

Rail Transit Industry Development in Australia - Report for CRRC Limited



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Rail Transit Industry Development in Australia – Report for CRRC Limited

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Picture 1 Opening of Sydney L2 light rail extension between Circular Quay and Randwick, 14 December 2019



Source: Transport for NSW website (14 December 2019).

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Glossary

ABARES	Australian Bureau of Agricultural and Resources Economics and Science
ABS	Australian Bureau of Statistics
ACCC	Australian Competition and Consumer Commission
ACT	Australian Capital Territory
AIBE	Australian Institute for Business and Economics (UQ)
ARA	Australasian Railway Association
BEL	Business, Economics and Law (Faculty, UQ)
BHPB	Broken Hill Pty Limited (BHP) Billiton
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BOOT	Build, Own, Operate and Transfer
CBD	Central Business District
CRRC	CRRC Limited
DBFM	Design, Build, Finance and Maintain
DBFO	Design, Build, Finance and Operate
EAIT	Engineering, Architecture, Information Technology (Faculty, UQ)
EMU	Electric multiple unit
EOI	Expression of Interest
ETSC	European Train Control System
FBO	Final Binding Offer
FMG	Fortescue Metals Group
GCLR	Gold Coast Light Rail
GDP	Gross Domestic Product
GFC	Global financial crisis
GWA	Genesee & Wyoming Australia
HCMT	High Capacity Metro Trains
HCS	High Capacity Signalling
IA	Infrastructure Australia
LNG	Liquefied natural gas
NGR	New Generation Rollingstock
NTK	Net tonne kilometres
NSW	New South Wales
NT	Northern Territory
NTK	Net Tonne Kilometres

PC	Productivity Commission
PN	Pacific National
PPP (1)	Purchasing Power Parity
PPP (2)	Public Private Partnership
QLD	Queensland
R&D	Research and Development
RBA	Reserve Bank of Australia
ROI	Registration of Interest
SA	South Australia
SEQ	South East Queensland
SM	Sydney Metro
SSR	Southern Shorthaul Railroad
TAS	Tasmania
UQ	The University of Queensland
US	United States
VFT	Very Fast Train
VIC	Victoria
WA	Western Australia

Executive Summary

Background

CRRC Limited has requested The University of Queensland (UQ) undertake a study into the market demand for rail transit vehicles in Australia. The Australian Institute for Business and Economics (AIBE) at UQ has undertaken the study jointly with Tulipwood Advisory Pty Ltd, a leading Australian economics consulting firm.

Structure of the Australian rail market

Capital city heavy rail passenger transit

There are five heavy rail passenger transit networks in Australia, operating in Australia's five largest capital cities. The two largest networks, in terms of annual passenger demand, are Sydney (360 million passenger journeys per year) and Melbourne (241 million passenger journeys per year). Brisbane (52 million) and Perth (61 million) operate mid-sized networks, while Adelaide (14 million) operates a relatively small heavy rail passenger network.

In total, as at 2019, it is estimated that 4,404 carriages operate on the five networks, with Sydney accounting for 40 percent of all carriages, followed by Melbourne (31 per cent) and Brisbane (18 per cent). Hobart, Canberra and Darwin currently do not operate heavy rail passenger networks and there are currently no credible plans to introduce new networks in these cities in the next decade (**Table E 1**).

Table E 1 Australian capital city rail passenger transit network (2018-2019).

Capital City (State)	Rail length (km)	Carriages (single unit)	Lines	Stations	Passenger journeys (per year)
Sydney (NSW)	813	1,751	9	175	359.2 million
Melbourne (VIC)	405	1,374	16	220	240.9 million
Brisbane (QLD)	689	813	13	152	52.4 million
Perth (WA)	181	330	5	72	60.6 million
Adelaide (SA)	126	136	6	89	14.0 million
Total	2,214	4,404	49	708	727.1 million

Sources: BITRE (2019), ARA (2019), ABS Census data, various State Government Transport Department Annual Reports, and Tulipwood Economics analysis. Reported passenger journey estimates are for the latest available financial year, being 2018-19.

Notes: The Greater Sydney network includes: the Sydney electrified network (including services to the Central Coast, Newcastle and Wollongong) and the Blue Mountains network (serviced by diesel locomotives). Greater Melbourne includes: the Melbourne electrified network and passenger services to Geelong. Greater Brisbane includes: the Brisbane-Gold Coast network and passenger services to the Sunshine Coast.

Capital city light rail passenger transit

Five Australian capital cities operate light rail networks, namely: Sydney, Melbourne, Gold Coast (which is a part of the Greater Brisbane conurbation), Adelaide and Canberra. Hobart, Perth and Darwin do not operate light rail passenger networks. In recent years, there have been a number of proposals to introduce a light rail network in Perth, but as yet there has been no commitment from the Western Australian (WA) Government. Based on this, it is possible that a light rail network could be introduced into any of these three cities by 2029, with the most likely candidate being Perth. The Melbourne light rail network has 250 km of light rail track length, operating 501 carriages and servicing 206 million passenger journeys per year.

Apart from Melbourne, which has maintained an extensive light rail network for over 100 years, the modern Australian light rail networks are in their infancy. Passenger demand in the new networks is growing steadily as commuters adapt to a new way of travelling within the central business district's (CBD) of Australia's major cities, and government policies (such as related to inner-city housing supply and traffic congestion) have been supportive of passenger demand growth. In our view, the increased use of toll roads and the high cost of car parking in Brisbane and Sydney will continue to shift commuters to light rail over the next decade. Sydney's new light rail passenger demand has reached 10.3 million passenger journeys per year already. Adelaide's network carries 9.5 million passengers per year, followed by the Gold Coast (7.7 million), and the new Canberra network (4.0 million) which began operations in early 2019 (**Table E 2**).

Table E 2 Light rail passenger transit market by capital city (2018-19).

Capital City (State)	Light rail track length (km)	Carriages (single unit)	Lines	Stations	Passenger journeys (per year)
Sydney (NSW)	12.8	12	1	23	10.3 million
Melbourne (VIC)	250.0	501	24	1,763	206.3 million
Gold Coast (QLD)	20.0	18	1	19	7.7 million
Adelaide (SA)	15.0	24	1	28	9.5 million
Canberra (ACT)	12.0	14	1	13	4.0 million
Total	309.8	569	28	1,846	237.8 million

Source: Various State Government publications and Tulipwood Economics analysis.

Notes: Both the 600 V DC and 750 V DC light rail electrical systems operate 'overhead' (or catenary). The passenger journey figure for Canberra is an early estimate because the system has been in operation for less than one year.

Regional rail passenger transit by state

Australia has an extensive regional rail passenger network reflecting the size of the country, although passenger numbers are small relative to capital city demand. Almost all regional passenger services in Australia are powered by diesel locomotives, and carriages tend to be quite old and require regular maintenance and upgrades. Regional services tend to depart from major capital city train stations including Central Station in Sydney, Southern Cross Station in Melbourne and Roma Street Station in Brisbane.

The two main networks are in regional New South Wales (NSW) (550 carriages) and regional Victoria (VIC) (342 carriages). The regional NSW network is the largest and services a number of inter-city routes (such as Sydney-Canberra) as well as a number of regional towns in western NSW (such as Bathurst and Dubbo). The VIC network is more compact, reflecting the fact that VIC is a small state by land area. The regional Queensland (QLD) passenger network is large by track length but there are very few carriages operating on the network (40 carriages) reflecting the low demand for regional rail services. QLD's regional road network is extensive and many regional mining operations use a 'drive-in drive-out' or 'fly-in fly-out' system for workers, limiting the demand for regional passenger rail services.

In total, regional passenger services carry 69.9 million passengers in 1,056 carriages on 20 lines over 17,800 km of track. Track gauges vary by state, but most of the track length is standard gauge (Table E 3).

Table E 3 Australian regional rail passenger transit network (2018-2019).

Regional network (by State)	Rail length (km)	Track gauge (mm)	Carriages	Lines	Passenger journeys (per year)
Regional NSW	6,000	1,435	550	5	46.4 million
Regional VIC	1,300	1,600 / 1,435	342	5	22.4 million
Regional QLD	4,000	1,067	40	5	0.8 million
Regional WA	3,500	1,067 / 1,435	14	4	0.2 million
Regional SA	2,979	1,435	110	1	0.1 million
Total	17,779	-	1,056	20	69.9 million

Source: Various State Government publications and Tulipwood Economics analysis.

Notes: The Adelaide-Darwin passenger service (the Ghan and Overlander) are counted in Regional SA (not NT). WA regional passenger track length includes the Perth to Adelaide Indian Pacific service.

Freight rail by commodity

The rail freight transport market consists of a small number of large private freight transport companies in Australia such as Aurizon (formerly Queensland Rail National), Pacific National (PN), Genesee & Wyoming Australia, Qube Logistics, SCT Logistics, Southern Shorthaul Railroad, Transvolution, Watco Australian and Bowmans Rail. Additionally, vertically integrated mining companies such as BHP Billiton, Rio Tinto, and Adani operate their own freight trains.

Rail freight has grown rapidly in Australia since 2000, reflecting the significant increase in demand for Australia's resources exports. Because of its geographic size, the Australian rail freight task is formidable and strategically and economically significant to Australia's living standards. Rail now accounts for more than half of Australia's total freight transport task, up from just over one-third at the beginning of this century.

Rail freight is a significant component of the Australian rail market. Freight rail services compete for capacity (or 'slots') on some capital city passenger networks, notably on some shared lines in the Brisbane and Sydney networks. For example, coal trains run through the Brisbane and the Sydney passenger network on the journey between mines and ports. Recently, the Australian and QLD Governments have agreed to invest in greater network capacity in the Brisbane passenger network in order to allow the Melbourne-Brisbane inland rail network to operate efficiently without being hampered by passenger trains.

Currently, there are an estimated **2,015 operational freight locomotives** in Australia. Just over one-fifth of these locomotives are dedicated to the Pilbara iron ore freight task. However, by net tonne kilometre, the Pilbara freight task accounts for two-thirds of the total Australian freight task. According to the Bureau of Infrastructure, Transport and Regional Economics (BITRE, 2019), approximately 50 percent of the fleet was aged 11 years or less, compared to approximately 13 years or less the previous year. The number of operational wagons is difficult to calculate, but it is estimated to be in the tens of thousands.

In the current Australian market, diesel and bi-modal locomotives are generally built by US companies (such as General Electric or Progress Rail) and wagons are generally built by Chinese companies, including CRRC Limited.

Bidding processes

The various Australian state governments that are responsible for procuring rail transit equipment utilise foreign manufacturers in order to promote competition based on price and quality. However, generally Australian state governments will incorporate 'local content' manufacturing rules into procurement contracts

in order to deliver 'local jobs' in their state. These rules are often an integral part of contracts with foreign companies to encourage local manufacturing employment. Local content rules are not mandated. Rather, various state governments have written down local content procurement *guidelines* that must be recognised when governments procure for major infrastructure projects.

For example, the NSW Procurement Policy Framework (2019) states that (NSW Government 2019, p.10):

“You must not discriminate against suppliers due to foreign affiliation or ownership, or the origin of their goods or services, for procurements covered by international procurement agreements.”

In practice, local content rules are generally applied strongly in states with Labor Governments, such as (currently) in QLD, VIC and WA. In NSW and South Australia (SA), which have Liberal National Governments, local content rules are weaker, with these governments preferring to source carriages at a lower price than could be produced in Australia. We understand that in WA, a recent contract specified a minimum local content rule of 35 per cent, however the winning bidder (Alstom) proposed a much higher percentage of local content, arguably because the tender process had a points-based system whereby a higher local content proportion earned the bidder more points.

The Liberal National governments also sometimes specify local content rules, but these are kept to a minimum to keep costs down. For example, a recent contract for bi-modal trains on NSW regional lines required some minor 'fit-outs' of carriages built overseas to be undertaken in Dubbo, NSW.

Under the tendering rules in all Australian states, state governments *must* consider the opportunity for private sector involvement, including from foreign bidders. No Australian state excludes the possibility of foreign companies bidding for Australian Government tenders.

Generally, pre-funding approval from government for major purchases will take about two to four years. There are a number of stages in the pre-funding approval process before the government will 'go-to-market' with its tender. The process begins with Strategy Planning within government departments before an Industry Briefing informs potential bidders of the government's plans. Following this, Industry Engagement is undertaken in order to develop the basic outlines of a Business Case, which is then undertaken, often by an external independent third party. The Business Case is then presented to the Transport Department for Review. If the department is satisfied that the Business Case is feasible then the proposal will go to Cabinet for approval, followed by Budget Approval (usually during the annual budgetary review process).

The stages are summarised in **Figure E 1** below:



Figure E 1 Generalised pre-funding approval stages, Australian state governments.

Once budget approval is finalised, which may also require securing federal government funding, state governments can then 'go-to-market'. The first step is generally a Registration of Interest (ROI) process, which effectively gauge the market to assess whether the procurement is achievable.

