OXFORD ECONOMICS

PORT OF LONDON AUTHORITY

FUTURE TRADE THROUGH THE PORT OF LONDON

ALTERNATIVE DECARBONISATION AND GROWTH PATHWAYS

MAY 2021

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Port of London Authority (PLA) commissioned Oxford Economics to produce forecasts of cargo handled in the Port of London to the year 2050 and identify opportunities and challenges for the PLA and stakeholders.

Background

- The Port of London handled 58m tonnes of freight traffic in 2019. The vast majority of these flows were inter-port trade (trade with other ports), accounting for close to 54 million tonnes; intra-port cargo volumes (cargo moving between terminals on the River Thames and cargo from Medway and Brightlingsea) accounted for over 4 million tonnes.

- The port plays a central role in supporting London's economy, so it is important to ensure it can continue to help deliver economic value and support jobs, while also supporting the UK's transition to net zero emissions in the years to 2050. In this context, the forecasts presented in this report provide guidance on economic direction and opportunity, with the purpose of informing strategic planning initiatives undertaken by the PLA and stakeholders.

Modelling Approach

- In addition to econometric analysis linking trade flows for each major product category to future trends in relevant economic drivers, the forecasts were guided by a detailed assessment of the impact of government policies in shaping future demand trends for each product. Specific attention was given to the impact of the UK government's **decarbonisation strategy** and recommendations from the Climate Change Committee (CCC) on how to achieve the 'net zero' emissions target by 2050.

- Other important contextual factors considered in the analysis included the long-term economic impacts of the coronavirus pandemic; the UK's departure from the European Union (Brexit); the Thames' winning bid for Freeport status; and various other behavioural changes affecting future logistics patterns, such as the accelerating growth of e-commerce.

- Our analysis was also informed by extensive **stakeholder engagement** to gather views and input from port operators and businesses using the port, as well as a selection of UK maritime business groups and external consultancies engaged in strategic projects to plan for the Port of London's future development. These consultations helped to shape our subsequent research and informed our forecasts.

Cargo forecasts under alternative scenarios

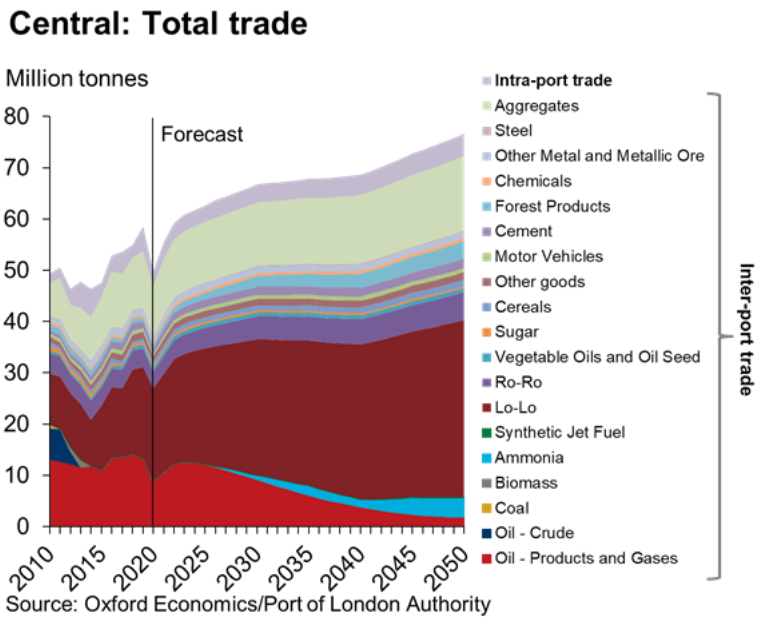
- Our **central** scenario for Port of London trade combines assumptions from the CCC's preferred 'Balanced Pathway' for achieving net zero with our central scenario for the economy and other factors influencing cargo flows to create what we view as the most likely future outcome for cargo flows. In order to capture the inherent uncertainties around the outlook, we then flexed these underlying assumptions to construct '**high trade'** and '**low trade'** scenarios that provide a plausible bandwidth around our central projection.

Fig. 1. Summary of scenario assumptions

Assumptions overview	Low trade	Central	High trade
Decarbonisation outcome	Net Zero 2042	Net Zero 2050	Net Zero 2050
Alternative UK decarbonisation pathways	CCC's Tailwind's assumptions	CCC's Balanced Net Zero Pathway assumptions	CCC's Headwind's assumptions
Underlying demand growth in UK/London	Consistent with ONS "***low growth***" population variant and Oxford Economics' ***downside*** GDP assumptions	Oxford Economics baseline view	Consistent with ONS "***high growth***" population variant and Oxford Economics' ***upside*** GDP assumptions
Port of London investment-led growth	Pessimistic assumptions (little to no growth in share of UK trade)	Oxford Economics baseline view (growth in share to 2030)	Optimistic assumptions (growth in share to 2050)
Net Port of London cargo impact	**Negative**	**Base case**	**Positive**

Projections from our **central scenario** for cargo flows show the total volume of cargo flowing through the Port of London increasing to 77 million tonnes by 2050, representing an increase of 18 million tonnes on 2019 levels. Within this, **inter-port trade** is projected to increase to 72 million tonnes by 2050.

Fig. 2. 'Central' scenario: Total cargo flows



- The key driver of growth in inter-port trade over this period is **unitised cargo**, which rises from 21 million tonnes in 2019 to 40 million tonnes by 2050. Oxford Economics estimates that food and manufacturing inputs make up over 56% by mass of unitised imports into the UK, whereas non-food consumer goods representing approximately 10% of total inflows. Although a smaller share of overall trade, the '**other cargo'** category is also projected to grow rapidly. A key driver is forest products, due to the projected increase in use of timber for construction.

- Conversely, **liquid bulk** represents a significant drag on volume growth over the forecast horizon. This reflects the projected significant decline of petroleum imports as fossil fuels are phased out, from over 13 million tonnes in 2019 to just 2 million tonnes by 2050. The decline in petroleum imports may be partially offset by new inflows of ammonia (used for the production of hydrogen), which in the central scenario is projected to reach 4 million tonnes by 2050 (albeit with considerable reliance on a number of assumptions).

Fig. 3. Central scenario: Outlook for inter-port cargo (million tonnes)

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Liquid bulk	20.3	14.6	10.0	9.4	7.2	-51%	-28%
of which Petroleum	19.2	13.3	8.9	6.1	1.8	-86%	-79%
Dry Bulk	10.3	14.6	13.2	17.0	19.2	31%	46%
Of which: aggregates/cement	6.9	12.4	10.9	14.5	16.5	33%	51%
Unitised Cargo	13.8	21.4	21.2	33.0	39.9	87%	88%
Other cargo	3.1	3.1	2.4	4.8	5.9	93%	148%
Total Inter-port	47.5	53.7	46.9	64.1	72.3	35%	54%

- Meanwhile, **intra-port trade** is projected to amount to around 4.3 million tonnes in 2050, representing a 23% increase on the 3.5 million tonnes traded on average each year over the period 2010-19.

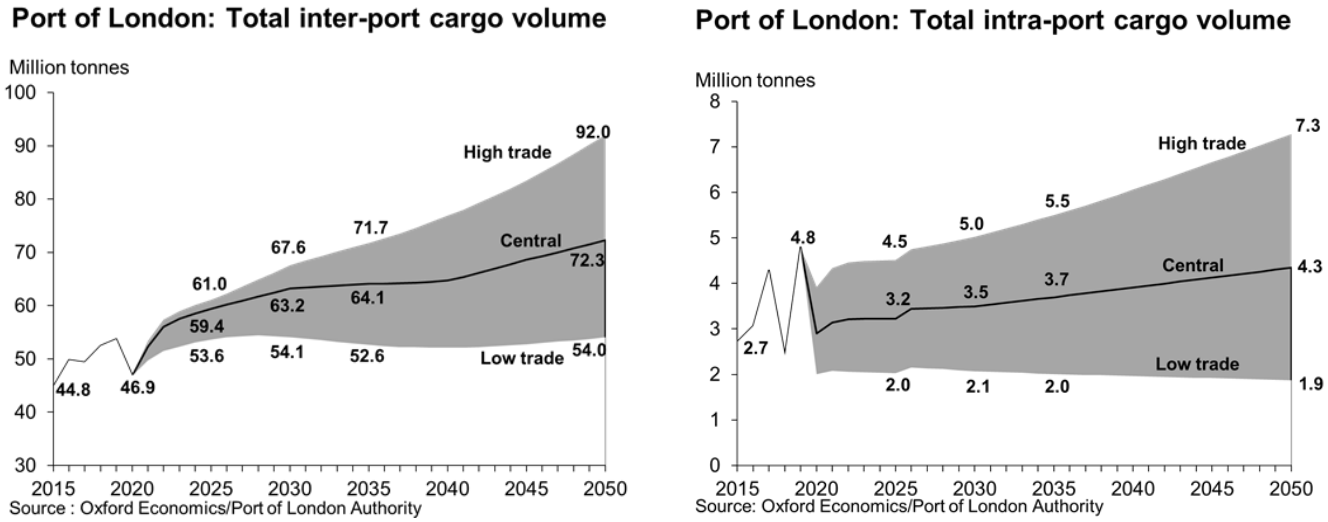
Fig. 4. Central scenario: Outlook for intra-port cargo (million tonnes)

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Aggregates	0.7	1.2	1.2	1.6	1.8	55%	51%
Construction waste	0.2	2.7	0.8	1.1	1.2	-55%	51%
Other	0.3	0.3	0.3	0.6	0.9	211%	243%
Waste	0.5	0.7	0.6	0.4	0.4	-35%	-32%
Total Intra-port	1.8	4.8	2.9	3.7	4.3	-9%	50%

- The outlook is subject to significant uncertainties, which create a wide dispersion of potential outcomes around this central case. In the **high trade** scenario, for example, total cargo flows reach almost 100 million tonnes by 2050 (of which inter-port cargo amounts to 92 million tonnes). The main driver of this improved outcome is the higher assumed growth in population and economic activity, which supports higher demand for unitised cargo and dry bulk (linked to construction activity).

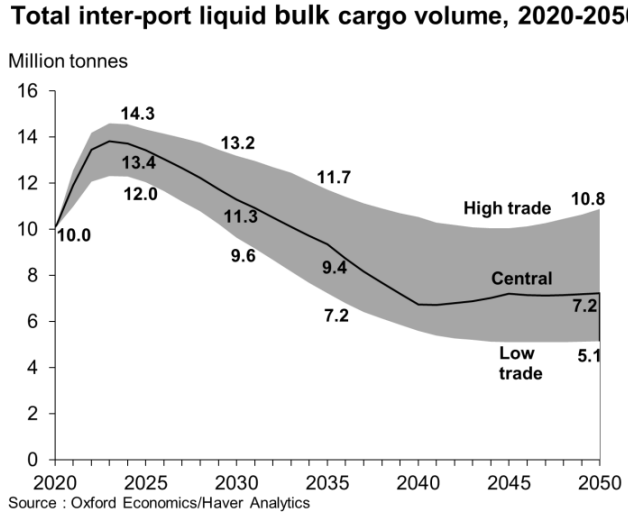
- Conversely, cargo flows are limited to just 56 million tonnes in the **low trade** scenario (of which inter-port cargo is limited to 54 million tonnes), leaving volumes largely unchanged from those experienced in recent years. But this outcome reflects the confluence of several negative factors, including sub-par economic growth, a failure to increase the port's share of UK trade, and accelerated behavioural changes that dampen demand for imports.

Fig. 5. Port of London cargo volume bandwidth



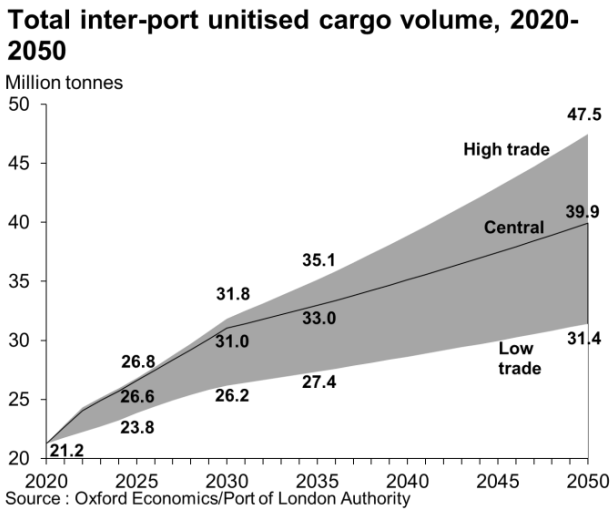
- Our analysis shows **liquid bulk** will lose volume compared to 2019 across all scenarios, but this ranges from a -65% loss in the 'low trade' scenario to -25% in the 'high trade' scenario. The outlook centres around the phase-out of petroleum and the level of substitution in the form of Ammonia.

Fig. 6. Liquid bulk scenario bandwidths



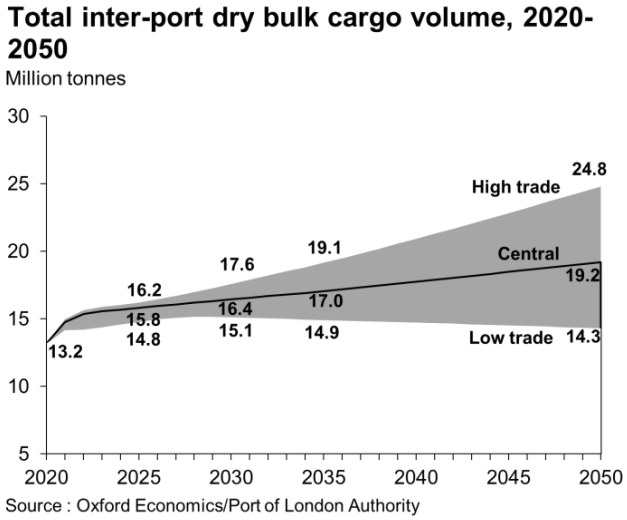
- Gains in total **unitised cargo** range from 47% in the 'low trade' scenario to 122% in the 'high trade' scenario (compared to 2019 levels). Gains are largely driven by the continued expansion of London Gateway, freeport status diverting trade from other ports, Brexit diverting Ro-Ro from Dover to London and GDP and population growth projections, ultimately increasing the port's share of UK unitised cargo.

Fig. 7. Unitised cargo scenario bandwidths



- Volume growth for **dry bulk** at the Port of London is largely dependent upon broad economic and demographic projections. Compared to 2019, the high trade scenario sees growth of 69%, while under the low trade assumptions volumes are slightly (-2%) lower in 2050 relative to 2019 levels.

Fig. 8. Dry bulk scenario bandwidths

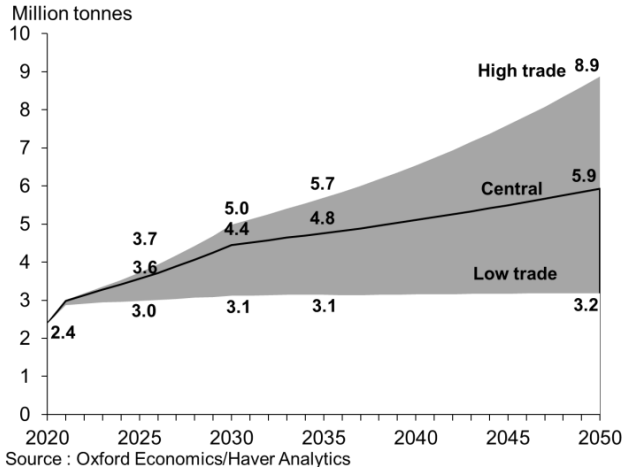


- Similar to the outlook for dry bulk, the outlook for **other cargo** (comprising steel, other goods, forest products and motor vehicles) is largely dependent upon broad economic and demographic trends. Our

analysis shows this category will largely gain volume compared to 2019 in all scenarios, from a low of 4% growth in the 'low trade' scenario, to more than doubling in the 'high trade' scenario (190% growth).

Fig. 9. Other cargo scenario bandwidths

Total inter-port other cargo volume, 2020-2050



Source : Oxford Economics/Haver Analytics

Opportunities and risks

- It is important to note that all the projections for cargo flows presented in this report are **unconstrained** by infrastructure capacity at the port. Realisation of the outcomes presented here will be contingent on ensuring infrastructure is maintained and extended as necessary to avoid potential bottlenecks in capacity to service the projected cargo volumes.

- There are additional risks to the outlook which have not been considered which may yield an outcome outside of the range of outcomes presented in this report. **Upside risks** include the potential size of the market for carbon-friendly fuels such as hydrogen (and the relatively low import penetration assumed by the CCC and this report), which may under an alternative set of assumptions generate trade which could dwarf any other cargo flow through the Port of London. Similarly, a substantial lowering of shipping costs and/or significant changes in policy to facilitate trade may reveal growth opportunities above and beyond the 'high trade' scenario projections presented in this report.

- **Downside risks** include disruptions to the historic relationships between trading volumes and economic activity. This could include a seismic shift in consumer behaviour or disruption in global trade flows (due to an aggressive trade war or increase in tariffs).

1. INTRODUCTION

1.1 BACKGROUND

The River Thames is the UK's busiest inland waterway, carrying 60% of all goods transported on the UK's inland waterway network. The river plays a crucial role in supporting London's economy, with the Port of London having handled 58m tonnes of freight traffic from around the world in 2019.

As the population and economy of the capital and surrounding region continue to expand, it is important to plan how this crucial component of London's transport network will develop to meet future demand. In this context, the Port of London Authority (PLA) commissioned Oxford Economics to produce forecasts of cargo handled in the Port of London to the year 2050 and identify opportunities and challenges for the PLA and stakeholders.

1.2 SCOPE OF THE STUDY

The forecasts were constructed with a specific focus on how the decarbonisation of the UK economy and transition to renewable energy will affect cargo flowing through the Port of London. This reflects the UK government's pledge to reduce greenhouse gas emissions to net zero by 2050, which will require systematic changes in business and consumer behaviours, as well as the energy system. The study considers different potential pathways to achieving the UK's net zero goal and implications for the volume and composition of future cargo flows.

Other important contextual factors considered in the analysis include the long-term economic impacts of the coronavirus pandemic, the UK's departure from the European Union, the Thames' winning bid for Freeport status, the Government's policy of 'levelling up' prosperity across the UK and various other behavioural changes affecting future logistics patterns, such as the accelerating growth of e-commerce.

1.3 APPROACH

As well as econometric modelling, the analysis was informed by extensive engagement with terminal operators and businesses using the port, as well as relevant industry groups representing the maritime sector, through a variety of workshops, online surveys and telephone interviews. This provided qualitative information that helped to inform the construction of the trade forecasts, as well as providing useful context around how businesses linked to the port are planning for the future.

1.4 OUTLINE

The report is organised as follows:

- **Section 2** describes recent trends in cargo flowing through the Port of London and how this past performance compares with other major UK ports.
- **Section 3** discusses future drivers of trade flowing through the Port of London and how these fit within our modelling framework.

- **Section 4** presents our long-term forecasts of trade through the port, with a split by cargo type.
- **Section 5** presents strategic implications for the port.

The Appendices present further detail on the qualitative stakeholder engagement exercise and quantitative modelling methodology, as well as more granular detail on the forecasts and drivers at the product level.

2. HISTORIC EVOLUTION OF PORT OF LONDON CARGO FLOWS

The Port of London handled around 58 million tonnes of cargo in 2019 (prior to the crisis), an increase of 9 million tonnes from 2010. The vast majority of these flows were inter-port trade (trade with other ports), accounting for close to 54 million tonnes; intra-port cargo volumes (cargo moving between terminals on the River Thames and cargo from Medway and Brightlingsea) accounted for over 4 million tonnes.

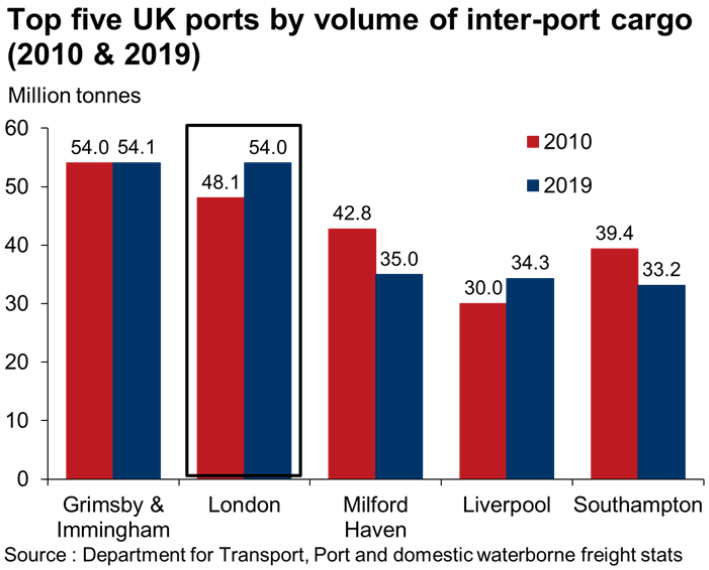
2.1 INTER-PORT CARGO

2.1.1 Overview

The Port of London handled 58m tonnes of cargo in 2019, an increase of 9m tonnes on 2010 levels.

The 54 million tonnes of inter-port cargo handled in 2019 (prior to the onset of the COVID-19 crisis) places the Port of London just behind the UK's largest port, Grimsby & Immingham, but significantly ahead of the next busiest UK port, Milford Haven (Figure 10). The volume of inter-port cargo handled by the Port of London has grown significantly over the past decade, increasing by 6 million tonnes between 2010 and 2019. Notwithstanding the sharp downturn in global trade experienced with the COVID-19 pandemic, the port still handled close to 47 million tonnes of inter-port cargo in 2020 (albeit the lowest level since 2015).

Fig. 10. Top 5 UK ports by volume of inter-port cargo, 2010 & 2019



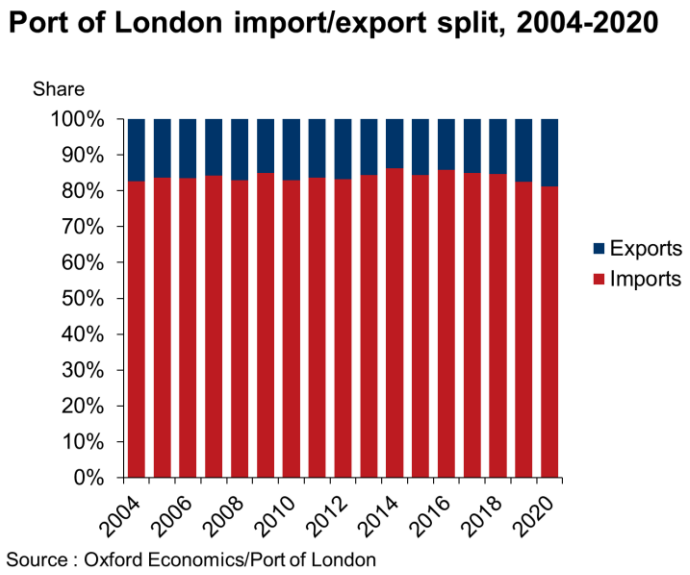
Source : Department for Transport, Port and domestic waterborne freight stats

2.1.2 Products traded

Imports have historically dominated inter-port cargo volumes, averaging 83% of freight handled over the past 5 years (Figure 11). While the underlying composition of cargos has changed considerably over time, aggregates,

petroleum and unitised cargo currently account for the majority of trade; together they represented around 87% of total imports and 85% of total inter-port trade in 2019, up from 84% and 81% respectively in 2014.

Fig. 11. Port of London import/export cargo split, 2004-2020



The port handled over 13m tonnes of petroleum products in 2019, although this fell sharply in 2020 due to mobility restrictions related to the pandemic.

Liquid bulk imports are of particular importance to the port, with 13.3 million tonnes of oil products handled in 2019, an increase of 1.6 million on 2014 levels (albeit falling to 8.9 million tonnes in 2020). Two-thirds of the 6.8m tonnes decline in inter-port cargo volumes observed in 2020 was due to the sharp decline in petroleum imports, a direct result of strictly curtailed mobility due to national lockdowns and international travel restrictions. Indeed, UK air passenger numbers fell by an estimated 72% in 2020, contributing to a decline of around 43% in aviation fuel imports at the port.

Dry bulk imports amounted to 13.4m tonnes in 2019 but fell significantly to 11.9 million tonnes in 2020. Almost of all of this decline can be attributed to aggregates and cement imports falling by 12%, a direct result of the contraction in UK construction activity as large swathes of the sector shut down in 2020 Q2 and other projects were delayed in the second half of the year.

Since the opening of London Gateway in 2015, the associated additional berth capacity has contributed to a 53% increase on 2014 levels in **unitised cargo** imports to 14.5 million tonnes in 2020, the equivalent of around 5 million tonnes, up from 14.2 million tonnes in 2019. Underlying this headline figure, a decline of 210,000 tonnes of Ro-Ro (Roll-on Roll-off) imports was more than offset by a 5.2 million tonnes increase in inwards Lo-Lo (Lift-on Lift-off) traffic.

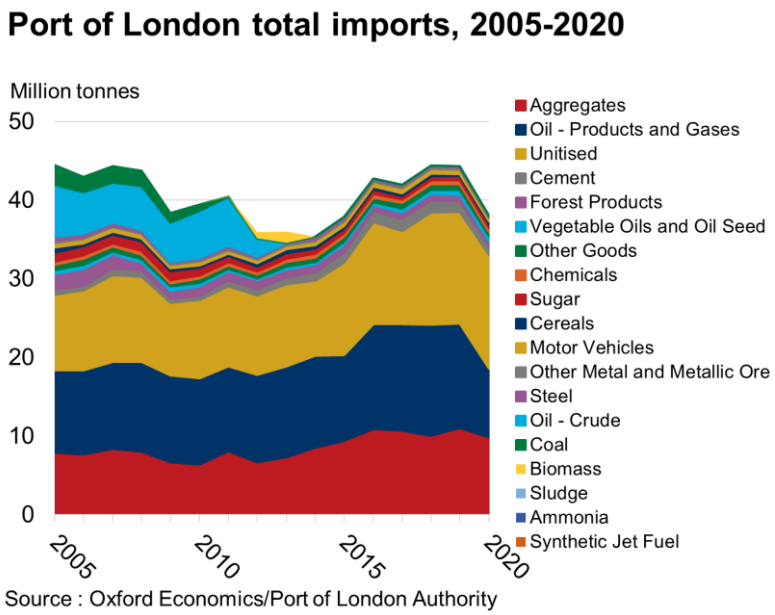
Fig. 12. Port of London inter-port trade by cargo group (million tonnes)

Cargo	Inward traffic				Outward traffic			
	2010	2014	2019	2020	2010	2014	2019	2020
Liquid bulk	17.8	12.5	14.4	9.8	2.4	0.4	0.2	0.3
Dry Bulk	9.1	10.9	13.4	11.9	1.2	1.4	1.3	1.2
Unitised	10.0	9.5	14.2	14.5	3.8	3.2	7.2	6.7
Other cargo	2.5	2.4	2.3	1.8	0.6	0.6	0.8	0.6
Total volume	39.4	35.3	44.3	38.0	8.1	5.6	9.4	8.8

Other cargo, comprising steel, other goods, forest products and motor vehicles, have experienced a fall of 26% between 2014 and 2020, the equivalent of 637,000 tonnes. This was driven by steel and forest products imports, which fell by 70% and 65% respectively over this period.

