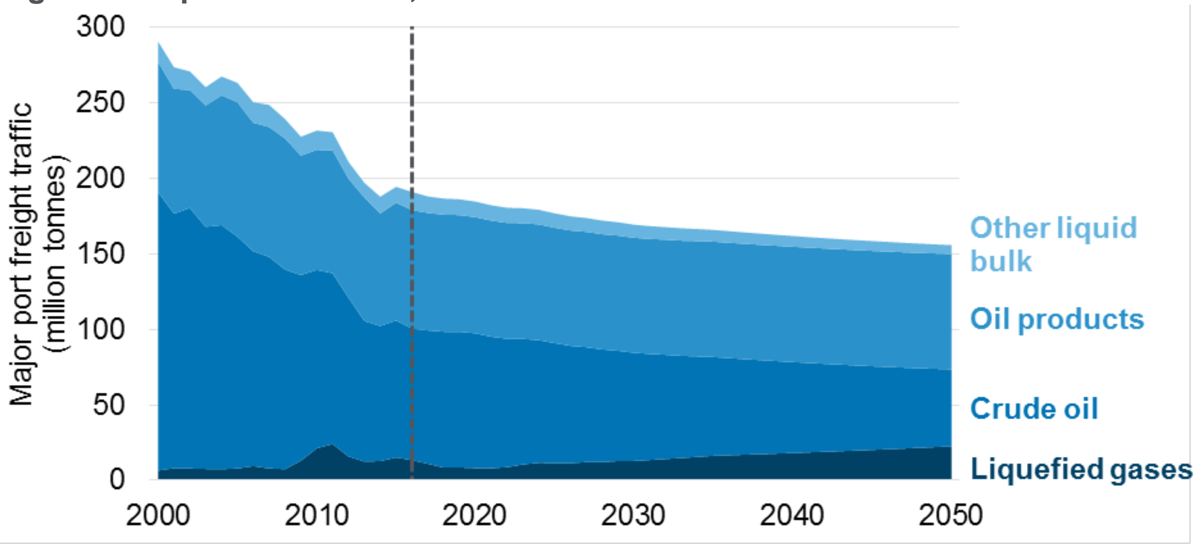
Figure 5 Unitised freight traffic, 2000-2050



Liquid bulk

4.9 Liquid bulk traffic is forecast to decrease, with the largest proportional decrease of the four cargo groups – an 18% reduction in tonnage by 2050. This is almost entirely due to falls in crude oil traffic, in line with the decreases which have been seen historically.

Figure 6 Liquid bulk traffic, 2000-2050

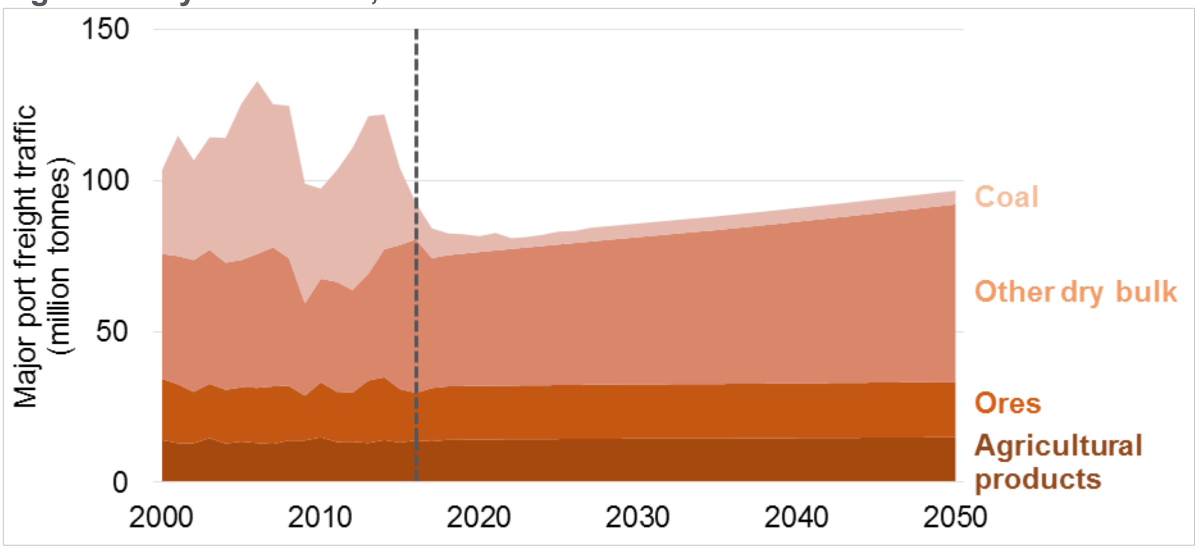


Dry bulk

4.10 Dry bulk traffic is forecast to have a large proportional decrease in the short-term, falling by 11 million tonnes from 2016 to 2020, driven primarily by demand for coal being projected to fall.

4.11 However in the long-term, dry bulk traffic is forecast to increase, with other dry bulk, the largest category, continuing to increase as it has done historically.

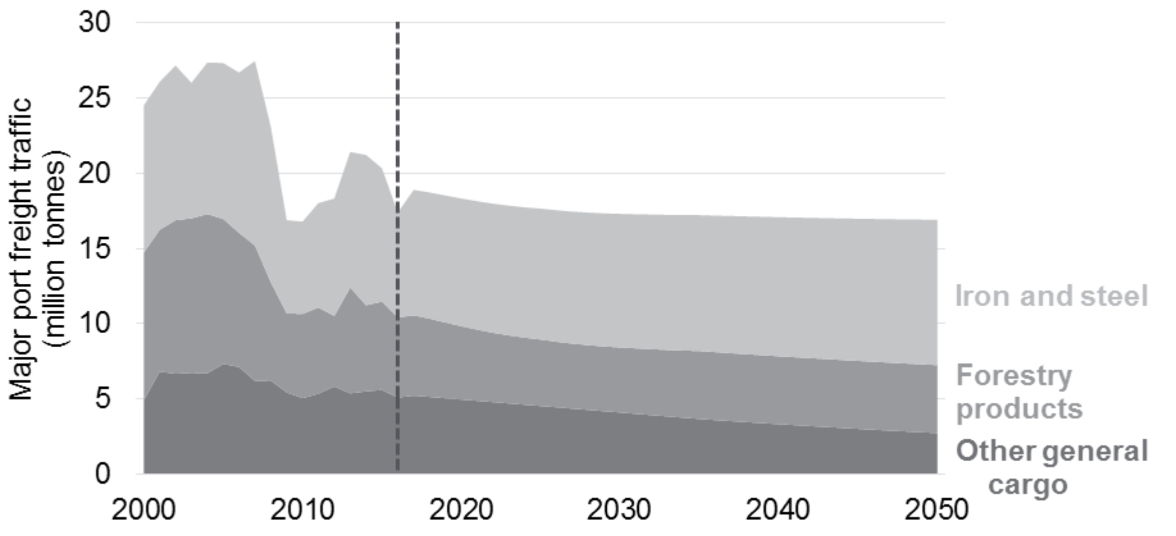
Figure 7 Dry bulk traffic, 2000-2050



General cargo

4.12 General cargo is forecast to decrease, primarily due to other general cargo continuing the decreasing trend seen historically. Iron and steel freight traffic is forecast to increase, but is not enough to offset the decreases in the other two categories.

