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Multimodal

Australian aggregate freight forecasts – 2019 update

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Bureau of Infrastructure, Transport and Regional Economics
Department of Infrastructure, Transport, Cities and Regional Development
GPO Box 501, Canberra ACT 2601, Australia
Telephone +61 2 6274 7210
Fax +61 2 6274 6816
E-mail bitre@infrastructure.gov.au
Internet www.bitre.gov.au

Foreword

Freight transport is essential to an efficient, modern functioning economy, facilitating the transport of export commodities to ports for export to overseas markets, the movement of imported goods from ports to domestic producers and consumers, movement of inputs across domestic producer supply chains and the supply of all consumables and durable goods enjoyed by households.

Equally important is the infrastructure that supports these freight movements. Ensuring the efficient and timely delivery of freight requires that infrastructure is adequate, fit-for-purpose which, in turn, requires appropriately timed and scoped infrastructure planning and investment.

Long-term forecasts of the likely future size and scope of the freight task help inform development of long-term infrastructure plans and investment priorities. This report provides long-term projections of likely growth in the national freight task, by major transport mode—road, rail, sea and air—out to 2040. This is the first issue in the BITRE's revamped forecasting series, which aims to provide regularly updated long-term forecasts of total Australian freight activity, by major transport mode, at national, state, territory and regional scale.

The freight forecasts presented in this report were prepared by David Mitchell. The coastal shipping forecasts are based on methods originally developed by Pearl Louis. The air freight forecasts are based on methods developed by James Wilson.

Gary Dolman
Head of Bureau
Bureau of Infrastructure, Transport and Regional Economics
November 2019

At a glance

- The Australian freight task has grown more than four-fold over the four-and-a-half decades to 2016, from around 127 billion tonne kilometres in 1971 to over 725 billion tonne kilometres in 2015–16—an average rate of growth of over 3.9 per cent per annum. Over that period:
    - Road freight has increased eight-fold, from around 26 billion tonne kilometres in 1970–71 to around 203 billion tonne kilometres in 2015–16.
    - Rail freight has increased more than ten-fold, from around 40 billion tonne kilometres in 1970–71 to around 414 billion tonne kilometres in 2015–16, propelled by the significant recent growth in iron ore and coal exports.
    - Coastal shipping volumes have grown approximately 50 per cent, from around 72 billion tonne kilometres in 1970–71 to around 110 billion tonne kilometres in 2015–16.
    - Air freight, which is several orders of magnitude smaller than other modes, has grown from around 90 million tonne kilometres in 1970–71 to 330 million tonne kilometres in 2015–16.
- More recently, freight growth has slowed across each of the three largest modes.
    - Road freight, for example, has grown by less 2 per cent per annum over the last six years, where prior to that growth had averaged over 3.5 per cent per annum.
    - Rail freight volumes are also growing more slowly as the boom in mineral exports experienced in the mid-2000s and early 2010s appears to have plateaued.
- The forecasts presented here project that growth in freight activity is likely to continue to slow over the medium-to-longer term, due to slower growth in overseas export demand for Australia's major mineral exports and slower future domestic economic growth, which directly influences freight volumes.
- Total domestic freight volumes are projected to grow by approximately 25 per cent between 2018 and 2040, principally due to slower projected growth in total rail freight volumes. By mode:
    - Road freight volumes are projected to grow by around 56 per cent between 2018 and 2040 (average annual growth of 2.0 per cent per annum), largely as a result of slower projected future domestic economic growth.
    - Rail freight volumes are projected to grow by around 16.4 per cent between 2018 and 2040 (average annual growth of approximately 0.69 per cent per annum), largely due to some small projected future growth in iron ore and coal exports.
    - Domestic coastal shipping volumes are projected to remain more or less around 2016 levels out to 2040.
    - Air freight volumes are projected to grow by around 17 per cent between 2018 and 2040 from 337 million tonne kilometres in 2018 to around 393 million tonne kilometres in 2040.

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Executive Summary

Freight transport and logistics services are essential to an efficient, modern functioning economy, interacting with practically every sector the economy, and providing a variety of different services to business customers. These range from just-in-time delivery services required by manufacturing businesses and perishable commodity supply chains, to the cost efficient movement of large volumes of bulk export commodities to ports for subsequent export to overseas markets.

Road freight services, in particular, touch nearly every sector of the economy to varying degrees. Road transport is the predominant mode of transport for urban, inter-urban and regional freight, and part of the supply chain for most imports. Even the major mineral resource industries, that rely on rail or coastal shipping for transport of their outputs, are dependent on road freight to transport machinery, capital equipment and other supplies to mine sites.

Rail and sea transport, by contrast, service a more limited set of commodities and markets, but are integral to several of Australia's major export commodity supply chains. Rail is essential to Australian iron ore and coal exports—transport of these two commodities alone accounts for over 75 per cent of total Australian rail freight volumes. Coastal shipping carries significant volumes of bulk primary products—notably bauxite, alumina, crude oil/condensate and refined petroleum—to locations for further processing and/or refining, and is the only mode of transport for most goods moved between Tasmania and the mainland.

This report presents long-term forecasts of the Australian freight task by major transport mode–road, rail, sea and air—out to 2040. This is the first issue in the BITRE's revamped forecasting series, which aims to provide regularly-updated long-term forecasts of Australian freight activity, by major transport mode, at national, state, territory and regional scale.

Historical freight trends

The Australian freight task has grown more than four-fold over the past four-and-a-half decades, from around 127 billion tonne kilometres in 1970 to over 725 billion tonne kilometres in 2015–16—an average rate of growth of around 3.9 per cent per annum.

Over that period, road freight volumes have increased eight-fold, from around 25 billion tonne kilometres in 1970–71 to around 203 billion tonne kilometres in 2015–16.

Rail freight has increased more than ten-fold, propelled in large part by the recent extraordinary growth in iron ore and coal exports, from around 40 billion tonne kilometres in 1970–71 to around 414 billion tonne kilometres in 2015–16.

Coastal shipping volumes have grown approximately 50 per cent, from around 72 billion tonne kilometres in 1970–71 to around 110 billion tonne kilometres in 2015–16.

Air freight, which is several orders of magnitude smaller than other modes, has grown from around 90 million tonne kilometres in 1970–71 to around 330 million tonne kilometres in 2015–16.

Key factors influencing domestic freight trends

Road freight

Because road freight touches nearly every sector of the economy, one of the key influences on the outlook for total road freight transport is the outlook for the overall economy. Particular sectors are more heavily road transport intensive than others, and account for a larger share of total road freight transport than other sectors. For example, the construction sector is heavily dependent on road transport for delivery of crude materials used in construction (e.g. sand, gravel and cement) and comprises around 30 per cent of total road freight tonnages. Similarly, the retail sector is also a heavy user of road freight services—e.g. food and live animals and beverages comprise around 13 per cent of total road freight tonnages, and manufactures and machinery together accounted for around 18.8 per cent of total road freight tonnages in 2017–18.

In understanding the factors driving growth in road freight activity, BITRE has investigated the relative influence of total domestic economic activity, trade volumes (imports and exports) and variations in sectoral output, particularly agriculture, fishing and forestry, construction, and retail and wholesale trade. While trade and sectoral activity indicators have a demonstrable statistical influence on total road freight activity, none explain as much of the observed variation in total road freight activity as gross national expenditure (GDP less net exports). Road freight transport costs also influence total road freight activity, although with a smaller impact.

In projecting likely future road freight trends, BITRE used a range of scenarios about the rate of growth in future domestic economic activity and likely future movements in road transport costs. These are discussed below.

Rail freight

Australian rail freight largely services several major export commodities and specific market sectors where rail offers superior cost and/or service quality competitive transport. The major sectors where rail transport predominates include:

- Iron ore
- Coal
  - Thermal coal
  - Metallurgical coal
- Cereal grains
- Sugar
- Steel products
- Interstate non-bulk freight – principally between east coast capitals and Perth
- Other rail freight (n.e.s.).[1]

The factors influencing growth in each of these market segments varies by product. Australian iron ore and metallurgical coal rail volumes, for example, are driven almost entirely by overseas export demand, particularly from China. Rail transport of agricultural commodities, by contrast are influenced more by domestic production, and particularly annual growing conditions.

Accordingly, BITRE separates rail freight into the following five broad components:

1 Other rail freight not elsewhere specified.

- iron ore
- coal
  - thermal coal
  - metallurgical coal
- interstate non-bulk freight
- all other rail freight

and separately forecasts likely future growth in each component, and sums the results to derive forecasts of total domestic rail freight. A brief outline of the forecasting procedure for these different traffic components is provided.

Rail commodity export freight forecast assumptions

Iron ore and, to a lesser extent, metallurgical coal export volumes have grown strongly over the last decade and a half, principally due to increased Chinese demand, and the future outlook for these commodities will be heavily influenced by China's future economic performance. Newly-industrialising developing economies, such as India, Vietnam, and Indonesia, have also announced plans to increase steel production, which Australia is well placed to supply. Hence, the long-term outlook for Australian exports of iron ore and metallurgical coal are heavily tied to the long-term outlook for global and Asian growth in steel production.

Similarly, Australian rail transport of thermal coal is directly dependent on thermal coal exports, which, in turn, is heavily dependent on global coal-fired electricity generation. The IEA (2014) identifies two overarching competing trends influencing the future outlook for global coal use:

i) Increasing economic and industrial development in many developing countries, resulting in increase demand for coal in electricity generation and industrial production.

ii) Growing public opposition to coal use and growing commercial sensitivities to the potential future liabilities of excessive reliance on coal.

The long-term outcomes of these competing influences are highly uncertain and the impact on Australian commodity exports could vary significantly depending on which influence predominates.

The projections adopt a scenario-based approach so as to encompass the range of potential future outcomes. The commodity-specific scenario outlooks and forecasts are based on published research by established domestic and international agencies, such as the Department of Industry, Innovation and Science's Office of the Chief Economist (DIIS-OCE), International Energy Agency (IEA) and United States' Energy Information Administration (EIA), and selected reputable private sector analysts.

For example, iron ore and metallurgical coal export forecasts are based on a range of informed sources on the global steel and Australian iron ore export markets, including DIIS-OCE and the IEA. The global coal outlook is based on projections published by the IEA, EIA and private sector operators.

In contrast, rail volumes of cereal grains and sugar are heavily dependent on available marketable supply, which is largely determined by domestic growing conditions, which can fluctuate significantly from year to year, but show relatively muted long-term trend growth.

Other rail freight transport forecast assumptions

The outlook for other rail freight—principally interstate non-bulk and finished steel product freight used domestically—are driven principally by domestic economic conditions and domestic supply chains. In projecting likely future road freight trends, BITRE uses a range of scenarios about the rate of growth in future domestic economic activity and likely future movements in transport costs. These assumptions are also discussed below.

Coastal shipping

Australian coastal shipping, like rail, principally services are defined set of commodities and markets. These include:

- Bauxite and alumina
- Iron ore
- Other dry bulk products
- Crude oil
- Petroleum products
- Other bulk liquids
- Intercapital container freight
- Bass Strait non-bulk freight.

In forecasting total coastal freight volumes, BITRE models and forecasts each of these commodity/market segments separately, and then sums the results to derive the aggregate domestic coastal shipping forecast. The coastal shipping forecasts also use a *scenario-based* approach, to capture the range of potential future outcomes, particularly for those commodities that are sensitive to overseas economic conditions and the relative competitiveness of Australian industry. Several of these scenarios are describe briefly below.

Bauxite and alumina forecast scenarios

Coastal movements of bauxite and alumina, for example, are dependent on continuing alumina refining and, to a lesser extent, aluminium production in Australia. As bauxite and alumina comprise over 40 per cent of total coastal freight (in both tonnes and tonne kilometre terms), changes in total bauxite and alumina movements have a large influence on total coastal freight volumes.

Australia has one of the world's largest resources and reserves of economically recoverable bauxite and is one of the largest bauxite producing countries. Australia exports some bauxite directly, but the majority is used domestically to produce alumina. In turn, some of this alumina is used as feedstock to domestic aluminium production, with the majority exported. While Australia's aluminium refining capacity has been declining recently, Australia's alumina production capacity has steadily increased over the last several decades.

The forecast scenarios consider three alternative likely future scenarios:

i) domestic production growth scenario – under which domestic production of alumina increases in line with historical growth over the forward horizon

ii) unchanged domestic production scenario – under which domestic bauxite and alumina production remain at current levels

iii) domestic alumina/aluminium production decline scenario – under which domestic production of aluminium and alumina declines, replaced by increased direct exports of bauxite from some sites.

The first scenario implies increased coastal movements of bauxite/alumina. The second scenario implies no change in coastal movements of bauxite/alumina. The decline in domestic alumina/aluminium production is assumed to *not* affect bauxite/alumina supply chain between Cape York Peninsula and and Gladstone, and so the impact on the domestic coastal shipping task is relatively small.

Iron ore

Nearly all domestic coastal iron ore shipments are to Port Kembla for input to BlueScope Steel's Port Kembla steelworks, which produces around 3.5 million tonnes of steel per year (BlueScope Steel Limited 2018), down from down from 6.5 million tonnes per annum prior to closure of its second smelter in 2011, largely for the domestic market.[2] Australia is a relatively small steel producer in global terms and the global industry is highly cost competitive. While domestic steel production appears set to continue for the foreseeable future, reductions in domestic production are not impossible. The forecast scenarios consider both possibilities, i.e. continuing steel production at Port Kembla, at current volumes, over the projection horizon, and reduction in remaining steel smelting capacity at some point over the projection horizon.

Crude oil and petroleum products

Coastal shipments of crude oil and petroleum products have been gradually declining recently due to a combination of declining domestic crude oil reserves, closure of domestic refinery capacity and the nature of Australian crude oils, which do not suit Australia's remaining domestic refining capacity. Hence, much of Australia's crude oil production is exported directly and refined product imported from south-east Asian refineries.

Absent additional major offshore discoveries, it is projected that domestic crude oil, and refined petroleum production, will continue to decline over the projection horizon, which will also influence future coastal shipping volumes.

Intercapital containerised and non-bulk Bass Strait freight

Intercapital container coastal freight includes all containerised trade between the five mainland capital city ports—Sydney, Melbourne, Brisbane, Adelaide and Perth (Fremantle Port). Intercapital containerised freight has grown substantially over the past decade and a half, from around 400 million tonne kilometres in 1995–96 to around 2250 million tonne kilometres in 2015–16 (measured on a freight-loaded basis).

Bass Strait non-bulk freight includes all freight not classified as either dry or liquid bulk that is loaded or unloaded at a Tasmanian port—this definition includes containers, break bulk products, pallets and timber. Tasmanian non-bulk coastal freight volumes increased significantly between 1996 and 2006, but has grown less quickly since then.

Both intercapital container and Bass Strait non-bulk freight are modelled as functions of economic activity—national domestic output for intercapital freight and Tasmanian gross state product (GSP) for Bass Strait freight—and domestic freight shipping costs. Again, in projecting likely future intercapital container and Bass Strait freight trends, BITRE adopts a range of scenarios about likely future growth in national output and Tasmanian GSP.

Air freight

Domestic air freight is carried in the cargo holds of passenger aircraft and by a small fleet of dedicated freight aircraft. Air freight is predominated by high-value, low-density freight, such as mail, small parcels and high value perishables.

Domestic air freight volumes are a fraction of freight volumes by the other major transport modes—in 2017–18, domestic air freight volumes totalled 230 thousand tonnes (measured on a traffic-on-board

2 Liberty OneSteel also produces about 1 million tonnes of steel a year at it's Whyalla Steelworks, using iron ore transported by rail from the nearby Middleback Ranges.

basis) and around 335 million tonne kilometres, but this can vary significantly from year to year. Air freight volumes have also grown relatively slowly over the past three decades.

Key forecast assumptions

Population growth, changing demographics, expected future domestic and overseas economic growth and oil prices are among the key factors that will influence likely future Australian freight growth. The key domestic population, economic activity and oil price forecast assumptions are briefly outlined here.

Future population growth

Assumed future population growth is based on the latest ABS' population projections (ABS 2018c), which project the total population will grow from around 24.6 million persons in 2017 to around 33.6 million persons by 2040 under Series B (growth of 1.35 per cent per annum). The ABS' high growth scenario (Series A) implies the population will grow to 35.6 million persons by 2040 (growth of 1.62 per cent per annum). The ABS' low growth scenario (Series C) implies the population will grow to 31.8 million persons by 2040 (growth of 1.1 per cent per annum).

Future economic growth

Assumptions about projected future Australian economic growth are based broadly on the methods underlying the five-yearly Treasury Intergenerational Report (IGR) (Treasury 2015), i.e. economic growth is broadly a function of population, workforce participation and productivity—the *three Ps*.

For the freight forecasts herein, BITRE has reviewed the latest trends in workforce demographics, labour force participation and productivity, and also considered aggregate trends in economic activity to derive projections of likely future growth in economic activity (output per capita). Three economic growth scenarios are used in deriving the freight task projections:

- A *low growth* scenario – under which real GDP per capita is projected to increase from around $73 300 per person in 2018 to around $89 100 in 2040 (average annual growth of 0.89 per cent per annum).
- A *medium growth* scenario – real GDP per capita is projected to increase to around $92 300 per person in 2040 (average annual growth of 1.06 per cent per annum).
- A *high growth* scenario – Treasury (2015) assumptions, under which real GDP per capita is projected and $101 900 per person (average annual growth of 1.51 per cent per annum).

When combined with the ABS population growth forecasts, these imply total economic growth:

- *Series C* population and *low growth* scenario – real GDP growth of around 2.0 per cent per annum between 2018 and 2040.
- *Series B* population and *medium growth* scenario – real GDP growth of around 2.4 per cent per annum between 2018 and 2040.
- *Series A* population and *high growth* scenario – real GDP growth of around 3.15 per cent per annum between 2018 and 2040.

World oil prices

Oil prices directly affect the cost of transport fuels and are a significant influence on broader economic activity. In deriving the freight forecasts presented here, BITRE has used world oil price scenarios produced by the United States' EIA (EIA 2018). EIA report three scenarios:

- EIA's *reference* scenario – world oil prices (West Texas Intermediate) are projected to increase from around $US 49 per barrel in 2017 to around $US 101 per barrel by 2040.
- EIA's *low price* scenario – world oil prices are projected to decline to around $US 25 per barrel in the near term, but increase thereafter, to be around $US 50 per barrel by 2040.
- EIA's *high price* scenario – world oil prices are projected to increase to over $US 200 per barrel by 2040.

The key forecast assumptions are listed in Appendix A.

Freight task forecasts by transport mode

The results of the models and key forecast assumptions outlined above are forecasts covering a likely range of future outcomes, with the most likely outcome generally falling near the middle of the range.

Under the median scenario, total domestic freight volumes are projected to grow by approximately 25 per cent between 2018 and 2040, which is significantly slower than historical rates of growth—largely as a result of slower future expected commodity export growth and slightly slower domestic economic growth. Table 1 shows, and Figure 1 illustrates, the historical and projected future freight task estimates, by transport mode, between 1971 and 2040.

Road freight volumes are projected to grow by around 56 per cent between 2018 and 2040 (central estimate) to around 337 billion tonne kilometres by 2040—average annual growth of 2 per cent per annum. Stronger future economic growth could result in demand growing to around 380 billion tonne kilometres by 2040 and below average growth could result in road freight growing to around 310 billion tonne kilometres.

Rail freight volumes are projected to grow by around 16.4 per cent between 2018 and 2040, to around 515 billion tonne kilometres in 2040 (average annual growth of approximately 0.69 per cent per annum), largely due to slower projected growth in iron ore and coal exports over the forecast horizon. Were the 'high scenario' outcomes realised for iron ore, coal and interstate rail freight, rail freight volumes could increase to as much as 555 billion tonne kilometres by 2040. However, were all 'low scenario' outcomes realised, rail freight volumes could grow to 465 billion tonne kilometres.

Domestic coastal shipping volumes are projected to remain more or less around current levels, around 109 billion tonne kilometres, out to 2040 under the central forecast scenario. Were the 'high scenario' outcomes to be realised across all commodities, total coastal shipping freight volumes could increase to around 130 billion tonnes kilometres in 2040, while if all 'low scenario' were realised, total coastal shipping freight volumes could decline to less than 78 billion tonne kilometres.

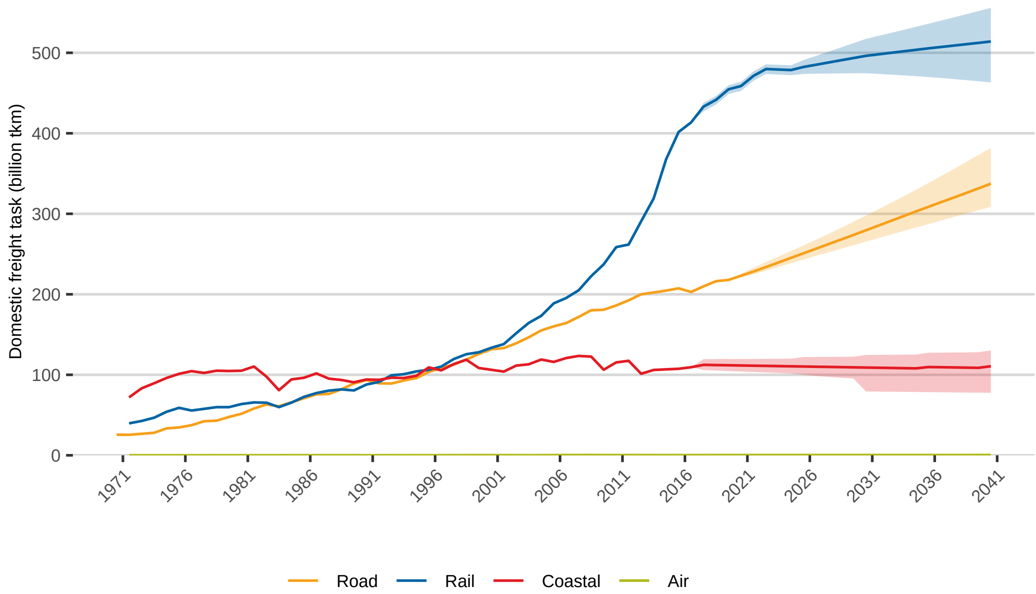
Air freight volumes are projected to grow by around 17 per cent between 2018 and 2040 from around 337 million tonne kilometres in 2018 to around 393 million tonne kilometres in 2040.

Table 1 Projected future freight task, by major transport mode, 2018–2040

	Mode				
Year	Road	Rail	Coastal	Air	Total
2018	216.3	441.6	112.1	0.3	770.4
2020	223.1	458.7	111.6	0.4	793.8
2025	250.9	482.4	110.3	0.4	844.0
2030	279.5	496.2	109.0	0.4	885.2
2035	308.7	505.5	109.7	0.4	924.2
2040	337.4	514.1	110.7	0.4	962.5

Source: BITRE estimates.

Figure 1 Projected future freight task, by major transport mode, 2018–2040



CHAPTER 1
Introduction

BITRE has periodically produced long-term forecasts at various levels of detail—e.g. national, state, corridor and network segment level—to help inform infrastructure planning and investment, transport policy and broader public debate. National-level estimates, in particular, help inform public discourse and provide the broader context in which decisions around transport infrastructure investment and policy.

Transport infrastructure is generally long lived and requires significant planning and long investment lead times. Long-term forecasts can help sort longer-term infrastructure planning priorities and provide likely long-term outlook for parameters used in making infrastructure investment decisions.

This report represents the first in the BITRE's revamped forecasting series, providing long-term forecasts of total Australian freight activity by major transport mode.

1.1 Australian freight industry and activity

Freight transport and logistics services are essential to an efficient, modern functioning economy, providing a variety of different services to a wide range of different businesses and customers.

Road freight touches nearly every sector of the economy to varying degrees. Road freight is the predominant mode of transport for urban, inter-urban and regional freight, and is part of the supply chain for most imports. Even resource industries, which may be heavily reliant on rail or coastal shipping for transport of outputs or key inputs, rely on road freight to transport critical inputs, such as machinery, transport equipment and other supplies.

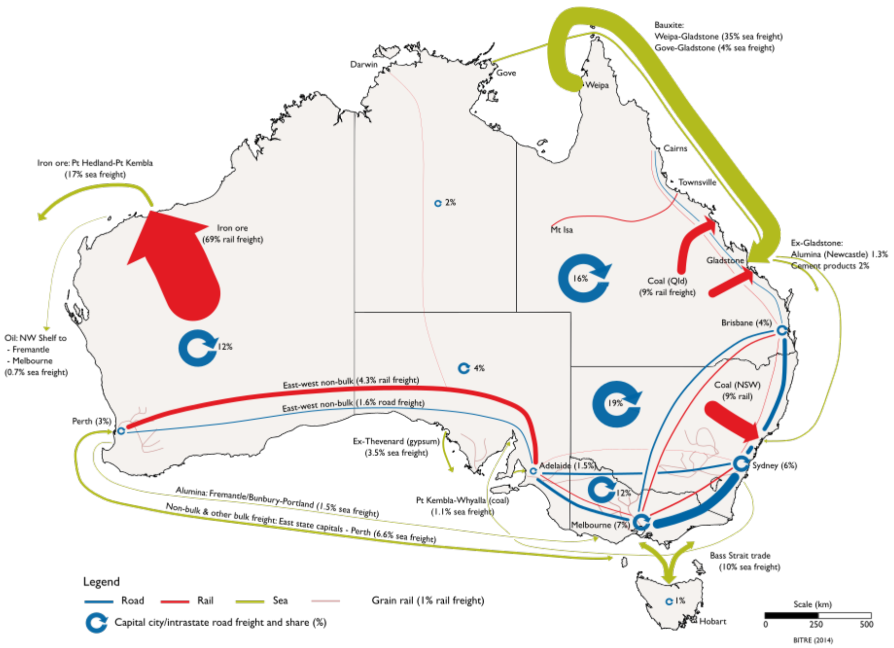
Rail and sea transport, by contrast, service a more limited set of commodities and markets, but are essential to several of Australia's major export commodity supply chains. For example, Australia's iron ore and coal exports comprise over 75 per cent of total Australian rail freight. Coastal shipping carries significant volumes of bulk primary products—notably bauxite, alumina, crude oil/condensate and refined petroleum—to locations for further processing and/or refining.

Figure 1.1 provides a stylised view of the major freight flows in Australia, which highlights the size and significance of major bulk commodity rail and coastal shipping movements.

The national accounts imply that the *transport sector* (including both passenger and freight transport) accounted for approximately 4.7 per cent of national output in 2015–16 (ABS 2018a).[3] However, this only accounts for transport activity undertaken by transport-sector firms—i.e. whose main business activity is transport. Including transport activity undertaken by non-transport enterprises (e.g. *in-house*

3 Transport, postal and warehousing sector activity accounted for 4.6 per cent of GDP in 2017–18.

Figure 1.1 Stylised map of Australian freight flows, 2015–16



transport services undertaken by mining companies, construction sector companies, retailers, etc.) total *transport activity* is estimated to have contributed around 7.2 per cent of GDP in 2015–16 (ABS 2018b). While this includes the contribution of passenger transport, it didn't attempt to measure and bring to account storage and warehousing activity undertaken outside the transport sector.[4]

Moreover, the transport sector directly employed around 620 thousand persons in 2015–16 (ABS 2019).[5] Adding in persons engaged in transport-related activities in other sectors of the economy, brings the total number of persons employed in *transport activities* to around 1027 thousand persons in 2015–16 (ABS 2018b).

1.2 Historical freight trends

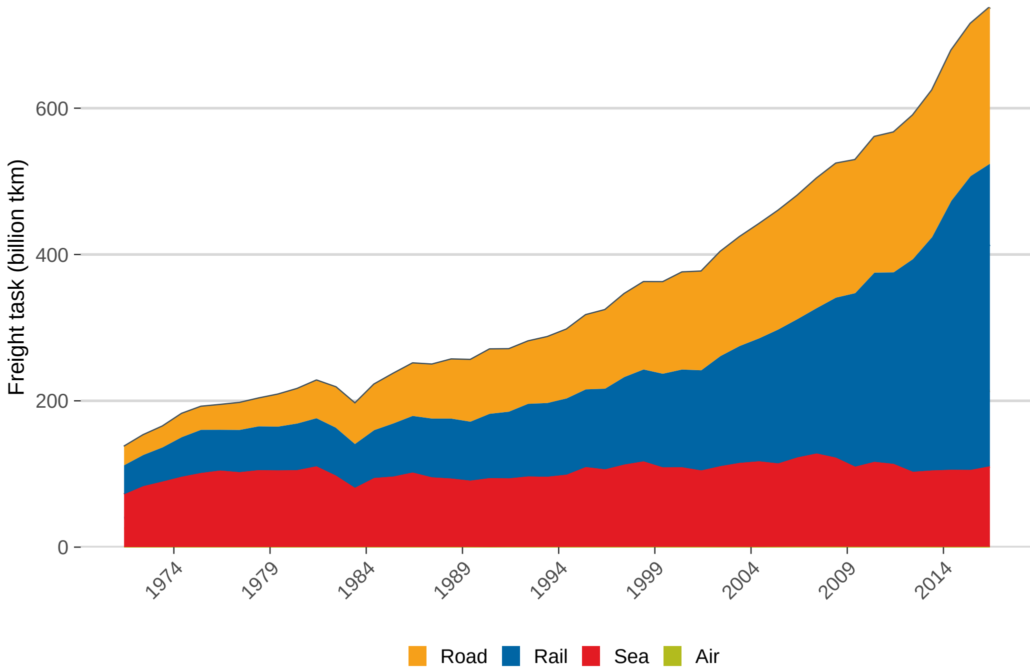
Total freight volumes in Australia have increased four-fold over the past four decades—from 127 billion tonne kilometres in 1970 to over 725 billion tonne kilometres in 2015–16—an average rate of growth of nearly 3.9 per cent per annum. The increasing volume of freight has been driven by strong growth in both urban and inter-urban non-bulk (4.8 and 4.4 per cent per annum, respectively), primarily carried by road transport, and bulk export commodity freight (5.4 per cent per annum since 1996), primarily carried by rail.