In Australia, government tendering processes are staged whereby interested parties are gradually short-listed to (usually) three preferred bidders. State governments generally look for a minimum of three bidders, such that if one bidder withdraws there are still two remaining bidders to enforce competition through the

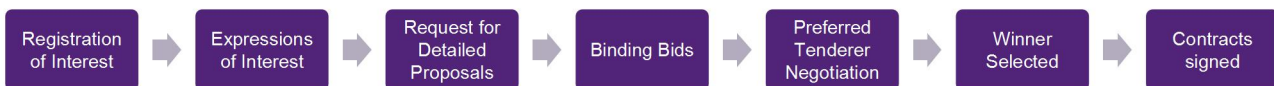
entire process. Following the selection of the preferred bidders, detailed negotiations begin. Following these negotiations, a winning bidder is selected and contracts are signed.

To further encourage competition, state governments will generally partly reimburse companies for their bids. The amount of funding is determined on a case-by-case basis, based on the state guidelines. For example, the NSW bid cost contribution policy states that (NSW Government, 2019):

“The bid cost contribution should be calculated as a percentage of the estimated bid costs and included as part of costings in the Final Business Case. Unless there is a compelling reason, the percentage of eligible pre-estimated bid costs to be reimbursed should be no more than 50 per cent. The bid cost contribution should be expressed as a capped dollar value. It should be offered to each unsuccessful proponent who meets the Mandatory Conditions.”

The stages are summarised **Figure E 2** below:

Figure E 2 Generalised go-to-market stages, Australian state governments.



Procurement and financing methods

Australian state governments use a variety of procurement and financing methods. Increasingly, state governments are using public-private partnership (PPP) financing models to lower the direct cost to the taxpayer and appropriately share delivery and operational risk with the supplier.

In recent years, the more common procurement methods have utilised the private sectors expertise from the design stage all the way through to operating the network, such as: Build, Own, Operate and Transfer (BOOT), Design, Build, Finance and Operate (DBFO), and Design, Build, Finance and Maintain (DBFM).

Other procurement and financial models include market-led (or unsolicited) proposals. That is, a supplier pitches an idea or plan for new rail equipment to the state government. This might involve demonstrating a low-cost way to upgrade existing carriages with new Wi-Fi technology or smart screens.

Rail manufacturers in the Australian market

There are a number of rail transit carriage, freight locomotive and wagon manufacturers operating in the Australian market, including:

- CRRC Limited;
- Bombardier Transportation;
- Downer EDI Rail;
- UGL Rail; and
- Alstom.

Today, most of the new stock of rail transit vehicles are built overseas, with some specified local content required. For example, Bombardier Transportation recently won the contract to build the new NGR700 rolling

stock for the QLD Government. The \$4.4 billion project, over 32 years, will deliver 75 new passenger trains for the Brisbane network under an 'Availability PPP' procurement and financing model. Currently, accessibility upgrades are being undertaken at the Downer EDI plant in Maryborough, QLD to add a second toilet on all 75 NGR six-carriage sets and meet local disability access requirements.

The new rapid-transit Sydney Metro rail system (utilising six- to eight-carriage train sets), which began operating on the North-West Rail Link in 2019, will use carriages built by international train manufacturer Alstom. These carriages will be built overseas.

In terms of freight rail, generally locomotives are sourced from the US and wagons from China. To minimise costs, US companies such as General Electric and Progress Rail may subcontract part of the work to companies based in India or Kazakhstan.

Findings

As part of this study, the main findings have been summarised.

Finding 1

It is believed that the strongest candidate for heavy rail passenger demand growth is Melbourne, where growth is forecast to be 2.7 per cent per year on average over the ten years to 2029. There are plans to expand the existing Melbourne network, most notably with a new link to Melbourne Airport. Melbourne has also enjoyed relatively strong population and economic growth over the last few years and it is believed this is likely to continue into the next decade.

It is also expected that growth in Sydney will be consistent and robust, at 2.5 per cent per year on average to 2029. There are plans to continue to expand Sydney's passenger rail network, most notably with the new Sydney Metro system. This expansion should induce further growth in demand and possibly lead to a shortfall of carriages towards the end of the next decade.

We expect relatively slower growth in Brisbane driven by several factors, including slower population growth generally, and job growth in the CBD.

Table E 4 Heavy rail passenger annual growth forecasts, 2020 to 2029.

Capital city market	Average annual growth (% per year)
Sydney	2.5%
Melbourne	2.7%
Brisbane	1.7%
Perth	2.1%
Adelaide	2.2%
Average (un-weighted)	2.2%

Source: Tulipwood Economics analysis.

Finding 2

Based on the growth rates set out above, it is estimated that there is little excess market demand in the Australian passenger rail transit market in the short-term (i.e. the next five years), because state governments have already largely planned for, and ordered, carriages and equipment to support forecast passenger growth and network expansion.

Based on the passenger demand growth forecasts undertaken, it is believed that in 2025, the only heavy rail passenger transit market that might have a shortfall of carriages is Sydney (-118 carriages). Based on this, notwithstanding (currently unknown) network expansions, the other heavy rail markets are likely to be in approximate equilibrium in 2025.

Finding 3

However, there will be a significant shortfall in the number of rail transit carriages in 2029 in Sydney and Melbourne. In Sydney, the shortfall is estimated to be 312 carriages in 2029. Whereas in Melbourne, the shortfall is estimated to be 486 carriages in 2029.

In Brisbane and Adelaide, it is estimated that there will be an equilibrium in the supply-demand balance for carriages in 2029. Finally, in Perth it is estimated that there will be an oversupply of carriages (of +74) given the central growth demand forecasts (**Table E 5**).

Table E 5 Projections of rail carriage stocks by capital city market.

Market	Current stock (carriages)	2029 stock* (carriages)	Based on Central Case growth forecasts	
			2029 Requirement	Shortfall/Excess (carriages) (+/-)
Sydney	1,751	1,760	2,072	-312
Melbourne	1,374	1,307	1,793	-486
Brisbane	813	963	962	+1
Perth	330	480	406	+74
Adelaide	136	172	169	+3
Total	4,404	4,682	5,402	-

Source: Tulipwood Economics analysis.

Notes: *2029 stock incorporates new rolling stock planned for and ordered, as well as retirements and likely refurbishments.

Finding 4

The demand for freight locomotives and wagons continues to grow strongly in Australia, driven by record volumes of iron ore and coal being exported to China, India, Japan and South Korea. Although the mining investment boom has peaked and Australia's terms of trade has declined from record levels, the permanent increase in the size of Australia's freight rail network (built during the mining boom) has allowed for today's record volumes of iron ore, coking and thermal coal exports. Based on this analysis, the most promising freight market for CRRC Limited will be the Pilbara iron ore market, where Rio Tinto, BHP Billiton and Fortescue Metals Group (and others) operate.

Table E 6 Projections of freight carriage stocks, locomotives.

Market for locomotives	Current stock	2029 Requirement	Shortfall/Excess (carriages) (+/-)
Pilbara iron ore	425	600	-175
Bowen Basin coal	361	509	-148
Hunter Valley coal	219	267	-48
NSW/WA wheat	100	122	-22
General commodities	910	1,165	-255
Total	2,015	2,663	-648

Source: Tulipwood Economics analysis.

Note: It has been difficult to develop a picture of planned locomotive and wagon purchases over the next ten years. Therefore, this has not been included in the analysis.

Recommendations

Recommendation 1

CRRC Limited actively pursues commercial opportunities in the Australian passenger and freight rail market, particularly in the Sydney and Melbourne heavy rail passenger transit market, and the light rail market in all jurisdictions. In our view, the Australian light market represents a significant opportunity for CRRC Limited.

As part of this, CRRC consider undertaking an Australian ‘roadshow’ of senior officials in the various state transport departments and network operators to advertise its capability, size, quality, innovative technology, local knowledge and international experience. This ‘roadshow’ would augment current industry engagement activities, such as CRRC Limited’s significant contribution to the annual ARA Conference and other activities associated with the ARA.

Recommendation 2

CRRC Limited consider establishing an Australian legal entity to undertake maintenance and refurbishment work on carriages built and supplied by CRRC and also other firms. This type of work is significant and likely profitable, as state governments and companies often first seek to extend the life of rolling stock before ordering new fleets.

CRRC Limited could consider partnering with, or purchasing, an existing Australian rail equipment manufacturer to make it easier to meet tendering rules, including any local content requirements specified by state governments.

Recommendation 3

CRRC investigate opportunities in the Australian rail freight market. The rail freight market is large in Australia, and is undergoing profound technological change with the development of driverless carriages that can operate on both electric networks and networks without electricity.

As part of this, CRRC Limited could invest further in locomotive-related R&D to develop products that would suit Australian conditions.

Recommendation 4

CRRC could partner with an Australian-based university to develop a research program that would be beneficial to both the Australian university and CRRC Limited.

CRRC could benefit from ongoing research into the Australian passenger rail transit market, light rail, regional rail, and rail freight market. The research would also boost awareness of CRRC in Australia and its reputation as a good corporate citizen.

1. Introduction

1.1 Background to the study

CRRC Corporation Limited (CRRC) has requested The University of Queensland (UQ) undertake a study into the market demand for rail transit vehicles in Australia. The Australian Institute for Business and Economics (AIBE) at UQ has undertaken the study jointly with Tulipwood Advisory Pty Ltd, a leading Australian economics consulting firm.

CRRC and UQ maintain a longstanding and strong relationship through the Faculty of Engineering, Architecture and Information Technology (EAIT) China Research Partnerships Institute within the School of Chemical Engineering at UQ and the CRRC Institute.

1.2 About CRRC Corporation Limited

CRRC is the world's largest rolling stock and rail equipment manufacturer. CRRC is a Chinese public company and a global player in rail transport manufacturing with a significant commercial footprint across many countries, including Australia.

CRRC is the world's largest supplier of urban rail transit vehicles and its businesses incorporate the research and development (R&D), design, manufacture, repair, sale, lease and technical services for rail transit vehicles (i.e. rolling stock), engineering machinery, and electrical and electronic equipment and parts. Headquartered in Beijing, CRRC Group incorporates 46 wholly-owned and majority-owned subsidiaries and have over 180,000 employees.

1.3 About the author

Joe Branigan is a leading Australian public policy economist and transport industry specialist with 25 years' experience working in government, academia and private sector consulting. Joe has undertaken a number of economic appraisals and Business Case studies of Australian passenger and freight rail networks for government agencies. Joe is a senior industry fellow with UQ attached to the Faculty of Business, Economics and Law (BEL). Joe also provides independent economic consulting services through his firm Tulipwood Advisory Pty Ltd and is a well-known media commentator and author in Australia.

1.4 About this report

This report is structured as follows:

- Chapter 1 provides a brief introduction and background to this study.
- Chapter 2 provides a brief overview of the Australian system of government, and identifies which level of government is responsible for the delivery of passenger rail transit services. The chapter then provides an overview of the Australian economy, including analysing recent growth and future growth prospects.
- Chapter 3 provides an overview of the Australian passenger rail transit industry.
- Chapter 4 identifies the current stock of passenger rail transit vehicles across Australia's major rail transit networks, and estimates the ten-year market demand (to 2029) trajectory for carriages and related rail transit equipment. As part of this, the chapter identifies the types of carriages in operation and their lifespan.

- Chapter 5 identifies the current stock and estimates the ten-year market demand for light rail passenger services in Australia.
- Chapter 6 identifies the current stock and estimates the ten-year market demand for regional passenger rail services in Australia.
- Chapter 7 provides an analysis of the Australian rail freight market, for locomotives and wagons, by major export commodity and container transport.
- Chapter 8 describes the bidding, procurement and financing processes used in Australia to procure passenger rail transit vehicles, for each major Australian state – being New South Wales (NSW), Victoria (VIC) and Queensland (QLD).
- Chapter 9 lists the major rail equipment manufacturers operating in the Australian market.
- Chapter 10 outlines the key findings and recommendations.

Appendices A through to R provide supporting information:

- Appendix A contains light rail and regional rail maps.
- Appendices B through to E provide ten-year forecasts for the Sydney rail, Metro, and light rail markets and the regional NSW market.
- Appendices F through to H provide ten-year forecasts for the Melbourne rail, Metro, and light rail markets and the regional VIC market.
- Appendices I through to K provide ten-year forecasts for the Brisbane and Gold Coast market, respectively, and the regional QLD market.
- Appendices L and M provide ten-year forecasts for the Perth and the regional Western Australia (WA) market.
- Appendices N through to P provide ten-year forecasts for the Adelaide rail and light rail markets, and the regional SA market.
- Appendix Q presents the forecast for Australian freight demand.
- Appendix R presents the current stock of locomotives and wagons, by company.

2. Overview of the Australian economy

This chapter sets out the relevant government and institutional context to the present study, focusing on:

- the structure of government and responsibilities for rail transport services;
- the structure of the Australian economy;
- Australia's recent economic performance; and
- projections for future economic growth in Australia.

2.1 Federal government structure

Australia's system of government comprises three tiers, being: (i) a national government, (ii) six states and two territories, and (iii) 547 local councils that make up the local government tier. All three tiers of government share responsibility for funding essential public services such as for health, education and transport. The states have primary responsibility for public transport service delivery, including heavy and light passenger rail, buses and ferries.