The composition of cargo traded through the Port of London has undergone some abrupt changes in the recent past. For example, the closure of the Coryton refinery in 2012, the last remaining major refinery on the Thames Estuary, abruptly ended the import of crude oil into the Port of London. Similarly, the conversion of Tilbury Power Station to biomass firing in 2011 resulted in coal imports to London drying up completely – the sharp downturn in coal imports represented another seismic shift in the port's history, from the 20 million tonnes of coal that had been entering the Thames each year in the late 1950s[1]).

Fig. 13. Port of London inward cargo traffic, 2005-2020

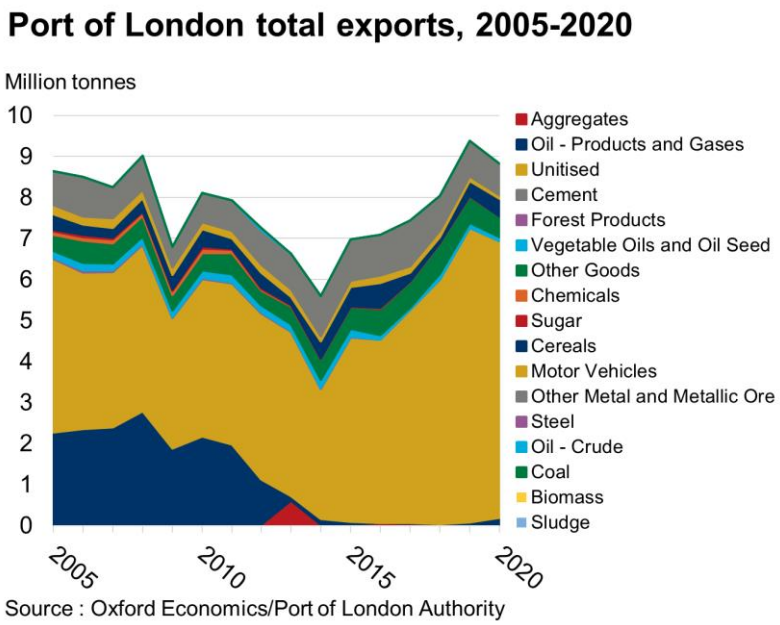


Source : Oxford Economics/Port of London Authority

[1] Special Correspondent (16 March 1959). "Industries along the Riverside". news. The Times (54410). London. col A, p. xi.

As with inward traffic, the largest **export** increases in both level and percentage terms in recent years have been Lo-Lo traffic, which increased by 3.8 million tonnes (183%) since 2014. Meanwhile, liquid bulk, dry bulk and other cargo all experienced a decline in outward traffic between 2014 and 2020, although given their small volumes this had a relatively modest impact on headline cargo volumes.

Fig. 14. Port of London outward cargo traffic, 2005-2020



Source : Oxford Economics/Port of London Authority

2.1.3 Geographic distribution of trade

Over 42% of inbound traffic to the Port of London originated from the EU, with 21% from other UK ports

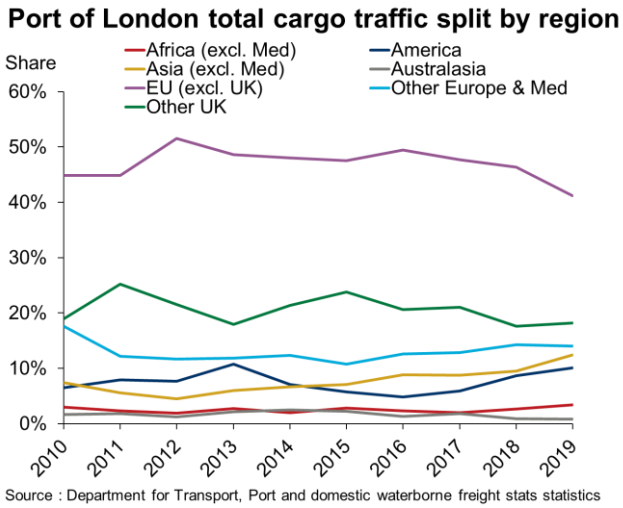
As of 2019 over 42% of inbound traffic handled at the port was from the EU (European Union), with 21% originating from other UK ports. But it is likely that the EU data includes a significant portion of goods that originated in Asia and other countries before being transhipped through EU trading hubs such as Rotterdam. Given the Port of London's' position in the South East of the UK, the port also handles a relatively high volume of traffic routed directly to/from Africa and Australasia. Within overall UK major port trade, the Port of London accounts for over 20% of trade with these geographies.

Fig. 15. Port of London total inter-port cargo by region, 2019

Region	Total tonnage (millions)	Share of inter-port cargo handled by Port of London	Share of total UK major port cargo
EU (excl. UK)	22.3	41%	11%
Other UK	9.8	18%	11%
Other Europe & Med	7.6	14%	12%
Asia (excl. Med)	6.7	12%	12%
America	5.4	10%	10%
Africa (excl. Med)	1.8	3%	22%
Australasia	0.4	1%	24%
Total	**54.0**	**100.0%**	**11.4%**

Between 2000 and 2019 total trade with the EU increased by 28% and remains the largest source of activity by volume, notwithstanding a modest decline in share of total cargo in recent years (Figure 16). It is likely that Brexit will only hasten this ongoing rotation in the port's trade toward non-EU partners.

Fig. 16. Port of London cargo traffic by geographic region, 2019



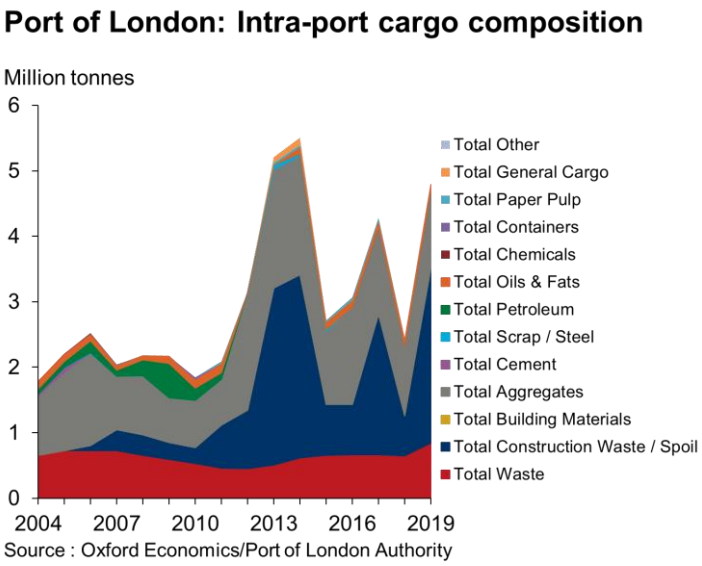
2.2 INTRA-PORT CARGO

Intra-port cargo volumes (cargo moving between terminals on the River Thames and cargo from Medway and Brightlingsea) more than doubled to over 4 million tonnes between 2010 and 2019 (the latest available data). Dry bulk cargo such as aggregates and cement, as well as construction waste and spoil, make up the majority of intra-port trade.

Intra-port cargoes are highly concentrated, with total waste, construction spoil and aggregates accounting for 98% of trade in 2019. Consistent with the closure of Coryton refinery in 2012, the last recorded intra-port petroleum movements occurred in 2011; the last intra-port movement of cement occurred in 2005.

Volumes have shown significant volatility in recent years, with a sharp rise in 2019 due to an increase in construction, excavation and demolition waste. Given the composition of trade flows driving this volatility, it is likely that this is linked to the 'lumpy' nature of construction projects along the Thames.

Fig. 17. Port of London intra-port cargo composition, 2004-2019



3. DRIVERS OF FUTURE TRADE THROUGH THE PORT OF LONDON

3.1 INDENTIFYING DRIVERS OF FUTURE TRADE FLOWS

Looking to the future, trade through the Port of London will be influenced by multiple factors. These include:

- **Driver 1:** The UK's decarbonisation strategy
- **Driver 2:** Developments in market demand
- **Driver 3:** Port of London investment-led growth

As the sensitivity of trade flows to each factor is likely to differ significantly between each cargo/product traded through the port, our projections were constructed at a disaggregated level.

In addition to econometric analysis linking trade flows for each major product category to future trends in relevant economic drivers, the forecasts were also guided by a detailed assessment of the impact of government policies in shaping future demand trends for each product. Our analysis was also informed by extensive stakeholder engagement to gather views and input from port operators and businesses using the port, as well as a selection of UK maritime business groups (summarised in Box 2).

Cargo projections are unconstrained, meaning it is assumed that infrastructure investment will be adequate to avoid potential bottlenecks in capacity.

It should also be noted that all projections for cargo flows presented in this report are **unconstrained** by infrastructure capacity at the port. In other words, it is assumed that infrastructure investment will be adequate to avoid potential future bottlenecks in capacity to service new and/or expanding trade at the port.

3.2 SCENARIO CONSTRUCTION

Recognising the uncertainties inherent in any forecast, we varied the underlying assumptions driving the projections to produce three alternative scenarios for the future evolution of the port's cargo flows.

Our **central** scenario for Port of London trade incorporates assumptions from the Climate Change Committee (CCC, the UK government's independent adviser on tackling climate change), on its recommended pathway to achieving a reduction in emissions consistent with 'net zero'. These are combined with our central scenario for the economy and other factors influencing cargo flows to create what we view as the most likely future outcome for cargo flows. We also construct '**high trade'** and '**low trade'** scenarios to provide a plausible bandwidth around our central projection.

Underlying assumptions were flexed along three key axes:

1) ***Driver 1: Alternative UK decarbonisation pathways***
    - All scenarios assume the UK achieves 'net zero' by 2050, in line with the Government's adoption of CCC recommendations. However, assumptions regarding the pathway towards this goal

can be calibrated in line with the CCC's alternative projections (as described in Section 3.3).

- The **central** scenario is consistent with the CCC's recommended *Balanced Pathway* for achieving net zero.
- Our **high trade** scenario is consistent with the CCC's *Headwinds* decarbonisation pathway, as this has more positive implications for cargo traded at the Port of London.
- Our **low trade** scenario is consistent with the CCC's *Tailwinds* decarbonisation pathway, which has more negative implications for cargo traded at the Port of London.
- Scenarios also incorporated alternative assumptions around the extent and composition of material and fuel switching in different sectors.

2) Driver 2: Underlying demand growth in UK/London

- Scenarios use alternative assumptions around the short- to long-term economic outlook (as described in Section 3.4).
- Our central trade scenario is consistent with the central economic scenario, while high trade and low trade variants incorporate assumptions from the upside and downside economic scenarios.

3) Driver 3: Port of London investment-led growth

- Alternative assumptions around the evolution of the Port of London's share of UK trade (by category of cargo) were informed by recent developments at the port and market research.
- Assumptions for the central scenario were flexed around a plausible upside/downside for each cargo type to feed into the alternative scenarios.

The table below illustrates how the **low trade** and **high trade** scenarios take the central assumptions and flex in such a way that generates a higher/lower trade outcome for the port.

Fig. 18. Summary of scenario assumptions

Assumptions overview	Low trade	Central	High trade
Decarbonisation outcome	Net Zero 2042	Net Zero 2050	Net Zero 2050
Alternative UK decarbonisation pathways	CCC's Tailwind's assumptions	CCC's Balanced Net Zero Pathway assumptions	CCC's Headwind's assumptions
Underlying demand growth in UK/London	Consistent with ONS "***low growth***" population variant and Oxford Economics' ***downside*** GDP assumptions	Oxford Economics baseline view	Consistent with ONS "***high growth***" population variant and Oxford Economics' ***upside*** GDP assumptions
Port of London investment-led growth	Pessimistic assumptions (little to no growth in share of UK trade)	Oxford Economics baseline view (growth in share to 2030)	Optimistic assumptions (growth in share to 2050)
Net Port of London cargo impact	**Negative**	**Base case**	**Positive**

High trade for example takes an optimistic view for the Port of London whenever possible, that is, over the forecast horizon it assumes above baseline economic and demographic growth for the London region, higher than baseline levels of cargo substitution, larger gains in share of UK trade captured by the port and a decarbonisation pathway more reliant on CCS (carbon

capture and storage) and as such has a lesser degree of impact on conventionally traded fuels. The opposite is true for the **low trade** scenario, with a more pessimistic view taken on each of the input assumptions surrounding cargo substitution, demand, economic and demographic growth, and share of UK trade.

The rest of this chapter discusses each of the key drivers of future trade in more detail, before summarising how we combine these multiple influences for constructing the trade scenarios.

3.3 DRIVER 1: THE UK'S DECARBONISATION STRATEGY

3.3.1 Government legislation

While future trends in demand are important drivers of trade, changes in government policy can have a significant influence on behaviours, with substantial effects on the composition of trade flows. The UK government's decarbonisation agenda represents a set of policy actions that are expected to result in significant structural shifts in domestic production and consumption patterns over the next few decades.

In April 2021, the UK government committed to reduce all emissions by 78% by 2035 (compared to 1990 levels)

The UK Climate Change Act contained the world's first legally binding national commitment to cut greenhouse gas emissions. The headline target was originally an overall cut in emissions of at least 80% by 2050 (relative to 1990), but this was amended in 2019 to a target of achieving net zero emissions by 2050. So-called 'carbon budgets' were also introduced under the Climate Change Act to have legally binding milestones to reach the 2050 target. Each carbon budget places a cap on the amount of greenhouse gases emitted in the UK over a five-year period.

The first five carbon budgets have been enshrined into law and run up to 2032. More recently in April 2021, the government also committed to the sixth carbon budget, which pledges to reduce all emissions by 78% by 2035 (compared to 1990 levels), as well as including the UK's share of international aviation and shipping within its target framework for the first time.

3.3.2 The Balanced Net Zero Pathway

The UK's government's independent adviser on tackling climate change, the Climate Change Committee (CCC), publishes recommendations on how to achieve the targeted reductions in emissions. At a high level, this will require action across four key areas as set out in the CCC's 'Balanced Net Zero Pathway' projections (their central scenario for net zero planning):

- Reducing demand for carbon intensive activities while improving efficiency in the use of energy and resources.
- Take-up of low carbon solutions while high-carbon options are phased out, should account for over half of the emissions reduction.
- Expansion of low-carbon energy supplies, namely low carbon electricity and hydrogen as new demand from transport, buildings and industry rise.
- Offsetting emissions, through nature-based solutions such as reforming land use and agriculture to artificial solutions including CCS

(Carbon Capture and Storage) to deliver engineered removal of CO2 at scale

While a host of measures with detailed sector level guidelines have been provided by the CCC, some of the largest shifts that will have major implications for the economy are expected to be on the following fronts:

Ending the use of fossil fuels: A crucial step towards achieving net zero emissions is eliminating the use of fossil fuels in powering our vehicles and energy systems. The CCC has recommended phasing out high carbon fuels across sectors in the economy through measures including phasing out fossil-fuelled cars and vans by 2032, oil boilers by 2028 (from residential homes), gas boilers by 2033 and gas power generation by 2030.

The CCC recommends phasing out fossil-fuelled cars and vans by 2032, oil boilers by 2028, gas boilers by 2033 and gas power generation by 2030.

Shifting to zero/low carbon energy sources: The CCC recommends that:

- Renewables contribute up to 90% of power generation by 2050,
- Electric vehicles account for 100% of sales of passenger vehicles by 2032,
- Building heating networks are electrified whilst phasing out oil and gas boilers and increasing electrification
- Use of alternative fuels such as hydrogen and biofuels, together with carbon capture and storage in industry and manufacturing.

The CCC's Balanced Pathway assumes that 13% of the UK's hydrogen requirements will be met by imports. It is likely that this hydrogen would be imported in the form of ammonia, a liquid-organic hydrogen carrier (e.g. methyl cyclohexane) or other organic molecules (e.g. methanol), as they are more cost effective and safe to transport over long distances.

While there are a number of potential candidates that could act as hydrogen carriers, our analysis assumes that this role is fulfilled by ammonia. Liquid ammonia has several key merits, including its high hydrogen content (18% by mass), ease of liquefaction and similar physical properties to liquefied petroleum gas, thereby providing an opportunity to use existing storage, transport and terminal equipment. Ammonia also has a long history of large-scale, cost optimised industrial production due to its global use as a fertiliser, chemical raw material and refrigerant. As well, liquid ammonia is already transported over large distances with good economics.

Furthermore, the CCC assumes that 25% of demand for ammonia to be used directly as bunker fuel for shipping will be imported.

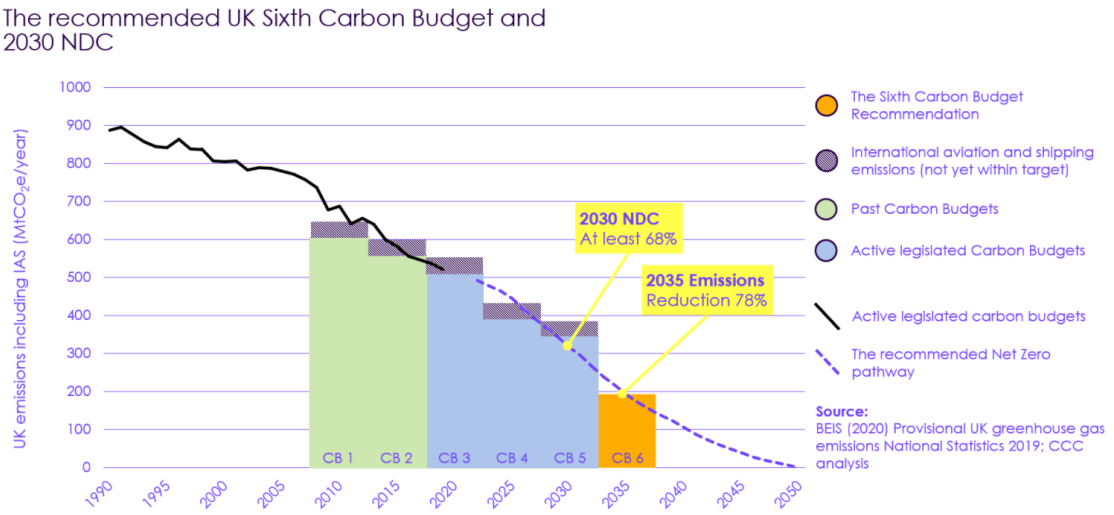
Material substitution in manufacturing and construction: Other major recommendations from the CCC are regarding substituting high emission materials and improving resource use and efficiency in the manufacturing and construction sector. These include:

- Re-using discarded steel products in industrial equipment.
- Yield improvement (metals) in car structures through cutting techniques.
- Substitution of high-carbon clinker for either waste products such as fly ash or ground granulated blast furnace slag or innovative new types of lower-carbon cementitious material.

- Increasing the use of timber and wood-based products in construction. The CCC projects that Timber frame and engineered wood use in new-build residential buildings will increase from 28% (in 2018) to 45% by 2050.

Agriculture and Land use: The CCC also emphasizes on changes to agricultural practices and improved land use among its measures to achieve UK's net zero target. It recommends a 20% shift away from red meat and dairy by 2030; 35% by 2050 (meat only) and increasing tree-planting rates.

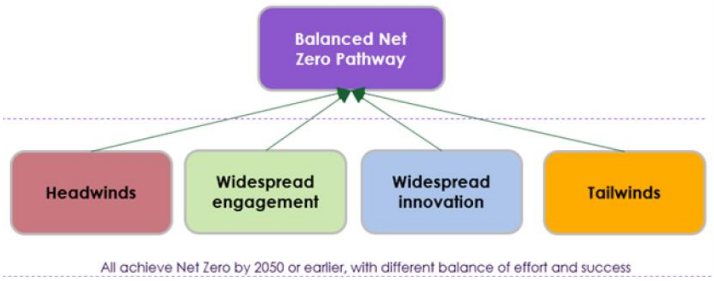
Fig. 19. The CCC 'Balanced Pathway' to net zero



3.3.3 Alternative CCC pathways to net zero emissions

While envisioning a path to net zero emissions, the CCC developed a number of scenarios to explore a range of ways for the UK to achieve its target. The scenarios illustrate how the pace of emissions reductions can vary between sectors if uncertainties resolve themselves in different ways. These scenarios formed a basis for identifying the Balanced Net Zero Pathway to 2050.

Fig. 20. Net zero pathways: Scenario framework



As illustrated by Figure 20 the CCC identified two pathways that represent alternative 'extremes' in terms of different balances of effort and success whilst still achieving the net zero target. These are:

- **Headwinds:** in this scenario, there are behavioural and technological shifts in favour of net zero emissions, however they are at the lower end of the scale and are not widespread behavioural shifts or innovations that significantly reduce the cost of green technologies. The reliance of hydrogen use and carbon capture and storage technology is higher in this scenario.
- **Tailwinds:** The tailwinds scenario assumes considerable success on both innovation and societal / behavioural change and goes beyond the Balanced Pathway to achieve net zero by 2042 (ahead of the 2050 target).

As the two scenarios differ in terms of the extent of behavioural changes, they also have quite different implications for shifts in fuel and material usage in the UK economy. In turn, this has implications for some of the cargo flows that have been traditionally important to the Port of London, especially petroleum products. Specifically, the 'tailwinds' pathway generally has more negative implications for cargos volumes with a high carbon content, while these cargo flows are less negatively affected in the 'headwinds' scenario.

BOX 1: THE CIRCULAR ECONOMY

The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products. A circular economy is regenerative by design and aims to gradually decouple growth from the consumption of finite resources.

The CCC has identified the circular economy as one of the key areas where investment and policy action should be targeted as part of the Government's climate strategy. Noting that recycling rates have 'plateaued' in England at around 45%, the CCC's Sixth Carbon Budget calls for a 68% recycling rate by 2030 covering all wastes in England via the Environment Bill. A ban on landfilling of all biodegradable municipal and nonmunicipal waste would be implemented from 2025 and exports of waste would be phased out by 2030.

The CCC's alternative pathways to net zero include flexed assumptions around the assumed shift towards a circular economy and associated rates of waste reduction and recycling. In terms of implications for the Port of London, this may impact intra-port waste shipments of household waste but it will have only a minor impact on the more significant trade in construction waste – noting that the UK had a target of 70% for non-hazardous construction and demolition waste but was already recovering 91% by 2016.

Furthermore, it is important to note that only a small portion of total unitised cargo is comprised of household consumables (which tend to eventually end up as waste). Oxford Economics estimates that only around 10% of unitised cargos are non-food household consumables, with the bulk of the remainder being food or beverages and inputs into manufacturing and building construction. As such, potential reductions in household consumption may be expected to have a relatively muted impact upon the port.

3.4 DRIVER 2: DEVELOPMENTS IN MARKET DEMAND

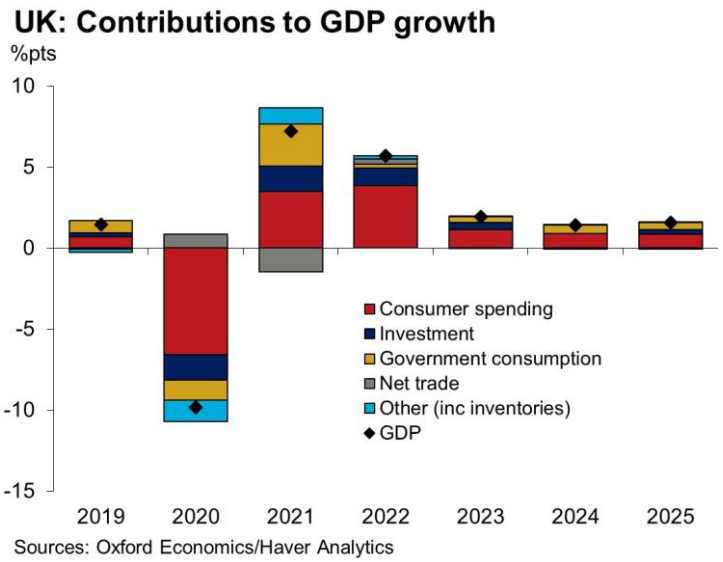
3.4.1 Central scenario: Near-term economic outlook (2021-25)

The timing of the removal of lockdown restrictions remains the key driver of the near-term economic outlook. The UK has adopted an aggressive approach to vaccination, allowing it to roll out its vaccination programme more quickly than most other countries. At the time of writing in May 2021, our expectation is that this will allow the UK to continue progressing along the government's roadmap for easing restrictions on schedule, meaning all remaining restrictions will fall away by late June.

With limited opportunities to spend during lockdown, households have been repaying unsecured credit and accumulating savings. This strengthening of household balance sheets has left consumers in a strong position to support the recovery by taking on new credit and spending some of their excess savings. Assuming our central scenario plays out, the lifting of restrictions on social consumption, and associated boost to confidence, should therefore trigger a strong consumer spending-led recovery.

Our central scenario envisages a strong consumer-led economic recovery to unfold as restrictions are lifted.

Fig. 21. Strong recovery in consumer spending to drive growth in 2021/22



Sources: Oxford Economics/Haver Analytics

The rebound in investment may be more protracted, as many firms were forced to take on new debt during the pandemic to plug holes in revenues and support cashflow. The resulting increase in debt servicing costs will therefore eat into funds available to invest. But as announced in the 2021 Budget, firms will be able to deduct 130% of investment costs from taxable income in 2021 and 2022 (this only applies to plant and machinery), which should encourage some firms to bring forward investment.

Meanwhile, we expect a modest drag from net trade in 2021/22, which partly reflects the fact that imports fell much more than exports in 2020 and, thus, have greater scope to rebound, particularly given that the strength of the consumer rebound is likely to boost demand for imports. It also reflects the increase in trade frictions following the introduction of the new UK-EU trade relationship, with exporters facing substantial new non-tariff barriers. Frictions

on imports into the UK will follow later but are likely be less significant (the government has delayed the introduction of full border checks for most EU imports until December 2021).

