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Multimodal

Australian aggregate freight forecasts – 2022 update

November 2022

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Foreword

Freight transport plays a significant and wide-ranging role across Australia's economy. It includes the movement of Australia's major bulk export commodities to ports for export, to the transport of raw materials and semi-processed commodities to businesses for further processing and finished products for household consumption. The importance and resilience of the Australian freight industry was demonstrated by the sector's strong performance throughout the COVID-19 pandemic, during which freight, and associated sectors, managed to maintain key supply chains and ensure availability of essential items throughout.

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 2050. This is the second issue in the BITRE's national-level freight forecasts, and updates BITRE's 2019 forecasts. Further freight forecast outputs will include interstate freight forecasts and port container import and export forecasts.

The forecasts presented in this report were prepared by David Mitchell and Joe O'Sullivan. The coastal shipping forecasts are based on methods originally developed by Pearl Louis.

Shona Rosengren

Head of Bureau
Bureau of Infrastructure and Transport Research Economics
November 2022

At a glance

- The Australian freight task has grown more than four-fold over the five decades to 2020, from around 127 billion tonne kilometres in 1970–71 to nearly 800 billion tonne kilometres in 2019–20—an average rate of growth of over 3.6 per cent per annum. Over that period:
  - Road freight has increased eight-fold, from around 26 billion tonne kilometres in 1970–71 to around 223 billion tonne kilometres in 2019–20.
  - Rail freight has increased more than ten-fold, from around 40 billion tonne kilometres in 1970–71 to nearly 450 billion tonne kilometres in 2019–20, propelled by the significant recent growth in iron ore and coal exports.
  - Coastal shipping volumes grew approximately 50 per cent over a similar period, from around 72 billion tonne kilometres in 1970–71 to around 120 billion tonne kilometres in 2018–19.
  - 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 295 million tonne kilometres in 2019–20.
- More recently, freight growth has slowed across each of the three largest modes.
  - Road freight, for example, has grown by around 2.0 per cent per annum over the last decade, where over the prior 40 years, road freight growth had averaged around 5 per cent per annum.
  - Rail freight volumes are also growing more slowly since 2015–16, as the boom in mineral exports experienced in the mid-2000s and early 2010s has plateaued.
- The forecasts project that growth in freight activity is likely to continue to slow over the medium-to-longer term, due to slower domestic income growth and slowing growth in overseas export demand for Australia's major mineral exports.
- Total domestic freight volumes are projected to grow by approximately 26 per cent between 2020 and 2050, principally due to slower projected growth in total rail freight volumes.
  - Road freight volumes are projected to grow by around 77 per cent between 2020 and 2050 (average annual growth of 1.9 per cent per annum), largely as a result of slower projected future domestic economic growth.
  - Rail freight volumes are projected to grow by around 5.7 per cent between 2020 and 2050 (average annual growth of approximately 0.18 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 2020 levels out to 2050.
  - Air freight volumes are projected to grow by around 103 per cent between 2020 and 2050 from 290 million tonne kilometres in 2020 to around 589 million tonne kilometres in 2050.
- Lastly, the freight forecasts presented in this report are predominantly based on the likely outlook for existing commodities, and do not explicitly factor in potential new transport tasks that may emerge in response to new technological opportunities. For example, the production of hydrogen from renewable energy sources (*green hydrogen*) is garnering significant attention. Large-scale domestic hydrogen generation, were it to be established in the future, might give rise to significant new domestic freight task.

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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, servicing manufacturing and perishable commodity supply chains, to movements of bulk export commodities to ports for subsequent export to overseas markets.

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

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

This report presents 30-year forecasts, from 2020 to 2050, of the Australian total freight task by major transport mode–road, rail, sea and air. The forecasts presented in this report update BITRE's 2019 freight forecasts (BITRE 2019a) and complement BITRE's latest interstate road freight forecasts (BITRE 2022).

Historical freight trends

The Australian freight task has grown more than four-fold over the past five decades, from around 127 billion tonne kilometres in 1970 to nearly 800 billion tonne kilometres in 2019–20—an average rate of growth of around 3.6 per cent per annum.

Over that period, road freight volumes have increased eight-fold, from around 26 billion tonne kilometres in 1970–71 to around 223 billion tonne kilometres in 2019–20.

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 nearly 450 billion tonne kilometres in 2019–20.

Coastal shipping volumes have grown approximately 50 per cent, from around 72 billion tonne kilometres in 1970–71 to around 120 billion tonne kilometres in 2018–19.

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 295 million tonne kilometres in 2019–20.

Key factors influencing domestic freight trends

Road freight

The road freight industry impacts nearly every sector of the economy. It comprises a major share of the transport task involved in movement of merchandise products consumed by households and intermediate inputs used in domestic industries. Road freight also plays a significant role in the transport of inputs to primary industries—agriculture, forestry and mining—and transporting the output of those industries to market.

Accordingly, Australian road freight activity is modelled as a single-equation econometric model that relates the national road freight task (measured in tonne kilometres) to domestic economic activity and road freight transport costs. BITRE's preferred forecasting model specification relates trends in per capita road freight activity to per capita real gross national income (GNI)—a measure of domestic output, less net payments to non-resident persons and businesses—and real road freight rates. In projecting likely future road freight trends, BITRE applies a range of scenarios about the rate of growth in future domestic economic activity, population growth and likely future movements in road transport costs.

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 and metallurgical coal exports
- Cereal grains
- Sugar
- Steel products
- Interstate non-bulk freight – principally between east coast capitals and Perth
- Other rail freight (not elsewhere specified).

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:

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

BITRE separately forecasts likely future growth in each component and sums the results to derive overall rail freight forecasts. 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, and Australia is well placed to service. 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 more importantly, 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 increased 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, Science and Resources' Office of the Chief Economist (OCE), International Energy Agency (IEA), United States' Energy Information Administration (EIA), and selected reputable private sector outlooks.

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 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 exhibit 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 again adopts a range of scenarios about the rate of growth in future domestic economic activity and likely future movements in transport costs. These scenarios are also discussed in the report.

Coastal shipping

Australian coastal shipping, like rail, principally services a limited 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 are also based on 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 continuation of on-shore alumina refining and, to a lesser extent, aluminium smelting in Australia. As bauxite and alumina comprise over 40 per cent of total coastal freight (in both tonnage 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 reserves and resources 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 contracted recently, Australia's alumina production capacity has steadily increased over the last several decades.

The forecast scenarios consider several alternative future scenarios, that cover a range of possible outcomes, spanning both increasing and declining coastal movements of bauxite and alumina.

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.[1] 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, further reductions in domestic production capacity 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 reductions in remaining steel smelting capacity at some point over the projection horizon.

1 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.

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 (Port of Fremantle). Intercapital containerised freight has grown substantially over the past decade and a half, from around 400 million tonne kilometres in 1995–96 to around 2.25 billion tonne kilometres in 2019–20 (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 have 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 2019–20, domestic air freight volumes totalled 230,000 tonnes (measured on a traffic-on-board 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 a combination of the Centre for Population (2021) and ABS (2018b) long-term population projections, which project the total population will grow from around 25.7 million persons in 2020 to around 35.3 million persons by 2050 under a combination of Centre for Population (2021) Central Scenario and ABS (2018b) Series B (i.e. growth of 1.06 per cent per annum). The high population growth scenario is based on a combination of the Centre for Population (2021) Pre-COVID Scenario and ABS (2018b) Series B population scenario, and implies the population will grow to 36.5 million persons by 2050 (growth of 1.18 per cent per annum). The low population growth scenario is based on a combination of the Centre for Population (2021) Extended COVID Scenario and ABS (2018b) Series C population scenario, and implies the population will grow to 33.1 million persons by 2050 (growth of 0.85 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 2021), i.e. economic growth is broadly a function of population, workforce participation and productivity.

For the freight forecasts presented in the report, BITRE 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 $77,400 per person in 2020 to around $99,500 in 2050 (average annual growth of 0.84 per cent per annum).
- A *medium growth* scenario – real GDP per capita is projected to increase to around $102,500 per person in 2050 (average annual growth of 0.94 per cent per annum).
- A *high growth* scenario – Treasury (2021) assumptions, under which real GDP per capita is projected and $122,900 per person (average annual growth of 1.55 per cent per annum).

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

- *Low* population and *low* economic growth scenario – real GDP growth of around 1.70 per cent per annum between 2020 and 2050.
- *Medium* population and *medium* economic growth scenario – real GDP growth of around 2.01 per cent per annum between 2020 and 2050.
- *High* population and *high* economic growth scenario – real GDP growth of around 2.75 per cent per annum between 2020 and 2050.

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 2021a). EIA (2021a) report three scenarios:

- EIA's *reference* scenario – world oil prices (West Texas Intermediate) are projected to increase from around $US 38 per barrel in 2020 to around $US 178 per barrel by 2050.
- EIA's *low price* scenario – world oil prices are projected to decline to around $US 30 per barrel in the near term, but increase thereafter, to be around $US 89 per barrel by 2050.
- EIA's *high price* scenario – world oil prices are projected to increase to over $US 406 per barrel by 2050.

The key forecast assumptions are listed in Appendix A.

Freight task forecasts by transport mode

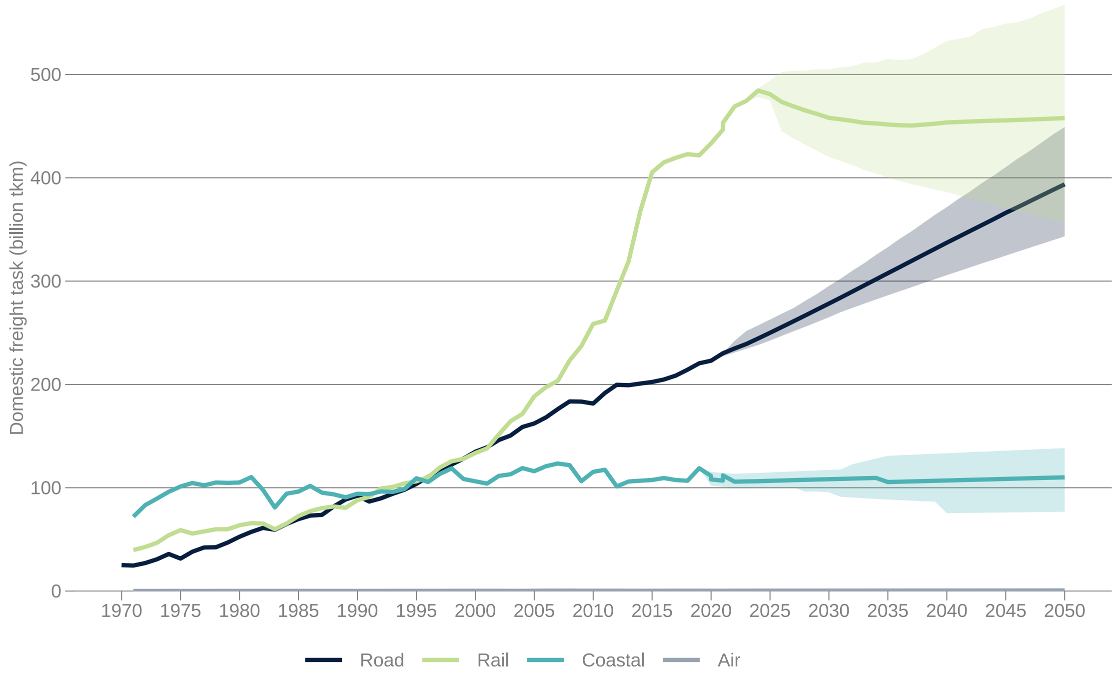
The results of the models and key forecast assumptions outlined above are forecasts covering a likely range of future outcomes, with the most likely outcome generally falling near the middle of the range.

Under the median scenario, total domestic freight volumes are projected to grow by approximately 26 per cent between 2020 and 2050, 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 2050.

Road freight volumes are projected to grow by around 77 per cent between 2020 and 2050 (central estimate) to around 394 billion tonne kilometres by 2050—average annual growth of 1.9 per cent per annum. Stronger future economic growth could result in demand growing to around 450 billion tonne kilometres by 2050 and below average growth could result in road freight growing to around 345 billion tonne kilometres.

Rail freight volumes are projected to grow by around 5.7 per cent between 2020 and 2050, to around 460 billion tonne kilometres in 2050 (average annual growth of approximately 0.18 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

Figure 1 Projected future freight task, by major transport mode, 2020–2050



Sources: BITRE estimates.

565 billion tonne kilometres by 2050. However, were all 'low scenario' outcomes realised, rail freight volumes could contract to around 355 billion tonne kilometres.

Domestic coastal shipping volumes are projected to remain more or less around current levels, around 119 billion tonne kilometres, out to 2050 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 138 billion tonnes kilometres in 2050, while if all 'low scenario' were realised, total coastal shipping freight volumes could decline to less than 77 billion tonne kilometres.

Air freight volumes are projected to grow by around 103 per cent between 2020 and 2050 from around 290 million tonne kilometres in 2020 to around 589 million tonne kilometres in 2050. Under the 'low scenario' total domestic air freight volumes are projected to grow to around 546 million tonne kilometres by 2050, while under the 'high scenario' total domestic air freight volumes could grow to around 700 million tonne kilometres by 2050.

Table 1 Projected future freight task, by major transport mode (billion tkm), 2020–2050

	Mode				
Year	Road	Rail	Coastal	Air	Total
2020	222.9	433.2	111.4	0.3	767.9
2025	250.0	480.9	106.7	0.4	838.0
2030	278.3	458.0	108.3	0.4	845.0
2035	307.7	451.6	105.5	0.5	865.2
2040	337.2	453.5	107.0	0.5	898.2
2045	366.1	455.6	108.6	0.5	930.8
2050	393.7	457.8	110.1	0.6	962.2

Source: BITRE estimates.

Potential new domestic freight opportunities

The freight forecasts presented in this report are predominantly based on the outlook for Australia's current manufacturing and industrial product mix, and do not explicitly factor in potential new transport tasks that may result from technological change and new market opportunities.

For example, large-scale domestic production of hydrogen using energy from renewable sources (*green hydrogen*) is attracting significant commercial interest. Were large-scale domestic hydrogen generation to prove economic, it is possible that generation will be concentrated in areas with access to reliable supplies of solar/wind and water, and closer to large overseas markets than large domestic population centres (i.e. northern Australia). If such were the case, then there might be a significant domestic freight task involved in transporting hydrogen from points of production to major domestic population centres, with potential implications for future coastal shipping and possibly also rail freight volumes.

1. Introduction

Transport infrastructure is long-lived and requires significant planning and long lead times to help identify and prioritise investment needs. High-level long-term transport outlooks can help identify longer-term infrastructure planning priorities and highlight the key factors that most significantly influence likely future transport growth.

BITRE's long-term freight forecasts are intended 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.

This report presents 30-year forecasts of the Australian total freight task by major transport mode—road, rail, sea and air—between 2020 and 2050. The forecasts presented in this report update BITRE's 2019 freight forecasts (BITRE 2019a) and complement BITRE's latest interstate road freight forecasts (BITRE 2022).

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, and is the predominant mode of transport for urban, inter-urban and regional freight, and an essential part of most import supply chains. 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 inputs.

Rail and coastal shipping 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 that illustrates the nature and location of Australia's major freight transport tasks.

In terms of economic contribution, the *transport sector* is the eleventh largest sector in the Australian economy, accounting for approximately 4.0 per cent of national output in 2020–21 (ABS 2021), and the ninth largest employment sector, accounting for around 659,000 persons (as at November 2021) (ABS 2022).

These estimates only include transport activity undertaken by firms whose primary business activity is transport. If transport activity undertaken by non-transport enterprises is also included (i.e. *in-house* transport services undertaken by mining companies, construction sector companies, retailers, etc.) *transport activity* would comprise the fourth-largest sector of the economy—ABS (2018a) estimated the total economic contribution of transport was around 7.2 per cent of GDP in 2015–16[2]—and would have been the sixth largest sector by employment—ABS (2018a) also estimated there were approximately 1.12 million transport-related jobs in 2015–16.[3]

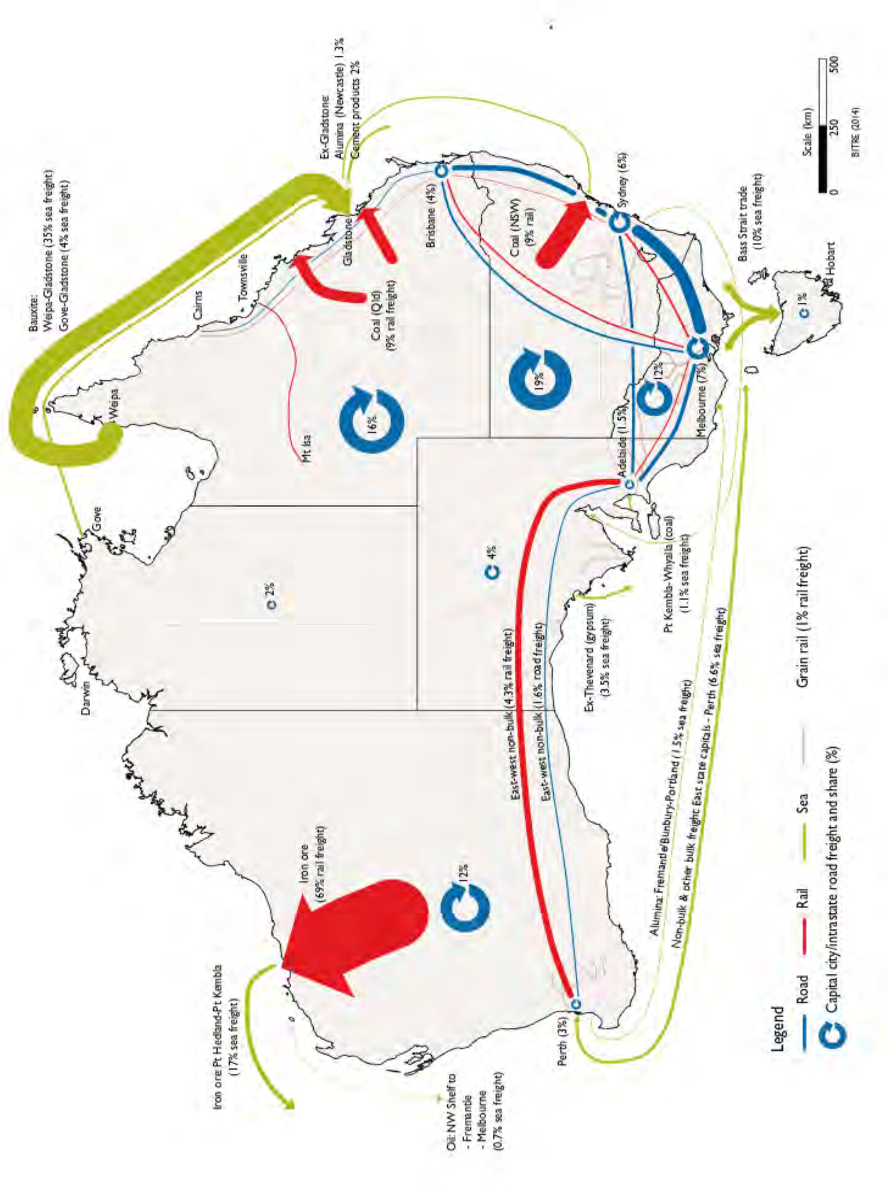
1.2 Historical freight trends

Total freight volumes in Australia have increased four-fold over the past five decades—from 137 billion tonne kilometres in 1970 to nearly 800 billion tonne kilometres in 2019–20—an average rate of growth of around 3.6 per cent per annum. The increasing volume of freight has been driven by strong growth in both urban and inter-urban non-bulk road freight—by approximately 4.0 and 4.9 per cent per annum, respectively (BITRE 2022)—and bulk export commodity freight, primarily carried by rail, which has grown by approximately 6.3 per cent per annum since 1996.

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

2 This estimate includes the contribution of passenger transport, but doesn't include storage and warehousing activity undertaken outside the transport sector.
3 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.

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

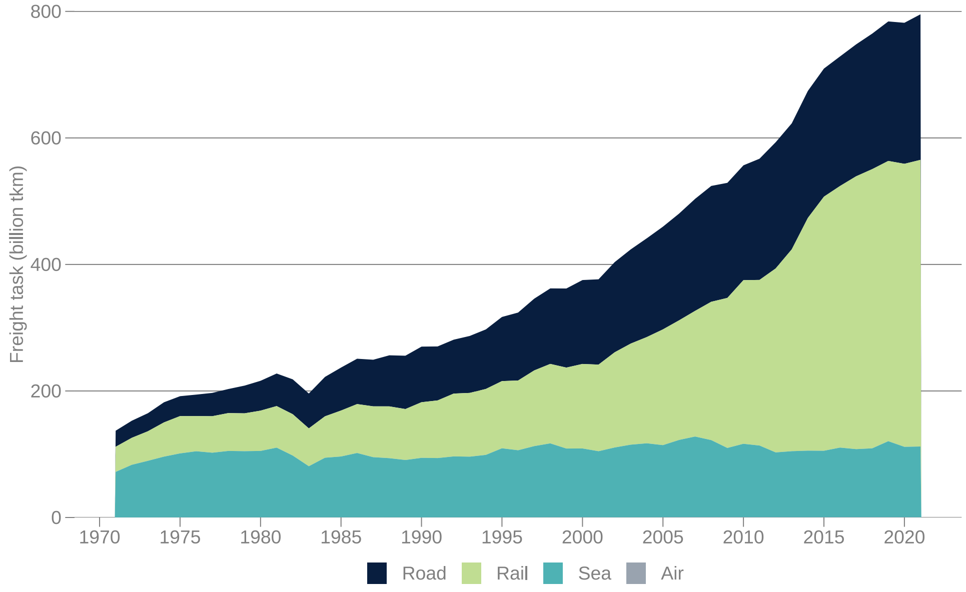


Source: BITRE estimates.

223 billion tonne kilometres in 2019–20. Total rail freight volumes have increased more than ten-fold, from around 40 billion tonne kilometres in 1970–71 to around 450 billion tonne kilometres in 2019–20. 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 2019–20. 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 340 million tonne kilometres by 2018–19, but fell slightly in 2020 to around 290 million tonne kilometres in 2019–20 due the impact of the COVID-19 pandemic on domestic air travel and flights.

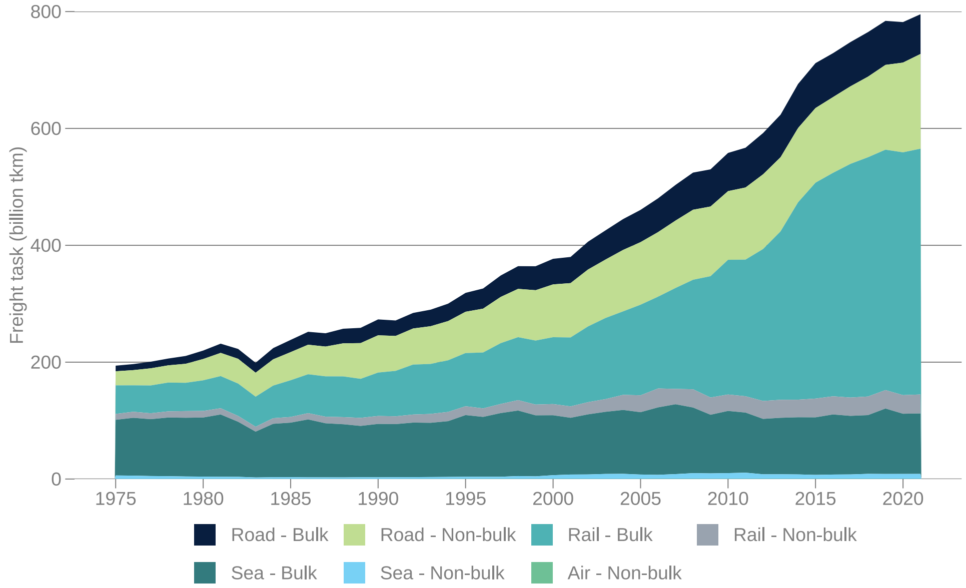
Figure 1.3 shows the relative contribution of bulk and non-bulk freight to the Australian freight task, by mode, since 1971. The significant growth in bulk rail freight volumes as a result of the mining is readily apparent between 2005–06 and 2016–17. Non-bulk road freight has also grown strongly over the past four decades.

Figure 1.2 Australian freight task, by mode, 1971–2020



Source: BITRE estimates.

Figure 1.3 Australian bulk and non-bulk freight task, by mode, 1971–2020



Source: BITRE estimates.

1.3 Freight forecast approach

The freight forecasts presented in the report have been derived using a combination of empirical models, other key commodity market outlooks and key forecast assumptions.

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

The report provides more detailed descriptions of the methods, sources and key assumptions used to derived the forecasts.

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 0.85 and 1.18 per cent per annum, to around 35.3 million persons by 2050, GDP per capita will increase from around $77,400 per person in 2020 to between $99,500 and $122,900 per person by 2050. Further details of the key assumptions underpinning the freight forecasts are provided in the body of the report and 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. Finally, Chapter 6 presents the combined freight aggregate freight forecasts. Several appendices provide supporting information.

2. Road freight outlook

2.1 Historical road freight trends

Over the past five decades, total road freight has increased more than eight-fold, from around 27 billion tonne kilometres in 1970–71 to around 223 billion tonne kilometres in 2019–20 (ABS 2020, and earlier issues). Growth in road freight was strongest in the 1970s and 1980s, when interstate and long-distance inter-regional road freight greatly expanded. However, growth in road freight has slowed since the early 1990s, 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 1.8 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 broad-based economy-wide and more transport-specific 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.[4]
- 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 a significant reduction in the average cost of road freight transport, the rapid growth in road freight volumes and significant increases in road freight productivity over that period. Since 2012, however, growth in road freight productivity has been more muted.

Figure 2.1 shows Australian road freight volume estimates between 1971 and 2020 (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 slowing growth in *per capita* road freight volumes since 2007, which is coincident with the onset of the Global Financial Crisis (GFC), stagnant growth in domestic household incomes and off-shoring of domestic manufacturing, including domestic vehicle manufacturing.

The estimates also imply the onset of the COVID-19 pandemic in April 2020 had little apparent impact on the overall road freight task in 2019–20. This is despite the increased complexity involved in maintaining freight supply chains, including interstate border controls, maintaining social distancing in supply chain handling and disruptions to supply chains due to increased demand for some commodities and shortages of other products due to disruptions to production.

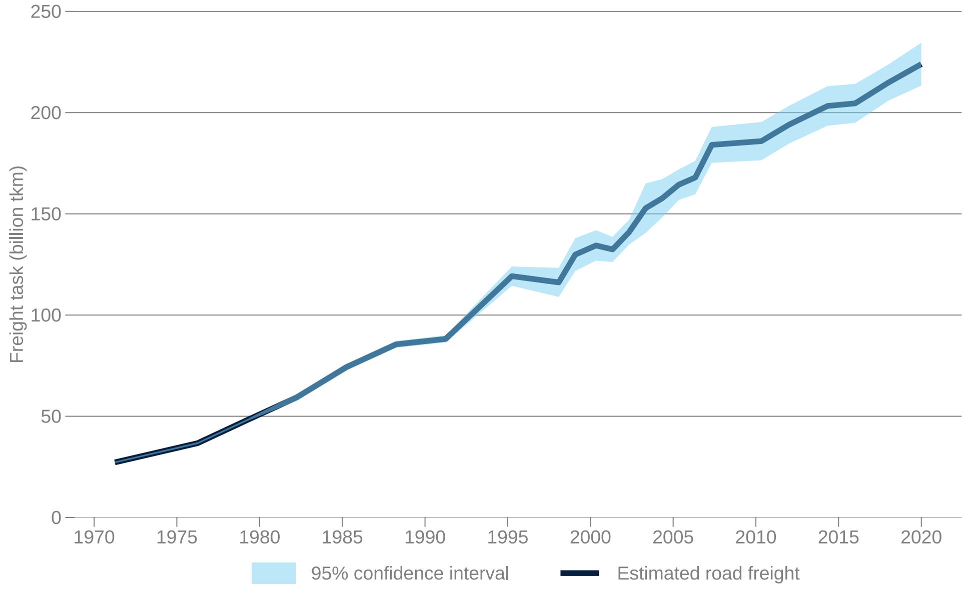
2.1.1 Road freight task composition

The road freight industry serves almost every sector of the economy. It comprises a major share of the transport task for practically every merchandise product consumed by households, intermediate inputs used in domestic secondary industries. Road freight also plays a significant role in the transport of inputs to primary industries—agriculture, forestry and mining—and transporting the outputs of those industries to market. The only segments of the domestic freight task where road freight plays only a minor role are in Australia's large bulk mineral transport supply chains—i.e. iron ore, coal, bauxite/aluminium and crude oil and condensate—where rail and coastal shipping predominate.