However, more than 80 per cent of taxation revenue collected in Australia is by the national government, and the states receive on average 45 per cent of their revenue from the national government.¹ As a result, the federal government can influence transport infrastructure priorities in states by providing funding (or withholding funding) for particular projects. Indeed, the national government has its own infrastructure advisory body named 'Infrastructure Australia', that provides it with advice on the major transport infrastructure priorities.²

State governments have responsibility for maintaining and augmenting passenger rail transit networks. These networks and the 'above-rail' operations are generally managed by government owned companies operating on a commercial basis or by franchisees (private operators), with operating subsidies provided by the state government. Generally, passenger rail transit networks in Australia operate at around 25 per cent cost recovery, with 75 per cent of costs provided by the State Government. State Governments provide the funds for network expansion, sometimes with direct financial support from the Australian Government.

2.2 Structure of the Australian economy

Australia is the world's 6th largest country by land area and 13th largest economy (in nominal \$US GDP terms). Australia's population, at 25.5 million in 2019, ranks 54th globally. Compared to the world's largest economies, the Australian economy is small, reflecting its population. Nonetheless, Australia is an advanced, high-income economy with a gross domestic product (GDP) per capita (in PPP terms) at around 80 per cent of US levels.

Australia maintains a relatively stable and predictable political and economic policy environment, with very few sudden shifts in economic policy direction. A notable exception has been recent political and economic debates around climate change and energy policy, the outcomes of which can impact on the future market demand for passenger rail transit services. For example, policies that seek to reduce transport emissions may favour increased subsidies for public transport services, such as light and heavy rail, which have lower emissions per person and private car travel.

¹ See the Budget Paper 3 Federal Financial Relations here: <https://budget.gov.au/2019-20/content/bp3/index.htm>

² <https://www.infrastructureaustralia.gov.au/>

Australia's main export industries are iron ore and coal (both for steelmaking and power generation), liquid natural gas (LNG), grains (particularly wheat), gold, beef, wool, international education services, and tourism. Australia's main imports are refined petroleum, motor vehicles (including cars, trucks and buses), telecommunications equipment and medicines. China has been Australia's major trading partner for a number of years and the trade and the investment relationship, as well as educational and cultural ties, continues to deepen between the two countries.

It has been estimated that around three-quarters of Australia's GDP is produced in its capital cities.³ Australia is a highly urbanised country with over 80 per cent of the population residing in the large cities and regional towns close to the eastern seaboard. Indeed, 71 per cent of Australia's population reside in one of the five Australian capital cities that operate a heavy rail passenger train network (Table 2.1).

Table 2-1 Population growth in Australian cities with heavy passenger rail transit networks, 2008 to 2018.

Capital city conurbation (with heavy rail passenger network)	Population (2018)	Population growth (total, %) (2008-2018)
Sydney (including Central Coast, Newcastle, Wollongong)	5,958,276	17.6%
Melbourne (including Geelong)	5,052,885	25.8%
Brisbane (including Gold Coast, Sunshine Coast)	3,392,287	23.1%
Perth (including Fremantle)	2,020,138	22.0%
Adelaide	1,326,958	10.5%
Total / 10-year growth (%)	17,750,544	20.8%
Proportion of Australia's total population (2018)	71%	-

Source: ABS 3218.0 Regional Population Growth Australia 2017-18, and Tulipwood Economics analysis.

2.3 Recent economic performance

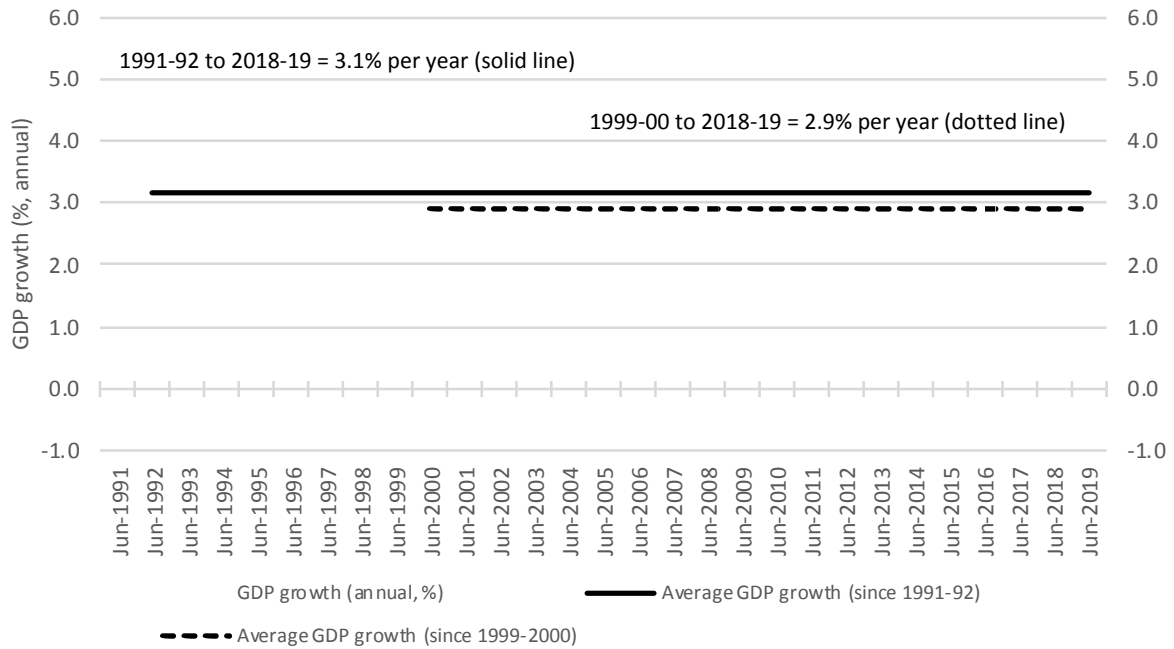
Australia's rate of economic growth, at 1.9 per cent in 2018-19, is currently below its long-run trend rate of 2.9 per cent per year over the past 20 years, and 3.1 per cent per year over the past 40 years.⁴ In recent years, economic growth has slowed in Australia following the 'once-in-a-century' mining boom (2003-2012) which was largely driven by increasing Chinese demand for Australian resources including iron ore, coking (steel) and thermal (power) coal. Other factors affecting recent growth include a slower rate of productivity growth (reflected in slower wages growth), the recent severe drought (limiting the volume of agricultural exports), and reduced public investment in infrastructure (reflecting public budget constraints at the national level and in some states).

Since Australia's last recession in 1990-91, the Australian economy has grown by 3.1 per cent per year on average for the past 28 years. Over the past 20 years (since 1999-2000), Australia's rate of GDP growth has been, on average, 2.9 per cent per year (Figure 2-1).

³ See, for example, Branigan (2016).

⁴ Australian economic statistics are reported in financial years. The Australian financial year runs from 1 July to 30 June.

Figure 2-1 Real annual GDP growth in Australia, 1990-91 to 2018-19.



Source: ABS 5204.0 Australian National Accounts and Tulipwood Economics analysis.

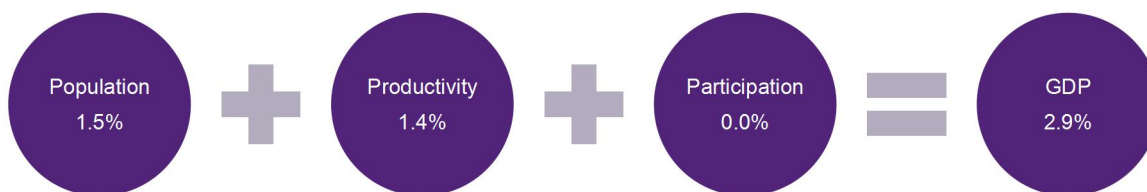
In the long-run, Australia’s GDP growth rate can be defined as follows:

$$GDP\ growth = Population\ growth + Productivity\ growth + Participation\ growth$$

This is the so-called “3-P’s” framework developed by the Australian Treasury Department. The framework is used to inform policies to increase Australia’s rate of economic growth in the long-run. While productivity growth and labour force participation growth lead to increases in both GDP and GDP per capita, population growth only leads to growth in GDP.

In very broad terms, the rate of growth shown in Figure 2-1 (above) has comprised 1.5 per cent per year population growth, and 1.4 per cent per year productivity growth, with the increase in the labour force participation rate being matched by an equivalent fall in average hours worked resulting in a zero per cent impact (Figure 2-2).

Figure 2-2 Historical composition of Australian economic growth, 1998-99 to 2018-19.



Source: ABS 5204.0 Australian National Accounts and Tulipwood Economics analysis.

2.4 Future economic growth prospects – the next ten years

Australia's future GDP growth over a ten-year period will be largely determined by structural, rather than cyclical, factors. As described, the three primary structural factors determining economic growth over the long-term are population growth, productivity growth and labour force participation growth.

The level of fertility, life expectancy and the rate of overseas migration into Australia determine population growth. Productivity growth is determined by the rate of technological innovation and government policies that might promote or deter the take-up of new technology. Finally, the labour force participation level is determined by how many people of working age choose to work, the number of hours worked, the unemployment rate and government policies (such as welfare payments) that affect a person's decision to work or not.

2.4.1 Population growth

In recent years, Australia's population growth rate has been largely determined by its migration policies. Australia's fertility rate has been fairly constant at 1.7 to 1.9 births per woman for many decades. Improvements in life expectancy are very gradual and barely affect the net rate of population growth.

Accordingly, assuming no significant change in Australia's migration policies, and no major external political or economic shock, Australia's population growth rate is expected to be slightly lower than its 20-year average (of 1.5 per cent per year) and to increase by 1.3 per cent per year over the next decade.

2.4.2 Productivity growth

The rate of productivity growth is difficult to predict because it is largely driven by unknown future technological change. However, most economic models use a standard one per cent per year improvement in technological innovation, which in turn improves labour productivity by at least the same factor. Productivity growth occurs in cycles, as periods of high capital investment or bursts of innovation eventually lead to higher labour productivity.

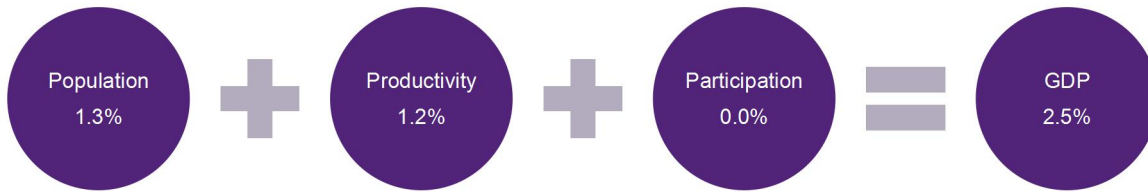
Over the past 40 years, Australia's rate of labour productivity growth has been 1.4 per cent per year. To account for the current low cyclical position of Australia's productivity cycle, we have subtracted 0.2 percentage points from this long-run rate, thus bringing the productivity growth estimate to 1.2 per cent per year over the next ten years.

2.4.3 Labour force participation growth

In terms of labour force participation, while there may be some marginal increase in female labour force participation in the next ten years, and a slight increase in the number of older Australians working longer and deferring retirement, this will be balanced against the trend steady decline in overall average hours worked. The rate of unemployment is assumed to remain steady at its 'natural rate' of between five to six per cent on average over the next decade. Therefore, it is assumed there will be no impact from the participation parameter on GDP growth.

In summary, it is believed that Australia's average rate of annual economic growth between 2020 and 2029 is likely to be 2.5 per cent per year in the absence of any major external economic or political shock, or significant policy changes domestically (Figure 2-3).

Figure 2-3 Projected economic growth for Australia.



Source: ABS 5204.0 Australian National Accounts and Tulipwood Economics analysis.

3. Overview of Australian passenger rail transit industry

This chapter describes:

- the overall demand and supply for passenger rail services in Australia's five heavy rail networks;
- passenger rail services in the Australian states and territories, and how these are predicted to evolve over the medium term (to 2029); and
- a brief overview of rail freight services.

3.1 Demand and supply for passenger rail services

This review covers the next decade from 2020 to 2029, and uses the current year (2019) as the base year for analysis and market demand forecasting.

Passenger services are almost entirely provided by state governments with only a very small percentage of privately-operated tourist services. Generally, all rail transit operations (heavy rail, light rail, regional rail) are heavily subsidised by the taxpayer. Accordingly, the level of investment and ongoing expenditure on rail transit services is a function of both public demand, government policy and the availability of public resources.

The demand for passenger transit rolling stock is influenced by:

- population growth, where NSW and VIC have recently experienced strong population growth, while QLD, WA and South Australia (SA) have experienced moderate population growth;
- the need to replace and upgrade the existing, older fleets;
- government policies in relation to road use and pricing, and local government policies in relation to supply and price of car parking in the major capital cities; and/or
- community obligations to regional areas that require the government to supply adequate transport services to all Australians.

The supply of new passenger transit vehicles is influenced by:

- New infrastructure delivery imperatives:
 - For instance, currently, civil infrastructure projects when considered across Australia are at overcapacity creating a national resources shortage, delaying future projects and in turn affecting rolling stock procurements.
 - The ability and timing to roll out the European Train Control System (ETCS) into brown field networks that will allow higher capacity services and therefore require more trains.
- Local content requirements (see discussion at Chapter 8):
 - Generally, Labour State Governments (VIC, QLD and WA) require high levels of local manufacturing content (30-60 per cent), which creates local jobs and business stimulus but affects cost, production capacity, efficiency and rolling stock procurement quantities.