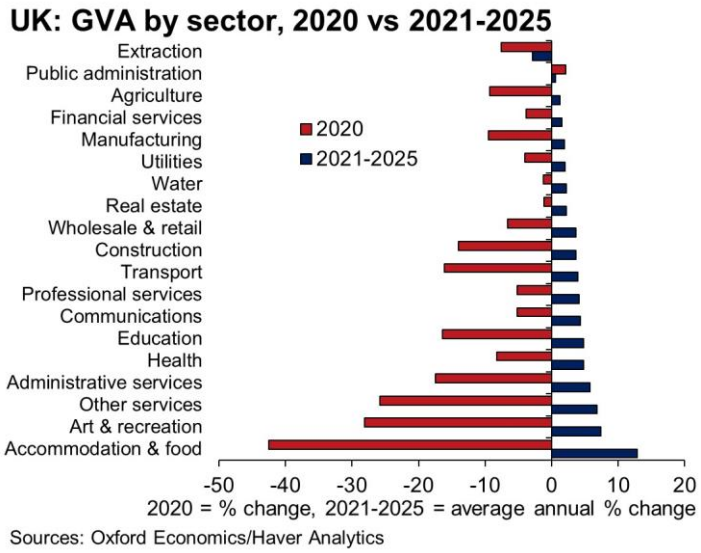
Oxford Economics' expectations of a strong near-term rebound in GDP growth are consistent with other forecasters, as illustrated by the table below. For example, the Bank of England expects GDP to expand by 7.3% in 2021, while HM Treasury's survey of independent forecasters indicates an average expectation of 6.7% growth in 2021.

Fig. 22. Comparison of GDP forecasts

Comparison of GDP Forecasts (Annual percentage change)	2021	2022	2023	2024	2025
Oxford Economics	8.3	5.6	1.9	1.4	1.5
Bank of England	7.3	5.8	1.3	-	-
HM Treasury consensus	6.7	5.7	2.1	1.6	1.6

Sectors which fared worst in 2020 are likely to see the strongest recoveries over the next few years. A strong recovery in spending in high-contact sectors, following the lifting of social distancing restrictions, will benefit sectors like accommodation & food and art & recreation. But while these sectors will see spectacular growth rates in 2021 and 2022, this is largely a function of the extent of the collapse they suffered in 2020 and even by 2025 we expect their output to still be close to pre-pandemic levels. The other sector we expect to struggle over the next five years is manufacturing, which has consistently underperformed for many years and faces additional challenges in the future from increased trade frictions with the EU.

Fig. 23. Consumer-facing sectors expected to enjoy the strongest rebounds



London is expected to outperform other regions over the next few years, largely due to its sectoral structure.

At the regional level, London and the South have been among those hit hardest by the crisis, due to their large services and contact sectors. But we expect London to outperform the other regions over the next few years, largely due to its sectoral structure, with financial & professional services, information & communication and administrative & support services driving growth nationally, and these sectors having a relatively large presence in the capital.

Fig. 24. London to outperform other regions over the next few years

Forecast for UK (Percentage change)						
	% total economy (2019)		Gross value added		Employment	
	Gross value added	Jobs	2020	2025 vs 2019	2020	2025 vs 2019
South East	14.8	13.7	-10.1	6.4	-4.0	2.1
Greater London	23.7	17.0	-9.4	8.7	-4.7	4.2
Eastern	8.8	9.0	-10.0	6.9	-3.3	2.5
South West	7.4	8.1	-9.0	7.2	-4.7	1.7
West Midlands	7.4	8.4	-13.5	2.3	-3.7	0.2
East Midlands	5.8	6.8	-10.1	7.1	-1.8	3.5
Yorkshire & Humberside	6.5	7.8	-9.0	7.0	-2.8	3.1
North West	9.6	11.0	-11.1	4.6	-2.2	0.8
North East	2.9	3.5	-10.3	5.0	-1.8	2.9
Wales	3.4	4.1	-9.0	6.6	-1.2	2.7
Scotland	7.4	8.1	-9.5	6.3	-4.1	1.8
Northern Ireland	2.2	2.5	-9.4	6.3	-3.8	2.4
United Kingdom	100.0	100.0	-9.8	7.2	-1.8	2.4

Source: Oxford Economics/Haver Analytics

Our forecasts implicitly assume that the long-term trend toward increased urbanisation will quickly reassert itself in the near term. Indeed, denser cities are more energy efficient, so these trends are also supportive of the Government's net zero emissions target. But it must also be recognised that the pandemic could entail lasting changes to how people live and work. More workers may wish to take advantage of remote working capabilities, for example, enabling them to move outside London in favour of smaller towns offering cheaper property and a higher quality of life. While this could potentially dampen urbanisation rates and the future growth of the capital, the impact on the Port of London may be less pronounced as it acts as a trading hub serving the wider South East region. Indeed, an increase in demand for housing in the region around the capital could stimulate construction and related economic activity that would have a positive impact on associated materials traded through the port.

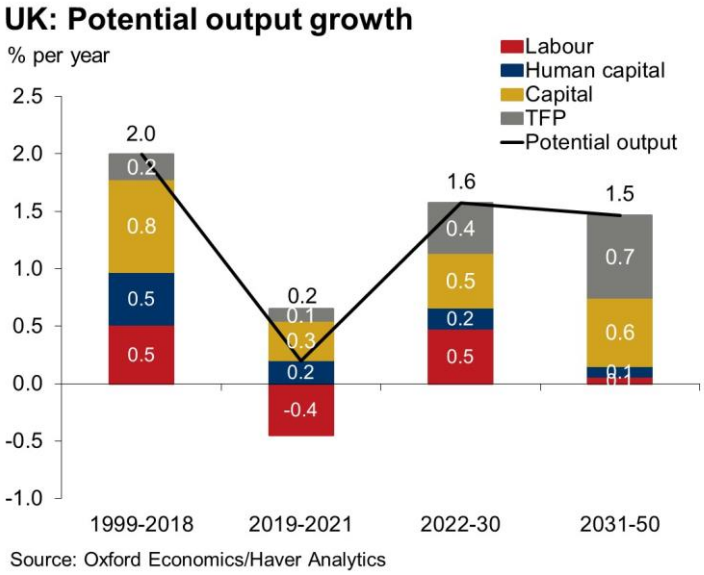
3.4.2 Central scenario: Long-term outlook (post-2025)

Our long-term forecast is based on a growth accounting framework underpinned by supply-side drivers. This is to say that, potential GDP growth can be decomposed into three drivers: capital formation, labour supply and total factor productivity (also referred to as technical progress).

Based on this framework, we project trend GDP growth to decelerate to around 1.6% pa in 2022-30 from 2.0% pa over the previous two decades, with a further moderation in growth to around 1.5% pa over the period 2031-50. This primarily reflects a much weaker contribution from labour supply (our population projections closely follow the ONS central forecasts), albeit partially offset by a slightly faster pace of productivity growth—although we do not envisage a rebound to levels experienced prior to the global financial crisis.

The UK's GDP growth is projected to slow to around 1.5% pa by 2030-50, primarily due to weaker demographics.

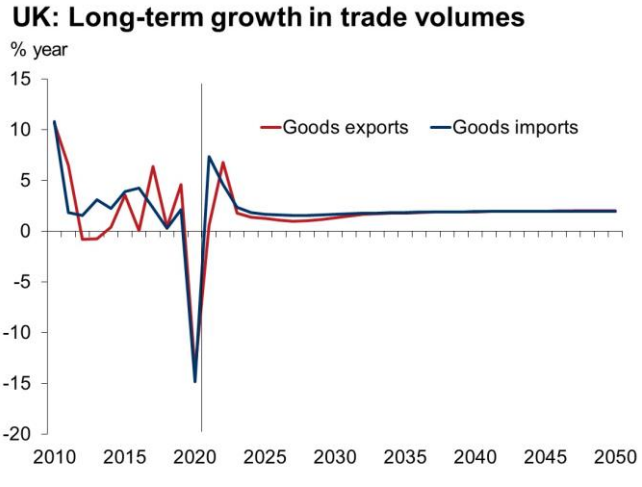
Fig. 25. Demographics to weigh on long-term growth prospects



Source: Oxford Economics/Haver Analytics

The UK is expected to remain a services-orientated economy over the long term, and trade growth in services will outstrip goods trade consistently in the years to 2050. At the national level, UK exports and imports of goods are forecast to average close to 2.0% annual growth in the period 2031-50. These projections take account of an assumed gradual liberalisation of trade policy internationally, with the UK benefitting from trade deals with non-EU countries in the wake of Brexit.

Fig. 26. Growth of UK trade in goods to moderate over the long-term



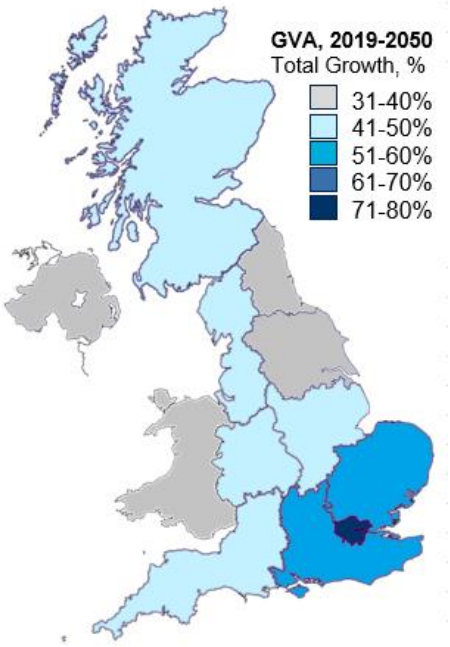
Source: Oxford Economics/Haver Analytics

As the production sector slows, the UK economy will become increasingly reliant on services – by 2050, private services will account for almost 70% of total economic activity. Major cities are expected to drive growth, led by London. We project that London's economy will be almost 80% larger in 2050 than in 2019 (measured in real terms).

This forecast is consistent with the Government's 'levelling up' agenda in that one way to increase the wealth of relatively poorer regions is to support the growth of existing clusters of high value-added businesses within them while improving transport links for the population in areas surrounding these clusters. For example, policies to catalyse new green growth clusters in traditional industrial areas can disproportionately benefit parts of the UK in the North of England without subtracting from opportunities in the South. 'Levelling up' of the UK does not mean 'levelling down' otherwise economically successful parts of the country such as London.

Furthermore, the policy to level up is also targeted at sub-regional disparities in otherwise economically prosperous regions such as the South East of England. The development of the Port of London – including the new Thames Freeport - has the potential to support regeneration and create high value new jobs across the Thames Estuary, which contains some of the most economically challenged neighbourhoods in the country.

Fig. 27. Sectoral growth profile favours metropolitan areas



3.4.3 Alternative economic scenarios

As the outlook remains uncertain, Oxford Economics have constructed two alternative economic scenarios to guide contingency planning. These are mostly driven by the potential evolution of the pandemic and vaccine

implementation in the near term, whereas in the long-term we flex assumptions around the future evolution of the economy's supply-side drivers.

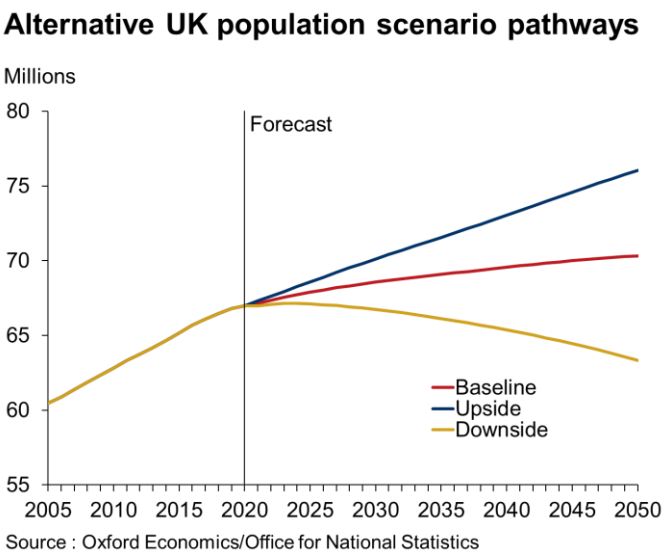
In the **downside scenario**, new virus variants result in renewed lockdown restrictions. With vaccines failing to halt the spread of more transmissible forms of coronavirus, public health measures are required for a protracted period. The result in the near term is weaker economic activity and further financial market weakness. The subsequent recovery is also sluggish, as the combination of persistent restrictions and increased risk aversion weigh heavily on both the UK and global economy. It is also likely that such a scenario would be characterised by increased rates of de-urbanisation. This would damage economic growth potential, as cities generate substantial scale economies and have proven to be very effective incubators of innovation.

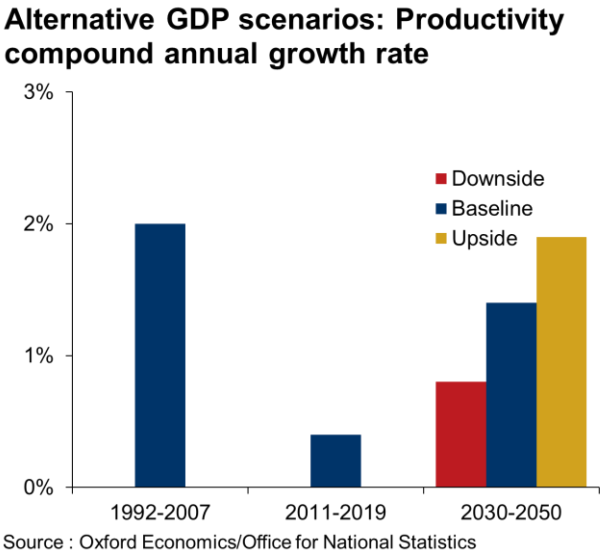
The scenario has significant negative implications for potential output and economic activity over the medium term. This is consistent with evidence from past pandemics, which suggests that near-term developments typically have important effects on capital accumulation, labour supply and productivity.

Longer-term, we also flex assumptions regarding growth in the economy's supply capacity:

- UK population growth follows the ONS 'low growth' population projections. This includes more pessimistic (compared to the central scenario) assumptions regarding future trends in fertility and mortality rates, as well as post-Brexit migration.
- The recovery of growth in trend output per worker is assumed to stall at 0.8% pa over the long-term (compared to 1.4% pa in the baseline). This is consistent with the economy falling into 'secular stagnation', perhaps due to a declining rate of innovation.

Fig. 28. Key drivers of long-term economic scenarios





In contrast, the **upside scenario** for the economy assumes global vaccine successes facilitate a faster easing of public health restrictions and an early return to full capacity. This encompasses faster vaccine rollout in other countries, which results in stronger demand for UK exports and also a quicker recovery for international tourism. A faster recovery would also allow UK unemployment to fall back more quickly.

The strength of the recovery ensures that the impact of the pandemic on the supply side of the economy is minimised and the level of global GDP by 2025 is no lower than anticipated prior to the crisis.

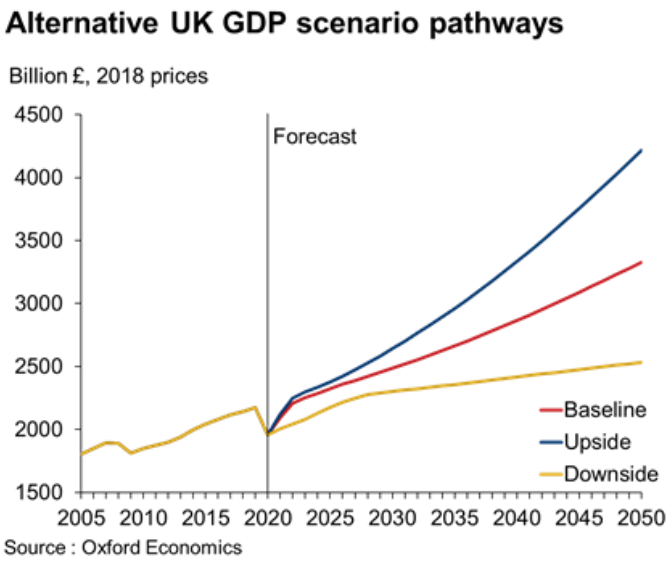
Longer-term, we again flex assumptions regarding growth in the economy's supply capacity:

- UK population growth follows the ONS 'high growth' population projections. These incorporate more optimistic (relative to their central scenario) assumptions around fertility, mortality and migration rates.
- Growth in trend output per worker is assumed to fully recover to the pre-crisis historic rate of 2.0% pa.

As illustrated by Figure 29, these variations in underlying assumptions regarding future developments and underlying drivers of economic growth lead to significant differences in the level of GDP by 2050. In fact, these upside/downside macroeconomic scenarios suggest a plausible margin of error around the baseline forecast for GDP of around +/-25% by 2050. This level of uncertainty is not without historical precedent, however, as the Global Financial Crisis resulted in UK GDP outturns being around 20% below pre-crisis forecasts after ten years.

Upside/downside macroeconomic scenarios suggest a plausible margin of error around the baseline forecast for GDP of around +/-25% by 2050.

Fig. 29. Alternative GDP scenarios

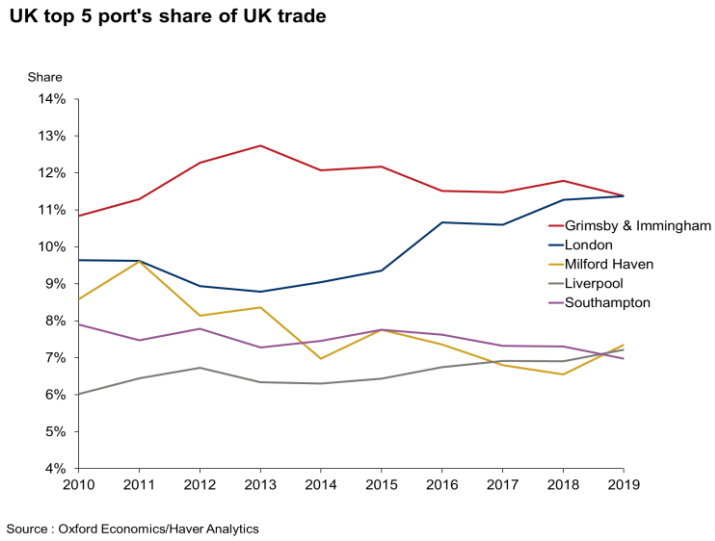


3.5 DRIVER 3: PORT OF LONDON INVESTMENT-LED GROWTH

In recent years there has been a noticeable uptick in the Port of London's share of UK trade volumes, increasing by 2 ppt (percentage points) in the period 2015-19 to 11%, the largest share gain of all UK ports. This has been driven by a doubling of the port's share of UK Lo-Lo traffic to over 22% and dry bulk traffic increasing by 5ppt.

In contrast, other UK ports of a comparative size have lost market share over the same period, including Felixstowe (-0.5 ppt), Grimsby & Immingham (-0.8 ppt), and Tees & Hartlepool (-1.5 ppt) (Figure 30).

Fig. 30. Evolution of top 5 UK ports' share of total trade



Source : Oxford Economics/Haver Analytics

The Port of London's share of UK trade volumes increased by 2 percentage points during the period 2015-19 to 11%, the largest share gain of all UK ports.

Ports may be viewed as the point in which logistics channels, trade channels and supply channels converge. The competitive position of a given port therefore depends not only on its physical characteristics, connectivity and efficiency, but also upon its position within a given supply chain. The contestability of seaborne traffic also varies by cargo type – for example, port traffic in the 'bulk' sector is generally linked to dedicated facilities which are closely associated with end users, so they are not generally footloose between ports. Competition is greater in the Ro-Ro and containers categories, where lines compete for business and may switch ports, especially where there is the need to accommodate larger ships or to park more trailers at a given terminal.

In this context, the Port of London benefits from a number of distinct advantages, reflecting its proximity to the capital city, ongoing improvements to its inland connectivity, as well as quality of the maritime infrastructure and frequency of services offered by the port:

- **Freeport status:** As discussed in the Appendix, designation of the Thames Freeport in March 2021 will help to accelerate investment into the port by offering businesses a liberal customs regime and a range of other tax and non-tax incentives. The Freeport will also help the Government's 'levelling up' agenda by serving as a catalyst for increased prosperity amongst left behind communities along the estuary.

- **Extensive rail network:** Ports with better rail access can generate greater volumes than those that do not. Tilbury 2 is completely rail enabled with construction aggregates having their own dedicated railhead. The opening of HS2 to passenger services over the forecast period will also allow greater rail capacity for freight to be moved across the country.
- **Brexit:** Full customs checks on imports from the EU have been delayed until December 2021. The introduction of these checks at the UK border and associated delays could change relative cost-benefit considerations for hauliers, with a slightly longer sea leg providing a more certain, less congested pathway to inland customers. It is likely that the Port of London will therefore benefit from the diversion of some Ro-Ro cargo from Dover as a result.
- **Geographic location***:* Chronic shortages of long-distance HGV drivers is increasingly influencing where cargo is landed. With the Port of London being in the wealth and population centre of the UK and future growth of the capital likely to outpace other UK regions, this represents a natural competitive advantage for the port.
- **London Gateway:** One of the main reasons the Gateway was built was to handle the world's largest container ships, which require deeper water, bigger cranes, and more space to store the containers discharged from them. Gateway is able to handle the world's largest 22,000 TEU container ships and is responsible for the majority of southern hemisphere containerised traffic in the UK, an advantage in a post-Brexit Britain.

The Port of London benefits from several distinct advantages, including proximity to the capital city, ongoing improvements to its inland connectivity, as well as quality of the maritime infrastructure.

All the above aspects have been factored into our cargo projection forecasts to adequately reflect developments 'on the ground' when estimating respective shares of UK trade for each category of cargo.

3.6 OVERVIEW OF SCENARIO ASSUMPTIONS

The table below provides an overview of how underlying assumptions have been adjusted to produce alternative outcomes that are more/less favourable for trade through the port.

Fig. 31. Alternative scenarios assumptions

Assumptions	High trade	Central	Low trade
Share of synthetic jet fuel import market	40.0%	40.0%	40.0%
Synthetic jet fuel imports begin	2026	2026	2026
GDP outlook	*Upside*	*Baseline*	*Downside*
Demographics outlook	*Upside*	*Baseline*	*Downside*
Share of UK ammonia bunker fuel to be imported	0.0%	50.0%	25.0%
Port of London market share of Lo-Lo imports (2050)	36%	33.2%	27.2%
Port of London market share of Ro-Ro imports (2050)	6.3%	5.7%	4.5%
UK air passenger numbers return to 2019 levels	2025	2025	2025
Land transportation levels relative to 2019 (2022)	100.0%	95.0%	90.0%
UK share of hydrogen demand met via imports*	14.0%	13.0%	12.0%
Port of London share of UK hydrogen imports*	22.0%	20.4%	18.3%
CCC pathway	*Headwinds*	*Balanced*	*Tailwinds*
Timber use in dwellings (2050)	80.0%	40.0%	28.0%
Decline in waste per capita from 2018 (2050)	-33.0%	-13.0%	-33.0%
Recycling rates for household waste (2050)	67.0%	67.0%	79.0%
*imports will be in the form of ammonia			

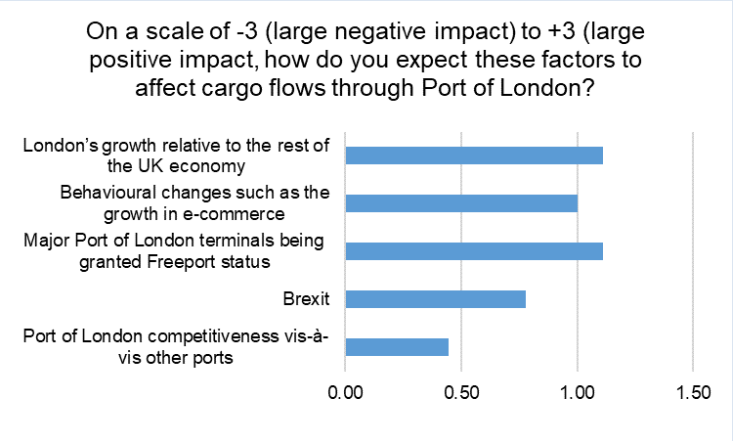
Of course, the sensitivity of trade flows to the levers we flex differs by cargo type. For example, the CCC net zero pathways are the most important driver of liquid bulk forecasts (mainly reflecting the impact on trade in petroleum products), whereas unitized cargo is more sensitive to assumptions around developments in the economy and demographics.

BOX 2: STAKEHOLDER ENGAGEMENT

This engagement was conducted through a combination of an online survey, workshops and one-to-one interviews. The consultations were particularly useful in helping us to understand the key drivers of the port's business, including any planned changes in operations and investments at the terminals that could affect future capacity. We also interviewed external consultants engaged to work on projects related to the Port of London's future development, including the Thames Freeport and hydrogen production facilities.

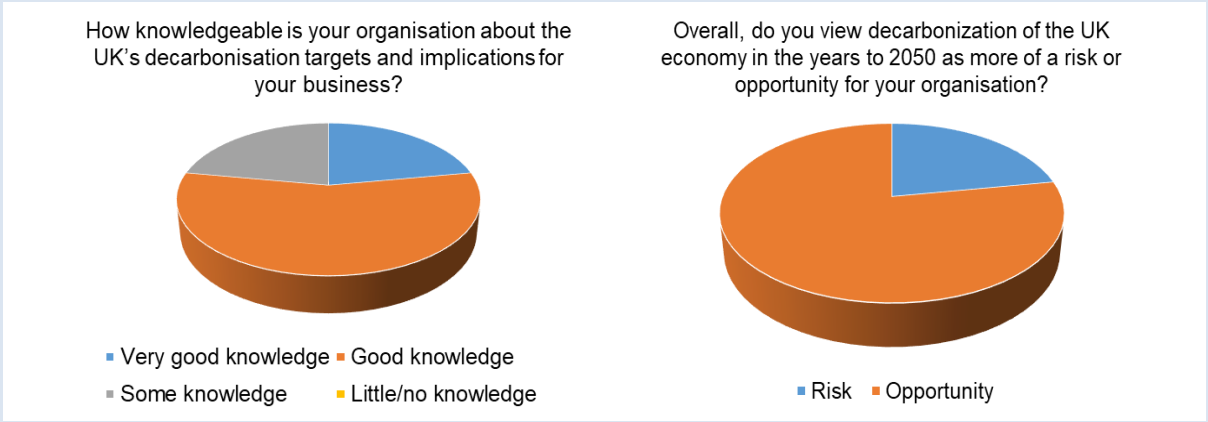
These consultations helped to shape our subsequent research and informed our forecasts. They also provided some interesting context regarding stakeholders' expectations for the future, revealing that most respondents were optimistic about the outlook despite the current headwinds facing the economy. Asked to rate on a scale of +3 (very positive) to -3 (very negative) the influence of multiple factors affecting the outlook for trade flows, the average response was positive and especially so around the influence of the growing London economy and the impact of the Thames Freeport on the port's future business (Figure 32). One respondent noted that *"London will always grow ahead of the rest of the UK".*

Fig. 32. Survey responses to factors affecting future trade flows



Focussing on the impact of the UK's decarbonisation policy agenda, most respondents claimed to have 'good' or 'very good' knowledge of these developments. They also viewed these developments as more of an opportunity than a risk, with one respondent noting how *"population density around the Thames will lead to shorter more environmentally friendly routes".*

Fig. 33. Survey responses to the influence of decarbonisation on the Port of London



4. PORT OF LONDON CARGO FORECASTS UNDER ALTERNATIVE SCENARIOS

4.1 PROJECTIONS OF TOTAL CARGO FLOWS

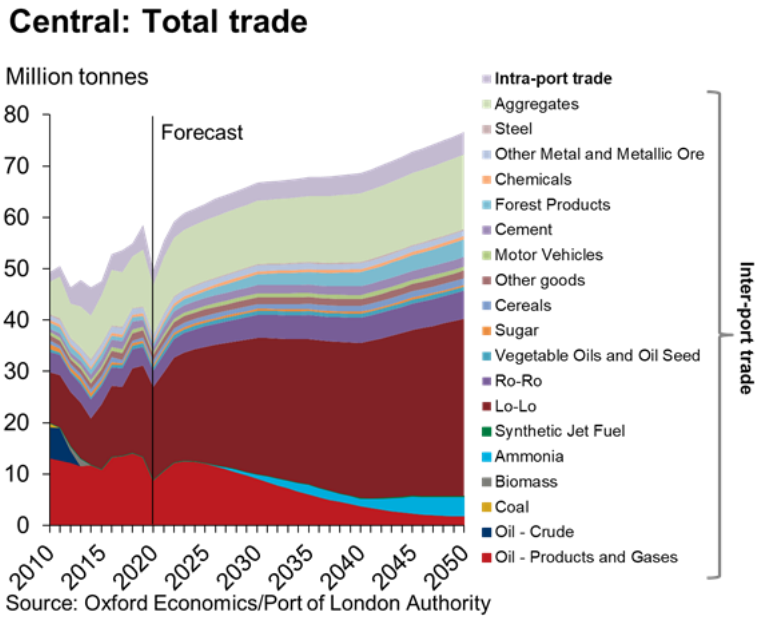
Projections from our **central scenario** for cargo flows show the total volume of cargo flowing through the Port of London is projected to increase to 77 million tonnes by 2050, representing an increase of 18 million tonnes on 2019 levels. Within this, **inter-port trade** is projected to increase to 72 million tonnes by 2050:

Our central scenario for cargo flows show the total volume of cargo flowing through the Port of London increasing to 77m tonnes by 2050, representing an increase of 18m tonnes on 2019 levels.