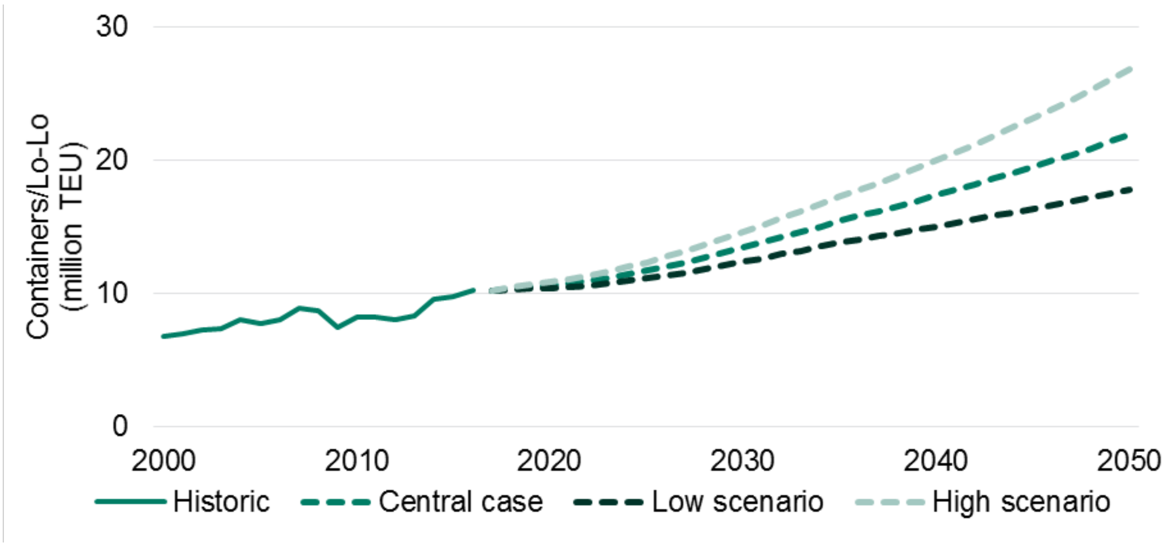
Figure 8 General cargo traffic, 2000-2050



Detailed forecasts

4.13 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 figures for this can be found in the accompanying tables.

Key drivers

GDP, Brent price

Commentary

The forecasts show strong growth in Lo-Lo traffic, with an average growth rate of 2.5% per year for tonnage and 2.4% per year for TEU.
This growth is driven by GDP growth, with Brent price having a very minor impact on the TEU forecast only, but also reflects the underlying trend of increased containerisation of other cargo categories.

Summary figures

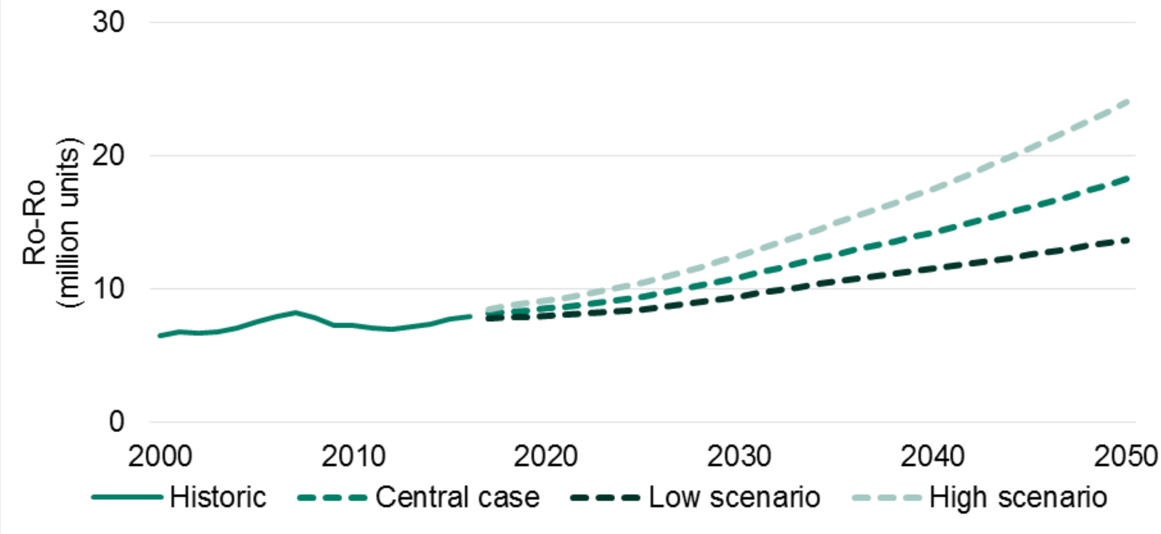
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	65.33	69.54	77.12	89.05	10.31	11.66	14.91
Growth from 2016		+6.4%	+18.0%	+36.3%	+57.9%	+78.5%	+128.2%
Million TEU	10.20	10.59	11.69	13.42	15.43	17.34	21.89
Growth from 2016		+3.8%	+14.6%	+31.6%	+51.3%	+70.0%	+114.6%

Scenarios

The scenarios reflect alternative projections of GDP growth and associated Brent price projections.

1. In a low GDP growth scenario, Lo-Lo traffic still grows strongly, but at a slightly lower rate of 1.7% per year on average for both tonnage and TEU.
2. In a high GDP growth scenario, the Lo-Lo traffic growth is even stronger with 3.2% growth per year for tonnage and 2.9% growth per year for TEU, on average.

Unitised freight: Ro-Ro



Notes:
The units forecast is calculated by converting the tonnage forecast into units based on the historic average tonnes per unit.

Key drivers

GDP

Commentary

The forecasts show similar levels of strong growth to Lo-Lo traffic, which is unsurprising as the tonnage forecasts are modelled together. The growth rates for Ro-Ro tonnage and units are exactly the same, averaging 2.5% per year.

Summary figures

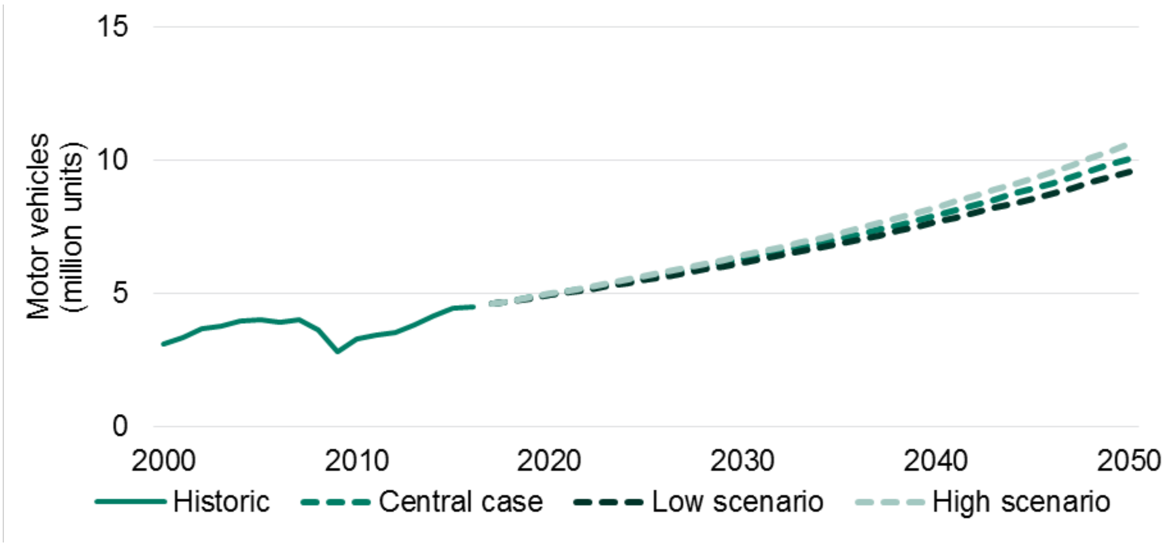
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	99.73	107.25	118.94	137.34	159.09	179.89	229.92
Growth from 2016		+7.5%	+19.3%	+37.7%	+59.5%	+80.4%	+130.5%
Million units	7.94	8.49	9.42	10.9	12.6	14.2	18.2
Growth from 2016		+7.5%	+19.3%	+37.7%	+59.5%	+80.4%	+130.5%

Scenarios

The scenarios reflect alternative projections of GDP growth. For units, they also include uncertainty around the tonnes per unit conversion factor.