- Generally, Liberal National Governments (NSW, SA) are prepared to benefit from a lower overseas price with a small local content requirement (ten per cent), which can therefore buy more rolling stock and that can be supplied more quickly.
- The ability of some states to fund major projects, which can be a barrier to investment. Some states are credit constrained, such as in QLD, which is currently consolidating its budget position after having lost its AAA credit rating in 2009. Many state governments borrowed heavily to fund major infrastructure projects during 2008-09 and 2009-10 as a response to the global financial crisis (GFC), leaving a more difficult fiscal position.

3.2 Capital city passenger rail markets

Australia has around 3,000 route kilometres of electrified track to service five urban passenger rail transit networks. There are a further 300 route kilometres of light rail (tram) tracks in operation. There are three different types of rail gauges used across the nation (Table 3-1):

- narrow gauge (1,067 mm or 3 ft 6 in), mostly found on shorter lines, particularly sugarcane tramways in QLD;
- standard gauge (1,435 mm or 4 ft 8 ½ in standard gauge); and
- broad gauge (1,600 mm or 5 ft 3 in) gauge.

Table 3-1 Heavy rail gauges and route kilometres.

State	Narrow 1,067 mm	Standard 1,435 mm	Broad 1,600 mm	Dual	Other	Total
NSW	8	7,071	73	0	1	7,153
VIC	16	1,222	2,894	32	28	4,192
QLD	7,583	67	0	84	4	7,739
WA	2,963	4,211	0	207	0	7,381
SA	828	3,114	253	22	0	4,217
TAS	667	0	0	0	0	667
ACT	0	6	0	0	0	6
NT	3	1,690	0	0	0	1,693
Total	11,801	17,381	3,221	346	35	33,052

Source: https://en.wikipedia.org/wiki/Rail_gauge_in_Australia#Rail_gauges_and_route_kilometres.

Notes: Regional and capital city rail maps for the East Coast states are shown in Appendix A.

Australia's passenger rail transit industry has been evolving rapidly to meet growing commuter demand, especially in its largest cities. New innovative technology and regulatory and governance changes have provided opportunities to expand heavy and light rail networks in most Australian capital cities.

In Brisbane and Melbourne, governments are investing in linking the capital city network to regional centres in order to lower the cost of travel to work, and expand work and study opportunities for people living in regional areas proximate to the city. Very significant network infrastructure investments have been made in the heavy rail network in Sydney, Melbourne and Brisbane. These networks, such as Cross River Rail in Brisbane and Sydney Metro, are currently being built and will add to the market demand for passenger rail transit vehicles in Australia.

Governments are also investing in trying to separate freight and passenger transit networks to drive productivity growth in freight transport and increase the number of possible passenger services on these currently shared urban networks. In Brisbane and Sydney, export coal trains share the network with passenger services, which limits the number of passenger and freight services on a single network.

The NSW and QLD Governments have committed to introducing the ETCS technology, at first as a trial on a core part of the urban network, in order to increase the number of train services in the network. However, the introduction of ETCS will require other changes to the existing network configuration, such as new single-decker trains in Sydney (to reduce dwell time), and additional carriages in the Brisbane network.

The rate of technological innovation continues to influence the types of train sets ordered, for example with the introduction of driverless metro trains in Sydney, improvements in vehicle design and performance, and movement towards real-time maintenance of transit vehicles.

3.3 Light and regional rail

3.3.1 Light rail

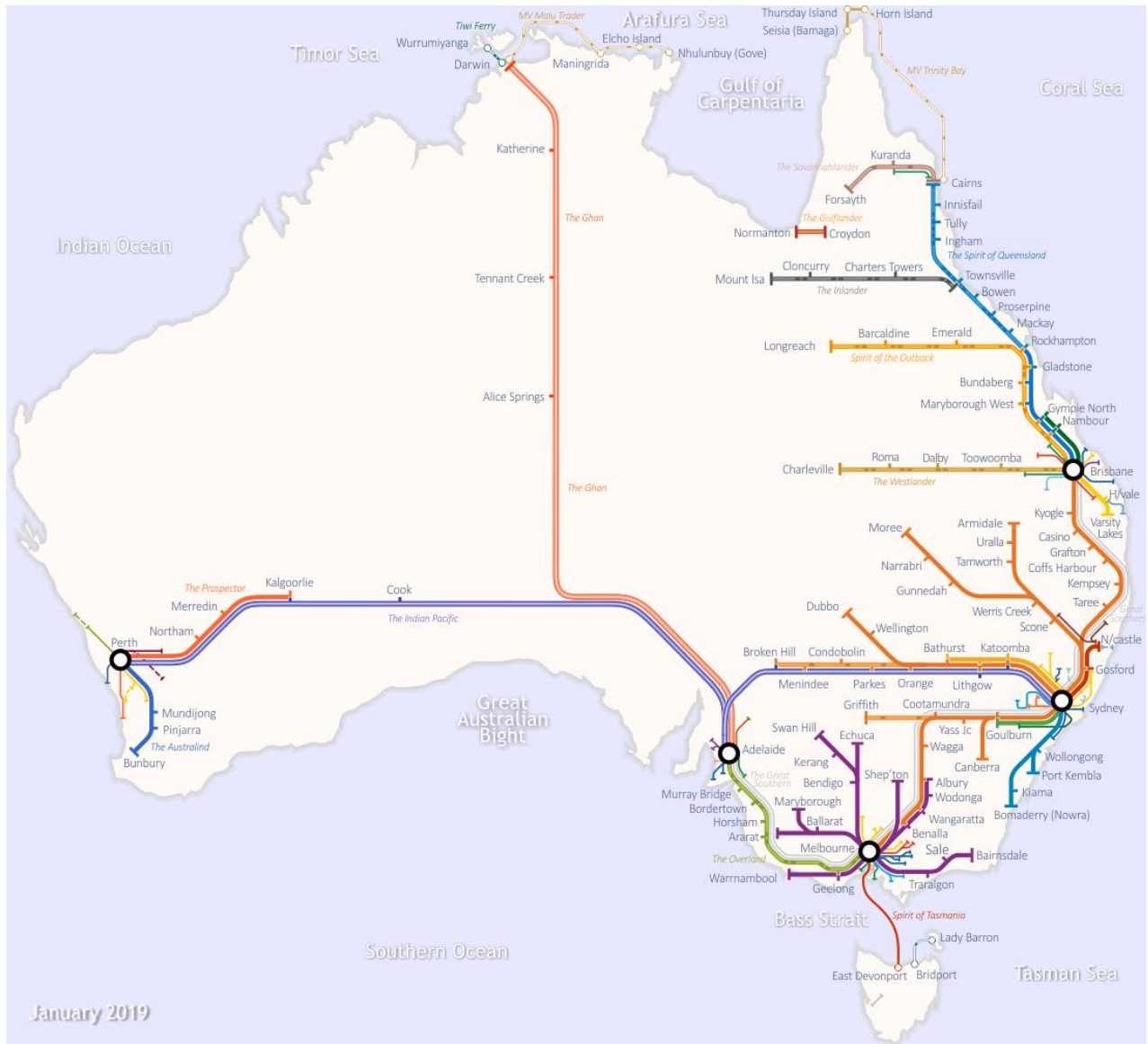
In Australia's largest cities, the provision of public transport services is increasingly coordinated across car, heavy rail, light rail, bus and ferry networks. In Sydney, Brisbane-Gold Coast and Canberra, governments have introduced significant light rail (tram) systems that have been designed to integrate with existing bus and heavy rail networks. In addition to Melbourne's extensive tram/light rail network, Sydney, Adelaide, and the Gold Coast's light rail networks are expanding. Construction is almost complete on the Australian Capital Territory (ACT)'s third stage light rail extension. Sydney has had very strong light rail patronage growth in recent years. In Brisbane, there has been a focus on expanding commuter car parks in suburban regions, to accommodate commuters who drive to the nearest train station to utilise the heavy rail network.

3.3.2 Regional rail

Australia operates extensive regional rail passenger transit networks, especially in NSW and VIC (Map 3-1). These networks generally operate at well below full cost recovery, and are heavily subsidised by state governments.

Currently, diesel locomotives power almost all regional train services. The current stock of diesel locomotives are primarily 'engine under the carriage' design, with very few trains now 'locomotive-pulled'.

NSW and VIC are now purchasing only bi-mode (diesel/electric) train sets for the future. This design will feature a diesel engine under the carriage, with an electric option overhead when electric capacity is available.

Map 3-1 National rail map Australia.


Source: Australian rail maps; <https://www.railmaps.com.au/austrail.htm>.

3.4 Analysis by State

3.4.1 New South Wales

Sydney has the largest heavy rail rolling stock fleet in Australia, all of which is standard gauge (1,435 mm). The network is congested on most routes during the morning (AM) and late afternoon/early evening (PM) peaks.

The NSW Government has committed to reducing congestion in the Sydney network in two ways, via:

- the construction of the Sydney Metro that is scheduled for completion in 2024, a new standalone railway that will deliver 31 metro stations and more than 66 kilometres of new metro rail that will eventually connect Sydney's north west region to the CBD and beyond to the south west; and

- the introduction of ETCS technology, which will allow trains to run closer together safely, first as a trial and then across the whole network.

Looking further ahead:

- In Sydney, the delivery of more new double deck trains and the conversion of outer suburban trains to suburban use should satisfy demand over the next five years.
- The life extension (by refurbishment and maintenance) of a major portion of the current fleet will contribute to meeting ongoing demand for the next three to five years; however, in our view more rolling stock will be required from 2025.
- The rollout and expansion of new metro style networks will open up new routes, north west and to the new airport in western Sydney, but will also take pressure off some of the existing network to the west and north of the CBD. This will address some of the increased demand towards the later part of the next decade (2025-2029).
- The roll out of ETCS across the brown field network will affect the demand for more and different rolling stock towards the last years of the next decade (2027-2029). For example, double-decker train sets are not suited to the short dwell times that the ETCS is designed for.

Regional NSW train services address the demand for short- and long-distance travel around NSW. Up to now, this service has been split with some growth in demand for the shorter routes and largely a community service obligation for the long-distance routes. Rolling stock demand was mostly influenced by the need to replace ageing trains. Over the medium- to long-term:

- Demand over the next five years will be satisfied with the delivery of two new fleets, electric multiple unit (EMU) trains for the short and bi-mode for the long-distance routes.
- Towards the last five years of the next decade demand will require further procurement of rolling stock.
- The federal government and the NSW government is exploring the feasibility of fast train services between Sydney and regional areas (such as Sydney-Canberra and Sydney-Wollongong). Therefore, it is not expected that these new networks will be in operation before 2029.

3.4.2 Victoria

VIC has one of the world's largest light rail fleets. Melbourne has the second largest heavy rolling stock fleet in the nation, predominately broad gauge and some standard gauge. The network is becoming congested so a High Capacity Signalling (HCS) system is being introduced to increase train frequency.

The light rail fleet is a mixture of old and new trams:

- The age of a large portion of the fleet requires further fleet procurement of additional rolling stock in the next five years; however
- any increase in capacity is limited to infrastructure constraints in power supply, stabling and increasing the size of the network.

Looking further ahead to projected developments in Melbourne:

- the delivery of new High Capacity Metro Trains (HCMTs) should satisfy demand over the next five years (2020-2024);
- the relatively young age of the current fleet will contribute to meeting the demand for rolling stock from 2025, however some fleet refurbishment and maintenance will be required;
- the expansion of the network will open up new routes (for instance, to Melbourne Airport), and will also take pressure off the network to the west of the CBD. This will address demand towards the later part of the decade (2027-2029); and
- the rollout of HCS across the brown field network will increase the demand for more rolling stock, which has been ordered. Further rollout towards the middle of decade will require more trains.

Regional VIC train services have moved from meeting community service obligations to addressing population growth demand in semi-rural areas. VIC is a smaller state compared to other states with a flatter topography allowing for the expansion and introduction of faster regional services. At present, the government is looking to reduce travel time between the CBD and regional areas both with faster rolling stock and improved network infrastructure.

Looking further ahead:

- likely passenger demand in the next five years (2020-2024) will require the procurement of additional rolling stock; and
- some of the additional demand is being met with the delivery of a small quantity of new diesel trains; however, the procurement process for the Next Generation Regional Train will start in 2020, possibly as bi-mode.

3.4.3 Queensland

The South East Queensland (SEQ) network (Brisbane-Gold Coast-Sunshine Coast) has the third largest heavy rolling stock fleet in the nation. Over the medium-term:

- the delivery of the New Generation Rollingstock (NGR) trains should just satisfy demand over the next five years (2020-2024) together with the life extension of some ageing rolling stock;
- the need to replace some of the old current fleet, passenger demand and the expansion of the inner-city network will require additional rolling stock from 2025; and
- the roll out of ETCS across the network will increase the requirement for more rolling stock towards the middle of the decade.⁵

The Gold Coast has a small but new light rail network that is growing in passenger demand. There are plans underway to expand the network over the next decade. There is also a proposal to introduce a light rail network in Brisbane, but the design is based on 'rubber wheels', not rail. The rubber-wheel technology allows for higher speeds and shorter braking distances, however energy consumption (operating costs) and emissions are higher.

A small fleet of tilt trains and very old locomotive hauled carriages services regional QLD. Rolling stock demand is mostly a community service obligation and there will be a need to replace ageing trains sometime in the next decade.

⁵ The ETCS for Brisbane's Cross River Rail Project will be delivered by Hitachi Rail STS.