- The key driver of growth over this period is **unitised cargo**, which rises from 21 million tonnes in 2019 to 40 million tonnes by 2050.
- Although a smaller share of overall trade, the '**other cargo'** category is also projected to grow rapidly. A key driver is forest products, due to the projected increase in use of timber for construction.
- Conversely, **liquid bulk** represents a significant drag on growth. This reflects the projected significant decline of petroleum imports as fossil fuels are phased out, from over 13 million tonnes in 2019 to just 2 million tonnes by 2050. The decline in petroleum imports is only partially offset by new inflows of ammonia (used for the production of hydrogen), which reach 4 million tonnes by 2050.

Meanwhile, **intra-port trade** is projected to amount to around 4 million tonnes in 2050. While this is little different to the volumes traded in 2019 (when there was a one-off spike in construction waste), it represents a 50% increase on 2020 levels.

Fig. 34. 'Central' scenario: Total cargo flows

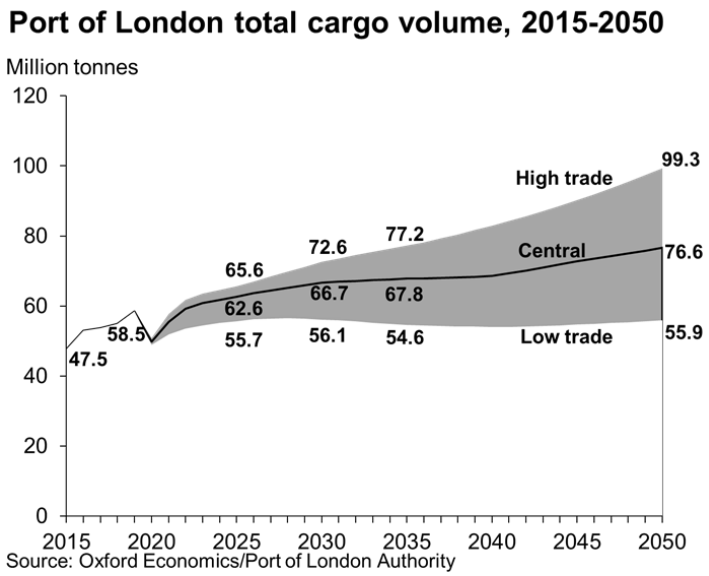


Source: Oxford Economics/Port of London Authority

The outlook is subject to significant uncertainties, which create a wide dispersion of potential outcomes around this central case. In the **high trade** scenario, total cargo flows reach almost 100 million tonnes by 2050; conversely, cargo flows are limited to just 56 million tonnes in the **low trade** scenario.

In the high trade scenario, total cargo flows reach almost 100 million tonnes by 2050; conversely, cargo flows are limited to just 56 million tonnes in the low trade scenario.

Fig. 35. Total cargo flows: Scenario bandwidth

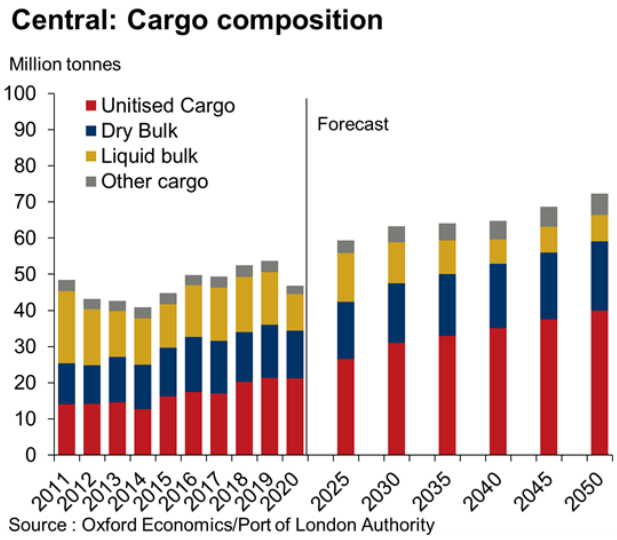


The remainder of this chapter discusses each of the cargo trades and their drivers. Additional detail on specific underlying products is provided in the Appendix.

4.2 INTER-PORT CARGO: AGGREGATE PROJECTIONS

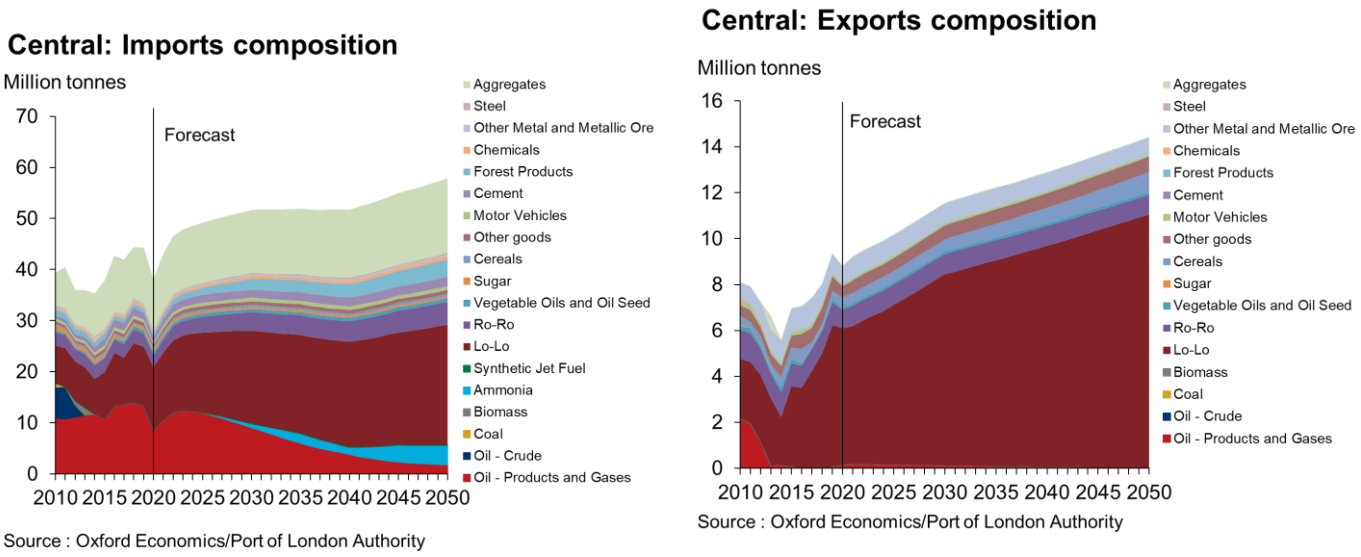
The central scenario for the Port of London trade incorporates significant declines to the bulk liquid volume imports as a result of incorporating the CCC's Balanced Net Zero Pathway for achieving net zero emissions (reflecting the phasing out of fossil fuels), but this is offset with growth outlooks across the unitised cargo, dry-bulk and break-bulk trades. As such, the net outlook is for inter-port trade volumes to reach 72 million tonnes by 2050, representing an increase 19 million tonnes on 2019 levels (or an increase of 25 million tonnes compared to 2020).

Fig. 36. 'Central' scenario: Inter-port cargo outlook



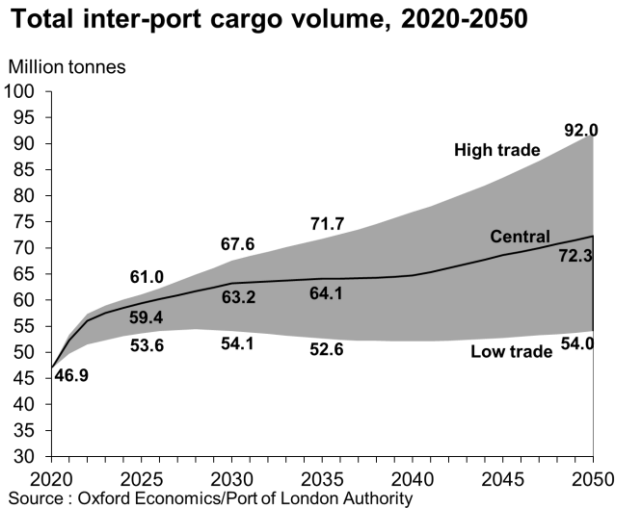
The key driver of growth for cargo volumes (other than the liquid bulks) is sustained growth in population and economic activity. Decarbonisation of the economy will also provide support to some new and/or growing trades (such as ammonia and timber) which arise from related policies vastly expanding their use across the energy and building sectors respectively.

Fig. 37. 'Central' scenario: Inter-port trade outlook by product type



But there are significant uncertainties around this central outlook. As illustrated in Figure 38, the 'low trade' and 'high trade' scenarios generate a substantial bandwidth around the central outlook, amounting to a range of around +/- 25% in total cargo volumes by 2050.

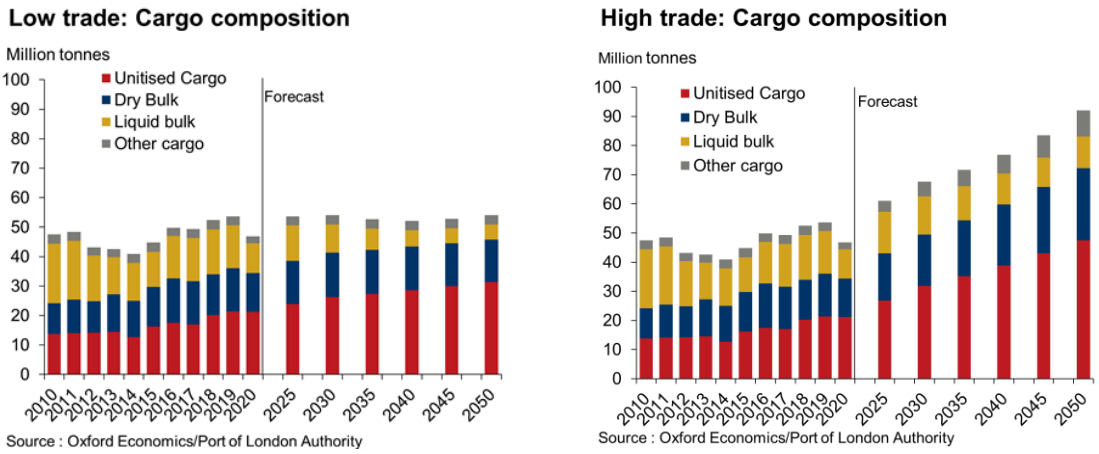
Fig. 38. Total inter-port cargo: Scenario bandwidth



In the 'low trade' scenario, the positive impact of substitution towards new cargos due to net zero are lower, and the declines in population and weaker productivity measures weigh on growth in construction materials and consumables. As liquid bulk volumes are nevertheless impacted by policy phasing out petrol and diesel in motor vehicles, the net impact of this is for cargo volumes by 2050 be largely unchanged from 2020.

The 'high trade' scenario broadly mirrors that of the 'low trade' insofar as a stronger population and economic outlook has a strong contribution to existing dry bulk and unitised cargo volumes, which is further lifted by a stronger swing (due to policy shifts) towards new climate-friendly trades (ammonia and timber). The net impact of this a near-doubling (from 2020 levels) by 2050, despite an otherwise weak outlook for petroleum products.

Fig. 39. Cargo flows in the *'Low Trade'* and *'High Trade'* scenarios



The remainder of this chapter discusses each of the main inter-port cargo types in turn, before then focussing on the outlook for intra-port trade.

4.3 INTER-PORT CARGO: LIQUID BULK

4.3.1 Forecast drivers

The liquid bulk outlook is heavily influenced by a mix of technological changes and government policies. Liquid bulk exports constituted little over 1% of total inter-port liquid bulk trade through the Port of London so the focus on this chapter is on import volumes.

Liquid bulk forecasts use a wide mix of assumptions and drivers and are unique in that certain liquid bulk products will be subject to prescriptive national policies that in some cases will legally limit the use of certain fuels (petroleum) and actively encourage investment and technological advancement in others (hydrogen). Therefore, a variety of drivers are used to produce a consistent narrative drawing on qualitive and quantitative assumptions to adequately reflect the seismic shifts expected in this area over the forecast horizon. These include:

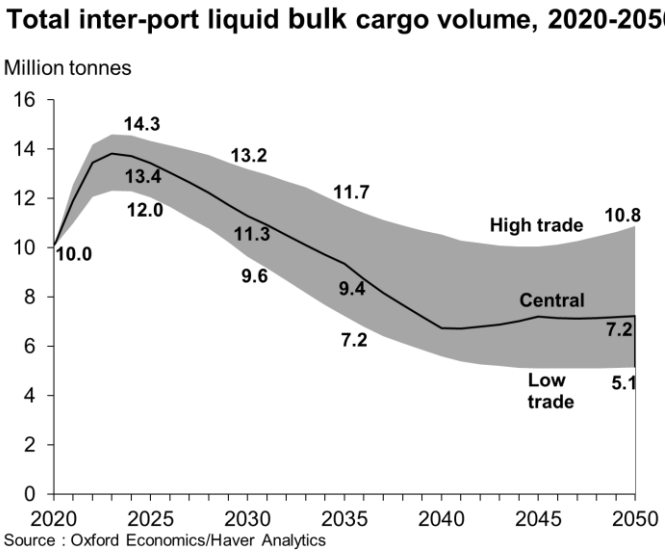
Liquid bulk will lose volume compared to 2019 across all scenarios, but this ranges from a -65% loss in the 'low trade' scenario to -51% in the 'central trade' scenario and -25% in the 'high trade' scenario.

1. **Climate Change Committee assumptions:** To keep scenarios consistent with CCC literature we have used liquid bulk demand forecasts (hydrogen and petroleum) as a direct driver of imports and assume, given the national nature of polices, that imports are affected equally regardless of port – i.e. if demand falls by 10% then imports of that given fuel fall by 10%. Our liquid bulk forecasts are also consistent with alternative CCC pathways.
2. **UK air passenger demand numbers:** These are a key determinant of aviation fuel demand and linked to Oxford Economics' travel and tourism forecasts to reflect the growth profile for coming years.
3. **Land transportation levels:** The rebound in land transportation levels will be a significant driver of petroleum demand in the short-run and, similar to air passenger numbers, this is used to reflect the growth profile for coming years.
4. **Macroeconomic drivers:** Economic activity drives the level of demand for fuels within an economy and as such we factor in alternative GDP projections across scenarios to capture this influence.
5. **Demographics outlook:** Similar to economic activity, population directly dictates the level of demand for energy within a society and as such is accounted for within our simulations.

4.3.2 Liquid bulk projections

Our analysis shows liquid bulk will lose volume compared to 2019 across all scenarios, but this ranges from a -65% loss in the 'low trade' scenario to -51% in the 'central' scenario and -25% in the 'high trade' scenario. The outlook centres around the phase-out of petroleum and the level of substitution in the form of Ammonia. It is anticipated that conventional fossil fuel trade will be outstripped by ammonia and synthetic jet fuel cargoes in 2044 under the central scenario.

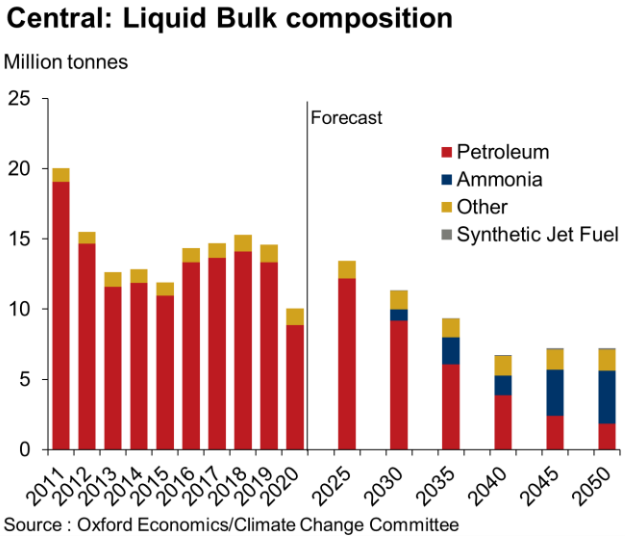
Fig. 40. Liquid bulk total cargo scenario bandwidths



Across all three scenarios, petroleum suffers dramatic reductions in imports through the Port of London, falling by 98% compared to 2019 levels in the 'low trade' scenario consistent with the CCC's 'tailwinds' pathway to net zero. Even in the 'high trade' and 'central' scenarios, petroleum imports fall by 81% and 86% respectively.

Petroleum imports suffer dramatic reductions across all scenarios, with declines ranging between -81% in 'high trade' and -98% in 'low trade' scenarios

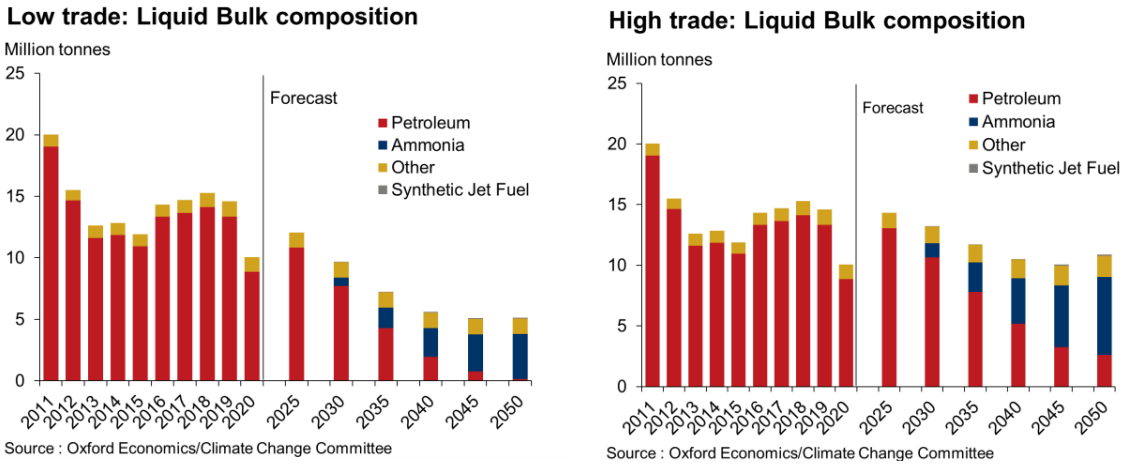
Fig. 41. Central scenario: Liquid bulk composition



Our analysis shows ammonia imports to the Port of London beginning in 2026 (consistent with CCC assumptions) and ranging between 3.6- 6.4 million tonnes by 2050. The majority of these imports would be chemically cracked into hydrogen within the UK, with a modest share to be used as a bunker fuel for shipping. The import of ammonia rather than hydrogen reflects the complexity and cost of transporting hydrogen over large distances.

Consistent with CCC assumptions, modest volumes of synthetic jet fuel are to start being imported in 2030, ranging from 86,000 tonnes to 113,000 tonnes in 2050, under the 'low trade' and 'high trade' scenarios respectively.

Fig. 42. 'Low trade' and 'High trade' liquid bulk composition



4.4 INTER-PORT CARGO: UNITISED CARGO

4.4.1 Unitised cargo forecast drivers

Unitised cargo will be a key driver of growth in trade volumes, rising from 21 million tonnes in 2019 to 40 million tonnes by 2050 in our central scenario.

In contrast to liquid bulk components which are expected to be subject to prescriptive national policies, unitised cargo forecasts are largely determined by the underlying economic and demographic environment, with narrative surrounding port specific developments used to drive changes in share of UK trade.

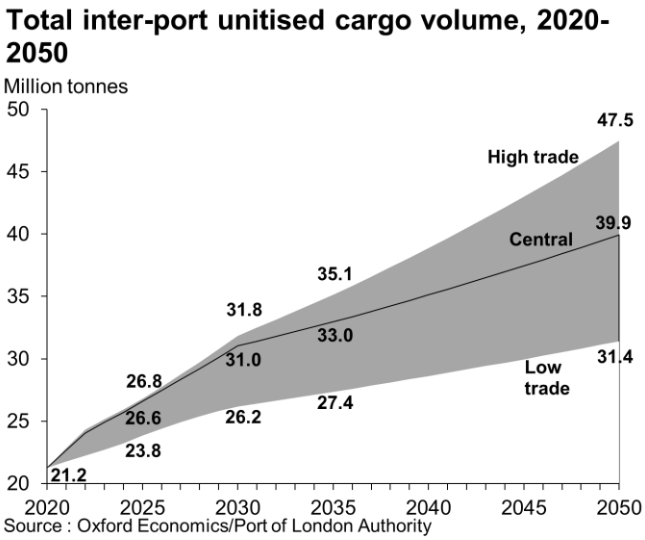
1. **Macroeconomic drivers:** Given the strong link between GDP and imports, economic activity is used as a demand driver for imports, with alternative economic outlooks produced by Oxford Economics used to produce a bandwidth around baseline.
2. **Demographics outlook:** Similar to economic activity, population has a direct impact on demand for goods within an economy, and as such we use population as a key driver of unitised imports, with alternative projections from the ONS used to produce a bandwidth around baseline.
3. **Port specific developments:** The recent freeport designation as well as the ongoing expansion of London Gateway are used to drive the narrative surrounding Port of London share of UK trade.
4. **Brexit:** Expectation by Port of London stakeholders that Brexit will divert Ro-Ro trade from Dover towards London.
5. **International conditions:** Unitised exports are dependent on the economic conditions of destination markets and as such GDP and population are used to drive exports.

4.4.2 Unitised cargo projections

In stark contrast to the double-digit falls in all other broad cargo groups, unitised cargo was the only broad cargo group to experience growth in imports during 2020, adding a modest 2% (0.3 million tonnes) to reach 14.5 million

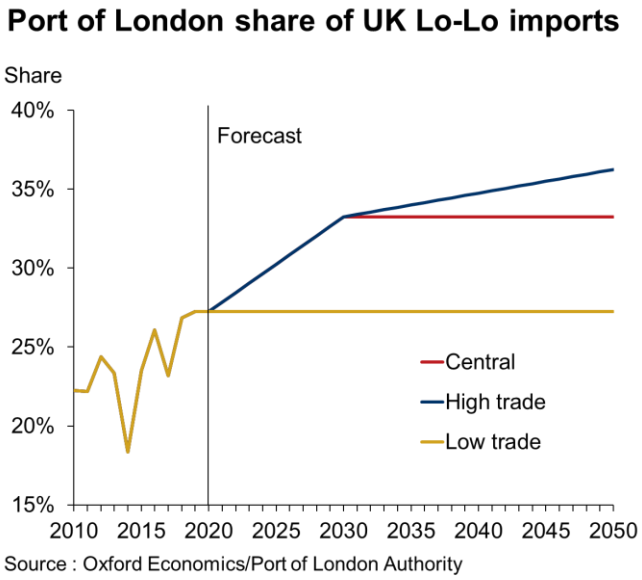
tonnes. This growth was driven entirely by the 0.5 million tonnes increase in Lo-Lo, given the fall in Ro-Ro inward traffic.

Fig. 43. Total inter-port unitised cargo bandwidths



Our analysis shows total unitised cargo will gain volume compared to 2019 and 2020 in all scenarios, however this ranges from a gain of 47% in the 'low trade' scenario to 87% in the 'central' scenario and 122% in the 'high trade' scenario (compared to 2019 levels). Gains are largely driven by the continued expansion of London Gateway, freeport status diverting trade from other ports, Brexit diverting Ro-Ro from Dover to London and GDP and population growth projections, ultimately increasing the ports share of UK unitised cargo.

Fig. 44. Port of London alternative shares of UK Lo-Lo imports, 2010-2050



Across all scenarios, containers are the pertinent driver of growth in unitised trade, with 21.1 million of the 26.2 million tonnes increase in unitised trade in the 'high trade' scenario originating from containers. By 2050, unitised cargo

will account for over half of all inter-port cargo handled by the port, reaching 58% in the 'low trade' scenario, an increase from 45% in 2020.

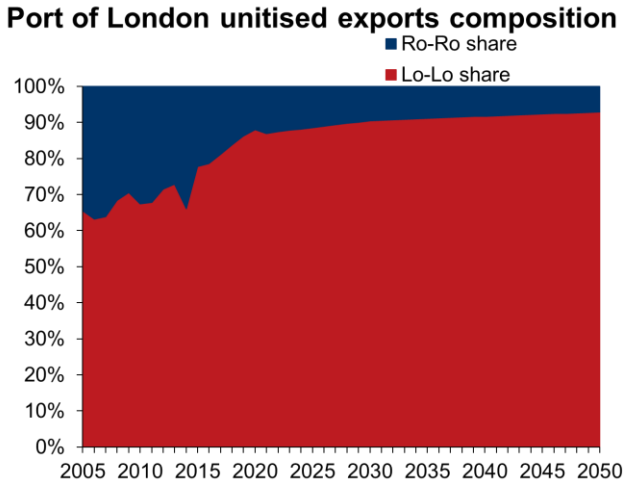
Exports are dominated by Lo-Lo, accounting for 88% of exports in 2020. Our view is that Ro-Ro will experience a modest decline of 140,000 tonnes between 2019 and 2050 in Ro-Ro exports, although significantly offset by a near doubling of Lo-Lo exports by 2050.