Figure 1.2 shows the size of the Australian road, rail, coastal shipping and air freight task since 1971. Road freight has grown eight-fold, from around 25 billion tonne kilometres in 1970–71 to around

4 By way of comparison, ALC (2014) estimated that the freight transport and logistics sector accounted for 8.6 per cent of GDP in 2013–14.

5 Transport, postal and warehousing sector employment totalled 659.4 thousand persons in May 2019.

Figure 1.2 Australian freight task, by mode, 1971–2016



203 billion tonne kilometres in 2015–16. Rail freight has grown more than nine-fold, from around 40 billion tonne kilometres in 1970–71 to around 414 billion tonne kilometres in 2015–16. Coastal shipping volumes have grown approximately 50 per cent since 1971, from around 72 billion tonne kilometres in 1970–71 to around 110 billion tonne kilometres in 2015–16. Air freight, which is several orders of magnitude smaller than either road, rail and sea freight, has grown from around 90 million tonne kilometres in 1971 to around 330 million tonne kilometres in 2016.

Figure 1.3 shows the relative contribution of bulk and non-bulk freight to the Australian freight task, by mode, since 1971. The expansion in bulk rail freight volumes due to the mining boom between 2005 and 2016 is very apparent. Non-bulk road freight has also grown strongly over the past four decades.

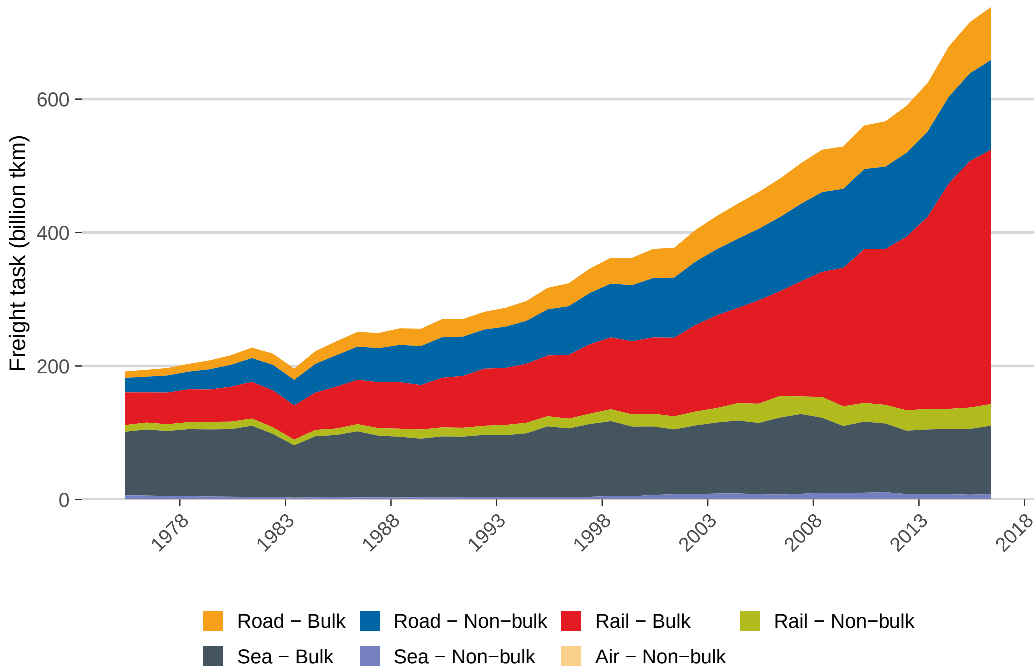
1.3 Freight forecast approach

The freight forecasts are derived using a combination of empirical models and key forecast assumptions. This report presents a summary of the methods, sources and key assumptions, and the forecasts of Australian domestic freight movements.

Aggregate road freight activity is forecast using econometric models, that relate road freight activity to economic activity and relevant economic factors, and assumptions about future population growth, future domestic economic growth and freight transport costs.

Australian rail freight forecasts are based on separate commodity-specific forecasts, particularly iron ore and coal. Projected future iron ore and coal exports are dependent on likely future overseas demand for those commodities.

Figure 1.3 Australian bulk and non-bulk freight task, by mode, 1971–2016



Australian coastal freight forecasts are also based on separate forecasts of coastal shipping commodity freight.

1.4 Key assumptions

Population growth, changing demographics, expected future domestic and overseas economic growth and oil prices are among the key factors that will influence likely future Australian freight growth. The key domestic population, economic activity and oil price forecast assumptions imply the population will grow by between 0.78 and 1.39 per cent per annum, to around 33.6 million persons by 2040, GDP per capita will increase from around $72 600 per person in 2018 to between $88 260 and $97 500 per person by 2040. Further details of the key assumptions underpinning the freight forecasts are provided through the body of the report (see also Appendix A).

1.5 Report structure

The report is structured as follows. Chapter 2 outlines the road freight forecasts. Chapter 3 outlines the rail freight forecasts. Chapter 4 outlines the coastal shipping freight forecasts. Chapter 5 outlines the air freight forecasts. Chapter 6 presents the combined freight aggregate freight forecasts. Several appendices provide supporting information.

CHAPTER 2
Road freight outlook

2.1 Historical road freight trends

Over the past four-and-a-half decades, total road freight has increased eight-fold, from around 27 billion tonne kilometres in 1970–71 to around 216 billion tonne kilometres in 2017–18 (ABS SMVU, various issues). Road freight growth was strongest in the 1970s and 1980s, when the road freight industry greatly expanded, particularly through growth in long-distance intercapital and interregional freight. Since the early 1990s, growth in road freight has slowed, from an average around 6 per cent per annum between 1971 and 1991, to around 3.8 per cent per annum between 1991 and 2012, and around 1.7 per cent per annum since 2012.

Much of the growth in domestic road freight experienced between 1970 and the early-2000s coincided with the introduction and implementation of a range of transport-specific and broader economy-wide economic reforms, including:

- Economy-wide tariff reductions, commencing in 1974
- Investment in the National Highway System (NHS)—e.g. sealing of the NHS in the mid-1970s, continued upgrade and duplication of significant parts of the system between the 1970s and early 2000s.
- Economic liberalisation of intrastate and interstate freight, with removal of commodity-specific restrictions then applying to intrastate transport[6]
- Several rounds of incremental reforms to heavy vehicle dimension and mass limits, which resulted in progressively broader network access for larger dimension and higher mass freight vehicles.

The combined impact of these activities and reforms contributed to the both the reduction in the cost of road freight transport, and the rapid growth in road freight volumes and improvement in road freight productivity experienced during that period. Since 2012, however, growth in per capita road freight has been more muted.

Figure 2.1 shows Australian road freight volumes estimates between 1971 and 2018 (together with the 95 per cent sample confidence interval). Figure 2.2 shows the average per capita road freight task over the same period, and highlights the recent plateauing in per capita road freight volumes experienced since 2007, which is coincident with the onset of the GFC, the mining construction boom and high point in the value of the Australian dollar due to the mining boom.

6 Though varying across jurisdictions, most states had legislation reserving transport of certain commodities to rail.

Figure 2.1 Australian road freight estimates, 95% confidence bounds, 1971–2018

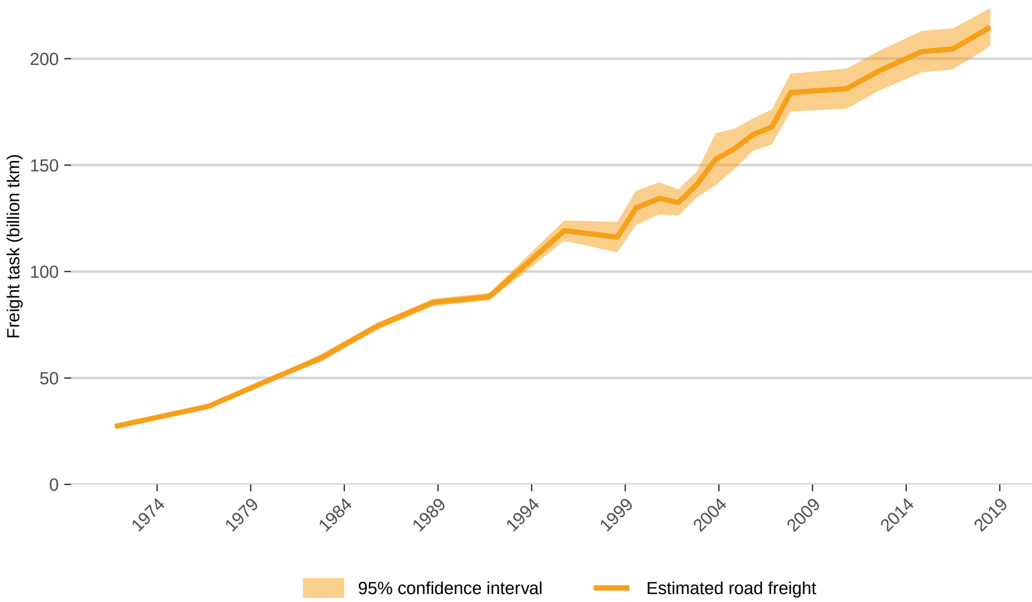


Figure 2.2 Australian road freight per capita, 1971–2018

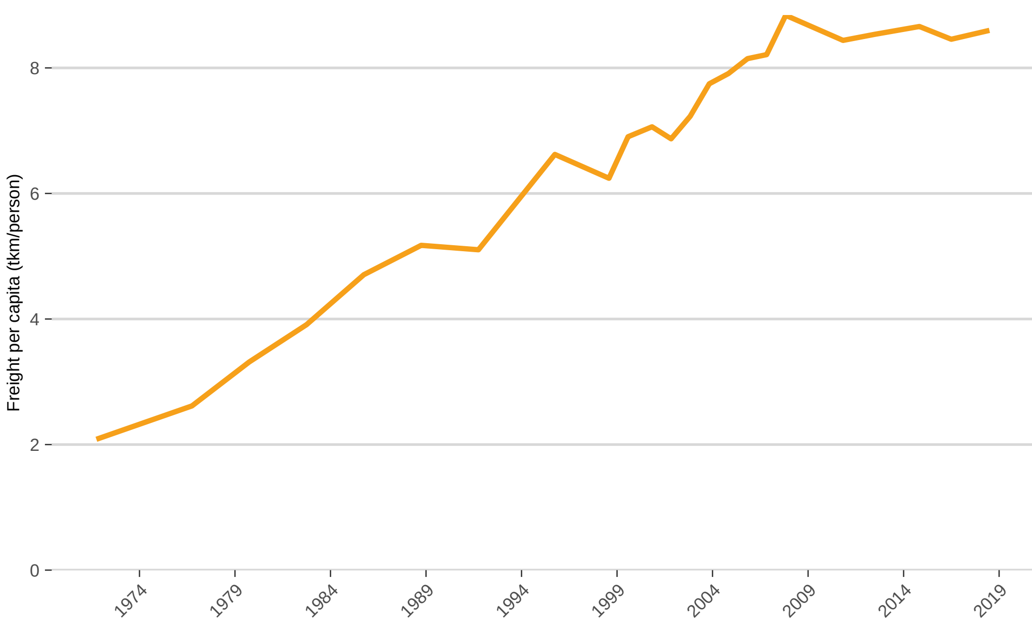
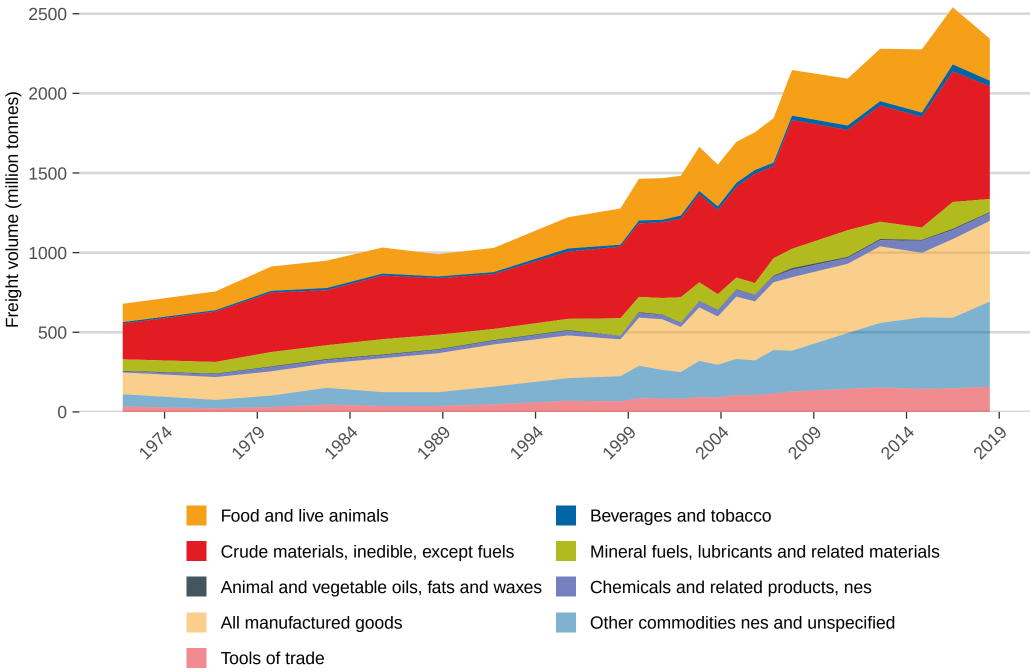


Figure 2.3 Road freight volumes, by commodity, 1971–2018



Road freight task composition

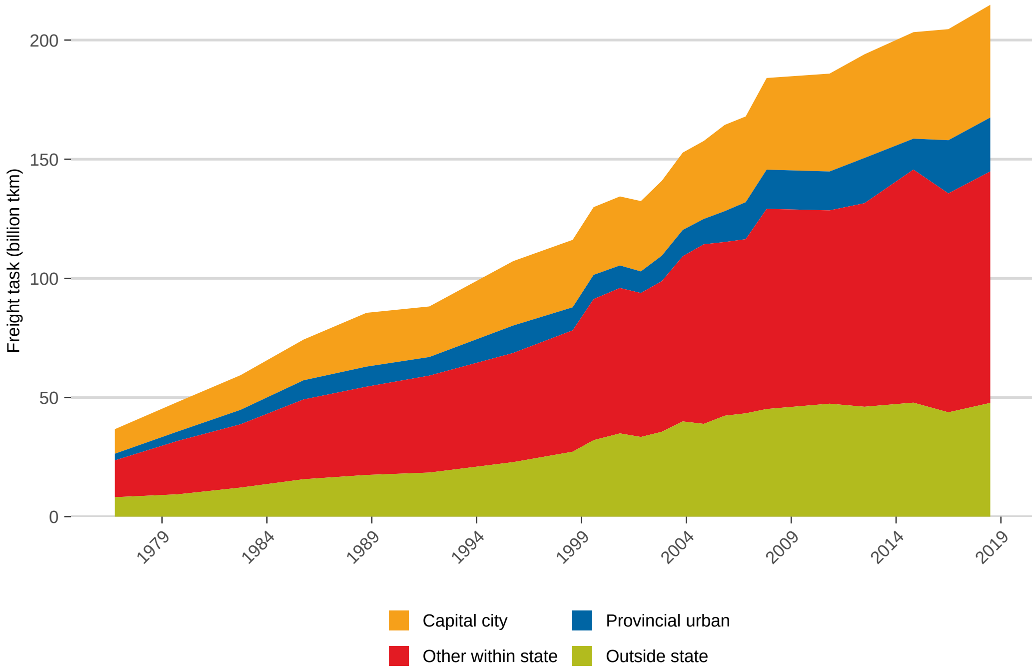
The road freight industry touches almost every sector of the economy. It is responsible for the transport of almost all merchandise consumed by households, all intermediate inputs used in secondary production and also a wide range of primary agricultural and mining outputs. Only the transport major parts of the domestic freight task where road freight plays only a minor role are the transport of bulk mineral exports—principally iron ore, coal and bauxite/aluminium—where rail and coastal shipping predominate, but even there road freight carries a share of this task.

By mass, crude materials (i.e. construction materials) comprise the largest share of total road freight volumes, accounting for around 30 per cent of all freight tonnes uplifted in 2017–18, followed by total manufactured goods (22 per cent) and food and live animals 11.3 per cent (see Figure 2.3). Other commodities not specified accounted from around 23 per cent of total road freight in 2017–18.

Figure 2.4 shows growth in road movements by area of operation. Capital cities and other major provincial urban centres account for between 30 and 40 per cent of total road freight, and the majority of road freight activity occurs outside cities. While road freight volumes have grown across all areas, the share of road freight occurring entirely within capital cities has declined from 28 per cent 1976 to 22 per cent by 2018. Provincial urban road freight has increased slightly over that period, mainly due to expansion in the number of urban areas classed within 'provincial urban'. All other freight accounts for around 65–70 per cent of total road freight tonne kilometres.

Figure 2.5 illustrates the spatial distribution of long-distance road freight. It highlights the significance of road freight using the major intercapital corridors—i.e. Sydney–Melbourne, Sydney–Brisbane, Melbourne–Brisbane, etc.—but also road freight movements between each of the capital cities and nearby regional centres.

Figure 2.4 Road freight volumes, by area of operation, 1971–2018



Drivers of road freight growth

Road freight volumes are primarily influenced by total economic activity. For example, higher household expenditure on consumer goods, greater building and construction activity, higher domestic manufacturing outputs, all involve increased use of road freight services to deliver goods, inputs and/or materiel from origin to final places of use.

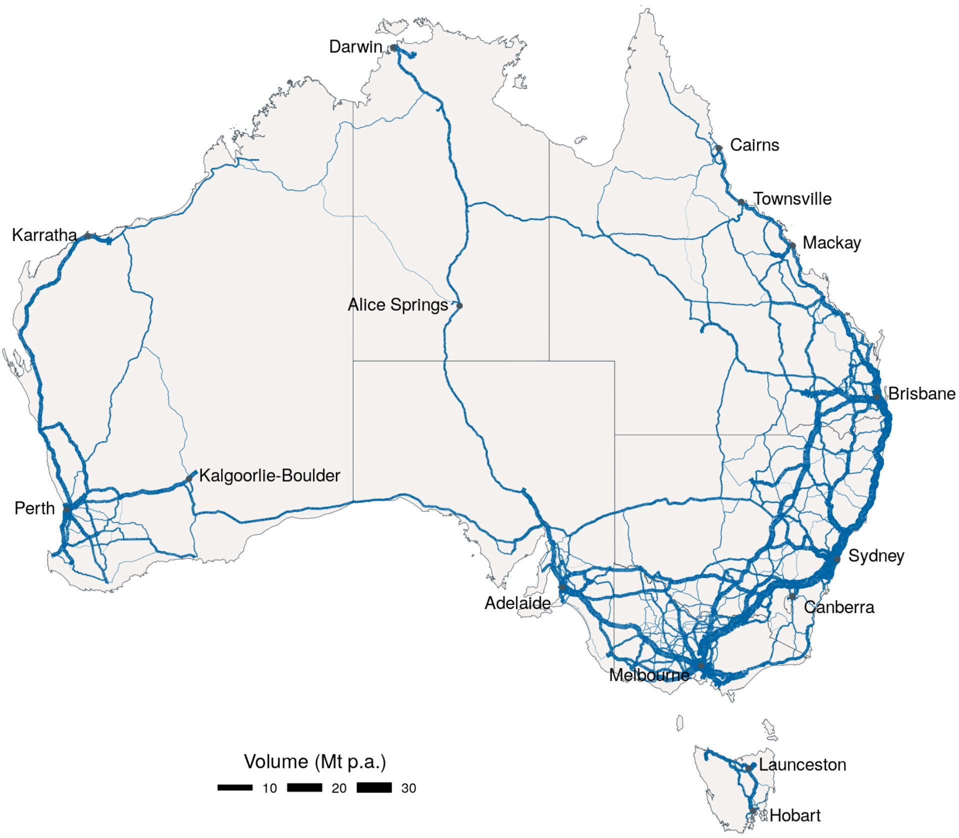
Geography and the spatial distribution of economic activity also plays a role in the amount of road freight activity—all else equal, the greater the distance between places of supply and places of use, the higher the volume of freight (measured in mass-distance terms).

Merchandise import and export volumes also influence domestic freight volumes, with increased trade volumes involving at least one, and often several separate freight movements to transporting exports (imports) to (from) the port from (to) the domestic origin (destination). However, the net effect of increased trade volumes on domestic transport is less clear. Where, for example, imports replace domestic production, the net effect may be a reduction in total domestic road freight volumes, particularly where the domestic supply chain involved several stages of production (e.g. car manufacturing or assembly). In contrast, direct import of motor vehicles requires only transport from port of entry to point of sale/use. Moreover, as a large share of Australia's population lives within 100 kilometres of Australia's major container import ports, the average haul length of imported finished motor vehicles is likely to be less than that of previous domestically manufactured vehicles.

Freight transport costs play a role in influencing freight mode choice (i.e. choice of road, rail or coastal shipping) and the longer-term choice of location of domestic production and distribution facilities.

Finally, the freight commodity mix, average product density and average haul length will also affect growth in the freight task. The changing nature of the Australian road freight task, which appears to involve substitution from movement of primary and secondary products to a greater mix of

Figure 2.5 Network-assigned origin–destination road freight flows, 2013–14



secondary and tertiary products, and from domestic manufactures to a greater share of imports will, in general, is likely to result in a general shift to slightly less dense freight on average and shorter average length hauls, as the import share of total domestic consumption goods increases.

2.2 Comparing Australian and international road freight trends

Comparing Australian and international aggregate road freight transport across developed countries, shows that Australia has one of the highest per capita rates of road freight activity among all developed countries (see Figure 2.6). Australia's current road freight transport intensity, almost 10 thousand tonne kilometres per person, is behind only the United States (approximately 12.5 thousand tonne kilometres per person, pre-2012) and level with Poland, which has experienced rapid growth in road freight volumes since the mid-2000s.[7] By comparison, road freight per capita levels in other comparable countries are far less, for example:

- Canada – 4.75 thousand tkm/person (in 2017)
- France – 2.50 thousand tkm/person
- Germany – 3.81 thousand tkm/person
- New Zealand – 5.73 thousand tkm/person
- United Kingdom – 2.36 thousand tkm/person.

Part of Australia's higher per capita road freight intensity is the 'tyranny of distance'—e.g. a large continent with long transport distances between major population centres and a relatively sparsely-populated continental interior. In many of these countries, rail and inland canals play a larger role and carry a higher share of non-bulk freight.

Growth in per capita road freight volumes also appears to have been slower in many other comparable developed countries over the same period, with per capita road freight volumes recently even declining in some countries—e.g. Belgium, Germany, Italy and the United States (prior to the series break in 2012).

The implications of road freight trends observed overseas, suggests that growth in Australian aggregate road freight movements is also likely to slow over the medium and long terms, particularly in the absence of additional productivity enhancing reforms either in the transport sector or elsewhere.

2.3 Modelling aggregate road freight activity

Aggregate Australian road freight activity is modelled as a single-equation econometric model that relates total road freight (measured tonne kilometres) and factors that influence long-term trends in aggregate road freight activity.

The principal factors that affect aggregate road freight volumes are gross domestic output/economic activity and road transport costs. In developing the forecasting model, BITRE tested several alternative measure of activity, including gross domestic product (GDP), gross national expenditure (GNE), total merchandise sector output (incl. wholesale and retail trade sectors),[8] and merchandise sector output plus merchandise trade (i.e. merchandise exports and imports). While all four activity measures provide reasonable predictions of road freight transport activity, the empirical results suggest that GNE provides the best predictions, particularly in the most recent period where road freight volumes have grown at below-historical-average rates of growth. (Empirical model results are presented in Appendix B, Table B.1.)

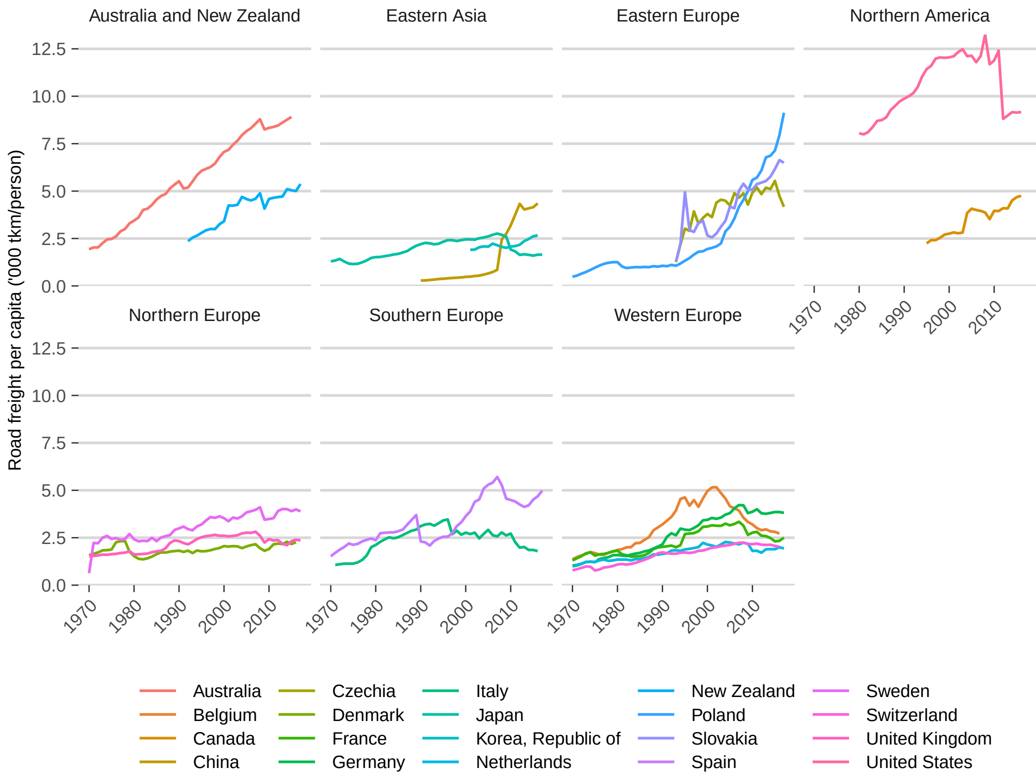
The forecasting model is specified in linear-log terms (i.e. linear in the dependent variable and log-independent variables), hence all parameter estimates reflect the marginal effect of a proportionate change in the relevant input variable. Figure 2.7 shows the actual and preferred road freight per capita model fit—this specification almost perfectly predicts the flattening in per capita road freight activity apparent since 2007.

Elasticities may be derived by dividing the relevant parameter estimates by the dependent variable. Figure 2.8 shows the estimated model elasticities, for the preferred GNE-based per capita model

7 Road freight volumes in Poland grew four-fold between 2003 and 2017, averaging growth of around 10.5 per cent per annum over that period; by far the fastest rate of growth in road freight across all OECD countries.

8 Merchandise sector output defined here as the output of Australian and New Zealand Standard Industrial Classification (ANZSIC) Divisions A–G: A – Agriculture, Forestry and Fishing, B – Mining, C – Manufacturing, D – Electricity, Gas, Water and Waste Services, E – Construction, F – Wholesale Trade, and G – Retail Trade.

Figure 2.6 International per capita road freight trends, for selected countries, 1971–2018



specification. It implies that the economic activity elasticity has declined from over 3.0 in the 1970s to around 1.0 in 2007, and appears to have remained around that level. Similarly, the real road freight rate elasticity has declined (in absolute levels) from around -1.0 in the 1970s, to around -0.3 today. Declining elasticities imply declining sensitivity to activity and prices (freight rates), and is consistent with experiences observed overseas and in other related transport markets.[9]

2.4 Aggregate road freight forecasts

This section presents aggregate road freight forecasts produced using the range of forecasting model specification presented in Section 2.3 (above), and the preferred model forecasts. Three sets of forecasts are presented for each model specification—*high*, *reference* and *low growth* scenarios. These scenarios are specific combinations of up-to-three separate scenarios for each of future population, income levels and oil prices. (All alternative population, income and oil price scenarios, and related assumptions, are outlined in Appendix A.)

Key assumptions

The forecast scenario assumptions outlined in Section 1.4 and Appendix A are then applied in the preferred forecasting model to derive a suite of alternative forecast scenario outcomes. The median

9 Litman (2019), for example, notes a range of transport elasticities have exhibited declining trajectories over time, particularly road transport related fuel use with respect to fuel prices.