By mass, crude materials (e.g. construction materials, sand, stone and gravel) typically comprise the largest share of total road freight volumes, accounting for around 30–35 per cent of all road freight tonnes uplifted, however, in 2019–20, the volume crude materials declined by over 35 per cent relative to 2017–18, which would be consistent with disruption to the construction sector, which experienced widespread cancellation,

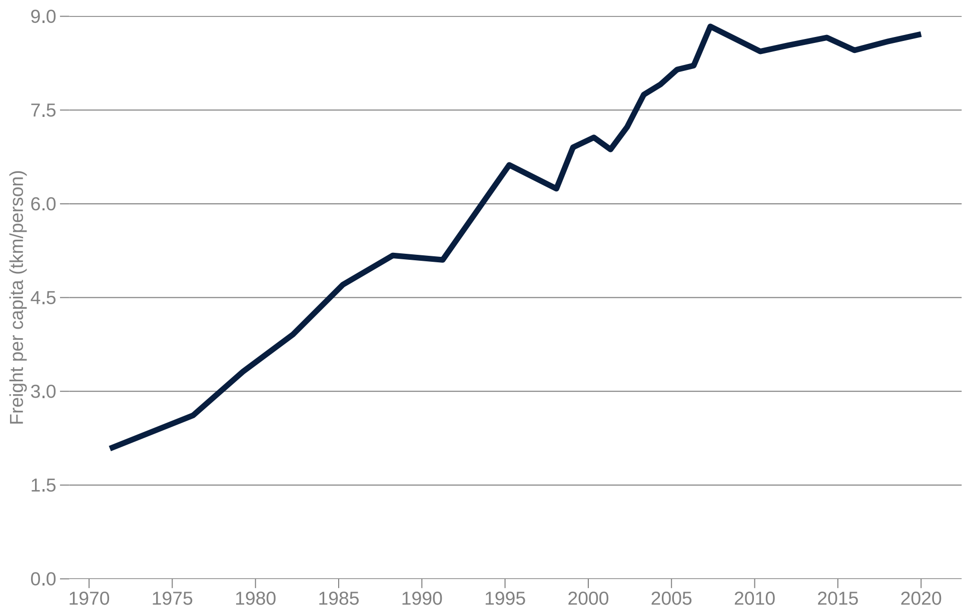
4 Though varying across jurisdictions, most states had legislation reserving transport of certain commodities to rail.

Figure 2.1 Australian road freight estimates (and 95% confidence bounds), 1971–2020



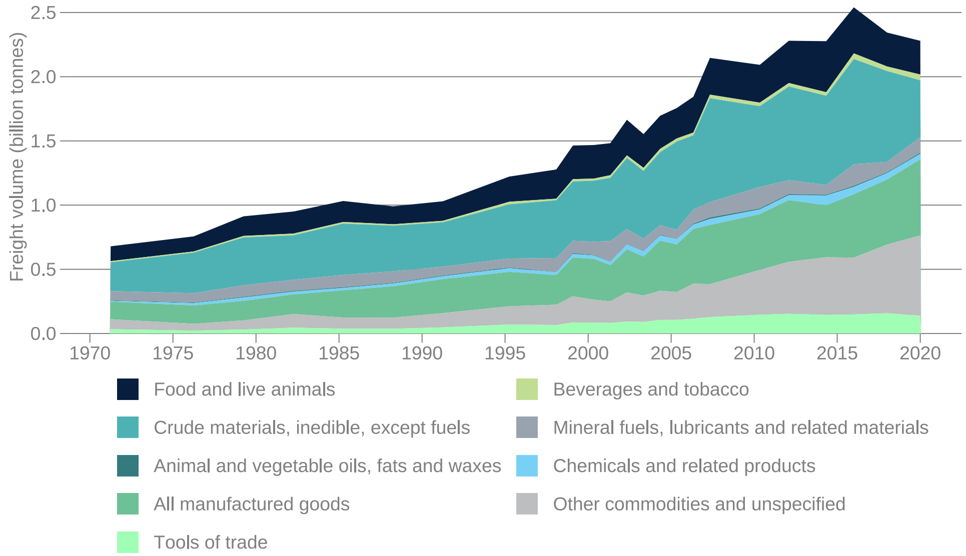
Source: ABS (2020) and earlier issues.

Figure 2.2 Australian road freight per capita, 1971–2020



Sources: ABS (2020) and earlier issues, and BITRE estimates.

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



Source: ABS (2020) and earlier issues.

slow down and/or cessation of construction projects (see Figure 2.3).[5] Of other commodities, total manufactured goods typically account for between 20–22 per cent of total road freight tonnages, which in 2019–20 increased to 26 per cent.[6] Food and live animals accounted for around 11.5 per cent of total freight tonnes in 2019–20 and other commodities and unspecified freight accounted for around 27.5 per cent of total road freight tonnes in 2019–20.

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 35 per cent of total road freight tonne kilometres, with the majority of road freight activity occurring outside cities. While road freight volumes have grown across all areas, the share of road freight occurring entirely within capital cities has declined from around 28 per cent in 1976 to around 22 per cent in 2019–20. Provincial urban road freight has increased slightly over that period, mainly due to expansion in the number of urban areas classed within 'provincial urban'. Non-urban road freight account for between 65 and 70 per cent of total road freight tonne kilometres. (BITRE (2022) provides more detailed forecasts of future capital city, interstate and intrastate road freight out to 2040.)

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.

2.1.2 Drivers of road freight growth

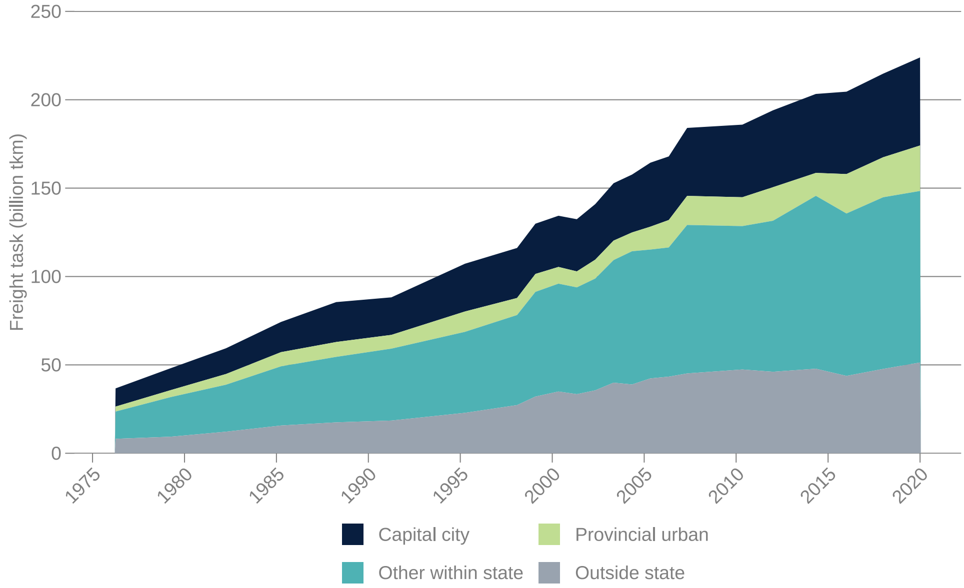
Road freight volumes are primarily influenced by total economic activity. For example, higher household expenditure on consumer goods, greater building and construction activity, higher domestic manufacturing outputs, all involve increased use of road freight services to deliver goods, inputs and/or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

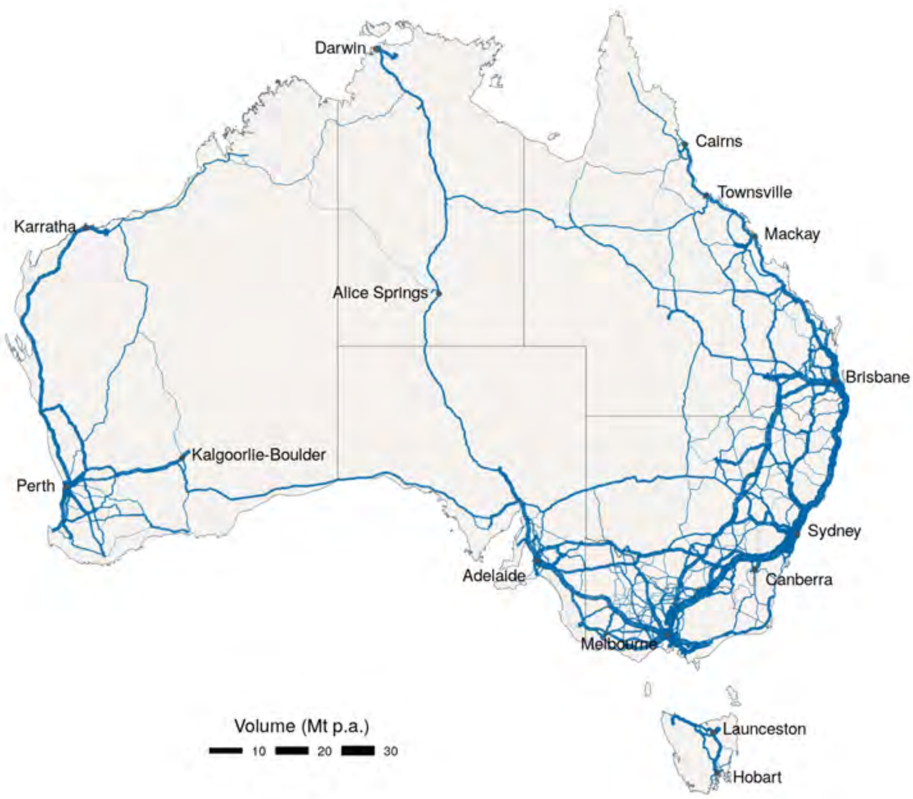
5 Reported volumes of tools-of-trade carried by LCVs also exhibited a drop relative to 2017–18, which would be consistent with the impact of COVID on domestic construction activity.
6 Comprising a 17 per cent increase in overall volumes when combined with the decline in construction material's freight task share.

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



Source: ABS (2020) and earlier issues.

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



Sources: ABS (2015) and BITRE estimates

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 secondary and tertiary products, and from domestic manufactures to a greater share of imports 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 International road freight trends

Comparing Australian road freight transport trends with road freight activity in other developed (and developing) countries, shows that Australia has one of the highest per capita rates of road freight activity among all countries (see Figure 2.6). Australia's current road freight transport intensity, approximately 8,800 tonne kilometres per person, is behind only the United States (approximately 9,240 tonne kilometres per person) and Poland (approximately 12,200 tonne kilometres per person), which has experienced rapid growth in road freight volumes since the mid-2000s, presumably predominantly due to growth in European freight transiting through Poland.[7] By comparison, road freight per capita levels in other comparable countries are far less. For example:

- Canada – 7,250 tkm/person (in 2018)
- France – 2,530 tkm/person
- Germany – 3,640 tkm/person
- New Zealand – 5,700 tkm/person
- United Kingdom – 2,100 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 other countries, particularly in Europe and the United States, rail and inland waterways play a larger role and carry a higher share of non-bulk freight.

Growth in per capita road freight volumes also appears to have slowed recently across many other developed countries, with per capita road freight volumes 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 longer terms, particularly in the absence of additional productivity enhancing reforms in either the transport sector or elsewhere.

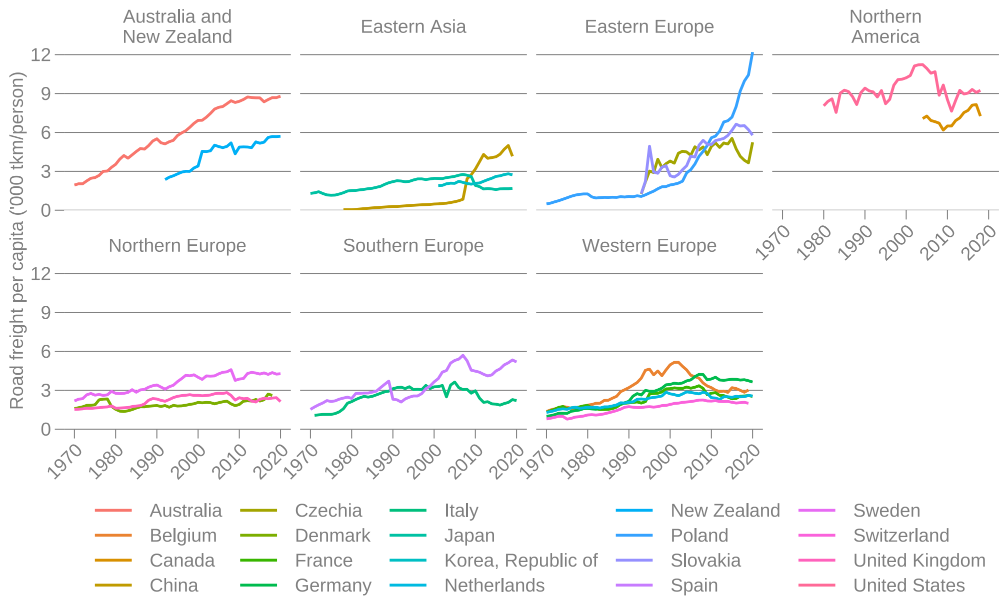
2.3 Modelling aggregate road freight activity

Aggregate Australian road freight activity is modelled as a single-equation econometric model that relates the national road freight task (measured in tonne kilometres) to domestic economic activity and road freight transport costs. BITRE's preferred forecasting model specification relates trends in per capita road freight activity to per capita real gross national income (GNI)—a measure of domestic output, less net payments to non-resident persons and businesses)—and real road freight rates.[8] (The empirical results for the preferred forecasting model are presented in Appendix Table B.1.)

7 Road freight volumes in Poland grew five-fold between 2001 and 2020, averaging growth of around 9.6 per cent per annum over that period; by far the fastest rate of growth in road freight across all OECD countries.

8 Other candidate economic activity measures tested included: gross domestic product, gross national expenditure and merchandise sector output, i.e. 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. While all four activity measures provide reasonable predictions of road freight transport activity, the empirical results suggest that GNI provides the best measure for the purposes of both prediction and forecasting.

Figure 2.6 International per capita road freight trends, for selected countries, 1971–2020



Sources: OECD (2022), UN (2019) and BITRE estimates.

Figure 2.7 shows the actual and preferred road freight per capita model fit—this specification almost perfectly predicts the plateau in per capita road freight activity apparent since 2007.

Figure 2.8 shows the estimated model elasticities, for the preferred per capita model specification. It implies that the economic activity elasticity has declined from over 3.0 in the 1970s to around 0.9 in 2007, and remained around that level since then. Similarly, the real road freight rate elasticity has declined (in absolute terms) from around -1.0 in the 1970s, to around -0.3 today. These results imply road freight demand has become less sensitive to changes in domestic economic activity and prices (freight rates), which is consistent with experiences observed overseas and in other related transport markets.[9]

2.4 Aggregate road freight forecasts

The forecast scenario assumptions outlined in Section 1.4 and Appendix A are then applied to the forecasting model to derive a suite of alternative scenario road freight forecasts. Three sets of forecasts are derived—*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. The median forecast scenario represents the BITRE's *reference case* forecasts of likely future aggregate road freight growth.

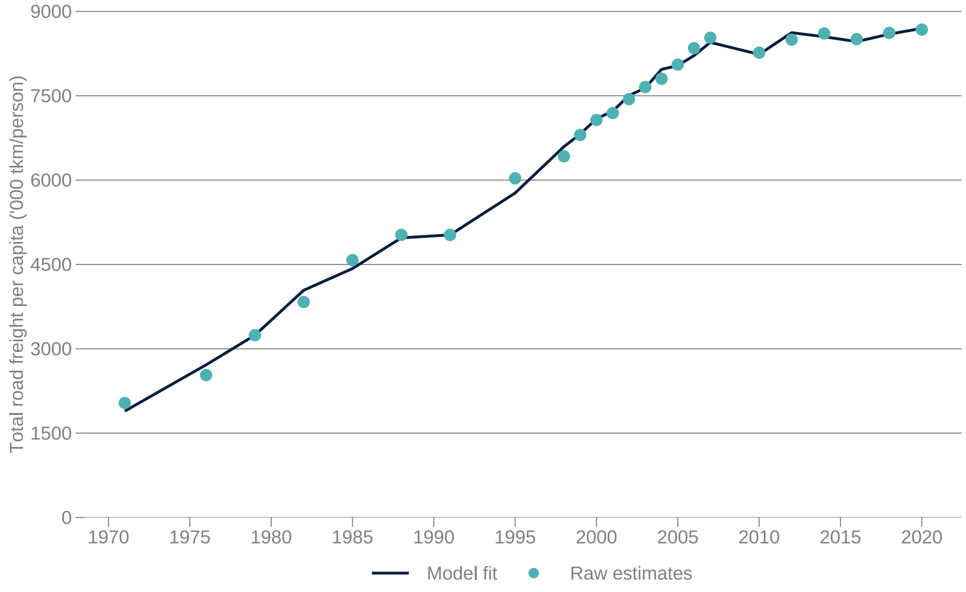
Figure 2.9 shows the aggregate reference case road freight forecasts, and the forecast range implied by the high and low forecast scenarios.

Under the *reference case* assumptions—which broadly reflect median GDP per capita growth assumptions, Centre for Population (2021) Central and ABS (2018b) Series B (median) combined population growth and EIA reference case world oil prices (see Appendix A)—road freight volumes are projected to increase from around 223 billion tkm in 2020 to around 308 billion tkm in 2035 and 394 billion tkm by 2050. This implies average annual growth of around 2.2 per cent per annum between 2020 and 2035 and 1.7 per cent per annum between 2035 and 2050.

The *low scenario* road freight forecasts—which assume below average GDP per capita growth, Centre for Population (2021) Extended and ABS (2018b) Series C combined population projections and EIA high case oil prices—imply road freight volumes would grow by around 1.7 per cent per annum between 2020 and 2035 (to around 286 billion tkm in 2035) and 1.2 per cent per annum between 2035 and 2050 (to around 343 billion tkm in 2050).

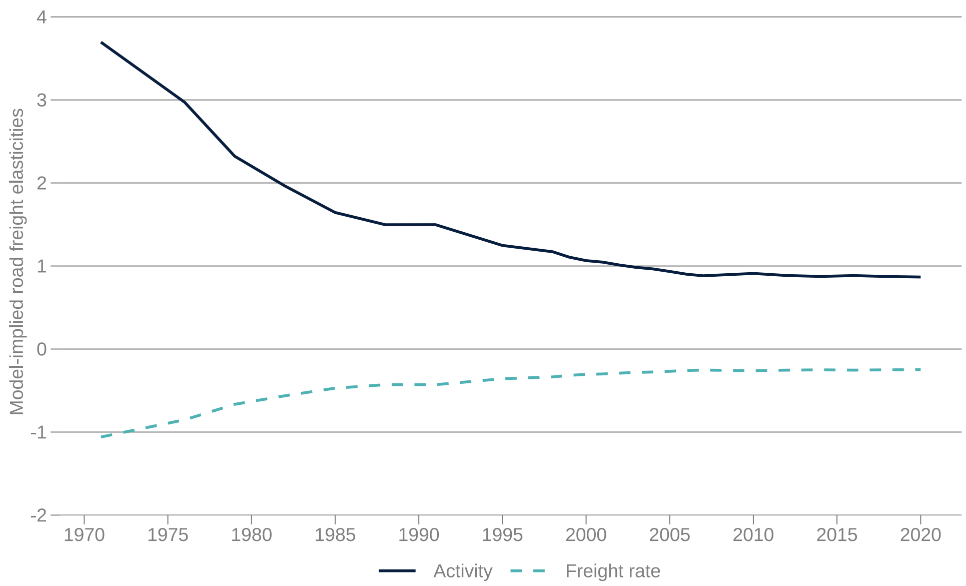
9 Litman (2019), for example, notes a range of transport elasticities have exhibited declining trajectories over time, particularly road transport related fuel use with respect to fuel prices.

Figure 2.7 Actual and estimated road freight per capita model fit, 1971–2020



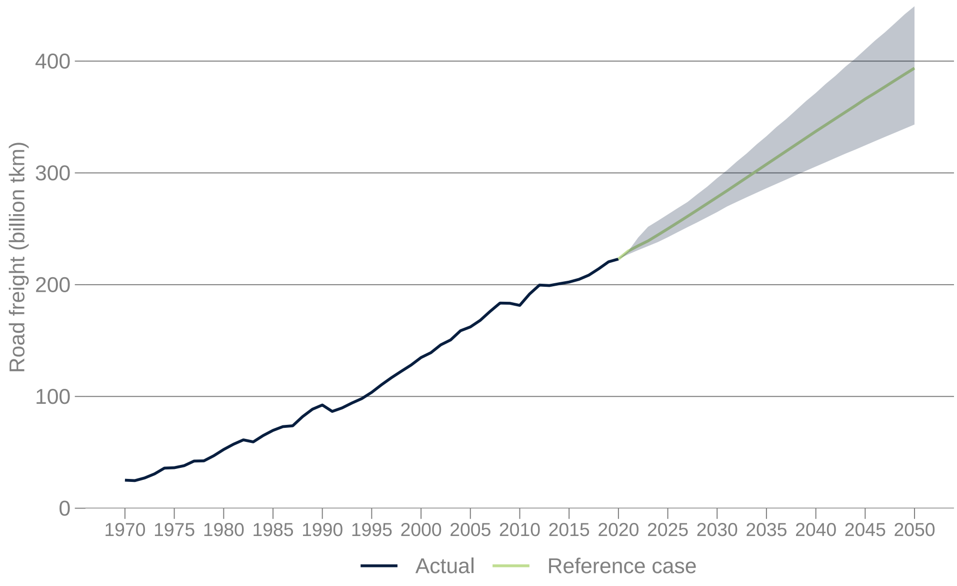
Source: BITRE estimates.

Figure 2.8 Aggregate road freight per capita model implied elasticities, 1971–2020



Source: BITRE estimates.

Figure 2.9 Preferred forecast aggregate road freight volumes, 2020–2050, reference growth case



Source: BITRE estimates.

The *high scenario* road freight forecasts assume above average GDP per capita growth, Centre for Population (2021) Central and ABS (2018b) Series A combined population projections and EIA low scenario oil prices, and imply road freight volumes would grow by around 2.7 per cent per annum between 2020 and 2035 (to around 333 billion tkm in 2035) and 2 per cent per annum between 2035 and 2050 (to around 449 billion tkm in 2050).

3. 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 450 billion tonne kilometres in 2019–20.

Figure 3.1 shows the approximate composition of the total rail freight task since 1971, and highlights the significance of iron ore movements to the total Australian rail freight task, which have increased from around 35 per cent of total rail tonne kilometres in 1989–90 to around 68 per cent in 2019–20. 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 20 per cent in 2019–20. Interstate non-bulk rail freight has grown from just under 5 billion tonne kilometres (around 11 per cent) in 1972 to around 24 billion tonne kilometres (5.6 per cent) in 2019–20. The remaining freight, which includes bulk grains and sugar cane rail volumes, which 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 billion tonne kilometres (around 5.6 per cent) in 2019–20.

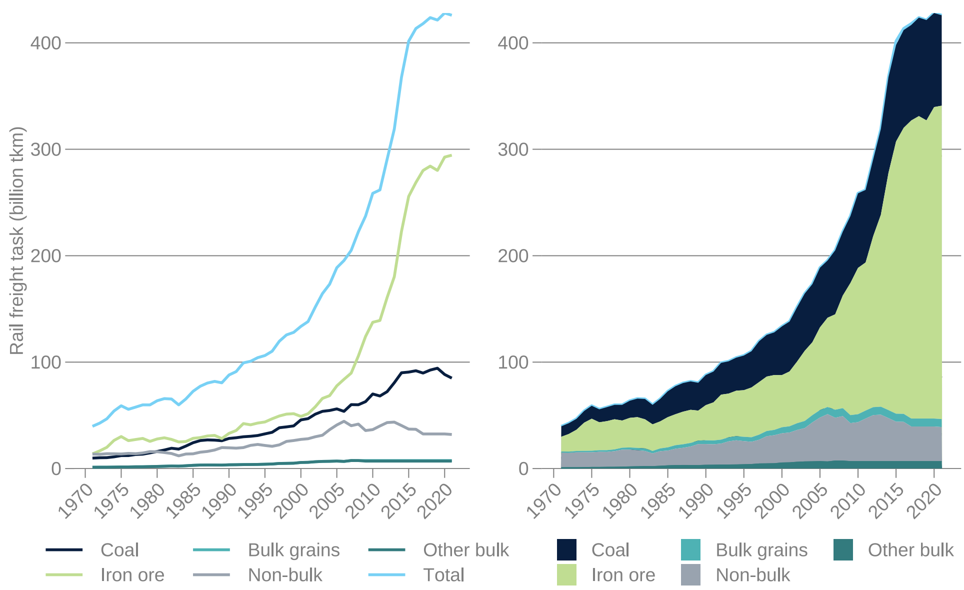
The factors behind the growth in these different rail freight commodities are very different. Growth in iron ore rail freight movements, for example, is driven by overseas demand for iron ore for use in steel production. Growth in coal rail freight volumes is also largely a function of overseas demand for:

i) metallurgical coal for steel production, primarily in north east Asia (i.e. China, Japan and South Korea), and
ii) thermal coal for energy generation, again primarily in north east Asia.

In contrast, intercapital non-bulk rail freight is influenced by domestic business and consumer demand, particularly in long-distance markets, and other rail freight volumes are driven by domestic production trends.