4.4.3 Unitised exports

Given exports of unitised cargo are determined mainly by GDP and population in the destination markets, we only produce one scenario that takes a central view on EU and non-EU GDP and population projections and use cargo projections for this one export scenario in combination with the three unitised imports scenarios to generate headline inter-port unitised cargo projections, this is true for Lo-Lo and Ro-Ro.

Ro-Ro exports are a small and falling share of unitised exports from the Port of London, losing over a third of volume since 2010 as result of a long and sustained decline in exports. Our projections expect a rebound in 2021 of around 10% to 903,000 tonnes followed by a continuation of the trend experienced in the 5 years prior to the pandemic, falling to 851,000 tonnes in 2050, a compound annual growth rate of 0.1% between 2020 and 2050. This reduces the Ro-Ro share of unitised exports to 8% from 12% in 2020.

Fig. 45. Port of London unitised exports composition



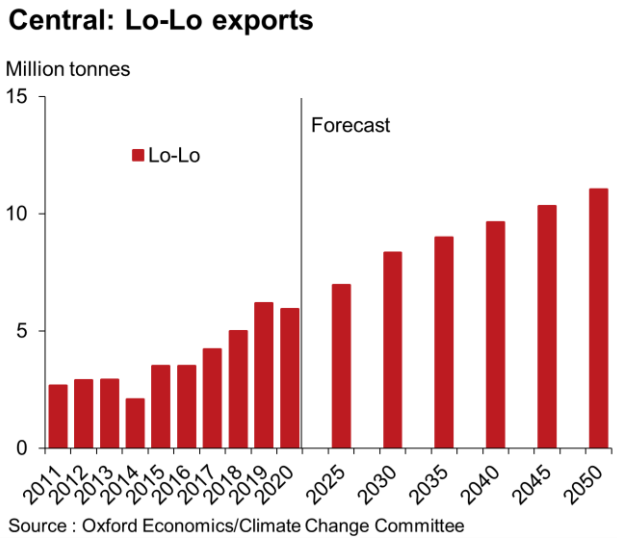
Source : Oxford Economics/Port of London Authority

With Ro-Ro exports in trend decline, we expect their share of unitised exports to fall to 8% in 2050 from 12% in 2020.

Unitised exports account for around 1/3 of the Port of London's unitised cargo volume in 2020, with nearly 90% of these exports being accounted for by Lo-Lo traffic totalling 5.9 million tonnes in 2020. The underpinning drivers of Lo-Lo exports in our analysis is the economic environment in destination markets, split as EU and Non-EU (Rest of World) and the share of UK container exports to each market captured by the Port of London.

Exports of containers from the port are expected to peak at 11.0 million tonnes in 2050 (Figure 46), an 86% increase on 2020 levels, equivalent to 5.1 million tonnes.

Fig. 46. Port of London Lo-Lo exports projections



Dry bulk cargo is expected to grow under all scenarios, reflecting expanding demand for cement and aggregates.

4.5 INTER-PORT CARGO: DRY BULK

4.5.1 Dry Bulk forecast drivers

Similar to the outlook for unitised cargo (which is also predominantly imported cargo), volume growth for dry bulk at the Port of London is largely dependent upon broad economic and demographic projections. By its nature, the dry bulk cargo movements involve minimal land-side movements, and as such, the Port of London has a relatively captive market (demonstrated by generally consistent import / export shares of total UK trade).

I. *Macroeconomic drivers:* Given the strong link between GDP and imports, economic activity is used as a demand driver for imports, with alternative economic outlooks produced by Oxford Economics used to produce a bandwidth around baseline.

II. *Demographics outlook:* Similar to economic activity, population has a direct impact on demand for goods within an economy, and as such we use population as a key driver of sugar and cereal imports and scrap metal exports, with alternative projections from the ONS used to produce a bandwidth around baseline.

4.5.2 Dry bulk projections

Our analysis shows total dry bulk cargo will gain volume compared to 2019 in the high trade and central scenarios, ranging from a gain of 69% to 31% respectively. Gains are largely driven by the continued growth in cement and aggregates, reflecting improvements in underlying economic activity. However, our analysis concludes that under the low trade assumptions volumes are slightly (-2%) lower in 2050 relative to 2019 levels.

Fig. 47. Dry bulk total cargo scenario bandwidths

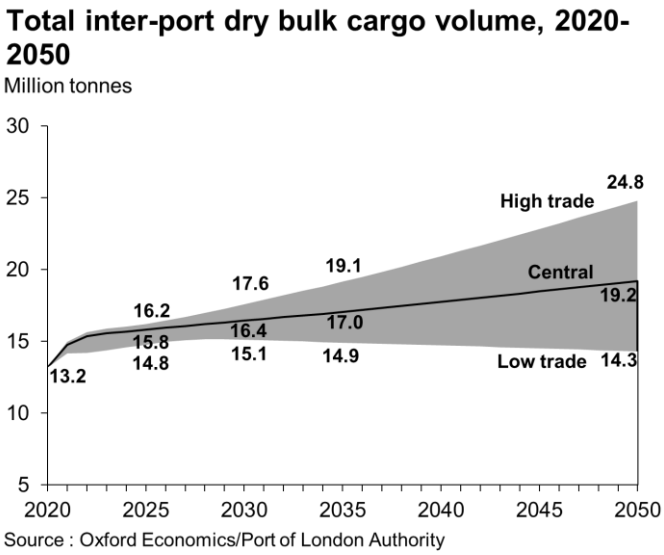
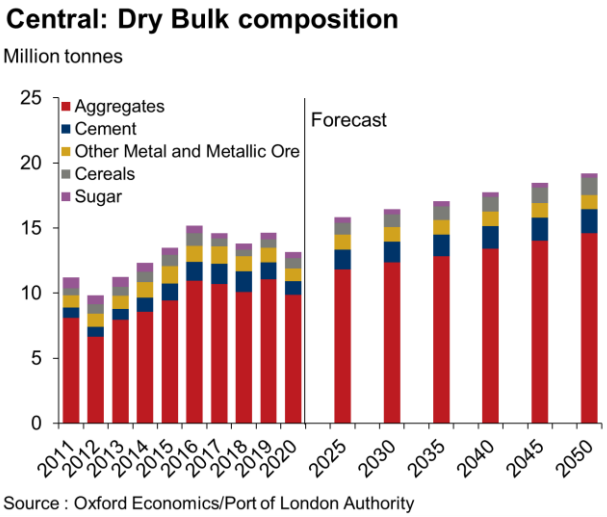
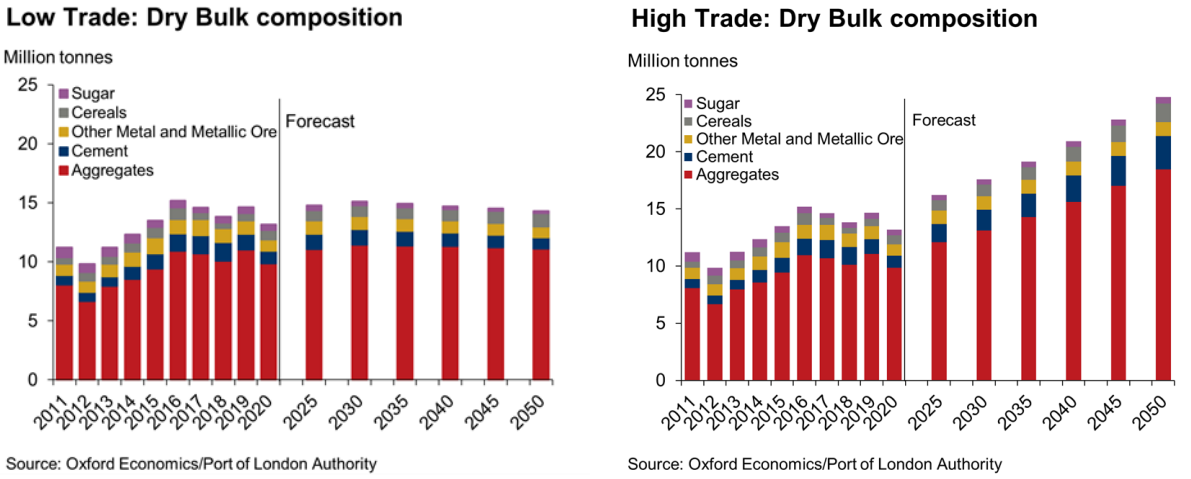


Fig. 48. '*Central trade*' Dry bulk composition



Across all three scenarios, the trading outlook is dominated by the forecasts of construction gross value-added, directly impacting aggregates and cement, and population/demand outlooks influencing the growth profile for metals, cereals and sugar.

Fig. 49. *'Low trade'* and *'High trade'* Dry bulk composition



4.6 INTER-PORT CARGO: OTHER CARGO

4.6.1 Other Cargo forecast drivers

Similar to the outlook for dry bulk, volume growth for Other Cargo at the Port of London is largely dependent upon broad economic and demographic projections. Timber products, like cement and aggregates, are dependent on the construction outlook, but also influenced by policies which have the potential to increase use of timber framing and engineered wood products in the building of detached housing and multi-story buildings.

Increased imports of forest products will be a key driver of growth in other cargo flows, reflecting increased use of timber for construction.

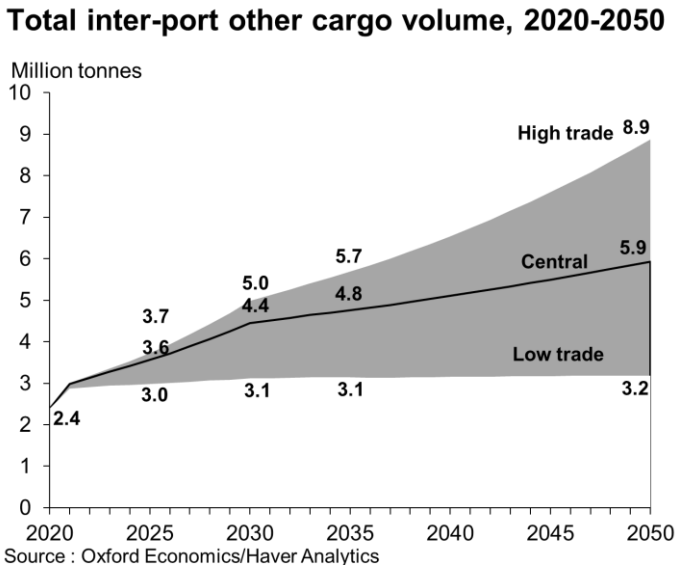
1. **Macroeconomic drivers:** Given the strong link between GDP and imports, economic activity is used as a demand driver for imports, with alternative economic outlooks produced by Oxford Economics used to produce a bandwidth around baseline.
2. **Demographics outlook:** Similar to economic activity, population has a direct impact on demand for goods within an economy, and as such we use population as a key driver of unitised imports, with alternative projections from the ONS used to produce a bandwidth around baseline.
3. **Electric Vehicle (EV) penetration:** The transition to EVs are expected to increase the mass per vehicle by 25% over the coming decade.
4. **Use of timber in construction:** A major contributor to changes in timber imports are alternative intensity factors for timber in building construction, which is informed by scenarios developed by the CCC in a 2019 report *Wood in Construction in the UK*[2].

[2] https://www.theccc.org.uk/publication/wood-in-construction-in-the-uk-an-analysis-of-carbon-abatement-potential-biocomposites-centre/

4.6.2 Other Cargo projections

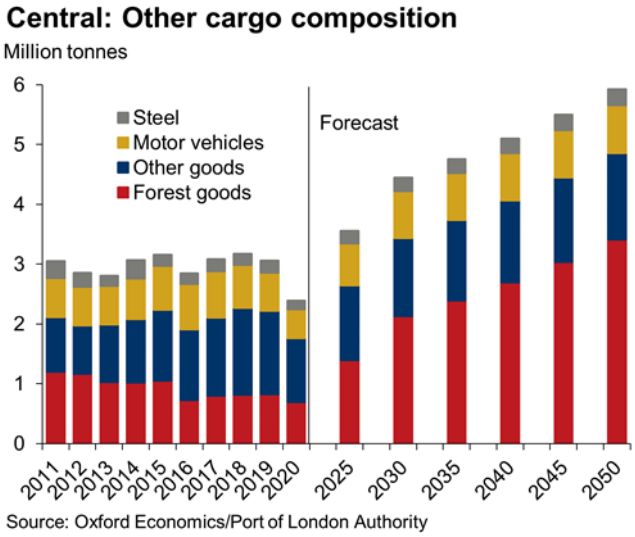
Our analysis shows total other cargo will gain volume compared to 2019 in all scenarios, from a low of 4% growth in the 'low trade' scenario, to nearly doubling in the 'central' scenario and more than doubling in the 'high trade' scenario (93% and 190% growth respectively).

Fig. 50. Other cargo scenario bandwidths



The stronger outlooks are largely driven by growth in forest products, (both total UK, as well as the Port of London's share of UK trade).

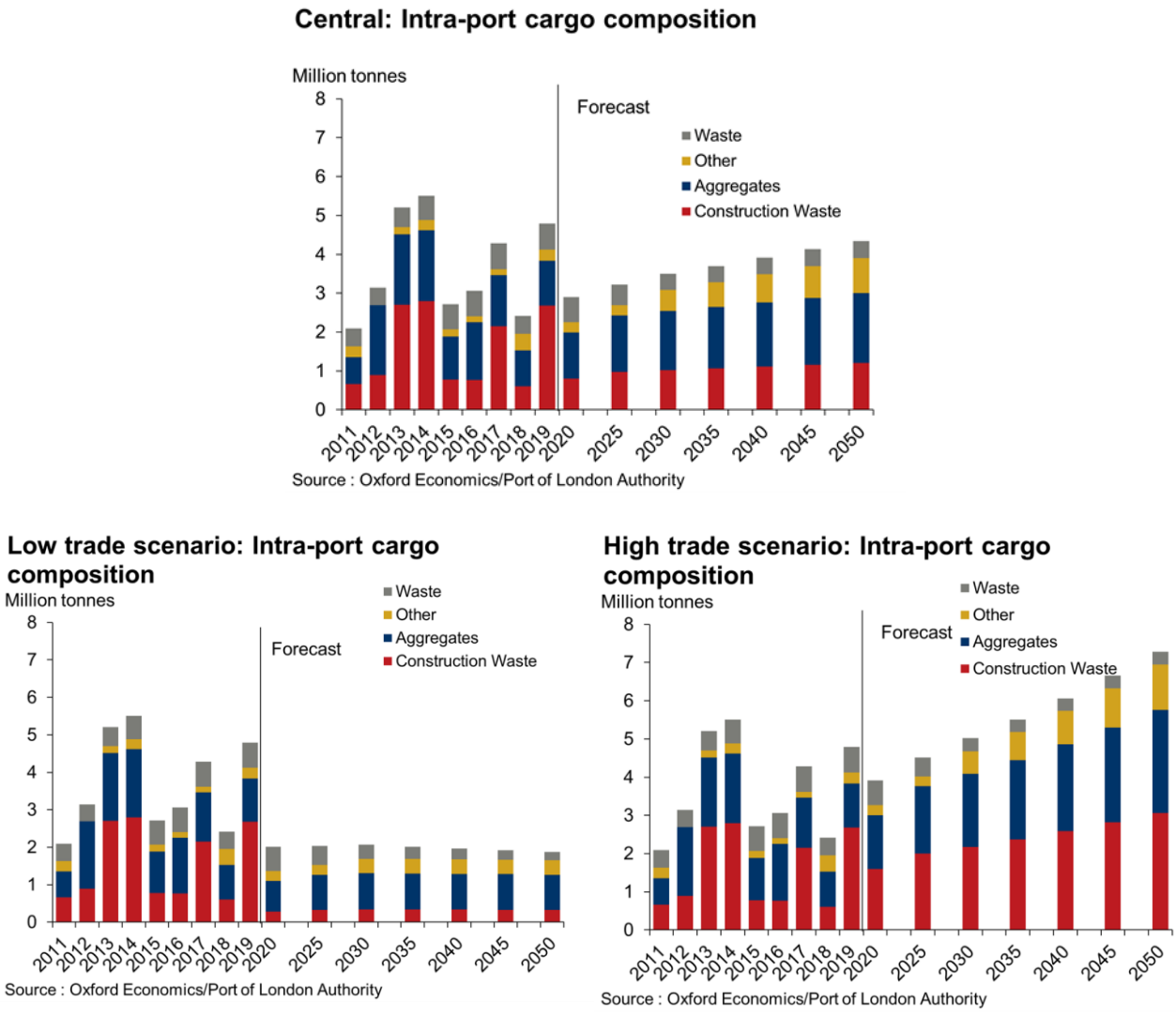
Fig. 51. '*Central trade'* Other Cargo composition



4.7 INTRA-PORT TRADE

Intra-port trade within the Port of London has been dominated by three broad classes of cargo types, namely aggregates (used in construction), construction waste / spoil, and waste. This is expected to continue to characterise intra-port trade flows in coming years.

Fig. 52. Composition of Intra Port Trade



4.7.1 Aggregates / Construction Waste and Spoil

Aggregates and Construction Waste/Spoil have increased exhibit a high level of year-to-year volatility, with highs of 4.5 million tonnes in 2013 and 2014.

Historic aggregates volumes carried along the Thames have been heavily influenced by major projects. Underneath the volatility has been a base level of required materials (when measured against underlying construction activity). This baseline has been used for the 'low trade' scenario, whereas the central and 'high trade' scenarios consider higher ratios of building materials to construction activity (effectively considering that the major projects which have

characterised London would be repeated in various guises over the forward outlook).

Similar to aggregates demand being driven by major projects, construction waste is similarly impacted by large engineering projects. As there is typically a lower level of baseline activity, the impact of major projects have had a stronger impact on year-to-year volatility, and as such there is a stronger variance between the different scenarios, but draws upon the same logic as the aggregates.

Future scenarios consider different average levels of major projects as a share of total construction activity, which in turn generate alternative demands for aggregates.

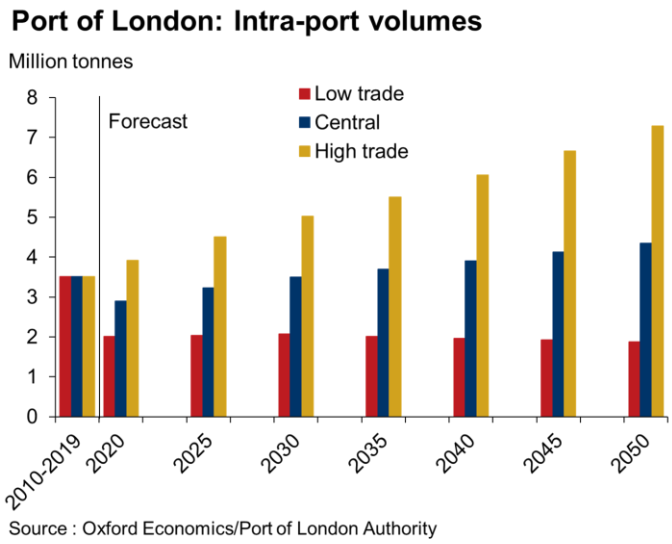
4.7.2 Waste / Other Cargo

The Port of London carries approximately 800,000 tonnes of waste per annum, and represents a fair share of the non-recycled waste-production within London (which is approximately 250kg per capita. The scenarios consider alternative declines in waste production (by between 13% and 33%) as well as improvements in recycling rates (from 45% currently to 68% or 79%). The net impact of this is that total waste movements are projected to decline in each scenario by between a quarter and a half.

4.7.3 Light Freight

The Port of London has commissioned an assessment of the market for light freight to be carried by the Port of London. The current market sizing estimates approximately 127,000 tonnes of food and 800,000 tonnes of goods could be carried on the Thames waterway. With that market potential growing in line with population and economic activity (respectively), under alternative demographic and macroeconomic scenarios (and a market capture ranging from 15% to 100%), light freight traffic could range from 120,000 tonnes to 950,000 tonnes.

Fig. 53. Intra-port trade scenarios



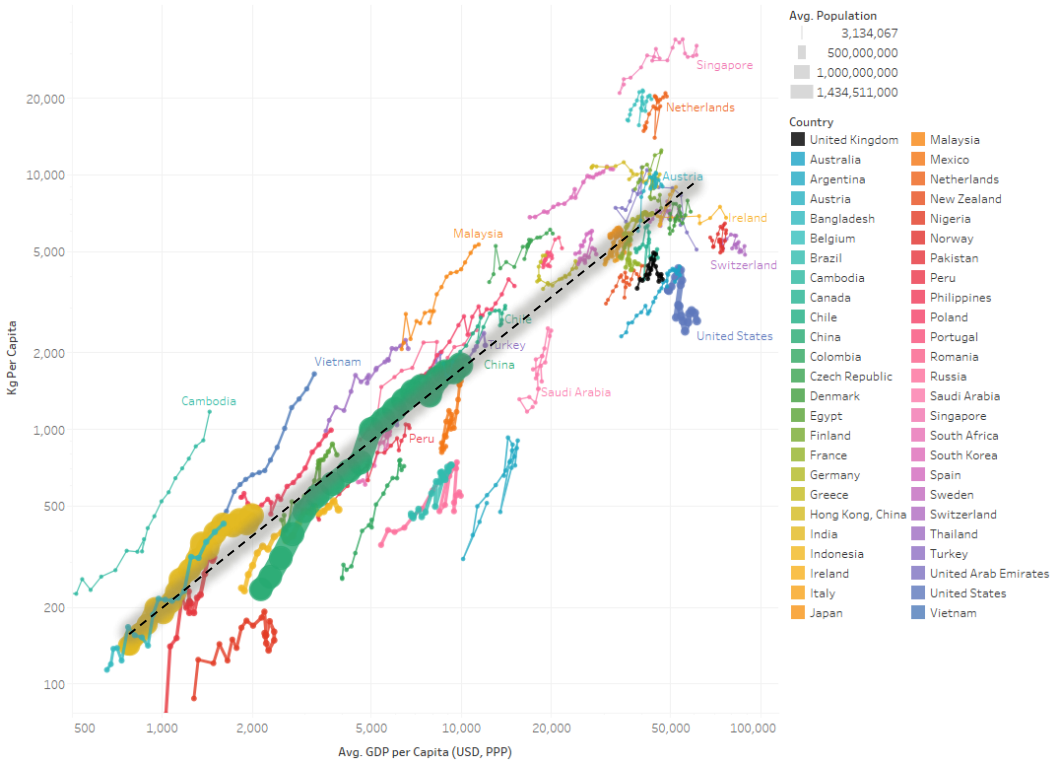
5. STRATEGIC IMPLICATIONS

5.1 GROWTH OPPORTUNITIES

The Port of London continues to be a conduit for economic activity within Greater London. As the composition of the economy evolves, so does trade through the Port of London. As we examine the impact of decarbonisation, individual cargo movements (such as hydrocarbons) are at risk, but these remain offset by both new cargos (ammonia) as well as those existing cargos (broadly defined) for which substitution to carbon friendly alternatives represent either a negligible net change from business as usual (e.g. dry bulk and unitised cargo), or a potential upside (e.g. timber).

It is important to note that all the projections for cargo flows presented in this report are **unconstrained** by infrastructure capacity at the port. Continued active investment in infrastructure and services is required at the Port of London under all scenarios, not only to cater for the growth of current trades, but to facilitate the extension to emerging cargos as well. Indeed, the port will need to be flexible in its long-term planning and continue to adapt to emerging trends in the maritime industry, such as changes in the size and types of ship needed to handle emerging cargoes, as well as increasingly sophisticated digital technology and automation.

Fig. 54. Total Import volumes (by Country, 2000-2019)



This has been an explicit assumption within the modelling undertaken by Oxford Economics, where the trade forecasts firstly are developed using unconstrained (demand driven) outlooks and secondly presume that the Port of

London's active participation in facilitating trade growth over the past 20 years is maintained.

As we look at the evolution of trades by select countries so far this century (see Figure 54 above), we note that there is a very clear relationship between broad economic activity and trading volumes, both across countries and across time (within countries). This is despite the degree of interconnectivity with other countries and degree of development spanning a wide range of outcomes. At the broadest level, we see a continuation of this trend for the UK (and London in particular) with strong growth in unitised cargo flows. Recall that trade through the Port of London has continued to climb over the past few decades, despite the loss of first coal volumes (which were once more than 20 million tonnes per annum) and then crude oil.

5.2 RISKS

There are additional risks to the outlook which have not been considered which may yield an outcome outside of the range of outcomes presented in this report.

5.2.1 Upside Risks

One of the known unknowns presented in this report is the shift towards carbon friendly fuels such as hydrogen and its derivatives (such as ammonia). The potential size of this market (and the relatively low import penetration assumed by the CCC and this report) may under an alternative set of assumptions generate trade which could dwarf any other cargo flow through the Port of London.

Similarly, a substantial lowering of shipping costs (for low cost and infrequently traded goods such as cement, bricks, etc.) may reveal growth opportunities above and beyond the 'high trade' scenario projections presented in this report. Mechanically, changes in policy (either domestically or with the UK's trading partners) which facilitates trade in those same goods would have a similar upward impact on cargo flows through ports.

5.2.2 Downside Risks

Downside risks include disruptions to the historic relationships between trading volumes and economic activity. This could include a seismic shift in consumer behaviour or disruption in global trade flows (due to an aggressive trade war or increase in tariffs).

For example, goods may be replaced less frequently (or owned at a lower rate, such as personal motor vehicle) which may disrupt the historic relationships used in the projections in this report. This was highlighted in the report (where a reduction in household consumption to reduce household waste may impact the estimated 10% (by mass) of unitised cargo imports which are household consumables.

A core tenet of the forecasts is that the impact from COVID is not expected to cause a permanent disruption to *what* people consume over the long term. And even if it causes some change in the *pattern* of consumption (e.g. due to more homeworking), this is less likely to impact where goods are imported to the UK.

If COVID does represent a shock from which cities such as London never recover, then there are potential downsides in the long run as the population and economic base may be eroded. However, this may be offset over the medium-term due to larger-than-usual construction activity (due to population movements into areas which do not have the carrying capacity in terms of dwellings and infrastructure and thus incentivise private and public construction investment, which require cement, aggregates, timber, and containerised building materials).

APPENDIX I: FORECASTING METHODOLOGY

OVERVIEW OF METHODOLOGY

As noted previously, we constructed projections of cargo flows for the major product categories traded through the port. These products were then aggregated to produce headline projections for the key cargo types: Unitised cargo, Liquid bulk, Dry bulk and Other cargo.