Figure 2.7 Actual vs. estimated road freight per capita model fit, 1971–2018

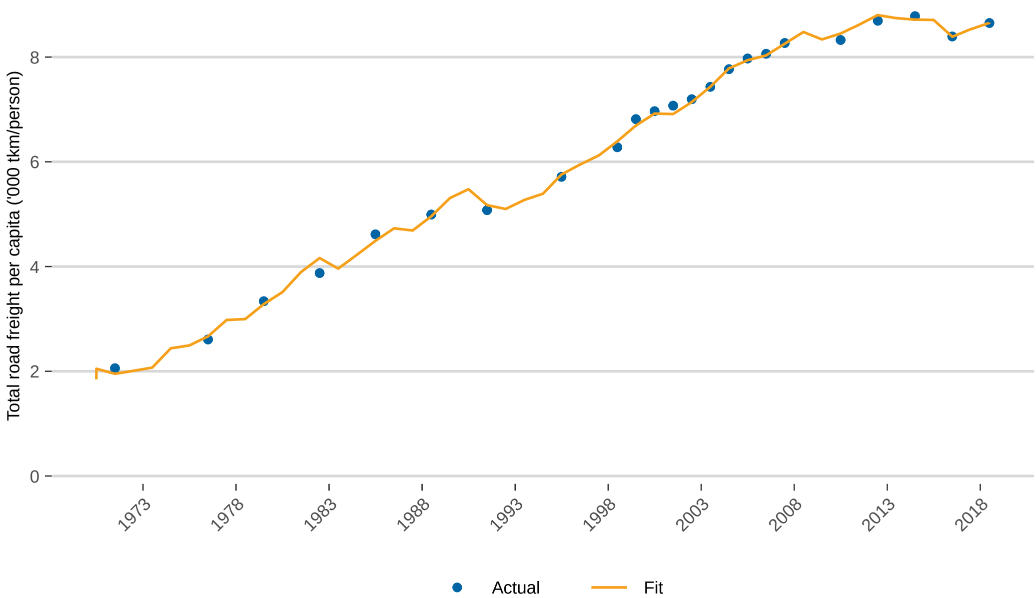


Figure 2.8 Aggregate road freight per capita model implied elasticities, 1971–2018

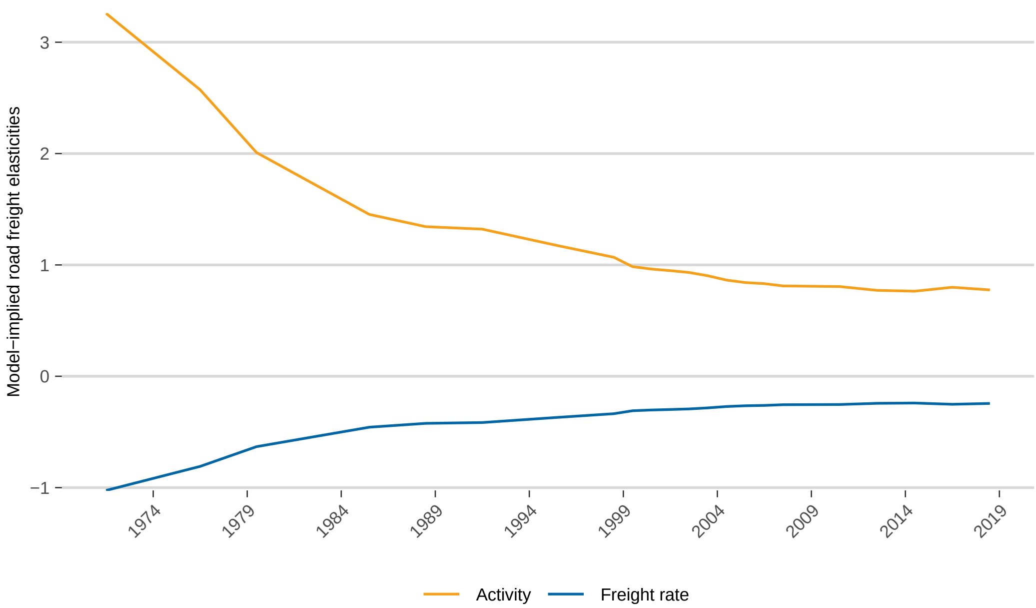
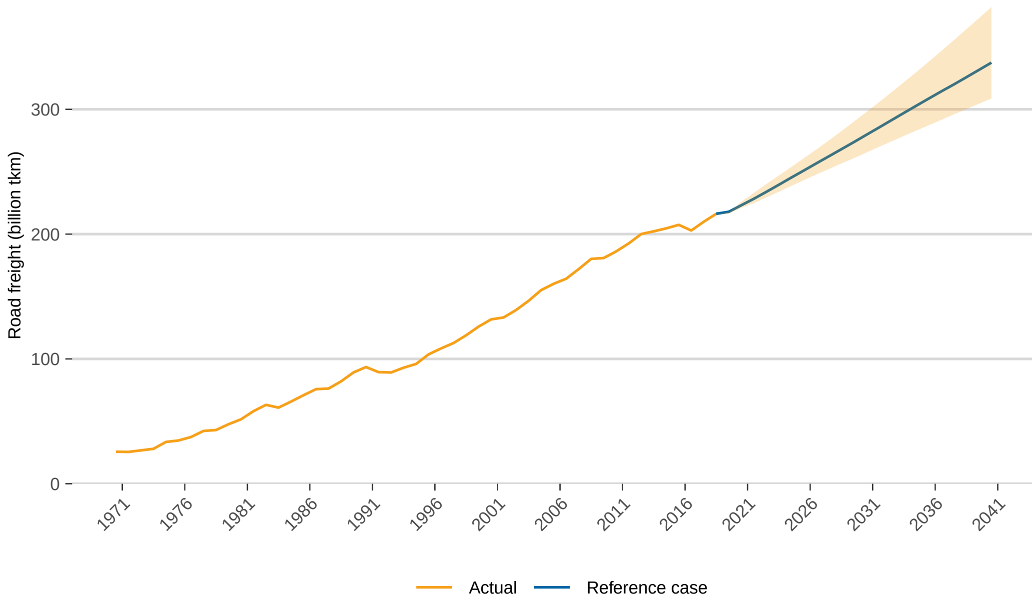


Figure 2.9 Preferred forecast aggregate road freight volumes, 2018–2040, reference growth case



forecast scenario represents the BITRE's *Reference case* forecasts of likely future aggregate road freight growth.

Aggregate road freight forecasts

Figure 2.9 shows the aggregate reference case road freight forecasts, and the forecast range implied by the high and low forecast scenarios.

Under the *reference case* assumptions—which broadly reflect median GDP per capita growth assumptions, ABS Series B (median) population growth and EIA reference case world oil prices (see Appendix A)—road freight volumes are projected to increase from around 216 billion tkm in 2018 to around 280 billion tkm in 2030 and 337 billion tkm by 2040. This implies average annual growth of around 2.2 per cent per annum between 2018 and 2030 and 1.9 per cent per annum between 2030 and 2040.

The *low scenario* road freight forecasts—which assume below average GDP per capita growth, ABS Series C population projections and EIA high case oil prices—imply road freight volumes would grow by around 1.7 per cent per annum between 2018 and 2030 (to around 265 billion tkm in 2030) and 1.5 per cent per annum between 2030 and 2040 (to around 309 billion tkm in 2040).

The *high scenario* road freight forecasts assume above average GDP per capita growth, ABS Series A population projections and EIA low scenario oil prices, and imply road freight volumes would grow by around 2.7 per cent per annum between 2018 and 2030 (to around 298 billion tkm in 2030) and 2.5 per cent per annum between 2030 and 2040 (to around 382 billion tkm in 2040).

CHAPTER 3
Rail freight outlook

This chapter outlines the methodology and key assumptions underpinning the BITRE's aggregate rail freight outlook.

3.1 Introduction

The Australian rail sector is integral to the movement of a range of bulk export commodities, notably iron ore, coal, bulk grains, and sugar cane, and also dense break-bulk products, including finished steel products and bulk fuels.

Domestic rail freight has grown more than ten-fold since 1971, from around 40 billion tonne kilometres in 1970–71 to around 414 billion tonne kilometres (tkm) in 2015–16, and more than doubling in the last decade due almost entirely to growth in iron ore and, to a lesser extent, coal exports. Figure 3.1 shows the approximate composition of the total rail freight task since 1971.

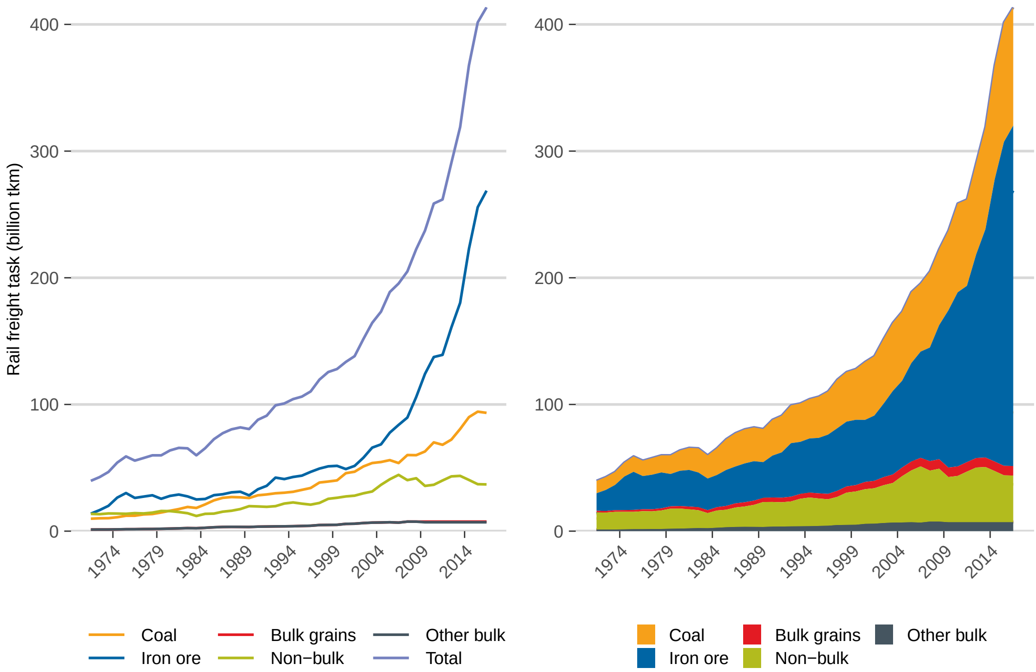
The figure highlights show the predominance of iron ore movements in the total Australian rail freight task, which has increased from around 35 per cent of total rail tonne kilometres in 1989–90 to around 65 per cent in 2015–16. Over that same period, volumes of coal carried by rail have tripled, but coal's share of total rail freight volumes has fallen from around 32 per cent in 1989–90 to around 22 per cent in 2015–16. Interstate non-bulk rail freight has grown from just under 5 billion tonne kilometres (around 11 per cent) in 1972 to around 26.6 billion tonne kilometres (6 per cent) in 2016. The remaining freight, which includes bulk grains and sugar cane rail volumes, can vary significantly from year-to-year depending on prevailing growing conditions, and other non-bulk freight, have increased from around 11 billion tonne kilometres in 1972 (approximately 26 per cent of then rail freight) to around 24.8 billion tonne kilometres (around 6 per cent) in 2016.

The drivers behind growth in these different rail freight commodities are very different. Growth in iron ore rail freight movements are driven by overseas demand for iron ore for use in steel production. Growth in coal rail freight volumes is also largely a function of overseas demand, but impacted by two different demand drivers—i) metallurgical coal export demand, also related to overseas steel production, primarily in north east Asia (i.e. China, Japan and South Korea), and ii) thermal coal export demand, again primarily fuelled by north east Asian energy demand. In contrast, intercapital non-bulk rail freight in influenced by domestic business and consumer demand, particularly in long-distance markets, and other rail freight volumes are driven by domestic production trends.

Accordingly, BITRE's aggregate domestic rail freight forecasting model splits rail freight into five separate broad, independent traffic components:

- Iron ore

Figure 3.1 Australian rail freight task, by major commodity group, 1971–2016



- Coal
    - Thermal coal
    - Metallurgical coal
- Interstate non-bulk freight
- All other rail freight

and separately models and forecasts each of those components, which are then summed to derive total rail freight forecasts.

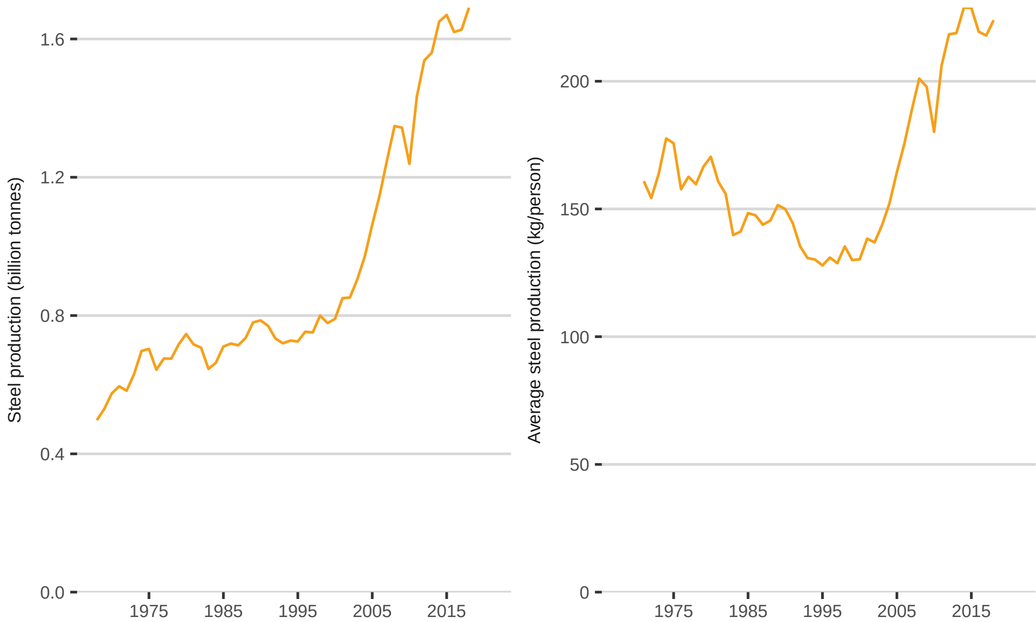
The following section describes each of the separate rail freight forecasting modules, key forecast assumptions and forecast freight volumes.

3.2 Rail freight forecasts

Australian iron ore rail freight forecasts

Australian iron ore rail freight forecasts are broadly based on the outlook for future total world steel production (Stage 1), likely future iron ore needs and Australia's likely share of global iron ore supply. The forecasts adopt a scenario-based approach, to capture the potential range of future outcomes. The forecasts are also heavily informed by announced country and company steel production and investment plans and/or targets. India, for example, has announced plans to increase domestic steel production to 300 million tonnes per annum (Mtpa) by 2030 (Ministry of Steel, India 2017). The following section outlines historical world and country steel and iron ore production and Australian iron ore exports.

Figure 3.2 World total and per capita steel production, 1971–2018



World steel production

Total global steel production has increased threefold since 1970, from around 0.6 billion tonnes (in 1970) to around 1.7 billion tonnes in 2018, and doubling since 2000 (see Figure 3.2). Over this same period, average global per capita steel production declined slightly between 1970 and 2000, from around 170 kilograms per person in 1970 to around 130 kilograms per person by 2000, but since 2000, due to the influence of China, total global per capita steel production has increased to over 220 kilograms per person in 2018.

Figure 3.3 shows country-specific steel production and average per capita steel production for major steel-producing countries. The left-hand-side panel shows Chinese steel production has more than quadrupled since 2000—average per capita production in China has grown from around 100 kilograms per person in 2000 to around 500 kilograms per person in 2017.

In most other major steel-producing countries, total steel production and average per capita production has remained relatively unchanged over the last 20–30 years. The major exception is South Korea—South Korean steel production has increased from around 25 million tonnes in 1990 to over 70 million tonnes in 2017, and average production has increased from around 600 kilograms per person in 1990 to around 1400 kilograms per person in 2017.

Lastly, Figure 3.5 shows the share of world steel production, in major steel-producing countries. Most significantly, China's share of total production has increased from less than 15 per cent in 1995 to nearly 50 per cent in 2017.

World steel production outlook

In developing its Australian iron ore rail forecast outlook, BITRE has drawn on official and reputable external medium and long-term forecasts of world and country steel and iron ore production. The outlooks of several key sources are outlined below.

Figure 3.3 Total and per capita steel production for selected countries, 1971–2018

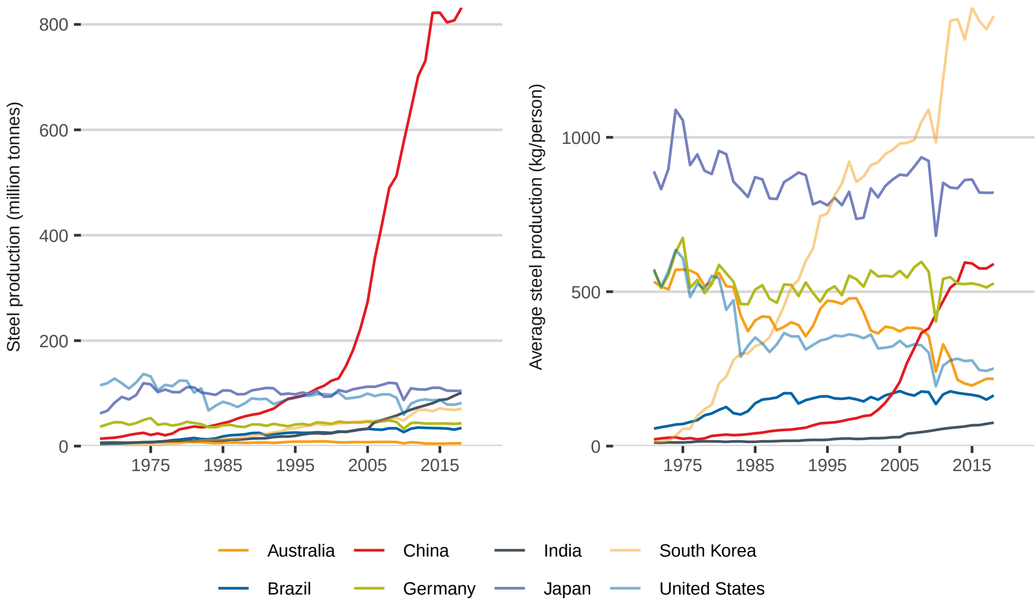


Figure 3.4 Total and per capita steel production vs. real GDP for selected countries, 1971–2018

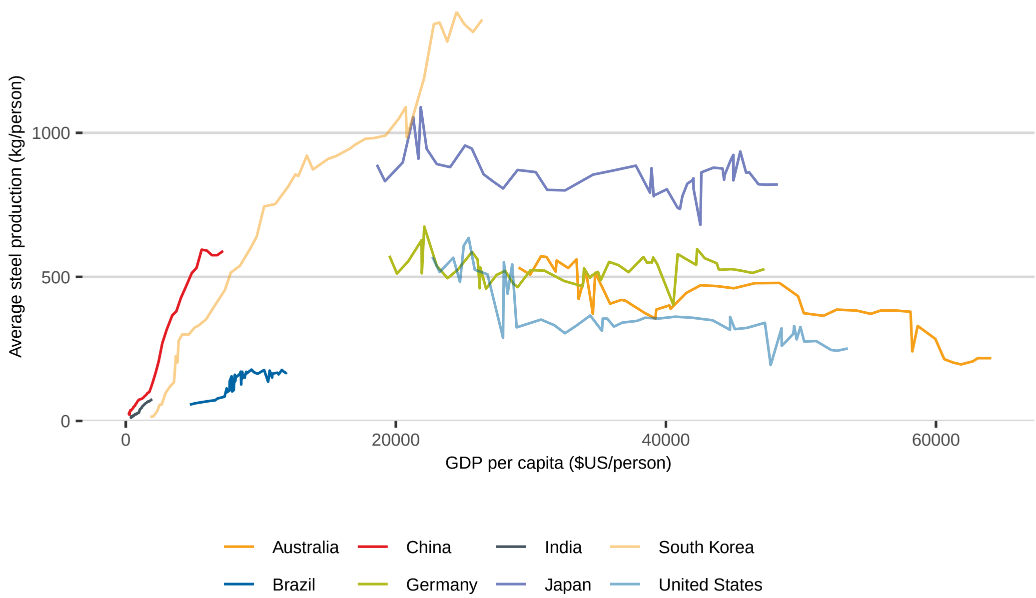
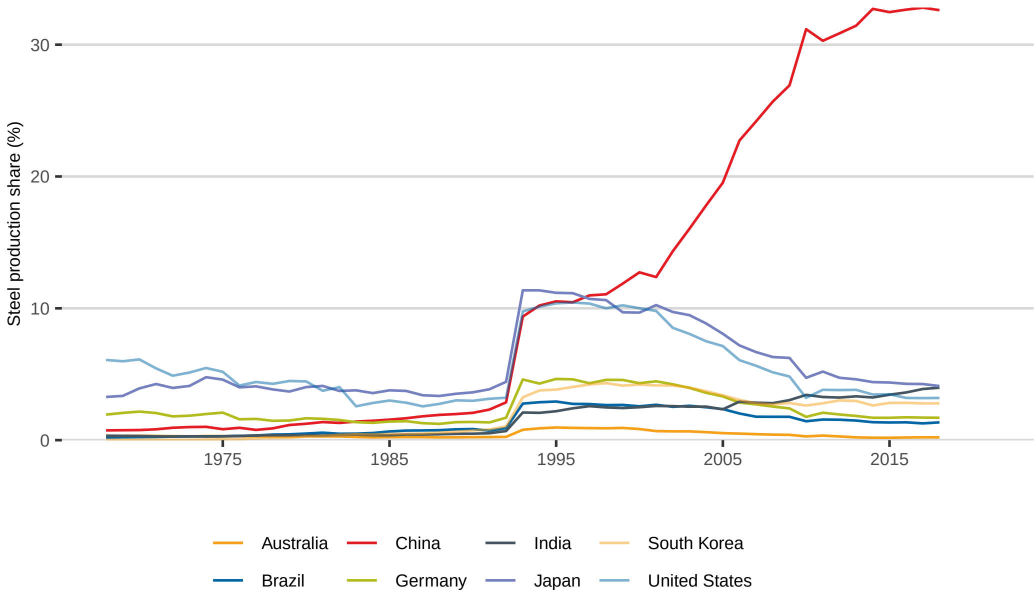


Figure 3.5 Share of world steel production, for selected countries, 1971–2018



OCE (DIIS) medium term steel and iron ore outlook

The Office of the Chief Economist (DIIS) produces medium-term (5-year) commodity outlook forecasts for major Australian commodities every quarter, including world steel and iron ore production. As at the time of writing, the latest forecasts were OCE (2019).

OCE (2019) projects that world steel production will continue to increase over the medium term, led by expansion of steel production in India, and other developing Asian countries such as Vietnam and Indonesia, to meet growing domestic demand. China's steel production is projected to shrink over the medium term, as slower growth and re-balancing of its economy reduce domestic demand for steel. In particular, OCE (2019, p. 25) notes the recent closure of several steel mills and imminent closure of several more before 2021 are set to reduce production capacity by around 22 Mtpa, although this will be offset by around 14 Mtpa in new capacity by 2022. Over the course of the medium term, OCE expects China's steel production will decline by around 1.2 per cent per annum, to around 863 million tonnes in 2024.[10]

OCE's medium-term outlook also appears to take into account a longer-term levelling in the steel intensity of China's economy (i.e. per capita steel consumption). China is also expected to use increasing quantities of scrap material in steel production, which will reduce the demand for iron ore and metallurgical coal (OCE 2019, p. 25), and potentially Australian exports of those two commodities. OCE also note there is substantial uncertainty around the trajectory of China's steel sector, as government policy has a significant influence.

OCE projects that China's steel consumption will shrink from around 860 million tonnes in 2018 to around 830 million tonnes by 2024, and production to decline from around 930 million tonnes in 2018 to around 863 million tonnes by 2024 (see Table 3.1).

10 Factors cited by OCE as contributing to the lower domestic steel production include slowing consumption, stricter environmental regulations, steel mill capacity rationalisations, shift in focus from quantity to quality and a shift away from steel-intensive export growth to a more consumer-driven economy.

Table 3.1 OCE forecast crude steel production by country, 2019–2024

	Calendar Year						
Country	2018	2019	2020	2021	2022	2023	2024
Brazil	35	34	34	35	35	35	35
China	928	918	900	888	869	865	863
European Union	168	171	174	178	178	178	178
India	106	115	123	132	141	150	156
Japan	104	105	106	105	104	104	103
Russia	72	72	72	72	72	71	71
South Korea	72	71	70	70	70	69	69
United States	87	84	83	85	87	90	92
World steel production	1 788	1 811	1 808	1 815	1 814	1 823	1 836

Sources: OCE (2019) and BITRE estimates.

Among other major steel producing countries, OCE expects Japanese steel production to decline by 0.2 per cent per annum over the medium-term outlook period and U.S. steel production to increase to around 92 million tonnes in 2024 (from 87 million tonnes in 2018).

India's steel production is projected to increase to around 156 million tonnes by 2024 (from just over 100 million tonnes in 2018). OCE notes that India overtook Japan in 2018 to become the second largest steel producer, but that despite recent growth India's steel intensity is currently around 77 tonnes per person, well below that of China and major developed countries. The Indian government has set a steel production capacity target of around 300 Mtpa by 2030 (Ministry of Steel, India 2017).[11]

Steel production is also expected to increase in a number of south and south east Asian nations (e.g. Indonesia, Vietnam) to meet increasing domestic steel demand. Australia is well placed to provide price-competitive, high-quality iron ore required to meet these needs.

Overall, OCE (2019) projects total global steel production will grow from around 1790 million tonnes in 2018 to round 1835 million tonnes by 2024, average annual growth of around 0.44 per cent per annum.

OCE (DIIS) Australian iron ore export outlook

The major influences on Australian iron ore exports are overseas demand and overseas domestic production, particularly in China and India, and competition from other major suppliers, particularly Brazil, which is the other major global iron ore exporter.

OCE expects China's iron ore imports to gradually decline due to declining steel production, although this will be partially offset by a projected decline in domestic Chinese iron ore inputs, and increasing use of scrap steel—in particular OCE notes that China has also recently been more supportive of electric arc furnaces (EAF), which use scrap steel as their main input and expects the share of steel produced using EAF to increase to 15 per cent by 2024 (from 9.3 per cent in 2018) (OCE 2019, p. 32).

OCE projects India's iron ore production will increased from around 200 million tonnes in 2018 to 251 million tonnes by 2024. India is expected to be self-sufficient in iron ore over the short term,

11 Blast furnaces, or basic oxygen furnaces (BF-BOF), are expected to contribute around 60–65 per cent of Indian crude steel capacity, with 35–40 per cent provided by EAF and induction furnaces (IF).

Table 3.2 OCE forecast iron ore trade, by country, 2019–2024

	Calendar Year						
Country	2018	2019	2020	2021	2022	2023	2024
Australia	836	867	864	888	906	903	902
Brazil	390	370	388	403	404	405	406
India	18	14	12	11	8	8	7
Ukraine	35	30	29	30	30	30	30
World trade	1 547	1 530	1 530	1 528	1 532	1 529	1 527

Sources: OCE (2019) and BITRE estimates.

however, domestic consumption is expected to exceed production by 2023, resulting in import growth.

In the medium term, OCE expects Australia and Brazil to maintain their share of global iron ore exports at around 54 and 24 per cent, respectively. Australia's iron ore export volumes are forecast to increase from around 840 million tonnes in 2018 to 888 million tonnes in 2021 and 900 million tonnes in 2024 (see Table 3.2).

Other long-term outlooks

There are a range of other sources that have also investigated and reported on long-term global steel consumption and production trends and provided projections, including Accenture (2017), Wood Mackenzie (2018) and IEA (2014), among others. This section outlines the key long-term themes that emerge from those reports.

Accenture 2017

Accenture (2017) reports on historical trends in country steel consumption and notes several key factors influencing the long-term steel demand (and production) outlook:

- As countries develop, steel consumption per capita increased to a peak point then consumption starts declining before finally plateauing.
- Peak per capita steel consumption (relative to GDP per capita) has been declining over time, as material substitution, quality improvement in materials and efficiencies in design are implemented.

Accenture (2017) use the automotive transport industry as an example of where trends are leading to reduced steel consumption:

- Changes in demand, due to ride sharing, transport-as-a-service (TaaS) and changing consumer preferences are reducing demand for private vehicle travel
- Longer lasting / reusable materials are will reduce annual demand for new vehicles
- Light-weighting of both steel inputs and by material substituting is reducing steel input per vehicle.

Consequently, Accenture (2017) project that global steel demand will grow by around 1.4 per cent per annum (between 2015 and 2035) to 2.0 billion tons by 2035, in their baseline forecasts. Accenture (2017) also posit two alternative 'disruptive' scenarios:

- 'Incremental' disruption, under which the above factors play out, and under which global steel demand grows by 1.1 per cent per annum to 1.87 billion tons by 2035, and
- 'Radical' disruption, under which global steel demand grows by 0.4 per cent per annum to 1.75 billion tones by 2035.

Under these scenarios, China's steel use is projected to shrink from currently 672 million tons (crude steel-equivalent use, 497 kg per capita) to around 537 million tons (388 kg per capita) under the Incremental scenario and 504 million tons (365 kg per capita) under the Radical scenario. Indian steel use is projected to grow from 80 million tons (61 kg per capita) to 237 million tons (150 kg per capita) in the Incremental scenario and 228 million tons (145 kg per capita) in the Radical scenario. Emerging country steel use is projected to increase by around 300 million tons between 2015 and 2035 under each of the scenarios.

Accenture (2017) also note that on the supply side, increase use of electric arc furnace (EAF) production, utilising increased volumes of scrap steel will reduce the demand for iron ore inputs. Hence, Accenture expects world iron ore demand to peak sometime around 2025 at around 2.24 billion tonnes, increasing from 2.01 billion tonnes in 2015, and ending at 2.16 billion tonnes in 2035.