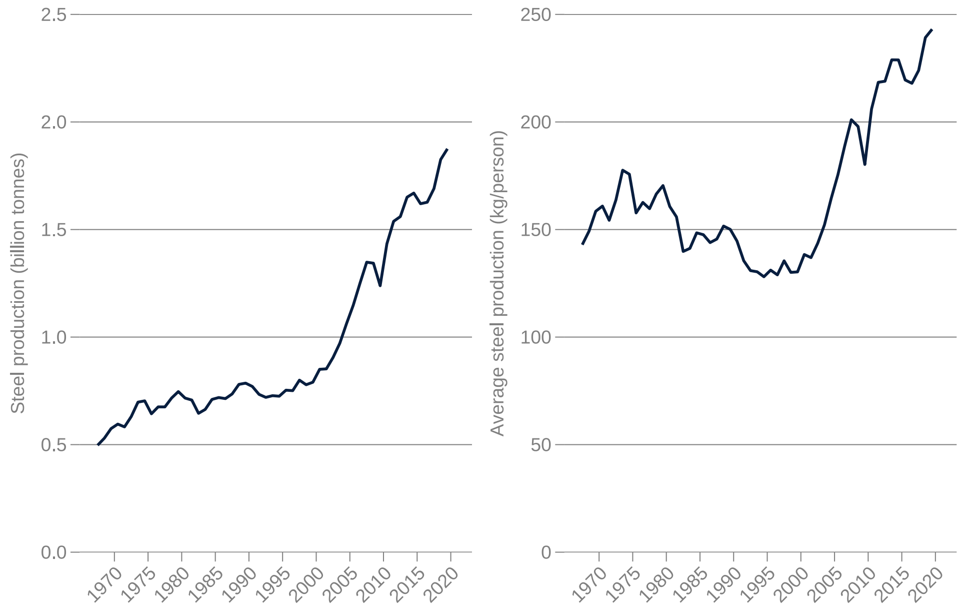
Accordingly, BITRE's aggregate domestic rail freight forecasting model splits rail freight into five separate broad freight segments:

Figure 3.1 Australian rail freight task, by major commodity group, 1971–2020



Source: WSA (2021) and earlier issues.

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



Sources: WSA (2021) and earlier issues, and BITRE estimates.

- Iron ore
- Thermal coal
- Metallurgical coal
- Interstate non-bulk freight
- All other rail freight.

BITRE separately models and forecasts each segment, which are then combined to derive total rail freight forecasts.

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

3.2 Australian iron ore rail freight forecasts

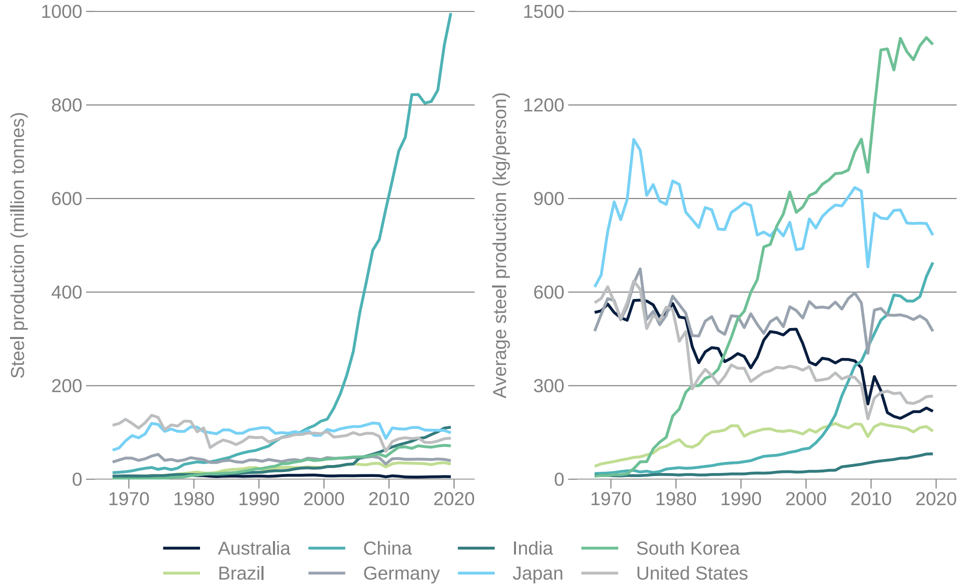
Australian iron ore rail freight forecasts are broadly based on the outlook for future total world steel production (Stage 1), likely future iron ore needs and Australia's likely share of global iron ore supply. The forecasts adopt a scenario-based approach, to capture the potential range of possible future annual steel production rates. 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.

3.2.1 World steel production

Total global steel production has increased threefold since 1970, from around 0.60 billion tonnes (in 1970) to around 1.88 billion tonnes in 2020, more than 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 240 kilograms per person in 2019.

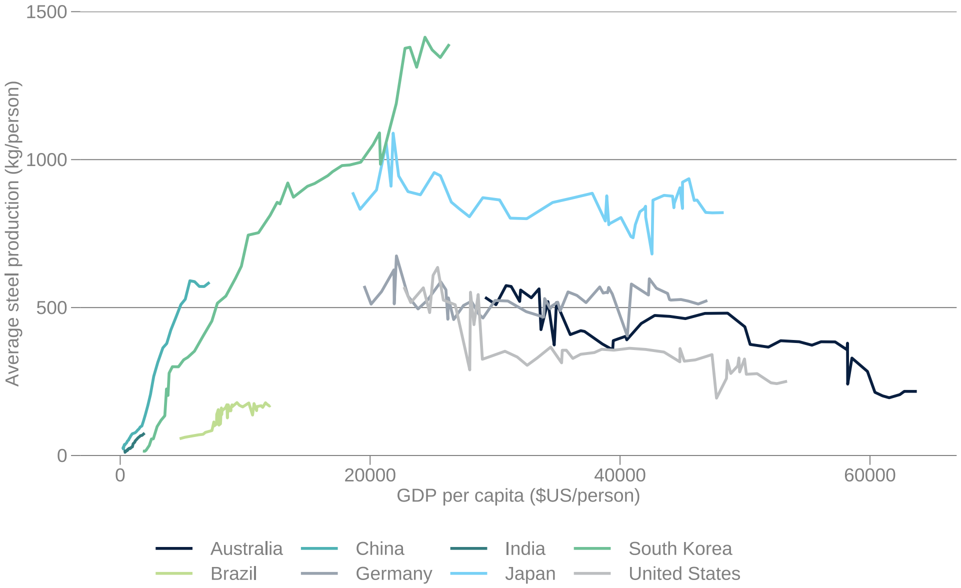
Figure 3.3 shows country-specific steel production and average per capita steel production for major steel-producing countries. The left-hand-side panel shows Chinese steel production has more than quadrupled since 2000 and average per capita production in China has grown from around 100 kilograms per person in 2000 to around 695 kilograms per person in 2019.

Figure 3.3 Total and per capita steel production for selected countries, 1971–2021



Sources: WSA (2021) and earlier issues, and BITRE estimates.

Figure 3.4 Total and per capita steel production vs. real GDP for selected countries, 1971–2021

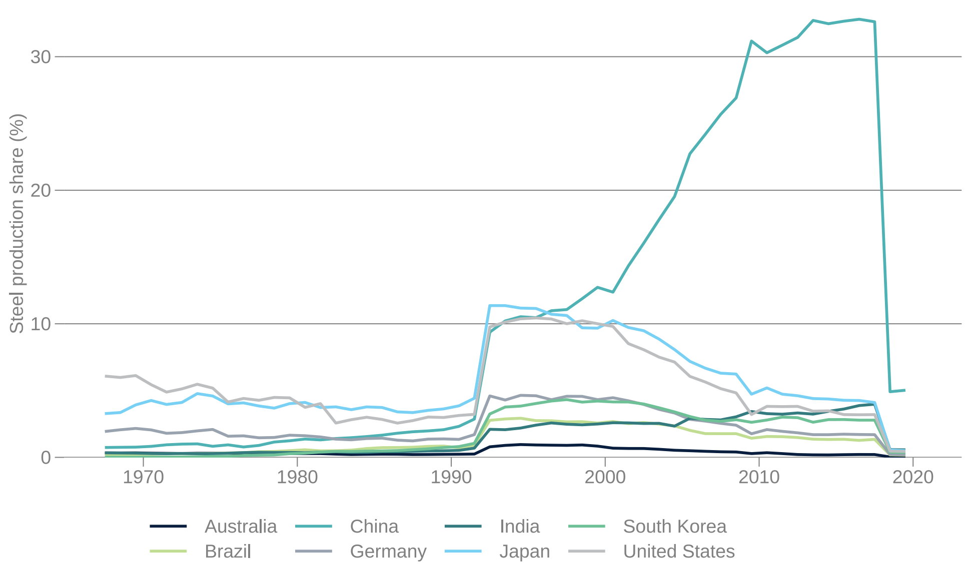


Sources: WSA (2021) and earlier issues and BITRE estimates.

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, where steel production has increased from around 23 million tonnes in 1990 to over 71 million tonnes in 2019, and average production has increased from around 540 kilograms per person in 1990 to around 1390 kilograms per person in 2019.

Lastly, Figure 3.5 shows the share of world steel production for major steel-producing countries. Most significantly, China's share of total production has increased from around 10, 10 per cent in 1995 to nearly 57 per cent in 2020.

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



Sources: WSA (2021) and earlier issues and BITRE estimates.

3.2.2 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, which are outlined below.

OCE medium term steel and iron ore outlook

The Office of the Chief Economist (DISAR) produces medium-term (5-year) commodity outlook forecasts for major Australian commodities, including world steel and iron ore production, in its March quarter issue each year. As at the time of writing, the latest publicly available OCE forecasts were OCE (2021).

OCE (2021, p. 27) notes that world steel consumption declined 0.9 per cent in 2020 due to the impact of the COVID-19 pandemic on global industrial production, particularly in Europe, the United States and Japan. OCE (2021, p. 27) also expects global steel consumption, and steel production, to rebound from the impact of COVID and to each rise by around 3 per cent rises in 2021 and 2022.

Over the next five years (the *medium term*) to 2027, OCE (2021) projects that world steel production will continue to increase, led by expansion of steel production in India, Japan, Brazil, Russia and several developing Asian countries, such as Vietnam, Malaysia, the Philippines, Myanmar and Indonesia. China's steel production is projected to grow only modestly, by around 0.5 per cent per annum over that period, as slower growth and efforts to re-balance its economy and curb domestic emissions reduce both domestic demand for and domestic production of steel. Steel production in India and Brazil, however, are each projected to grow by more than 8 per cent per annum, and production in each of Japan, Russia and South Korea are projected to grow by more than 3.5 per cent per annum over the same period.[10]

OCE's medium-term outlook also takes into account a longer-term levelling in the steel intensity of China's economy (i.e. per capita steel consumption). OCE (2021) notes there is substantial uncertainty around the trajectory of China's steel sector, as government policy has a significant influence. Despite this, OCE (2021) expects China to use increasing quantities of scrap material in steel production, which will reduce the demand for iron ore and metallurgical coal (OCE 2021, p. 25), and potentially Australian exports of those two commodities. OCE (2021) projects that China's steel consumption will increase from around 900 million tonnes in 2020 to around 978 million tonnes by 2026, and production to grow from around 1054 million tonnes in 2020 to around 1086 million tonnes by 2026 (see Table 3.1).

10 Note these projections were prepared almost 12 months prior to Russia's invasion of Ukraine, an event event that is likely to impact medium-term Russian production and use.

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

Country	Calendar year						
	2020	2021	2022	2023	2024	2025	2026
China	1 054	1 071	1 080	1 086	1 089	1 087	1 086
European Union	130	134	134	134	133	132	131
India	99	102	113	124	135	146	157
Japan	83	92	94	97	99	101	104
United States	72	75	77	79	81	83	84
Brazil	31	33	36	40	44	48	52
Russia	71	73	76	78	82	86	90
South Korea	67	73	75	77	79	81	83
World steel production	1 828	1 883	1 936	1 986	2 038	2 083	2 129

Sources: OCE (2021) and BITRE estimates.

Among other major steel producing countries, OCE expects Japanese steel production to increase by 3.7 per cent per annum over 2020 levels to around 104 million tonnes in 2026 and U.S. steel production to recover to around 84 million tonnes by 2026, from 72 million tonnes in 2020.

India's steel production is projected to increase to around 157 million tonnes by 2026, from just under 99 million tonnes in 2020.[11] Notwithstanding recent output growth, India's steel intensity is currently around 77 tonnes per person, well below that of China and other major developed countries. The Indian government has set a steel production capacity target of around 300 Mtpa by 2030 (Ministry of Steel, India 2017).[12]

Steel production is also expected to increase in several other 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 (2021) projects total global steel production will grow from around 1830 million tonnes in 2020 to around 2130 million tonnes by 2026, average annual growth of around 2.57 per cent per annum.

OCE Australian iron ore export outlook

Australia is the predominant global supplier of iron ore used in steel production, supplying over 53 per cent of all iron ore exports in 2020, with the majority supplied to China. Brazil is the second largest iron ore producer and exporter, accounting for around 24 per cent of global iron ore exports in 2020. Hence, the major factors affecting Australian iron ore exports are overseas demand, particularly China, and competition from other major suppliers, particularly Brazil.

Despite efforts to increase use of scrap steel and increase the share of steel produced using electric arc furnaces (EAF) in China, OCE expects China's iron ore imports to continue to grow as a result of declining domestic Chinese iron ore availability, from 9.3 per cent in 2018 (OCE 2021, p. 32).

With India's steel production projected to increase by around 50 million tonnes between 2020 and 2026, India is likely to require increasing imports of iron ore over the medium-term, with OCE projecting India's iron ore import needs likely to increase from around 5 million tonnes in 2022 to around 70 million tonnes by 2026 (OCE 2021, p. 39).

In the medium term, OCE expects Australia's share of global iron ore exports to increase from around 56 per cent in 2020 to around 60 per cent by 2026, and Brazil's share of exports to increase from around 22 per cent in 2020 to around 25 per cent by 2026. Australia's iron ore export volumes are projected to increase from around 870 million tonnes in 2020 to 1103 million tonnes in 2026 (see Table 3.2).

Domestic iron ore projects (mines) OCE expects to become operational over the medium-term outlook horizon include:

- Rio Tinto's Mesa B, C and H, Pannawonica and Koodaideri projects
- BHP's South Flank project
- Fortescue Mining Group's Eliwana project
- Roper Bar and Frances Creek mines in the Northern Territory
- Several smaller mines in South Australia, Western Australia and Tasmania (OCE 2021, p. 37).

11 India overtook Japan in 2018 to become the second largest steel producer (OCE (2021)).
12 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	2020	2021	2022	2023	2024	2025	2026
Australia	868	897	950	963	987	1 084	1 103
Brazil	341	396	428	446	461	459	455
Ukraine	30	22	26	25	24	20	26
India	34	40	30	30	28	23	31
World trade	1 552	1 686	1 716	1 739	1 763	1 799	1 844

Sources: OCE (2021) and BITRE estimates.

3.2.3 Other long-term outlooks

Several other sources also analyse and produce long-term projections of global steel consumption and production, and iron ore production and exports. These include Wood Mackenzie (2021d), Wood Mackenzie (2021c), IEA (2019), and Accenture (2017a) among others. This section outlines the key long-term outlooks from several of these sources.

Wood Mackenzie (2021)

Wood Mackenzie (2021d) project apparent finished global steel consumption to increase from around 1760 million tonnes in 2020 to around 1929 million tonnes by 2035 (average annual growth of 0.61 per cent per annum) and global steel production to increase from around 1879 million tonnes in 2020 to around 2042 million tonnes by 2035 (0.55 per cent per annum).[13]

Wood Mackenzie (2021d) project significant changes in country consumption and production over the next 15 years. In particular, China's share of consumption is projected to decline, from around 56 per cent in 2020 to 39 per cent by 2035, while the Indian and South East Asian share of finished steel consumption are projected to increase from 5 to 11 per cent and 4 to 7 per cent, respectively, between 2020 and 2035.

On the production side, Wood Mackenzie (2021d) projects Chinese crude steel production to decline from around 1065 million tonnes in 2020 to 855 million tonnes by 2035 (implying China's share of global production declines from 57 per cent in 2020 to 42 per cent by 2035). Wood Mackenzie (2021d) also project India's crude steel production will grow from around 100 million tonnes in 2020 to around 230 million tonnes by 2035 (an increase in the share of global production of 5 per cent in 2020 to 11 per cent by 2035). South East Asian crude steel production is projected to increase from around 43 million tonnes (2 per cent of global production) in 2020 to around 91 million tonnes (4.5 per cent) by 2035 (Wood Mackenzie 2021d).

Wood Mackenzie (2021d) also outline several long-term technology trends impacting impacting global steel production, including:

- Increasing preference for Electric-Arc Furnace (EAF) and use of scrap steel in steel feedstock, replacing more carbon-intensive Basic Oxygen (blast) Furnaces (BOF).
- Development of and transition to use of hydrogen in primary steel production (H2-steel), in place of coal.

Wood Mackenzie (2021d, p. 9) project the EAF share of global steel production to increase from around 27 per cent in 2020, to around 41 per cent by 2035. The most significant contributors to the increasing share of EAF production are China, Japan and South Korea. China's EAF steel production share is projected to increase from around 10 per cent in 2020 to around 26 per cent by 2035. The combined EAF steel production share across Japan and South Korea is projected to increase from around 28 per cent in 2020 to around 40 per cent by 2035.

Wood Mackenzie (2021d, p. 10) expect scrap steel use to increase from around 580 million tonnes (28 per cent of total metal input) in 2020 to around 776 million tonnes (36 per cent) by 2035. Over the same period, Wood Mackenzie (2021d) project scrap availability to grow by around 1.7 per cent per annum between 2020 and 2035. Lastly, Wood Mackenzie (2021d) project H2-steel could comprise as much as 10 per cent of global output by 2050.

The implications of the foregoing is that raw metal feedstock requirements (iron ore metal content) is projected to fall from around 1361 million tonnes in 2020 to around 1225 million tonnes by 2035 (a decline of 0.7 per

13 Beyond 2035, Wood Mackenzie (2021d) project steel consumption will grow by around 0.89 per cent per annum between 2035 to 2050, to around 2203 million tonnes by 2050, and steel production to grow by around 0.79 per cent per annum over the same period, to around 2297 million tonnes by 2050.

cent per annum). The implications of the above for Australia are that Australian iron ore exports are likely to remain above 900 million tonnes per year over the long term (Wood Mackenzie 2021c).

IEA World Energy Outlook iron ore outlook

The International Energy Agency's 2019 World Energy Outlook also obliquely references likely future world steel consumption and production trends, through its projections of likely future metallurgical coal consumption. It notes that the iron and steel sector emits approximately 2 gigatonnes of greenhouse emissions annually, with the majority of steel produced in blast furnaces using coal.[14] Like Wood Mackenzie (2021d), IEA (2019) notes that under its *Stated Policies Scenario* (baseline scenario) steel production is expected to decline in China between 2019 and 2040, and 'increase strongly in India and other developing Asian economies' (IEA 2019, p. 233).

IEA's *Sustainable Development Scenario* envisages reductions in iron and steel demand of 15 per cent by 2050 due to light-weighting of cars and trucks (for fuel consumption purposes) and efficiencies in the capital stock present in the buildings and power sectors, e.g. via retrofitting building stock to improve the energy efficiency (IEA 2019, pp. 109, 314). IEA (2019) also envisages increasing electrification of steel production (i.e. increased EAF-based production), increasing use of scrap steel as feedstock (IEA 2019, p. 235), and uptake of hydrogen-fuelled steel production (H2-steel) from 2025 onwards.

IEA (2019) projects global demand for steel is likely to grow by around 20 per cent (or 0.8 per cent per annum) between 2018 and 2040 (from around 1800 million tonnes in 2018 to around 2090 million tonnes by 2040) under the *Stated Policies Scenario*, but grow only to 1840 million tonnes by 2040 under the *Sustainable Development Scenario* (IEA 2019, p. 313). IEA (2019) also note that motor vehicles currently account for around 12 per cent of total steel demand and 14 per cent of global aluminium consumption, and they assume a 12 per cent reduction in light and heavy vehicle sales by 2040 under the *Sustainable Development Scenario* in comparison with the *Stated Policies Scenario*. IEA (2019) also notes that the increasing shift from internal combustion engine vehicles towards electric and fuel-cell electric vehicles will also change the material requirements of vehicles and see more aluminium in place of steel inputs (IEA 2019, pp. 313-314). As a consequence global steel demand falls by 12 per cent under their *Sustainable Development Scenario* relative to the *Stated Policies Scenario* (IEA 2019, pp. 316).

Accenture 2017

Accenture's report on historical trends in country steel consumption and notes several key factors influencing the long-term steel demand (and production) outlook (Accenture 2017a, Accenture 2017b):

- As countries develop, steel consumption per capita increases 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 (2017a) 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 (2017a) 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 (2017a) also posit two alternative 'disruptive' scenarios:

- 'Incremental' disruption (*Incremental* scenario), 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 (*Radical* scenario), under which global steel demand grows by 0.4 per cent per annum to 1.75 billion tonnes by 2035.

14 According to WEO, production of steel, cement and aluminium accounts for 10 per cent of global energy consumption IEA (2021a).

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

Accenture (2017a) also expect on the supply side, to see increased use of electric arc furnace (EAF) production, increased use of scrap steel feedstock, reducing iron ore input demand requirements. Hence, Accenture (2017a) 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.

3.2.4 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 of Wood Mackenzie (2021c), IEA (2019), Accenture (2017a) and other sources. Around these forecasts BITRE posit three broad scenarios, based on different potential future global steel production outlooks:

i) Base case steel demand scenario (Scenario 1) – Under this scenario, world steel demand is projected to continue to increase out to 2050, to around 2460 million tonnes. Chinese steel demand is projected to have already peaked and will decline over the projection horizon, with production growth switching to other Asian countries. Under this scenario, Australian iron ore exports are projected to grow to 1100 million tonnes by 2040 and over 1170 million tonnes by 2050.

ii) Moderate steel demand growth 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 products and use of substitutes—*Reduce–Re-use–Re-manufacture–Recycle*—results in a 7 per cent reduction in world steel demand relative to the base case scenario.[15] Under this scenario, Australian iron ore exports are projected to decline slightly over the projection horizon, to around 850 million tonnes between 2030 and 2050.

iii) Increased scrap utilisation scenario (Scenario 3) – The third scenario involves accelerated transition to electric arc furnaces and increased availability and use of scrap in primary steel production (and hence less demand for iron ore feedstock) particularly across in China, but also in other developing steel producers. Under this scenario, the share of steel produced from blast furnaces is projected to decline by around 1.5 per cent per annum between 2025 an 2050.[16]

Figure 3.6 shows the assumed growth in global iron ore demand under the three scenarios (Panel a) and implied growth in Australian iron ore exports (Panel b).

These forecasts imply total future Australian iron ore rail freight volumes could increase by as much as 32 per cent under Scenario 1 or decrease by as much as 15 per increase under Scenario 3 between 2020 and 2050.

- Under Scenario 1 total iron ore rail freight volumes are projected to increase from around 294 billion tonne kilometres in 2020 to around 385 billion tonne kilometres by 2050.
- Under Scenario 2 total iron ore rail freight volumes are projected to increase to around 330 billion tonne kilometres by 2025, but decline slightly over the next 25 years to around 315 billion tkm in 2050.
- Under Scenario 3 total iron ore rail freight volumes are projected to peak around 330 billion tonne kilometres by 2025 and decline to around 275 billion tonne kilometres by 2040 and 250 billion tonne kilometres by 2050.

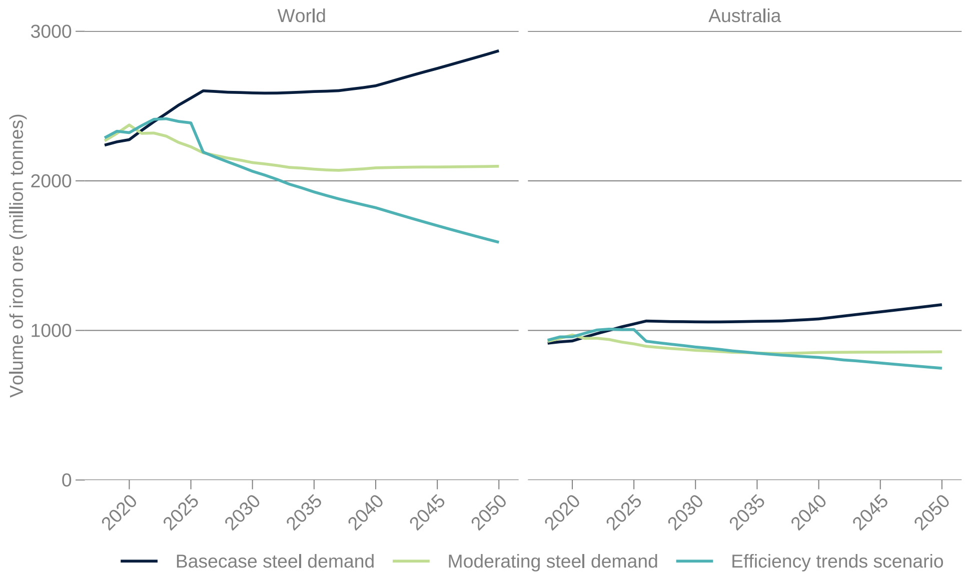
Figure 3.7 shows the implications for Australian iron ore rail freight volumes under each of these scenarios.

3.3 Coal rail freight forecasts

Australia is one of the two largest coal exporters in the world (behind only Indonesia) and responsible for approximately 8 per cent of global production and 30 per cent of total global coal trade in 2020. Australia

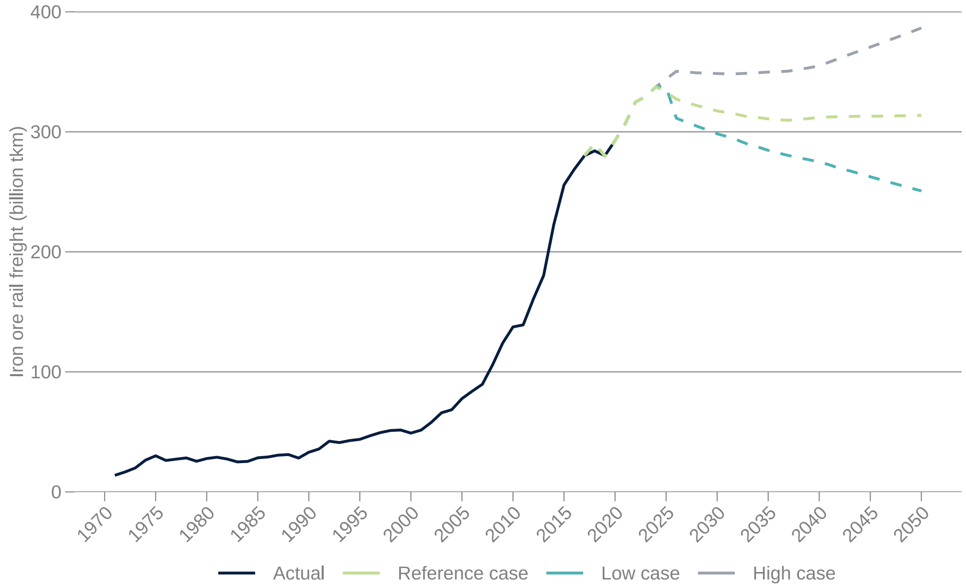
15 A roughly 0.2 per cent per annum improvement in the steel use efficiency.
16 The share of scrap in steel production is likely to increased under all scenarios, but most aggressively under this scenario.

Figure 3.6 World iron ore demand and Australian iron ore production forecast scenarios, 2020–2050



Sources: WSA (2021), IEA (2021a), OCE (2021), Wood Mackenzie (2021d) and BITRE estimates.