For **inter-port imports** (currently around 70% of total port trade), we followed a two-step procedure:

- The first step involved forecasting imports by product categories at the national level
    - For some product categories, we link directly to relevant economic drivers (using econometric techniques).
    - Where decarbonisation policies are likely to affect future trade flows, we link directly to CCC projections (particularly relevant for liquid bulk).
- The second step in the estimation procedure is to relate these national-level forecasts to the share of imports captured by the Port of London, which reflects the port's evolving competitiveness and general demand conditions in the South East.

For **inter-port exports** (currently around 20% of total port trade), we employed econometric forecasting techniques to project forward the volume of exports based on drivers such as output in the port's hinterland, competitiveness trends and external demand.

For **intra-port trade** (currently around 10% of total trade), future trends are linked mainly to economic activity in the construction sector, and developments in waste and light freight sectors.

MODELLING FRAMEWORK BY PRODUCT CATEGORY

The following section expands in more detail the methods taken to forecast each cargo flow as well as how cargoes are aggregated to the broad headline groups.

In order to build a bottom-up profile for each of the broad cargo groups; liquid bulk, dry bulk, unitised cargo and other cargo, forecasts were produced at a more disaggregated level to adequately reflect idiosyncrasies of cargoes even within the same broad cargo group. The table below shows how we allocated each cargo to a parent group, with forecasts produced at the component level and aggregated to headline.

Fig. 55. Broad cargo group allocation

Broad cargo group	Components
Total	Liquid bulk, dry bulk, unitised, other cargo
Liquid bulk	Petroleum, ammonia, synthetic jet fuel, vegetable oils, chemicals
Dry bulk	Aggregates, cement, other metal and metallic ore, sugar, cereals
Unitised	Lo-Lo, Ro-Ro
Other cargo	Forest products, steel, motor vehicles, other goods

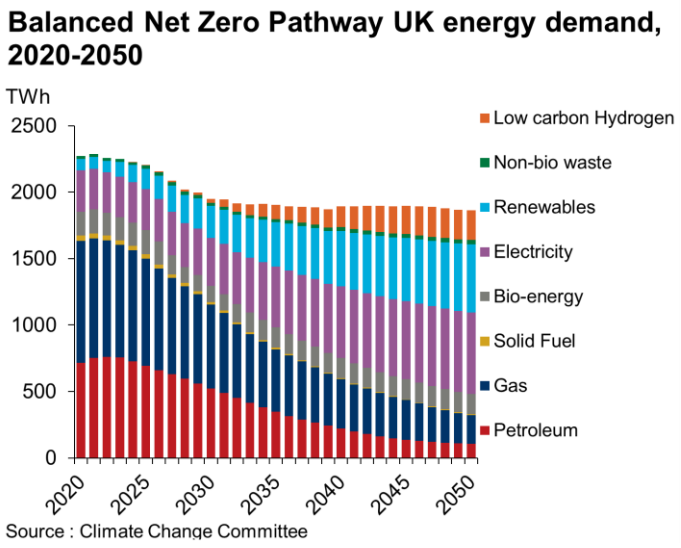
The disaggregated cargo flows are forecast in the following way to generate the **central** scenario:

Petroleum

Given 2020 imports of petroleum are not reflective of the true underlying demand as a result of the pandemic, it was necessary to approach the forecast period 2021-25 different from the long run. Demand for petroleum is largely split into demand from land transportation and demand from aviation and the differing expectations regarding the rebound in each sector made this disaggregation necessary.

The near-term forecast of petroleum demand depends on land transportation levels returning to some semblance of normal levels experienced prior to the pandemic. We therefore assume that by 2022 land transportation reaches 95% of 2019 levels and as such assume this component of petroleum imports also reach 95% of 2019 levels by 2022 and then follows the Climate Change Committee's UK Balanced Net Zero Pathway petroleum demand expectations to 2050.

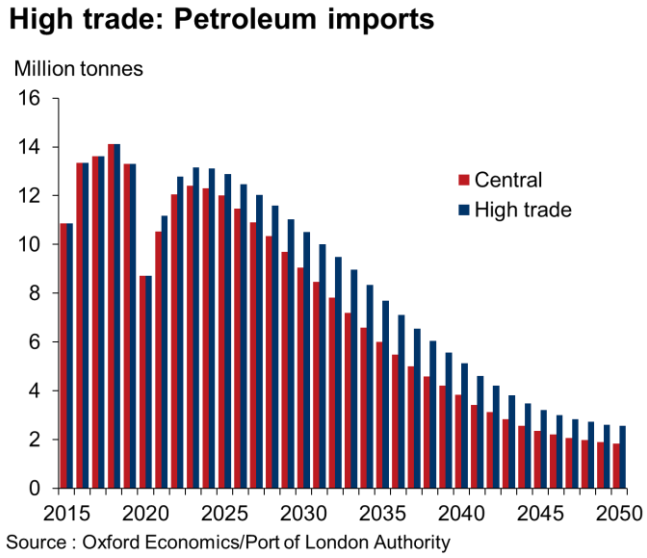
Fig. 56. Balanced Net Zero Pathway UK energy demand, 2020-2050



In line with Oxford Economics' travel and tourism forecasts it is expected that UK air passenger numbers will reach pre-pandemic levels in 2025, and we therefore assume the rebound in the aviation fuel demand component of petroleum follows this pathway and applies to this component of petroleum imports before following the same CCC UK petroleum demand series as above to 2050.

Consistent with the CCC's 'Headwinds' petroleum demand forecasts to 2050, carbon policies only manage to bring forward societal/behavioural change and innovation at the lesser end of the scale with more reliance on the use of large hydrogen infrastructure to achieve net zero emissions by 2050 whilst being the scenario with the largest demand for conventional fuels. Although similar to the central scenario to the extent that imports never quite regain their 2019 levels, they do reach 99% of 2019 levels in 2023 to peak at 13.2 million tonnes.

Fig. 57. Petroleum imports comparison: *'High trade'* versus *'Central'*



Given the small and inconsequential volumes of petroleum exports, we assume that these grow in line with the CCC's UK demand for petroleum to 2050.

Ammonia

In an effort to phase petroleum out of the energy mix, large scale electrification will occur. But the CCC envisages that low-carbon hydrogen shall also play a significant role in meeting energy demand in transportation, industry, buildings and areas less suited to electrification such as shipping. Whilst natural gas pipelines could be used to carry large volumes of hydrogen directly to market and offers a long-term solution, the cost of retrofitting natural gas infrastructure and end-user requirements put such actions many years from feasibility. On the other hand, the chemical properties of hydrogen make it difficult to store and transport, with high associated costs (three times the cost of transporting

ammonia)[3] and therefore it is assumed that the share of UK demand for hydrogen being met through imports would be done so as Ammonia.[4]

Ammonia imports are considered to have two distinct components i) imports as ammonia to be used a bunker fuel for shipping ii) imports of ammonia to be chemically cracked into hydrogen to meet domestic hydrogen demand.

The bunker fuel component is forecast using assumptions and data directly from the CCC whom state the expected UK demand for ammonia as a bunker fuel to 2050, with imports beginning in 2030 and assumptions surrounding the share of UK demand to be met via imports; 25% in the central scenario corresponding to the Balanced Net Zero Pathway.

The second and most considerable component of ammonia imports are those the CCC defines as hydrogen imports. Due to the cost and complexity of storing and transporting hydrogen it is widely accepted that ammonia will be imported and subsequently converted to hydrogen once onshore. Therefore, in forecasting ammonia imports we use the CCC's time series to 2050 on UK hydrogen imports, assume these imports are as ammonia (making the appropriate mass conversion) and then apply assumptions around Port of London's share of UK trade.

The Port of London is assumed to gain a 22% share of UK ammonia imports by 2050 in the 'high trade' scenario, compared to just over 20% in the 'central' scenario reflecting the more favourable economic conditions assumed under the 'upside' macroeconomic pathway. The Port of London is assumed to gain a 18.3% share of UK ammonia imports by 2050 in the 'low trade' scenario, compared to just over 20% in the 'central' scenario reflecting the less favourable economic conditions assumed under the 'downside' macroeconomic pathway.

At this stage it is assumed the Port of London does not export ammonia over the forecast horizon, however this is subject to change.

Synthetic Jet Fuel

Total UK synthetic jet fuel imports are estimated by the Climate Change Committee, along with a timeline showing imports beginning in 2026, to which we apply assumptions around Port of London's share of UK imports, in line with London's share of UK flights.

[3] Transporting costs of liquid ammonia and liquid hydrogen are 1.09 $/GJ and 3.24 $/GJ. Al-Breiki,M and Bicer,Y (2020) *Comparative cost assessment of sustainable energy carriers produced from natural gas accounting for boil-off gas and social cost of carbon*, : Science Direct.

[4] "Ammonia has several desirable characteristics that suggest its use as a medium to store hydrogen. First, it can be liquefied under mild conditions. This means that ammonia can be stored in a simple, inexpensive pressure vessel. Second, ammonia has a large weight fraction of hydrogen. Hydrogen constitutes 17.65% of the mass of ammonia. When these two factors are combined, the result is a liquid that is simply contained, with a volumetric hydrogen density about 45% higher than that of liquid hydrogen. Ammonia can be decomposed (cracked) over a catalyst to produce the desired fuel— hydrogen (H2) along with nitrogen (N2) a non-toxic, non-greenhouse gas." US Department of Energy, https://www.energy.gov/sites/prod/files/2015/01/f19/fcto_nh3_h2_storage_white_paper_2006.pdf

At this stage it is assumed the Port of London does not export synthetic jet fuel over the forecast horizon, however this is subject to change.

Vegetable oils

Imports projections are determined on a per-capita basis, that is, a ratio of vegetable oil imports to London population is calculated (vegetable oil imports/London population) and applied to population forecast for London to 2050. We use a five-year rolling average to capture recent trends but also to smooth any fluctuations in ratio, albeit this series is stable over history.

Given exports of vegetable oils will almost exclusively be as a by-product of consumption, we also apply a similar approach based on population albeit an export per-capita ratio.

Sugar

Sugar import forecasts to 2029 are underpinned by the OECD's Food and Agriculture Outlook[5], with the assumption sugar imports to the Port of London move in line with wider European imports of sugar. Imports in the period 2030-2050 grow at the 2028/29 growth rate.

Sugar exports are expected to remain at zero in the forecast horizon.

Cereals

Cereal imports forecasts to 2029 are underpinned by the OECD's Food and Agriculture Outlook, with the assumption cereal imports to the Port of London move in line with wider European imports of cereal. Imports in the period 2030-2050 grow at the 2028/29 growth rate.

Similar to imports, exports to 2029 are underpinned by the OECD's Food and Agriculture Outlook, with the assumption cereal exports from the Port of London move in line with wider European exports of cereal. Exports in the period 2030-2050 grow at the 2028/29 growth rate.

Other goods

Imports and exports are based on the same import/export per-capita method as sugar and cereals. For imports we use a 5-year rolling average and for exports a 15-year average, this is because there has been a gradual uptake in this ratio for imports whereas exports ratio has remained effectively flat with a standard deviation of 0.8% since 2005. Forecasts are therefore driven by the population of London.

Lo-Lo

Total UK Lo-Lo imports are forecast using simple linear regression analysis, with the elasticity between annual GDP per capita growth and annual growth of UK container imports being used to generate projection over the forecast horizon using a mass per capita method.

5 https://stats.oecd.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=HIGH_AGLINK_2020&ShowOnWeb=true&Lang=en

$$\ln\left(\frac{kg}{capita}\right) = 0.96 \times \ln\left(\frac{GDP}{capita}\right) + \beta$$

The implications of this are that imports (in mass per capita) grow at 0.96% of the rate of GDP (per capita) growth. Informed assumptions around the Port of London's share of UK trade are then applied to total UK Lo-Lo imports. These share assumptions take full account of stakeholder responses as well as ongoing and expected developments at the port over the forecast horizon.

Using GDP per capita allows alternative assumptions around demographics and economic outlook to be input to generate various trade flow projections.

The 'high trade' scenario is the most optimistic in terms of the Port of London's share of UK trade, assuming the port mirrors 'central' share growth to 2030, before growing by a further 50% of the share growth between 2020 and 2030, gaining 36% of the UK Lo-Lo import market by 2050. GDP per capita growth is also assumed to be on average 0.5% higher in each year from 2021 to 2050, based on ONS high population variant forecasts and Oxford Economics 'upside' economic projections.

Therefore, the implications of the various scenarios developed by Oxford Economics for The Port of London are largely consistent with the relationships we have observed historically, with imports undershooting GDP growth primarily because of the decline in petrochemicals (and the shift towards electrons which doesn't generate mass).

Lo-Lo exports are set at the UK level with informed assumptions around the Port of London's share of EU and non-EU container exports applied to the headline figure. To forecast national Lo-Lo exports, these are split into EU and non-EU exports, with the forecast weighted by the trade volume share split between each region and applied to GDP per capita growth in each, with an in-built assumption regarding future split between EU and non-EU trade.

Ro-Ro

Total UK Ro-Ro imports are forecast using simple linear regression analysis, with the elasticity between annual GDP per capita growth and annual growth of UK Ro-Ro imports being used to generate projection over the forecast horizon using a mass per capita method.

$$\ln\left(\frac{kg}{capita}\right) = 0.85 \times \ln\left(\frac{GDP}{capita}\right) + \beta$$

The implications of this are that imports (in mass per capita) grow at 0.85% of the rate of GDP (per capita) growth. Informed assumptions around the Port of London's share of UK trade are then applied to total UK Ro-Ro imports. These assumptions take full account of stakeholder responses as well as ongoing and expected developments at the port over the forecast horizon.

Ro-Ro exports are assumed to grow at the compound annual growth rate of the period 2015-2019 over the forecast period given the sustained decline in exports since 2011.

Motor vehicles

Imports forecasts are modelled using a three-step process.

The first step considers the units of motor vehicles for the whole of UK, which are measured on a per-capita basis. Using the 15 years to 2019 as a benchmark, import volumes have averaged 3.8 vehicles per 100 residents (this is also the average volumes in 2018 and 2019, prior to the impact of the COVID-19 pandemic). This ratio is used for all scenarios (implicitly assuming that the rate of car ownership remains unchanged under various scenarios), and therefore the alternative population outlooks have a direct impact on the total market size.

The second step looks at mass tonne per vehicle. There has been an increasing mass per vehicle due to changes in the fleet composition (with total European sales of SUV's increasing from 10% of total car sales in 2010 to 36% in 2019), but data in 2020 suggests that the growth of SUV's had stalled in 2020, in part due to growth of electric vehicle sales. Electric vehicles, however, tend to be heavier due to the contribution from battery packs, by approximately 25%, which is incorporated into the forward outlook on a linear basis to 2030 as new vehicle sales with internal combustion engines are phased out.

The third step considers the Port of London's share of total imported vehicles. London's share of total imports has declined markedly, from an average 19% in the mid-2000s, down to an average of 14% in the late-2010s. This latter ratio holds for all scenarios.

Exports of motor vehicles had declined by over 60%, from 260,000 tonnes in 2004 to 90,000 in 2020. All scenarios hold exports unchanged over the forward outlook.

Other metals and metallic oil

Imports of metals and scrap into the Port of London have roughly followed Gross Value Added (GVA) of the UK construction sector, with 258,000 tonnes in 2019. As the comparable data for the whole of the UK is not available, import volumes into the Port of London is directly modelled off of changes in GVA, with alternative scenarios incorporating the alternative GDP outlooks.

Export volumes are mostly scrap metals, resulting from decommissioned motor vehicles. As the stock of vehicles (and decommissions) are anchored off of population, changes in the population outlook are used to project alternative volumes under each scenario.

Forest products

Forest products are comprised of two sub-groups, paper and timber, with no reported exports since 2016.

Paper imports through the Port of London have been largely unchanged since 2008, and are held at 2019 (pre-COVID) levels over the forward outlook.

Timber volumes incorporate three different assumptions (which vary by scenario):

1. Total UK construction gross value added
2. Apparent UK timber use in construction.
3. Port of London investment-led growth

Total UK construction gross value added in each the scenarios is a direct function of the alternative GDP outlooks modelled.

Timber use in the UK in the alternative scenarios rely heavily upon a CCC report published in 2019 on *Wood Construction in the UK*.[6] Data from the Structural Timber Association (STA) were used to estimate that 28% of all UK housing starts were timber frame in 2016, with this share unchanged over the forward outlook under business as usual (which is incorporated into the *Low Trade* scenario). Official UK statistics for 2019 have estimated apparent consumption of timber products as 10,281,000 tonnes, which is converted into tonnes / construction GVA and remains unchanged over the forward outlook.

The central scenario takes into account the *Moderate Growth* outlook developed by the CCC, which has timber framing (and engineered wood products) make up 45% of new builds by 2050, with the high trade scenario having that share increase to 80%. As such, the timber use / GVA increase by 45/28 for the central scenario, and by 80/28 for the high trade scenario. This increase is assumed to be linear over 30 years.

Timber imports through the Port of London have declined markedly over the past two decades, with a share in 2019 of 3.7% of total UK timber imports (or 2.5% of total UK apparent consumption). The low trade scenario assumes a continuation of business as usual, but both the central and high trade scenarios have the Port of London recover to 15% of total UK timber imports by 2030.

Cement

Cement imports through the Port of London are modelled in five stages:

1. Total GB cementitious material holding cement intensity constant.
2. Netting out the impact of product substitution from cement to alternative building products (i.e. timber framing and engineered wood products).
3. Netting out impact of increasing fly ash substitution for cement clinker.
4. Import volumes as the difference from consumption and domestic production.
5. The Port of London's share of total import volumes.

The first step allows for cementitious consumption to grow in line with construction GVA (which varies by scenarios).

The second step takes into account the substitution of cement to engineered wood products in the *Central* and *High Trade* Scenarios, using a 1:1 ratio, in apartments and other high-rise buildings. The intensity factors incorporated are informed by the CCC report used to model timber demand.

The third step considers an increase in fly ash or granulated slag in making of concrete, which is the same under all scenarios (increasing by 7% over 30 years).

[6] https://www.theccc.org.uk/wp-content/uploads/2019/07/Wood-in-Construction-in-the-UK-An-Analysis-of-Carbon-Abatement-Potential-BioComposites-Centre.pdf

The fourth step considers domestic production of cement clinker. After declining by a third between 2007 and 2009, production recovered in the 2010s and have been largely stable since 2015. All scenarios assume continued stable production of clinker, therefore imports are calculated as the difference between GB demand and domestic production.

The fifth Cement imports into the Port of London comprise of both cement clinker and slag/fly ash, in roughly equal measure. Public statistics of the import volumes of each suggest that the Port of London comprises of 24% and 19%, respectively, of total UK imports of the two subgroups in 2019.

Aggregates

Imports of aggregates through the Port of London are modelled directly off of UK construction Gross Value Added (GVA), with 2019 as the reference year. While a significant portion of aggregates are mixed with cement to create concrete, aggregates are also heavily used in the construction of roads and other building products. Each scenario keeps the Port of London import tonnes / Construction GVA constant over the forward outlook, with differences in GVA (driven by changes in GDP) yielding alternative trading volume outlooks.

Steel

Import volumes of metals and scrap into the Port of London over the past 20 years have broadly moved in line with changes in UK construction activity, with generally more volatility in scrap imports than metals. The 2019 ratio of imports to Construction GVA are used for the forward outlook, with imports in that year 258,000 tonnes.

Export volumes are more substantial, with scrap averaging 838,000 tonnes per year between 2004 and 2020, albeit with some year-to-year volatility. 2021 volumes are taken to be the average of the preceding five years. As most of this scrap is the result of decommissioned motor vehicles, and the stock of vehicles (and decommissions) are anchored off of population, changes in the population outlook are used to project alternative volumes under each scenario.

Chemicals

Chemical imports through the Port of London have grown in line with changes in UK GDP, with the relationship maintained over the alternative scenarios.

The table below gives a high-level overview of the fundamental underlying drivers behind the forecasts of inter-port imports for each product.

Fig. 58. Key drivers of inter-port imports

Imported cargo	Key drivers
Aggregates	GDP, cement demand
Petroleum	UK petroleum demand (CCC)
Ammonia	UK demand for hydrogen and ammonia for shipping, Port of London share of UK imports
Synthetic jet fuel	UK demand for synthetic jet fuel from CCC, Port of London share of UK imports
Unitised cargo	GDP, population, Lo-Lo share of UK imports and Ro-Ro share of UK imports
Cement	GDP, Timber share of non-residential buildings
Forest products	Port of London share of UK trade, GDP, Timber share of non-residential buildings
Vegetable oils	Population
Other goods	GDP, Population
Chemicals	GDP
Sugar	OECD European sugar import forecasts, Population
Cereals	OECD European cereal import forecasts, Population
Motor vehicles	Population, average weight (tonnes) per vehicle imported
Other metal and metallic ore	Population
Steel	GDP

APPENDIX II: DETAILED PROJECTIONS BY PRODUCT

The tables below provide detail on the inter-port cargo forecasts for each scenario. The remainder of this chapter examines projections for trade in the products underlying these cargoes, followed by detail on intra-port trade.

Fig. 59. Inter-port cargo projections across the three scenarios

CENTRAL: INTER-PORT TRADE

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Liquid bulk	20.3	14.6	10.0	9.4	7.2	-51%	-28%
of which Petroleum	19.2	13.3	8.9	6.1	1.8	-86%	-79%
Dry Bulk	10.3	14.6	13.2	17.0	19.2	31%	46%
Of which: aggregates/cement	6.9	12.4	10.9	14.5	16.5	33%	51%
Unitised Cargo	13.8	21.4	21.2	33.0	39.9	87%	88%
Other cargo	3.1	3.1	2.4	4.8	5.9	93%	148%
Total Inter-port	47.5	53.7	46.9	64.1	72.3	35%	54%

LOW TRADE SCENARIO: INTER-PORT TRADE

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Liquid bulk	20.3	14.6	10.0	7.2	5.1	-65%	-49%
of which Petroleum	19.2	13.3	8.9	4.3	0.2	-99%	-98%
Dry Bulk	10.3	14.6	13.2	14.9	14.3	-2%	9%
Of which: aggregates/cement	6.9	12.4	10.9	12.6	12.1	-2%	11%
Unitised Cargo	13.8	21.4	21.2	27.4	31.4	47%	48%
Other cargo	3.1	3.1	2.4	3.1	3.2	4%	33%
Total Inter-port	47.5	53.7	46.9	52.6	54.0	1%	15%

HIGH TRADE SCENARIO: INTER-PORT TRADE

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Liquid bulk	20.3	14.6	10.0	11.7	10.9	-25%	8%
of which Petroleum	19.2	13.3	8.9	7.8	2.6	-81%	-71%
Dry Bulk	10.3	14.6	13.2	19.1	24.8	69%	88%
Of which: aggregates/cement	6.9	12.4	10.9	16.3	21.4	73%	96%
Unitised Cargo	13.8	21.4	21.2	35.1	47.5	122%	123%
Other cargo	3.1	3.1	2.4	5.7	8.9	190%	271%
Total Inter-port	47.5	53.7	46.9	71.7	92.0	71%	96%

INTER-PORT TRADE: LIQUID BULK

Petroleum imports

Assumptions

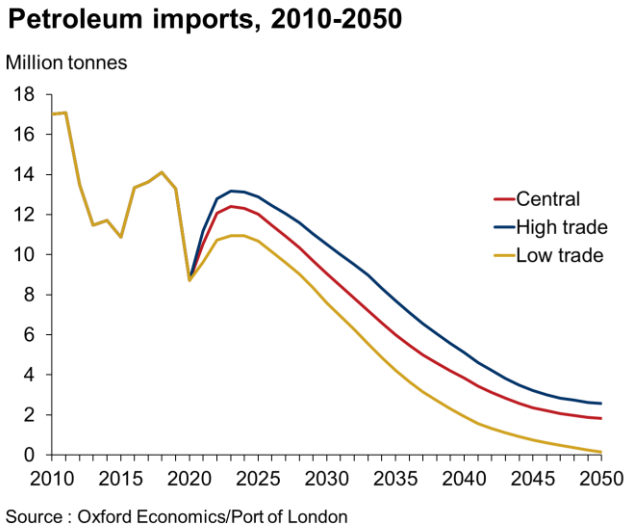
- 'Central' scenario assumes petroleum demand from land transportation recovers to 85% of 2019 levels by 2021 and 95% by 2022.
- 'High trade' and 'low trade' scenarios flex *'Central'* demand assumptions around land transportation levels up and down respectively by 5%, reaching 100% of 2019 levels by 2022 in high trade simulation and 90% in low trade.
- Oxford Economics forecasts that UK air passenger numbers shall return to 2019 levels by 2025. As such, the aviation fuel component of petroleum demand is expected to reach 2019 levels by 2025 in all scenarios.
- Petroleum imports at the port across all scenarios are consistent with published CCC net zero petroleum demand assumptions to 2050. Our 'central' forecasts are consistent with the CCC's *Balanced Net Zero Pathway*, with 'high trade' and 'low trade' consistent with the CCC's *Headwinds* and *Tailwinds* alternative net zero pathways.
- 'High trade' and 'low trade' petroleum imports are consistent with 'upside' and 'downside' GDP and population projections respectively.
- Given petroleum demand will largely be dictated by Government carbon policies, scenarios make no explicit port share assumption.

Owing to the COVID-19 pandemic, imported petroleum volume through the port fell by 4.6 million tonnes (-34%) in 2020 to 8.7 million tonnes, the lowest level in living memory and 51% of 2010 levels. Oxford Economics estimates UK air passenger numbers fell by 74% in 2020 whilst Department for Transport[7] estimates that all motor vehicle traffic fell by 19% to September and provides a basis for our assumption that by year end, motor traffic fell to 80% of 2019 levels.

Under the **central scenario**, petroleum imports remain below 2019 levels throughout the forecast period, albeit a partial recovery is expected in the short-run. Imports peak at 12.4 million tonnes in 2023 (93% of 2019 levels) as demand from aviation gradually returns to more 'normal' levels by 2025 and demand from surface transport also recovers. Imports begin to fall modestly from 2024 despite the continued recovery of the aviation sector, however, as changes in behaviour around surface transport begin to drag on petroleum demand nationally.