1. In a low GDP growth scenario, Ro-Ro traffic still grows strongly, but at a slightly lower rate of 1.7% per year on average for both tonnage and units.
2. In a high GDP growth scenario, the Ro-Ro traffic growth is even stronger with 3.2% growth per year on average for both tonnage and units.

Unitised freight: Motor vehicles



Key drivers

GDP per adult

Commentary

The forecast continues the GDP related growth that has been seen historically, with an average growth rate of 2.4% per year.

There are questions about how sustainable the long-term growth is due to changing attitudes towards driving[7], but there is a lack of firm evidence on exactly how this could change demand for motor vehicles. As a result, we have chosen to continue the growth in the long-term, which is consistent with the car ownership projections used in DfT's Road Traffic Forecasts[8].

Summary figures

Year	2016	2020	2025	2030	2035	2040	2050
Million units	4.46	4.94	5.57	6.28	7.04	7.93	10.06
Growth from 2016		+10.7%	+24.9%	+40.7%	+57.6%	+77.6%	+125.5%

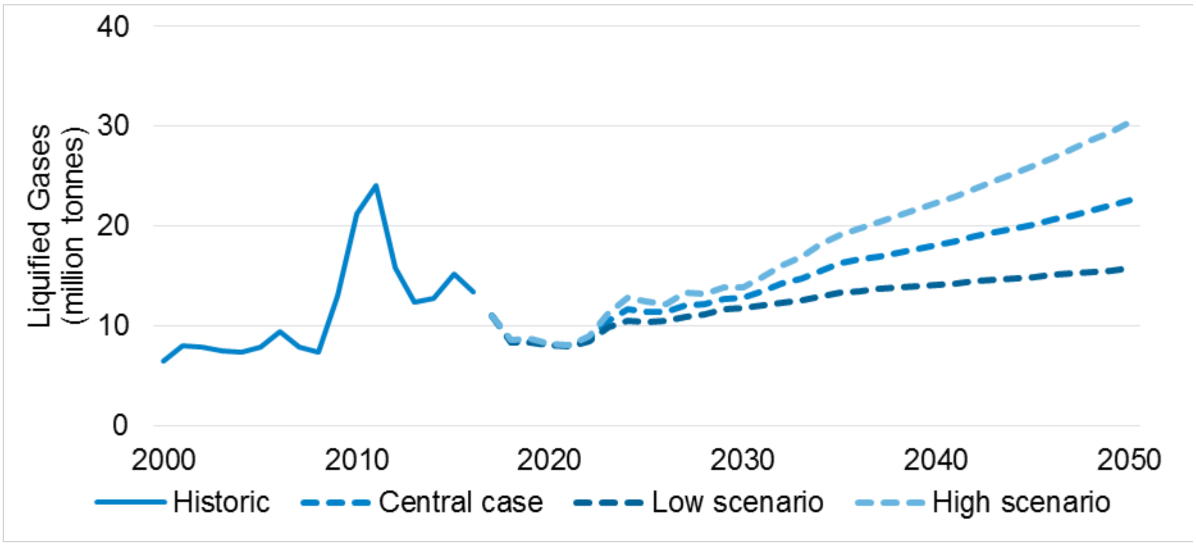
Scenarios

The scenarios reflect alternative projections of GDP growth.

1. In a low GDP growth scenario, the forecast is slightly lower, with an average growth rate of 2.3% per year.
2. In a high GDP growth scenario, the forecast is slightly higher, with an average growth rate of 2.6% per year.

[7] Young people's travel – what's changed and why, UWE Bristol / University of Oxford https://www.gov.uk/government/publications/young-peoples-travel-whats-changed-and-why
[8] Road Traffic forecasts 2018, DfT https://www.gov.uk/government/publications/road-traffic-forecasts-2018

Liquid bulk: Liquefied gases



Key drivers

Gas supply – LNG and generic imports

Commentary

The forecast of liquefied gas initially drops in 2017 and 2018 (18% and 23% decreases respectively), before roughly levelling at just over 8 million tonnes. There are large increases projected during 2022-2024 (averaging 13% growth per year), with growth levelling off in the long term at 2% per year on average. Liquefied gases traffic has been volatile historically, as it is strongly affected by global supply and prices, and there is a large amount of uncertainty around future gas supply in general.

Summary figures

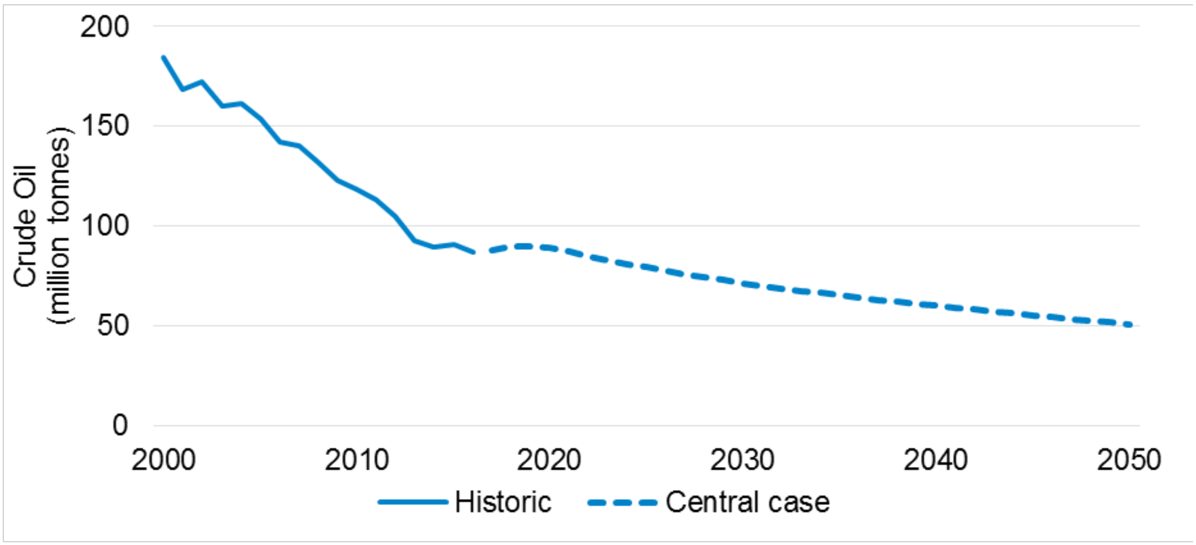
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	13.40	8.13	11.47	12.86	16.28	18.15	22.54
Growth from 2016		-39.4%	-14.4%	-4.0%	+21.5%	+35.4%	+68.2%

Scenarios

The scenarios are based on alternative assumptions about the proportion of generic gas imports being provided by LNG, reflecting uncertainty about the future gas supply.

1. In a low LNG supply scenario, the forecast is slightly lower in the short term with a larger gap in the long term where tonnage grows 1% per year.
2. Similarly, in a high LNG supply scenario, the forecast is only slightly higher in the short term, but has much higher growth in the long term at 3% per year.

Liquid bulk: Crude oil



Key drivers

Oil production, oil refinery throughput

Commentary

The crude oil forecast shows a fairly steady downward trend, in line with oil production projections. Tonnage is forecast is decrease 1.7% per year on average.
It should be noted that crude oil imports are strongly related to oil refinery throughput. As there are no official forecasts of refinery throughput, for this forecast, we have projected it based on the percentage change in 2017 (-0.2%), which is almost flat. However, there could easily be large changes in refinery throughput in the future which would greatly impact crude oil traffic.