Figure 3.7 Australian iron ore rail freight scenario forecasts, 2020–2050

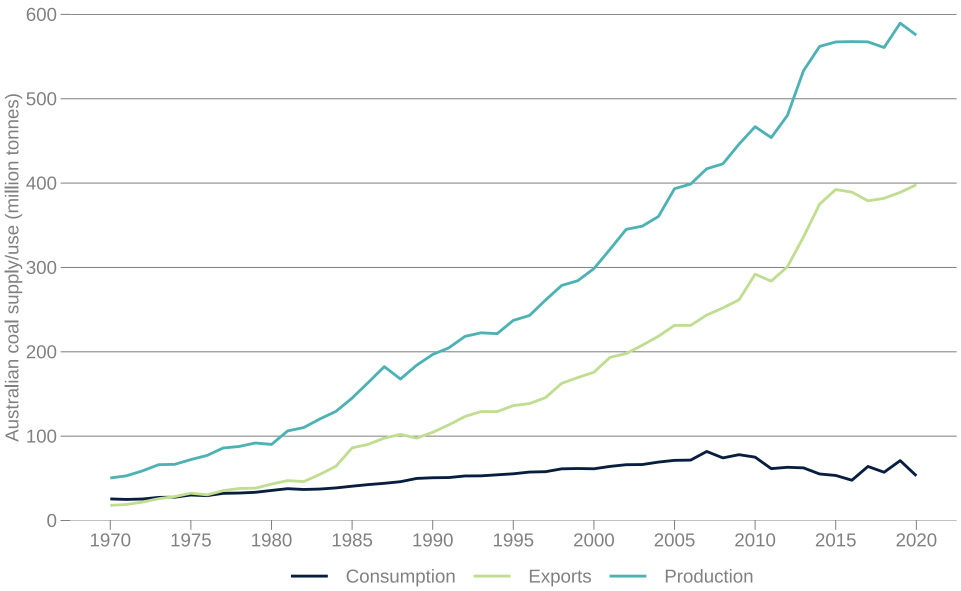


Source: BITRE estimates.

exports approximately 85 per cent of total annual saleable coal production in any single year. Consequently, forecasting Australia's likely future coal rail freight volumes principally depends on the future outlook for world coal demand.

Australia produced around 580 million tonnes of coal in 2019–20, exporting around 398 million tonnes and consuming 53 million tonnes. Metallurgical coal exports totalled around 177.3 million tonnes in 2019–20 (44.5 per cent of total exports), and thermal coal exports totalled 212.7 million tonnes in 2019–20.

Figure 3.8 Australian coal production, consumption and exports, 1970–2021



Sources: OCE (2022) and BITRE estimates.

3.3.1 Total global coal production and consumption trends

Total world coal production grew from around 3.8 billion tonnes in 1980 to around 8.0 billion tonnes in 2013, and since then annual production has varied between 7.3 and 8.0 billion tonnes per year. In 2018–19, total global coal production was around 8.0 billion tonnes, but in 2019–20 production declined to 7.6 billion tonnes due to the COVID-19 pandemic—Figure 3.9 shows trends in total world coal production between 1980 and 2020. Over the same period, total metallurgical coal consumption (and production) has increased from around 458 million tonnes in 1980 to over 1015 million tonnes in 2020, with much of that growth attributable to growth in Chinese steel production since 2000.

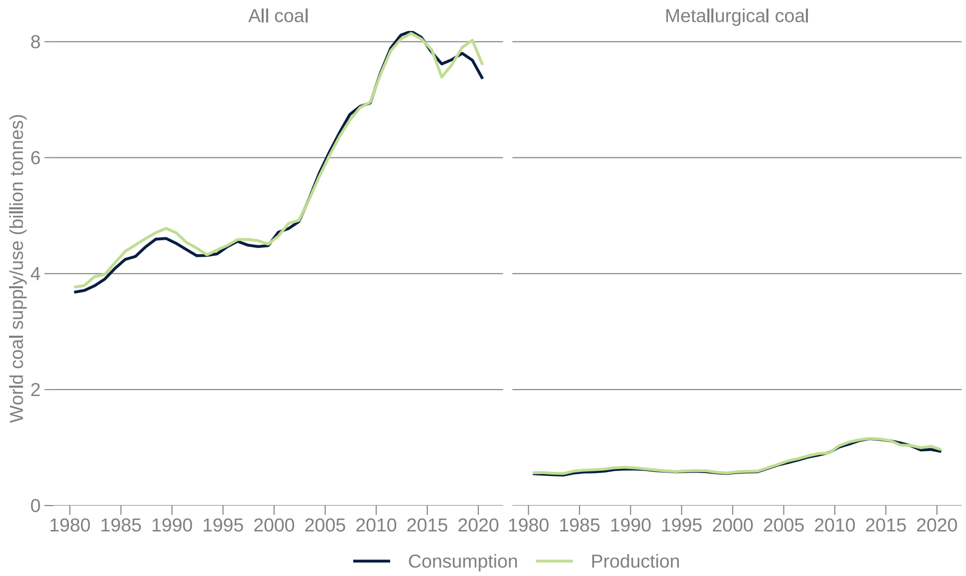
3.3.2 World coal use and Australian coal export outlook

In deriving its long-term Australian coal rail freight scenarios, BITRE has used the medium-term (5-year) commodity outlooks of the Office of the Chief Economist (OCE) (OCE 2022) and the long-term coal energy outlook scenarios for world and Australian coal demand from the International Energy Agency (IEA) (IEA 2021a) and U.S. Energy Information Administration (EIA) (EIA 2021b). The OCE medium-term projections inform the near-term 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.

International Energy Agency coal production forecasts

The International Energy Agency (IEA) produces annually energy outlooks that provide long-term (20–30 year) scenarios of world and region-specific energy supply and demand by fuel type (e.g. coal, oil, gas, renewables, etc.). The latest IEA World Energy Outlook (IEA 2021a) presents three long-term energy development scenarios, which include specific estimates of likely future global and regional coal production and demand:

Figure 3.9 World coal production and consumption, 1980–2020



Sources: OCE (2022) and BITRE estimates.

1. *Stated Policies Scenario* (SPS), which reflects current policy settings based on a sector-by-sector assessment of the specific policies that are in place, as well as those that have been announced by governments around the world.
2. *Announced Pledges Scenario* (APS), which assumes that all climate commitments made by governments around the world, including Nationally Determined Contributions (NDCs) and longer term net zero targets, will be met in full and on time.
3. *Sustainable Development Scenario* (SDS), which sets out a narrow but achievable pathway for the global energy sector to achieve net zero CO2 emissions by 2050.

Stated Policies Scenario (SPS) coal forecasts

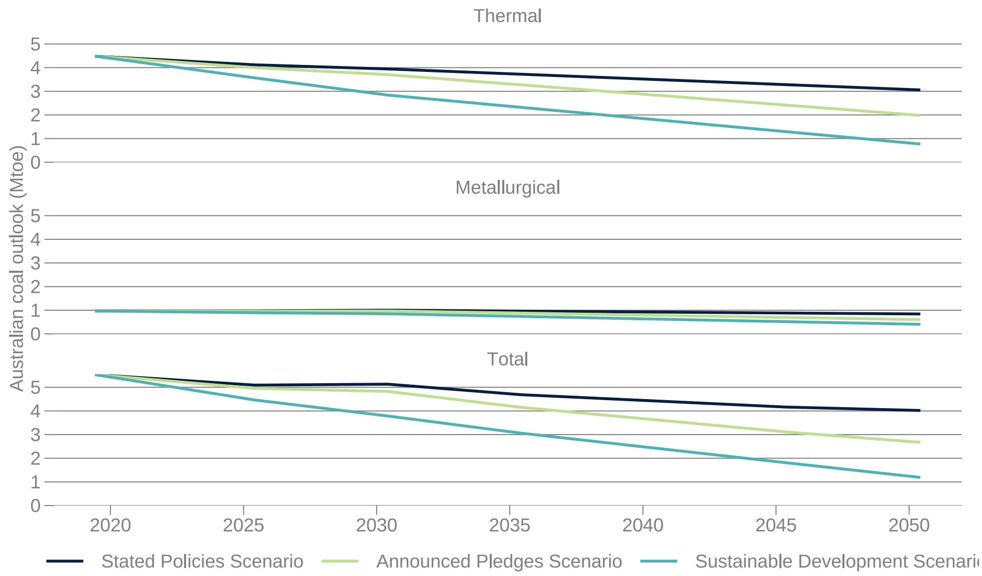
Under the SPS, world coal demand (and production) is projected to decrease from around 5317 Mtce to around 5132 Mtce by 2030 (a 3.5 per cent reduction of 2020) and 4019 Mtce by 2050 (-24 per cent relative to 2020).[17] The projected reduction in coal demand will be primarily due to a 30 per cent decline in the power sector over this period as wind and solar provide an increasing share of electricity generation, while coal use by industry is projected to fall by around 10 per cent between 2030 and 2050. In China, IEA projects 30–35 per cent reduction in coal use across both the electricity and industry sectors between 2030 and 2050. In India, IEA projects that while coal use for electricity generation is likely to decline, by around 35 per cent between 2030 and 2050, most of that reduction is offset by increases in industrial use, such that coal demand peaks in the mid-2030s but declines thereafter, but will still be above 2020 levels by 2050 (IEA 2021a, pp. 244).

Global thermal coal production under the SPS is projected to fall from around 4300 Mtce to around 3945 Mtce (-8 per cent) by 2030 and 3057 Mtce (-29 per cent) by 2050, and metallurgical coal production is projected to increase from around 940 Mtce in 2020, to around 1005 Mtce (7 per cent) by 2030, but decrease to around 2672 Mtce (down 10 per cent over 2020) by 2050. Under the SPS, coal demand is projected to fall between 2020 and 2050 in China and Japan, but increase over the same time frame in India and Southeast Asia.

Announced Pledges Scenario (APS) coal forecasts

17 Note that all WEO energy use estimates are provided in million tonnes of coal equivalent (Mtce) energy—IEA one tonne coal is equivalent to around 29.3GJ. 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.

Figure 3.10 IEA world coal consumption outlook, 2020–2050



Sources: IEA (2021a) and BITRE estimates.

Under the APS, total world coal demand is projected to decrease to around 4828 Mtce by 2030 (a 9 per cent reduction on 2020) and 2672 Mtce by 2050 (down 50 per cent on 2020). Under this scenario, coal use in China falls by nearly 70 per cent between 2030 and 2050, primarily due to electrification of many industrial processes (e.g. increase used of electric arc furnaces for iron and steel production) and reduced coal use in power generation (IEA 2021a, pp. 245).

World thermal coal production is projected to decline to around 3703 Mtce (-14 per cent) and 1982 Mtce (-54 per cent) by 2050, and metallurgical coal production is projected to increase 3 per cent, to around 970 Mtce by 2030, and thereafter decline 35 per cent over 2020 levels, to around 605 Mtce. Coal demand in India and Southeast Asia is projected to increase between 2020 and 2050 under the APS.

Sustainable Development Scenario (SDS) coal forecasts

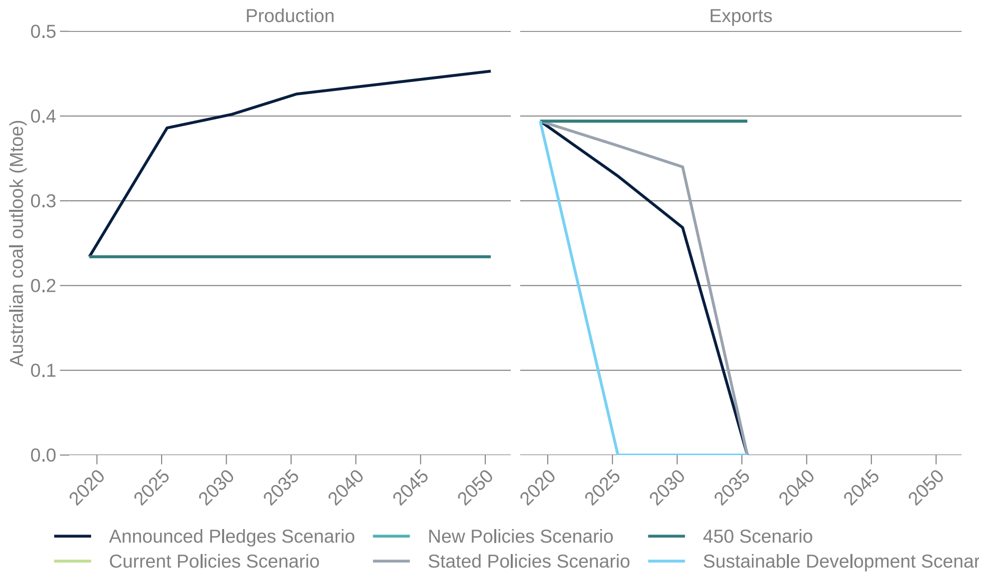
And under the SDS scenario, world coal demand is projected to decline to around 3786 Mtce by 2030 (a 29 per cent reduction on 2020) and 1189 Mtce by 2050 (78 per cent below 2020 levels) (IEA 2021b). Thermal coal production is projected to decline shrink 34 per cent to 2839 Mtce by 2030 and by a further 72 per cent from 2030 to around 710 Mtce by 2050, and metallurgical coal production is projected to increase 3 per cent, to around 970 Mtce by 2030, and thereafter decline 35 per cent over 2020 levels, to around 605 Mtce (IEA 2021b). Under the SDS scenario, coal demand is projected to be lower in 2050 than in 2020 across all of China, Japan, India and Southeast Asia (IEA 2021a, p. 318).

Figure 3.10 shows the IEA world thermal, metallurgical and total coal consumption outlook between 2020 and 2050 under each of the three alternative forecast scenarios.

IEA projections – Australian coal production and exports

IEA (2021a) includes some estimates of Australia's potential future coal production and export outlook under the SPS and APS scenarios. Under the SPS, IEA (2021a) projects that Australian coal exports will fall by around 5 per cent between 2020 and 2030 to around 340 Mtce in 2030, principally due to declining demand in Japan and Korea. However, coking coal exports are projected to increase slightly and the IEA suggests Australian thermal coal exports will displace some Indonesian exports to 2030 (IEA 2021a, pp. 242–243). Under the APS, IEA projects that Australian coal exports fall by 25 per cent by 2030. And under the SDS scenario, global coal

Figure 3.11 Australian coal production, exports and consumption outlook, 2017–2050



Sources: IEA (2021a) and BITRE estimates.

trade drops by more than 50 per cent to 2030 and production in all exporting countries falls sharply (IEA 2021a, pp. 242–243).

IEA (2021a, p. 265) also notes that under the SDS the production of hydrogen, or ammonia from electricity that has been converted and reconverted during storage, is likely to emerge as replacement for fossil fuel energy sources, and that Australia is well-placed to transform renewable-generated energy into hydrogen and/or ammonia for export. While the domestic transport implications of such pathways are yet unclear, it is likely that many such domestic production facilities would be located near export facilities, hence domestic transport impacts may involve little land transport.

Figure 3.11 shows BITRE estimates of the IEA coal outlook scenarios on potential future Australian coal production and exports.

OCE medium term outlook

The Office of the Chief Economist (DISAR) produces medium-term (5-year) commodity outlook forecasts for major Australian commodities in the first quarter each year, including separate forecasts of Australian metallurgical and thermal coal exports.

OCE (2022) projects that over the medium term world metallurgical coal trade will grow by around 1.0 per cent per annum between 2021 and 2027, from around 323 million tonnes in 2021 to around 343 million tonnes by 2027 (OCE 2022, p. 54). India overtook China in 2021 as the largest metallurgical coal importer, and OCE projects India's demand will grow by 3.6 per cent per annum between 2021 and 2027, from 73 million tonnes in 2021 to 90 million tonnes by 2027. OCE projects Chinese imports will decline slightly between 2021 and 2027, from around 53 million tonnes in 2021 to around 49 million tonnes by 2027, as domestic steel production contracts in response to slower economic growth and increasing use of scrap steel in primary steel production. OCE (2022) expects Australia to remain the predominant metallurgical coal exporter, accounting for between 50 and 55 per cent of total world exports between 2021 and 2027, with exports of metallurgical coal to increase from around 167 million tonnes in 2021 to around 185 million tonnes by 2027 (OCE 2022, p. 62) (see Table 3.3).

OCE (2022) projects over the medium term that world thermal coal trade will decrease by around 1 per cent per annum, from around 1060 million tonnes in 2021 to around 990 million tonnes by 2027, due to global efforts to transition from high-carbon to low-carbon energy sources. OCE (2022) note, for example, that 'coal imports to European nations are expected to decline particularly rapidly in the second half of the outlook period as coal plant retirements gather pace' (OCE 2022, p. 66). Even in Asia, where thermal coal demand is likely to hold up longer than in other regions, as a result of increasing economic and industrial demand, overall thermal coal imports are projected to decline by slightly (by less than 1 per cent per annum) between 2021 and 2027, from

Table 3.3 OCE forecast metallurgical coal exports, major exporting countries, 2021–2027

	Calendar year						
Country	2021	2022	2023	2024	2025	2026	2027
Australia	167	179	179	181	181	183	185
United States	40	41	41	39	40	41	42
Canada	29	29	29	26	26	26	26
Russia	32	30	33	33	33	33	34
Mongolia	22	22	26	30	29	28	29
Mozambique	5	6	7	7	8	9	9
World trade	323	321	330	331	334	338	343

Source: OCE (2021) [p. 62].

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

	Calendar year						
Country	2021	2022	2023	2024	2025	2026	2027
Indonesia	440	432	430	430	430	429	427
Australia	199	204	205	207	207	209	209
Russia	172	171	173	173	173	173	176
Colombia	32	34	35	36	33	31	31
South Africa	80	81	81	80	75	70	64
United States	32	29	31	25	22	17	15
Total world trade	1 059	1 024	1 018	1 015	1 012	1 003	990

Sources: OCE (2022) and BITRE estimates.

865 million tonnes in 2021 to 823 million tonnes by 2027. OCE (2022) projects China's thermal coal imports will decline from around 262 million tonnes in 2021 to around 211 million tonnes by 2027, but Indian thermal coal imports will increase from around 151 million tonnes in 2021 to around 173 million tonnes by 2027. Thermal coal imports by Japan and South Korea are also projected to decline over the OCE outlook horizon. 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 2022, p. 75) (see Table 3.4).

OCE's thermal and metallurgical coal export projections together imply total Australian coal exports will increase slightly over the next 5 years from around 383 million tonnes in 2020 to around 394 million tonnes by 2027.

Wood Mackenzie Australian coal production outlook

Wood Mackenzie's longer-term coal market projections suggest Australian coal exports will increase from around 370 million tonnes in 2021 to around 430 Mtpa by 2030 (average annual growth of 1.7 per cent p.a.) and close to 500 Mtpa by 2050 (Wood Mackenzie 2021a, p. 3). Wood Mackenzie (2021a) project metallurgical coal demand to grow to around 270 million tonnes and thermal coal demand to grow to around 260 million tonnes by 2050 (Wood Mackenzie 2021a, p. 2). Like the IEA and OCE, Wood Mackenzie expect significant growth in demand for Australian coal from India, but note that the medium-term outlook is increasingly at risk (Wood Mackenzie 2021a, p. 2), due to international carbon mitigation efforts, access to financing and willingness to invest. Wood Mackenzie's long-term mineral resource outlook suggests that Australia could continue to export at or near current levels out to 2050, should there be sufficient demand, with the majority supplied by new resource projects.[18]

United States' EIA coal production and use forecasts

The U.S. Energy Information Administration (EIA) also regularly produces long-term projections of future world energy production and use, at country and/or region-level, including projections of coal production and use (EIA 2021b, and earlier issues). EIA's projections comprise several scenarios—median (*Reference*) case projections and high/low growth and high/low oil price variations. Detailed projections are provided for the *Reference* case, and summary projections for the variations.[19]

18 Currently operating mines would account for around 25 per cent of production by 2050.

19 EIA notes that it's Reference case projections are 'modelled based on assumptions that reflect current energy trends and relationships, existing laws and regulations, and select incremental economic and technological changes over time' EIA (2021c) p. 1. In particular, EIA

EIA (2021b)'s Reference case projects total world coal consumption will continue to grow over the next three decades from around 7200 metric tonnes in 2020 to around 8300 metric tonnes by 2050—a compound average annual growth rate of 0.5 per cent per annum.[20] By way of comparison, IEA's Stated Policies Scenario outlook projects global coal demand to *decline* by 0.9 per cent per annum between 2020 and 2050.

EIA projects China's coal use will decline by around 0.5 per cent per annum between 2020 and 2050, while coal consumption in India and other development Asian economies are each projected to grow by around 3.1 per cent per annum over the same period—in other words, decreasing coal consumption in China, the United States and other OECD countries, will be more than offset by increasing consumption in India, Africa, the Middle East and other non-OECD Asian countries. (Coal consumption in OECD countries is projected to decline by around 0.8 per cent a year over this period.)

With regard to China, EIA (2021b) projects that both energy generation and industrial use of coal will decline between 2020 and 2050:

- Metallurgical coal use is projected to decline from around 620 million tonnes in 2020 to around 320 million tonnes by 2050—average annual growth of -2.1 per cent per annum.
- Thermal coal use is projected to decline from around 3350 million tonnes in 2020 to around 3100 million tonnes by 2050—an average rate of growth of -0.3 per cent per annum (EIA 2021b, converted to metric tonnes).

Again, EIA's projections of Chinese coal demand are significantly above IEA's SPS projections, which project Chinese coal demand to decline by 1.3 per cent per annum between 2020 and 2050.

EIA projects India's coal demand to increase 140 per cent between 2020 and 2050, due to new coal-fired electricity generating capacity and increased industrial production. Industrial coal use (metallurgical coal) is projected to grow 160 per cent, from around 105 million tonnes in 2020 to around 280 million tonnes by 2050, and thermal coal use is projected to increase by 140 per cent over the same period. India's domestic coal production is projected to increase by around 3.1 per cent per annum, from around 580 million tonnes in 2020 to around 1440 million tonnes by 2050.

With respect to international coal trade, EIA projects that Australia and Indonesia will remain the largest coal exporting countries out to 2050, with total global trade in coal projected to grow at an average of 0.9 per cent per year between 2020 and 2050. EIA projects Australian coal exports will increase by around 1 per cent per annum between 2020 and 2050, with thermal coal exports projected to increase 1.2 per cent per annum, from around 185 million tonnes in 2020 to around 260 million tonnes by 2050, and metallurgical coal exports are projected to increase 0.9 per cent per annum, from around 200 million tonnes in 2020 to around 273 million tonnes by 2050.

3.3.3 Australian coal rail freight projections

The IEA (2021a), EIA (2021b), Wood Mackenzie (2022), Wood Mackenzie (2021a) and OCE (2022) projections imply a potentially wide range of potential future trajectories for Australian coal production and exports. All four sources imply continued growth in Australian coal exports over the next five years. Thereafter, EIA (2021b) and Wood Mackenzie (2021a) project continuation of currently enacted energy and emissions policies, and continuing growth in Australian coal production and exports over the long-term to 2050. In contrast, IEA (2021a) project declining coal production over the long term.

In order the reflect the range of potential future Australian coal production and export outcomes, BITRE posits three broad scenarios, based on combinations of the IEA (2021a), EIA (2021b), Wood Mackenzie (2022), Wood Mackenzie (2021a) and OCE (2022) coal outlooks:

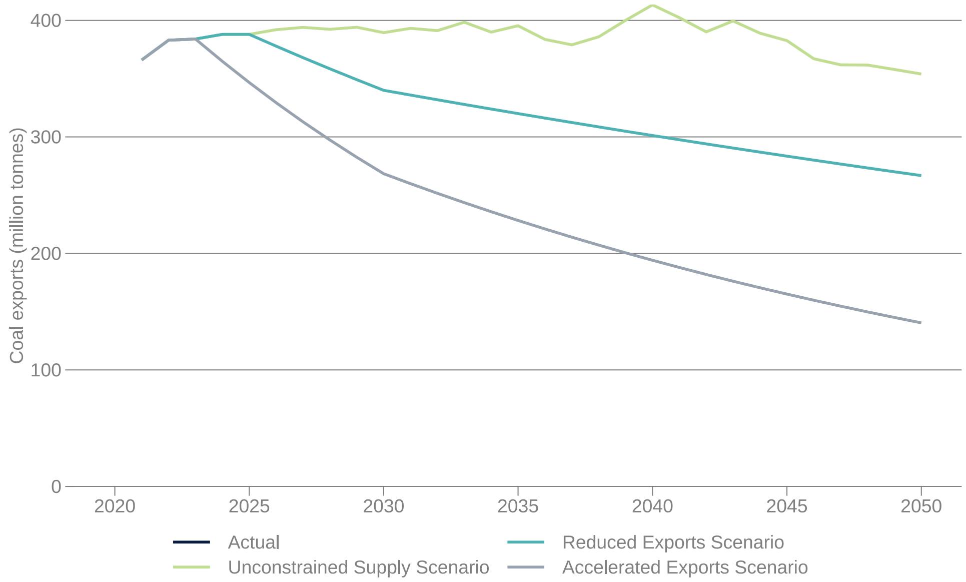
i) *Unconstrained supply scenario* (High scenario) – under this scenario, Australian coal exports are projected to grow slightly over the next twenty years to peak at around 415 million tonnes in 2040 and thereafter decline to around 360 million tonnes by 2050.

ii) *Reduced exports scenario* (medium scenario) – under this scenario, Australian coal exports are projected to remain around 380 to 390 million tonnes between now and 2025, and thereafter decline gradually to around 270 million tonnes by 2050. The *reduced exports scenario* broadly reflects the IEA's Stated Policy Scenario assumptions about implied Australian coal exports.

notes emerging policy directives that are not law, such as commitments made by China's government in 2020 to achieve carbon-neutral status by 2060, which could contribute to lower energy use and emissions, are not included in EIA's Reference case because they are not enacted policies. This may explain the difference between EIA's reference case long-term global coal demand outlook and IEA's Stated Policies Scenario outlook.

20 EIA estimates converted from *short tons* to metric tonnes at 0.907185 short tons per metric tonne.

Figure 3.12 Australian coal export forecast scenarios, 2020–2050



Sources: IEA (2021a), OCE (2021), EIA (2021b), Wood Mackenzie (2021a) and BITRE estimates.

iii) *Accelerated reduced exports scenario* (low scenario) – under this scenario, emissions reduction policies implemented overseas further reduces long-term demand for coal, and impacts demand for Australian coal such that exports decline by around 30 per cent between 2020 and 2030 and a further 50 per cent between 2030 and 2050, to around 150 million tonnes by 2050. The *accelerated reduced exports scenario* broadly reflects the IEA's Announced Policies Scenario assumptions about implied Australian coal exports.

Figure 3.12 illustrates Australian coal export volume forecast scenarios.

Under the unconstrained supply scenario, total domestic coal rail freight would increase from around 93.5 billion tonne kilometres in 2020 to as round 99 billion tonne kilometres by 2040, and decline slightly thereafter to around 85 billion tonne kilometres by 2050. Under the reduced exports scenario, total coal rail freight volumes would peak in 2025, at around 93 billion tonne kilometres and thereafter decline to around 72 billion tonne kilometres by 2040 and around 64 billion tonne kilometres by 2050. Under the accelerated reduced exports scenario, total coal rail freight volumes have already peaked and are expected to decline to around 83 billion tonne kilometres by 2025, 47 billion tonne kilometres by 2040 and 34 billion tonne kilometres by 2050 (see Figure 3.13).

Lastly, the coal rail freight projections in this update differ significantly to those presented in BITRE (2019a), and the reflect the increased urgency of policy makers to respond to the need to reduce global greenhouse gas emissions, particularly through reduced coal consumption.