3.4.4 Western Australia

Perth has the fourth largest heavy rolling stock fleet in Australia, which operates on a predominately narrow gauge:

- The relatively young age of the current fleet will largely contribute to meeting the demand for rolling stock up to 2025; however, some fleet refurbishment may be required before 2029.
- Given forecast demand, the recent procurement of the new C series trains should satisfy demand over the next ten years. Accordingly, there does not seem to be an available market for rail transit vehicles in Perth over the next decade.

A small fleet of diesel trains services regional WA. Rolling stock demand is mostly a community service obligation and there is a need to replace ageing trains. The recent procurement of the new C series trains order also includes the replacement of a small quantity of ageing diesel trains, which should satisfy regional WA demand to 2029.

3.4.5 South Australia

Adelaide has a small passenger rail transit fleet with a mixture of old diesel and new electric broad-gauge trains. The recent procurement of new additional series 2 trains, the life extension of the old diesel fleet and relatively young age of the current fleet will satisfy demand over the next ten years. This analysis includes the further electrification of the network.

The interstate train services (Adelaide-Darwin and Adelaide-Melbourne) are owned and operated by a private company. The fleet of carriages is small and very old, and the locomotives are leased.

3.4.6 Australian Capital Territory (Canberra)

Passenger services commenced on the Canberra light rail network in 2019 under a 20-year PPP (public-private partnership) concession. Stage 2A business case was approved in September 2019 and Stage 2B is being planned.

3.4.7 Northern Territory (Darwin)

There are currently no heavy or light passenger rail networks in the Northern Territory (NT). There is a freight and tourist line that operates between Adelaide and Darwin. The Ghan passenger service operates on the Adelaide-Darwin line weekly, utilising locomotives supplied by Pacific National (PN).

3.5 Australia's freight network

3.5.1 Overview

Australia is one of the world's largest exporters of iron ore, metallurgical coal, thermal coal, gold, liquefied natural gas (LNG) and grain. Most of these exports travel from regions in inland Australia to its key ports via dedicated freight rail lines. In recent years, following tens of billions of dollars in additional capital investment during the mining boom, the volume of Australia's major resources exports has grown strongly.

Rail now accounts for more than one-half of Australian freight transport activity, up from approximately 36 percent in 2000. The Bureau of Infrastructure, Transport and Regional Economics (BITRE) estimates Pilbara iron ore transportation accounted for approximately 64 percent of the national net tonne kilometres (NTK) in 2015-16, while combined coal transportation in QLD and NSW comprised approximately 20 percent of the national NTKs for the same period. Rail is also often central to moving other bulk commodities, such as grains, sugar, and timber, especially to ports, as well as containerised export agricultural commodities. Rail

and road transport compete strongly for short-haul and long-distance non-bulk freight, but as distances increase rail transport's competitiveness increases.

The principal Australian commodities networks are:

- the iron ore railways in WA's Pilbara region (2,642 route kilometres);
- the coal networks in central QLD (1,979 route kilometres) and the NSW Hunter Valley Coal network (approximately 785 route kilometres); and
- approximately 5,100 route kilometres of operational railway that are largely or exclusively used for grain haulage (such as from southern WA and central NSW).

Currently, it is estimated that there are **2,015 operational freight locomotives** in Australia. According to the BITRE (2019), approximately 50 percent of the fleet was aged 11 years or less, compared to approximately 13 years or less the previous year. It is difficult to estimate the number of wagons operating in Australia, but it would be in the order of several thousands.

3.5.2 Unique characteristic of Australia's freight market

- Passenger is government owned, long-term and more stable, therefore fewer variables to impact on numbers.
- Freight is driven by many variables, which cause operators/owners to respond to market forces over a short period.
- However, iron ore fleets are quite stable, involve the same operators and long-term contracts, and has unique rolling stock (36t-40t axle load) that cannot move around the country with mature and strategic fleet planning, procurement and maintenance. Ore prices may vary but volumes are generally stable so fleets sizes retained over a long period.
- Coal fleets are reasonably stable as they are mostly unique locos and have heavy axle load use. Again, prices may vary but volumes are generally stable, however coal haulage contracts are frequently tendered which can impact on fleet utilisation. One of the key factors impacting on utilisation is that NSW and QLD have different rail gauges so fleets are trapped in each state. This is partly the reason why only two large main operators can afford to store rolling stock until the next contract.
- The bulk/general/intermodal fleet has been combined as one because this is where the loco fleet's numbers vary from year to year as they are often moved around from one product to another. The rolling stock has a lot more flexibility (other than gauge) to move from grain to general haulage and container movement. Fleets are sold, leased or stored due to demand. Some of the key factors impacting on demand can be caused by changes to haulage contracts, seasonal climate change (grain) and operating costs of small mining companies.

With due regard to the factors identified above, the number of locomotives in Australia is estimated, as follows:

- The iron ore market has at least 425 locomotives, but possibly several more;
- QLD coal has 361 between Aurizon and PN;
- NSW coal has 219 between Aurizon and PN; and
- Bulk and General are over 1,000 (of which around 100 locos are dedicated to wheat export).
 - However, there are quite a few locomotives that are either stored or leased in this category.

4. Market demand for passenger rail transit vehicles and equipment

This chapter describes:

- the passenger rail transit market as it stands today;
- future projected demand for passenger rail services;
- a methodology for calculating future demand for passenger rail services;
- three central market demand scenarios; and
- the stock of carriages that forms the baseline for each market demand scenario.

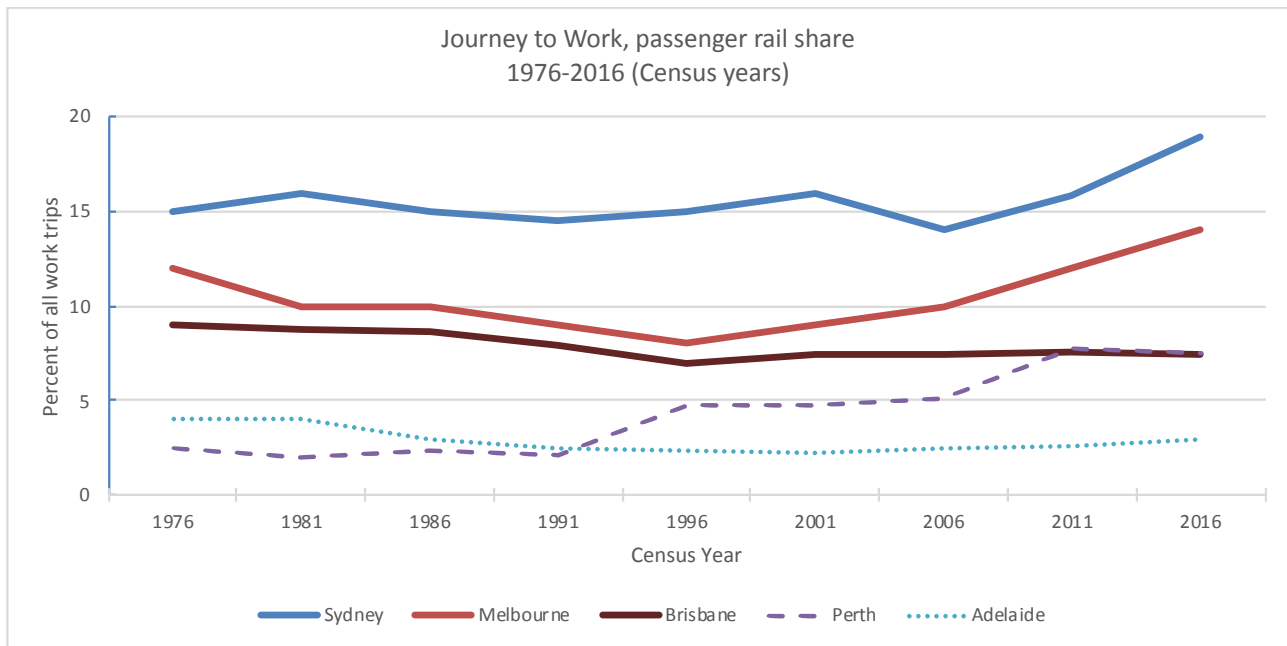
4.1 Overview of the current passenger rail transit market

Australia's five largest capital cities, namely Sydney, Melbourne, Brisbane, Perth and Adelaide, maintain urban passenger rail transit networks. Traditionally, the heavy rail networks in these cities have exhibited a 'hub and spoke' pattern designed to move a large volume of commuters into and out of the CBD for work. These existing radial networks are today being augmented by the interconnection of high capacity bus routes, commuter carparks, new heavy rail lines (such as the Metro in Sydney), and new light rail networks (such as the Gold Coast Light Rail [GCLR] network).

Historically, Australia's cities have grown outwards with traditionally little regard for densification or urban infill strategies. In Brisbane and Melbourne, the terrain is relatively flat and there are no natural barriers to outward expansion. In the past, the flat terrain lowered the cost of urban expansion relative to urban infill. Indeed, the Brisbane conurbation today extends to the Gold Coast in the south and to the Sunshine Coast in the north and west to Ipswich.

On the other hand, Sydney has natural barriers to expansion, with the Blue Mountains to the west and difficult rocky terrain and national parks to the north and south. In recent years, especially in Sydney, Australia's major cities have focussed on urban infill strategies and, as part of that strategy, increased investment in inner-city accommodation and public transport (in particular, light rail), to facilitate liveability and urban efficiency.

In Australia's five largest cities the 'journey to work' mode share, although less than other advanced countries with much larger urban populations and dense rail transit networks, has been increasing steadily. In Sydney and Melbourne in particular, the passenger rail share has been rising consistently over the past two decades (Figure 4-1).



Source: ABS Census data and Tulipwood Economics analysis.

Figure 4-1 Journey to work rail share, 1976 to 2016.

4.2 Current passenger demand in 2018-19

In total, it is estimated that currently **4,404 passenger transit carriages** operate on 49 separate lines across five capital city heavy rail networks. These carriages service a total of 727 million passengers per year across 708 train stations.

In terms of passenger numbers:

- the Sydney market (at 49.4 per cent share) represents almost half of all heavy rail passenger journeys in Australia;
- the Melbourne market (at 33.1 per cent share) represents one-third of the total Australian market for all heavy rail passenger journeys in Australia; and
- Brisbane (7.2 per cent), Perth (8.3 per cent) and Adelaide (1.9 per cent) comprise only small shares of the total market.

All Australian passenger rail transit networks are electrified, either at 1,500 V DC (Sydney and Melbourne) or 25,000 V AC (Brisbane, Perth, Adelaide). Track gauges ranges from Narrow Gauge (1,067 mm) in Brisbane and Perth, Standard Gauge (1,435 mm) in Sydney, and Broad Gauge (1,600 mm) in Melbourne and Adelaide (Table 4-1).

Table 4-1 Australian capital city rail passenger transit network, 2019.

Capital City (State)	Rail length (km)	Track gauge (mm)	Carriages (single unit)	Lines	Stations	Electrification (overhead)	Passenger journeys (per year)
Sydney (NSW)	813	1,435	1,751	9	175	1,500 V DC	359.2 million
Melbourne (VIC)	405	1,600	1,374	16	220	1,500 V DC	240.9 million
Brisbane (QLD)	689	1,067	813	13	152	25,000 V AC	52.4 million
Perth (WA)	181	1,067	330	5	72	25,000 V AC	60.6 million
Adelaide (SA)	126	1,600	136	6	89	25,000 V AC	14.0 million
Canberra (ACT)	0	-	0	-	-	-	-
Hobart (TAS)	0	-	0	-	-	-	-
Darwin (NT)	0	-	0	-	-	-	-
Total	2,214	-	4,404	49	708	-	727.1 million

Source: BITRE, ARA, ABS Census data, State Government Transport Department Annual Reports and Tulipwood Economics analysis.

Notes: Greater Sydney includes the Sydney-Central Coast-Newcastle-Wollongong passenger network. Greater Melbourne includes the Melbourne-Geelong network. Greater Brisbane includes the Brisbane-Gold Coast-Sunshine Coast network.

4.3 Future demand

4.3.1 Drivers of future demand

It is believed, given that new carriages have been ordered in all five Australian passenger rail markets, a ten-year market demand analysis is more helpful for CRRC than a shorter five-year analysis. Currently, it is not expected that there will be any credible plan to introduce new heavy rail networks into any other Australian capital city such as in Canberra, Hobart or Darwin. However, there are plans to augment the existing light rail network in Canberra, and a serious proposal to introduce a 'rubber-wheel' light rail network in Brisbane.

Future rail demand is influenced by several factors related to population, incomes, economic growth, technology, and government policy:

- There are current plans to augment all five existing heavy rail networks, and trains have been ordered for delivery over the next five years for these networks. Most notably, Sydney is introducing a multibillion-dollar metro heavy rail network designed to move an additional 100,000 passengers per day, to be fully operational in 2024.⁶ Also, work has begun on Brisbane's Cross River Rail network augmentation.⁷
- Population growth and economic growth are the two main long-term drivers of passenger demand. A growing population will add to passenger demand as new passengers travel for work, study or leisure. In the end there is a well-defined and widely accepted relationship between economic growth and passenger growth, which tends to hold across most advanced economies. The transport economics literature defines this relationship as follows:⁸

⁶ <https://www.sydneymetro.info/>

⁷ <https://crossriverrail.qld.gov.au/>

⁸ See, for example, Banister (2012).