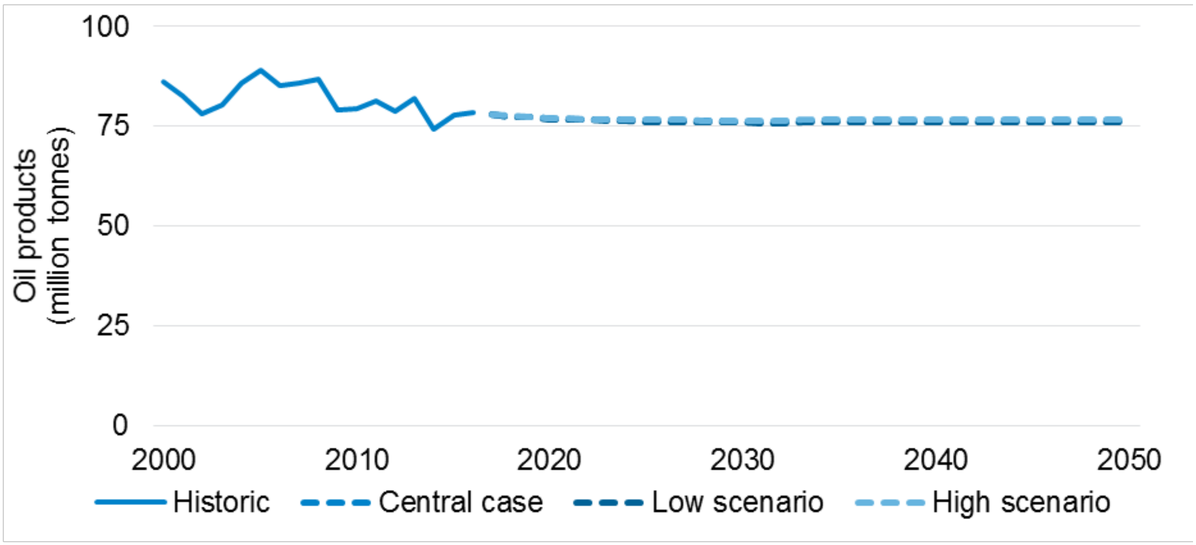
Summary figures

Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	87.09	89.26	79.41	71.61	65.39	60.17	50.94
Growth from 2016		+2.5%	-8.8%	-17.8%	-24.9%	-30.9%	-41.5%

Scenarios

There are no scenarios for this forecast.

Liquid bulk: Oil products



Key drivers

Oil products demand

Commentary

The oil products forecast has a small decreasing trend during 2017-2035, dropping -0.1% per year on average over that period. Beyond 2035 the forecast is flat-lined at 76 million tonnes.

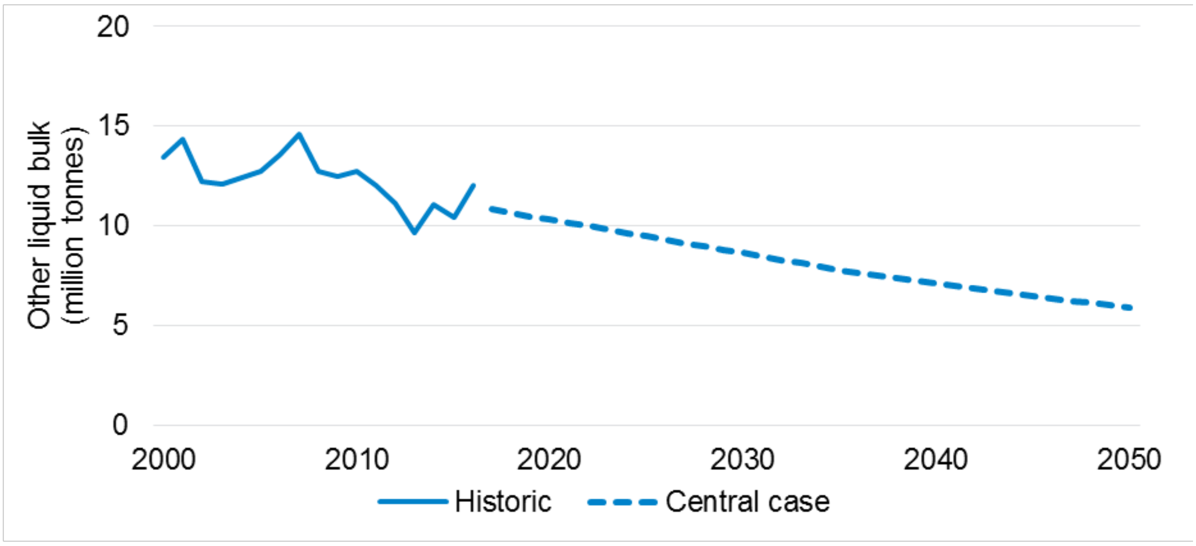
Summary figures

Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	78.45	76.89	76.42	76.20	76.38	76.38	76.28
Growth from 2016		-2.0%	-2.6%	-2.9%	-2.6%	-2.6%	-2.6%

Scenarios

The scenarios reflect alternative projections of oil products, in line with high and low GDP growth scenarios. These alternative projections make very minor changes to the forecast, with slightly greater and lesser decreases in the short-term forecasts.

Liquid bulk: Other



Key drivers

Historic trend

Commentary

Other liquid bulk includes a wide range of non-petrochemical liquids (e.g. molasses, juices, and ethanol) which cover a range of industries. As a result, it was not possible to identify external key drivers for the whole group and the forecast for other liquid bulk is based solely on the historic downward trend. This trend has an average decrease of -1.8% per year, which results in tonnage halving by 2050. It is likely that this decrease is partly driven by the shift from liquid bulk to tank containers for some shipments.

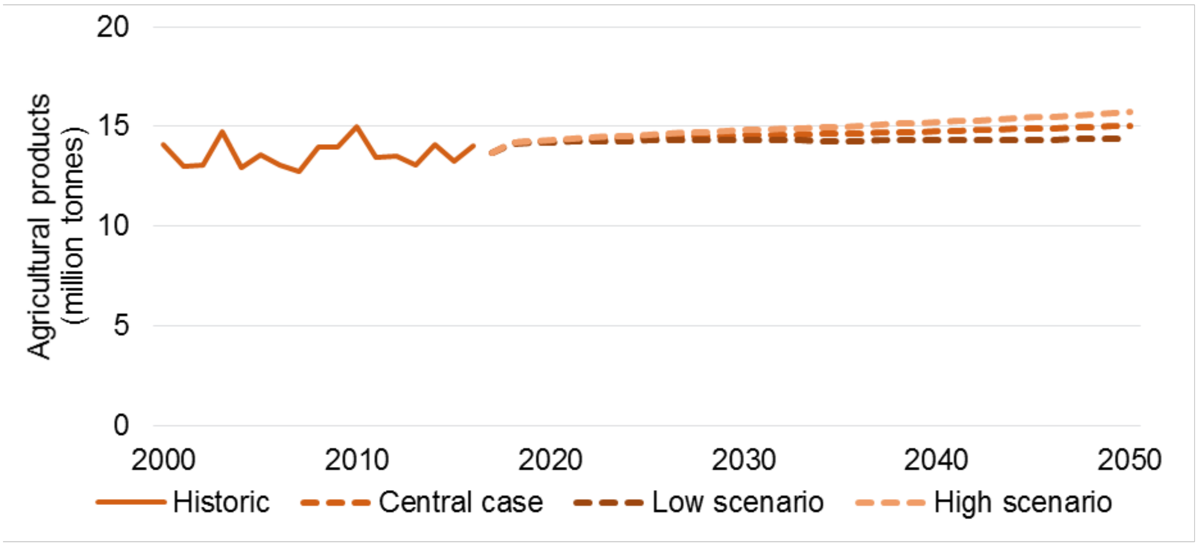
Summary figures

Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	12.05	10.33	9.48	8.64	7.80	7.12	5.93
Growth from 2016		-14.3%	-21.3%	-28.3%	-35.3%	-41.0%	-50.8%

Scenarios

There are no scenarios for this forecast.

Dry bulk: Agricultural products



Notes:
The 2017 value uses actual data on cereal trade and cereal exports had dropped that year, which is why traffic drops in that year unlike the rest of the forecast.

Key drivers

Population, trends in cereal production and cereal trade

Commentary

The forecasts show a small but steady increase in agricultural products traffic, with an average growth rate of 0.2% per year.
Most of this growth comes from imports, which accounted for 55% of this traffic in 2016. These imports are mainly driven by population, as a larger population will consume more agricultural products.