Wood Mackenzie (2018)

Wood Mackenzie (2018) expect global steel demand and production growth to grow by around 0.5 per cent per year, due to slower expected future Chinese growth. They anticipate India will to provide the next 'engine of global growth' in steel production and use, but that Indian growth is not expected to accelerate until after 2021. Like Accenture (2017), Wood Mackenzie (2018) also highlight the long-term trend factors impacting global steel production as including:

- Light-weighting of the automotive industry
- Transfer of steel production and steel-intensive manufacturing to emerging countries
- Increasing share of EAF steel in the production mix.

On the last point, Wood Mackenzie (2018) expect EAF production to increase to 32 per cent of total steel production by 2040, up from 28 per cent in 2018, mostly due to higher scrap availability and use in China, but also higher utilisation of EAF assets around the world.

Other research and steel industry stakeholders, such as World Steel Association (2017) and McKinsey & Company (2018), report similar recent trends and note the same significant factors affecting future steel demand, even if they don't provide long-term estimates of likely future global steel output.

IEA World Energy Outlook iron ore outlook

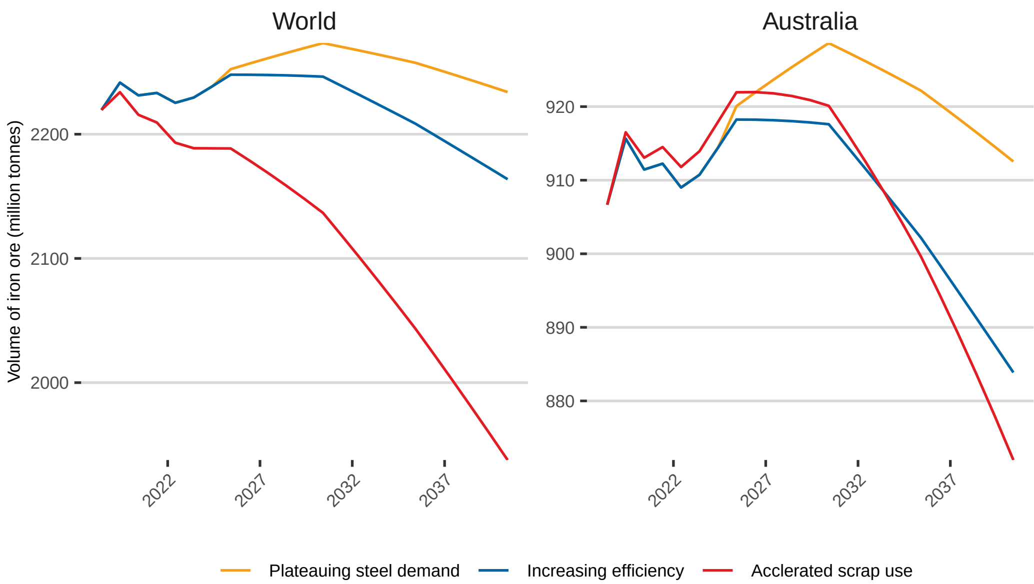
The International Energy Agency's annual World Energy Outlook also obliquely references likely future world steel consumption and production trends, through its projections of likely future metallurgical coal consumption. In particular, IEA (2014) implies that global steel production will plateau after 2025, with Chinese crude steel production declining after 2020 (IEA 2014, pp. 183, 192). Under IEA (2014), Chinese crude steel production peaks before 2020, growing by 1.6 per cent per annum between 2012 and 2020, but declines thereafter, by -1.2 per cent per annum between 2020 and 2030, and by -1.7 per cent between 2030 and 2040. IEA (2014, p. 290) also presumes higher scrap metal use (using electric arc furnaces (EAFs)) in the steel industry by 2040,[12] which is broadly consistent with Wood Mackenzie (2018) and other long-term outlooks.

Long-term Australian iron ore export scenarios

BITRE's long-term Australian iron ore export scenarios begin with the OCE five-year outlook and appends long-term assumptions about future world steel demand and the consequences for future Australian iron ore consumption. The forecasts posit three broad scenarios:

12 IEA (2014) notes that currently 29 per cent of steel is produced in EAFs, with the majority in China, the United States and India.

Figure 3.6 World iron ore demand and Australian iron ore production forecast scenarios, 2018–2040



i) Plateauing future world steel demand (Scenario 1) – Under this scenario, world steel demand is projected to continue to increase out to 2040. Chinese steel demand is projected to have already peaked and to decline over the projection horizon, replaced by growth in consumption (and production in other Asian countries).

ii) Incremental efficiencies scenario (Scenario 2) – Under this scenario, changes in steel demand and incremental efficiency improvements in steel manufacture and use, through increased 'light-weighting' of steel and use of substitutes—*Reduce–Re-use–Re-manufacture–Recycle*—results in a seven per cent reduction in world steel demand over Scenario 1.[13]

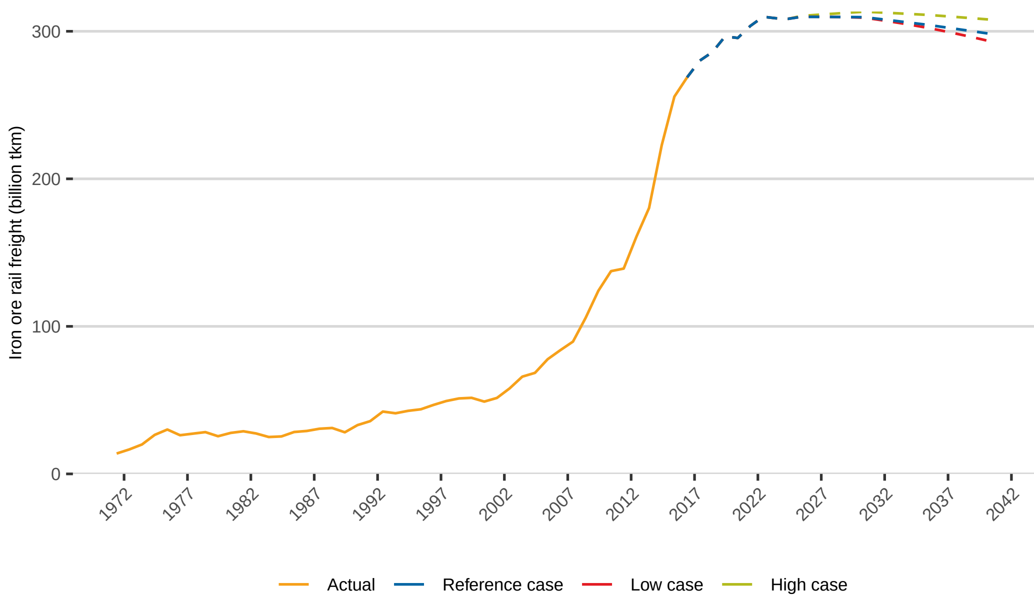
iii) Increased scrap availability scenario (Scenario 3) – The third scenario involves accelerated availability of scrap steel across developing countries, particularly in China, and increased use of scrap in production of primary steel products (and hence less demand for iron ore feedstock). Under this scenario, the share of steel produced from scrap is assumed to increase from around 25 per cent in 2015 to around 40 per cent by 2040.[14]

These scenarios have varying implications for global iron ore demand. Under the first scenario, total world iron ore demand (and production) is projected to increase from around 2160 million tonnes in 2017 to around 2235 million tones by 2040, to around 2164 million tonnes under Scenario 2, and decline to around 1938 million tonnes under Scenario 3 (see Figure 3.6, Panel (a)). Accordingly, Australian iron exports are projected to increase to around 930 Mtpa by 2030, but decline thereafter to around 912 million tonnes in 2040 under Scenario 1. Under Scenario 2, iron ore exports are projected to increase slightly (to around 918 Mtpa) by 2028, but then decline to around 885 million tonnes by 2040, and under Scenario 3, iron ore exports are projected to follow a similar trajectory to that of Scenario 2, but decline to around 870 million tonnes by 2040 (see Figure 3.6, Panel (b)).

These forecasts imply the following total iron ore rail freight volume outcomes:

13 A roughly 0.2 per cent per annum improvement in the steel use efficiency.
14 The share of scrap in steel production is likely to increased under all scenarios, but most aggressively under this scenario.

Figure 3.7 Australian iron ore rail freight scenario forecasts, 2018–2040



- Under Scenario 1 total iron ore rail freight volumes are projected to increase from around 216 billion tonne kilometres in 2017 to around 220 billion tkm by 2030, but thereafter decline to around 216 billion tkm in 2040.
- Under Scenario 2 total iron ore rail freight volumes are projected to increase from only slightly over 2017 levels over the next few year, but then decline to around 209 billion tkm in 2040.
- Under Scenario 3 total iron ore rail freight volumes are projected to follow a similar trajectory to that of Scenario 2, but decline to around 205 billion tkm in 2040.

Figure 3.7 shows the implications for Australian iron ore rail freight volumes under each of these scenarios.

Coal export freight forecasts

Australia, along with Indonesia, is one of the two largest coal exporting countries in the world. Consequently, forecasting Australia's likely future coal rail freight volumes is almost entirely dependent on likely future world coal demand.

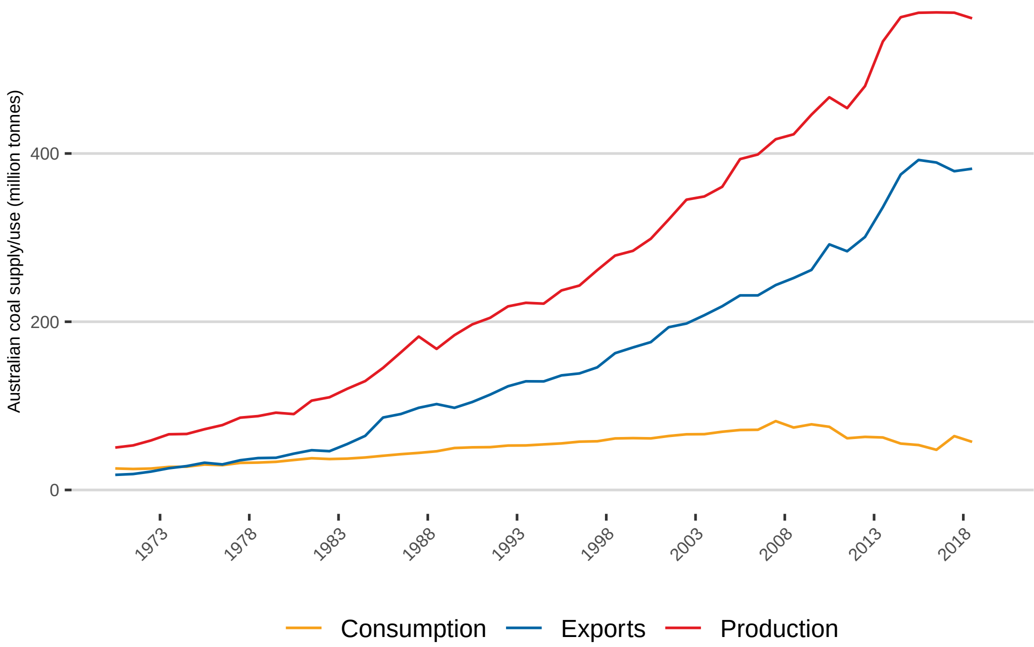
Australia currently produces around 560 million tonnes of coal per annum, exporting around 381.9 million tonnes and consuming 57.2 million tonnes in 2017-18. Metallurgical coal exports totalled around 179.2 million tonnes in 2017-18 (46.9 per cent of total exports), and thermal coal exports totalled 202.7 million tonnes.

IEA (2014) identifies two overarching and competing trends in the future outlook for global coal demand:

i) Increasing economic progress and growing industrialisation in many developing countries, e.g. India, Indonesia, Vietnam, etc., resulting in increased demand for coal in electricity generation and industrial production (e.g. metallurgical coal for steel production).

ii) Growing community opposition to coal use, and also increasing commercial sensitivity to the potential future liabilities of excessive reliance on coal and coal projects.

Figure 3.8 Australian coal production, consumption and exports, 1970–2016



As one of the largest coal exporting countries, Australian coal exports are unlikely to be able to avoid these influences, and while in the short-to-medium term, developing country needs may lead to increased coal exports, in the longer term the size and extent of world and country responses to climate change may reduce the significance of Australia's coal exports and coal rail freight task. This is particularly the case for Australia's thermal coal exports, where renewables, gas, oil and other energy sources compete directly with coal.

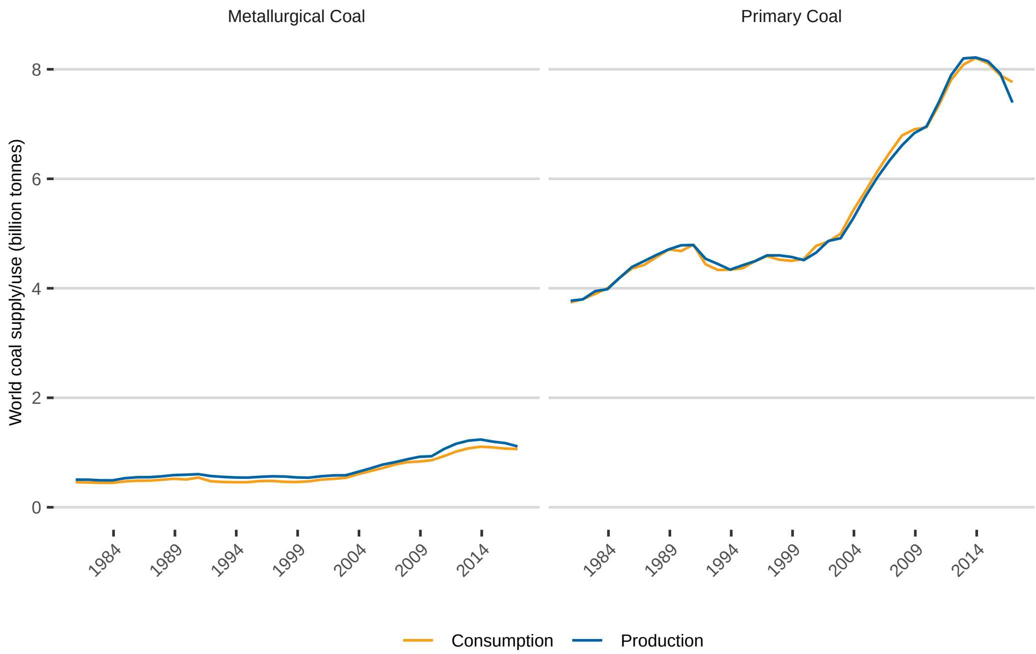
In contrast, Australian metallurgical coal exports (and hence rail volumes) will largely be a function of industrial activity, particularly steel production in current major steel-producing countries—China, Japan and South Korea—and major developing countries, such as India, Indonesia and Vietnam.[15] Under the steel production scenarios presented in Section 3.2, steel production is assumed to peak over the near to medium term, and then decline over the longer run. Depending on the size of the response, that may accelerate take up of alternative technologies, e.g. replacement of blast furnace technology with electric arc furnaces (EAF) and increased use of used (scrap) steel.

Total global coal production & consumption trends

Total world coal consumption (and production) has grown from 3.8 billion tonnes in 1980 to around 8.2 billion tonnes in 2013. Since 2013, however, total world coal consumption has declined slightly, to 7.4 billion tonnes in 2016 (see Figure 3.9). Over the same period, total metallurgical coal consumption (and production) has grown from around 458 million tonnes in 1980 to over 1050 million tonnes in 2017, with much of that growth occurring since 2000, principally due to growth in Chinese steel production.

15 Blast furnace based steel production requires around 600 kilograms of coke, or around 770 kilograms of coal, per tonne of steel (WCA 2017).

Figure 3.9 World coal production and consumption, 1980–2016



World coal use and Australian coal export outlook

BITRE has used the medium-term (5-year) commodity outlooks of the Office of the Chief Economist (OCE) (OCE 2019) and the long-term coal energy outlook scenarios for world and Australian coal demand from the International Energy Agency (IEA) (IEA 2014) and U.S. Energy Information Administration (EIA) (EIA 2017) to inform likely future Australian coal export and rail freight scenarios. The OCE medium-term projections are used to develop the five year coal rail freight forecasts in the BITRE's rail freight forecasts, and the IEA and EIA long-term outlook scenarios underpin the BITRE's coal rail freight forecasts beyond the first five years.

OCE (DIIS) medium term outlook

The Office of the Chief Economist (DIIS) produces medium-term (5-year) commodity outlook forecasts for major Australian commodities every quarter. OCE produces separate forecasts for metallurgical and thermal coal.

OCE (2019) projects that over the medium term world metallurgical coal trade will grow by around 1.0 per cent per annum (OCE 2019, p. 41), to reach 345 million tonnes by 2025. India is expected to be the key source of demand growth and overtake China as the world's largest metallurgical coal importer before 2024, to service the expansion of its steel sector. Further, OCE expects China's import demand to decline, as domestic steel production contracts in response to slower economic growth and increasing use of scrap steel in primary steel production. Overall, OCE expects Australia to remain the dominant exporter of metallurgical coal, accounting for around 55 per cent of world exports by 2025. Accordingly, OCE projects Australia's exports of metallurgical coal to increase from around 178 million tonnes in 2018 to around 204 million tonnes by 2022, and 194 million tonnes in 2024 (OCE 2019, p. 46) (see Table 3.3).

OCE (2019) projects over the medium term that world thermal coal trade will decline slightly, but

Table 3.3 OCE forecast metallurgical coal exports, major exporting countries, 2019–2024

	Calendar year						
Country	2018	2019	2020	2021	2022	2023	2024
Australia	178	188	197	201	204	201	194
Canada	30	31	32	33	33	34	34
Mongolia	26	26	26	26	26	28	30
Mozambique	8	8	9	10	11	12	13
Russia	26	28	28	28	29	30	31
United States	55	52	52	52	48	44	40
World trade	325	332	338	341	344	345	345

Sources: OCE (2019) and BITRE estimates.

Table 3.4 OCE forecast thermal coal exports, major exporting countries, 2019–2024

	Calendar year						
Country	2018	2019	2020	2021	2022	2023	2024
Australia	208	204	212	222	224	224	225
Colombia	80	80	78	76	76	76	76
Indonesia	429	433	411	389	381	374	366
Russia	172	176	179	182	186	191	195
South Africa	79	81	81	82	84	85	87
United States	51	46	44	43	44	44	45

Sources: OCE (2019) and BITRE estimates.

remain around 1.1 billion tonnes (OCE 2019, p. 50). OCE expects China's thermal coal imports to decline, replaced by increased domestic production. China is expected to remain the largest thermal coal importer in 2024. Thermal coal imports to other developed countries are projected to decline as countries transition away from coal-fired power generation. However, coal imports to countries in south and south-east Asia are projected to increase over the medium term. Overall, OCE projects Australia's thermal coal exports are projected to increase slightly, from around 19 per cent in 2018 (208 million tonnes) to around 21 per cent (225 million tonnes) in 2024 (OCE 2019, p. 58) (see Table 3.4).

Combining thermal and metallurgical coal exports, total Australian coal exports are then projected to grow increase from around 386 million tonnes in 2018 to around 420 million tonnes in 2024.

International Energy Agency coal production forecasts

The International Energy Agency (IEA) produces annual energy outlooks that provide long-term (20-year) scenario outlooks of world and country/region-specific energy supply and demand by fuel type (e.g. coal, oil, gas, renewables, etc.). IEA (2014)[16] presents three scenarios:

1. Continuing policy scenario (CPS – high) – only takes account of policies and measures that have already been enacted.
2. New policies scenario (NPS – medium) – assumes continuation of existing policies and measures as well as the implementation of policy proposals (even if yet to be formally adopted).
3. 450 (CO_2 PPM) scenario (450S – low) – illustrates the actions that would be required to achieve

16 For the 2019 freight forecasts, the 2014 WEO estimates were the lastest available to BITRE, which contain separately identifiable Australian coal freight.

and energy trajectory consistent with limiting the long-term increase in average global temperature to 2°C.

Under the NPS, world total primary energy demand is projected to grow to around 18 293 Mtoe (74 per cent from fossil fuels) by 2040.[17]. Under the CPS, total primary energy demand is projected to grow to around 20 039 Mtoe by 2040 (80 per cent from fossil fuels). Finally, total energy demand is projected to grow to around 15 629 Mtoe by 2040 under the 450S Scenario (fossil fuel share – 59 per cent) (IEA 2014, pp. 55–56).

Under the NPS total world coal production is projected to increase by 14 per cent between 2012 and 2040, from around 5667 Mtoe in 2012 to 6354 Mtoe by 2040. Thermal coal production is projected to grow 19 per cent (to 5280 Mtoe) and metallurgical coal production is projected to shrink by 7 per cent to 850 Mtoe in 2040 (IEA 2014, p. 604).

In contrast, under the CPS total world coal production is projected to increase to 8371 Mtoe (48 per cent over 2012 levels) and under the 450 Scenario world coal production is projected to decrease to 3700 Mtoe (35 per cent decline over 2012 levels)—with most of that decrease due to reduced steaming coal output (IEA 2014, p. 605).[18]

Under the NPS, 70 per cent of global coal output in 2040 is projected to come from four countries: China, India, Indonesia and Australia (IEA 2014, p. 181). Australia's share of world coal production is projected to increase from around 6 per cent in 2012 (343 Mtoe) to around 8 per cent in 2040 (539 Mtoe) under the NPS, driven by continued strong growth in exports, to become the largest OECD coal producer by 2035 (IEA 2014, pp. 183–184). IEA also projects total trade volumes for coal under the NPS, will increase from around 278 Mtoe in 2012 to around 479 Mtoe by 2040—a 72 per cent increase in total coal exports (IEA 2014, p. 184).

India's coal import dependency is projected to increase from 25 per cent in 2010 to around 40 per cent by 2040. Coal imports to other Asian non-OECD countries (including Malaysia, Thailand, Chinese Taipei, Bangladesh and Pakistan) are projected to nearly triple between 2012 and 2040 to over 290 Mtoe by 2040. Imports into Japan and Korea are projected to decline by 30 per cent due to reduced use of coal in energy generation.

IEA (2014, p. 185) also project that Australia will dominate the coking coal trade, accounting for 60 per cent of total global coking coal trade by 2040.

Figure 3.10 shows the IEA Australian coal production, exports and consumption outlook.

United States Energy Information Agency coal production forecasts

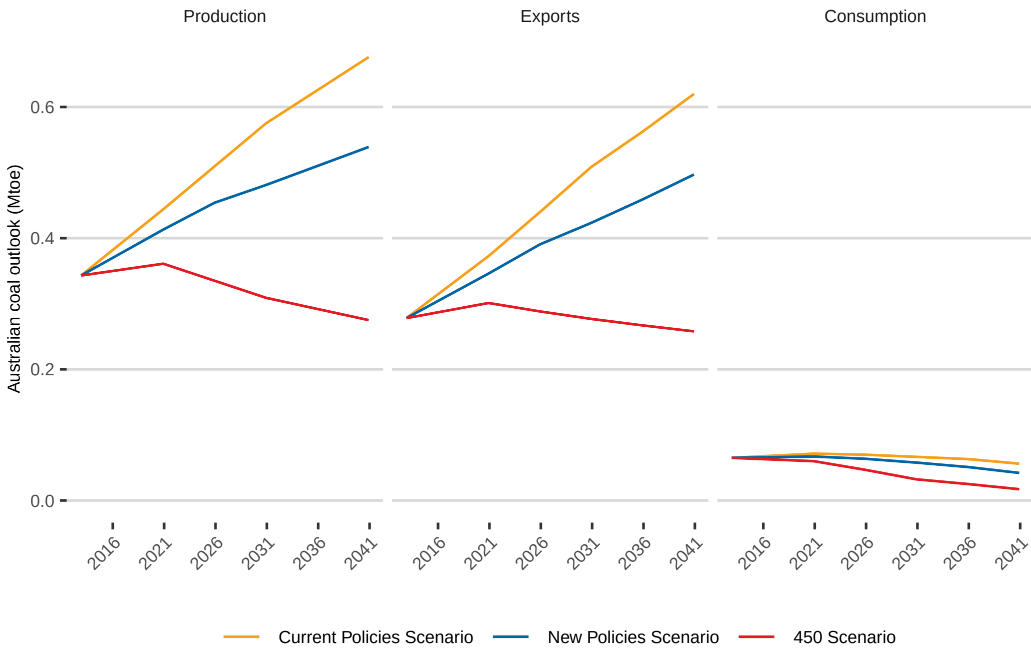
The U.S. Energy Information Administration (EIA) also produces regularly updated long-term forecasts of world coal production and consumption, including at region/country level (EIA 2017, and earlier issues).

EIA (2017) projects total world coal consumption will peak at around 163.1 quadrillion British thermal units (Btu, about 4110.4 Mtoe), and remain at around that level out to 2050. China is projected to continue to remain the largest single-country consumer of coal out to 2050, consuming around 85.5 quadrillion Btu in 2016, but declining to around 65.5 quadrillion Btu by 2050. EIA projects that India

17 Note that all WEO energy use estimates are provided in million tonnes of oil equivalent (Mtoe) energy. For the BITRE's forecasts, the WEO estimates are *not* converted to an equivalent volume (mass) of coal, but the implied growth rates are applied to base year Australian coal production, consumption and export volumes.

18 IEA energy use statistics group Australia in OECD Asia Oceania, which also includes Japan, South Korea and New Zealand (IEA 2014, p. 708).

Figure 3.10 Australian coal production, exports and consumption outlook, 2017–2040



will exhibit the largest single country growth in coal energy consumption, from around 14 quadrillion Btu in 2016 to around 33.6 quadrillion Btu by 2050—around 2.6 per cent per annum a year. Japanese and South Korean coal use is projected to remain around current levels (approximately 7.5 quadrillion Btu), while coal demand in other Asian countries is projected to increase from around 7.5 quadrillion Btu in 2015 to around 13.6 quadrillion Btu by 2040.

Overall, EIA projects that decreasing coal consumption in China, the United States and other OECD countries, will be offset by increasing consumption in India and, to a smaller extent, Africa, the Middle East and other non-OECD Asian countries. (Coal consumption in OECD countries is projected to decline by around 0.6 per cent a year over this period, replaced by natural gas and renewables.)

With regard to China, EIA (2017) projects that both electricity and non-electricity use of coal will decline between 2023 and 2040:

- Non-electricity industrial use is projected to decline from around 46 quadrillion Btu to 34 quadrillion Btu, due to decreasing use of industrial steam applications and metallurgical coal in steel manufacturing.[19]
- EIA (2017) expects China's self-sufficiency policy priority will see China continue to import only around 3 per cent of its coal for consumption through to 2040.

Indian coal demand project to increase 90 per cent between 2015 and 2040, due to new coal-fired electricity generating capacity. India is projected to increase its coal production by 0.6 billion tons by 2040. Also, coal use in industrial applications is projected to grow 90 per cent between 2015 and 2040. Notwithstanding the increase in coal use, its share of Indian energy consumption is projected to decrease from 49 per cent in 2040 to 43 per cent by 2040.

19 Implying EIA are projecting declining Chinese steel production.

Coal consumption across the rest of non-OECD Asia is projected to increase by 2.4 per cent a year between 2015 and 2040.

Based on the foregoing, EIA projects that Australia will remain one of the largest coal-producing countries and that Australia and Indonesia will remain the largest coal exporters, with total global trade in coal projected to grow at an average of 1 per cent a year.

EIA projects metallurgical coal trade will continue to increase gradually over time as industry consumption shifts to India, and other countries, and that Australia will continue to be the world's largest coal exporter to 2040, accounting for 37 per cent of coal exports in 2040.

Based on these assumptions, the EIA projections imply Australian coal exports will increase by around 1.4 per cent per annum to around 560 million tonnes by 2040.

Australian coal rail freight projections

BITRE's long-term coal export scenarios begin with the OCE's five-year outlook and then appends long-term assumptions about future world coal consumption and Australian exports. Based on the OCE projections, Australian coal rail freight volumes are projected to increase by around 8.5 per cent between 2018 and 2024.[20]

Beyond 2024, the projections include multiple forecast scenarios, based on the IEA (IEA 2014) and U.S. EIA (EIA 2017) outlooks. Under the IEA's New Policies Scenario, Australian coal exports are projected to increase to around 545 million tonnes by 2040 (40 per cent above 2018 coal export volumes). Under the IEA's Continuing Policies Scenario, Australian coal exports are projected to grow to around 610 million tonnes (58 per cent above 2018 coal export volumes). Lastly, under the IEA's 450 Scenario, Australian coal exports are projected fall below current levels, to around 370 million tonnes in 2040 (4 per cent below 2018 coal exports). Finally, EIA's projections imply that Australian coal exports will increase to around 560 million tonnes by 2040. Figure 3.11 illustrates the Australian coal export forecast scenarios.

Under these scenarios, total domestic coal rail freight would increase from around 93 billion tonne kilometres in 2018, to around 131.0 billion tonne kilometres in 2040 under the IEA's New Policies Scenario, 146.2 billion tonne kilometres under the Continuing Policies Scenario and around 125.7 billion tonne kilometres under the EIA's reference case. Only under the IEA's 450 Scenario would Australia bulk coal rail freight volumes decline, to around 89.2 billion tonne kilometres in 2040 (see Figure 3.12). For the overall rail freight forecasts, the IEA reference case is used as the reference scenario for future coal rail freight volumes.

Interstate non-bulk rail freight forecasts

Australian interstate non-bulk rail freight comprises rail freight between Australian capital cities and some interstate freight to and from regional intermodal hubs—e.g. Albury–Wodonga, Parkes, etc. Domestic interstate non-bulk rail freight has increased from around 4.7 billion tonne kilometres in 1971–72 to around 26.6 billion tonne kilometres in 2015–16, average annual growth of 4.0 per cent per annum over that period. Figure 3.13 shows the growth in interstate rail freight since 1971–72.