[7] https://www.gov.uk/government/statistics/provisional-road-traffic-estimates-great-britain-october-2019-to-september-2020

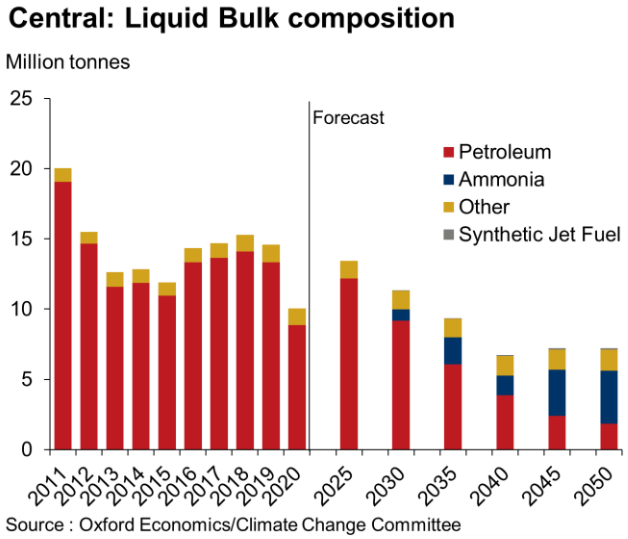
Fig. 60. Petroleum imports comparison across scenarios [2010 to 2050]



Source : Oxford Economics/Port of London

As shown in Figure 60, imports in our central scenario fall to 1.8 million tonnes by 2050 (14% of 2019 levels). Policies – such as the 2032 phase-out date for fossil fuel cars and vans and regulatory approval to drive fossil fuelled road vehicles limited to 2050 – will effectively entirely remove the road component of petroleum demand with the remaining demand for petroleum almost exclusively for the use of the aviation sector.

Fig. 61. Central scenario: Liquid bulk composition



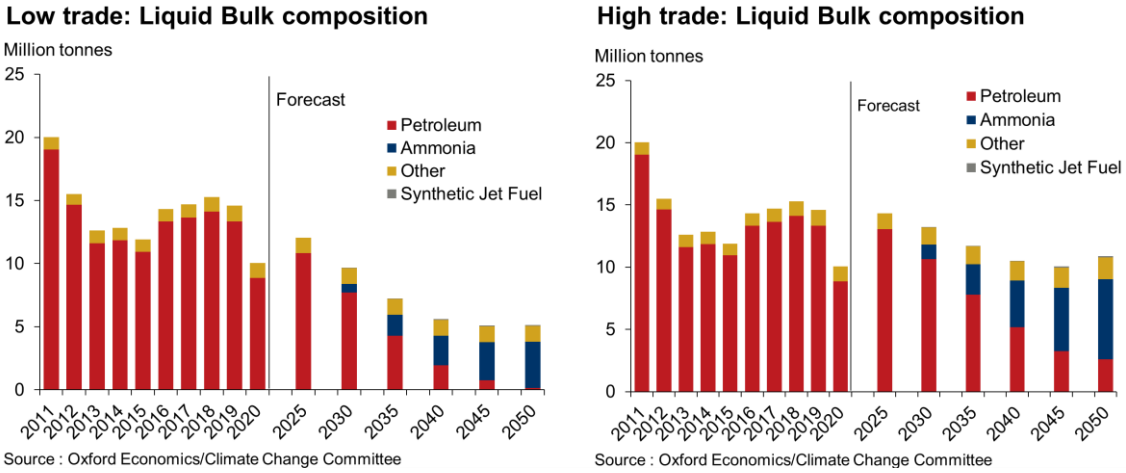
Source : Oxford Economics/Climate Change Committee

High trade scenario

Consistent with the CCC's 'Headwinds' petroleum demand forecasts to 2050, carbon policies only manage to bring forward societal/behavioural change and innovation at the lesser end of the scale with more reliance on the use of large hydrogen and infrastructure to achieve net zero by 2050 whilst being the scenario with the largest demand for conventional fuels. Although similar to the central scenario to the extent that imports never quite regain their 2019 levels, they do reach 99% of 2019 levels in 2023 to peak at 13.2 million tonnes.

The 'high trade' scenario expects 2050 imports of petroleum at the Port of London to be 2.6 million tonnes, 40% higher than in the 'central' scenario, albeit 81% lower than 2019 levels. This higher levels of residual imports are largely explained by a full rebound in demand from surface transport by 2022 (5% more than in central), the phase out of fossil-fuelled road vehicles pushed back to 2035 (2 years later than central), a more favourable economic outlook than that assumed in the central scenario, consistent with the Oxford Economics 'upside' pathway and only 50% of HGVs adopting efficiency measures (30% lower than in central).

Fig. 62. '*Low Trade*' and '*High Trade*' liquid bulk composition



Low trade scenario

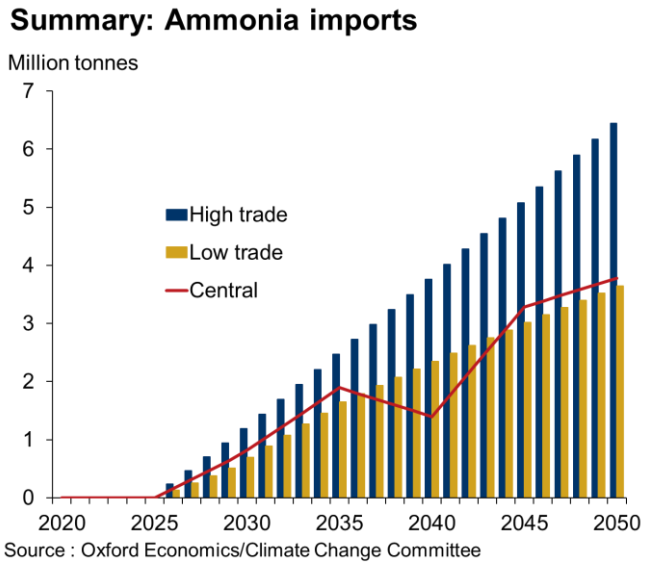
The 'low trade' scenario expects 2050 imports of petroleum at the Port of London to decline sharply to 160,000 tonnes, over 91% lower than in the 'central' scenario and 98% lower than 2019 levels. The almost eradication of demand for petroleum is accounted for by a 15% reduction in air passenger numbers by 2050, the phase out of fossil-fuelled road vehicles brought forward to 2030 (two years earlier than 'central' and five years earlier than 'high trade'), 100% of HGVs adopting efficiency measures (20% more than in 'central' and 50% more than 'high trade'), a 34% reduction in car miles (compared to 17% in 'central' and 12% in 'high trade'), 250km/yr. of rail electrification (compared to 200km/yr. in 'central' and 'high trade') and a more pessimistic economic outlook than that assumed in the central scenario, consistent with the Oxford Economics 'downside' pathway.

Ammonia imports

Assumptions

- All scenarios assume that CCC assumptions for hydrogen imports take the form of ammonia imports (as confirmed by stakeholder engagement with hydrogen infrastructure experts).
- 'Central' scenario assumes 13% of the UK's demand for hydrogen will be imported (as Ammonia) – consistent with CCC assumptions. 'High trade' and 'low trade' scenarios flex this share to 14% and 12% respectively.
- 'Central' scenario assumes 25% of the UK's demand for Ammonia to be used as a bunker fuel for shipping will be imported. 'High trade' and 'low trade' scenarios assume this share is 0% and 50% respectively.
- Similar to the port's share of UK fuel imports (excl. crude oil), the port is assumed to capture 19% of UK ammonia imports, growing to 20.4% in 2050, reflecting London's growing relative share of UK GDP over the forecast horizon in the 'central' scenario.
- Ammonia imports begin in 2026 across all scenarios, consistent with CCC timing profiles.

Fig. 63. Ammonia imports comparison across scenarios



Central scenario

In an effort to phase petroleum out of the energy mix, large scale electrification will occur. But the CCC envisages that low-carbon hydrogen shall also play a significant role in meeting energy demand in transportation, industry, buildings and areas less suited to electrification such as shipping. Whilst natural gas pipelines could be used to carry large volumes of hydrogen directly to market and offers a long-term solution, the cost of retrofitting natural gas infrastructure and end-user requirements put such actions many years from feasibility. On the other hand, the chemical properties of hydrogen make it difficult to store and transport, with high associated costs (three times the cost of transporting

ammonia) and therefore it is assumed that the share of UK demand for hydrogen being met through imports would be done so as Ammonia.

Under the ***central* scenario** it is expected that the Port of London will import 3.8 million tonnes of ammonia in 2050 (Figure 63) of which 360,000 tonnes are to be used as a bunker fuel for shipping; the remaining 3.4 million tonnes would be chemically decomposed (cracked) to produce hydrogen (H2) along with nitrogen (N2) a non-toxic, non-greenhouse gas[8]. This diversification is expected to offset 55% of the estimated losses in oil imports by 2050.

This is consistent with the UK importing 13% of its demand for Hydrogen assuming the CCC's timing profile, entirely in the form of Ammonia, with the Port of London capturing 20.4% of this UK import market from 19.2% in early forecast years, reflecting London's growing relative share of UK GDP under the *'baseline'* economic outlook.

Given the technological scale up and cost reductions required, imports of ammonia to be used as a bunker fuel for shipping begins in 2030, whilst ammonia imports to be cracked into hydrogen begin in 2026. This is the same across all scenarios.

High trade scenario

Assumptions are underpinned by the CCC's 'Headwinds' scenario which has the highest demand for hydrogen of all the CCC alternative pathways, with 14% assumed to be imported, compared to 13% in the Balanced Net Zero Pathway scenario, consistent with our 'central' simulation. Demand in this scenario is explained by large scale use of hydrogen in HGVs, grid conversion trials in the 2020s, large-scale conversions (patchwork conversions in 'central') starting from 2030 around industrial clusters and radiate out at 10 km/yr and 20% of homes on gas grid with hydrogen by 2035.

The Port of London is assumed to gain a 22% share of UK ammonia imports by 2050, compared to just over 20% in the 'central' outlook reflecting the more favourable economic conditions assumed under the 'upside' macroeconomic pathway.

Low trade scenario

By 2050, imports of Ammonia under the 'low trade' scenario are 4% below the 'central' scenario at 3.6 million tonnes, despite the CCC assumptions having demand for hydrogen in the 'Tailwinds' scenario marginally higher than in the Balanced Net Zero Pathway consistent with our 'central' simulation, however as the 'low trade' scenario is consistent with the 'downside' population and GDP pathway, it keeps ammonia imports lower by 2050. 50% of all ammonia to be used in the UK as bunker fuel for shipping is assumed to be imported in this scenario, compared to 25% in 'central' and 0% in 'high trade', this equates to 718,000 tonnes.

The Port of London is assumed to gain a 18.3% share of UK ammonia imports by 2050, compared to just over 20% in the 'central' outlook reflecting the less

[8] Ammonia Energy Association: https://www.ammoniaenergy.org/articles/progress-toward-ammonia-to-hydrogen-conversion-at-h2-fueling-stations/

favourable economic conditions assumed under the 'downside' macroeconomic pathway.

Synthetic Jet Fuel imports

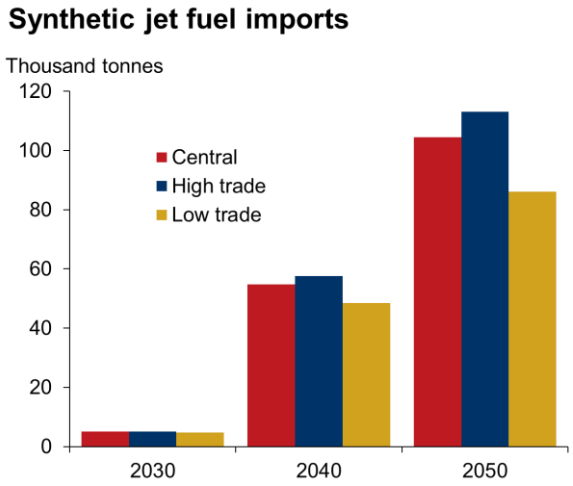
Assumptions

- All scenarios assume the Port of London captures 40% of UK Synthetic jet fuel imports, further adjusted for population.
- 'High trade' and 'low trade' synthetic jet fuel imports are consistent with 'upside' and 'downside' economic and population projections respectively.
- Synthetic jet fuel imports begin in 2026 across all scenarios, consistent with CCC timing profiles.

Central scenario

Synthetic jet fuels are expected to be imported in low volumes beginning in 2026, with demand largely met via domestic production across all scenarios, with a team of researchers at the University of Oxford revealing in January 2021 a cost-effective and efficient way of producing carbon-neutral jet fuel from carbon dioxide. By 2050, synthetic jet fuel accounts for 1.4% of liquid bulk trade at the port, equal to 105,000 tonnes, assuming the Port of London captures 40% of the CCC's estimated 260,000 tonnes of synthetic jet fuel to be imported by the UK in 2050.

Fig. 64. Synthetic jet fuel imports: 'Central' versus 'Low trade' and 'High trade'



Source : Oxford Economics/Climate Change Committee

High trade scenario

Imports of synthetic jet fuels are marginally higher in 2050 in the 'high trade' scenario, at 116,000 tonnes, although the share of liquid bulk is actually lower than in the 'central' scenario at 1.1%, due to higher levels of ammonia and petroleum imports under this scenario. Imports are higher due to the

assumption of stronger underlying GDP and population growth than assumed under the 'central' scenario.

Low trade scenario

Imports of synthetic jet fuels are lowest in the 'low trade' scenario, at 86,000 tonnes in 2050, albeit 1.6% of total liquid bulk trade as traditional fossil fuels are all but eradicated. Imports are weaker due to the assumption of weaker underlying GDP and population growth than assumed under the 'central' scenario.

Vegetable oils imports

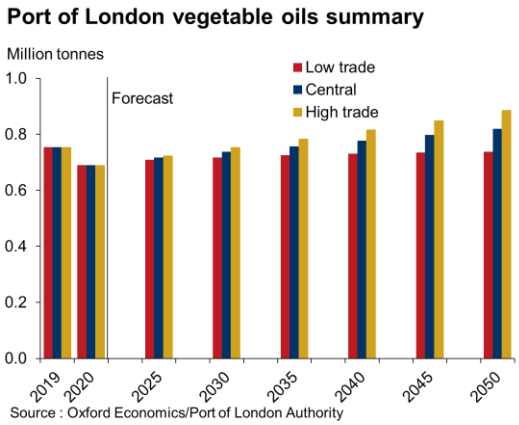
Assumptions

- Assumes vegetable oil imports per capita remain at 2020 ratio and is applied to London population projections to 2050.
- 'High trade' and 'low trade' vegetable oils imports are consistent with 'Upside' and 'Downside' population projections respectively.

Central scenario

Vegetable oils account for just over 1% of inter-port volumes handled by the port and have given underlying consumption-based nature of vegetable oils the traded volumes are closed related to London's demographic developments. Vegetable oil imports relative to the population of the London area have remained stable in history, with the ratio of 0.05 in 2020 the same as in 2005 and as such we hold this ratio flat over the forecast. We foresee vegetable oil imports peaking at 693,000 tonnes in 2050 accounting for 85% of all inter-port vegetable oil trade through the port (Figure 65).

Fig. 65. Vegetable oils: 'Central' versus 'Low trade' and 'High trade'



High trade scenario

The higher population growth assumptions of the London region under the **high trade** generates a forecasted 750,000 tonnes of vegetable oil imports in

2050, 8% higher than under the **central scenario** (Figure 65), albeit less than 1% of total imports.

Low trade scenario

Owing to the weaker population growth assumptions under the **low trade** scenario imports peak at 624,000 tonnes in 2050, 17% below **high trade** outcome and 10% below **central** scenario.

Liquid bulk exports

Liquid bulk exports constituted little over 1% of total inter-port liquid bulk trade through the Port of London and we foresee exports of such cargoes to remain an immaterial share of trade, peaking at 162,000 tonnes in 2050 under the *'High trade'* scenario. The closure of Coryton refinery in 2012 and anticipated carbon policy mean a revival of oil related exports is highly unlikely. A potential area of opportunity is if the port was to begin exporting hydrogen once domestic production matures and scales up, however as of 2021 information is not at a sufficient enough level as to incorporate into liquid build export forecasts. As such, under the **central scenario** vegetables oil exports account for 125,000 tonnes (84%) of the forecasted 150,000 tonnes of liquid bulk exports in 2050.

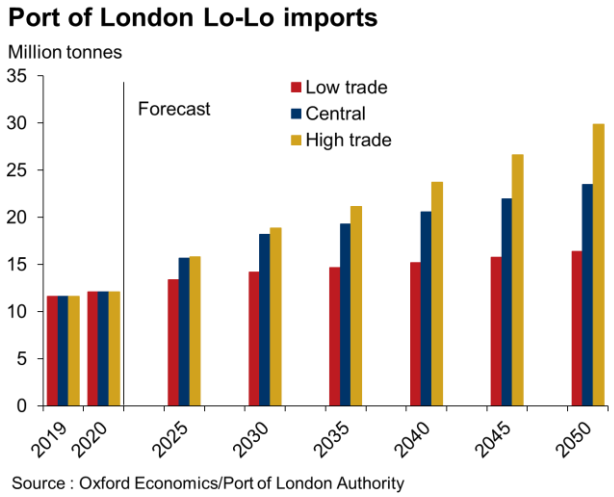
INTER-PORT TRADE: UNITISED CARGO

Lift-on Lift-off (Lo-Lo) imports

Assumptions

- 'Central' scenario assumes Port of London share of UK Lo-Lo imports increases from 27.2% in 2020 to 33.2% in 2030. This is the same increase in share as between 2005 and 2020, albeit 5 years sooner due to additional berthing capacity attributable to London Gateway and marginal diversion of cargo from Dover. Share then remains flat at 2030 level in the period 2031-2050 to give a balanced outlook.
- 'High trade' assumes the same market share profile as 'central' to 2030, however grows by a further 50% of the growth between 2020 and 2030, peaking at 36.2% in 2050, 3ppt higher than 'central'.
- Econometric relationship over history is assumed to hold in forecast across scenarios, albeit with different population and GDP outlooks consistent with alternative macroeconomic outlooks.
- 'Low trade' assumes market share remains at 2020 level during entire forecast horizon, neither gaining share nor losing.
- 'High trade', 'low trade' and 'central' scenarios are consistent with the 'upside', 'downside' and 'baseline' alternative macroeconomic projections respectively.

Fig. 66. Lo-Lo imports: 'Central' versus 'Low trade' and 'High Trade'



Source : Oxford Economics/Port of London Authority

Central scenario

In contrast to the outlook for liquid bulk imports which will largely be determined by prescriptive national carbon policy going forward, the differing outlooks in unitised cargo imports are principally explained by the share of the expected UK market captured by the Port of London and underlying economic and demographic expectations.

Consistent with the 'baseline' economic growth and population projections and using the 0.96 elasticity, our 'central' scenario estimates the UK Lo-Lo import market to total 70.7 million tonnes in 2050, of which the Port of London will capture 33%, an increase of 6ppt from 2020. We assume Port of London share peaks in 2030 and remains at this level to 2050. The resulting trade volumes are an increase in Lo-Lo of 94% on 2020 levels by 2050, or 23.5 million tonnes.

Since the opening of the £1.5 billion London Gateway complex in 2015, the Port of London's share of UK Lo-Lo imports has increased substantially from 18% in 2014 to 27% in 2020 with the extra berthing capacity expected to contribute substantially to the volume of container imports handled by the port over the forecast horizon given proximity to the large and fast growing population and wealth centres of London and the South East and the expanding deep-sea capabilities facilitating the world's largest container vessels from across the world, at a time when the UK is looking further a-field to establish trading relations post Brexit.

Freeport status granted in March 2021 is expected to provide an attractive investment opportunity for manufacturing firms looking to take advantage of the favourable tax regime at the port. Notwithstanding, only a modest positive impact is expected at the port in terms of container imports, as it is largely displaced trade from ports not granted freeport status as opposed to generating new trade with international markets.

High trade scenario

The assumptions underlining the 'central' scenario are flexed around 3 key axes to produce the 'high trade' and 'low trade' outlooks for container imports

through the Port of London i) GDP growth, ii) population growth and iii) share of UK Lo-Lo import market captured by Port of London.

The 'high trade' scenario is the most optimistic in terms of Port of London share of UK trade, assuming the port mirrors 'central' share growth to 2030, before growing by a further 50% of the share growth between 2020 and 2030, gaining 36% of the UK Lo-Lo import market by 2050 (Figure 66). GDP per capita growth is also assumed to be on average 0.5% higher in each year from 2021 to 2050, based on ONS high population variant forecasts and Oxford Economics 'Upside' economic projections.

By 2050 Lo-Lo imports reach 29.9 million tonnes, 27% higher than under the 'central' scenario and more than double the 12.1 million tonnes imported in 2020, a compound annual growth rate of 3.1% per year, 0.9ppt in excess of GDP per capita growth with the excess driven by the increase in share of UK trade.

Low trade scenario

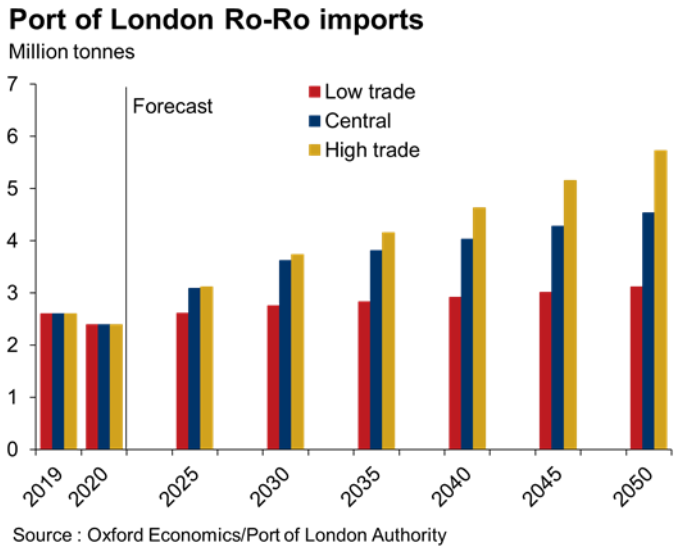
The 'low trade' scenario assumes a pessimistic outlook for the port, with no gain in share in the 30 years from 2021-2050, remaining at 27% in the forecast horizon (Figure 66). This scenario is also consistent with our 'Downside' economic outlook with weaker economic fundamentals and falling population, weighing heavily on demand from London and the South East. Despite these pessimistic assumptions, container imports are still expected to be 35% above 2020 levels by 2050, reaching 16.4 million tonnes, albeit much lower than the 23.5 million tonnes in the 'central' outlook.

Roll-on Roll-off (Ro-Ro) imports

Assumptions

- 'Central' scenario assumes Port of London share of UK Ro-Ro imports increases from 4.5% in 2020 to 5.7% in 2030. This is the equivalent to the Ports' highest share in recent history. Share is held flat at 5.7% to 2050.
- 'High trade' assumes the same market share profile as 'central' to 2030, however grows by a further 50% of the growth between 2020 and 2030, peaking at 6.3% in 2050, 0.6ppt higher than 'central'.
- 'Low trade' assumes market share remains at 2020 level during entire forecast horizon, neither gaining share nor losing.
- 'High trade', 'low trade' and 'central' scenarios are consistent with the 'upside', 'downside' and 'baseline' alternative macroeconomic projections respectively.

Fig. 67. Ro-Ro imports: 'Central' versus 'Low trade' and 'High trade'



Central scenario

Despite the Port of London accounting for over 11% of total UK trade volumes, only 4.5% of the UK's Ro-Ro imports passed through the Port of London in 2020 and has remained around this level for more than a decade.

Similar to Lo-Lo, econometric analysis of annual UK historic Ro-Ro import growth produces an elasticity of 0.84 when regressed on GDP per capita growth for the UK, that is grow at 0.84% the rate of GDP per capita growth, a lower elasticity than that for Lo-Lo (0.96). Consistent with the *'Baseline'* economic growth and population projections and using the 0.84 elasticity, our 'central' scenario estimates the UK Ro-Ro import market to total 79.3 million tonnes in 2050, of which the Port of London will capture 5.7%, an increase of 1.2ppt from 2020. We assume Port of London share peaks in 2030 and remains at this level to 2050.

The split between Lo-Lo and Ro-Ro imports will remain around 5:1 ratio, with Ro-Ro imports of 4.5 million tonnes compared to 23.5 million tonnes of Lo-Lo imports.

Following stakeholder engagement, all scenarios assume a portion of the share gain is due to diverted Ro-Ro trade from Dover being sent as unaccompanied Ro-Ro via the Port of London as a direct result of the additional paperwork and costs associated with bringing accompanied Ro-Ro across The Channel to Dover. The investment in Tilbury 2 provides the capacity for this shift in freight patterns, and further berth expansions are expected to be developed as additional trades are realised.

High trade scenario

As was the case with Lo-Lo imports, the 'central' scenario are flexed around 3 key axes to produce the 'high trade' and 'low trade' outlooks for Ro-Ro imports through the Port of London i) GDP growth, ii) population growth and iii) share of UK Ro-Ro import market captured by Port of London.

The 'high trade' scenario is the most optimistic in terms of Port of London share of UK trade, assuming the port mirrors 'central' share growth to 2030, before growing by a further 50% of the share growth between 2020 and 2030, gaining 6.3% of the UK Ro-Ro import market by 2050 (Figure 67). GDP per capita growth is also assumed to be on average 0.5% higher in each year from 2021 to 2050, based on ONS high population variant forecasts and Oxford Economics 'Upside' economic projections.

By 2050 Ro-Ro imports reach 5.7 million tonnes, 26% higher than under the 'central' scenario and more than double the 2.4 million tonnes imported in 2020, a compound annual growth rate of 3.0% per year, 0.8ppt in excess of GDP per capita growth with the excess driven by the increase in share of UK trade.

Low trade scenario

The 'low trade' scenario assumes a pessimistic outlook for the port, with no gain in share in the 30 years from 2021-2050, remaining at 4.5% in the forecast horizon (Figure 67). This scenario is also consistent with our 'Downside' economic outlook with weaker economic fundamentals and falling population, weighing heavily on demand from London and the South East. Despite these pessimistic assumptions, Ro-Ro imports are still expected to be 31% above 2020 levels by 2050, reaching 3.1 million tonnes, albeit 31% lower than the 'central' outlook

Unitised exports

Assumptions

- UK Lo-Lo exports split between EU and non-EU expected to remain at 2020 share throughout forecast period (30:70), with UK forecast determined by a weighted GDP per capita forecast in these destination markets.
- EU and Rest of World economic projections are consistent with Oxford Economics' latest global outlook
- Port of London share of UK exports to EU and non-EU destinations expected to increase from 14.8% and 30.5% in 2020 to 18.5% and 38.2% respectively, growing in line with the ports share of UK unitised imports from the 'central' scenario in the imports section above.
- For unitised cargo exports just the one scenario is produced as forecasts are largely driven by economic activity in destination markets for which we take a central view on.

Our projections are consistent with economic and demographic projections in line with Oxford Economics' latest global outlook, the split between UK container exports to EU and Non-EU remaining at 30:70 over the forecast horizon and the Port of London gaining 18.5% and 38.2% of UK container exports to the EU and Non-EU markets respectively (grown in line with Port of London share of UK unitised imports). This increase in share of UK trade is consistent with the rapid growth in Lo-Lo exports observed since the opening

of London Gateway, with container exports almost trebling since 2014. By 2050 Lo-Lo exports will account for 93% of unitised exports from the Port of London.