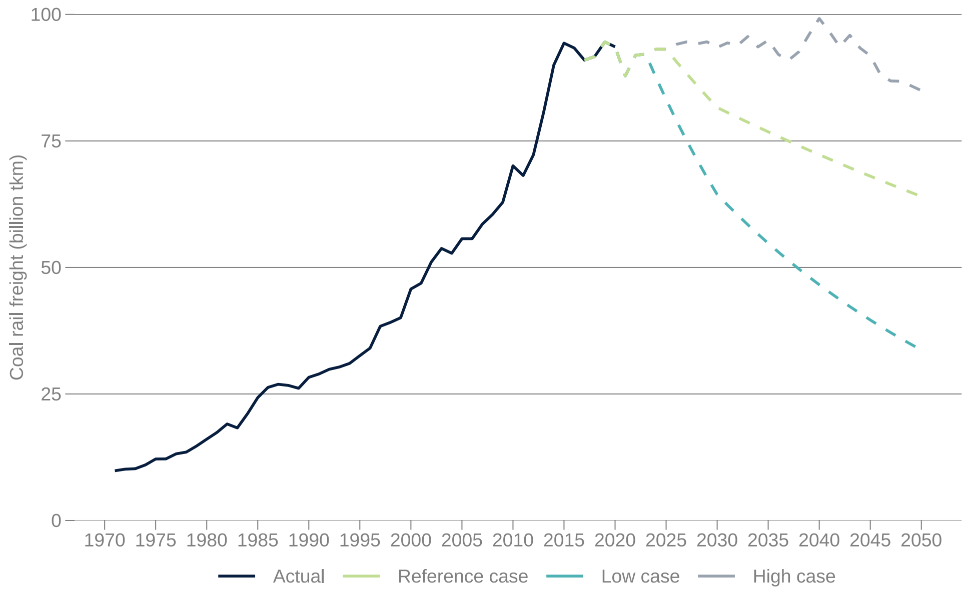
3.4 Interstate non-bulk rail freight forecasts

Australia's interstate non-bulk rail freight task comprises freight moved by rail between Australian capital cities and regional intermodal hubs (e.g. Albury–Wodonga, Parkes, Kalgoorlie, etc.). Domestic interstate non-bulk rail freight has increased from around 4.7 billion tonne kilometres in 1971–72 to around 24.0 billion tonne kilometres in 2019–20—an average annual growth rate of 3.3 per cent per annum over that time. Figure 3.14 shows the growth in interstate rail freight since 1971–72.[21]

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—average annual growth of 4.2 per cent per annum. Growth in East–West rail freight is driven principally by population growth and economic activity in Western Australia. Some of the

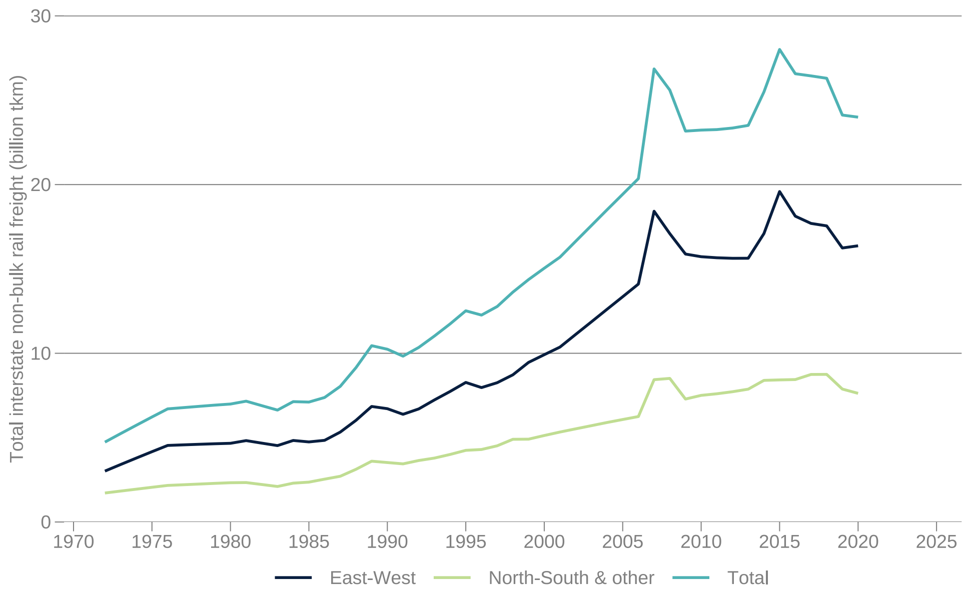
21 Note that comprehensive estimates of intercapital and interstate non-bulk rail freight are not available since 2015–16, and recent trends have been inferred by BITRE from reported movements in gross rail freight tonnages reported by track managers across the various network line segments. Further details are provided in Appendix B.

Figure 3.13 Australian coal rail freight forecast scenarios, 2020–2050



Source: BITRE estimates.

Figure 3.14 Interstate non-bulk rail freight, 1971–2016



Source: BITRE estimates.

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 by 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 and 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 2019–20—an average annual growth rate of 3.7 per cent per annum. North–South and 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, road accounts for the majority of North–South non-bulk freight, with rail accounting for less than 30 per cent.

3.4.1 Forecasting interstate non-bulk rail 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.[22]

BITRE 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 and other rail freight comprises between 15-20 per cent of total interstate non-bulk rail freight (BITRE 2018, and earlier issues).

The 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 2020 and 2050, 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 2020 levels (2.2 per cent per annum), to around 32.5 billion tonne kilometres in 2050. 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 2050, 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 by 2050.

North–South and 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 2020 and 2050. The implication of this is that total North–South and other non-bulk rail freight is likely to grow by around 2.4 per cent between 2020 and 2050, under the medium case assumptions and absent any other changes.

3.4.2 Impact of Inland Rail infrastructure

The Australian Government is funding construction of critical missing rail network segments that will join to form a new 1700-kilometre inland rail link 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 now expected to commence operating from around 2027.

The North–South and 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 and other non-bulk rail freight will increase by around 3 per cent per annum between 2020 and 2050, to around 17 billion tonne kilometres by 2049–50.

Overall interstate non-bulk rail freight (i.e. East–West and North–South and other rail freight) is projected to increase from around 26.6 billion tonne kilometres in 2016 to around 52 billion tonne kilometres in 2050—average annual growth of around 2.8 per cent per annum over that period. Figure 3.15 shows projected future growth in non-bulk rail freight between 2018 and 2050.

3.5 Other bulk and steel rail freight

Other bulk commodities carried by rail include bulk grains,[23] 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 group' based on historical traffic growth.

22 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.

23 Bulk grains typically include wheat, coarse grains (barley, sorghum, oats, corn and triticale), pulses (lupins, field peas, chick peas, etc) and canola seeds.

Figure 3.15 Forecast interstate non-bulk rail freight volumes, 1971–2050

Source: BITRE estimates.

Total other bulk rail freight volumes has increased from around 2.4 billion tonne kilometres in 1971–72 to around 14.4 billion tonne kilometres in 2019–20 (see Figure 3.16)—and average annual growth rate of 3.5 per cent per annum. Most of that growth occurred between 1972 and 2003, with volumes since 2003 varying between 13.5 and 14.5 billion tonne kilometres, depending largely on the size of the annual grain harvest.

3.5.1 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 bulk grain carried to port by rail. Australian grain harvests can fluctuate significantly from year to year, depending on rainfall before and during the growing season. 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.

Over the past four decades (1979–80 to 2019–20) the area allocated to wheat, coarse grains, pulses and canola has grown by around 1 per cent per annum, and total production has increased by around 2.3 per cent per annum, implying average yield growth of around 1.3 per cent per annum. Over the next several decades climate change is likely to pose the most significant downside risk to future Australian grain production levels. For the forward projections, BITRE posits three alternative bulk grain production scenarios, to reflect the potential range of future grain production between 2020 and 2050:

- Low growth scenario – 0.5 per cent per annum
- Medium (BAU) growth scenario – 1.25 per cent per annum
- High growth scenario – 2.0 per cent per annum.

3.5.2 Steel rail freight forecasts

The majority of the steel rail freight task involves transport of raw and finished steel products from domestic steelworks to mills and downstream processing facilities. While transport of raw steel may be undertaken by any of the major transport modes, rail is a major part of the transport task for raw and finished steel products between domestic steelworks, mills and distribution centres.[24]

24 For example, raw steel produced at Liberty Steel's Whyalla steelworks is transport to product mills in Melbourne, Sydney and Newcastle. And rolled and milled steel products are transported from Liberty Steel's mills and BlueScope Steel's Newcastle mill either direct to fabricators or to it's product distribution centres.

Domestic production of raw steel is around 5 million tonnes per annum (off a production capacity around 5.5 Mtpa, down from an average of around 7.2 Mtpa prior to 2010–11.) Australia imports a further 32 per cent of its total structural steel demand (ADC 2017). Whilst stronger international and individual country responses to climate change may provide Australia with economic opportunities in renewable energy fuelled industrial production (e.g. steel), the baseline projections assume the distance of Australia to potential export markets means that Australian steel production will continue to primarily support domestic consumption needs. With steel rail traffic predominantly comprising movements of raw and milled/rolled steel products between existing production and distribution centres, steel rail traffic volumes are projected to grow only marginally between 2020 and 2050.

3.5.3 Cane sugar rail freight forecasts

Cane sugar is transported from farms to mills by a combination of truck and dedicated cane railways—cane rail freight volumes are included in BITRE's estimates of total other bulk rail freight volumes. Over the past four decades cane cultivation and production have both increased by approximately 1 per cent per annum (with average yield's increasing only slightly). Over the long-term forecast horizon, BITRE has assumed cane production, and hence cane rail freight volumes, will increase by around 0.50–0.75 per cent per annum.

3.5.4 Other mineral ores and concentrates

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

3.5.5 Total other bulk and steel rail freight forecasts

Total other bulk rail freight has increased from around 11.2 billion tonne kilometres in 1971–72 to around 24.8 billion tonne kilometres in 2019–20 (see Figure 3.16), an average annual rate of 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.

Combining the assumed grain, cane and steel rail freight traffic growth implies total other bulk and steel rail freight growth scenarios between 2020 and 2050:

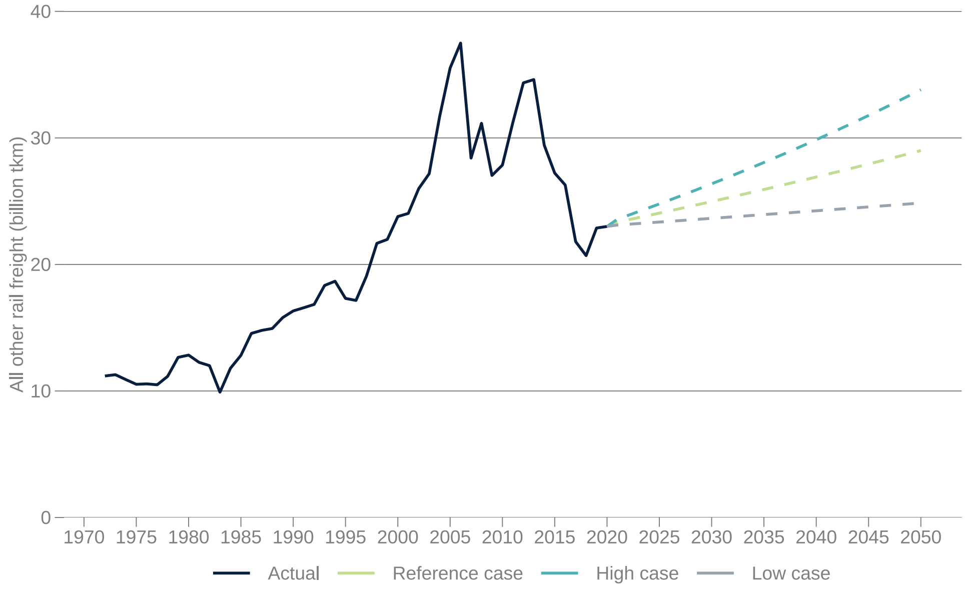
- Low growth scenario – 0.25 per cent per annum
- Medium (BAU) growth scenario – 0.75 per cent per annum
- High growth scenario – 1.25 per cent per annum.

Under the medium (BAU) growth scenario, total other bulk and steel rail freight is projected to grow from around 23.0 billion tonne kilometres in 2019–20 to around 29.0 billion tonne kilometres in 2050. Under the low case scenario, total other bulk and steel rail freight is projected to grow to around 24.0 billion tonne kilometres by 2050 and the high case scenario allows for total other bulk and steel rail freight of around 33.8 billion tonne kilometres by 2050 (see Figure 3.16).

3.6 Other rail freight opportunities

Aside from commencement of rail services when the new Inland Rail line opens, there appear to be few announced significant opportunities to 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 include any specific additional rail freight opportunities.

Figure 3.16 All-other rail freight forecasts, 1971–2050



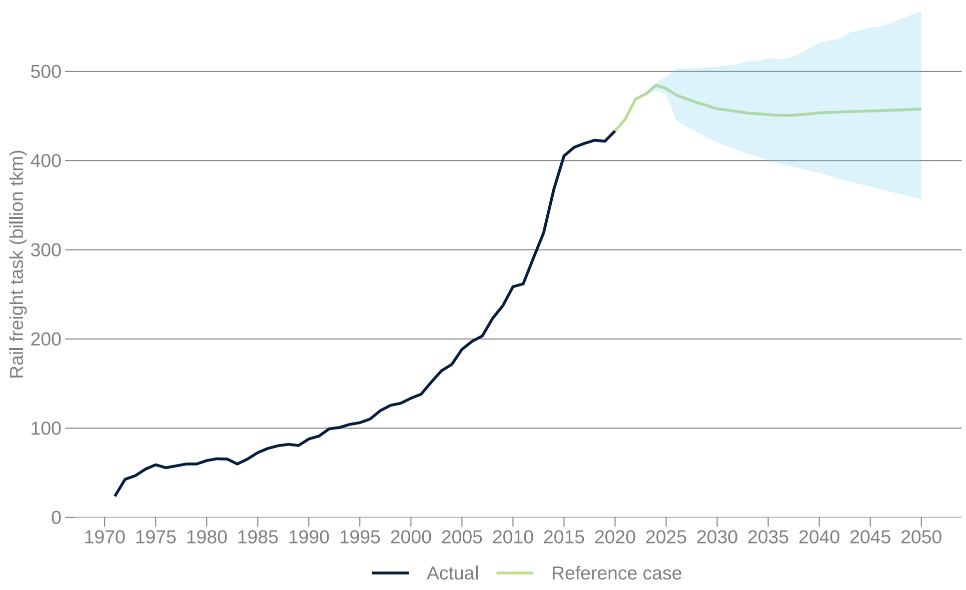
Source: BITRE estimates.

3.7 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 three decades or so to 2050. Figure 3.17 shows the forecast scenarios for total rail freight volumes between 2019–20 and 2049–50.

Under the reference case scenario, the total rail freight task is projected to grow by around 5.7 per cent between 2020 and 2050, from around 433 billion tonne kilometres in 2020 to around 458 billion tonne kilometres by 2050. Under the high growth scenario, rail freight volumes are projected to grow 31 per cent (over 2020 estimated volumes) to around 567 billion tonne kilometres by 2050, and under the low case scenario, rail freight volumes could shrink by around 17.6 per cent (over 2020 volumes) to around 357 billion tonne kilometres by 2050.

Figure 3.17 Forecast total rail freight movements, 2019–20 to 2049–50



Source: BITRE estimates.

4. Coastal shipping freight outlook

4.1 Introduction

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

This chapter outlines the methodology and key assumptions underpinning BITRE's reference case and alternative scenario forecasts of Australian coastal shipping activity between 2020 and 2050.

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 2019–20—an average annual growth rate 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 54 million tonnes in 2019–20 (average annual growth of 0.40 per cent per annum).[25]

Figure 4.1 shows trends in total coastal tonne kilometres and tonnes uplifted, from 1995–96 to 2018–19, 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 (126 billion tonne kilometres) in 2006–07 due, in large part, to increases in Bass Strait and other dry bulk traffics. Between 2006–07 and 2014–15, coastal freight volumes fell to around 50.3 million tonnes (105 billion tonne kilometres), and were around 51.8–51.9 million tonnes (between 106 and 109 billion tonne kilometres) in each of 2015–16, 2016–17 and 2017–18. Total coastal freight volumes surged again in 2018–19, to around 54 million tonnes (118 billion tonne kilometres), due principally to drought-related transport of grain from Western Australia to eastern states.

4.3 Coastal freight forecasts

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

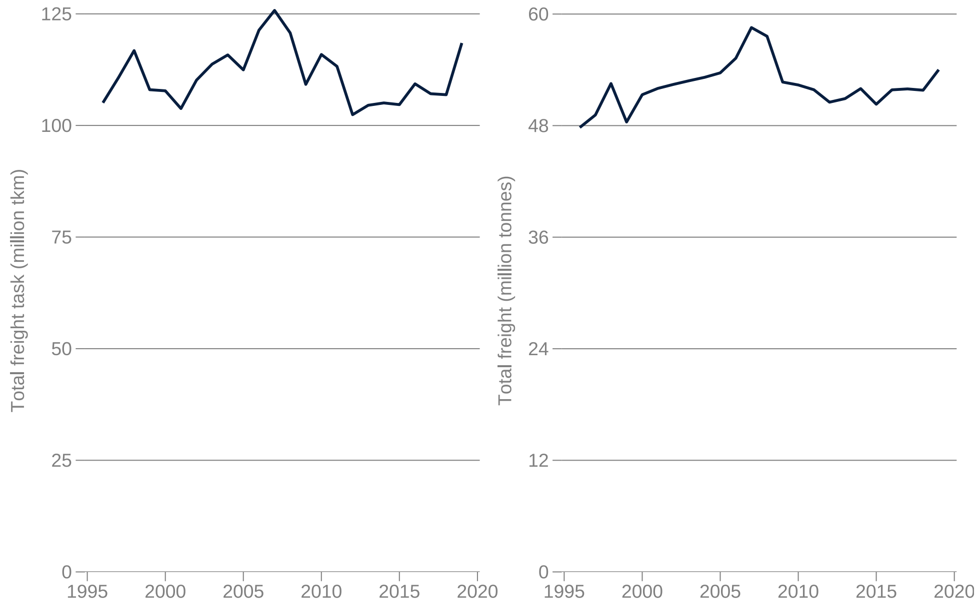
- Bauxite (and alumina)
- Other dry bulk
- Iron ore
- Crude oil
- Petroleum products
- Other bulk liquids
- Intercapital containers
- Bass Strait non-bulk freight
- All other coastal freight

Each commodity/market segment is modelled and forecast separately, and the separate forecasts combined into an aggregate coastal shipping forecast. 'All other coastal 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 respectively, for each of the nine commodity–market segments. The figure highlights that the significant year-to-year volatility observed in total coastal freight is also reflected across many of the major coastal freight commodity tasks.

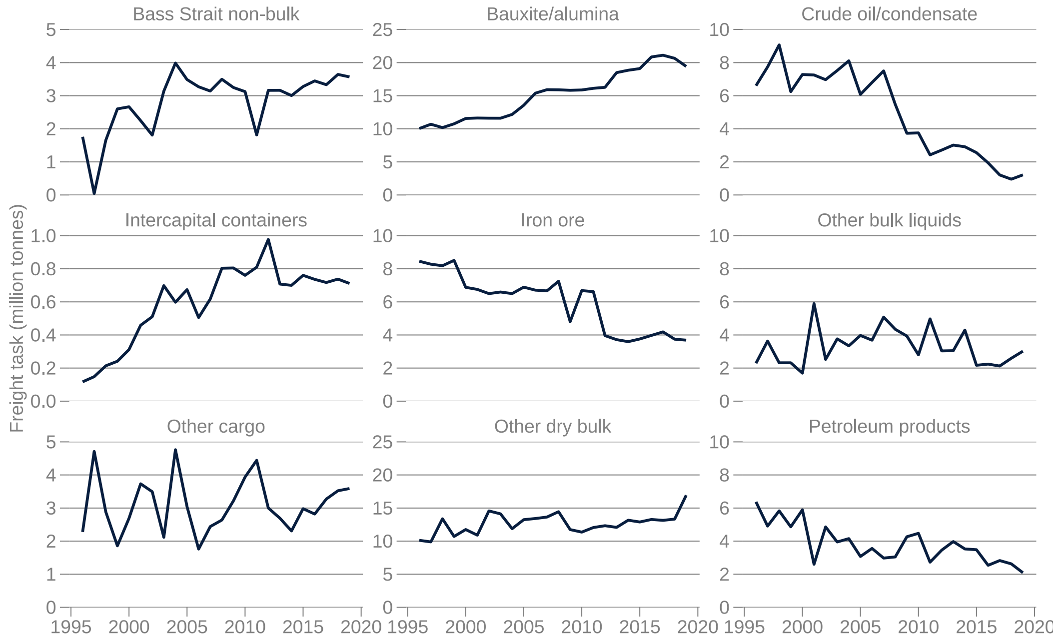
25 Unless otherwise specified, all coastal freight tonnage estimates presented here are based on the port of loading.

Figure 4.1 Total coastal freight loaded, 1995–96 to 2019–20



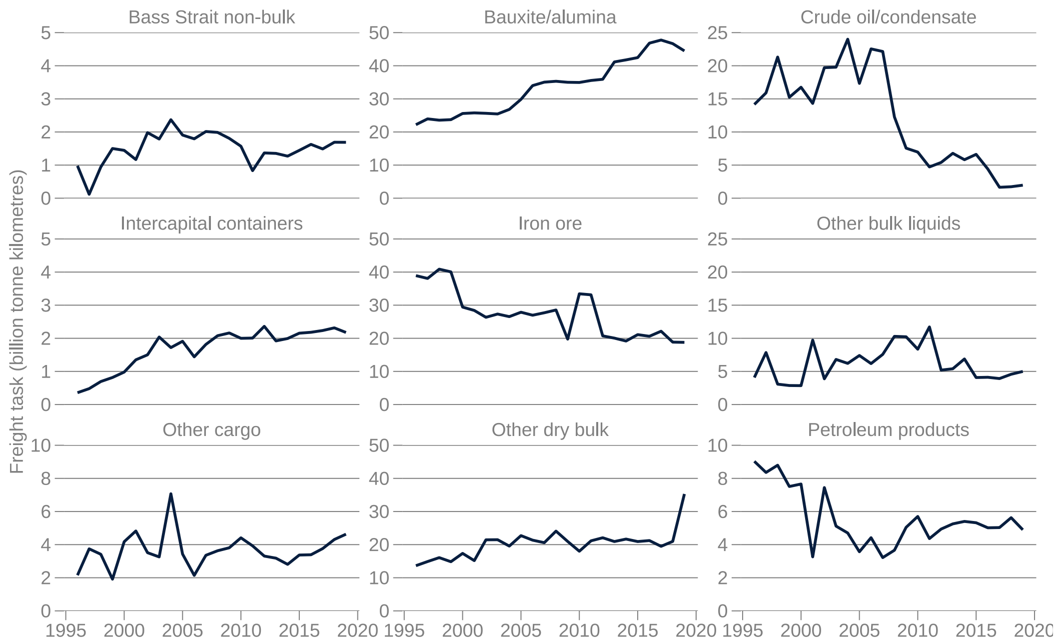
Source: BITRE (2021).

Figure 4.2 Total coastal freight tonnes, by major commodity group, 1995–96 to 2019–20



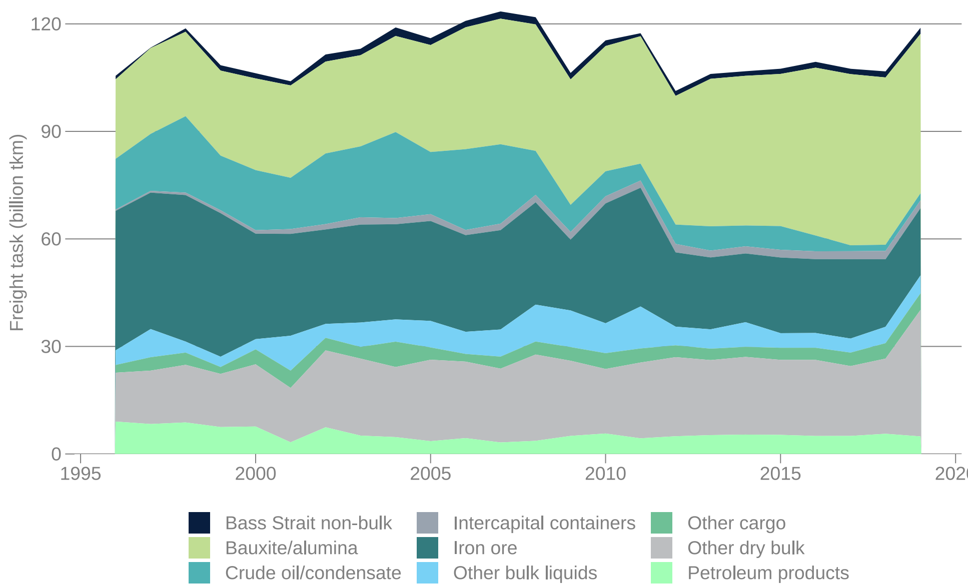
Source: BITRE (2021).

Figure 4.3 Total coastal freight tonne kilometres, by major commodity group, 1995–96 to 2019–20



Source: BITRE (2021).

Figure 4.4 Share of total coastal freight tonne kilometres, by major commodity group, 1995–96 to 2019–20

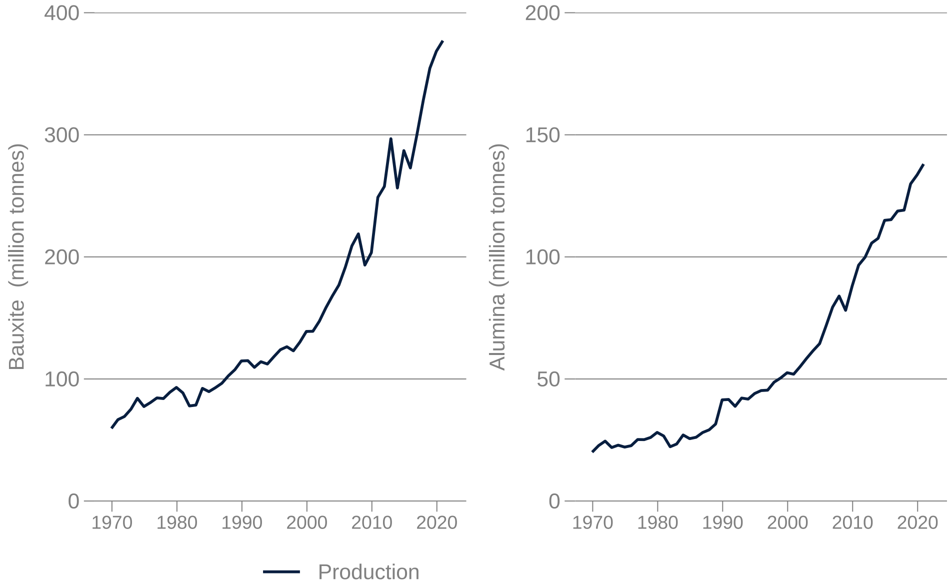


Source: BITRE (2021).

Figure 4.4 shows the relative share of coastal freight (measured in tonne kilometres) by commodity–market segment between 1995–96 and 2019–20. Bauxite and alumina accounts for the largest share, around 37.4 per cent, followed by other dry bulk cargoes (i.e. coal, gypsum, cement, etc., 29.7 per cent) and iron ore (15.8 per cent).

The following sections outline the forecasts for each of the separate coastal freight commodity–market segments.

Figure 4.5 World bauxite, alumina and aluminium production levels, 1970–2021



Source: OCE (2022) and BITRE estimates.

4.3.1 Bauxite/alumina coastal freight outlook

World aluminium industry production totalled approximately 377 million tonnes of bauxite, 138 million tonnes of alumina and 67.5 million tonnes of aluminium in 2021 (OCE 2022, p. 135), and has more than tripled in the 30 years between 1991 and 2021 (equivalent to average growth of 4 per cent per annum). Figure 4.5 shows trends in global bauxite, alumina and aluminium production between 1970 and 2021. China accounts for much of the recent increase in global primary aluminium production, with production there increasing from around 2.6 million tonnes in 1998–99 to an estimated 38.8 million tonnes in 2020–21 (IAI 2022, and BITRE estimates).