A one per cent per annum increase in economic growth will lead to a 0.75 per cent per annum increase in passenger growth.

- In the short- to medium-term, the structure of existing contracts will also impact on additional demand. Some contracts might ‘lock-up’ a government for a number of years in the future, with options for more trains written into current contracts. This means competitors are unable to have the opportunity to enter the market for several years.
- Finally, many areas of government policy affect the market demand for passenger rail transit services. For instance, the level of subsidy a government provides to passenger rail services. In Brisbane for example, when the state government tried to increase rail fares earlier this decade, passenger demand began to level off and even decline on some routes. How the government sets prices across substitute modes of travel, such as for car and bus travel, will also critically influence demand for rail transit vehicles. In addition, government climate and energy policy, and taxes will also affect modal choice.

Importantly, any expansion of supply must be able to be accommodated. New trains need stabling yards and sufficient platform lengths and network expansion to operate. Budgets need to be sufficient to absorb increased maintenance budgets for a larger fleet. For these reasons, often supply will lag demand for a number of years before governments commit to large fleet upgrades.

The schematic below describes the main drivers of future demand (Figure 4-2).

Figure 4-2 Factors affecting the demand for rail transit vehicles.



Source: Tulipwood Economics.

4.3.2 Analysis of passenger demand by rail transit market

The Australian economy can be highly regional in its growth patterns and, in some regions, highly cyclical. It is, therefore, prudent to examine each passenger rail transit market separately.

Population and passenger growth have varied across Australia’s capital cities (Table 4-2):

- In Greater Sydney, the population has increased by 1.6 per cent per year on average over the past decade. In the state of NSW, economic growth has been 2.4 per cent per year on average over the same period. Heavy rail passenger demand growth has been increasing, rising from a 20-year average of 1.6 per cent per year, to 2.1 per cent over the past ten years, to 2.8 per cent over the past five years. This increase reflects Sydney's steadily increasing population as well as a significant expansion in capacity. More capacity is due to come online over the next few years with the rollout of the Sydney Metro Network. Nonetheless, Sydney's trains are generally congested during the AM and PM peaks.
- Compared to Greater Sydney, Greater Melbourne has enjoyed a higher population and (state-wide) economic growth rate over the past decade. Yet, passenger demand growth has been declining across the network. Melbourne has a significant light rail network, which competes with the heavy rail network in the inner-city.
- Growth in Brisbane and Perth is more cyclical and influenced by Australia's resources exports and terms of trade. When Australia is exporting record amounts of iron ore and coal, Perth and Brisbane do well, with increased government tax revenues funding additional government employees and infrastructure investment. On the other hand, when there is a reduction in global demand for Australia's resources exports, Perth and Brisbane tend to suffer in terms of population and economic growth. This is reflected in the recent slower growth in passenger demand numbers.
- Adelaide is a smaller city and relies on government investment, especially in health, education and defence industries to maintain positive growth.

Table 4-2 Population, economic and passenger demand growth, by capital city.

State / 10-year growth	Population growth	Economic growth	Average annual passenger demand growth (%)		
	2007-08 to 2017-18	By State, 2007-08 to 2017-18	5-year	10-year	20-year
Greater Sydney	1.6%	2.4%	2.8%	2.1%	1.6%
Greater Melbourne	2.3%	2.6%	0.9%	1.3%	3.7%
Greater Brisbane	2.1%	2.3%	1.2%	-0.5%	1.5%
Greater Perth	2.0%	3.8%	-0.6%	1.2%	3.9%
Greater Adelaide	1.0%	1.5%	7.5%	1.9%	1.8%

Sources: ABS, State Government publications and Tulipwood Economics analysis.

4.4 Methodology for calculating market demand

4.4.1 Formula derivation

Based on our analysis of the main drivers of passenger demand growth, a formula has been developed for calculating annual market demand over a ten-year period, which is derived as follows:

$$\text{Annual Market Demand growth 10-year} = [\text{Population growth 10-year} + (0.75 * \text{Economic growth 10-year}) + \text{Passenger Demand growth (5-yr, 10-yr, 20-yr)}] / 3$$

This formula represents a relatively straightforward and transparent approach for approximating future demand for passenger services in a particular geographic context. The formula incorporates and equally weights recent population growth, economic growth and passenger demand growth. Based on the transport economics literature, the formula applies a 75 per cent weighting to the economic growth figure. The formula also weights passenger demand growth across five, ten and 20 years to avoid overweighting any short-term cyclical component of passenger demand. The formula avoids double-counting drivers of demand, by taking an average across the three primary drivers that are measurable, namely: population growth, economic growth, and previous passenger demand growth.

Based on the formula, forecast annual market demand growth over the next ten years ranges from 1.5 per cent per year in the Brisbane network to 2.1 per cent per year in the Melbourne and Perth networks. Sydney's passenger demand growth is forecast to be 1.9 per cent per year over the next decade, while Adelaide's growth rate is forecast to be slightly higher at 2.0 per cent per year. The unweighted average annual demand growth is forecast to be 1.9 per cent per year across the five networks.

It is noted that this initial market demand estimate, by city, is a first approximation before applying a number of 'judgement factors' to these estimates (Table 4-3).

Table 4-3 Forecast market demand by capital city heavy passenger rail network, average annual growth.

Capital city market	Initial market demand estimate
Greater Sydney	1.9%
Greater Melbourne	2.1%
Greater Brisbane	1.5%
Greater Perth	2.1%
Greater Adelaide	2.0%
Average growth (unweighted)	1.9%

Source: Tulipwood Economics analysis. Formula developed by Tulipwood Economics.

4.4.2 Adjusting for the economic cycle, planned network expansion, existing overcrowding and pro-public transport policies

This formulaic estimate is backwards-looking and does not account for either: (1) the starting point of the five passenger rail networks in terms of current congestion, planned network expansion, or (2) current / future government policy in relation to supporting (or not supporting) passenger rail transport, climate change and energy policy, or (3) government policies towards transport substitutes such as car use and buses. The estimate also assumes that previous ten-year economic growth and population growth data reflect long-run trends.

The projected demand forecasts need to be adjusted for the economic cycle in the resources states of QLD and WA, planned network expansion, existing shortfalls and overcrowding, and government policy, so as to develop realistic projections. Thus:

- The economies of QLD and WA have experienced slower population and economic growth following the end of the mining boom. As a result, government revenue to fund major infrastructure projects has become scarcer. This will limit both the need for new network expansion (since population growth will be lower), and the financial capacity of the QLD and WA Governments to fund major rail transport infrastructure projects (since government revenues will be lower).
- The Sydney passenger rail transport network is notoriously overcrowded. Load factors in Sydney range from 162 per cent capacity to 185 per cent capacity in the morning peak between 8am and 9am. With that said, the Sydney Metro network is under construction and due to begin operations in 2024. If realised, Sydney will have 31 metro railway stations and a 66 km standalone metro railway system, increasing the capacity of train services across Sydney from about 120 an hour today, to up to 200 services an hour beyond 2024.
- The first stage of the Sydney Metro was awarded to Alstom, a French multinational rail manufacturer with a strong presence in Australia. The carriages are to be manufactured in India.
- On the Melbourne network, 7.2 per cent of AM-peak services are above the benchmark loads (i.e. the service is overloaded), and 10.2 per cent of PM-peak services are overloaded compared to the benchmark set by the VIC Government.
- Planned Melbourne extensions include the Metro Tunnel and Airport Rail Link and faster passenger services between Melbourne and Geelong.
- In Brisbane, the Cross River Rail extension linking the CBD to South Brisbane has been in response to expected congestion on the Maryvale Bridge. Cross River Rail is a \$5.4 billion project that will expand capacity into Brisbane's CBD and between north and south Brisbane.⁹
- Bombardier have a contract option to build another 150 carriages, of which 25 carriages are required for Cross River Rail. The QLD Labor Government is currently in negotiations with Bombardier about building these additional carriages in Australia, via a subcontract with Downer EDI at Maryborough, QLD.
- Existing plans that are due to be implemented also need to be considered. This analysis assumes that the ETCS control system is introduced into the Sydney, Melbourne and Brisbane train networks by 2029. There are currently concrete plans to introduce the ETCS technology into the Brisbane and Sydney networks in the next few years.

Table 4-4 summarises the additional considerations that are relevant to developing the forecasts. A factor of 0.2 percentage points has been added to (or subtracted from) the initial market demand estimate, to account for the four additional factors identified. For example, in Sydney's case, 0.2 percentage points have been added for three of the factors identified (being for planned network expansion, overcrowding and pro-public transport policies). In Brisbane and Perth, 0.2 percentage points have been subtracted to reflect the slowdown in population as a result of the slowdown in global resources prices and demand growth relative to the mining boom period.

⁹ The Cross River Rail Project will be delivered as a Public Private Partnership.

Table 4-4 Adjusting passenger rail demand for the local context.

Passenger transit market	Major planned network expansion?	Current overcrowding?	Pro-public transport policies?	Cyclical economic factors?	Additional supply response (% point)
Sydney	Yes	Yes	Yes	No	+0.6
Melbourne	Yes	Yes	Yes	No	+0.6
Brisbane	Yes	No	Yes	Yes (-ve)	+0.2
Perth	No	No	Yes	Yes (-ve)	+0.0
Adelaide	No	No	Yes	No	+0.2

Sources: Tulipwood Economics analysis.

4.5 Market demand scenarios

Based on the analysis described above, three scenarios were developed as a basis for the market demand forecasts. These forecasts are not only based on an analysis of recent population, economic and passenger growth, but also on a review of the likely future economic cycle, existing contracts for rail transit equipment, and state government forecasts of population growth that are publicly available (Table 4-5).

In the central case, demand forecasts range from 1.7 per cent per year in Brisbane through to 2.7 per cent per year in Melbourne over the period 2020 to 2029. In this scenario, passenger demand in Perth is expected to grow by 2.1 per cent per year, Adelaide by 2.2 per cent per year, and Sydney by 2.5 per cent per year.

Furthermore a scenario range of +/- 0.3 percentage points has been applied, such that:

- the minimum growth forecasts range from 1.4 per cent in Brisbane to 2.4 per cent in Melbourne; and
- the high growth forecasts assume growth of 2.0 per cent in Brisbane to 3.0 per cent and Melbourne.

Table 4-5 Market demand forecasts by scenario.

Market / growth scenario	Minimum growth (%)	Central Case (%)	High growth case (%)
Greater Sydney	2.2%	2.5%	2.8%
Greater Melbourne	2.4%	2.7%	3.0%
Greater Brisbane	1.4%	1.7%	2.0%
Greater Perth	1.8%	2.1%	2.4%
Greater Adelaide	1.9%	2.2%	2.5%

Source: Tulipwood Economics analysis. The minimum and high growth scenarios are based on a +/- 3% range around the central case forecast.

4.6 Stock of rail carriages in 2029, by capital city market

The stock of rail carriages in 2029 has been estimated by considering current orders and expected retirements (net of likely refurbishments), as shown in Table 4-6 (below). On that basis, the requirement for carriages in 2029 has been derived, as well as the resulting shortfall or excess of carriages.

Based on the analysis, it is believed there will be a shortage of carriages in the Sydney (-312) and Melbourne (-486) heavy rail passenger markets in 2029. It is estimated that the Brisbane (+1) and Adelaide (+3) markets will be approximately in equilibrium in 2029, while Perth will have an excess of 74 carriages.

Accordingly, the available market demand for heavy rail carriages in 2029 is estimated to be 798 carriages in the Sydney and Melbourne markets. It is not envisaged that additional rail transit equipment will be required for the heavy rail passenger networks in Brisbane, Perth and Adelaide.

Table 4-6 Projections of rail carriage stocks, by capital city market.

Market	Current stock (carriages)	2029 stock* (carriages)	Based on Central Case growth forecasts	
			2029 Requirement	Shortfall/Excess (carriages) (+/-)
Sydney	1,751	1,760	2,072	-312
Melbourne	1,374	1,307	1,793	-486
Brisbane	813	963	962	+1
Perth	330	480	406	+74
Adelaide	136	172	169	+3
Total	4,404	4,682	5,402	-

Source: Tulipwood Economics analysis.

Notes: * 2029 stock incorporates new rolling stock planned for and ordered, as well as retirements and likely refurbishments.

5. Light rail (tram) passenger transit markets

This section analyses the light rail (tram) passenger transit markets in Australia, focusing on:

- the current role of light rail in selected Australian capital cities;
- future growth projections for light rail; and
- projected rail transit demand for light rail in 2029.

5.1 Current situation

Five Australian capital cities operate light rail networks, namely: Sydney, Melbourne, Gold Coast (which is a part of the Greater Brisbane conurbation), Adelaide and Canberra. The Melbourne light rail network is by far the largest, with 250 km of light rail track length, operating 501 carriages and servicing 206 million passenger journeys per year. Hobart, Perth and Darwin do not operate light rail passenger networks. In recent years, there have been a number of proposals to introduce a light rail network in Perth, but as yet there has been no commitment from the WA Government. And in Sydney, a second light rail network – the Parramatta Light Rail - in the west of the city will open in 2023.