INTER-PORT TRADE: DRY BULK

Aggregates

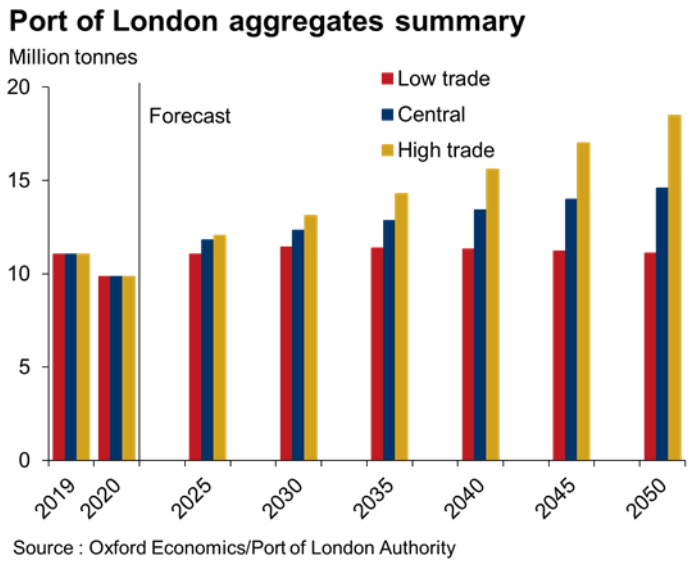
Assumptions

- Metals exports (which are predominately scrap motor vehicles) move in line with population projections.
- Port of London's share of total exports to remain unchanged
- 'High trade' and 'low trade' scenarios vary in accordance with alternative population outlooks

Aggregates demand into the Port of London are expected to grow in line with underlying construction activity. Based on our estimates of local demand, a sizeable share of London's requirements for aggregates (for road construction and as inputs into mortar and concrete) are carried along the Thames, with sea-dredged aggregates making up the majority of the cargo.

Our modelling for throughput at Port of London uses the 2019 import tonnes per unit of UK construction gross value-added, which for the three key scenarios increases by 1%, 32% and 67% respectively for 'low trade', 'central' and 'high trade'. As the 2019 import volumes were 11.0 million tonnes, these alternative outlooks have a substantial impact on total trade.

Fig. 68. Aggregates: 'Central' versus 'Low trade' and 'High trade'



Cement

Assumptions

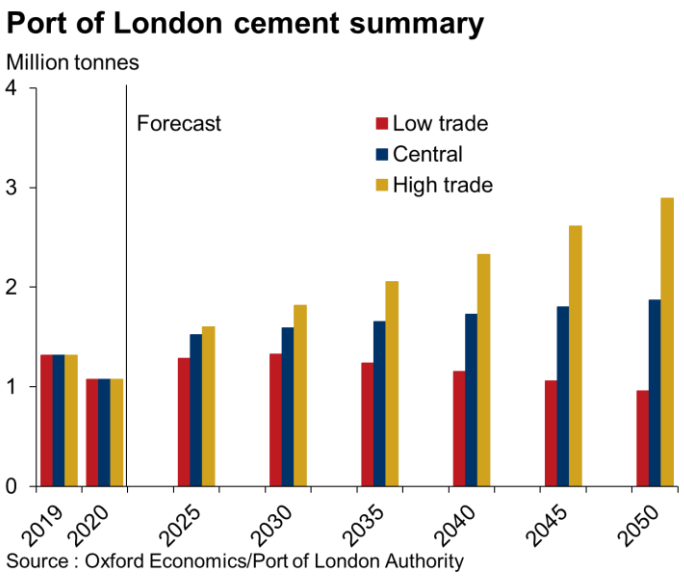
- Cement imports grow largely in line with changes in Construction Gross Value Added (including for the 'high trade' and 'low trade' scenarios), but with variances around that profile impacted by domestic production and product substitution – with engineered wood products demand derived from the CCC report '*Wood in Construction in the UK'*.
- 'High trade' and 'low trade' aggregates imports are consistent with 'upside' and 'downside' differences in the GDP projections from the central forecast.
- Port of London's share of import volumes do not change

Cement demand in London and the south east are expected to grow in line with underlying construction activity. Explicit in all the scenarios is an underlying assumption that not only is the a gradual transition to using more fly ash and/or granulated slag in cement mixes (at the expense of clinker), but also that domestic UK production of both products remains unchanged over the forward outlook.

Volume outlooks under the 'low trade' scenario are expected to recover partially to 2030, and then decline to below 1.0 million tonnes by 2050. In contrast, under the 'high trade' scenario, 2050 trade volumes are almost triple 2020 levels at 2.9 million tonnes, despite a mild-offsetting influence from product substitution to engineered wood products. The central scenario splits this difference, with sustained growth.

Each of the scenarios remains very dependent upon the local outlook for continued cement clinker production, which due to heavy energy intensity, is exposed to potential risks of trade disruption, with most of those risks yielding upside for the Port of London.

Fig. 69. Cement: 'Central' versus 'Low trade' and 'High trade'



Other Metals and Metallic Ores

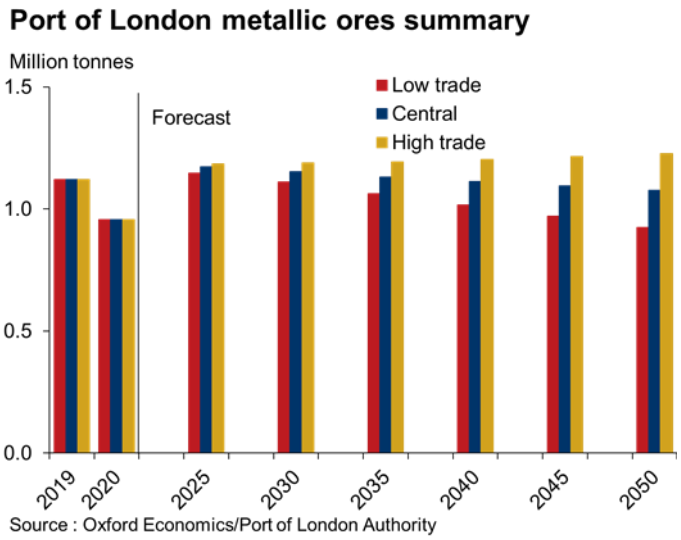
Assumptions

- Metals exports (which are predominately scrap motor vehicles) move in line with population projections.
- Port of London's share of total exports to remain unchanged
- 'High trade' and 'low trade' scenarios vary in accordance with alternative population outlooks

Import volumes of metals and scrap into the Port of London over the past 20 years have broadly moved in line with changes in UK construction activity, with generally more volatility in scrap imports than metals. The 2019 ratio of imports to construction GVA are used for the forward outlook, with imports in that year 258,000 tonnes.

Export volumes are more substantial, with scrap averaging 838,000 tonnes per year between 2004 and 2020, albeit with some year-to-year volatility. The range of alternative projections are narrow (anchored to the population outlooks under each scenario), with trading growth of only 13% between 2020 and 2050 for the 'central' scenario, falling to -3% for the 'low Trade' scenario, and rising to 28% for the 'high Trade' scenario.

Fig. 70. Metallic Ores: 'Central' versus 'Low trade' and 'High trade'



Other Dry Bulk

Assumptions

- Coal and biomass imports to remain at zero across all scenarios given no volume traded since 2010 and 2013 respectively.
- Sugar and cereal imports are consistent with OECD Food and Agricultural Outlook 2020.
- 'High trade' and 'low trade' volumes are consistent with 'upside' and 'downside' differences in the population projections from the central forecast.

Sugar imports forecasts to 2029 are underpinned by the OECD's Food and Agriculture Outlook[9], with the assumption sugar imports to the Port of London move in line with wider European imports of sugar. Imports in the period 2030-2050 grow at the 2028/29 growth rate.

Sugar exports are expected to remain at zero in the forecast horizon.

Cereal imports forecasts to 2029 are underpinned by the OECD's Food and Agriculture Outlook, with the assumption cereal imports to the Port of London move in line with wider European imports of cereal. Imports in the period 2030-2050 grow at the 2028/29 growth rate.

Similar to imports, exports to 2029 are underpinned by the OECD's Food and Agriculture Outlook, with the assumption cereal exports from the Port of London move in line with wider European exports of cereal. Exports in the period 2030-2050 grow at the 2028/29 growth rate.

INTER-PORT TRADE: OTHER CARGO

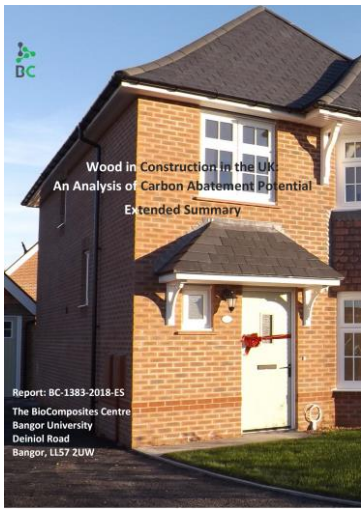
Forest Products

Assumptions

- 'High trade' and 'low trade' aggregates imports are consistent with 'upside' and 'downside' differences in the GDP projections from the central forecast.
- Port of London's share of UK import volumes do not change (from 2019) at 3.7% under the 'low trade' scenario, but increase to 15% of total UK trade under the 'central' and 'high trade' scenarios.
- Timber intensity for building activity increase from current levels in the 'central' scenario, and more so again in the 'high trade' scenario.
- Domestic production of timber products is maintained under all scenarios.

9 https://stats.oecd.org/OECDStat_Metadata/ShowMetadata.ashx?Dataset=HIGH_AGLINK_2020&ShowOnWeb=true&Lang=en

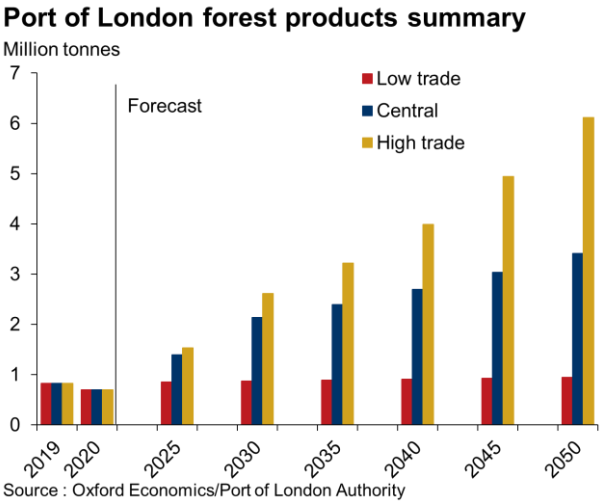
Forest products are comprised of two sub-groups, paper and timber, with no reported exports since 2016. Paper imports through the Port of London have been largely unchanged since 2008, and are held at 2019 (pre-COVID) levels over the forward outlook.



All the forecasts changes to the trade of forest products comes from increase in timber use in buildings (primarily detached dwellings). This analysis has been heavily influenced by a report commissioned by the Committee on Climate Change published in 2019, *Wood in Construction in the UK: An Analysis of Carbon Abatement Potential*. In this trade report, we have adopted the increase in timber frame penetration (and estimated engineered wood product demand) under three scenarios *(BAU growth, Moderate growth, High growth)* and have applied these to the construction outlook for the UK under the three scenarios developed in this report (*Low trade, Central,* and *High trade*, respectively).

Under the 'central' scenario, where the Port of London's share of timber imports increase to 15% and timber use in dwellings increase (from 28% to 45%), trade in Forest Products are expected to nearly triple from 2019 levels by 2050 to 2.5 million tonnes. Under a stronger economic outlook and higher timber use in the 'high trade' scenario, trade increases over the same period by 263% (to 3.0 million tonnes). In contrast, the net impact for Forest Products under the 'low trade' scenario is a decline in total trade (of 7%) by 2050.

Fig. 71. Forest products: 'Central' versus 'Low trade' and 'High trade'



Motor Vehicles

Assumptions

- Motor vehicle imports (in units) continue to grow in line with population
- Mass per unit trends up over the next decade reflecting the greater mass of EVs as compared to ICE.
- 'High trade' and 'low trade' scenarios vary in accordance with alternative population outlooks
- The Port of London's market share of UK imports does not vary by scenario, holding at 2019 levels.

Imports of new motor vehicles into the UK arrive via several different ports, with trading volumes into London (as of 2019) representing 14% of total UK imports, a level which has been closely maintained since 2012. The slowdown in trade volumes in 2020 resulted in the lowest volumes in at least two decades for the port, driven in part due to lower production and COVID-19 lockdowns restricting purchasing. While a return to pre-pandemic purchasing behaviour will drive a medium-term increase in volumes, mass tonnes imports will be further lifted by the increased mass of electric vehicles (as compared to internal combustion engines). This transformation of new vehicle sales to 2030 is expected to increase mass per vehicle by 25%, with no further changes expected thereafter.

Population projections in each of the scenarios drive growth thereafter, with imports per annum holding at a 15-year (pre-COVID) average of 3.8 per 100 residents.

Motor vehicle exports out of the Port of London have been on a long-term downward trend, with a record low of 95,000 tonnes in 2020, halving through the 2000s. For simplicity, we have assumed that the Port of London maintains this same level over the forward outlook under all scenarios.

The net impact of the flat export volumes, increased mass per vehicle and population growth generates total motor vehicle trade under the 'central' scenario of 25%. With a different population projection under the 'high trade' ('low trade') scenario, these forecasts increase (decrease) to 34% (14%).

Other goods

Assumptions

- Port of London trade volumes unchanged over the forecast period under all scenarios.
- 'High trade' and 'low trade' volumes are consistent with 'upside' and 'downside' differences in the population projections from the central forecast.

Other trades, which collectively make up 1.2 million tonnes in 2020 (down from 1.6 million tonnes in 2019), been modelled by considering imports / exports per unit of GDP or population, using the pre-COVID levels in 2019 as a base year. These trades are projected to increase by 7% in the central scenario by 2050, with a range of +- 13% on that under the ‘high trade’ and ‘low trade’ scenarios.

INTRA-PORT TRADE

Fig. 72. Intra-port cargo projections across the three scenarios

CENTRAL: INTRA-PORT TRADE

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Aggregates	0.7	1.2	1.2	1.6	1.8	55%	51%
Construction waste	0.2	2.7	0.8	1.1	1.2	-55%	51%
Other	0.3	0.3	0.3	0.6	0.9	211%	243%
Waste	0.5	0.7	0.6	0.4	0.4	-35%	-32%
Total Intra-port	1.8	4.8	2.9	3.7	4.3	-9%	50%

LOW TRADE SCENARIO: INTRA-PORT TRADE

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Aggregates	0.7	1.2	0.8	1.0	0.9	-19%	15%
Construction waste	0.2	2.7	0.3	0.3	0.3	-88%	15%
Other	0.3	0.3	0.3	0.4	0.4	32%	46%
Waste	0.5	0.7	0.6	0.3	0.2	-67%	-66%
Total Intra-port	1.8	4.8	2.0	2.0	1.9	-61%	-7%

HIGH TRADE SCENARIO: INTRA-PORT TRADE

Cargoes	2010	2019	2020	2035	2050	% increase 2019	% increase 2020
Aggregates	0.7	1.2	1.4	2.1	2.7	133%	91%
Construction waste	0.2	2.7	1.6	2.4	3.1	14%	91%
Other	0.3	0.3	0.3	0.7	1.2	307%	350%
Waste	0.5	0.7	0.6	0.3	0.3	-49%	-48%
Total Intra-port	1.8	4.8	3.9	5.5	7.3	52%	86%

APPENDIX III: BENCHMARKING TO PREVIOUS FORECASTS

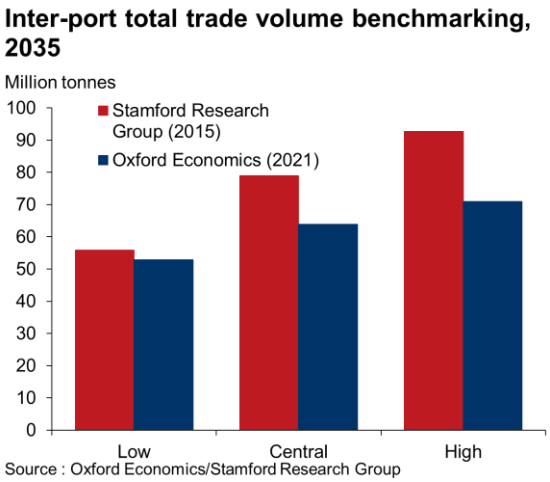
A useful benchmark for our projections of Port of London cargo flows is the forecast produced by Stamford Research Group in November 2015[10]. Their forecasts covered only the years to 2035, but it may still be instructive to examine both how their forecasts compared with the outturn in the years to 2020, as well as how they compare with our updated projections for 2035. It should be noted that we did not have access to all the assumptions used in their projections, so we cannot provide definitive explanations for any observed discrepancies.

INTER-PORT TRADE

Stamford Research Group projected total inter-port cargo volumes would be around 60m tonnes in their 'central' simulation for 2020, with a range around this of between 49m tonnes and 65m tonnes in their Low and High scenarios respectively. The outturn for inter-port cargo volumes in 2020 was 47m tonnes, which was 22% below the 'central' outlook and a more modest 5% below their 'low' outlook. Of course, benchmarking to 2020 may not be fair given the extraordinary disruption to trade that occurred as a result of the pandemic – had port trade in 2020 grown at the same rate (a COVID-19 counterfactual) as it did between 2018/19, cargo volumes would have been approximately 55m tonnes, which falls between Stamford's 'low' and 'central' outlooks.

Looking to 2035, the Oxford Economics central scenario puts inter-port cargo volumes at 64m tonnes, with a scenario bandwidth of between 53m and 72m tonnes in the low and high trade scenarios respectively. These projections are lower than Stamford across all three scenarios, with the largest discrepancy in the high scenarios (Figure 73)

Fig. 73. Total inter-port trade benchmarking, 2035



[10] https://www.pla.co.uk/assets/forecasts-consultationdocumentv11december-1.pdf

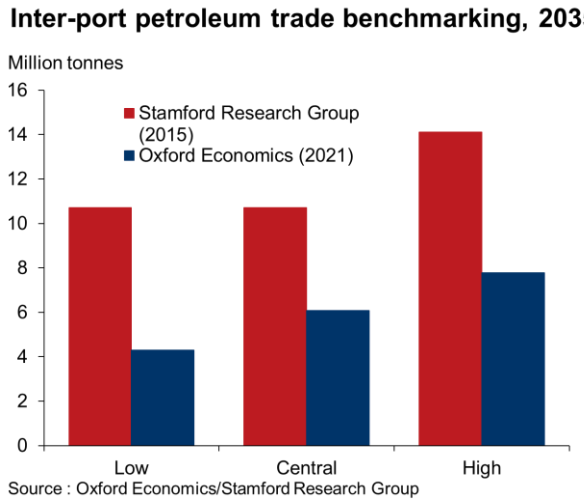
Differences in the outlook are likely to reflect a number of developments since the Stamford Group projections were constructed. These include:

1. **Brexit:** The Stamford forecasts were produced before the Brexit referendum of 2016. The UK's departure from the EU is expected to have a significant long-term negative impact on UK-EU trade volumes. Growth in the UK population is also likely to be reduced as a result of Brexit and the new restrictions placed on inward migration from the EU.

2. **COVID-19:** Although the economy is expected to recover strongly as lockdown restrictions are eased, the impact of the pandemic will be felt for many years. This includes long-term impacts on the economy from firm bankruptcies and lower investment, as well as permanent changes to behaviour, such as the accelerated shift to e-commerce.

3. **Climate Policy:** As of April 2021, the UK government have committed to adopting the recommendations of the Climate Change Committee's Sixth Carbon Budget to achieve net-zero carbon emissions by 2050. This includes the phase-out of fossil fuelled vehicles by 2032, and largely explains the significant difference in petroleum trade forecasts by 2035.

Fig. 74. Inter-port petroleum trade benchmarking, 2035

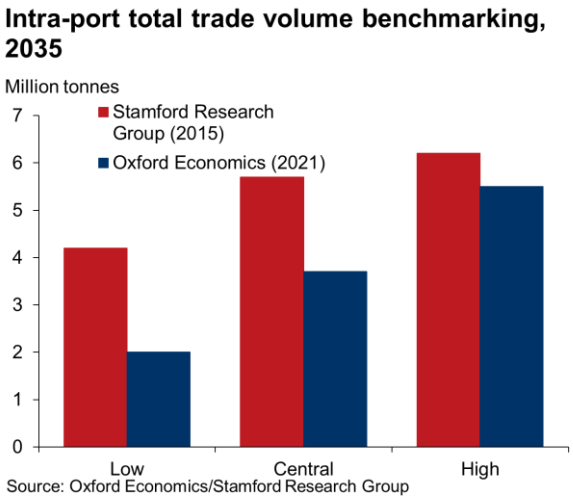


INTRA-PORT TRADE

The intra port trade volumes developed by Oxford Economics were undertaken at an individual cargo basis, and cannot be directly compared with the scenarios put forth by Stamford Research Group (which only reported on total flows). As intra-port volumes were consistently between 1.8 and 2.7 million tonnes in the 12 years to 2011 (prior to the recent major engineering projects taking place within London), this remains a reasonable floor for total intra-port, with the upside not dissimilar to previous records (with more than 5 million

tonnes of cargo movements in 2013 and 2014). These scenarios are largely independent of climate policy, and rather reflect changes in local activity along the Thames waterway.

Fig. 75. Total intra-port trade benchmarking, 2035



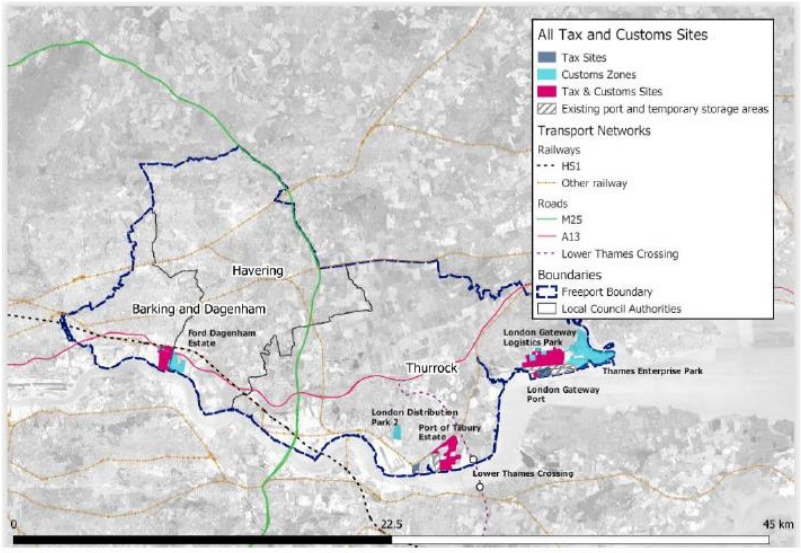
APPENDIX IV: THE THAMES FREEPORT

Government policy can have an important influence on developments at the port level, with the decision to reintroduce Freeports to the UK one such example.

Freeports are a special economic zone where standard customs laws do not apply. The UK government is reintroducing freeports[11] as part of its plans to boost trade in the wake of Brexit, with the 2021 Budget announcing the locations of eight freeports to be established across England: East Midlands Airport, Felixstowe & Harwich, Humber, Liverpool City Region, Plymouth, Solent, Teesside and Thames. It is hoped that they will become national hubs for global trade and investment across the UK, while also promoting regeneration and job creation as part of the government's agenda to level up communities.

The Thames Freeport will be a digitally-linked economic zone connecting Ford's Dagenham Engine plant with terminals at London Gateway and Tilbury. Figure 76 shows the proposed outer boundary/sites of the Thames Freeport area.

Fig. 76. Location of the Thames Freeport[12]



[11] Seven freeports existed for various periods in the UK between 1984 and 2012, until the UK government allowed the domestic legislation that set up these ports to expire.

[12] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/977223/Freeport_Location_Maps.pdf

As well as benefitting from a liberal customs regime, a range of incentives are available to businesses looking to expand and relocate to the Freeport[13] in the following areas:

- Tax incentives
  - Employers' national insurance contributions (NIC) relief
  - Business rate relief
  - Enhanced capital allowances
  - Enhanced structures and buildings allowance
  - Stamp duty land tax relief
- Planning incentives
  - Streamlined planning process to aid brownfield site development and increased regulatory flexibility for innovative activities.
- Innovation incentives
  - Successful bidders will be able to access seed capital funding.

The Government is also exploring the creation of 'regulatory sandboxes' which can help to facilitate the trialling and testing of new technology and processes. It is hoped that this will serve as a platform to test new ideas and support business and industry to decarbonise in line with the UK's net zero emissions target[14]. Proposed investments in the Thames Freeport already include a hydrogen fuel production, storage and fuelling project.

Critics of freeports point to the potential for these zones to merely displace business away from other areas of the UK without increasing the overall size of the economy. While these arguments may have some merit at the macro level, our view is that the establishment of the Thames Freeport will be a net positive for economic activity in the Port of London and help to accelerate inward investment. This has been factored into our modelling of future trade flows and Port of London share of UK trade.

[13] UK Government policy on freeports, House of Commons Briefing Paper, Number 8823, 20 April 2021.

[14] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/924644/FINAL_-_200923_-_OFF_SEN_-_Freeports_Con_Res_-_FINAL.pdf

APPENDIX V: STAKEHOLDER ENGAGEMENT

As discussed in Box 2 within Section 3 of the main text, we conducted an extensive stakeholder engagement exercise to collect input from a broad range of terminal operators, port users, shipping organisations, and external consultants working with the Port of London on its long-term development. This engagement was conducted through a combination of an online survey, workshops and one-to-one interviews. Organisations that participated in these consultations are listed below:

Online survey

CEMEX UK Marine Ltd, Thames Estuary Growth Board, GPS Marine Contractors Ltd, Puma Energy (UK) Ltd, Hanson Marine Ltd, DP World London Gateway, Tarmac Marine Ltd, FM Conway, Thames Enterprise Park Ltd.

One-to-one interviews

Port of Tilbury, Greenergy, Tarmac, Port of Tilbury, UK Chamber of Shipping, UK Major Ports, Vivid Economics (Freeport consultants), DNV (Hydrogen project consultants)

Workshop 1

DP World, Ford, Forth Ports, Greenergy, Tate & Lyle

Workshop 2

ASR Group, Barking & Dagenham Council, British Ports, Castlepoint, Cemex, City of London, Cory Group, Department for Transport, East Sussex County Council, Environment Agency, Ford, Hanson UK, Highways England, iSec Group, Keltbray, Logistics UK, London Assembly, London First, London Gateway, Navigator Terminals, Port of Tilbury, Suffolk County Council, Tarmac, Thurrock, Transport for London, UK Major Ports

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