Summary figures

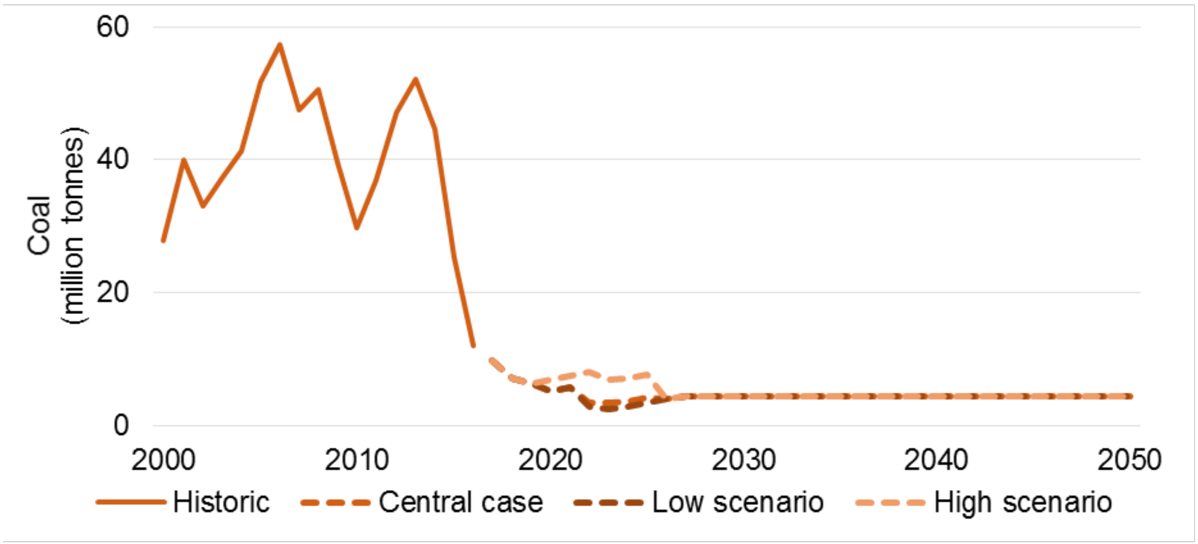
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	14.01	14.28	14.44	14.56	14.63	14.77	15.04
Growth from 2016		+1.9%	+3.1%	+4.0%	+4.4%	+5.4%	+7.4%

Scenarios

The scenarios reflect alternative projections of population growth.

1. In a low population scenario, agricultural products are almost flat, increasing by only 0.05% per year on average.
2. In a high population scenario, agricultural products have a higher rate of growth, increasing by 0.3% per year on average.

Dry bulk: Coal



Key drivers

Coal power plant capacity, trends in coal production

Commentary

Coal power plant capacity is set to drop to 0 by 2026, which drives decreases in coal traffic from 2016 to 2026. After that, coal traffic is forecast to level off to meet the remaining level of demand for other purposes, such as coke manufacture and blast furnaces.

The slight increases seen 2024 to 2027 are due to declining coal production resulting in the need for more coal imports.

Summary figures

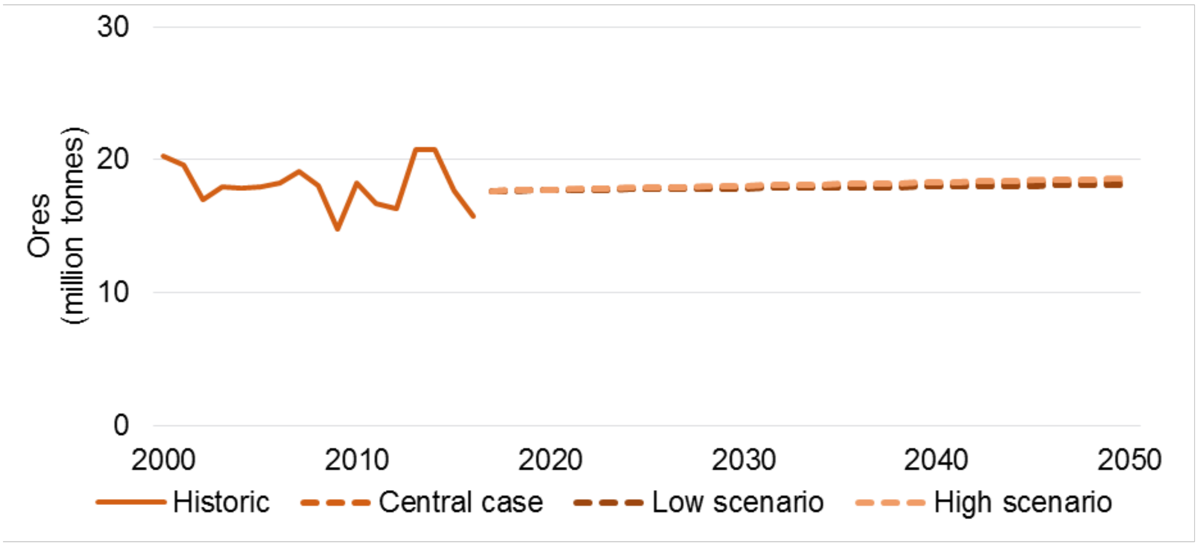
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	12.01	5.23	4.26	4.52	4.52	4.52	4.52
Growth from 2016		-56.4%	-64.5%	-62.4%	-62.4%	-62.4%	-62.4%

Scenarios

The scenarios reflect alternative projections of coal power plant capacity under low and high energy prices scenarios.

1. In a low energy price scenario, coal power plant capacity drops to 0 faster, so coal traffic is slightly lower 2022-2026.
2. In a high energy price scenario, coal power plant capacity stays at higher levels for longer, but still drops to 0 in 2026. As a result, coal traffic actually increases 2020-2022 before dropping to the same level as the central case in 2026.

Dry bulk: Ores



Key drivers

Iron/steel products traffic (which is driven by steel use and population projections)

Commentary

The forecasts show a small steady increase in ores traffic, with an average growth rate of 0.1% per year.
This forecast is driven by the iron/steel products forecast which is discussed later.

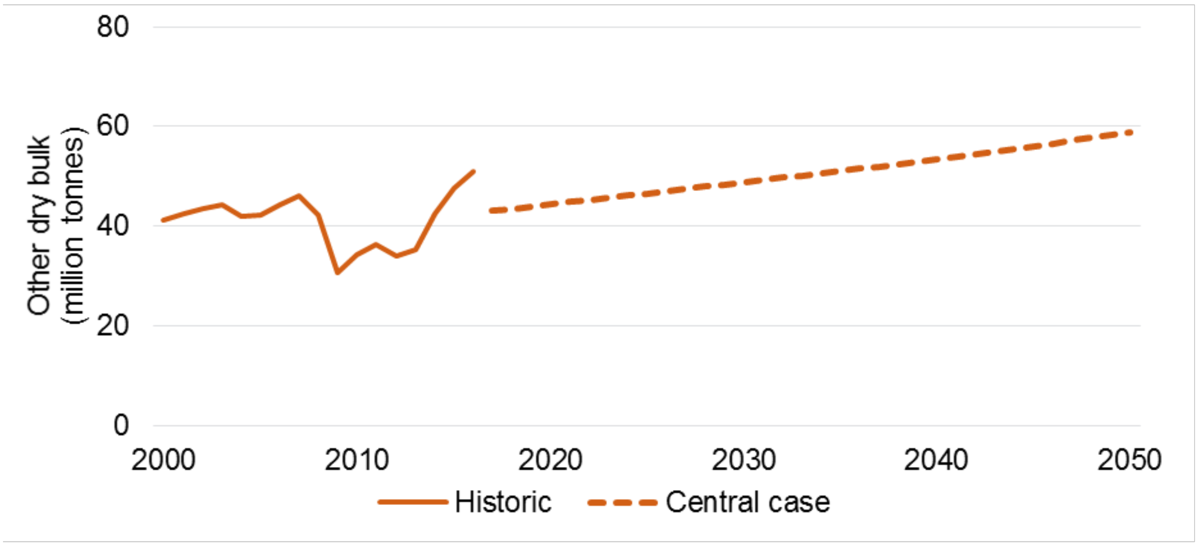
Summary figures

Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	15.71	17.74	17.86	17.96	18.04	18.15	18.37
Growth from 2016		+12.9%	+13.6%	+14.3%	+14.8%	+15.5%	+16.9%

Scenarios

The scenarios reflect alternative projections of population. These alternative projections make very slight changes to the forecast, with low population corresponding to a slightly lower forecast and high population corresponding to a slightly higher forecast.