Rail freight volumes between east coast capitals—Sydney, Melbourne, Brisbane and Adelaide—and Perth (*East–West* rail freight), which predominantly consists of intermediate and final consumption goods destined for Perth and regional Western Australia, increased from around 3.0 billion tonne kilometres in 1971–72 to around 18.1 billion tonne kilometres (see Figure 3.13)—average annual growth of 4.2 per cent per annum. Growth in East–West rail freight is driven principally by population

20 Medium-term projections are also reasonably informed by completed, committed and planned coal export infrastructure.

Figure 3.11 Australian coal export forecast scenarios, 2018–2040

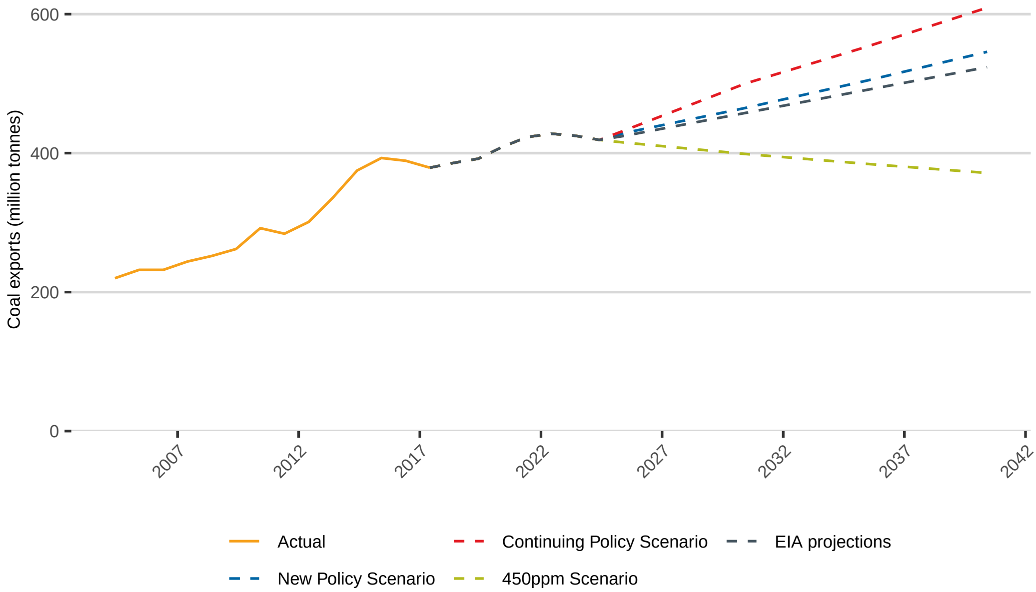


Figure 3.12 Australian coal rail freight forecast scenarios, 2018–2040

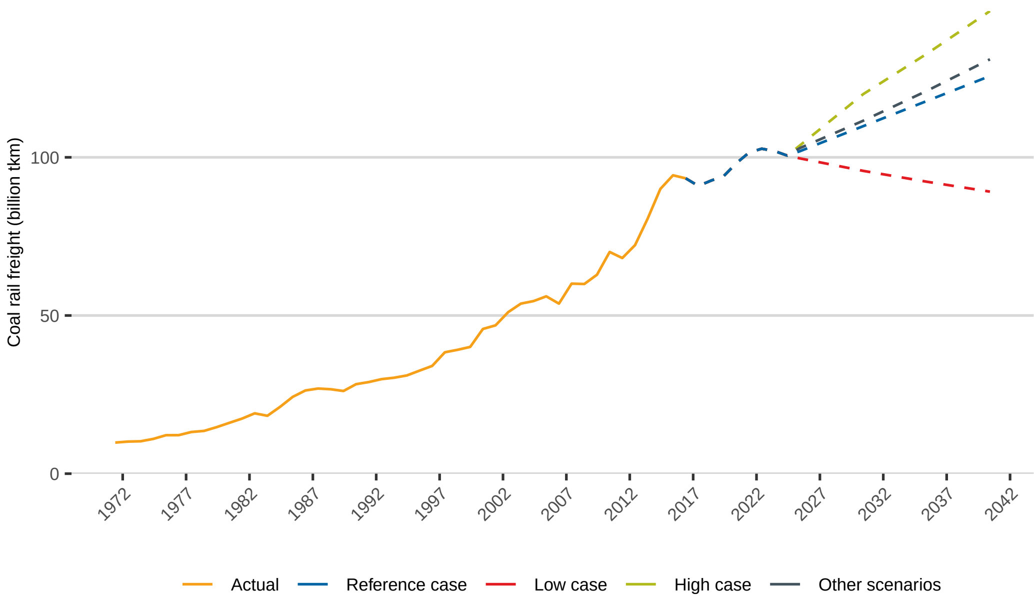
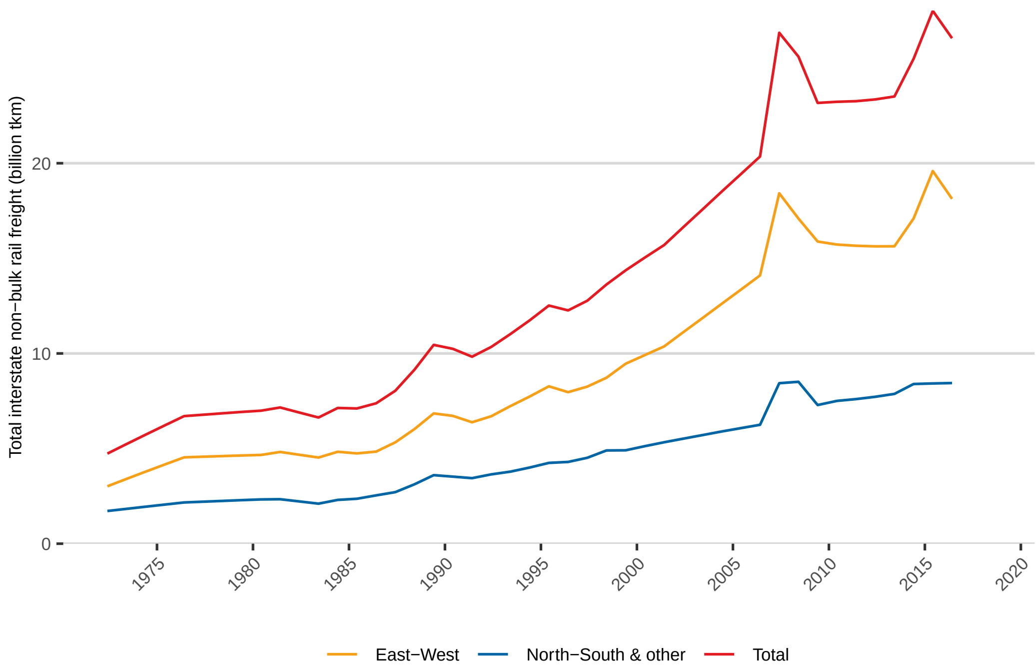


Figure 3.13 Interstate non-bulk rail freight, 1971–2016



growth and economic activity in Western Australia. Some of the growth in East–West rail freight over that period is due to cessation of Australian flagged domestic shipping services between eastern Australia and Perth. While there is some non-bulk shipping between eastern Australia and Perth provided international liner shipping under coastal trading licenses (previously single and/or continuing voyage permits.) Rail carries the majority of East–West origin–destination freight.

East-coast (*North–South & other*) non-bulk rail freight volumes have increased from around 1.7 billion tonne kilometres in 1971–72 to around 8.4 billion tonne kilometres in 2015–16— average annual growth of around 3.7 per cent per annum (see Figure 3.13). North–South & other rail freight faces greater competition from road freight services, which can provide direct door-to-door delivery, shorter delivery times, and do not face the additional pick-up and delivery costs associated with rail services. As a consequence, rail accounts for less than 30 per cent of North–South non-bulk freight, with road accounting for the majority.

Forecasting interstate non-bulk freight

BITRE's aggregate domestic interstate non-bulk rail freight forecasting model splits interstate non-bulk rail freight into two separate components:

i) East-West non-bulk rail freight—comprising rail freight between New South Wales, Victoria and South Australia to/from South Australia and Western Australia.

ii) North-South and other interstate non-bulk rail freight—i.e. NSW–Vic–Qld and other non-bulk rail freight.[21]

21 For the purposes of modelling, East–West interstate non-bulk rail freight volumes are assumed to comprise all interstate non-bulk rail freight from South Australia (SA) and Western Australia (WA), and fifty-five (55) per cent of all interstate non-bulk rail freight from New South Wales (NSW) and Victoria. North–South and other interstate non-bulk rail freight are assumed to comprise the remainder of total interstate non-bulk rail freight.

and models and forecasts each component separately.

Based on recent BITRE interstate non-bulk freight statistics, East–West rail freight comprises around two-thirds of total interstate non-bulk rail freight and North–South & other rail freight comprises between 15-20 per cent of total interstate non-bulk rail freight (BITRE 2018, and earlier issues).

East–West non-bulk rail freight forecasts are based on the modelled relationship with Western Australian economic output (GSP) and rail freight rates. (Appendix B.2 provides the empirical forecasting model results.) Western Australian GSP is projected to increase by around 2.3 per cent per annum between 2016 and 2040, while rail freight costs are projected to vary principally with changes in fuel costs. Again, the forecasts cover a range of alternative scenario assumptions. Under the medium case, East–West non-bulk rail freight is projected to increase by 68 per cent over 2016 levels (2.2 per cent per annum), to around 32.5 billion tonne kilometre in 2040. Under the high scenario, East–West non-bulk rail freight volumes would grow 85 per cent (2.6 per cent per annum) to around 36 billion tonne kilometres by 2040, and under the low case East–West non-bulk rail freight volumes would grow by around 60 per cent to around 31 billion tonne kilometres in 2040.

North–South & other non-bulk rail freight is modelled as a function of New South Wales–Victoria–Queensland GSP and rail freight costs. Combined east coast state GSP is assumed to grow by around 2.5 per cent per annum between 2016 and 2040. The implication of this is that total North–South & other non-bulk rail freight is likely to grow by around 2.4 per cent between 2018 and 2040, under the medium case assumptions and absent any other changes.

Impact of Inland Rail

The Australian Government is funding construction of critical missing rail network segments that will join to form a new 1700 kilometre inland rail line between Melbourne and Brisbane, running via regional Victoria, New South Wales and southern Queensland. Early construction works commenced in 2017 and are expected to take 10 years to complete, with the first trains expected to commence operating in the mid-2020s.

The North–South & other non-bulk rail freight forecasts take into account the planned opening of Inland Rail in the mid-2020s, and the impact on rail freight volumes estimated in the Inland Rail Business Case (ARTC 2015). In particular, ARTC (2015) projected that Melbourne–Brisbane intercapital rail freight would increase to around 9.8 billion tonne kilometres by 2039–40 (ARTC 2015, p. 129). Including the impact of Inland Rail, BITRE projects total North–South & other non-bulk rail freight will increase by around 3 per cent per annum between 2016 and 2040, to around 17 billion tonne kilometres by 2039–40.

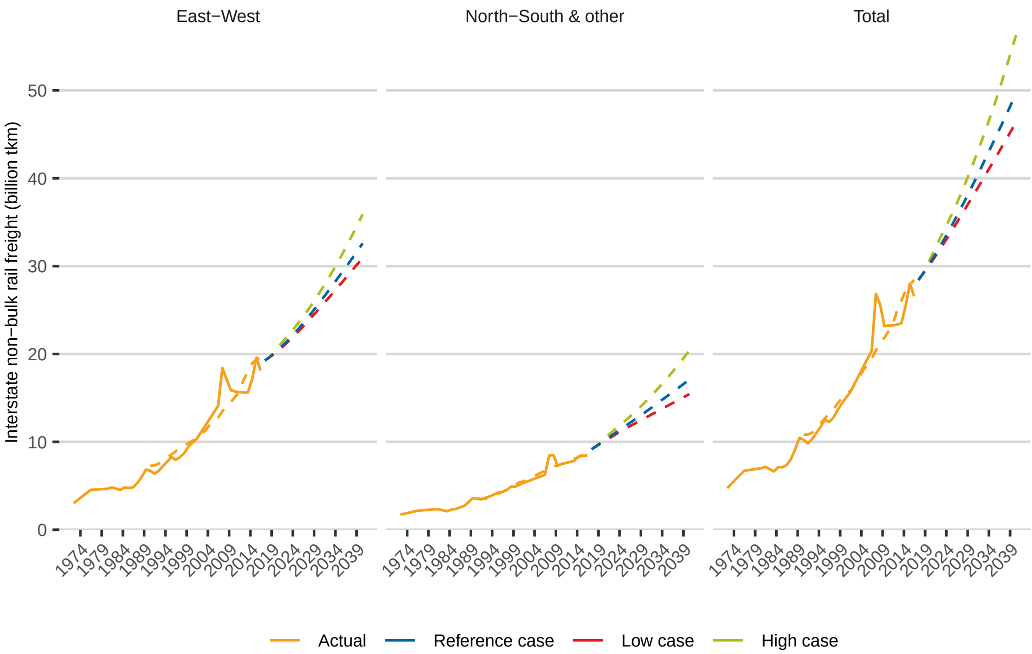
Overall interstate non-bulk rail freight (i.e. East–West and North–South & other rail freight) is projected to increase from around 26.6 billion tonne kilometres in 2016 to around 52 billion tonne kilometres in 2040—average annual growth of around 2.8 per cent per annum over that period. Figure 3.14 shows projected future growth in non-bulk rail freight between 2018 and 2040.

Other bulk and steel rail freight

Other bulk commodities carried by rail include grains, raw sugar cane (via dedicated cane railways in central and north Queensland), other mineral ores such as zinc, copper, mineral sands (either as ore or in concentrate), and bauxite (in Western Australia). Growth in other bulk commodity rail freight volumes is modelled as a single ‘commodity’ within these forecasts, based on historical traffic growth.

Other bulk rail freight has increased from around 11.2 billion tonne kilometres in 1971–72 to around 24.8 billion tonne kilometres in 2015–16 (see Figure 3.15), average annual growth of 1.8 per cent per

Figure 3.14 Forecast interstate non-bulk rail freight volumes, 1971–2040



annum. Most of that growth occurred between 1972 and 2003, with volumes since 2003 varying between 27 and 37 billion tonne kilometres.

Grain export freight forecasts

Annual bulk rail grain freight movements are largely affected by seasonal growing conditions—the larger the grain harvest, the larger the volumes of grain rail freight. Australian grain harvests can fluctuate significantly from year to year, depending on the location, volume and timing of rainfall. Over the long term, trend growth in grain production is affected principally by yields and area planted. Both are heavily influenced by seasonal conditions and world prices. Prices and harvest size in northern hemisphere growing regions can influence the level of planting undertaken in the following Australian growing season. Climate change is anticipated to pose the most significant downside risk to Australian grain production levels. The current projections are derived at the state level based on historical trend planting and yields, and expected export volumes.

Steel rail freight forecasts

Transport of finished steel products from mill to either downstream processing facilities or direct to customers are a major rail freight task. Australian steel consumption is correlated with domestic construction activity, and hence future rail steel freight volumes. Australia has the world's largest reserves and resources of iron ore and coal, the main raw materials used in steel production. While stronger global and country responses to climate change may provide Australia with a competitive advantage in renewable energy generation, and hence industrial production, the baseline projections assume the distance of Australia to potential export markets means that Australian steel production will remain primarily for domestic consumption needs. Hence, steel movements will be movements from steel production facilities, Port Kembla and Whyalla, to capital cities.

Cane sugar rail freight forecasts

Like grains, cane sugar rail freight volumes are also largely a function of domestic production, and dependent on average yields and area planted, with year-to-year production often varying significantly with changes in growing conditions. Long-term production trends are a function of Australian sugar industry competitiveness. In these forecasts, domestic cane sugar production is projected to grow at trend historical growth rates.

Other mineral ores and concentrates

Mineral ore/concentrate traffic is generally tied to world commodity pries and domestic resource availability—the current projections assume production will remain around current levels—i.e. which implicitly assumes either existing mine reserves and resources are sufficient to maintain current production levels over the forecast horizon, or new resources are brought on stream as existing mine outputs diminishes.

Total other bulk and steel rail freight forecasts

Other bulk rail freight has increased from around 11.2 billion tonne kilometres in 1971–72 to around 24.8 billion tonne kilometres in 2015–16 (see Figure 3.15), average annual growth of 1.8 per cent per annum. Most of that growth occurred between 1972 and 2003, with volumes since 2003 varying between 27 and 37 billion tonne kilometres.

Due to the variability in all other rail freight volumes, we again adopt a scenario based approach to the likely future size of this freight task. Under the reference case scenario, total other bulk and steel rail freight is projected to grow from around 24.8 billion tonne kilometres in 2015–16 to around 33.8 billion tonne kilometres in 2040. Under the low case scenario, total other bulk and steel rail freight is projected to grow to around 27.9 billion tonne kilometres by 2040 and the high case scenario allows for total other bulk and steel rail freight of around 37.8 billion tonne kilometres by 2040 (see Figure 3.15).

3.3 Other rail freight opportunities

Apart from commencement of new services via Inland Rail, there are few other obvious opportunities that might significantly increase rail freight volumes. Increasing transport fuel costs would improve rail's cost competitiveness with road transport and may result in some freight modal shift. However, this might also stimulate development of alternative renewable-powered (electricity or hydrogen) trucks and/or application of (semi-) automated road freight vehicle technology, such as vehicle platooning on long-distance routes, which could favour road transport in the longer run.

The forecasts presented here do not anticipate any additional rail freight opportunities.

3.4 Total rail freight forecasts

Combining the separate rail freight component forecasts, presented above, implies that total Australian rail freight volumes are likely to grow only moderately over the next two decades or so to 2040. Figure 3.16 shows the forecast scenarios for total rail freight volumes between 2015–16 and 2039–40.

Under the reference case scenario, the total rail freight task is projected to grow by around 24 per cent between 2016 and 2040, from around 414 billion tonne kilometres to around 516 billion tonne kilometres by 2040. Under the high growth scenario, rail freight volumes are projected to grow 35 per cent (over 2016 volumes) to around 560 billion tonne kilometres by 2040, and under the

Figure 3.15 Forecast all other rail freight volumes, 1971–2040

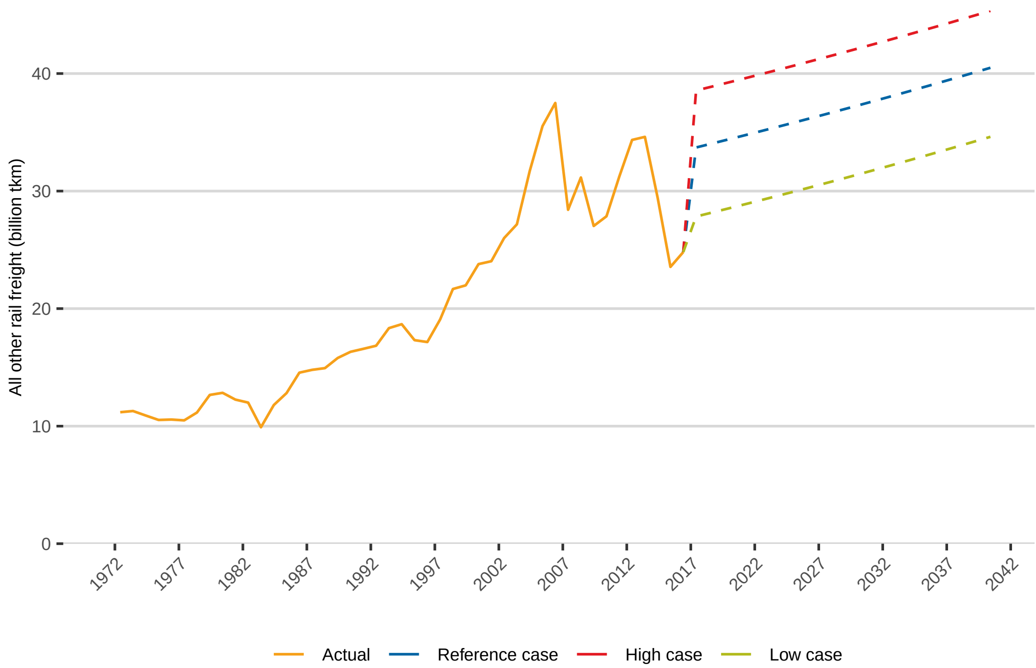
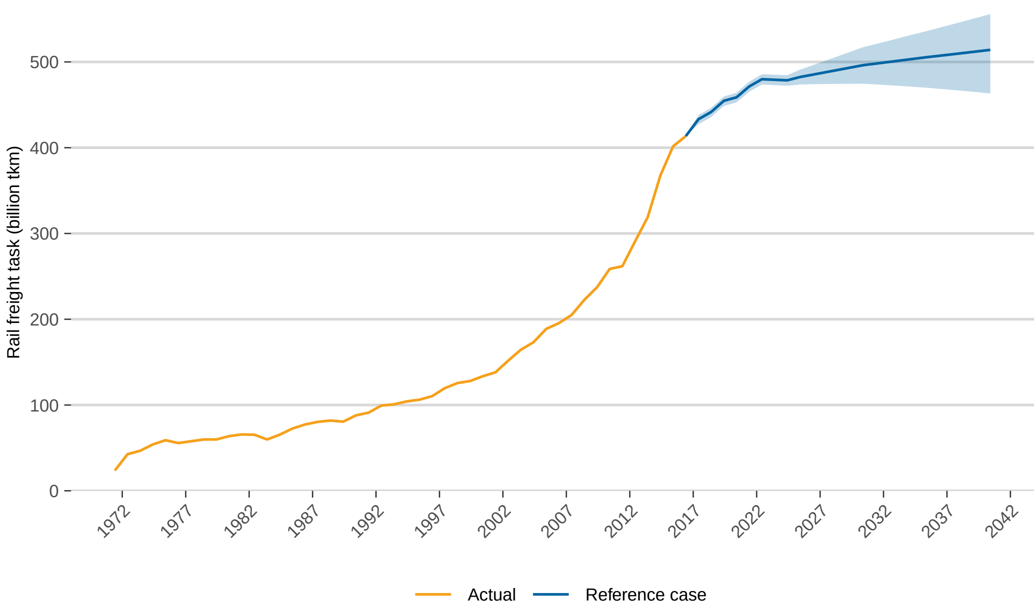


Figure 3.16 Forecast total rail freight movements, 2016–17 to 2039–40



low case scenario, rail freight volumes would grow by around 13 per cent (over 2016 volumes) to around 465 billion tonne kilometres in 2040.

CHAPTER 4
Coastal shipping freight outlook

This chapter outlines the methodology and key assumptions underpinning BITRE's reference-case and alternative scenario forecasts of Australian coastal shipping activity between 2018 and 2040.

4.1 Introduction

Australian coastal shipping, like rail, is integral to the transport of several bulk commodities, from place of primary production (or extraction) to locations for further processing. Key domestic industry supply chains that rely on coastal shipping include the domestic aluminium, steel and petroleum industries. Coastal shipping is also the main freight transport mode between Tasmania and the mainland and also carries small volumes of freight between Australian capital cities.

4.2 Historical trends in coastal shipping

Total coastal freight volumes have grown only modestly over the past five decades, increasing from around 72 billion tonne kilometres in 1970–71 to around 110 billion tonne kilometres in 2015–16—average annual growth of 0.95 per cent per annum over that period. By mass, coastal freight volumes have increased from around 44.6 million tonnes in 1971–72 to around 51.7 million tones in 2015–16 (0.34 per cent per annum).[22]

Figure 4.1 shows total coastal tonne kilometres and tonnes uplifted between 1995–96 and 2015–16, and highlights the significant year-to-year variability in coastal freight movements. In particular, coastal freight volumes increased significantly between 2004–05 and 2007–08, to around 59 million tonnes (128 billion tkm) in 2006–07 due, in large part, to increases in Bass Strait and other dry bulk traffics. Since then, coastal freight volumes have fallen again (by around 10 per cent), back to around pre-2001–02 levels. Since 2007–08, total coastal freight loaded has fallen at an average annual rate of 2.6 per cent per annum and currently coastal freight tonnages are lower than at the start of the century.

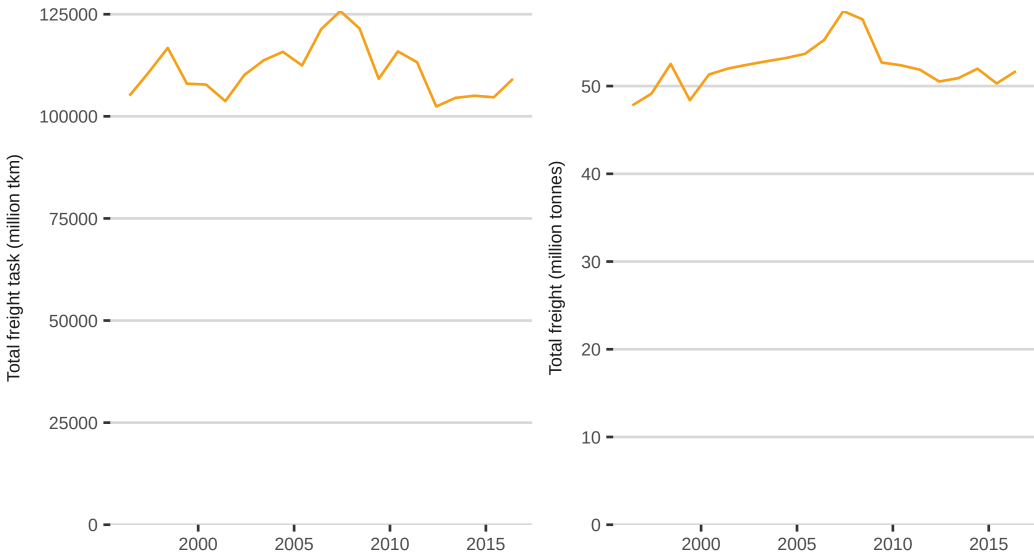
4.3 Coastal freight forecasts

Reflecting the disparate nature of Australian coastal shipping, BITRE's aggregate domestic sea freight forecasting model splits sea freight into the following nine broad commodity/freight market segments:

- Bauxite (and alumina)

22 All coastal freight tonnage estimates presented here are based on the port of loading, unless otherwise specified.

Figure 4.1 Total coastal freight loaded, 1995–96 to 2015–16



- Other dry bulk
- Iron ore
- Crude oil
- Petroleum products
- Other bulk liquids
- Intercapital containers
- Bass Strait non-bulk freight
- All other coastal freight

Each commodity/market segment is modelled and forecast separately, and the separate forecasts combined into an overall aggregate forecast. All other freight includes all freight not otherwise captured in one of the other eight specific commodity/market segments.

Figures 4.2 and 4.3 show historical coastal freight volumes (in tonnes and tonne kilometres) separately for each of the nine board market segments, and highlight that the significant year-to-year volatility also extends to most of the major coastal freight commodity tasks.

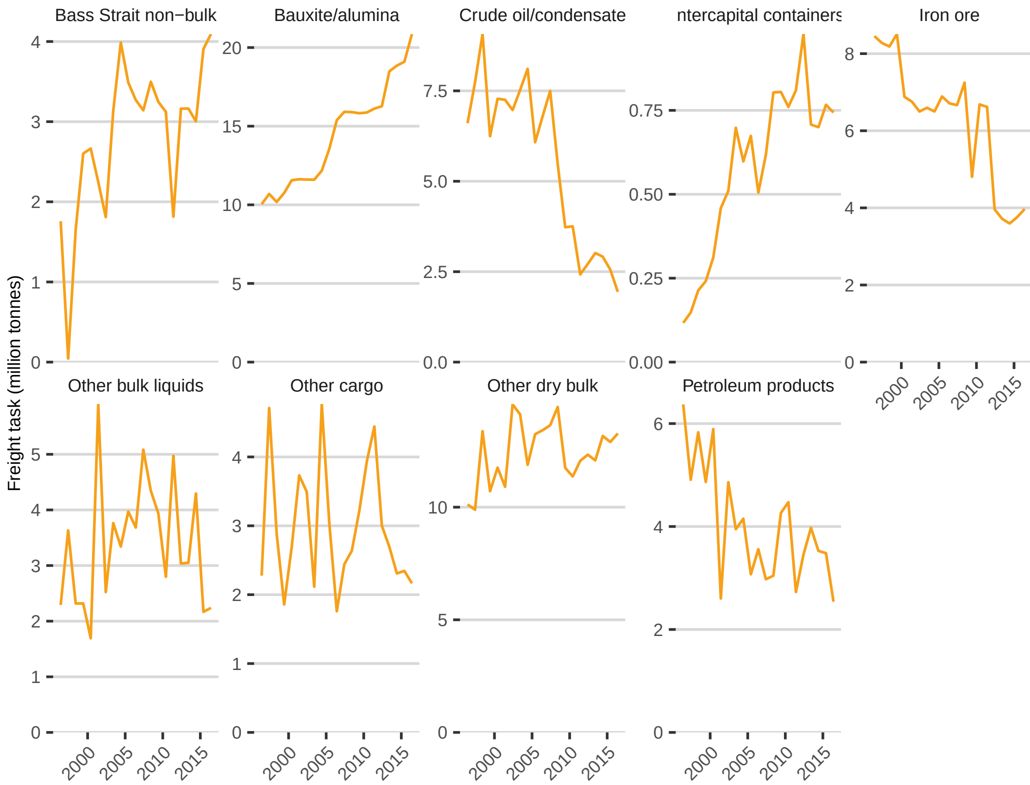
Figure 4.4 shows the relative share of coastal freight (measured in tonne kilometres) by commodity market segment between 1995–96 and 2015–16. Bauxite and alumina accounts for the largest share, around 42.8 per cent, followed by other dry bulk cargoes (i.e. coal, gypsum, cement, etc., 19.4 per cent) and iron ore (18.8 per cent).