Australia has among the world's largest reserves and resources of economically recoverable bauxite—the principal ore used in the production of primary aluminium. In 2020–21, Australia produced approximately 103 million tonnes of bauxite, 20.8 million tonnes of alumina and 1.6 million tonnes of aluminium. Figure 4.6 shows historical growth in Australian bauxite, alumina and aluminium production and exports since 1970—domestic bauxite production has increased more than nine-fold, alumina production more than eight-fold and domestic aluminium production more than seven-fold.

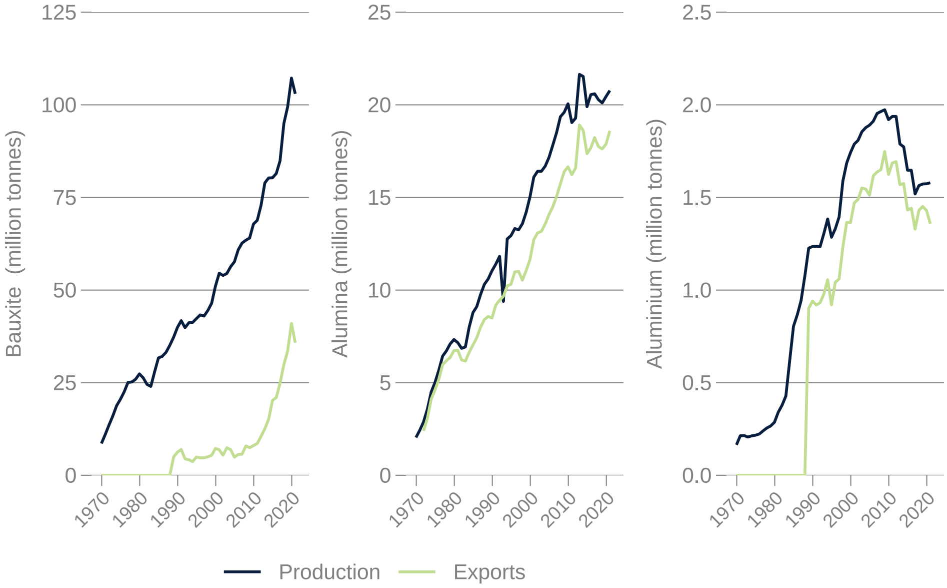
In Australia, bauxite is mined at a small number of sites, the largest sites at Weipa (Cape York, Queensland), the Darling Ranges (Western Australia) and at Gove (Arnhem Land, Northern Territory). The majority of Australia's bauxite output is transported from mine to another domestic location for refining into alumina, with a small share exported directly—although the amount of bauxite exported overseas has increased significantly since 2011–12, with most of that export growth sourced from Gove and more recently Rio Tinto's new Amrun mine (Cape York). A small proportion of the alumina produced in Australia is used as input to domestic aluminium refineries, with the overwhelming majority exported overseas.

The most significant coastal shipping movements of bauxite in Australia are from Weipa (from Rio Tinto's East Weipa, Andoom and Amrun mines) to Gladstone (central Queensland), for refining into alumina. The majority of the alumina refined at Gladstone is exported overseas, with small amounts transported from Queensland to New South Wales and Tasmania for refining. There are significant coastal shipments of alumina from Western Australia to Victoria for aluminium production.[26]

Bauxite/alumina movements are 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. With the expansion of production capacity at the Yarwun alumina refinery (Gladstone), shipments increased to 16.3 million tonnes in 2012–13. In 2018–19, bauxite and alumina coastal freight volumes totalled 20.8 million tonnes.

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

Figure 4.6 Australian bauxite, alumina and aluminium production and exports, 1970–2021



Source: OCE (2022) and BITRE estimates.

BITRE's long-term forecast approach adopts a scenario-based approach to encompass the potential range of future volumes of bauxite and alumina likely to be shipped around the coast. Like the iron ore and coal rail industry outlooks (presented in Chapter 3), the aluminium industry outlook begins with the OCE (2022) short-to-medium term outlook (to 2027). That outlook projects Australian bauxite production to remain more or less around 100 million tonnes per annum between 2020–21 and 2026–27—increasing to around 106 million by 2023–24 and declining slightly to around 101 million tonnes per annum by 2026–27 (OCE 2022, p. 124). OCE (2022) expects no significant expansions or major disruptions at current alumina operations, and projects domestic alumina production to remain around 21 million tonnes per annum between 2020–21 and 2026–27. Lastly, OCE (2022) projects domestic aluminium refining capacity to remain around 1.6 million tonnes a year from 2022—23 onwards (OCE 2022, pp. 128, 132).

The implications of OCE (2022) for domestic coastal shipping volumes are continuation of the current level of bauxite movements from Weipa to Gladstone and existing alumina shipment volumes between alumina refineries and aluminium smelters between 2020–21 and 2026–27.

Beyond 2026–27, the size of the Australian bauxite coastal shipping task will depend principally on future domestic bauxite output, and the installed production capacity of the domestic alumina and aluminium facilities. 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.

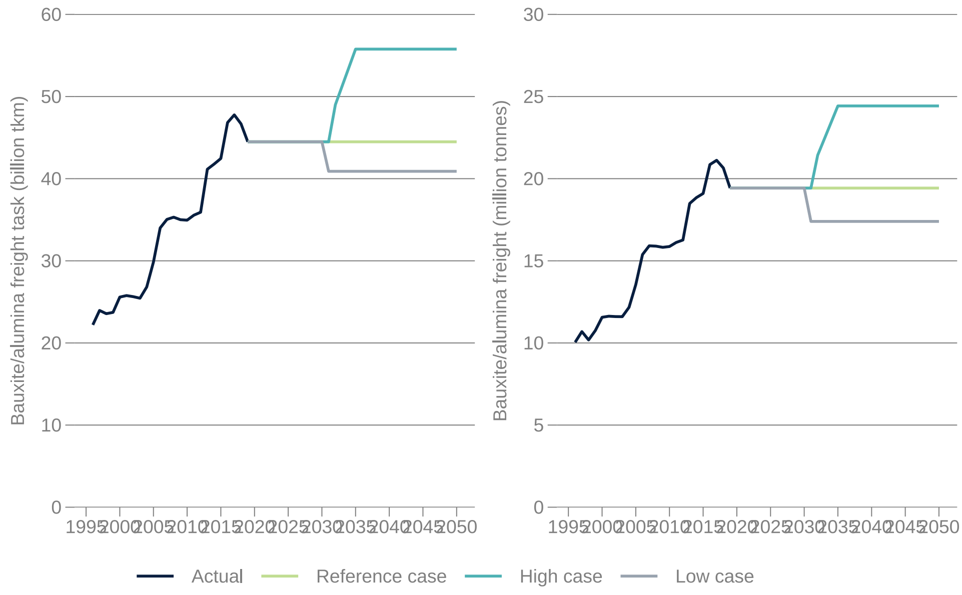
The economics of the aluminium industry favours the location of alumina refining capacity generally close to bauxite mines, to control transport costs, while processing of alumina into aluminium is more influenced by the availability of relatively cheap and abundant energy (electricity) supplies. Australian bauxite and alumina production costs are among the lowest in the world (OCE 2022, Figures 11.17 & 11.18, p. 133) and Australian bauxite reserves are sufficient to support continued Australian bauxite production at current levels out to at least 2040 (Senior et al. 2021, Wood Mackenzie 2021b), if not well beyond. Hence, Australia is well-positioned to continue to be a large bauxite and alumina producer, with continued domestic movements.

Domestic alumina/aluminium production growth scenarios

BITRE consider three long-term domestic bauxite/alumina/aluminium production scenarios beyond 2026–27:

i) *business as usual* (BAU) domestic alumina/aluminium production scenario
ii) *high* growth domestic alumina/aluminium production scenario
iii) *low* growth domestic alumina/aluminium production scenario.

Figure 4.7 Domestic bauxite/alumina coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

Figure 4.7 shows the alternative domestic bauxite/alumina coastal freight outlook scenarios to 2049–50.

Under the BAU scenario, domestic bauxite output, alumina refining and aluminium production remains around OCE (2022) 2026–27 levels out to 2050, with domestic coastal shipping volumes to remain around current levels out to 2050.

The *high* growth scenario presumes that Australia not only maintains its relative cost advantage in the production of alumina over the long term, but that increasing uptake of renewable energy generation, particularly in central and north Queensland, where such facilities would likely to be located, further improves the cost competitiveness of domestic alumina and aluminium production. As a consequence, some of the bauxite currently being exported from Weipa (Amrun mine) is refined domestically (at Gladstone) from around 2030 to 2035, with a consequent increase in domestic coastal movements of bauxite between Weipa and Gladstone. Under this scenario, domestic coastal movements of bauxite and alumina increase by up to 5 million tonnes per annum, and the coastal shipping task by up to 11 billion tonne kilometres. While it is not envisaged that this scenario is likely, it is included to cover the potential range of future coastal freight outcomes.

Lastly, the *low* growth scenario allows for the possibility that domestic alumina and aluminium refining/smelting activity declines over the forecast horizon. Though unlikely, a reduction in aluminium industry-related coastal freight could arise from a reduction in domestic bauxite extraction from Rio Tinto's Weipa mines and/or a reduction in on-shore alumina refining, and increased direct export of bauxite.[27] For this scenario, BITRE assumes that 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).

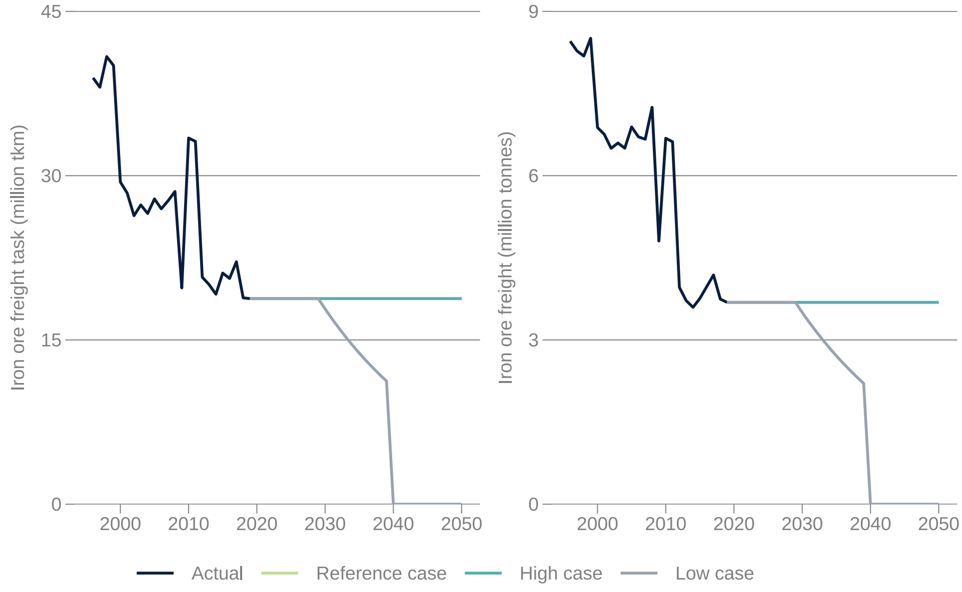
4.3.2 Iron ore coastal freight outlook

Over the last decade, Australian coastal movements of iron ore have averaged between 3.6 and 4.0 million tonnes per annum. The majority of the iron ore movements are from the Pilbara (Port Hedland) to Port Kembla, for input to BlueScope Steel's Port Kembla steelworks.[28] Smaller volumes of iron ore, sourced from the Savage River iron ore mine in Tasmania, are also moved from Port Latta (Tasmania) to Port Kembla.

27 An active domestic alumina/aluminium industry is an explicit economic, development and/or strategic priority in many countries, and hence costs are not the only factor influencing the geographic location of alumina refining and smelting operations. Hence, despite Australia's relative cost advantage in alumina production, it's possible, albeit unlikely, for that activity, and aluminium refining, to transfer overseas.

28 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.

Figure 4.8 Domestic iron ore coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

In October 2011, BlueScope Steel closed one of its then two remaining smelters, halving the steelworks' capacity and resulting in a near halving of the amount of iron ore shipped to Port Kembla, which was previously around 6.5 million tonnes per annum, and corresponding reduction in coastal freight volumes. All of BlueScope Steel's current steel production is used to supply the domestic steel market. Future coastal movements of iron ore are therefore directly tied to continuing supply of feedstock to BlueScope Steel's Port Kembla steel plant.

Steel production is a highly cost competitive global enterprise and Australian steel competes with lower cost imported steel. Australian steel is constructed to Australian standards, and most is used in structural applications, such as infrastructure, buildings and construction, where it is required to meet minimum tensile strength levels and have good weldability. Australian steels are also likely to be more rust resistant and welds endure better than cheaper quality imported steel. Hence, despite significant competition from cheaper imports, there will still be significant demand for Australian steel in structural applications.[29]

BITRE again adopts a scenario-based approach to reflect the range of potential future iron ore coastal freight outlooks. In developing the outlook it was considered unlikely that domestic steel output (and coastal shipments of iron ore) would grow significantly over the forecast horizon.[30] Hence, BITRE considers just two scenarios:

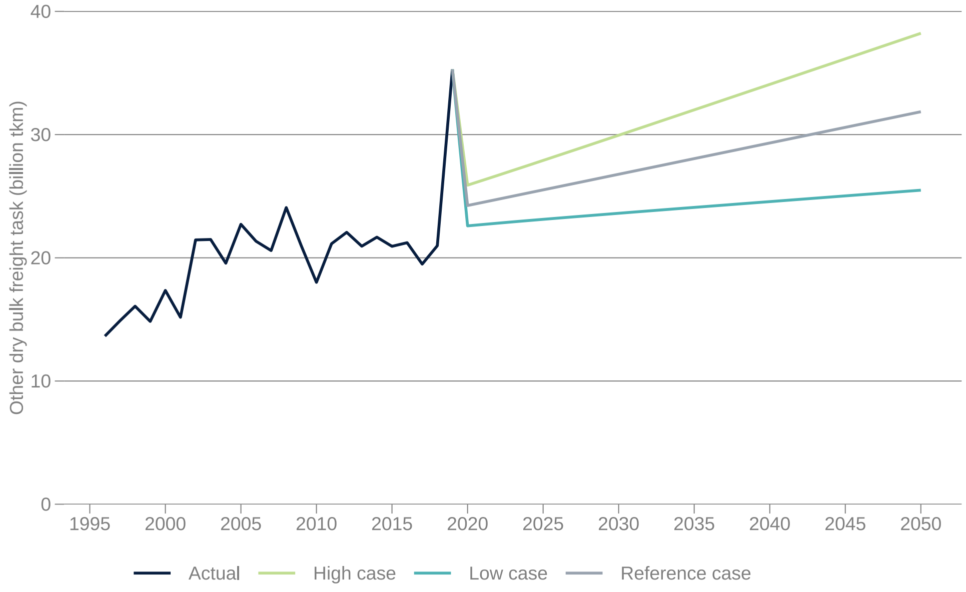
i) Business-as-usual (reference case) scenario
ii) Low domestic steel production scenario.

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 2049–50.

The low steel production scenario is purely a '*what if*' scenario—i.e. what would be the impact on domestic coastal movements of iron ore if domestic steel production were to decline at some point over the forecast horizon. There are no indications that this likely to occur, and strong reasons (given above) in favour of continuing domestic production. However, for the purposes of modelling likely future coastal freight volumes, this scenario assumes reduction of domestic iron ore shipments from 2040 onwards. Figure 4.8 shows the domestic iron ore coastal freight volumes to 2049–50 under each of the two scenarios.

29 Further details about the Australian steel industry available in ASI (2022).
30 While Australia has abundant iron ore reserves, the majority is located far from major population centres and energy supplies. Moreover, Australia's industrial production base is predominantly located in the south east of the country, distant from major world markets. Additional domestic production would require significant initial investment in domestic steel production capacity. More likely, any shortfall in Australian steel demand would be imported.

Figure 4.9 Domestic other dry bulk coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

4.3.3 Other dry bulk coastal freight outlook

Other dry bulk coastal freight modelled here includes all freight classified as *dry bulk* in the Australian Coastal Freight database (BITRE 2021), excluding bauxite and iron ore. Other dry bulk commodities include: fertilisers, cement/clinker, non-iron metalliferous ores, sands, limestone, gypsum, dolomite, cereal grains, sugar (raw and refined), coking coal, salt and woodchips, among other commodities.

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 2019–20, albeit with 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 volumes fluctuating more or less around 23 million tonnes per annum over the last decade.[31] Total dry bulk coastal freight volumes increased significantly in 2018–19 as a result of the transport of cereal grains from Western Australia and South Australia—4.5 million tonnes and 813,000 tonnes, respectively—to the east coast to support livestock producers during the height of the 2017–2019 drought experienced across New South Wales, Queensland and parts of Victoria.[32]

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, but exclude the one-off grain movement surge in 2018–19. Hence, the long-term forecast for coastal dry bulk freight out to 2049–50 are around trend volumes observed since 2006–07, around 21.5 billion tonne kilometres per year. Given the significant volatility in dry bulk grain movements in any one year, the actual volume of other dry bulk freight could vary within a wide range. In line with the approach adopted for other commodity freight tasks, high and low forecast scenarios are based on the high and low prediction intervals from the trend regression model. Under the high scenario dry bulk coastal freight volumes could increase to around 24 billion tonne kilometres by 2050, and under the low scenario dry bulk coastal freight volumes would increase only slightly to around 19 billion tonne kilometres by 2050.

Figure 4.9 shows domestic dry bulk coastal freight outlook scenarios to 2049–50.

4.3.4 Crude oil and condensate coastal freight outlook

Australian domestic crude oil and condensate production has declined from around 30.3 billion litres in 1995–96 to around 15.5 billion litres in 2017–18, increasing slightly to 18.4 billion litres in 2019–20. Much of this decline

31 No statistically significant trend could be inferred post 2006–07.
32 Approximately 65 per cent of domestic coastal shipments of Western Australian and South Australian cereal grains were to Queensland, 30 per cent to New South Wales and the remaining 5 per cent to Victoria.

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 more or less halved since 2010–11.[33]

Australian coastal shipments of crude oil and condensate have broadly followed trends in domestic production, declining by over 80 per cent between 1995–96 and 2019–20, from around 16 million tonnes in 1995–96 to around 4.0 million tonnes in 2019–20. Although the decline in coastal shipping volumes has been 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 2019–20 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 now has only two operating refineries: Ampol refinery, Lytton (Qld) and the Viva refinery, Geelong (Vic.). OCE (2019, p. 78) also notes the nature of Australia's crude oils, which are predominantly light (low density) and sweet (low sulphur content), do not suit Australia's domestic refinery capabilities, which were originally built to use higher-density crude oils. Additionally, much of Australia's crude oil and condensate production is closer 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) also note that the 'trend of decreasing oil resources is not expected to change within existing 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 oil resources in Australia. These include:

- competition from alternative transport energy sources, such as biofuels, hydrogen and synthetic fuels, and increasing uptake of electric vehicles,
- increasing community support for transition to *clean* (non-carbon based) energy sources, and pressure to reduce reliance on conventional fuels.

In BITRE's long-term freight outlook, the long-term outlook for domestic crude oil and condensate coastal shipping volumes will depend most critically on the capacity and continuing operation of Australia's remaining domestic refineries. Three scenarios are considered:

i) Reference case – under the reference case, it is assumed that domestic refining capacity continues until 2034–35.
ii) High scenario case – under this scenario domestic refining capacity is assumed to remain around current levels out to 2050.
iii) Low scenario case – under this scenario domestic refineries continue to operate until 2027, and thereafter both remaining refineries close.

Figure 4.10 shows domestic crude oil and condensate coastal freight outlook scenarios to 2049–50.

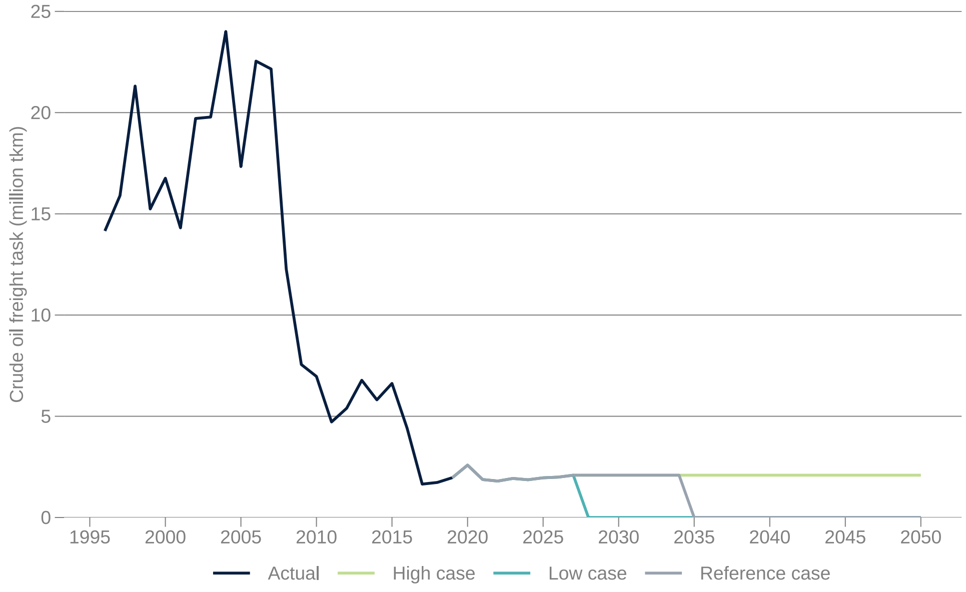
4.3.5 Refined petroleum products coastal freight outlook

Australian refined petroleum products are used predominantly for 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 industrial uses (e.g. mining). 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 4.11). 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 long-term outlook scenarios follow the domestic refinery capacity assumptions outlined above. Under the reference case scenario, petroleum product transport is projected to continue at around current levels to 2034–35 and thereafter effectively cease as refining capacity closes. Under the high scenario, domestic refining capacity is assumed to continue out to 2050, and domestic petroleum product coastal freight volumes continue around current levels out to 2050. Under the low scenario, domestic refineries cease operating around 2027, with all Australia's fuel needs provided by overseas imports, again implying much reduced domestic coastal movements of petroleum products after 2027.

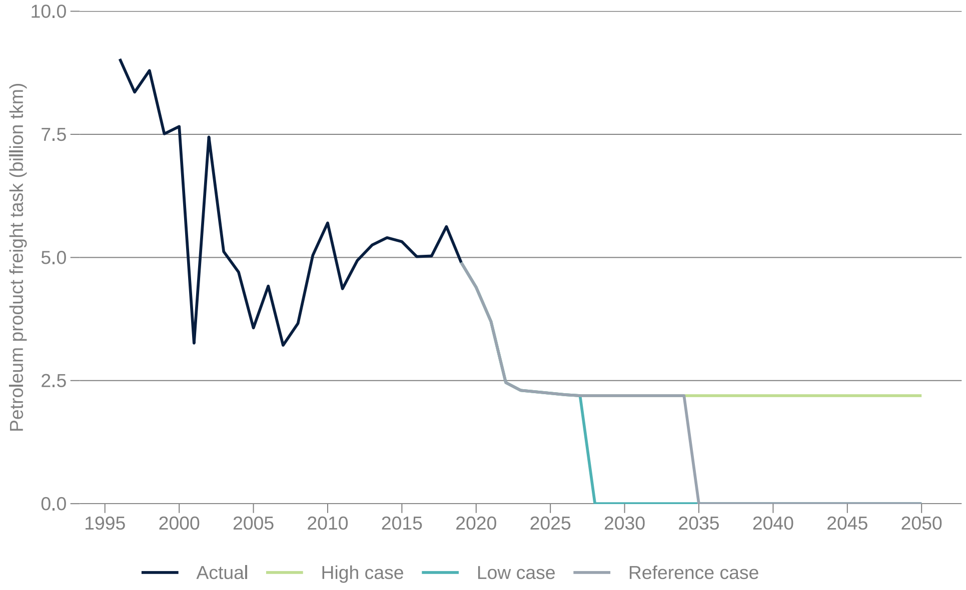
33 Proven reserves and resources in these basins have also declined. GA (2017) notes that Australia has limited identified conventional oil resources but large prospective unconventional resources (i.e. shale oil and oil shales).

Figure 4.10 Domestic crude oil and condensate coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

Figure 4.11 Domestic petroleum product coastal freight outlook scenarios, 1995–96 to 2049–50



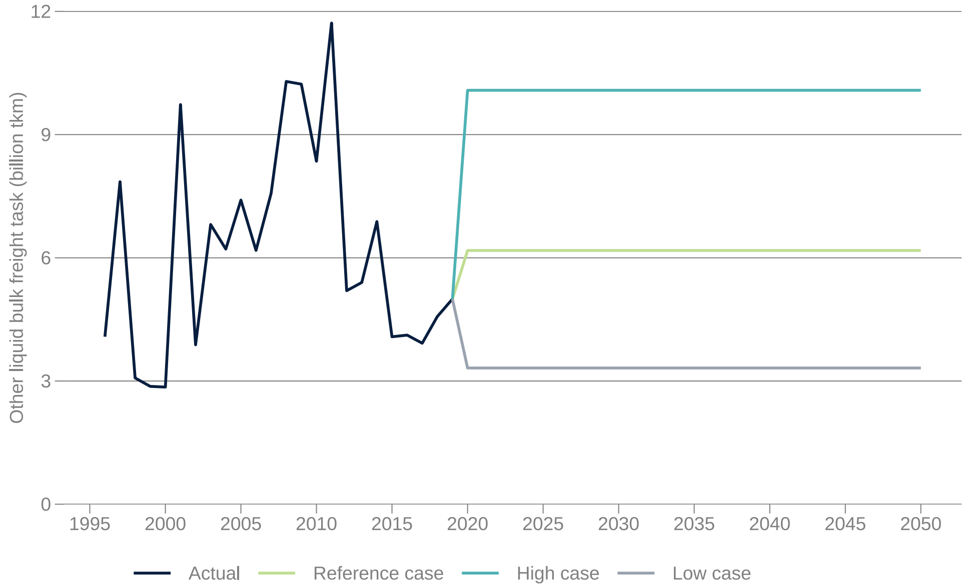
Sources: BITRE (2021) and BITRE estimates.

Figure 4.9 shows domestic petroleum product coastal freight outlook scenarios to 2049–50.

4.3.6 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. Other significant liquid bulk commodities moved round the coast include liquefied gases, ammonia and molasses. Figure 4.12 shows the significant year-to-year variability in liquid bulk coastal movements, which have generally fluctuated between 4 and 9 billion tonne kilometres per annum, albeit with no statistically significant trend. There have been years when liquid bulk coastal freight

Figure 4.12 Domestic other liquid bulk coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

volumes have been above 9 billion tonne kilometres (2007–08 to 2011–12) and years more recently (since 2012–13) when other liquid bulk 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 other liquid bulk coastal 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 4.12 shows domestic other liquid bulk coastal freight outlook scenarios to 2049–50.