Dry bulk: Other



Key drivers

Historic trend

Commentary

As with other liquid bulk, other dry bulk includes a wide range of products (e.g. cement, aggregates, wood pellets) and it was not possible to identify external key drivers for the whole group.

The forecast is based on the historic trend, which results in an average increase of 0.9% per year. This growth is likely due to increasing demand for biomass[9]. The port freight statistics do not record biomass separately, but HMRC statistics on trade with non-EU countries do and these show that biomass trade has greatly increased historically.

Summary figures

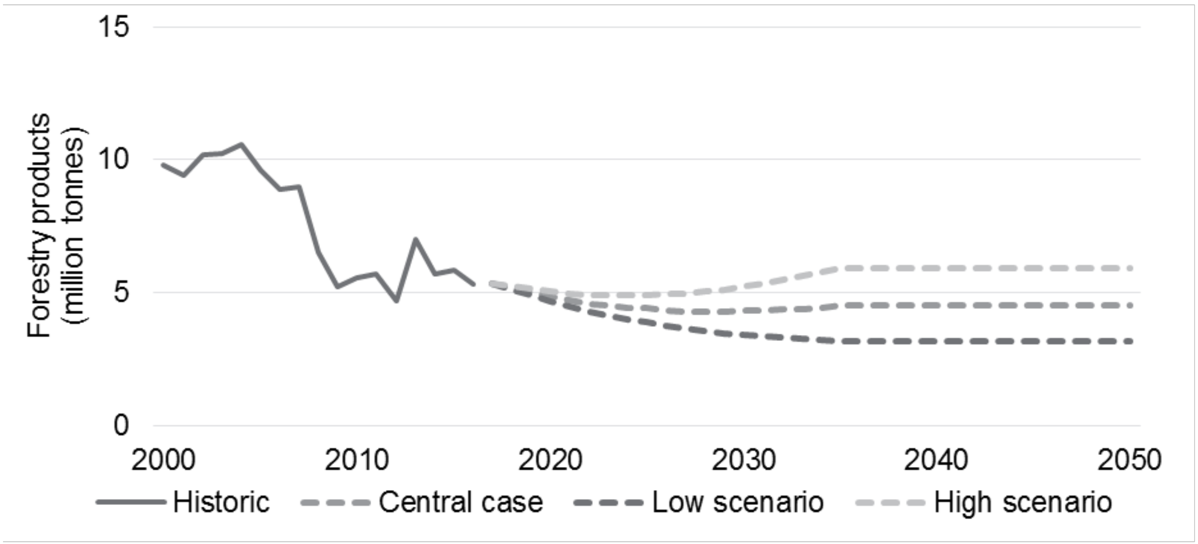
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	50.88	44.40	46.61	48.83	51.05	53.51	58.82
Growth from 2016		-12.8%	-8.4%	-4.0%	+0.3%	+5.2%	+15.6%

Scenarios

There are no scenarios for this forecast.

[9] Biomass: Biological material that can be used as fuel or for industrial production.

General cargo: Forestry products



Key drivers

GDP

Commentary

Forestry products are forecast to initially decrease, driven by the decreasing trend seen historically, to a low point of 4.3 million tonnes in 2029 (-19% from 2016, averaging -1.6% per year). After that, GDP growth begins to counter the trend and forestry products increase slightly. The forecast is then flat-lined from 2035.

Summary figures

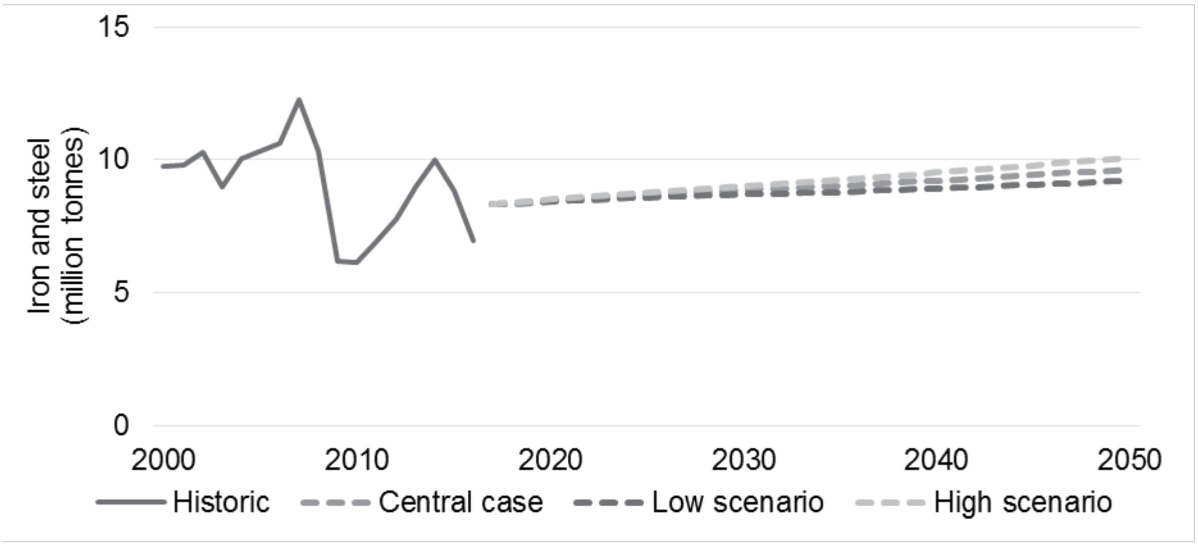
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	5.31	4.86	4.41	4.32	4.51	4.51	4.51
Growth from 2016		-8.4%	-16.9%	-18.7%	-15.1%	-15.1%	-15.1%

Scenarios

The scenarios reflect alternative projections of GDP growth.

1. In a low GDP growth scenario, GDP growth is not strong enough to counter the historic downwards trend and forestry products decrease by an average of -2.8% per year until being flat-lined from 2035 at a level 29% lower than the central case.
2. In a high GDP growth scenario, forestry products only decrease up to 2023 (averaging -1.2% per year) before increasing 0.8% per year on average up to 2035. The forecast is flat-lined from 2035 at a level 31% higher than the central case.

General cargo: Iron/steel products



Key drivers

Steel use per capita, population

Commentary

Iron and steel products traffic is forecast to steadily increase, with an average growth of +0.4% per year.
This forecast assumes that steel use per capita will remain constant in the future. In practice, steel use is related to the performance of other industries, such as the construction and automotive sectors, and has fluctuated historically due to this.