Bauxite/alumina coastal freight outlook

Australia has among the world's largest resources and reserves of economically recoverable bauxite—the principal ore used in the production of primary aluminium. In 2015–16, Australia produced around 81.8 million tonnes of bauxite, 20.5 million tonnes of alumina and 1.6 million tonnes of aluminium. In the same year, world aluminium industry production totalled approximately 286 million tonnes of bauxite, 108.7 million tonnes of alumina and 57.4 million tonnes of aluminium.

World primary aluminium production has increased from around 15.1 million tonnes in 1981 to

Figure 4.2 Total coastal freight tonnes, by major commodity group, 1995–96 to 2015–16



around 64.3 million tonnes in 2018. Much of the increase in global primary aluminium production is due to China, which has increased production from around 2.6 million tonnes in 1999 to around 36.5 million tonnes in 2018.

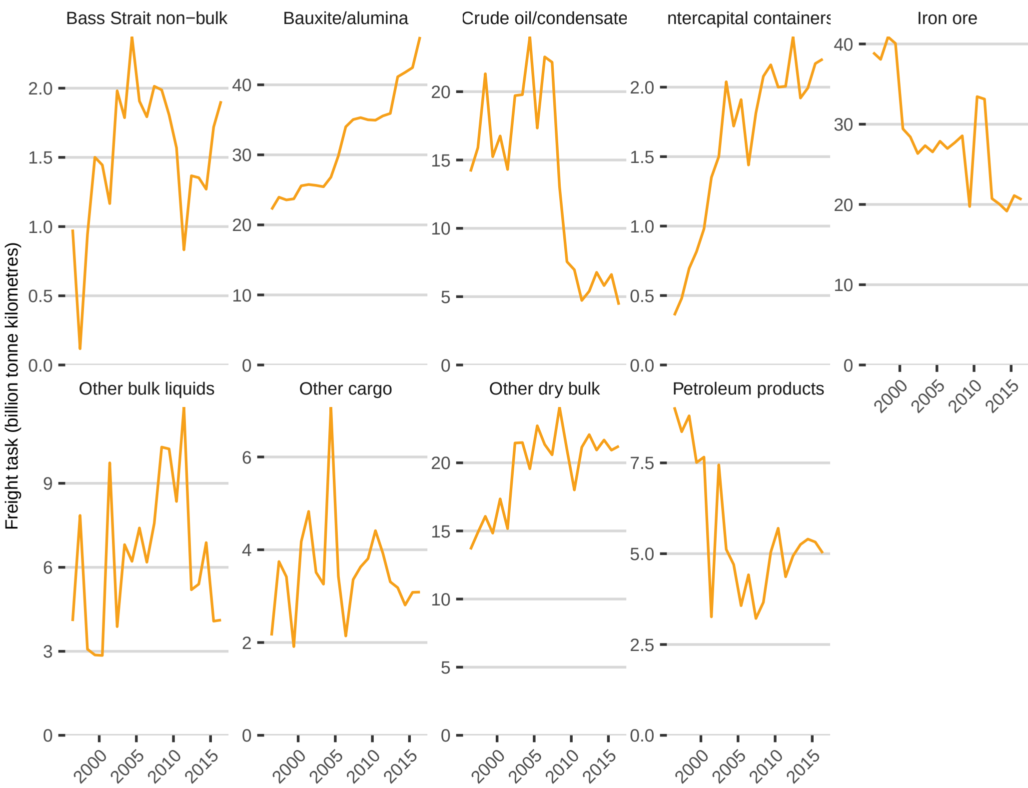
Bauxite is mined at several sites around Australia, and subsequently refined and concentrated into alumina and aluminium, respectively. The most significant coastal shipping movement of bauxite in Australia is between Weipa, on the Cape York Peninsula, and Gladstone, in central Queensland, where it is refined into alumina. Some of this alumina, in turn, is used to produce aluminium domestically, but the majority is exported overseas, with a significant proportion going to China. There are also significant coastal shipments of alumina from Western Australia to Victoria and Queensland to New South Wales and Tasmania.[23]

The bauxite/alumina freight task is by far the largest single-commodity coastal shipping task in Australia. Between 2006–07 and 2011–12, coastal shipments of bauxite and alumina were approximately 13 million tonnes per year. Shipments increased in 2012–13 to 16.3 million tonnes, associated with expanded production capacity at the Yarwun alumina refinery (Gladstone). In 2015–16, bauxite and alumina coastal freight totalled 20.8 million tonnes.

The economics of the aluminium industry favours processing of bauxite (into alumina) relatively close to the place bauxite extraction, due to the cost of transport, while processing of alumina into aluminium is more influenced by the availability of relatively cheap and abundant energy (electricity)

23 The principal seaborne movements of alumina are between Gladstone and Newcastle, Gladstone–Bell Bay and Bunbury/Fremantle–Portland.

Figure 4.3 Total coastal freight tonne kilometres, by major commodity group, 1995–96 to 2015–16



supplies. Though small volumes of Australian bauxite is currently exported directly, with large reserves of cost competitive bauxite, the economics would appear to favour the continuing onshore refining of bauxite for subsequent export.

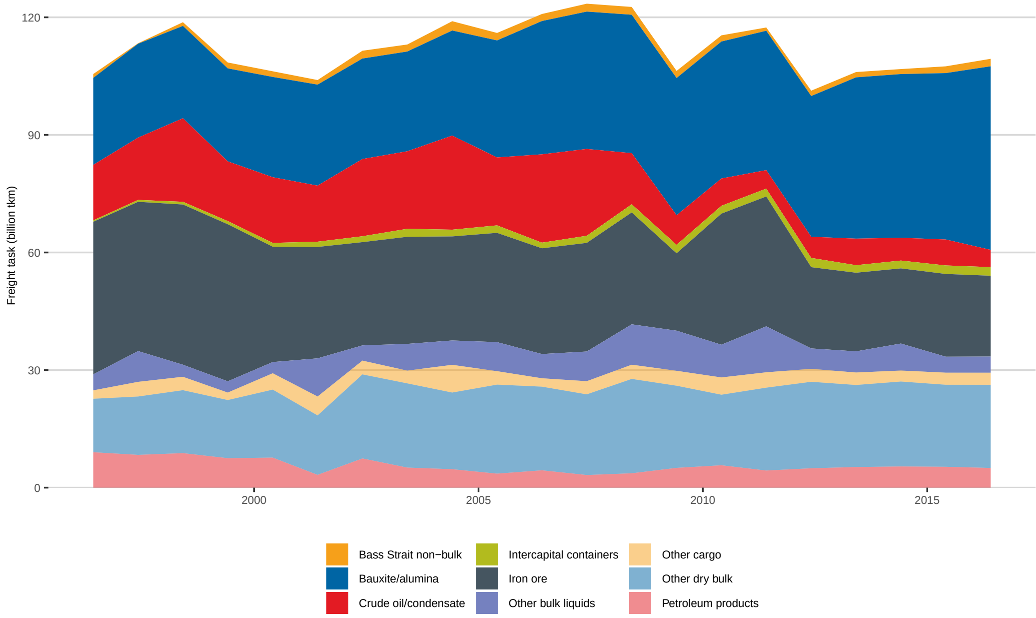
Like other major bulk commodities, the forecasting method adopts a scenario-based approach, to capture the range of potential future coastal shipping outlooks for bauxite and alumina. Like the iron ore and coal rail industry outlooks (presented in Chapter 3), the aluminium industry outlook begins with the OCE (2019) short-to-medium term outlook (to 2024).

Essentially, OCE (2019) projects no increase in domestic alumina production over the next 4–5 years, noting that 'there are no planned expansions of major disruptions expected at existing operations … suggesting little change in alumina/aluminium production in the short-to-medium term' (OCE 2019, p. 97).

OCE projects total bauxite production will grow from around 95 million tonnes in 2017–18 to around 122 million tonnes by 2021–22—driven by the additional of new capacity at Metro Mining's Bauxite Hill and Rio Tinto's Amrun project. OCE (2019) implicitly expects all of this extra production to be directly exported. The implications of this for domestic coastal shipping are negligible—envisaging continuation of the current level of bauxite movements from Weipa to Gladstone and existing alumina shipping movements between alumina refineries and aluminium smelters.

Beyond 2023–24, the size of the Australian bauxite coastal shipping task will depend principally

Figure 4.4 Share of total coastal freight tonne kilometres, by major commodity group, 1995–96 to 2015–16



on future domestic bauxite mining output, and the size of the domestic alumina, and aluminium, production industry. The main factors affecting the global aluminium industry are: increasing costs (especially energy), low prices, high global inventories, the increasing influence of financial markets and high Chinese production. Australian producers have, for the past four years, also had to contend with a very strong Australian dollar, but the value of the dollar has fallen recently making Australian exports more cost competitive.

Three scenarios are considered beyond 2023–24:

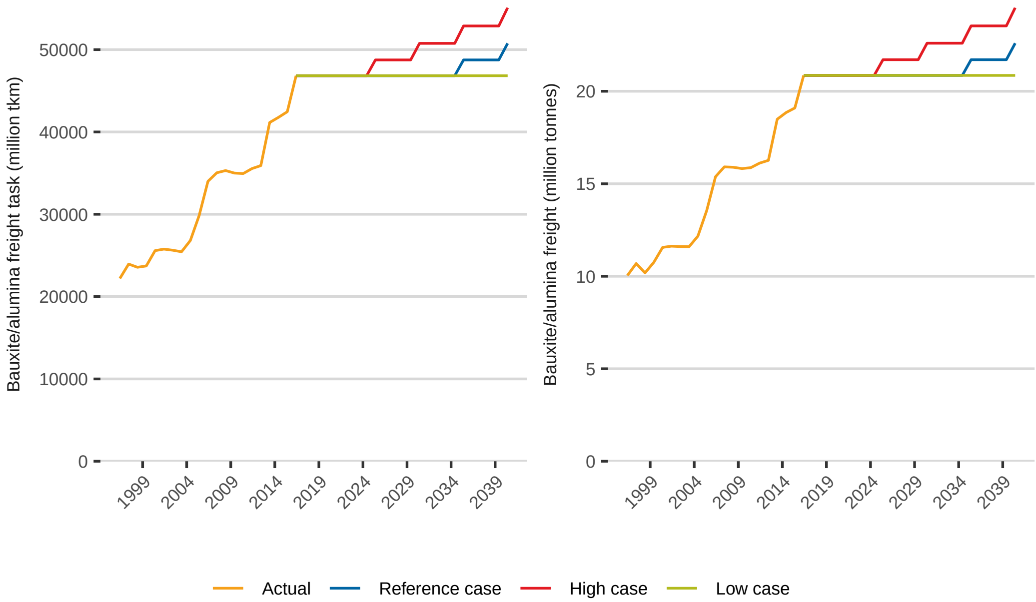
i) domestic alumina/aluminium production *growth* scenario
ii) domestic alumina/aluminium production *high growth* scenario
iii) domestic alumina/aluminium production *decline* scenario.

Domestic alumina/aluminium production growth scenario

The potential growth scenarios assume that Australia retains it's competitive advantage in the production of alumina and aluminium over the long term, leading to further long-term investment in refining and smelting production capacity, and hence greater coastal bauxite movements.[24] In Australia's favour, it has one of the largest reserves of bauxite in the world, and hence it is likely to continue to remain a major source of refined alumina, if not raw bauxite, for the foreseeable future. Also in Australia's favour, it has a significant advantages in renewable energy generation, particularly in central and north Queensland, where such facilities would likely to be located. Under the *growth* scenario, BITRE assumes incremental 5 per cent increases in alumina production at Gladstone, with equivalent increases in coastal bauxite movements, from Weipa to Gladstone in

24 Such a scenario is highly uncertain—attraction of aluminium industry operations, and the jobs associated with that activity, has been a driver of government industry policy in many countries, and so economic fundamentals may not determine the location of such activity.

Figure 4.5 Domestic bauxite/alumina coastal freight outlook scenarios, 1995–96 to 2039–40



2034–45 and 2039–40. Under the *high growth* scenario, BITRE assumes these incremental increases begin in 2029–30, and are followed by additional increases in 2034–35 and 2039–40.

Domestic alumina/aluminium production high growth scenario

The domestic alumina/aluminium production high growth scenario assumptions are much the same as the growth scenario, but would see slightly earlier incremental increases in domestic alumina production commencing in 2024–25 (5 per cent) and incremental 5 per cent increases every subsequent five years.

Domestic alumina/aluminium production decline scenario

The alumina/aluminium production decline scenario envisages reductions in domestic alumina refining and aluminium smelting capacity—closure of a couple of the existing, smaller aluminium refineries (e.g. Portland and Bell Bay) with more direct export of bauxite and alumina. Under this scenario, alumina shipped between Bunbury/Fremantle–Portland and Gladstone–Newcastle and Gladstone–Bell Bay would cease—replaced by direct export of alumina and/or bauxite from Bunbury/Fremantle and Gladstone, but movements of bauxite between Weipa and Gladstone would still continue (also assuming no additional alumina refinery capacity at Gladstone).

Figure 4.5 shows the domestic bauxite/alumina coastal freight outlook scenarios to 2039–40.

Iron ore coastal freight outlook

Nearly all of the coastal iron ore freight in Australia currently goes to Port Kembla for use in BlueScope Steel's Port Kembla steelworks.[25] In October 2011, BlueScope Steel closed one of its then two remaining smelters, due to cost pressures, halving the steelwork's capacity and leading to a near halving of the amount of iron ore shipped to Port Kembla from around 6.5 million tonnes per annum

25 Liberty OneSteel also produces about 1 million tonnes of steel a year at it's Whyalla Steelworks, using iron ore transported by rail from the nearby Middleback Ranges.

to 3.5 million tonnes per annum. Prior to 2011, coastal iron or freight volumes were relatively stable. All of BlueScope Steel's remaining steel production is used to supply the domestic steel market.[26]

Future coastal movements of iron ore are therefore directly tied to continuing domestic steel production. Steel production is highly cost competitive and there is no guarantee that steel production will continue in Australia indefinitely.

While Australia has abundant iron ore reserves, most of it is located remote from population centres. Moreover, Australia's industrial production base is predominantly located in the south east of the country, distant from major world market. Hence, it is difficult to envisage a scenario in which domestic steel production, and coastal shipping of iron ore, increases significantly over the foreseeable future. Additional domestic production would require significant initial investment in domestic steel production capacity. More likely, any shortfall in Australian steel demand would be imported.

Accordingly, BITRE again adopts a scenario-based approach to include the range of future possible outcomes. Two scenarios are considered for Australian coastal movements of iron ore:

i) Business-as-usual (reference case) scenario
ii) Low iron ore production scenario.

The business-as-usual scenario assumes that BlueScope Steel and Liberty OneSteel continue to produce steel for the domestic market and that any significant increase in Australian steel demand is met through imports. Under these assumptions, coastal iron ore movements are projected to remain at around current levels out to 2039–40.

The low-haulage scenario is where one or both of Liberty OneSteel and/or BlueScope Steel's steel production facilities were to close at some point over the forecast horizon. Only in the latter case would the domestic coastal movements of iron ore decline or cease. This is the only other scenario considered for iron ore.

Figure 4.6 shows domestic iron ore coastal freight outlook scenarios to 2039–40.

Other dry bulk coastal freight outlook

Other dry bulk freight includes all freight classified as 'dry bulk' in the Australian Coastal Freight database (BITRE 2017), excluding bauxite and iron ore. Other dry bulk commodities can be divided into separate categories:

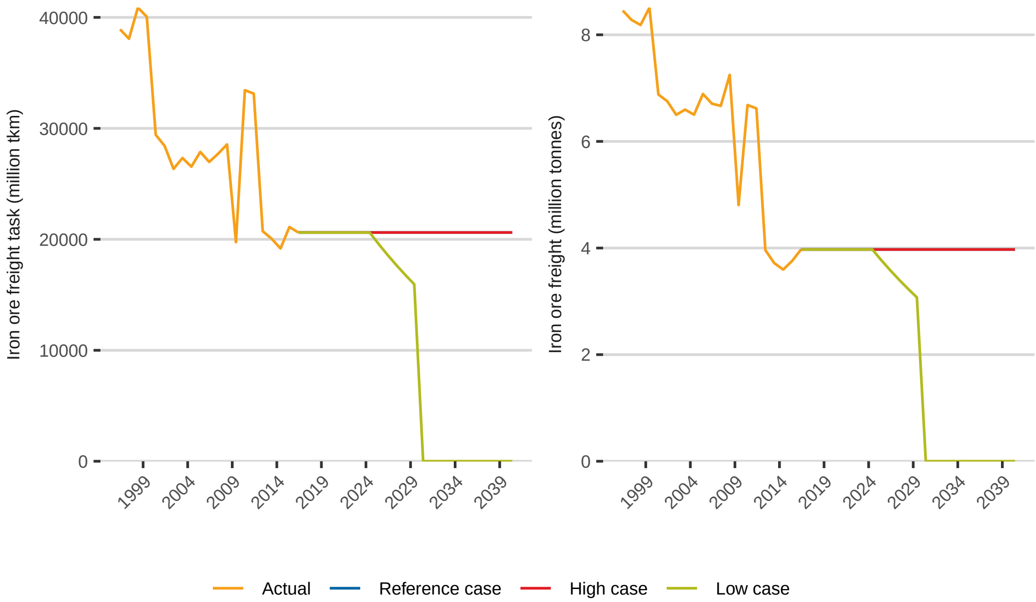
i) products for domestic consumption—e.g. fertiliser, cement/clinker, etc., and
ii) raw or intermediate inputs—e.g. alumina, zinc ores, limestone, etc.

Coastal shipping movements of other dry bulk goods has increased, in trend terms, over the last 20 years from around 13.0 million tonnes in 1995–96 to around 23.0 million tonnes in 2015–16, around significant year-to-year variability. Most of the increase in dry bulk coastal freight appears to have occurred between 1995–96 and 2006–07, with trend volumes relatively unchanged since then, fluctuating around 23 million tonnes over the last decade.[27]

Other dry bulk coastal freight is modelled against trend, and the model results used to project long-term future dry bulk freight volumes. The long term forecasts build off recent observed trend growth. Hence, the long-term forecast for coastal dry bulk freight out to 2039–40 are around trend volumes observed since 2006–07, around 21.5 billion tonne kilometres per year. Given the high

26 Prior to BlueScope Steel's capacity reduction, Port Hedland, Whyalla and Port Latta all supplied iron ore to Port Kembla. However, there is currently conflicting data on whether Whyalla and Port Latta still ship iron ore to Port Kembla.
27 No statistically significant trend could be inferred post 2006–07.

Figure 4.6 Domestic iron ore coastal freight outlook scenarios, 1995–96 to 2039–40



volatility in the data series, in any one year the actual other dry bulk freight task could vary within a wide range. Consistent with the approach adopted for other commodity freight tasks, low and high scenarios are based on the high and low prediction intervals from the trend regression model. Under the high scenario dry bulk coastal freight volumes are projected to grow to around 24 billion tonne kilometres by 2040, and under the low scenario coastal freight volumes are projected to decline to around 19 billion tonne kilometres by 2040.

Figure 4.7 shows domestic dry bulk coastal freight outlook scenarios to 2039–40.

Crude oil and condensate coastal freight outlook

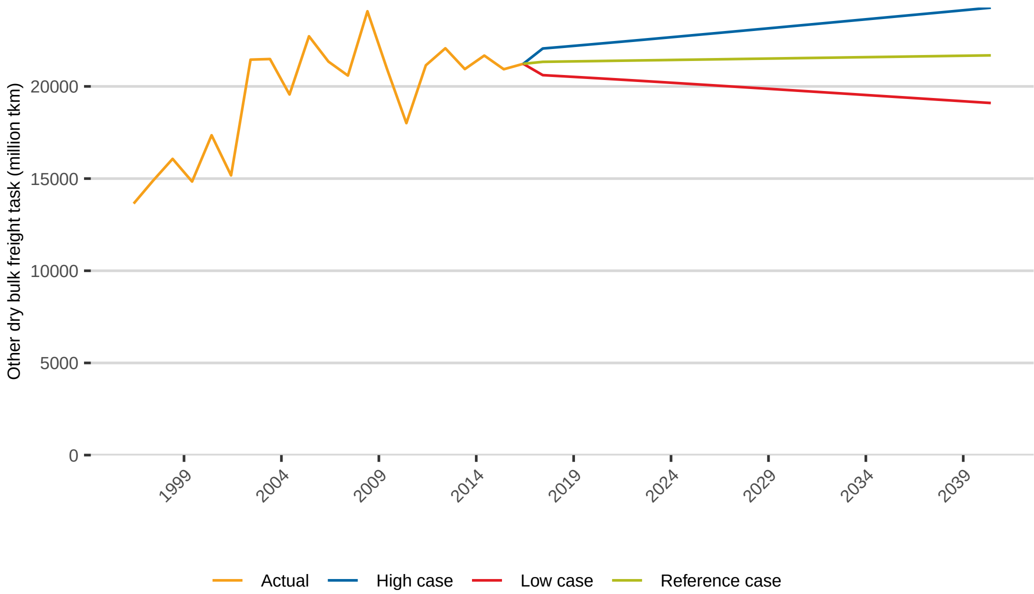
Australian crude oil and condensate production has declined from around 30.3 billion litres in 1995–96 to around 18.4 billion litres in 2015–16, and around 15.5 billion litres in 2017–18. Much of this decline in production has been experienced since 2008–09, and is attributable to declining output from the North West Shelf (Carnarvon Basin) and Bass Strait (Gippsland Basin) oilfields, which have approximately halved since 2010–11. Moreover, proven reserves and resources in these basins has also declined.[28]

Australian coastal shipments of crude oil and condensate have followed domestic production, declining by over 80 per cent between 1995–96 and 2015–16, from around 16 million tonnes in 1995–96 to around 4.0 million tonnes in 2015–16. This decline is much faster than the decline in domestic crude and condensate production—in 2006–07 around 40 per cent of domestic crude and condensate was shipped coastally, but by 2015–16 only 19 per cent of domestic production was shipped around the coast.

Moreover, the majority of Australia's crude oil and condensate production is now exported directly—Australia has only four operating refineries: Altona (Vic.), Geelong (Vic.) Lytton (Qld) and Kwinana

28 GA (2017) notes that Australia has limited identified conventional oil resources but large prospective unconventional resources (i.e. shale oil and oil shales).

Figure 4.7 Domestic other dry bulk coastal freight outlook scenarios, 1995–96 to 2039–40



(WA). Also, OCE (2019, p. 78) notes that the nature of Australia's crude oils, which are predominantly light (low density) and sweet (low sulphur content), and do not suit Australia's domestic refinery needs, which were built to use higher-density crude oil. Additionally, much of Australia's crude oil and condensate production is more proximate to south east Asian refineries, which are well-suited to use Australian petroleum feedstock. Hence, unless there are significant crude oil/condensate discoveries in south and eastern basins (e.g. Bass/Otway, Gippsland, Bowen/Surat), Australian domestic crude oil transport volumes are likely to continue to decline.

GA (2017) note that the 'trend of decreasing oil resources is not expected to change within the exiting basins. Absent new discoveries, Australian oil production is expected to continue to decline. While Australia has potential to find significant unconventional oil resources (GA 2017), there are a range of factors that will challenge the feasibility of developing these resources in Australia. These include:

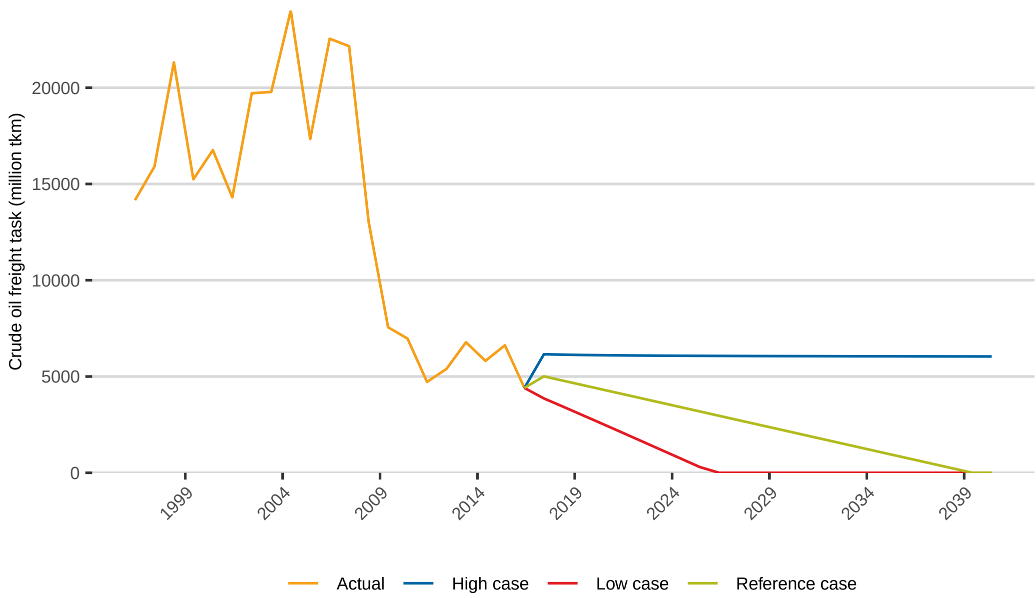
- competition from alternative transport fuels, such as electric vehicle, biofuels, hydrogen and synthetic fuels
- increasing community opposition to carbon-based fuels which could see pressure to reduce reliance on conventional fuels.

Consequently, the scenarios considered here project continuing declines in domestic production and domestic shipping volumes of crude oil and condensate. Again, three scenarios are considered:

i) Reference case - long-term trend decline in domestic movements of crude oil domestic shipping volumes
ii) High scenario case - upper bound of annual crude oil domestic shipping volumes
iii) Low scenario case - lower bound of annual crude oil domestic shipping volumes.

The reference case (medium) scenario assumes coastal shipments of crude and condensate decline by around of around 3 per cent per annum between 2018 and 2040. The high scenario assumes (a bit unrealistically) continuing current levels of production and domestic movements over the

Figure 4.8 Domestic crude oil and condensate coastal freight outlook scenarios, 1995–96 to 2039–40



forecast horizon. The low scenario assumes slightly faster reduction in domestic coastal crude oil and condensate movements than in the reference case and cessation of crude oil and condensate transport beyond 2034–35.

Figure 4.8 shows domestic crude oil and condensate coastal freight outlook scenarios to 2039–40.

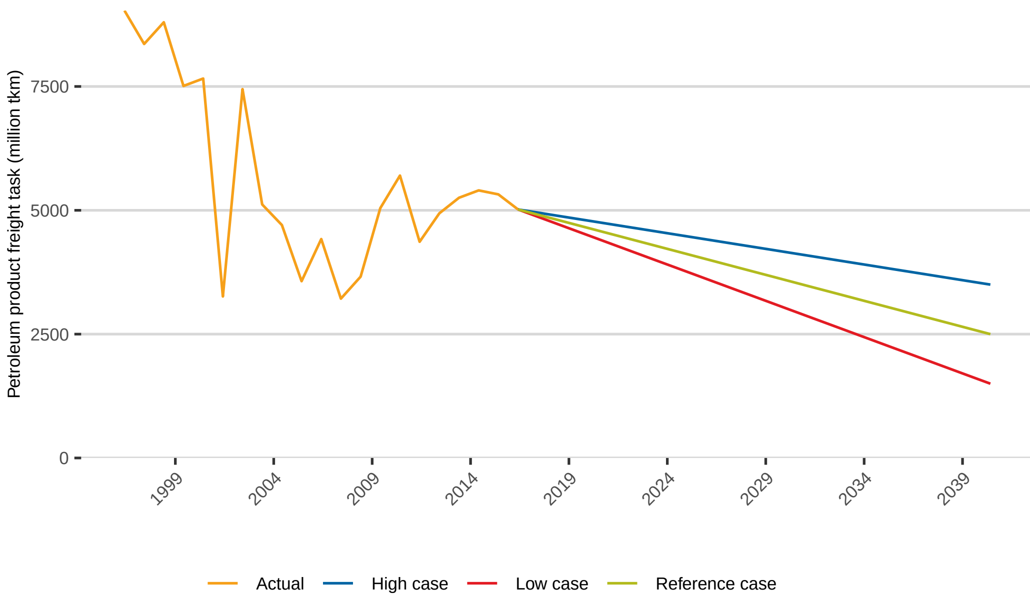
Refined petroleum products coastal freight outlook

Refined petroleum products are used predominantly in transport, mining and energy generation. Coastal shipping of refined petroleum products has historically comprised movements from capital city refineries to regional ports, for subsequent distribution to nearby regional centres and/or significant industry uses (e.g. mines). The historical data for coastal shipping of petroleum products shows that coastal petroleum product movements have been highly variable around an apparent long-term decline in total volumes (see Figure 4.9). Some domestic movements have been replaced by direct import of refined petroleum products from overseas refineries. Industry sources expect that the coastal trade will decline as domestic refineries close (AIP 2014, Bremner 2014).

BITRE's forecast scenarios assumed continuing declines in coastal shipping of refined petroleum products. Under the reference case scenario, petroleum product transport is projected to decline to around 2.0 billion tonne kilometres in 2040 (average annual growth of -2.8 per cent per annum between 2016 and 2040). Under the low case, refined petroleum product coastal movements are projected to decline by around -4.9 per cent per annum to 2040 and under the high case scenario refined petroleum product coastal movements are projected to decline by around -1.5 per cent per annum over the same period.