4.3.7 Intercapital container coastal freight outlook

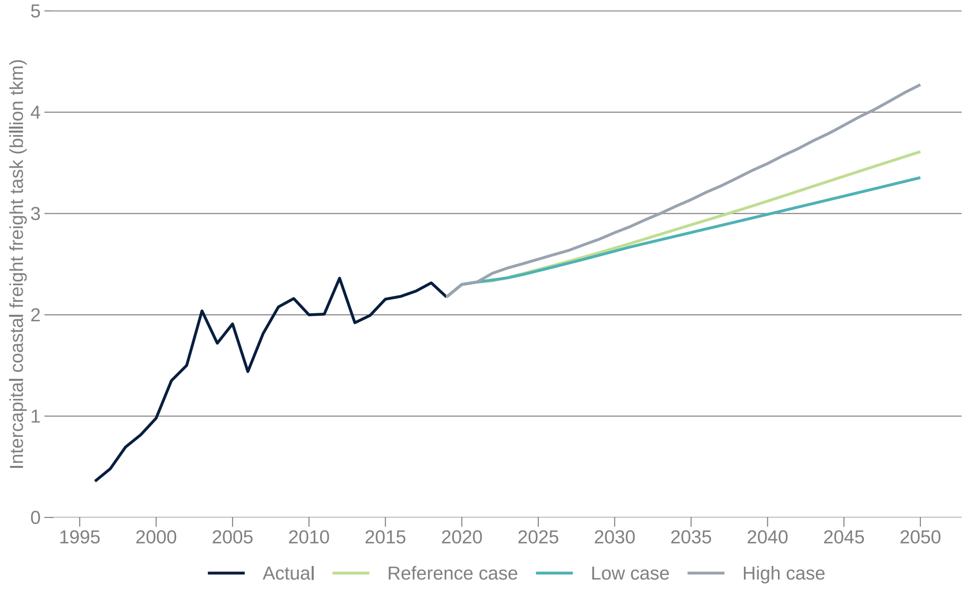
Intercapital container coastal freight is defined as all container trade between the five mainland capital city ports—Sydney, Melbourne, Brisbane, Adelaide and Perth (Port of Fremantle). Figure 4.13 shows intercapital container freight has grown substantially over the past decade-and-a-half, from around 360 million tonne kilometres in 1995–96 to around 2200 million tonne kilometres in 2019–20 (on a freight loaded basis), an average annual increase of over 8.6 per cent per annum over that period.[34] Much of this growth in container numbers occurred between 1995–96 and 2003–04, with growth post 2004 around 2.1 per cent per annum.

BITRE's aggregate forecasting method for intercapital container shipping movements is based on a 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 post-2004 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 2049–50 under the reference case scenario.

The high and low growth scenarios are based on the high and low economic growth and population growth scenarios (listed in Appendix A). Importantly, this analysis does not incorporate other potentially significant factors that might influence growth in intercapital coastal shipping volumes, such as significant changes in

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

Figure 4.13 Domestic intercapital container coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

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 4.13 shows domestic intercapital container coastal freight outlook scenarios to 2049–50.

4.3.8 Bass Strait non-bulk freight outlook

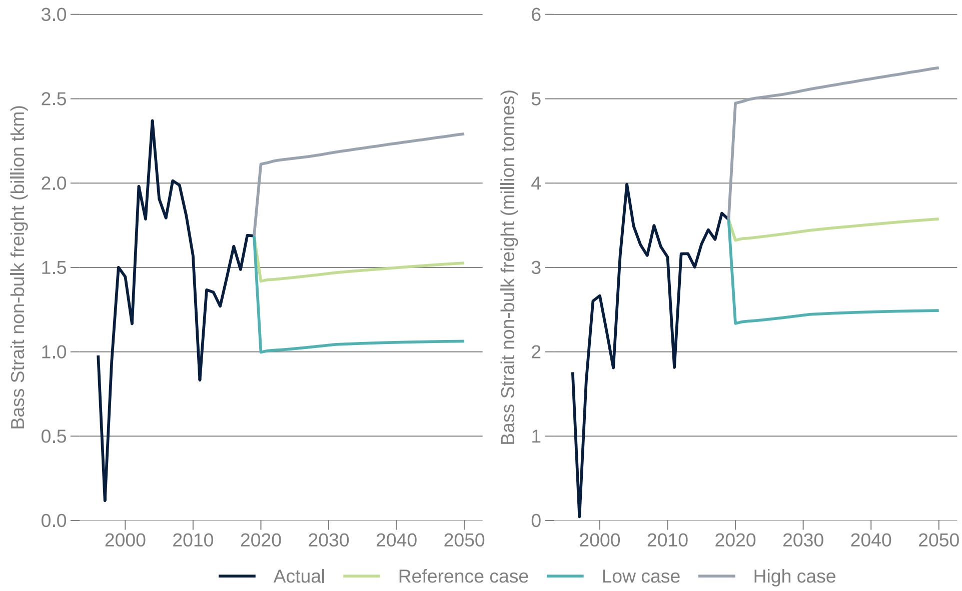
Bass Strait non-bulk freight is defined here to include all freight not classified as either dry or liquid bulk that is loaded or unloaded at a Tasmanian port, excluding intra-Tasmanian freight. This definition includes not only containers but also transport equipment, break-bulk freight, pallets and timber. 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 4.14 shows non-bulk freight loaded and discharged at Tasmanian ports between 1995–96 and 2019–20. Between 1996–96 and 2019–20 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.[35] 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 combined Centre for Population (2021) and ABS (2018b) 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 the combined Centre for Population (2021) Central and ABS (2018b) Series B (median) population growth for Tasmania, implying average annual growth in Tasmanian GSP of 1.59 per cent per annum between 2019–20 and 2049–50. 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.

35 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 4.14 Bass Strait non-bulk coastal freight outlook scenarios, 1995–96 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

Assuming the relationships between Bass Strait non-bulk freight and Tasmanian GSP continue to hold over the forecast horizon, the Tasmanian GSP forecasts imply trend[36] levels of Bass Strait non-bulk freight increasing from around 1.45 billion tonne kilometres in 2020 to around 1.62 billion tonnes kilometres in 2050 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 growth 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 growth scenario implies growth in Bass Strait freight of around 0.7 per cent per annum between 2020 and 2050, 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 2050.

Figure 4.14 shows Bass Strait non-bulk coastal freight outlook scenarios to 2049–50.

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.

4.3.9 All other coastal freight outlook

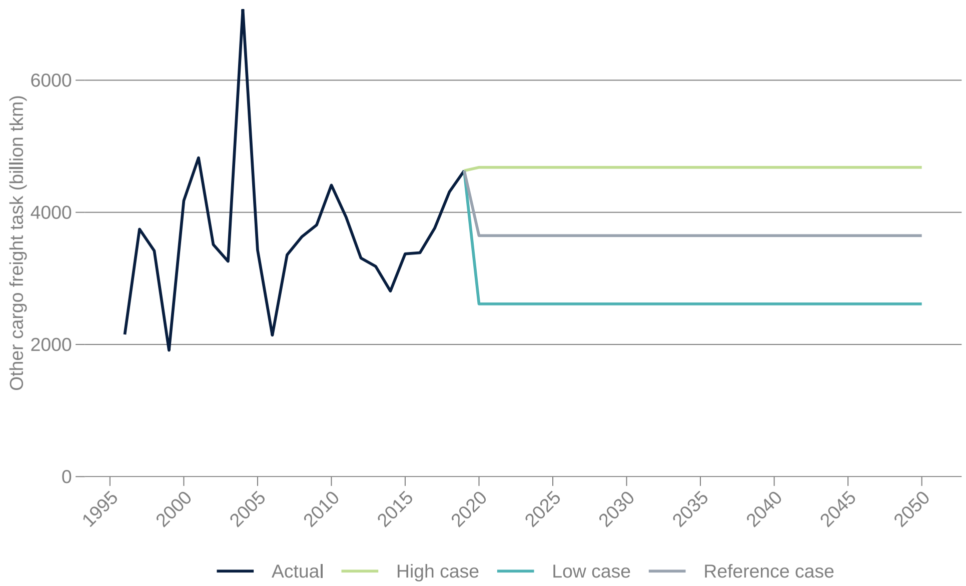
All other coastal freight includes all other freight not specified elsewhere and comprised around 2.8 per cent of total coastal freight in 2019–20. Historical data shows significant year-to-year variability but no significant trend growth in all other coastal freight.

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

Figure 4.15 shows all other coastal freight outlook scenarios to 2049–50.

36 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 4.15 Domestic all other coastal freight outlook scenarios, 1995–96 to 2049–50



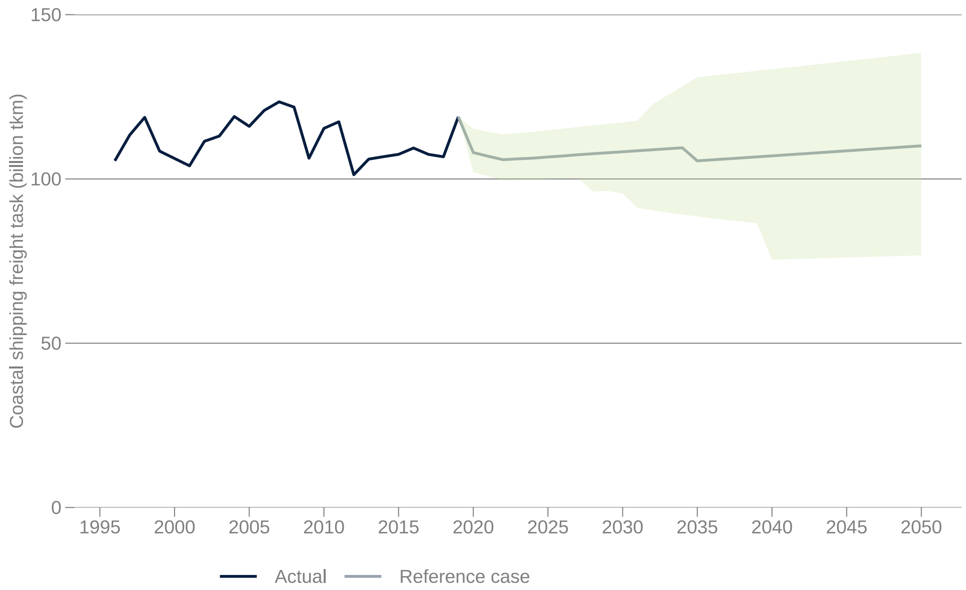
Sources: BITRE (2021) and BITRE estimates.

4.4 Total coastal shipping outlook

Combining the separate reference case commodity–market coastal freight forecasts implies total coastal shipping volumes decline from around 119 billion tonne kilometres in 2020 to around 110 billion tonne kilometres by 2050 under the reference case. The low case scenario would see total coastal shipping volumes declining to around 77 billion tonne kilometres by 2050—assumptions about bauxite/alumina production dominate this result. The high case scenario implies coastal shipping freight increasing to around 138 billion tonne kilometres by 2050—average annual growth of around 0.5 per cent per annum. Again, this scenario result is also predominated by the high growth bauxite/alumina scenario assumptions.

Figure 4.16 shows forecast of total coastal freight between 2019–20 to 2049–50.

Figure 4.16 Forecast total coastal freight movements, 2019–20 to 2049–50



Sources: BITRE (2021) and BITRE estimates.

5. Domestic air freight outlook

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 about the mix of commodities carried by domestic aviation.

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

5.2 Historical air freight volumes

Domestic air freight volumes are a fraction of the freight volumes carried by the other major transport modes—in 2019–20 domestic air freight volumes totalled 209,200 tonnes (measured on a traffic-on-board basis) and around 290.2 million tonne kilometres, slightly down on 2018–19 activity (230,900 tonnes and 331.3 million tonne kilometre) due to COVID-19 (BITRE 2019b). Air freight activity can also vary significantly from year to year—air freight volumes have been as low as 191,000 tonnes (270 million tkm) in 2014–15 and as high as 250,000 tonnes (333 million tkm) in 2010–11 (BITRE 2019b).

Figure 5.1 shows published quarterly freight, mail and total air freight volumes (measured in both tonnes and tonne kilometres) since 1984–85. 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.[37] The data also shows the impact of several domestic and international events on domestic air freight volumes, in particular:

- 1989 Pilot's dispute, which impacted air freight activity in late 1989 and early 1990
- September 11 and collapse of Ansett Airlines in late 2001
- Severe Acute Respiratory Syndrome (SARS) in 2002–2004 – the peak impact on Australian domestic air freight volumes appears most significant in early 2003
- COVID-19 which affected domestic and international air passenger movements, and consequently reduced air freight cargo capacity.[38]

Figure 5.1 also shows a drop in domestic air freight activity in financial years 2013–14, 2014–15 and 2015–16, reportedly due to a transport mode change by a single large air freight customer.

Overall air freight volumes (in tonnage terms) grew by around 14 per cent between 1984–85 and 2019–20 (i.e. by under 0.4 per cent per annum). However, when measured in tonne kilometre terms, air freight volumes increased by around 87 per cent between 1984–85 and 2019–20 (approximately 1.8 per cent per annum).

5.3 Air freight forecasts

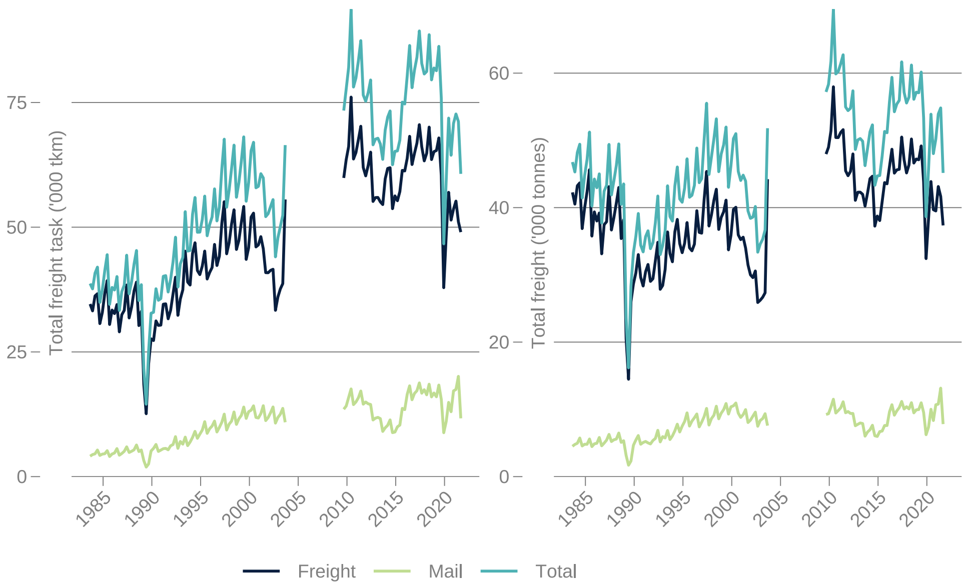
BITRE's aggregate domestic air freight forecasts are based on econometric models relating quarterly historical air freight volumes and domestic economic activity. (The model specification and parameter estimates are listed in Appendix B.) The model also includes factors to account for seasonal variations in aggregate air freight and several period-specific dummy variables that account for the events outlined above.[39] The model results imply domestic air freight demand is relatively responsive to domestic activity, with an implied elasticity of around +0.85 to GDP.

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

38 In response to the COVID-19, the Australian Government provided temporary, targeted, emergency support help keep global air freight supply chains open via the International Freight Assistance Mechanism (IFAM) and other COVID support mechanisms. IFAM operated from 1 April 2020 to 30 June 2022, and helped move high-value perishable Australian products to existing international markets.

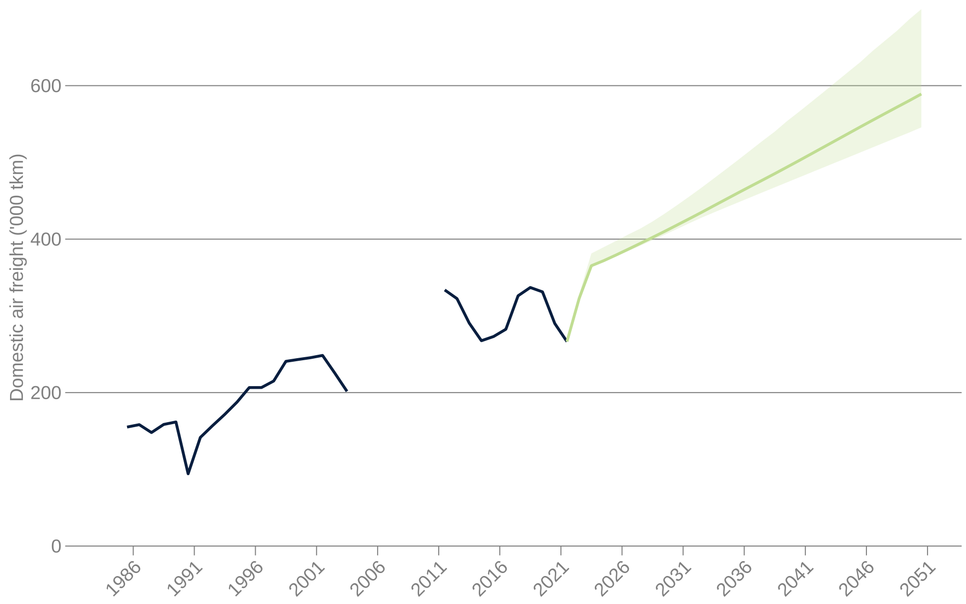
39 BITRE tested a range of alternative model specifications to predict air freight and mail volumes, including multivariate specifications relating domestic air freight to domestic economic conditions and passenger aviation activity.

Figure 5.1 Total air freight and mail volumes, 1984–85 to 2020–21



a. Data not available between 2003–04 and 2009–10.
b. Break in series in January 2010—cargo statistics published prior to 2010 only includes freight cargo and mail carried in the cargo hold of passenger aircraft. Data collected since 2010 includes freight cargo and mail carried in the cargo holds of scheduled passenger flights and also cargo carried on dedicated air freight operations.
Sources: BITRE (2019b) and BITRE estimates.

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



Sources: BITRE estimates

Quarterly frequency forecasts of air freight and mail are derived and the results combined and aggregated to derive forecast total annual domestic air freight volumes. Confidence intervals are based on the combined low and high activity and population growth scenarios.

Based on these models, total domestic air freight volumes are projected to increase by around 103 per cent between 2019–20 and 2049–50, from around 290 million tonne kilometres in 2019–20 to around 589 million tonne kilometres by 2049–50. The prediction interval implies that total air freight volumes could range anywhere between 546 and 700 million tonne kilometres by 2049–50.

6. Australian freight outlook

This report has presented updated forecasts of Australia's total freight task, by major transport mode. It represents an update to the forecasts published in BITRE (2019a), and is part of BITRE's revamped suite of freight forecast products, which aim to provide regularly updated long-term forecasts of total Australian freight activity, by major transport mode, at national, state, territory and regional scale. (A companion report, BITRE (2022), provides forecasts of capital city, interstate and intrastate road freight to 2040.)

In developing the forecasts, BITRE has drawn on historical trend information and reputable assumptions and projections of likely future economic growth, population growth and the domestic and world market outlooks for particular commodities that are significant within Australia's 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 26 per cent between 2019–20 and 2049–50, from around 764 billion tonne kilometres in 2019–20 to around 962 billion tonne kilometres in 2049–50—an average annual rate of growth of around 0.9 per cent per annum. Table 6.1 presents projected future freight task estimates, by transport mode, at five-year intervals between 2020 and 2050.

Road freight volumes are projected to grow by around 77 per cent between 2020 and 2050 under the reference case scenario, to around 394 billion tonne kilometres by 2050—an annual average rate of growth of 1.9 per cent per annum. Stronger future economic growth could result in demand growing to around 450 billion tonne kilometres by 2050 and below average growth could result in road freight growing to around 345 billion tonne kilometres.

Rail freight volumes are projected to grow by around 5.7 per cent between 2020 and 2050, to around 460 billion tonne kilometres in 2050 (an average annual rate of growth of approximately 0.18 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 565 billion tonne kilometres by 2050. However, were all 'low scenario' outcomes realised, rail freight volumes could contract to around 355 billion tonne kilometres.

Domestic coastal shipping volumes are projected to remain more or less around current levels, around 120 billion tonne kilometres, out to 2050 under the central forecast scenario. Were the 'high scenario' outcomes to

Figure 6.1 Actual and projected future freight task, by major transport mode, 1971–2050

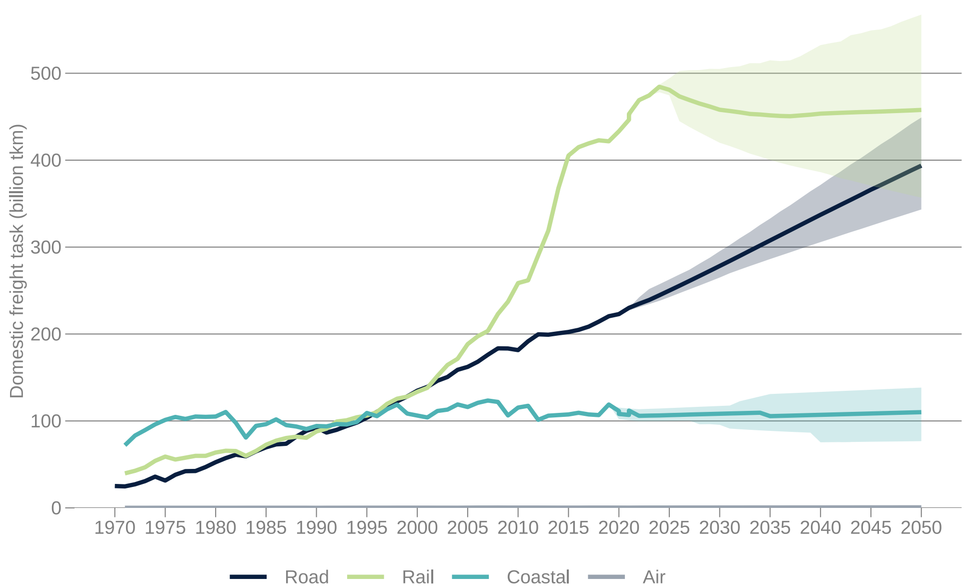


Table 6.1 Projected future freight task, by major transport mode (billion tkm), 2020–2050

	Mode				
Year	Road	Rail	Coastal	Air	Total
2020	222.9	433.2	111.4	0.3	767.9
2025	250.0	480.9	106.7	0.4	838.0
2030	278.3	458.0	108.3	0.4	845.0
2035	307.7	451.6	105.5	0.5	865.2
2040	337.2	453.5	107.0	0.5	898.2
2045	366.1	455.6	108.6	0.5	930.8
2050	393.7	457.8	110.1	0.6	962.2

Source: BITRE estimates.

be realised across all commodities, total coastal shipping freight volumes could increase to around 138 billion tonnes kilometres in 2050, while if all ‘low scenario’ were realised, total coastal shipping freight volumes could decline to around 75 billion tonne kilometres.

Air freight volumes are projected to grow by around 103 per cent between 2020 and 2050 from around 290 million tonne kilometres in 2020 to around 589 million tonne kilometres in 2050.

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 a combination of the Centre for Population (CfP) *2021 Population Statement* population projections (Centre for Population 2021) and ABS (2018b) population projections. Centre for Population (2021) includes three population projection scenarios:

i) business-as-usual (BAU) projections,
ii) low migration (*NOM downside*) scenario, and
iii) high migration (*NOM upside*) scenario.

The Centre for Population (2021) projections extend out to 2031–32 only. The ABS (2018b) projections also present three primary population projection series—Series' A, B and C. The ABS (2018b) projections extend out to 2061.

In order to generate long-term freight forecasts out to 2050, BITRE has spliced the ABS (2018b) projection scenario growth rates onto the Centre for Population (2021) population projections. The combined *central* (or *reference*) case combines the Centre for Population (2021) Central scenario and ABS (2018b) Series B projections. The combined high case combines the Centre for Population (2021) Pre-COVID projections and ABS (2018b) Series A projections. Finally, the combined low case combines the Centre for Population (2021) Extended COVID scenario projections and ABS (2018b) Series C projections.

Under the central case scenario, the total population is projected to increase to around 35.3 million persons in 2050, an average rate of growth of 1.06 per cent per annum between 2020 and 2050. Under the high case scenario, the total population is projected to increase to around 36.5 million persons in 2050, an average rate of growth of 1.18 per cent per annum between 2020 and 2050. In the low case scenario, the total population is projected to increase to around 33.1 million persons in 2050, an average rate of growth of 0.85 per cent per annum between 2020 and 2050. By way of reference, the population grew by 1.37 per cent per annum between 1990 and 2020.

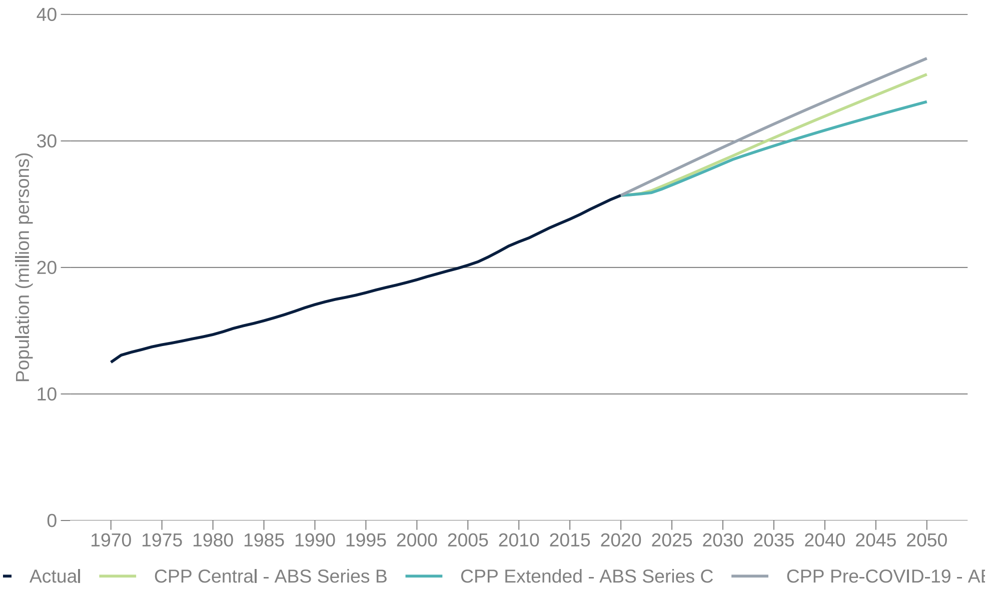
Figure A.1 shows the projected population under the three primary Centre for Population (2021) and ABS (2018b) scenario combinations. And Figure A.2 and Table A.1 show the projected rate of population growth under the three projection scenarios.

Table A.1 Projected population levels, by scenario, 2020 to 2050

	Scenario		
Year	CPP Central - ABS Series B	CPP Extended - ABS Series C	CPP Pre-COVID-19 - ABS Series B
2020	25.70	25.70	25.70
2030	28.48	28.20	29.49
2040	31.95	30.84	33.10
2050	35.26	33.10	36.52
Avg. ann. growth (% p.a.)	1.06	0.85	1.18

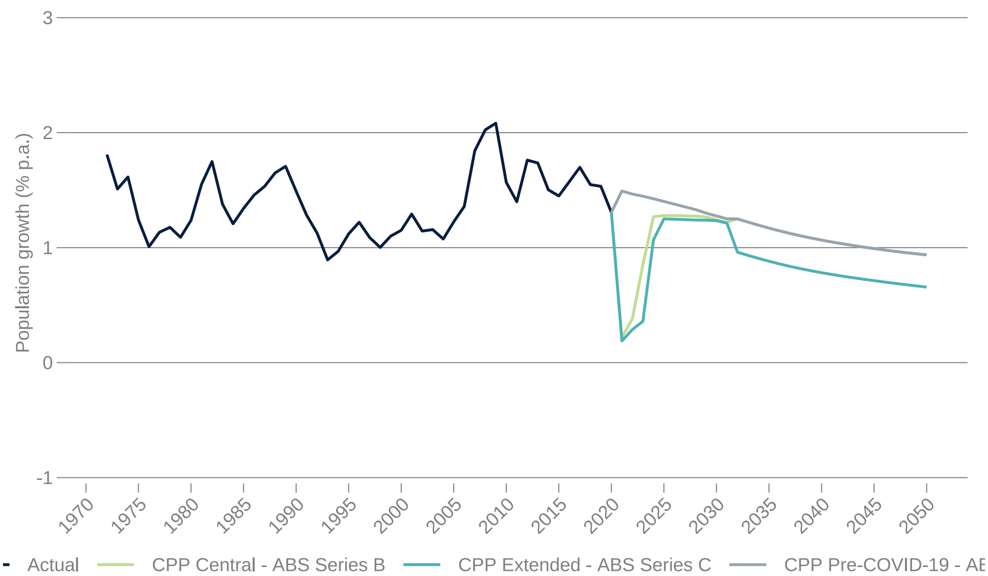
Sources: Centre for Population (2021), ABS (2018b) and BITRE estimates.