Summary figures

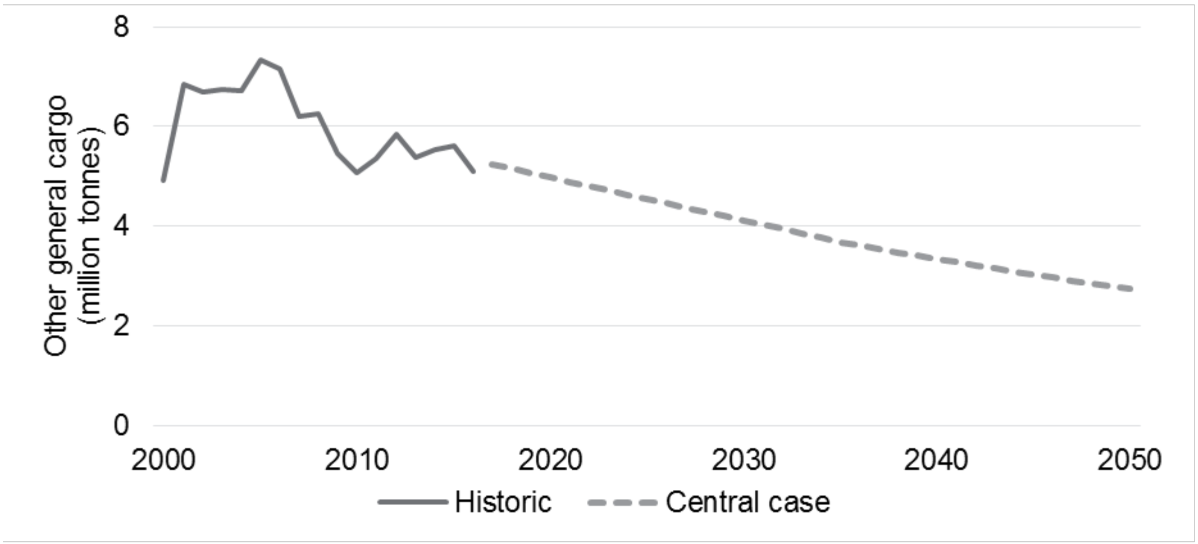
Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	6.96	8.47	8.68	8.87	9.02	9.22	9.64
Growth from 2016		+21.7%	+24.7%	+27.3%	+29.5%	+32.4%	+38.5%

Scenarios

The scenarios reflect alternative projections of population.

1. In a low population scenario, iron/steel products grows at a slightly lower rate, averaging +0.3% per year.
2. In a high population scenario, iron/steel products have a slightly higher growth rate, averaging +0.6% per year.

General cargo: Other



Key drivers

Historic trend

Commentary

Other general cargo includes break-bulk cargo (e.g. pipes, produce in bags, 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.
The forecast is based solely on the historic trend, which results in an average decrease of -1.9% per year. This decrease is likely partly due to increased containerisation of goods, i.e. shipments previously carried as break-bulk being moved in containers instead.

Summary figures

Year	2016	2020	2025	2030	2035	2040	2050
Million tonnes	5.11	4.98	4.55	4.12	3.69	3.34	2.75
Growth from 2016		-2.6%	-11.0%	-19.5%	-27.9%	-34.6%	-46.2%

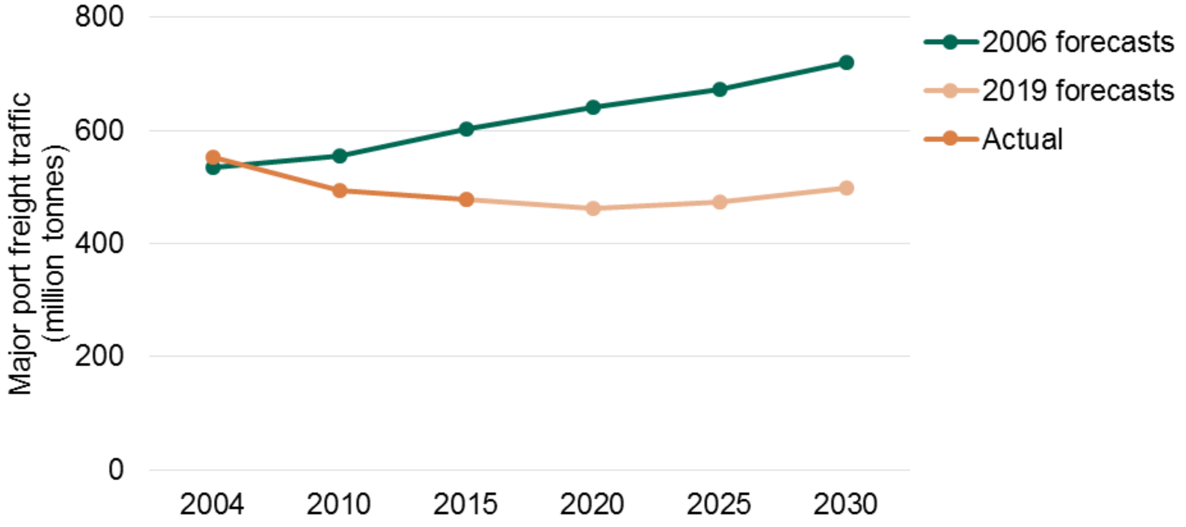
Scenarios

There are no scenarios for this forecast.

Comparison with previous forecasts

4.14 The previous port freight traffic forecasts produced in 2006 were based on 2004 data and forecast in 5 year intervals out to 2030. As these forecasts were produced shortly before the 2008/09 drop in port freight caused by the global recession, they overestimated freight and consequently the new forecast start at a lower level.

Figure 9 Comparison of 2006 and 2019 forecasts (excluding motor vehicles)



4.15 Looking at the forecasted percentage changes, the 2006 forecasts had many cargo categories relatively flat for the period 2020-2030. These new forecasts have clearer directions for each cargo category during this period, reflecting the fact that as it is closer there is less uncertainty about the direction of travel.

4.16 Some noticeable differences are the more negative forecasts for liquid bulk, coal and general cargo, in line with the large decreases which were seen 2004-2015. At the other end of the spectrum, the 2019 forecasts have a more positive forecast for other dry bulk.

Table 3 Comparison of percentage changes in 2006 and 2019 forecasts

	Percentage change 2004-2015		Percentage change 2020-2030	
	2006 forecasts	Actual	2006 forecasts	2019 forecasts
Lo-Lo & Ro-Ro	45%	11%	30%	28%
Liquefied gas	320%	105%	0%	58%
Crude oil	-18%	-44%	0%	-20%
Oil products	11%	-9%	14%	-1%
Other liquid bulk	10%	-16%	0%	-16%
Liquid bulk	2%	-27%	5%	-8%
Agriproducts	-1%	2%	-2%	2%
Coal	-3%	-39%	-2%	-14%
Ores	5%	-1%	3%	1%
Other dry bulk	5%	13%	0%	10%

	Percentage change 2004-2015		Percentage change 2020-2030	
Dry bulk	2%	-9%	-1%	5%
Forestry products	13%	-44%	5%	-11%
Iron/steel	1%	-12%	3%	5%
Other general cargo	1%	-17%	0%	-17%
General cargo	6%	-26%	3%	-6%
Total	12%	-13%	12%	8%

5. Next phase

5.1 While this report represents the conclusion of a project to build a bespoke forecasting model for UK port traffic, it is intended to be the first step in an iterative process of engaging with industry and other users and developing the forecasts. This section sets out the next phase of work.

Collecting feedback from users and stakeholders

5.2 The first step of the next phase will be to listen to the people who use this report and the forecasts to understand how they use them. This will allow us to consider whether to change the structure and format of outputs from the model to take account of the needs of the end user. Initial engagement suggests that some further breakdown of categories would be useful for some users (for example, Ro-Ro split into accompanied and unaccompanied trailers).

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

Testing

5.4 One future project strand will focus on testing the accuracy and predictive power of the forecasting model itself. This will consider the use of alternative methods for identifying the relationship between historic port traffic and historic key drivers. At present a linear regression approach is used, but other options may have stronger predictive power.

5.5 It may also involve reviewing the forecasting method for long-term (i.e. after 2035) forecasts and exploring the options of more sophisticated methods instead of the current simple trend.

Products in the forecasting model

5.6 Another project strand will investigate the tools that go in the forecasting model itself, on the basis of user feedback. This will likely include the treatment of uncertainty, for example refining the scenarios, or incorporating other measures of uncertainty, such as prediction intervals.

New data points

5.7 There will naturally be a process of periodically updating all the datasets to cover the latest historic 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 In general, each of the cargo categories has its own model, which is unrelated to the other forecasts (except for possibly using the same key drivers). There are three exceptions for this:

- Ro-Ro and Lo-Lo tonnage, which are forecast together and then split.
- Ro-Ro units, which is forecast based on the Ro-Ro tonnage forecast.
- Ores, which is forecast based on the iron and steel forecast.