Figure 4.7 shows domestic petroleum product coastal freight outlook scenarios to 2039–40.

Figure 4.9 Domestic petroleum product coastal freight outlook scenarios, 1995–96 to 2039–40



Other liquid bulk coastal freight outlook

Other liquid bulk freight is defined here to include all bulk liquids except crude oil and refined petroleum products. The single largest component of this trade is sulphuric acid, the annual coastal trade volume of which is between 0.25 and 0.55 million tonnes per annum. Liquefied gases, ammonia and molasses are also significant—ammonia is a key input used in refining bauxite into alumna. Figure 4.10 shows the significant year-to-year variability in liquid bulk coastal movements, which generally fluctuate roughly between 4 and 9 billion tonne kilometres per annum, but with no statistically significant trend. There have been years when liquid bulk coastal freight volumes have been above 9 billion tonne kilometres (2007–08 to 2011–12) and years more recently (since 2012–13) when freight volumes have been less than 4 billion tonne kilometres per annum.

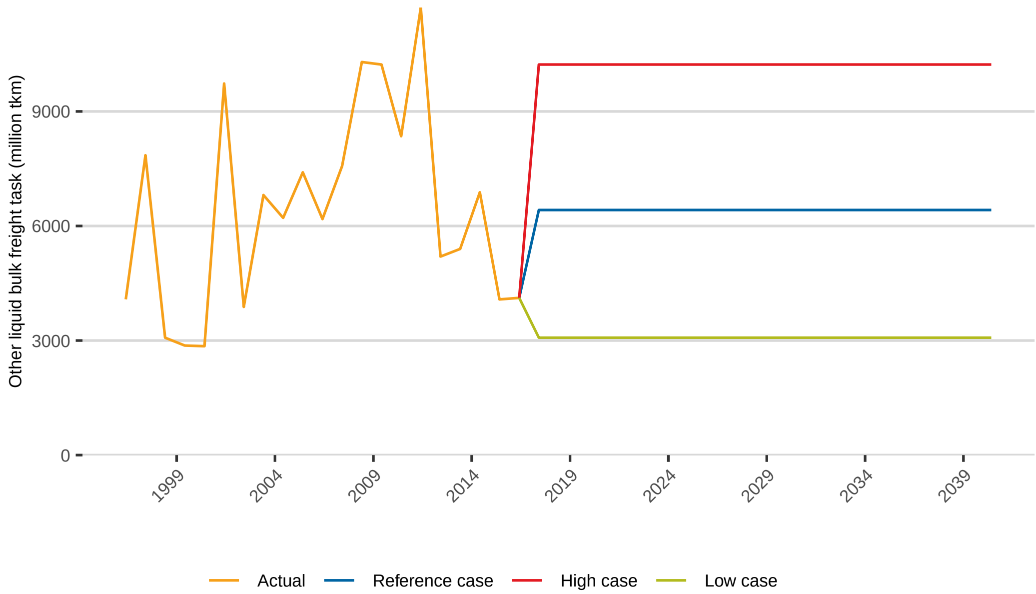
In the absence of any significant trend information, BITRE has assumed that the other liquid bulk coastal freight task will be around the historical average bulk liquid trade volumes—approximately 6.5 billion tonne kilometres per annum. However, the high year-to-year variability means that in any single year coastal other liquid bulk freight volumes could vary significantly around this value. The high and low scenarios cover the potential range of bulk liquid transport volume outcomes. The high scenario assumes bulk liquid coastal freight volumes around 10.2 billion tonne kilometres per annum—the 90th percentile of historical levels. The low scenario assumes bulk liquid coastal freight volumes of around 3 billion tonne kilometres per annum—the 10 percentile of historical volumes.

Figure 4.10 shows domestic other liquid bulk coastal freight outlook scenarios to 2039–40.

Intercapital container coastal freight outlook

Intercapital container coastal freight is defined as all container trade between the five mainland capital city ports—Sydney, Melbourne, Brisbane, Adelaide and Perth (Fremantle Port). Figure 4.11 shows intercapital container freight has grown substantially over the past decade and a half, from around 360 million tonne kilometres in 1995–96 to around 2200 million tonne kilometres in 2015–16 (on a

Figure 4.10 Domestic other liquid bulk coastal freight outlook scenarios, 1995–96 to 2039–40



freight loaded basis), an average annual increase of over 8.6 per cent per annum over that period.[29] Much of this growth in container numbers occurred between 1995–96 and 2003–04, with growth post 2004 around 2.1 per annum.

BITRE's aggregate forecasting method for intercapital container shipping movements is based on historical relationship between trend growth in intercapital containers and economic activity and coastal shipping freight rates. The model implies a structural break around 2003–04, with significantly different rates of growth before and after this time. The projections assume the relationship between intercapital non-bulk shipping and economic activity continues to hold over the forecast horizon. Combined with assumed projected long-term trend GDP growth implies trend growth in intercapital containerised coastal freight of around 0.9 per cent per annum, with total intercapital container freight projected to grow from around 2.2 billion tonne kilometres in 2015 to around 2.7 billion tonne kilometres by 2039–40 under the reference case scenario.

The high and low growth scenarios are based on the high and low economic growth and population growth scenarios. Importantly, the above analysis does not incorporate other potentially significant factors that might influence growth in intercapital coastal shipping volumes, such as significant changes in relative freight costs (especially coastal shipping versus rail), rail freight volumes (to account for modal substitution), and coastal shipping supply conditions (e.g. service levels, total or available capacity, etc.).

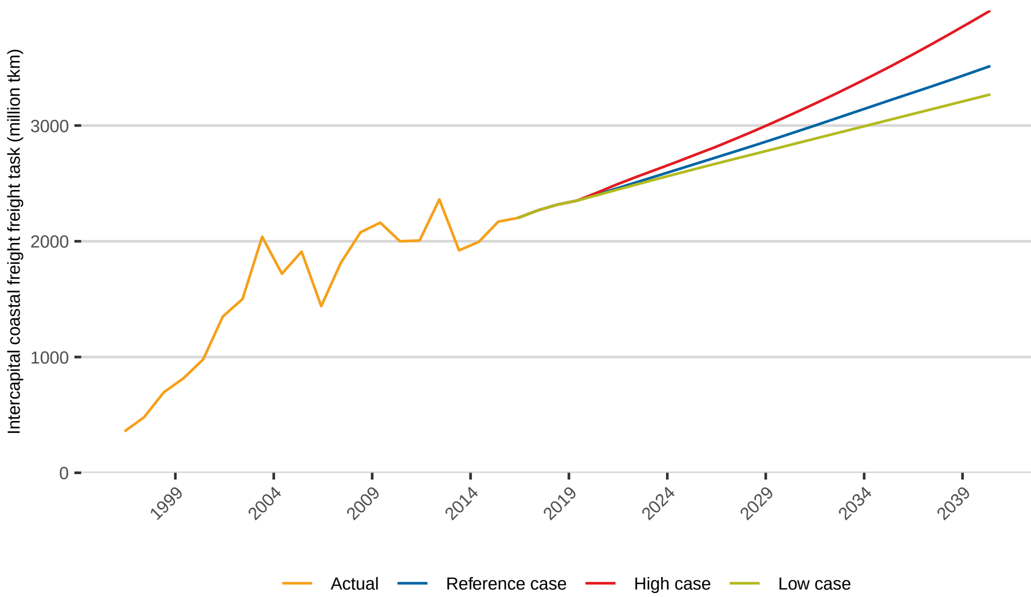
Figure 4.11 shows domestic intercapital container coastal freight outlook scenarios to 2039–40.

Bass Strait non-bulk freight outlook

Bass Strait non-bulk freight is defined here to include all freight not classified as either dry or liquid bulk that is loaded or unloaded at a Tasmanian port, excluding intra-Tasmanian freight. This definition includes not only containers but also transport equipment, break bulk freight, pallets and timber.

29 On a freight discharged basis, the annual average growth rate of intercapital containers is around 7 per cent per annum.

Figure 4.11 Domestic intercapital container coastal freight outlook scenarios, 1995–96 to 2039–40



Modelling total non-bulk Bass Strait freight, as opposed to just containerised Bass Strait freight, avoids data issues arising from potentially inconsistent data classification at port of loading or discharge and also because non-bulk traffics might variously be carried in containers or as break-bulk, depending on container availability, ship availability and/or customer requirements (e.g. if there is no container ship available, freight might be loaded onto pallets and shipped as break bulk).

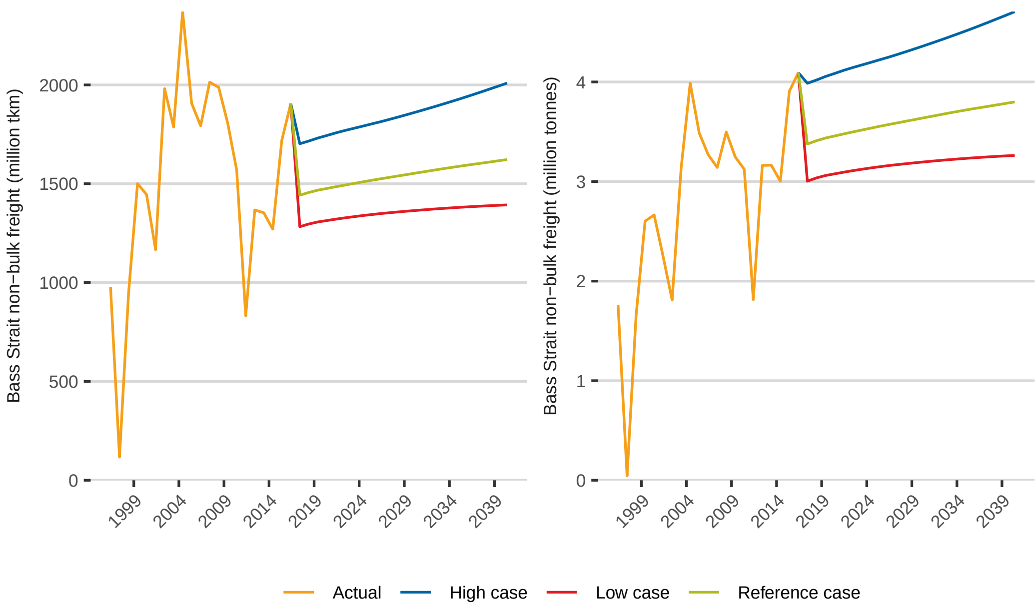
Figure 4.12 shows non-bulk freight loaded and discharged at Tasmanian ports between 1995–96 and 2015–16. Between 1996–96 and 2015–16 non-bulk freight **to** Tasmania grew at an average annual rate of 3.1 per cent per annum, from 1.4 million tonnes to 2.0 million tonnes. Over the same period, non-bulk freight **from** Tasmania grew at an average annual rate of 2.7 per cent per annum from 1.7 million tonnes to 2.4 million tonnes.[30] However, most of the growth occurred in the first half of this period with no discernible trend growth, although significant year-to-year variability, since 2002–03.

Despite the significant variability in total Bass Strait non-bulk freight, BITRE models *trend* growth in Bass Strait freight as a function of Tasmanian GSP, with separate growth parameters pre- and post-2003. BITRE then projects future Bass Strait non-bulk coastal freight trend volumes based on long-term forecasts of Tasmanian GSP. Tasmanian GSP, in turn, is the product of assumed growth in per capita Tasmanian GSP and ABS projections of Tasmanian population growth. The reference case scenario assumes per capita GSP grows in line with reference case growth rates for per capita GDP and ABS Series B Tasmanian population projections (ABS 2018c), implying average annual growth in Tasmanian GSP of 1.59 per cent per annum between 2015–16 and 2039–40. Under the high scenario, Tasmanian GSP is projected to grow by 2.4 per cent per annum and under the low scenario, Tasmanian GSP is projected to grow by 1.0 per cent per annum over the same period.

Assuming the relationships between Bass Strait non-bulk freight and Tasmanian GSP continue to hold

30 There are some issues with the accuracy of Tasmanian-sourced data in the early 2000s. In order to minimise these, discharge port records were used for estimates of freight loaded in Tasmania and the loading port records used for estimates of freight discharged in Tasmania.

Figure 4.12 Bass Strait non-bulk coastal freight outlook scenarios, 1995–96 to 2039–40



over the forecast horizon, the Tasmanian GSP forecasts imply trend[31] levels of Bass Strait non-bulk freight increasing from around 1.450 billion tonne kilometres in 2017 to around 1.62 billion tonnes kilometres in 2040 under the reference case—average annual growth of 0.5 per cent per annum over that period. The low and high growth scenarios also incorporate the observed range of variability in Bass Strait freight volumes. The low scenario, for example, projects growth in Bass Strait freight of around 0.35 per cent per annum, but is adjusted downwards to account for Bass Strait freight being around the lower end of the range observed since 2002–03, i.e. around 1.4 billion tonne kilometres. The high scenario implies growth in Bass Strait freight of around 0.7 per cent per annum between 2017 and 2040, adjusted upwards to account for Bass Strait freight being around the upper end of the range observed since 2002–03, i.e. around 2.0 billion tonne kilometres by 2040.

Importantly, the analysis does not incorporate other potentially significant factors to the Bass Strait sea freight task such as changes in relative freight costs, periodic amendments to Commonwealth assistance arrangements (e.g. Tasmanian Freight Equalisation Scheme), and coastal and international shipping capacity servicing Tasmania.

Figure 4.12 shows Bass Strait non-bulk coastal freight outlook scenarios to 2039–40.

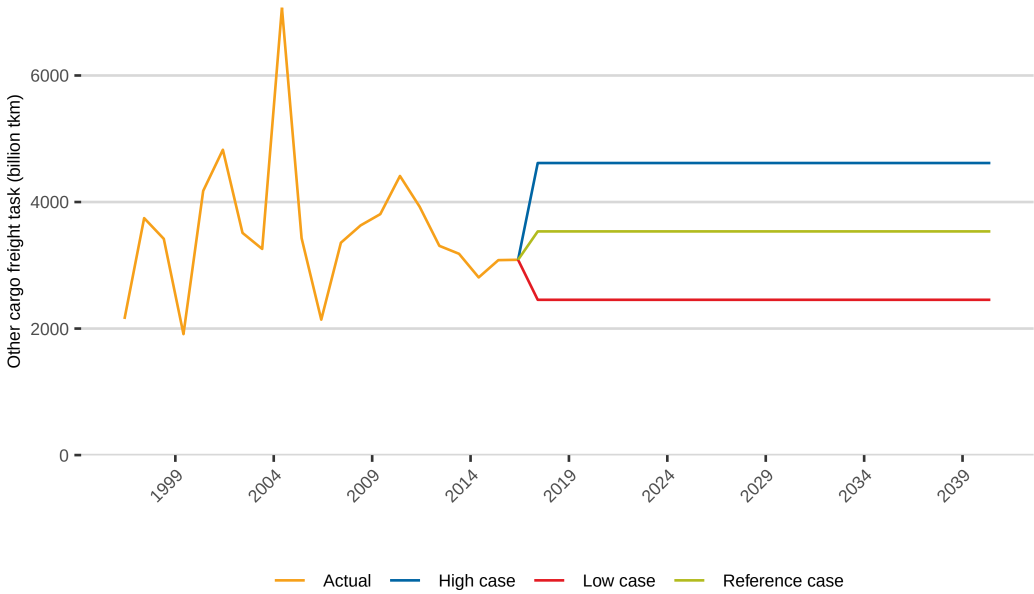
All other coastal freight outlook

All other coastal freight includes all other freight not specified elsewhere and comprises around 2.8 per cent of total coastal freight in 2015–16. Historical data shows significant year-to-year variability but no significant trend growth in all other coastal freight.

In view of there being no apparent trend growth in all other coastal freight, future coastal freight is simply extrapolated from historical other cargo volumes, with the high and low case scenarios

31 Trend growth is used here because of the volatility in the freight volumes. The trend non-bulk freight to Tasmania in 2012–13 was 2.1 million tonnes compared to an actual value of 2.0 million tonnes.

Figure 4.13 Domestic all other coastal freight outlook scenarios, 1995–96 to 2039–40



assumed equal to the upper and lower bound of historical other cargo volumes, 2.5 and 4.6 billion tonne kilometres, respectively.

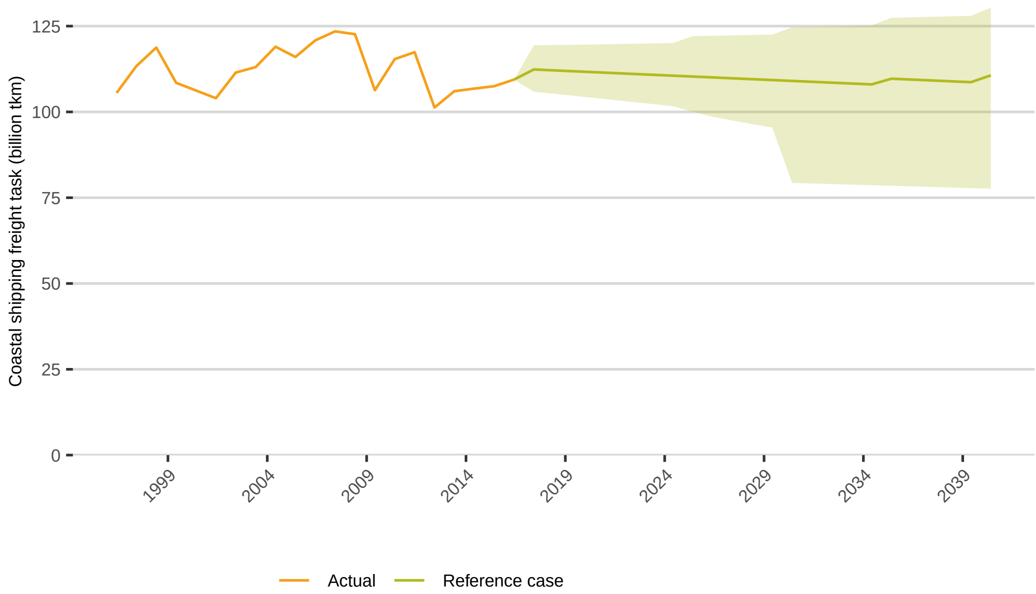
Figure 4.13 shows all other coastal freight outlook scenarios to 2039–40.

4.4 Total coastal shipping outlook

Total coastal shipping freight is based on combining the forecasts across the nine modelled commodity groups. The total coastal shipping freight under the reference case scenario implies total coastal shipping volumes increase from around 109 to around 111 billion tonne kilometres by 2040. The low case scenario would see total coastal shipping volumes declining to around 78 billion tonne kilometres by 2040—assumptions about bauxite/alumina production dominate this result. The high case scenario implies coastal shipping freight increasing to around 130 billion tonne kilometres by 2040—average annual growth of around 0.7 per cent per annum. Again, this scenario result is also predominated by the high growth bauxite/alumina scenario assumptions.

Figure 4.14 shows forecast of total coastal freight between 2016–17 to 2039–40.

Figure 4.14 Forecast total coastal freight movements, 2016–17 to 2039–40



CHAPTER 5
Domestic air freight outlook

This chapter presents BITRE's forecasting methodology and long-term forecasts of aggregate domestic air freight and air mail activity in Australia.

5.1 Introduction

Domestic air freight is carried in the cargo holds of passenger aircraft and by a small fleet of dedicated freight aircraft. Air freight is predominated by high-value, low-density freight, such as mail, small parcels and high value perishables, however, publicly available data provide little information available about the mix of commodities carried by domestic aviation.

5.2 Historical air freight volumes

Domestic air freight volumes are a fraction of freight volumes by the other major transport modes—in 2017–18, domestic air freight volumes totalled 230 thousand tonnes (measured on a traffic-on-board basis) and around 335 million tonne kilometres, but this can vary significantly from year to year as air freight volumes have been as low as 191 thousand tonnes (270 million tkm) in 2014–15 and as high as 250 thousand tonnes (333 million tkm) in 2010–11.

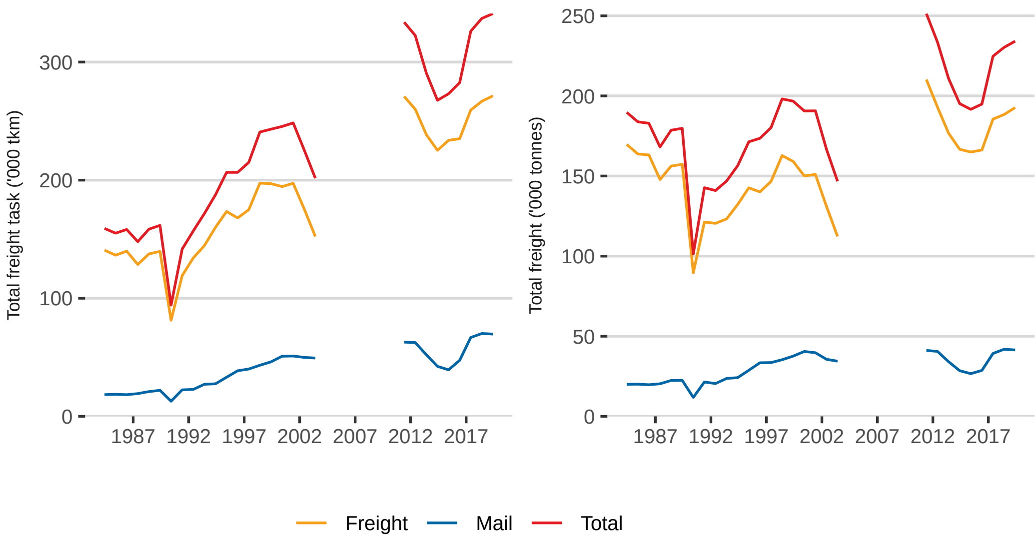
Figure 5.1) shows published annual freight, mail and total air freight volumes (measured in both tonnes and tonne kilometres) since 1984–85. Importantly, the raw published data includes a break-in-series in January 2010—prior to this date air freight data provided a partial measure of total domestic air freight, including freight cargo and mail carried in the cargo hold of schedule passenger flights, whereas since 2010, air freight data also includes cargo carried on domestic dedicated air freight services.[32] Consequently, the raw data provides only approximate measures of long-term growth in domestic air freight volumes. Nonetheless, the data suggests that total air freight volumes have growth by less than 25 per cent since 1984–85 (under 0.7 per cent per annum), and total air freight tonne kilometres have grown by less than 100 per cent (less than 2.4 per cent per annum).

5.3 Air freight forecasts

BITRE's aggregate domestic air freight forecasts are based on simple univariate forecasting models based on quarterly air freight volumes. The models take into account seasonal variations in aggregate

32 Data not available between 2003–04 and 2009–10.

Figure 5.1 Total air freight and mail volumes, 1984–85 to 2017–18

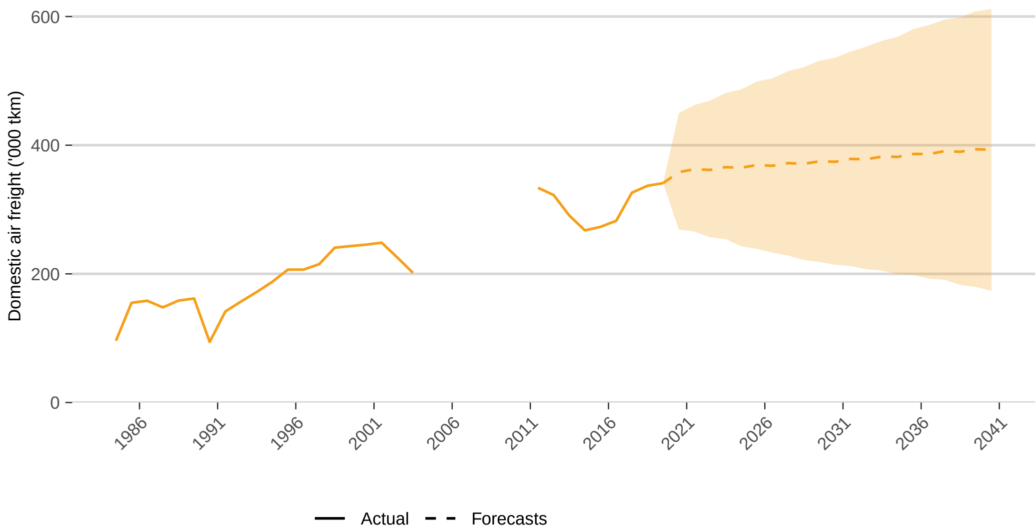


air freight. The univariate models provided the best historical fit to the domestic air freight volumes.[33] Separate quarterly forecasts of air freight and mail are derived and the results combined and aggregated to estimate total annual domestic air freight volumes. Confidence intervals are based on the error bounds derived from the univariate model, and increase significantly over the forecast horizon.

Based on these models, total domestic air freight volumes are projected to increase by around 17 per cent, from around 337 million tonne kilometres in 2017–18 to around 393 million tonne kilometres by 2039–40. The prediction interval implies that total air freight volumes could range anywhere between 174 and 612 million tonne kilometres in 2039–40.

33 BITRE tested a range of alternative model specifications to predict air freight and mail volumes, including multivariate specifications relating domestic air freight to domestic economic conditions and passenger aviation activity. However, none of the tested specifications exhibited any correlation with domestic air freight.

Figure 5.2 Domestic air freight outlook, 1995–96 to 2039–40



CHAPTER 6

Australian freight outlook

This is the first issue in the BITRE's revamped forecasting series, which aims to provide regularly updated long-term forecasts of total Australian freight activity, by major transport mode, at national, state, territory and regional scale.

This report has presented methods, assumptions and forecasts of likely future long-term national domestic freight growth in Australia. In developing the forecasts, BITRE has drawn on historical trend information and reasonable forecasts of likely future economic growth, population growth and the domestic and world market outlooks for particular commodities that are significant within the Australian domestic freight task.

The central (*Reference case*) scenario forecasts are BITRE's best estimates of likely future growth in domestic freight. However, recognising the uncertainty inherent in predicting the future, the forecasts include a range of alternative scenarios to try to reflect the range of possible future outcomes.

Figure 6.1 shows the median freight forecasts, by transport mode, and the high and low scenario outcome ranges. Overall freight is projected to grow by approximately 25 per cent between 2018 and 2040 between 2017–18 and 2039–40, from around 770 billion tonne kilometres in 2015–16 to around 962 billion tonne kilometres in 2039–40—average annual growth of around 1.3 per cent per annum.

Table 6.1 lists projected future freight task estimates, by transport mode, between 2018 and 2040.

Road freight volumes are projected to grow by around 56 per cent between 2018 and 2040 under the reference case scenario, to around 337 billion tonne kilometres by 2040—average annual growth of 2 per cent per annum. Stronger future economic growth could result in demand growing to around 380 billion tonne kilometres by 2040 and below average growth could result in road freight growing to around 310 billion tonne kilometres.

Rail freight volumes are projected to grow by around 24.3 per cent between 2018 and 2040, to around 515 billion tonne kilometres in 2040 (average annual growth of approximately 0.91 per cent per annum), largely due to slower projected growth in iron ore and coal exports over the forecast horizon. Were the 'high scenario' outcomes realised for iron ore, coal and interstate rail freight, rail freight volumes could increase to as much as 555 billion tonne kilometres by 2040. However, were all 'low scenario' outcomes realised, rail freight volumes could grow to 465 billion tonne kilometres.

Domestic coastal shipping volumes are projected to remain more or less around current levels, around 110 billion tonne kilometres, out to 2040 under the central forecast scenario. Were the 'high scenario' outcomes to be realised across all commodities, total coastal shipping freight volumes could

Figure 6.1 Actual and projected future freight task, by major transport mode, 1971–2040

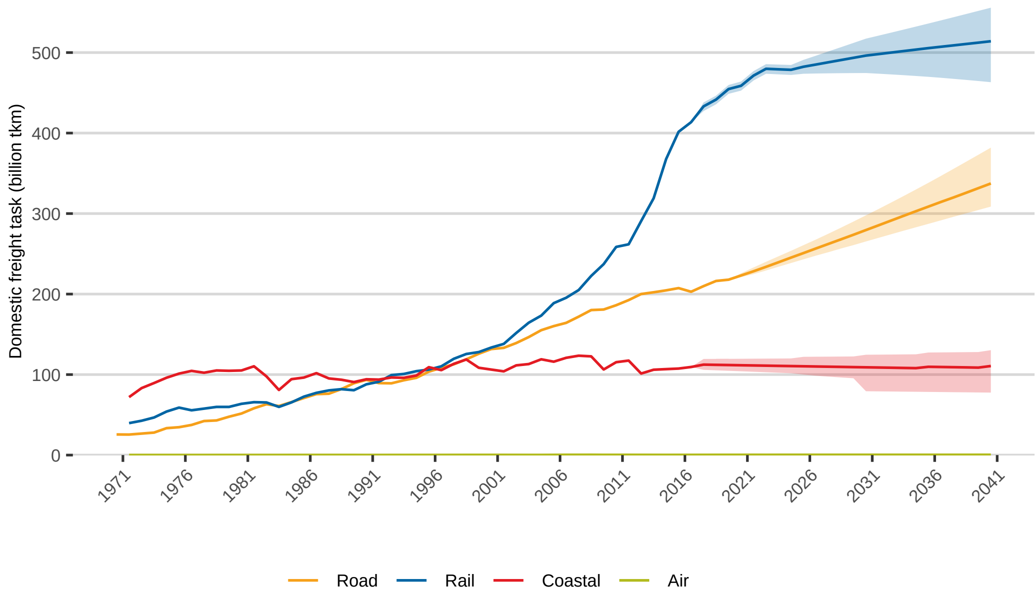


Table 6.1 Projected future freight task, by major transport mode, 2018–2040

	Mode				
Year	Road	Rail	Coastal	Air	Total
2018	216.3	441.6	112.1	0.3	770.4
2020	223.1	458.7	111.6	0.4	793.8
2025	250.9	482.4	110.3	0.4	844.0
2030	279.5	496.2	109.0	0.4	885.2
2035	308.7	505.5	109.7	0.4	924.2
2040	337.4	514.1	110.7	0.4	962.5

Source: BITRE estimates.

increase to around 130 billion tonnes kilometres in 2040, while if all 'low scenario' were realised, total coastal shipping freight volumes could decline to around 80 billion tonne kilometres.