Therefore, it is possible that a light rail network could be introduced into any of these three cities by 2029, with the most likely candidate being Perth. Apart from Melbourne, which has maintained an extensive light rail network for over 100 years, the modern Australian light rail networks are in their infancy. The light rail fleets are modern, and passenger demand is growing steadily as commuters adapt to a new way of travelling within the CBD of Australia's major cities.

Government policies (such as related to inner-city housing supply and traffic congestion) have been supportive of passenger demand growth. Furthermore, the increased use of toll roads and the high cost of car parking in Brisbane and Sydney might continue to shift commuters to light rail over the next decade. Sydney's new light rail passenger demand has reached 10.3 million passenger journeys per year already. Adelaide's network carries 9.5 million passenger journeys per year, followed by the Gold Coast (7.7 million), and the new Canberra network (4.0 million) which began operations in early 2019 (Table 5-1).

The GCLR network is a success story for the light rail mode, and now connects the Gold Coast tourist areas (such as Surfers Paradise and Broadbeach) to the Brisbane rail passenger network via the connection at Helensvale.¹⁰ In addition, there are plans for Brisbane's first light rail network in many decades. The Brisbane proposal is for a rubber-wheeled system connecting the CBD to South Bank and the inner Brisbane suburbs. Despite this new growth, it is clear that Melbourne will remain the dominant light rail market in Australia for many decades.

¹⁰ The city of the Gold Coast is, effectively, a part of the Brisbane conurbation.

Table 5-1 Light rail passenger transit market, by capital city.

Capital City (State)	Light rail track length (km)	Track gauge (mm)	Carriages (single unit)	Lines	Stations	Power source	Passenger journeys (per year)
Sydney (NSW)	12.8	1,435	12	1	23	750 V DC	10.3 million
Melbourne (VIC)	250.0	1,435	501	24	1,763	600 V DC	206.3 million
Gold Coast (QLD)	20.0	1,435	18	1	19	750 V DC	7.7 million
Adelaide (SA)	15.0	1,435	24	1	28	600 V DC	9.5 million
Canberra (ACT)	12.0	1,435	14	1	13	750 V DC	4.0 million
Total	309.8	-	569	28	1,846	-	237.8 million

Source: Various State Government publications and Tulipwood Economics analysis.

Notes: Both the 600 V DC and 750 V DC light rail electrical systems are overhead (or catenary). The passenger journey figure for Canberra is an estimate because the system has been in operation for less than one year.

5.2 Growth projections

Applying a similar methodology to that used in the heavy rail analysis, average annual growth forecasts were developed for each of the light rail networks, based on current light rail network size. Based on this, it is expected that passenger demand growth in Sydney, Melbourne and Canberra will be strongest at 2.7 per cent per year on average to 2029. It is expected that the Gold Coast will also perform well, especially as the region further integrates its transport network and the outlook for tourism is robust.

Beyond this, it is believed there is great potential for light rail in Australia over the next decade. Potentially, it is likely that all networks will be expanded, thus allowing for greater demand growth. Moreover, the network in Sydney and the proposed network in the Brisbane CBD might be significantly expanded. Given the real possibility of further network expansion, two sets of growth forecasts for light rail passenger demand have been provided (Table 5-2).

The second set of forecasts are higher, and range between 1.9 per cent per year in Adelaide to 3.2 per cent per year in Sydney and Canberra, where it is most likely that the existing light rail network will be expanded. It is also expected that there will be a stronger passenger growth in Melbourne if there is an expansion in the light rail network. These higher forecasts are informed by the rate of population and job creation in the CBD's and inner-city regions.

Table 5-2 Light rail passenger demand growth forecasts, 2020-2029.

Market	Average annual growth (%)	Potential annual growth after 2025 with possible network expansion (%)
Sydney (NSW)	2.7%	3.2%
Melbourne (VIC)	2.7%	3.0%
Gold Coast (QLD)	2.4%	2.9%
Adelaide (SA)	1.6%	1.9%
Canberra (ACT)	2.7%	3.2%
Average (unweighted)	2.4%	2.8%

Source: Tulipwood Economics analysis.

5.3 Projections for the stock of light rail carriages in 2029

Based on current network size, most Australian light rail markets are forecast to be in approximate equilibrium, except for Melbourne. In Melbourne, continued demand growth is expected to lead to a shortfall by 2029 of 154 carriages.

Table 5-3 presents the forecasts for the number of light rail carriage stocks by capital city market. These forecasts are conservative in the sense that they assume no expansion (beyond current plans) in the light rail networks (see discussion above).

It is conceivable, and believed to be likely, that the Sydney, Brisbane-Gold Coast and Canberra light rail networks will expand, thus creating greater capacity for demand growth. Further, government policies in all Australian jurisdictions favour public transport over private car travel. For example, public transport is heavily subsidised and government policy objectives focus on ‘taking cars off the road’. Accordingly, it is possible that average annual growth in Australia’s light rail market, from around 2025, could be above three per cent per annum. This could create a significant shortfall in carriages in all markets by 2029 and into the 2030’s.

Table 5-3 Projections of light rail carriage stocks, by capital city market.

Market	Current stock (carriages)	2029 stock* (carriages)	Based on Central Case growth forecasts	
			2029 Requirement	Shortfall/Excess (carriages) (+/-)
Sydney	12	91	102	-11
Melbourne	501	506	660	-154
Brisbane	18	29	23	+6
Adelaide	24	24	28	-4
Canberra	14	17	18	-1
Total	569	667	831	-170**

Source: Tulipwood Economics analysis.

Notes: * 2029 stock incorporates new rolling stock planned for and ordered, as well as retirements and likely refurbishments. ** This figure is the sum of the negative numbers. This is because it would not be realistic to expect trading of light rail transit stock between jurisdictions. Hence, the negative figure represents the total forecast shortfall of light rail transit stock in Australia in 2029.

6. Regional passenger rail transit markets

This section reviews the Australian regional passenger rail transit markets, focusing on:

- an overview of Australia's regional passenger rail transit markets;
- Australia's regional rail passenger transit networks;
- recent trends in regional rail passenger services;
- relevant considerations for regional passenger rail looking forward; and
- projections for the stock of regional rail carriages in 2029.

6.1 Overview of regional passenger rail transit markets

Australia has an extensive regional rail passenger network of approximately 18,000 track kilometres, reflecting the size of the country and historical settlement patterns in the southeast of the country (Figure 6-1). Much of the regional NSW and VIC networks, which are the largest in terms of passenger demand, developed because of agricultural, pastoral and mining activities in the inland parts of the state and the need to transport commodities to capital cities and their ports. The regional network in both NSW and VIC is extensive and is likely to expand in the next decade.

The regional QLD rail network was developed first to support agricultural and mining activities and exports via the Port of Brisbane. Over time, these networks converted from largely freight activities to tourist activities. The four main regional passenger networks in QLD service the towns along the QLD coast as far north as Cairns, and inland to Charleville, Longreach, Mt Isa and Normanton. The regional QLD network has shown little growth in recent years.

The two main regional passenger rail networks in WA service the inland mining town of Kalgoorlie and the southern town of Bunbury. From Adelaide in SA, there is a regional passenger line to Melbourne, the north-south link to Darwin and the east-west link between Perth and Sydney, which stops in Adelaide. The WA and SA networks have shown little growth in recent years.

Figure 6-1 Australian regional rail passenger transit markets.



Source: BITRE (2019).

In total, the Australian regional passenger network services 69.9 million passengers on predominantly diesel-powered locomotives and older carriages.

6.2 Regional rail passenger transit networks

In terms of the relative importance of regional rail in Australia by jurisdiction (Table 6-1):

- The largest regional rail network in Australia is in NSW with 550 carriages operating on around 6,000 km of track length and servicing 46.4 million passengers across five main lines and 29 stations. Most of the NSW fleet is diesel-powered with some electric services operating between major regional centres proximate to Sydney.
- The VIC regional rail network is around 1,300 km in track length and operates 342 carriages servicing 22.4 million passengers across five main lines and 100 stations.
- The regional QLD network is large but many services have ceased operating in recent years. What remains are four main lines operating 40 carriages and servicing 0.8 million passengers per year across 68 stations.
- The regional WA and SA networks are small and service regional areas proximate to the capital cities.

Table 6-1 Australian regional rail passenger transit network in 2019.

Capital City (State)	Rail length (km)	Track gauge (mm)	Carriages (single unit)	Lines	Stations	Power source	Passenger journeys (per year)
Regional NSW	6,000	1,435	550	5	29	Diesel	46.4 million
Regional VIC	1,300	1,600/ 1,435	342	5	100	Diesel	22.4 million
Regional QLD	4,000	1,067	40	4	68	Diesel	0.8 million
Regional WA	3,500	1,067/ 1,435	14	4	10	Diesel	0.2 million
Regional SA	2,979	1,435	110	1	5	Diesel	0.1 million
Regional ACT	0	-	0	0	0	-	0
Regional TAS	0	-	0	0	0	-	0
Regional NT	0	-	0	0	0	-	0
Total	17,779	-	1,056			-	69.9 million

Source: Various State Government publications and Tulipwood Economics analysis.

Notes: The Adelaide-Darwin passenger service (the Ghan and Overlander) are counted in Regional SA (not NT). ACT and SA regional passenger networks are counted in the NSW and SA networks respectively. The number of regional stations in VIC and WA have been estimated.

6.3 Recent trends in regional passenger rail transit services

Each regional rail transit market in Australia is unique. Thus:

- WA and QLD are very large states with very small populations and the regional rail lines operate more as a community service than as a viable commercial operation.
- NSW is a smaller state geographically with a larger population, and has more lines than in WA and QLD. Patronage has been increasing in NSW on its intercity (between cities) services but has declined on its other regional network.
- The QLD regional rail network is heavily tourism dependent and relies on promotion and a strong flow of domestic and international visitors. In recent years, QLD regional passenger demand has grown strongly, by more than five percent on average over the previous three years.
- In WA, regional rail patronage continues to decline, falling by six percent in 2016-17. There have been a number of mechanical issues (with rolling stock) and track shutdowns, which have led to the decline in patronage in the west.
- In VIC, the V/Line regional patronage continues to grow following significant investment by the VIC Government in the regional rail network, including the opening of Caroline Springs station and additional services being added (V/Line 2017a, p.17).

6.4 Projections for the stock of regional rail carriages in 2029

The projections for passenger demand growth over the next decade are unpinned by the forecasts for population growth and economic growth by region as well as applying judgement around the likely use and expansion of regional rail networks by state. Therefore, there is potential for continued growth in the NSW and VIC regional passenger markets. It is estimated that both markets will continue to grow, at 2.2 per cent

per year on average over the next decade. The VIC Government has invested heavily in developing its regional rail capacity in recent years, and passenger growth has been accordingly strong. Whereas in NSW, recent investments should underpin further growth. In addition, there are four proposals for Very Fast Trains (VFTs) currently being considered and debated in NSW. If one of these proposals were to be approved in the next few years, regional passenger growth would be expected to be at least one per cent per year higher than the current forecast in the latter half of next decade (Table 6-2).

Table 6-2 Regional passenger demand growth forecasts, 2020-2029.

Market	Average annual growth (%)
Regional NSW	2.2%
Regional VIC	2.2%
Regional QLD	0.5%
Regional WA	0.5%
Regional SA	0.5%
Average (unweighted)	1.2%

Source: Tulipwood Economics analysis based on ABS regional economic and population growth data.

6.5 Projections for the stock of carriages, regional Australia

Based on the passenger demand forecasts outlined above, a significant shortfall in carriages is forecast in the regional VIC market. However, it is believed that the other regional markets will remain approximately in equilibrium.

It is expected that by 2029, the regional VIC network will require an additional 130 carriages. Clearly, given this expected shortfall, it is anticipated that the VIC Government would tender for additional carriages around 2025, to ensure the shortfall is met with additional stock.

It is believed that the most difficult market to forecast is NSW because it will largely depend on whether the NSW Government commit to one of the four VFT options. Therefore, the most likely option will be the Sydney-Canberra route, or possibly the Sydney-North Coast-Newcastle route. It is not believed that the Sydney-Illawarra route is economic because of the relatively small population residing in Wollongong. It is more likely the NSW Government commits to better linking Wollongong into the Sydney Train Network based on existing technology, probably via southwest Sydney (i.e. the proposed Maldon-Dombarton link).

Table 6-2 Projections of regional carriage stocks, by regional market.

Market	Current stock (carriages)	2029 stock* (carriages)	<i>Based on Central Case growth forecasts</i>	
			2029 Requirement	Shortfall/Excess (carriages) (+/-)
Regional NSW	550	693	684	+9
Regional Victoria	342	295	425	-130
Regional Queensland	40	40	42	-2
Regional WA	14	15	15	0
Regional SA	110	110	110	0
Total	1,056	1,153	1,276	-132

Source: Tulipwood Economics analysis.

Notes: * 2029 stock incorporates new rolling stock planned for and ordered, as well as retirements and likely refurbishments. ** This figure is the sum of the negative numbers. This is because it would not be realistic to expect trading of regional rail transit stock between jurisdictions. Hence, the negative figure represents the total forecast shortfall of regional rail transit stock in Australia in 2029.