A.2 The following sections detail the methodology used for each cargo category to produce forecasts up to 2035.

Tonnage models

A.3 Combined **Ro-Ro and Lo-Lo** tonnage traffic is forecast using a regression model on first order differences with GDP. This combined forecast is split into Ro-Ro and Lo-Lo based on the average proportional split seen in historic data (1988-2016).

A.4 **Liquefied gases** traffic is forecast in three components:

- LNG imports: Forecast based on National Grid's Future Energy Scenarios, with an assumption about the proportion of generic imports that will be LNG.
- LNG exports: Forecast based on the percentage of LNG imports re-exported in 2016 and 2017 (the only two full years since the UK began exporting LNG).
- LPG traffic: Historic traffic is estimated as the difference between liquefied gases traffic and LNG imports/exports. It is forecast as the average for 2009-2016.

A.5 **Crude oil** traffic is forecast in two components:

- Crude oil outward traffic: Forecast using a regression model with oil production projections.
- Crude oil inward traffic: Forecast using a regression model with oil refinery throughput (which is projected based on the percentage change in throughput from 2016 to 2017).

A.6 **Oil products** traffic is forecast using a regression model with oil products demand.

A.7 **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 CAGR of the period 1984-2017.
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 2008-2017.

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 2000-2017.

6 Cereal imports = domestic use + exports + change in stock - production

A.8 **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 1996-2017.

b. Deep-mined and other sources of coal production is projected as a flat-line from 2017.

2 Coal demand is projected by type:

a. Heat generation, coke manufacture, and blast furnaces demand is projected as a flat-line from 2017.

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 2012-2017.

4 Coal imports = demand + exports - production

A.9 **Iron and steel** traffic is forecast using a regression model with steel use (which is projected based on population projections and the average steel use per capita during 2008-2016).

A.10 **Ores** traffic is forecast using a regression model with iron and steel traffic.

A.11 **Forestry products** traffic is forecast using a regression model on first order differences 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; and
- Trade in newsprint, which is projected using the trend 2009-2017.

A.12 **Other liquid bulk**, **other dry bulk**, and **other general cargo** are forecast using the trends in historical data. For other liquid bulk and other general cargo, the trends for 2000-2016 are used. For other dry bulk, the trend for 2006-2016 is used.

Unitised models

A.13 **Lo-Lo** traffic is forecast using a regression model with GDP and Brent prices.

A.14 **Ro-Ro** traffic is forecast using Ro-Ro tonnage forecast and the average tonnes per unit.

A.15 **Motor vehicles** traffic is forecast using a regression model on first order differences with the number of private cars (which is projected using a regression model on first order differences with GDP per adult).

Long-term forecasts methodology

A.16 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 lack of any strong evidence for long-term traffic forecasts, simple trend projections or flat-line projections are used.

A.17 The trend projections use the compound annual growth rate (CAGR) of the short-term forecast to project beyond 2035 and are used for all cargo categories except oil products, coal, and forestry products. These forecasts are instead held constant from 2035. This was done because there was insufficient evidence to judge which direction the forecasts would move in.

Table 4 Long term growth rates in the central case forecasts

Cargo group	Cargo category	Long-term growth rate
Unitised freight	Ro-Ro (tonnage)	+2.5%
	Ro-Ro (units)	+2.5%
	Lo-Lo (tonnage)	+2.5%
	Lo-Lo (TEU)	+2.4%
	Motor vehicles (units)	+2.4%
Liquid Bulk (tonnage)	Crude Oil	-1.7%
	Oil products	0.0%
	Liquefied gases	+2.2%
	Other liquid bulk	-1.8%
Dry bulk (tonnage)	Agricultural products	+0.2%
	Coal	0.0%
	Ores	+0.1%
	Other dry bulks	+0.9%
General cargo (tonnage)	Forestry products	0.0%
	Iron and Steel	+0.4%
	Other general cargo	-1.9%

Annex B: Data sources

B.1 Data on port freight came from DfT's published port statistics, with the exception of Lo-Lo units. For Lo-Lo units, data from 2000 onwards came from DfT's published port statistics, but data prior to 2000 came from OECD container transport 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)	1988-2016
	Ro-Ro (units)	1988-2016
	Lo-Lo (tonnage)	1988-2016
	Lo-Lo (TEU)	1982-2016
	Motor vehicles (units)	1996-2016
Liquid Bulk	Crude oil	2000-2016
	Oil products	1994-2016
	Liquefied gases	2000-2016
	Other liquid bulk	2000-2016
Dry bulk	Agricultural products	1996-2016
	Coal	1994-2016
	Ores	2000-2016
	Other dry bulk	2006-2016
General cargo	Forestry products	1996-2016
	Iron and steel products	2000-2016
	Other general cargo	2000-2016

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

Table 6 Data sources

Name	Historical data source	Projection source	Scenario projections
GDP	ONS - ABMI series (1970-2017)	OBR - Economic & Fiscal Outlook and Fiscal Sustainability Report	Central projection with growth decreased/increased by 0.5pp

Name	Historical data source	Projection source	Scenario projections
Population	ONS - Mid-year population estimates (1971-2017)	ONS - Principal population projections	Low/high migration projections
Private cars	DfT - Vehicles statistics (1996-2017)	Produced in model	Produced in model based on GDP and population scenarios
Wood in rough, pulp, and newsprint trade	HMRC - Trade statistics (1996-2017)	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) (1996-2017)	Produced in model	Demand linked to coal power plant capacity scenarios
Brent price	US EIA - Europe Brent spot price (1982-2017)	US EIA - Annual energy outlook (reference case)	Low/high economic growth projections
Steel use	World Steel Association - Apparent steel use (2000-2016)	Produced in model	Produced in model based on population scenarios
Energy consumption of petroleum products	BEIS - Energy & emissions projections (1998-2017)	BEIS - Energy & emissions projections (reference scenario)	Low/high growth scenarios
Oil products demand	OGA - Production and expenditure projections (2000-2017)	OGA - Production and expenditure projections	Adjusted in line with energy consumption of petroleum products scenarios
LNG imports and exports	BEIS - DUKES (2000-2017)	Imports: National Grid - Future energy scenarios (Two Degrees) Exports: Produced in model	Assumption of the proportion of generic imports met by LNG varied
Cereal production area, production volume, change in stock, imports, exports, and domestic use	DEFRA - UK agriculture statistics (1984-2017)	Produced in model	Produced in model based on population scenarios
Oil production	Production and expenditure projections, OGA (1998-2017)	Production and expenditure projections, OGA	None
Oil refinery throughput	DUKES, BEIS (1997-2017)	Produced in model	None

Annex C: Econometric methods

C.1 The forecast approach uses an Ordinary Least Squares calculation of dependent and explanatory variables to identify a time-series relationship between historic port traffic and the set of explanatory variables defined in Annex A.

C.2 For each cargo market, the general form of the relationship is described below:

$$Fit = \alpha i + \beta iZit + \varepsilon it$$

Where

F_{it} = Port traffic at time t for market i

Z_{it} = A set of explanatory variables at time t for market i

ε_{it} = error in prediction at time t for market i

α_i, β_i = parameters to be estimated

C.3 The variables that are used for forecasting are selected following a process of assessing the performance various regression models, by considering:

- Sign of the individual explanatory variables; for instance, if GDP increases we might expect port traffic imports to go up. We would expect, therefore, to find an estimate in the regression output that is positive. If the regression estimate is negative, this would be a cause for concern.
- Measures of model fit, such as the F-test, adjusted R-squared, Mallows CP stat and Bayesian Information Criterion (BIC).
- T-statistics of individual explanatory variables for statistical significance.
- Tests for heteroskedasticity, normality of residuals and autocorrelation, to ensure that the OLS approach produces non-biased, efficient parameters.