Air freight volumes are projected to grow by around 17 per cent between 2018 and 2040 from around 337 million tonne kilometres in 2018 to around 393 million tonne kilometres in 2040.

APPENDIX A
Key forecast inputs and assumptions

This appendix outlines the key forecast inputs and assumptions used in producing the aggregate freight forecasts.

A.1 Australian population projections

The population projections used in the forecasts are based on ABS 2017 population projections (ABS 2018c), which provides three core population projection series—Series A, B and C.

Under Series A, the total population is projected to increase to around 35.6 million persons in 2040, an average rate of growth of 1.62 per cent per annum in 2040. Under Series B, the total population is projected to increase to around 33.6 million persons in 2040, an average rate of growth of 1.35 per cent per annum in 2040. And under Series C, the total population is projected to increase to around 31.8 million persons in 2040, an average rate of growth of 1.1 per cent per annum in 2040.

Figure A.1 shows the projected population under the three scenarios. By way of reference, the population grew by 1.37 per cent per annum between 1990 and 2018.

Figure A.2 (and Table A.1) shows the projected rate of population growth under the three projection scenarios. Under Series A, the projected future population growth rate declines from around 1.79 per cent per annum in 2019 to around 1.39 per cent per annum in 2040. Under Series B, the projected future population growth rate declines from around 1.71 per cent per annum in 2019 to around 1.07 per cent per annum in 2040. And under Series C, the projected future population growth rate declines from around 1.63 per cent per annum in 2019 to around 0.78 per cent per annum in 2040.

Table A.1 Projected population levels, by scenario, 2018 to 2040

		Scenario		
Year	Actual	Series A	Series B	Series C
2018	24.98	24.98	24.98	24.98
2020	NA	25.88	25.83	25.78
2030	NA	30.69	29.89	29.14
2040	NA	35.58	33.55	31.79
Avg. ann. growth (% p.a.)	NA	1.62	1.35	1.10

Sources: ABS (2018c) and BITRE estimates.

Figure A.1 Actual and projected estimated resident population, 1971–2040

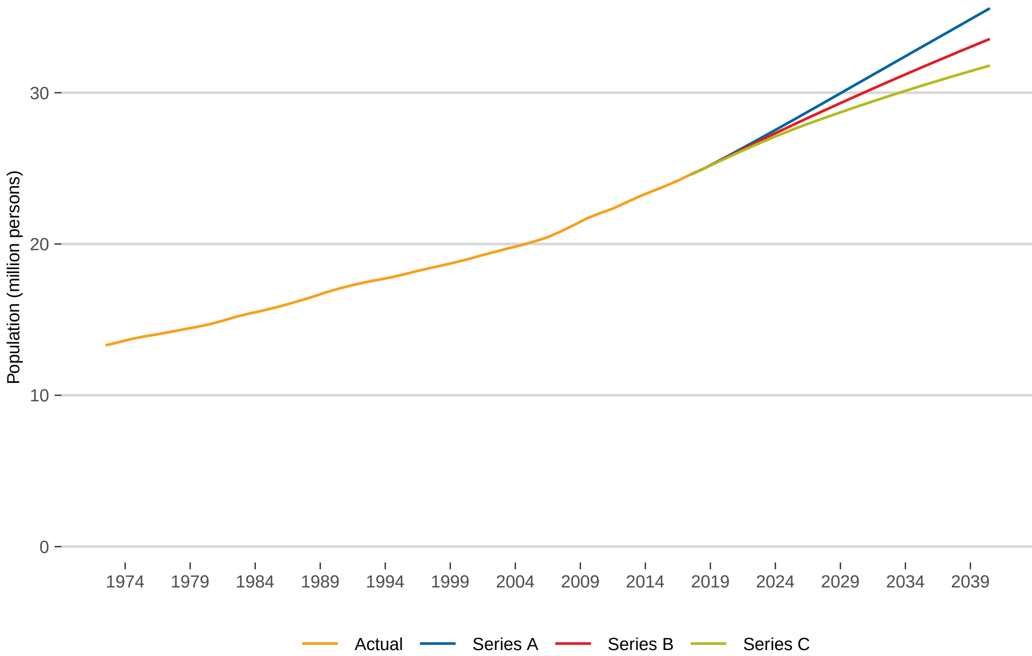


Figure A.2 Actual and projected estimated resident population growth, 1971–2040

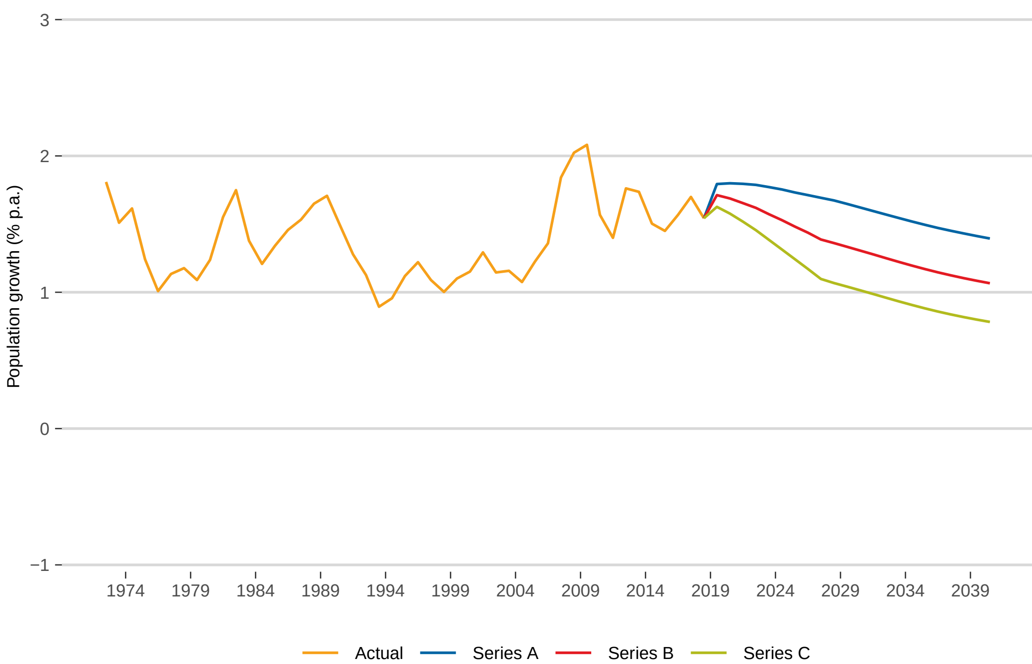
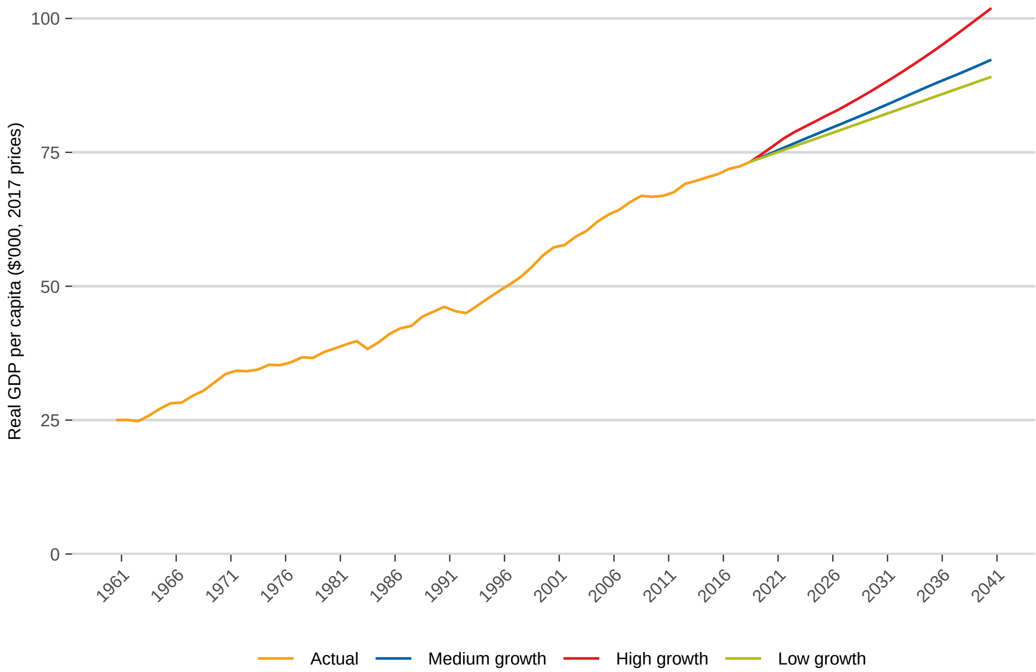


Figure A.3 Actual and projected GDP per capita forecast scenarios, 1971–2040



A.2 Australian economic growth projections

Australian economic growth projections are based broadly on historical trend growth in GDP and GDP per capita over the last 40–50 years.

Three scenarios are considered:

- Low growth scenario – based on projected future trend growth in GDP(E) per capita to 2040.
- Medium growth scenario – based on projected future trend growth in GDP(I) per capita to 2040, in turn based on assumptions about future productivity growth, workforce participation and population demographics.
- High growth scenario – based on the Treasury 2015 Intergenerational Report long-term GDP growth projections, which assume average productivity growth of 1.5 per cent per annum (Treasury 2015).

Figure A.3 shows the projected forecast real GDP between 2018 and 2040 under alternative scenarios. Figure A.4 shows the implied annual forecast growth rates. Table A.2 shows that real GDP is projected to increase from around $73 300 per person in 2018 to around $89 100 in 2040 under the lowest scenario (average annual growth of 0.89 per cent per annum), around $92 300 per person under the median scenario (average annual growth of 1.06 per cent per annum) and $101 900 per person under the high scenario (average annual growth of 1.51 per cent per annum).

A.3 World oil price scenario assumptions

Oil price scenarios used in developing the aggregate freight forecasts are based on the United States' EIA (2018) international energy outlook world oil price scenarios. The EIA project that in the

Figure A.4 Actual and projected GDP per capita forecast scenario growth, 1971–2040

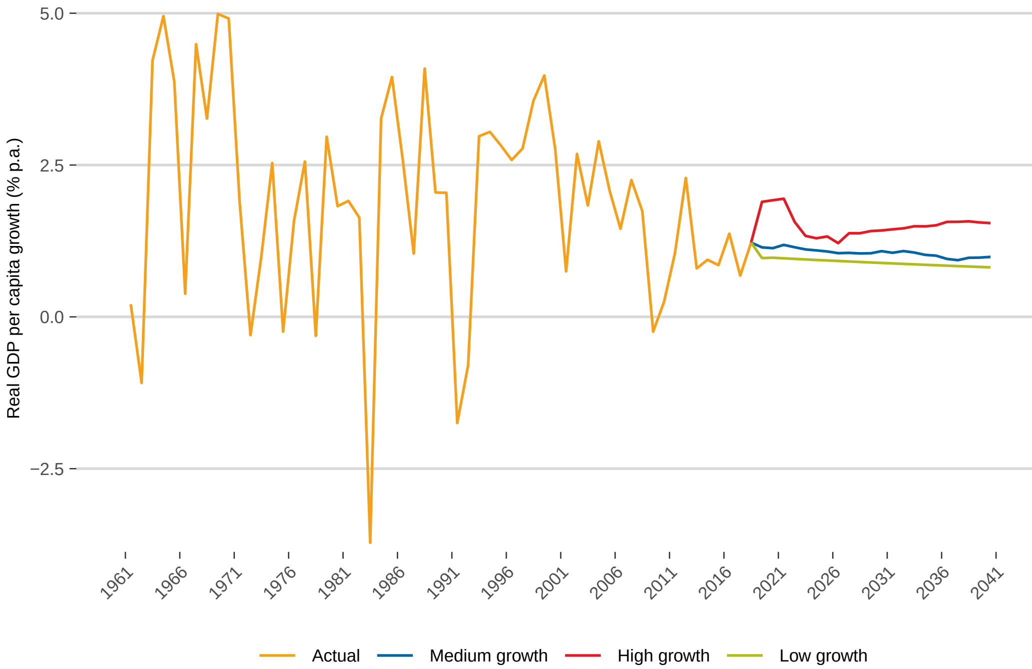


Table A.2 Projected GDP per capita, by scenario, 2018 to 2040

		Scenario		
Year	Actual	Medium growth	High growth	Low growth
2018	73 267	73 267.00	73 267.00	73 267.00
2020	NA	74 943.46	76 088.72	74 696.93
2030	NA	83 515.82	87 665.81	81 900.22
2040	NA	92 298.00	101 930.00	89 106.89
Avg. ann. growth (% p.a.)	NA	1.06	1.51	0.89

Sources: Treasury (2015) and BITRE estimates.

reference case, world oil prices (West Texas Intermediate) will increase from around $US 49 per barrel in 2017 to around $US 101 per barrel by 2040. Under the low price case, world oil prices are projected to decline in the near term, but increase thereafter, to be around $US 50 per barrel by 2040. Under the high price case, world oil prices are project to increase to over $US 200 per barrel by 2040 (see Table A.3).

Figure A.5 EIA oil price scenarios, 2018–2050

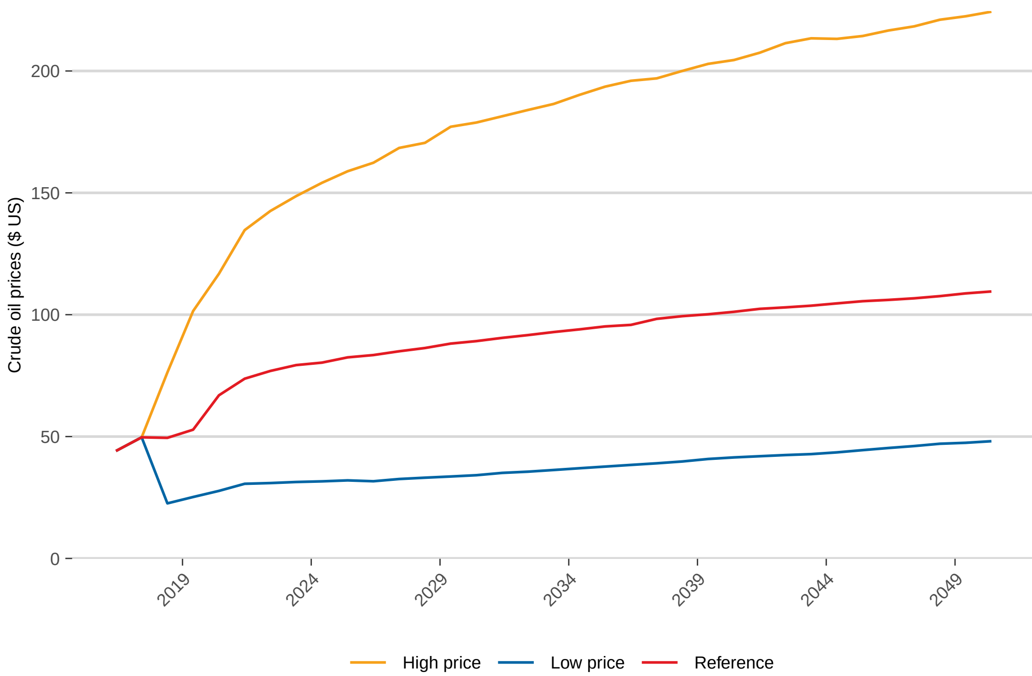


Table A.3 U.S. EIA world oil price scenarios (West Texas Intermediate), 2018 to 2040

	Scenario		
Year	Low price	Reference	High price
2017	49.7	49.7	49.7
2020	27.7	66.9	116.8
2030	34.1	89.2	178.8
2040	41.4	101.2	204.5

Sources: EIA (2018).

APPENDIX B
Freight forecast model results

This appendix presents selected freight forecast model results discussed in the body of the report.

B.1 Road freight model results

Table B.1 lists the regression results for the aggregate per capita road freight model and Figure B.1 shows actual and model-predicted road freight volumes between 1971 and 2018.

Table B.1 Estimation results - aggregate per capita road freight model

	Dependent variables
	Road freight per capita GNE-based model fit
Constant	−15,332.400***
	(809.918)
Log (GNE per capita)	6,707.965***
	(122.680)
Log (Real freight rate)	−2,110.244***
	(187.605)
Dummy 2016	−377.915***
	(101.116)
Observations	23
R^2	0.998
Adjusted R^2	0.997
Residual Std. Error	107.771 (df = 19)
F Statistic	2,667.708*** (df = 3; 19)
Note:	*p<0.1; **p<0.05; ***p<0.01

B.2 Interstate non-bulk rail freight model results

Figure B.2 shows actual and model-predicted interstate freight volumes between 1972 and 2016.

Figure B.1 Actual vs. estimated aggregate road freight per capita model specifications, 1971–2018

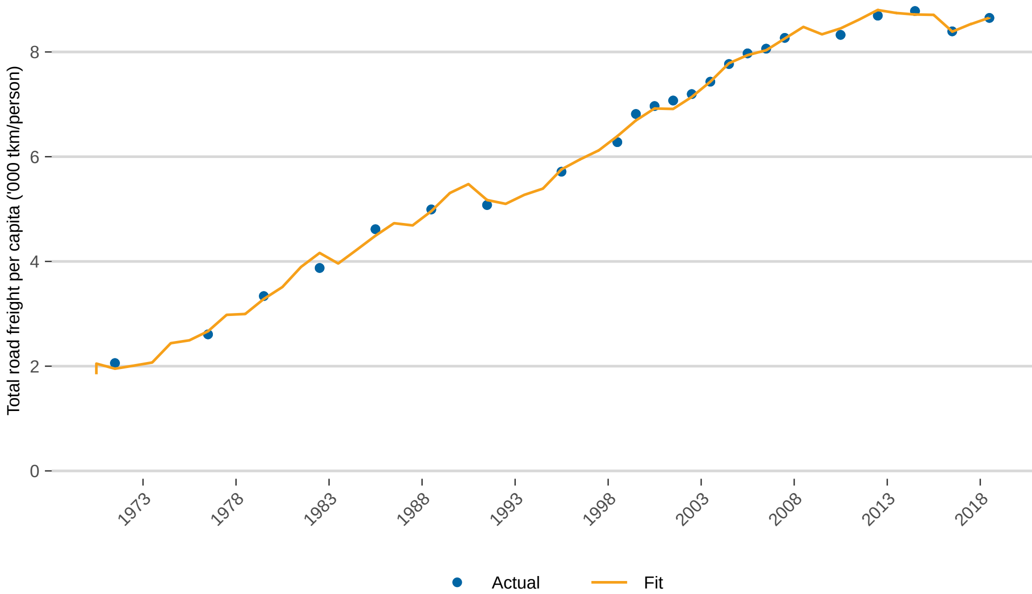
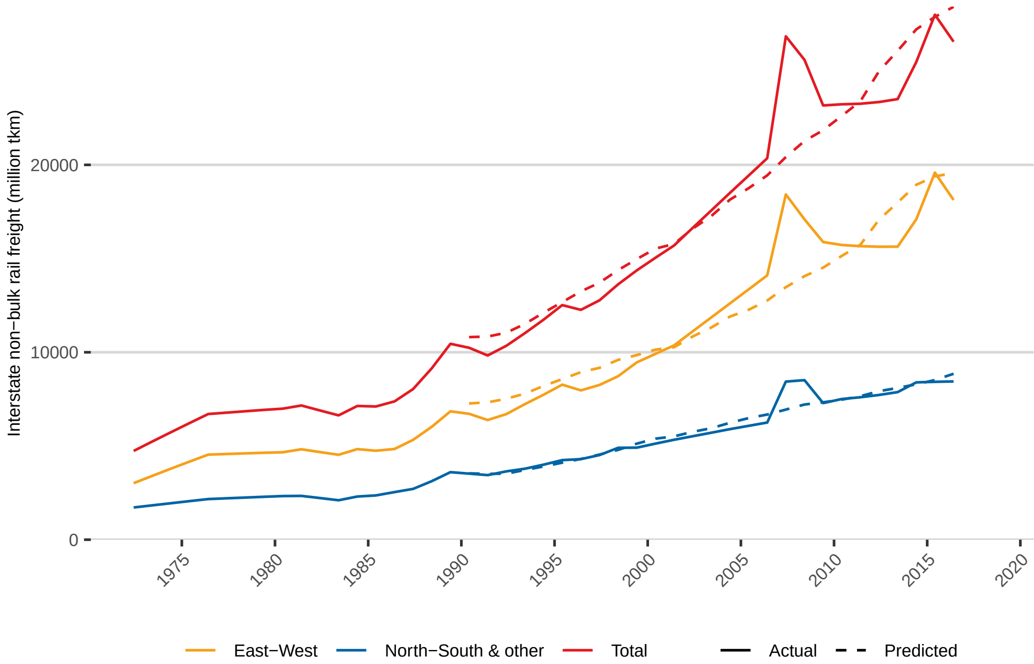


Table B.2 Estimation results - non-bulk rail freight models

	Dependent variables	
	East–West	North–South & other
Constant	1,693.071*	−1,181.498***
	(852.074)	(374.626)
GSP (WA)	0.070***	
	(0.005)	
GSP (NSW, Vic. & Qld)		0.008***
		(0.0004)
Observations	27	27
R^2	0.874	0.939
Adjusted R^2	0.869	0.937
Residual Std. Error (df = 25)	1,525.052	447.017
F Statistic (df = 1; 25)	172.796***	385.466***
Note:	*p<0.1; **p<0.05; ***p<0.01	

Figure B.2 Interstate non-bulk rail freight, actual and model predictions, 1972–2016



APPENDIX C
Freight task forecasts

This appendix lists the aggregate freight forecast tasks by transport mode. Table C.1 lists actual (1971–2018) and reference case forecast freight volumes (2019–2040). Table C.2 lists the *high case* scenario forecast freight volumes and Table C.3 lists the *low case* scenario forecast freight volumes.

Table C.1 Actual and reference case scenario freight forecasts (billion tkm), 1971–2040

	Mode				
Year	Road	Rail	Coastal	Air	Total
1971	25.5	39.7	72.0	0.1	137.3
1972	26.7	42.7	83.2	0.1	152.7
1973	28.0	46.7	89.5	0.1	164.3
1974	33.5	54.1	96.1	0.1	183.8
1975	34.6	59.0	101.2	0.1	194.9
1976	37.4	55.6	104.6	0.1	197.8
1977	42.3	57.7	102.3	0.1	202.4
1978	43.0	59.8	105.1	0.1	208.1
1979	47.7	59.8	104.7	0.1	212.3
1980	51.6	63.7	105.1	0.1	220.5
1981	58.1	65.7	110.3	0.1	234.3
1982	63.2	65.4	97.8	0.1	226.5
1983	61.0	59.8	80.9	0.1	201.8
1984	65.8	65.4	94.3	0.2	225.7
1985	70.9	72.6	96.3	0.2	240.0
1986	75.8	77.3	101.8	0.2	255.1
1987	76.3	80.4	95.2	0.1	252.0
1988	82.0	81.9	93.6	0.2	257.6
1989	89.2	80.6	90.7	0.2	260.7
1990	93.5	87.9	94.2	0.1	275.7
1991	89.4	91.1	93.8	0.1	274.5
1992	89.1	99.3	96.4	0.2	285.0
1993	93.0	100.8	96.0	0.2	289.9
1994	96.0	104.2	98.8	0.2	299.2
1995	103.7	106.2	109.2	0.2	319.3
1996	108.4	110.3	105.5	0.2	324.4
1997	112.7	119.6	113.4	0.2	346.0
1998	118.9	125.6	118.7	0.2	363.5
1999	125.9	128.0	108.5	0.2	362.6
2000	131.7	133.6	106.2	0.2	371.7
2001	133.2	138.1	104.0	0.2	375.6
2002	139.2	151.7	111.5	0.2	402.6
2003	146.6	164.4	113.1	0.2	424.2

(continued)

Table C.1 Actual and reference case scenario freight forecasts (billion tkm), 1971–2040 *(continued)*

Year	Road	Rail	Coastal	Air	Total
2004	155.2	173.2	119.0	0.2	447.6
2005	160.2	188.7	116.0	0.3	465.2
2006	164.3	195.5	120.8	0.4	480.9
2007	171.9	205.0	123.5	0.4	500.8
2008	180.2	222.6	122.6	0.4	525.8
2009	180.8	237.2	106.3	0.3	524.7
2010	186.2	258.6	115.4	0.3	560.5
2011	192.5	261.8	117.4	0.3	572.1
2012	200.1	290.7	101.3	0.3	592.4
2013	202.2	319.0	106.0	0.3	627.5
2014	204.6	367.7	106.8	0.3	679.4
2015	207.4	401.6	107.5	0.3	716.8
2016	202.9	413.5	109.4	0.3	726.1
2017	209.9	433.2	112.4	0.3	755.7
2018	216.3	441.6	112.1	0.3	770.4
2019	217.9	454.6	111.8	0.3	784.7
2020	223.1	458.7	111.6	0.4	793.8
2021	228.3	471.4	111.3	0.4	811.4
2022	233.8	479.8	111.1	0.4	825.1
2023	239.5	479.2	110.8	0.4	829.9
2024	245.3	478.6	110.6	0.4	834.8
2025	250.9	482.4	110.3	0.4	844.0
2026	256.7	485.1	110.0	0.4	852.2
2027	262.3	487.9	109.8	0.4	860.4
2028	268.0	490.7	109.5	0.4	868.6
2029	273.7	493.5	109.3	0.4	876.8
2030	279.5	496.2	109.0	0.4	885.2
2031	285.3	498.1	108.8	0.4	892.6
2032	291.2	499.9	108.5	0.4	900.1
2033	297.1	501.8	108.3	0.4	907.5
2034	302.9	503.7	108.0	0.4	914.9
2035	308.7	505.5	109.7	0.4	924.2
2036	314.4	507.2	109.4	0.4	931.4
2037	319.9	508.9	109.2	0.4	938.4
2038	325.7	510.6	108.9	0.4	945.6
2039	331.5	512.3	108.7	0.4	952.9
2040	337.4	514.1	110.7	0.4	962.5

Sources: BITRE estimates.

Table C.2 High case scenario freight forecasts (billion tkm), 1971–2040

	Mode				
Year	Road	Rail	Coastal	Air	Total
2018	216.3	446.5	119.5	0.3	782.6
2019	217.7	459.7	119.6	0.3	797.3
2020	225.9	464.1	119.7	0.4	810.0
2021	233.1	477.0	119.8	0.5	830.2
2022	240.1	485.6	119.9	0.5	846.0
2023	246.9	485.1	120.0	0.5	852.4
2024	253.8	484.6	120.1	0.5	858.9

(continued)

Table C.2 High case scenario freight forecasts (billion tkm), 1971–2040 *(continued)*

Year	Road	Rail	Coastal	Air	Total
2025	260.8	490.9	122.1	0.5	874.3
2026	267.8	496.1	122.2	0.5	886.6
2027	275.1	501.4	122.3	0.5	899.3
2028	282.5	506.7	122.4	0.5	912.1
2029	290.1	512.0	122.5	0.5	925.1
2030	297.8	517.3	124.7	0.5	940.3
2031	305.6	521.0	124.8	0.5	951.9
2032	313.6	524.7	124.9	0.6	963.8
2033	321.7	528.5	125.0	0.6	975.8
2034	329.9	532.3	125.2	0.6	987.9
2035	338.2	536.1	127.4	0.6	1 002.3
2036	346.8	539.9	127.6	0.6	1 014.9
2037	355.4	543.8	127.7	0.6	1 027.6
2038	364.2	547.8	127.9	0.6	1 040.4
2039	373.0	551.7	128.0	0.6	1 053.3
2040	381.9	555.7	130.4	0.6	1 068.6

Sources: BITRE estimates.

Table C.3 Low case scenario freight forecasts (billion tkm), 1971–2040

	Mode				
Year	Road	Rail	Coastal	Air	Total
2018	216.3	435.7	105.3	0.3	757.7
2019	216.3	448.7	104.7	0.3	770.1
2020	221.0	452.7	104.1	0.3	778.1
2021	224.8	465.3	103.5	0.3	793.8
2022	229.3	473.6	102.9	0.3	806.0
2023	233.9	472.9	102.3	0.3	809.4
2024	238.6	472.2	101.7	0.2	812.7
2025	243.2	473.7	100.0	0.2	817.1
2026	247.8	474.0	98.6	0.2	820.6
2027	252.1	474.2	97.5	0.2	824.0
2028	256.6	474.4	96.4	0.2	827.6
2029	260.8	474.5	95.4	0.2	831.0
2030	265.4	474.6	79.3	0.2	819.4
2031	269.8	473.7	79.1	0.2	822.9
2032	274.2	472.9	79.0	0.2	826.3
2033	278.6	471.9	78.8	0.2	829.6
2034	282.9	470.9	78.6	0.2	832.7
2035	287.2	469.9	78.5	0.2	835.8
2036	291.6	468.7	78.3	0.2	838.7
2037	295.9	467.4	78.1	0.2	841.6
2038	300.2	466.0	78.0	0.2	844.4
2039	304.4	464.7	77.8	0.2	847.0
2040	308.7	463.2	77.6	0.2	849.7

Sources: BITRE estimates.

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