Figure A.1 Actual and projected estimated resident population, 1971–2050



Sources: Centre for Population (2021), ABS (2018b) and BITRE estimates.

Figure A.2 Actual and projected estimated resident population growth, 1971–2050



Sources: Centre for Population (2021), ABS (2018b) and BITRE estimates.

A.2 Australian economic growth projections

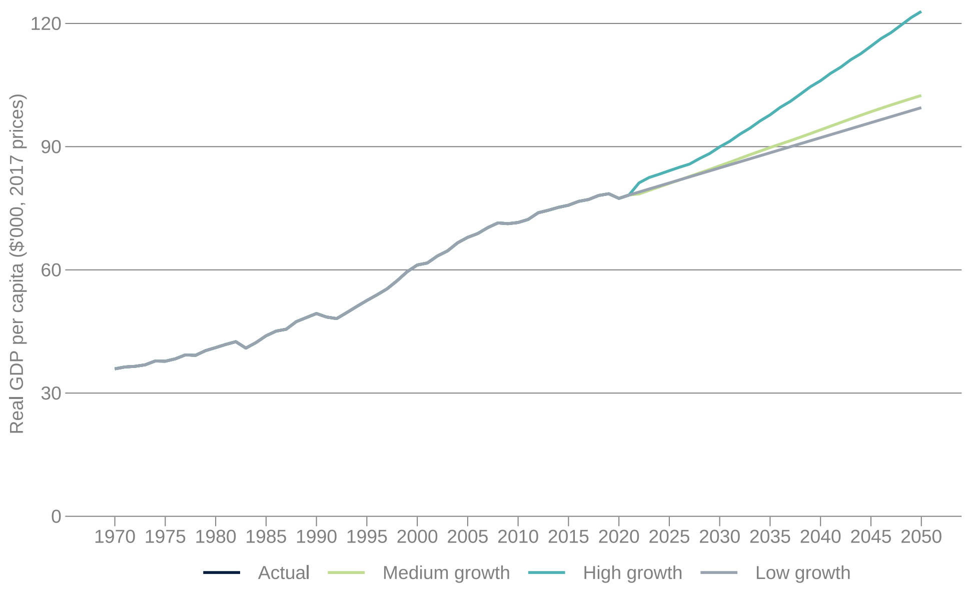
Australian economic growth projections are based on historical trend growth in GDP and GDP per capita over the last five decades.

Three scenarios are considered:

- Low growth scenario – based on projected future trend growth in GDP(E) per capita to 2050.
- Medium growth scenario – based on projected future trend growth in GDP(I) per capita to 2050, in turn based on assumptions about future productivity growth, workforce participation and population demographics.
- High growth scenario – based on the Treasury 2021 Intergenerational Report long-term GDP growth projections, which assumed average labour productivity growth of 1.5 per cent per annum over the projection horizon (Treasury 2021).

Figure A.3 shows the projected forecast real per capita GDP between 2020 and 2050 under alternative scenarios. Figure A.4 shows the implied annual forecast growth rates. Table A.2 shows that real per capita GDP is projected to increase from around $77,400 per person in 2020 to around $99,500 in 2050 under the lowest scenario (average annual growth of 0.84 per cent per annum), around $102,500 per person under the median scenario (average annual growth of 0.94 per cent per annum) and $122,900 per person under the high scenario (average annual growth of 1.55 per cent per annum).

Figure A.3 Actual and projected GDP per capita forecast scenarios, 1971–2050



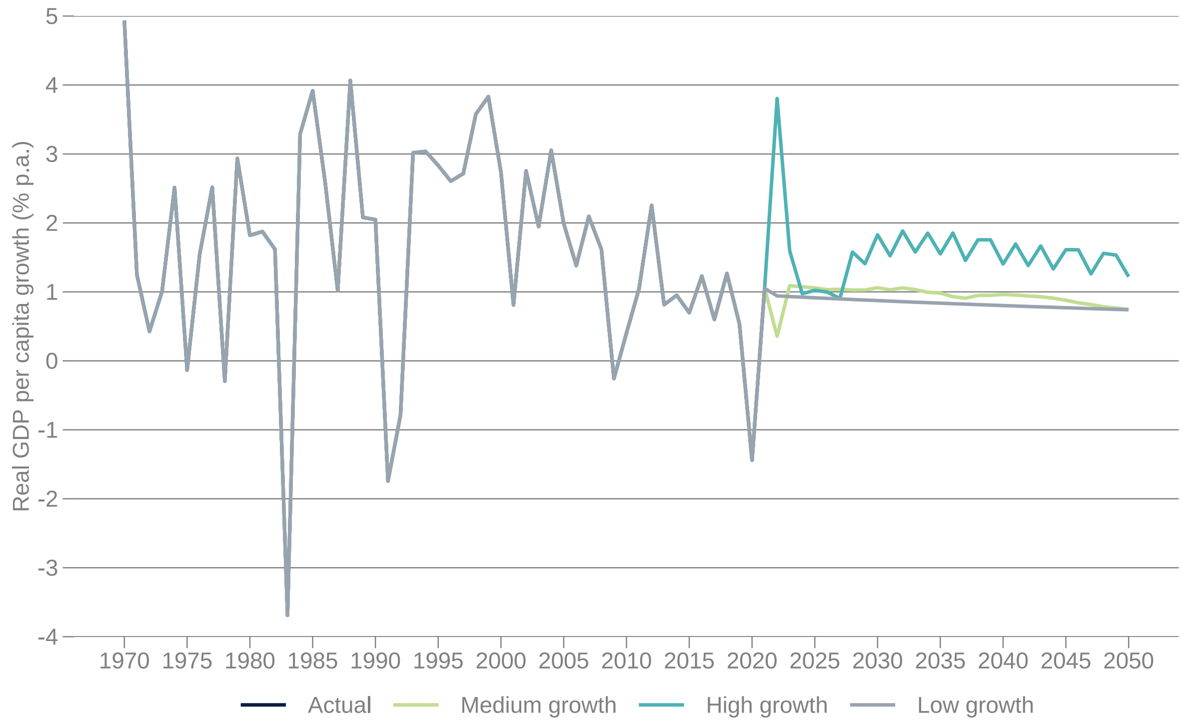
Sources: Treasury (2021) and BITRE estimates.

Table A.2 Projected GDP per capita, by scenario, 2020 to 2050

	Scenario		
Year	Low growth	Medium growth	High growth
2020	77,400	77,400	77,400
2030	84,835	85,339	89,944
2040	92,175	94,083	106,054
2050	99,498	102,461	122,925
Avg. ann. growth (% p.a.)	0.84	0.94	1.6

Sources: Treasury (2021) and BITRE estimates.

Figure A.4 Actual and projected GDP per capita forecast scenario growth, 1971–2050

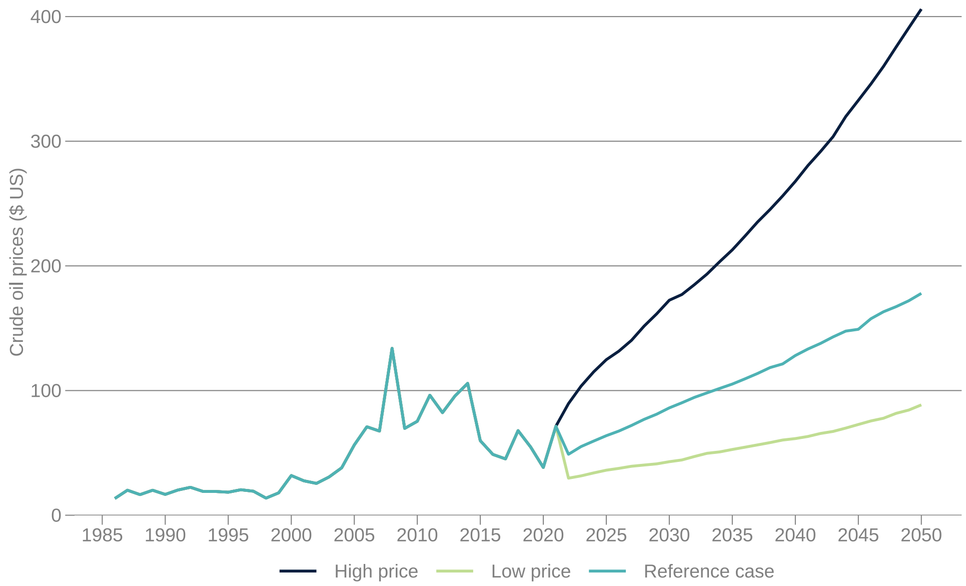


Sources: Treasury (2021) and BITRE estimates.

A.3 World oil price scenario assumptions

Oil price scenarios used in developing the aggregate freight forecasts are based on the United States' EIA (2021a) world oil price outlook scenarios. The EIA project that in their reference case, world oil prices (West Texas Intermediate) will increase from around $US 71.4 per barrel in 2021 to around $US 177.9 per barrel by 2050. Under the low price case, world oil prices are projected to decline in the near term, but increase thereafter, to be around $US 88.5 per barrel by 2050. Under the high price case, world oil prices are projected to increase to over $US 406 per barrel by 2050 (see Table A.3).

Figure A.5 EIA oil price scenarios, 2020–2050



Source: EIA (2021a)

Table A.3 U.S. EIA world oil price scenarios, 2020 to 2050

Year	Scenario		
	Reference case	High price	Low price
2020	38.3	38.3	38.3
2030	86.1	172.5	42.9
2040	128.1	267.8	61.5
2050	177.9	406.0	88.5

Note: [a] West Texas Intermediate crude oil prices
Source: EIA (2021a).

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

The aggregate road freight forecasting model is specified in linear-log terms—i.e. linear in the dependent variable and logarithmic in the independent variables. Table B.1 lists the regression results for the aggregate per capita road freight model—all parameter estimates, therefore, reflect the marginal effect of a proportionate change in the relevant input variable—and Figure B.1 shows actual and model-predicted road freight volumes between 1971 and 2020.

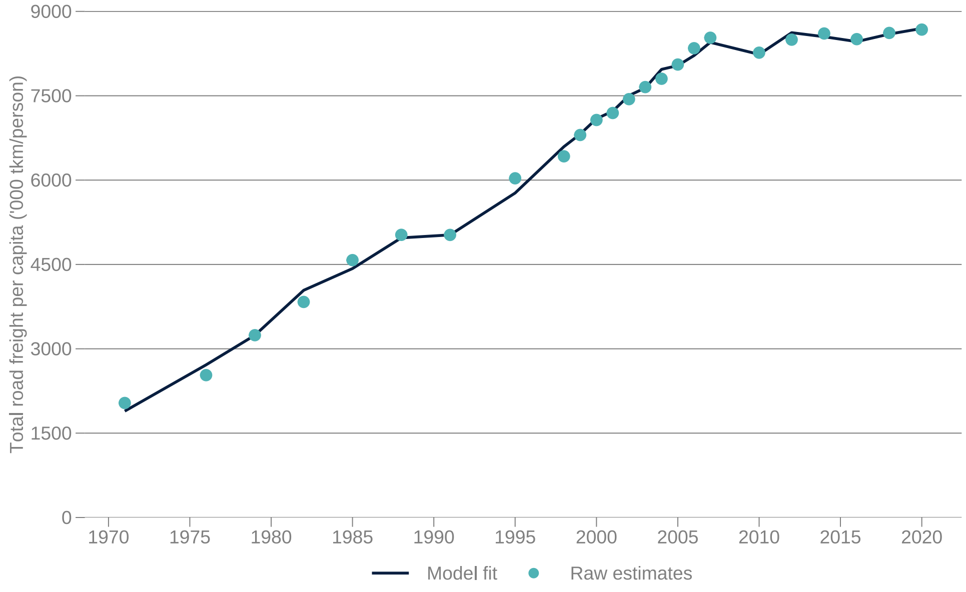
Table B.1 Estimation results – aggregate per capita road freight models

	Model 1
Intercept	-18290.800***
	(1425.255)
log(GNI per capita)	7525.865***
	(232.762)
log(Frgt rate)	-2157.340***
	(277.754)
Dummy - Post-GFC	-612.551***
	(121.892)
Dummy - 1991	-203.953
	(143.087)
Dummy - COVID (2020-2021)	-207.555+
	(114.557)
Num.Obs.	24
R2	0.997
R2 Adj.	0.996
Log.Lik.	-147.342
RMSE	112.20

Source: BITRE estimates.

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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



Source: BITRE estimates

B.2 Interstate non-bulk rail freight model results

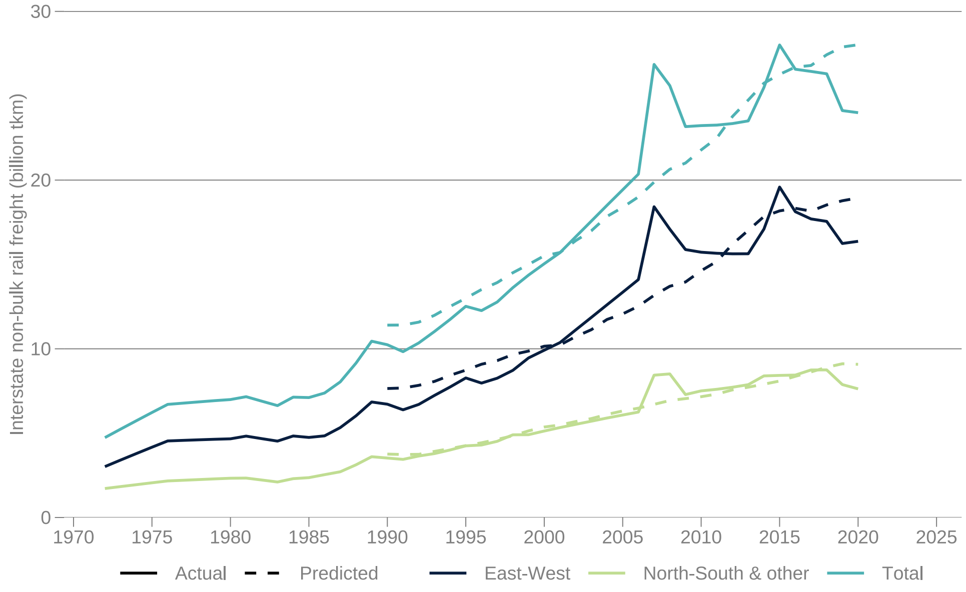
Table B.2 lists the regression results for the aggregate interstate non-bulk rail freight forecasting models and Figure B.2 shows actual and model-predicted interstate freight volumes between 1972 and 2020.

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

	East-West	North-South
Intercept	2805.155**	-421.762
	(815.170)	(433.265)
GSP (WA)	0.052***	
	(0.004)	
GSP (NSW-Vic-Qld)		0.007***
		(0.000)
Num.Obs.	31	31
R2	0.857	0.898
R2 Adj.	0.852	0.894
Log.Lik.	-272.316	-241.121
RMSE	1580.42	577.76

Source: BITRE estimates.

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



Source: BITRE estimates

B.3 Air freight model results

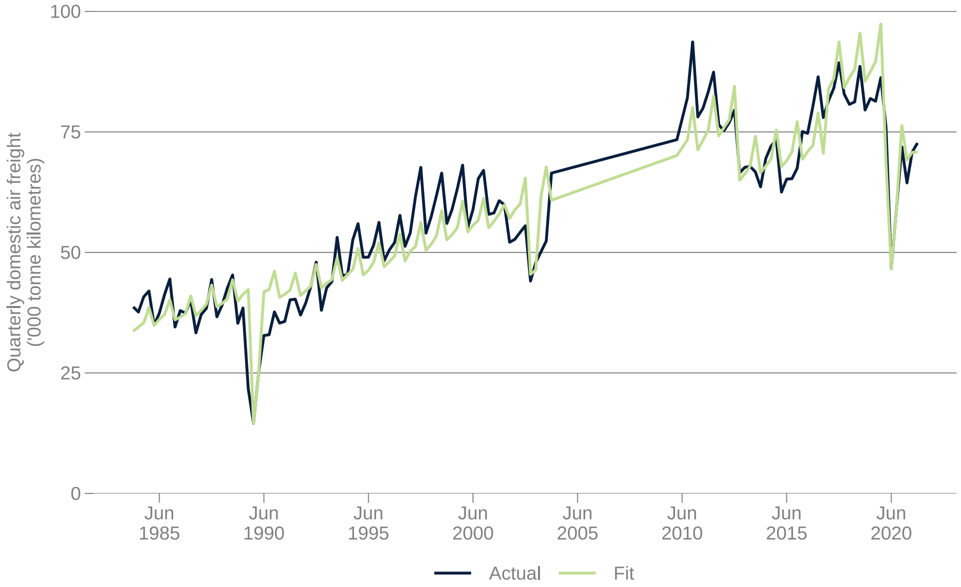
Table B.3 lists the regression results for the preferred aggregate domestic air freight forecasting model specification and Figure B.3 shows actual and model-predicted air freight task between 1984–85 and 2020–21.

Table B.3 Estimation results – domestic air freight forecasting model

	Model 1
Intercept	0.157
	(0.439)
log(GDP)	0.854***
	(0.035)
Pilot's dispute - Dec 1989	-1.148***
	(0.117)
Pilot's dispute - Mar 1990	-0.490***
	(0.117)
Sept. 2001	-0.058
	(0.117)
SARS (2003 Q1-Q2)	-0.252**
	(0.083)
Qantas freight dummy	-0.151***
	(0.035)
Dummy - COVID (2020q2-2021q4)	-0.237***
	(0.057)
Dummy - 2020q2	-0.339**
	(0.127)
Dummy - 2020q3	-0.144
	(0.127)
Num.Obs.	128
R2	0.889
R2 Adj.	0.878
Log.Lik.	102.455
RMSE	0.11

Source: BITRE estimates.

Figure B.3 Domestic air freight, actual and model predictions, 1984–85 to 2020–21



Source: BITRE estimates

Appendix C – Freight task forecasts

This appendix lists the aggregate freight forecast tasks by transport mode. Table C.1 lists actual (1971–2020) and reference case forecast freight volumes (2020–2050). 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), 1971–2050

	Mode				
Year	Road	Rail	Coastal	Air	Total
1971	24.7	39.7	72.0	0.094	136.5
1972	27.1	42.7	83.2	0.094	153.1
1973	30.8	46.7	89.5	0.095	167.1
1974	35.9	54.1	96.1	0.114	186.2
1975	31.4	59.0	101.2	0.111	191.7
1976	38.1	55.6	104.6	0.106	198.4
1977	42.2	57.7	102.3	0.106	202.3
1978	42.4	59.8	105.1	0.117	207.5
1979	47.0	59.8	104.7	0.123	211.6
1980	52.5	63.7	105.1	0.124	221.5
1981	57.3	65.7	110.3	0.124	233.4
1982	61.2	65.4	97.8	0.134	224.5
1983	59.3	59.8	80.9	0.142	200.2
1984	65.0	65.4	94.3	0.155	224.9
1985	69.6	72.6	96.3	0.155	238.7
1986	73.0	77.3	101.8	0.158	252.3
1987	73.8	80.4	95.2	0.148	249.5
1988	82.0	81.9	93.6	0.158	257.6
1989	88.6	80.6	90.7	0.162	260.1
1990	92.4	87.9	94.2	0.094	274.6
1991	86.6	91.1	93.8	0.142	271.7
1992	89.8	99.3	96.4	0.157	285.6
1993	94.1	100.8	96.0	0.172	291.1
1994	98.1	104.2	98.8	0.188	301.3
1995	103.7	106.2	109.2	0.207	319.3
1996	110.5	110.3	105.5	0.207	326.5
1997	116.8	119.6	113.4	0.215	350.0
1998	122.5	125.6	118.7	0.241	367.1
1999	128.1	128.0	108.5	0.243	364.8
2000	134.8	133.6	106.2	0.245	374.9
2001	139.2	138.1	104.0	0.248	381.5
2002	146.2	151.7	111.5	0.225	409.6
2003	150.6	164.4	113.1	0.202	428.3
2004	158.8	171.5	119.0	0.192	449.5
2005	162.2	188.4	116.0	0.279	466.9
2006	168.1	197.4	120.8	0.380	486.7
2007	176.1	203.5	123.5	0.371	503.4
2008	183.5	223.1	121.9	0.401	528.9
2009	183.4	237.2	106.3	0.329	527.2
2010	181.5	258.6	115.4	0.321	555.8
2011	191.7	261.8	117.4	0.334	571.2
2012	199.6	290.7	101.3	0.322	592.0
2013	199.2	319.0	106.0	0.291	624.5
2014	200.8	367.7	106.8	0.268	675.6
2015	202.4	405.3	107.5	0.273	715.4
2016	204.8	415.0	109.4	0.283	729.4
2017	208.5	419.3	107.5	0.326	735.6
2018	214.2	422.8	106.7	0.337	744.1
2019	220.5	421.7	118.9	0.331	761.4
2020	222.9	433.2	111.4	0.290	767.9
2021	230.1	446.5	106.9	0.266	783.8

(continued)

Table C.1 Actual and reference case scenario freight forecasts (billion tkm), 1971–2050 *(continued)*

	Mode				
Year	Road	Rail	Coastal	Air	Total
2022	234.8	469.1	105.9	0.323	810.1
2023	239.1	474.5	106.1	0.365	820.1
2024	244.5	484.5	106.3	0.372	835.7
2025	250.0	480.9	106.7	0.379	838.0
2026	255.5	473.4	107.0	0.387	836.3
2027	261.1	469.1	107.4	0.394	838.0
2028	266.8	465.1	107.7	0.402	840.0
2029	272.5	461.7	108.0	0.410	842.7
2030	278.3	458.0	108.3	0.418	845.0
2031	284.0	456.6	108.6	0.426	849.6
2032	289.9	455.0	108.9	0.435	854.3
2033	295.9	453.2	109.2	0.443	858.7
2034	301.8	452.6	109.5	0.452	864.2
2035	307.7	451.6	105.5	0.460	865.2
2036	313.6	450.9	105.8	0.469	870.7
2037	319.5	450.6	106.1	0.477	876.6
2038	325.4	451.4	106.4	0.485	883.7
2039	331.3	452.3	106.7	0.494	890.8
2040	337.2	453.5	107.0	0.502	898.2
2041	342.9	454.0	107.3	0.511	904.7
2042	348.6	454.5	107.6	0.520	911.3
2043	354.4	454.9	107.9	0.529	917.8
2044	360.1	455.3	108.2	0.537	924.2
2045	366.1	455.6	108.6	0.546	930.8
2046	371.5	456.0	108.9	0.555	936.8
2047	377.0	456.4	109.2	0.563	943.1
2048	382.7	456.8	109.5	0.572	949.5
2049	388.2	457.3	109.8	0.580	955.8
2050	393.7	457.8	110.1	0.589	962.2

Sources: BITRE estimates.

Table C.2 High case scenario freight forecasts (billion tkm), 1971–2050

	Mode				
Year	Road	Rail	Coastal	Air	Total
2020	222.9	433.2	111.4	0.290	767.9
2021	230.1	446.7	114.3	0.266	791.4
2022	242.2	470.7	113.5	0.328	826.7
2023	251.8	476.5	113.9	0.381	842.6
2024	257.2	486.7	114.3	0.389	858.6
2025	262.8	494.1	114.8	0.398	872.1
2026	268.5	502.6	115.3	0.406	886.7
2027	274.0	503.5	115.8	0.414	893.7
2028	281.0	503.7	116.3	0.423	901.4
2029	287.7	505.1	116.8	0.433	910.0
2030	295.3	504.9	117.2	0.444	917.9
2031	302.4	506.9	117.7	0.455	927.4
2032	310.2	508.0	122.7	0.467	941.4
2033	317.4	511.6	125.5	0.479	954.9
2034	325.5	511.5	128.2	0.491	965.7
2035	332.8	514.9	130.9	0.503	979.1
2036	340.9	514.0	131.4	0.516	986.9
2037	348.2	514.8	131.9	0.528	995.5
2038	356.2	519.6	132.4	0.540	1 008.7
2039	364.2	526.0	132.9	0.554	1 023.7
2040	371.6	532.4	133.4	0.566	1 037.9
2041	379.6	534.6	133.9	0.579	1 048.7
2042	386.9	536.6	134.4	0.592	1 058.5
2043	395.1	543.7	134.9	0.605	1 074.3
2044	402.3	546.0	135.4	0.618	1 084.3
2045	410.3	549.2	135.9	0.631	1 096.1
2046	418.4	550.5	136.4	0.645	1 105.9
2047	425.7	554.1	136.9	0.658	1 117.4
2048	433.7	559.1	137.4	0.671	1 130.9
2049	441.9	563.3	137.9	0.686	1 143.7
2050	449.1	567.4	138.4	0.700	1 155.6

Sources: BITRE estimates.

Table C.3 Low case scenario freight forecasts (billion tkm), 1971–2050

	Mode				
Year	Road	Rail	Coastal	Air	Total
2020	222.9	433.2	111.4	0.290	767.9
2021	227.1	446.3	100.8	0.266	774.5
2022	230.9	468.8	99.6	0.324	799.7
2023	234.5	474.0	99.7	0.367	808.5
2024	238.1	478.2	99.8	0.371	816.4
2025	242.4	474.6	100.0	0.377	817.3
2026	247.0	444.9	100.1	0.384	792.3
2027	251.5	438.1	100.3	0.391	790.3
2028	255.8	431.9	96.2	0.399	784.4
2029	260.4	426.0	96.3	0.406	783.1
2030	265.0	420.0	95.5	0.413	780.9
2031	269.9	416.3	91.2	0.421	777.8
2032	274.1	412.1	90.5	0.428	777.1
2033	278.2	407.5	89.8	0.435	776.0
2034	282.2	404.1	89.2	0.441	775.9
2035	286.2	400.2	88.6	0.448	775.5
2036	290.1	397.0	88.0	0.454	775.6
2037	294.0	393.9	87.5	0.461	775.9
2038	298.0	391.3	87.0	0.467	776.7
2039	301.9	388.7	86.5	0.474	777.6
2040	305.7	386.2	75.4	0.480	767.9
2041	309.5	383.0	75.6	0.487	768.6
2042	313.4	379.2	75.7	0.493	768.8
2043	317.2	376.7	75.8	0.500	770.2
2044	320.8	373.6	76.0	0.506	770.9
2045	324.6	370.7	76.1	0.513	771.9
2046	328.4	367.8	76.2	0.519	772.9
2047	332.2	365.0	76.3	0.526	774.0
2048	335.9	362.2	76.5	0.532	775.1
2049	339.6	359.5	76.6	0.539	776.2
2050	343.3	356.9	76.7	0.546	777.5

Sources: BITRE estimates.

Acronyms and abbreviations

ARTC – Australian Rail Track Corporation

BITRE – Bureau of Infrastructure and Transport Research Economics

DIRN – Defined Interstate Rail Network

OD – origin–destination

TIC – Transport and Infrastructure Council

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