7. Market demand for rail freight locomotives and wagons

7.1 Background

Rail freight is a significant component of the Australian rail market. It is estimated that there are approximately **2,015 operational freight locomotives** operating across a number of unique networks, including:

- the iron ore rail networks in the Pilbara region of WA;
- the large coal export networks in the Bowen Basin (Central QLD) and the Hunter Valley (NSW);
- the wheat export networks in western NSW and southern WA; and
- the regional freight network that transports non-bulk goods, cars, trucks and containers between major cities.

Over the next decade, a new coal rail network will be built in the Galilee Basin to export thermal coal to India and elsewhere.

The Melbourne-Brisbane inland rail route is a significant development in the rail freight market, with important implications for the demand for locomotives and wagons in the next decade. These non-resource rail freight services also compete for capacity (or 'slots') on some capital city networks, notably on some lines in the Brisbane and Sydney networks. It is therefore relevant to consider the freight market in Australia in terms of both how it impacts on passenger rail demand in the major cities and also for its own commercial opportunities.

Based on BITRE (2019) analysis, it is estimated that approximately half the fleet of locomotives is aged less than ten years.

7.2 Recent growth

Rail freight volumes have grown rapidly in Australia since 2000, reflecting the significant increase in demand for Australia's resources exports. Rail now accounts for more than half of all freight transport in Australia. This compares to a share of just over one-third in 2000. The Australian mining boom (2003-2011), driven by rising demand from China for Australian iron ore and coal, has permanently increased the size and scale of Australia's rail freight network. The volumes of iron ore, metallurgical coal and thermal coal being hauled across the rail network for export are now at record levels (Chart 7-1).

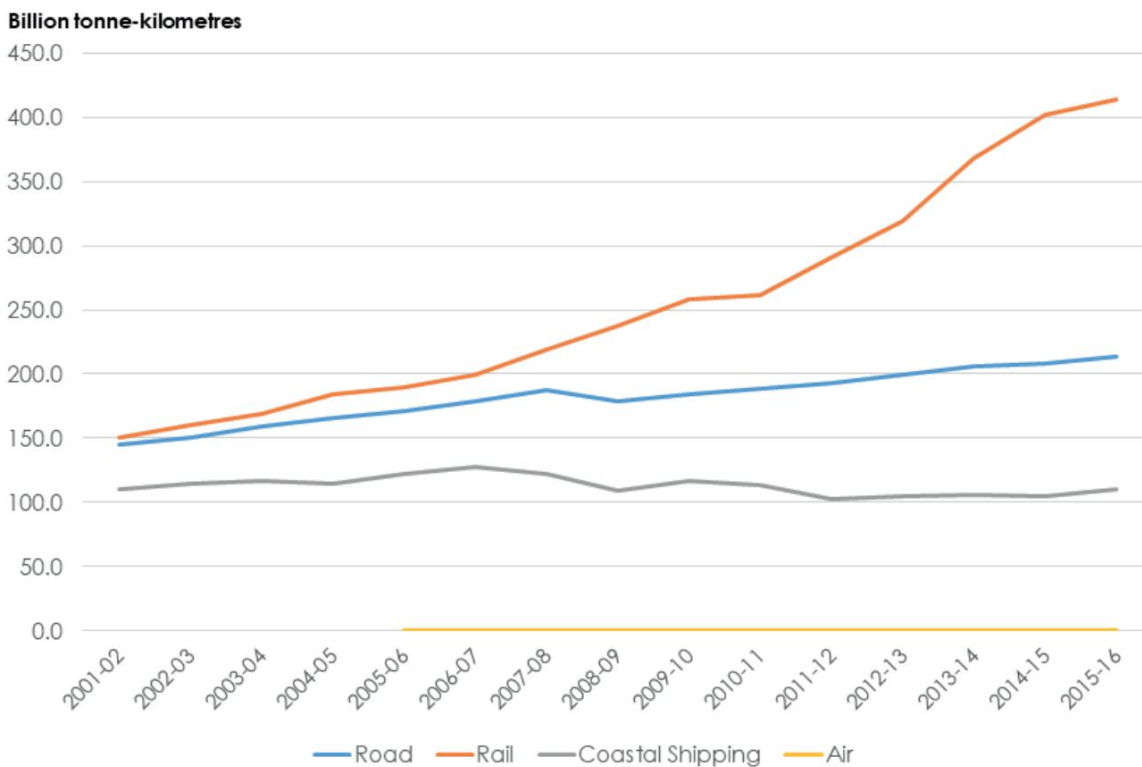
Overall, these trends have had a profound effect on Australia's economy, including increased demands on freight supply chains and the consequent rapid increase in public and private infrastructure investment. At the same time, there has been a concomitant rapid increase in population. The resulting increased economic activity has put enormous pressure on the freight and shared passenger rail transport networks in its major cities, especially around Australia's ports and in Sydney, Melbourne and Brisbane.¹¹

¹¹ See, for example, the RBA Research Discussion Paper: *The Effect of the Mining Boom on the Australian Economy* (Downes et al, RDP 2014-08).

It is expected that this growth will continue with work beginning on the Melbourne-Brisbane inland freight rail route, which will transport bulk commodities such as grains, sugar, timber, containerised agricultural exports and non-bulk freight as well as imported containers.¹²

In the current Australian market, US companies generally build diesel and bi-modal locomotives (such as General Electric or Progress Rail) whereas Chinese companies (i.e. CRRC) and Indian companies generally build wagons.

Chart 7-1 Historical growth in freight demand.



Source: BITRE (2019).

Table 7-1 (below) summarises the most recent information on the national freight task based on NTK. According to the most recent estimate developed by BITRE, total NTKs reached 413.5 million in 2015-16.

¹² The Melbourne-Brisbane inland rail route is not new. Rather, the plan is to upgrade many sections to improve the efficiency of the route overall.

Table 7-1 The national freight task by commodity and year.

Year	Bulk	Bulk NTKs	Intermodal	Intermodal NTKs	Total	Total NTKs
2007–08	642 826	n/a	19 519	n/a	662 345	n/a
2008–09	705 039	n/a	17 481	n/a	722 520	n/a
2009–10	798 763		16 521		815 284	
2010–11	-	n/a	-	n/a	-	n/a
2011–12	-	n/a	-	n/a	-	n/a
2012–13	1 012 997	n/a	27 559	n/a	1 040 556	n/a
2013–14	1 089 566		21 891	n/a	1 111 457	n/a
2014–15	1 210 949	349 014 582	24 272	n/a	1 235 221	n/a
2015–16	1 322 085	381 125 118	25 366	32 364 817	1 347 451 934	413 489 935
2016–17	n/a	n/a	n/a	n/a	n/a	n/a

Notes: The table excludes traffic data for some of the smaller train operators, such as Sydney Rail Services. Data for 2010–11, 2011–12, and 2016–17 are not available.

Sources: BITRE estimates; Previous *Trainline* editions that sourced operator provided data.

7.3 Rail freight operators

The rail freight transport market consists of a relatively limited number of large private freight transport companies in Australia such as Aurizon (formerly Queensland Rail National), PN, Genesee & Wyoming Australia, Qube Logistics, SCT Logistics, Southern Shorthaul Railroad, Transvolution, Watco Australia and Bowmans Rail. Further, vertically integrated mining companies such as Rio Tinto, Fortescue Metals Group, and BHP Billiton operate their own rail freight locomotives in the Pilbara (WA) and elsewhere.

The two largest freight companies are Aurizon and PN. Based on earlier year's data reported by BITRE (2019), it is estimated that the total combined freight haulage from Aurizon and PN to be at least 130 billion NTK:

- **Aurizon:** Aurizon has the largest fleet of coal-hauling locomotives and wagons in Australia. It is estimated that in 2019, Aurizon operated with around 300 locomotives and approximately 8,500 coal wagons.
- **PN:** It is estimated that PN owns and operates between 570 and 626 locomotives, primarily being Diesel-Electric hybrids operating on standard gauge freight lines. PN is likely to be operating more than 10,000 wagons at any one time.

Beyond Aurizon and PN, there are a number of middle tier operators, such as:

- **Genesee and Wyoming:** Genesee and Wyoming haul around 552,000 carloads of various agricultural, minerals and intermodal deliveries across Australia.
- **Watco Australia:** In 2016, Watco Australia was awarded an infrastructure train contract by Brookfield Rail to operate infrastructure trains with two 422-class locomotives purchased from CFCL Australia. In December 2016, Watco Australia acquired a majority shareholding in Intermodal Group, a WA intermodal container transport group. In July 2017, Watco Australia took over the operation of the Forrestfield to Fremantle Harbour intermodal container service from SCT Logistics with flat wagons purchased from CFCL Australia. In late 2019, Watco Australia commenced operations in QLD under a

seven-year contract with GrainCorp. Eight locomotives from the National Railway Equipment Company and 128 wagons from China have been ordered.

7.4 Demand for freight rolling stock

Freight rolling stock is predominately influenced by export commodities demand, which depends on international market forces. There is some domestic movement of freight by rail and this is likely to increase with the development of the Melbourne-Brisbane inland rail route.¹³ That said, domestic freight competes with regional road networks and is unlikely to grow strongly (other than on the Melbourne-Brisbane route) because roads are generally more efficient for carrying freight over shorter distances.¹⁴

Freight services are broken up into the following categories:

- Intermodal services generally travel up and down the east coast of Australia or east-west across the country on a standard gauge network. This section of freight struggles to be profitable on the north-south corridor, however when the Melbourne-Brisbane inland rail route is upgraded allowing double stacking rolling stock to operate, this might then become very competitive compared to road freight. The east-west service competes better against road, because of the greater distances, and is likely to continue to do so.
- Coking Coal (i.e. metallurgical coal used for steelmaking) is mainly exported to key customers in China, India, South Korea and Japan. The expectation is that the demand will continue to grow at around one per cent per year until 2030. As QLD is the main source of coking coal, demand for narrow gauge rolling stock will continue.
- Thermal Coal (i.e. for power generation) is used both domestically and exported. The domestic market is affected by public pressure to reduce the reliance on coal-fired power stations; this also applies to some countries internationally, although the number of coal-fired power stations globally continues to grow.¹⁵ NSW is the major producer of thermal coal in the Hunter Valley, which is transported on a standard gauge network, and as the volume exported still remains high, it is believed there will be a need to replace any aged rolling stock for the immediate future.
- Iron Ore is predominantly mined in WA and transported to Port Headland for export on very large standard gauge rolling stock. Generally, market intelligence indicates that locomotives are US designed and wagons are sourced from China. Australia is the world's largest exporter of iron ore and China remains by far its major customer. International demand is expected to slow to long-run levels and, hence, demand for new rolling stock will likely be only to replace any ageing equipment.
- Grain transport varies considerably due to climatic conditions. Currently eastern states are in a period of prolonged drought and harvests are nil or very poor. The eastern states have a mixture of the three types of gauges. WA is in a slightly better position in terms of the drought and operates narrow- and standard-gauge rolling stock.

7.5 Freight rolling stock market demand forecast, 2020 to 2029

The following sets out the derivation of the forecast demand for freight rolling stock and locomotives. These forecasts are derived from commodity export growth forecasts, given that Australia's main commodity exports utilise more than 90 per cent of the freight network.

¹³ See here for further information about the Melbourne to Brisbane inland rail project: <https://inlandrail.artc.com.au/>

¹⁴ The development in recent years of B-Double and larger trucks, satellite tracking technology, intermodal hubs and 'just-in-time' delivery processes has made trucks much more efficient, especially for 'last mile' delivery.

¹⁵ According to the International Energy Agency, coal-fired electricity generation capacity will approximately double between 2000 and 2020, after which demand will likely stabilise in the 2020's.

7.5.1 Commodity export growth to 2029

BITRE (2019) estimate that, by volume, the Pilbara iron ore exports account for two-thirds of the volume on Australia's rail freight network. Assuming no major adjustments to the global cost curve for the delivery of iron ore, it is estimated that the average long-run growth in iron ore volumes are to be 3.5 per cent per year. This figure is slightly above the long-run global growth figure of three per cent, but below the expected economic growth rates in China and India in the near future (six per cent). In the long-run, it is expected that the economic growth rates in China and India will decline further, reflecting slowing population and productivity growth as those two countries' economies continue to develop.

It is expected that global demand for iron ore and coking coal will continue to grow in line with the expected average economic growth rates of Australia's major customers for steelmaking inputs. Australia's iron ore exports are forecast to rise from an estimated 850 tonnes currently (in 2019-20) to be more than one billion tonnes per year by the end of the next decade.

Similar growth for coking (or metallurgical) coal is expected, which is the other primary ingredient in the steelmaking process.

It has been widely reported that a number of countries, including Australia, are reducing their reliance on thermal coal due to concerns about global warming. This concern is expected to dampen the growth in demand for thermal coal exports over the next decade. Nonetheless, new coal-fired power stations are still being built in China and India, and elsewhere, and Australia's thermal coal is of a high quality. Therefore, some growth in thermal coal exports is expected, but at a lower rate than for steelmaking inputs.

The QLD Government has approved the new Galilee thermal coal basin for development. The main mining company will be the Indian conglomerate Adani, which plans to export the thermal coal to India for electricity generation. Because this is a new mine, volumes are expected to grow strongly during the ramp-up phase of production in the next decade.

Australian wheat exports have declined on world markets due to reduced supply (caused by the drought) and higher domestic prices (caused by the drought) shifting supply away from traditional global markets (such as China and Indonesia). In fact, in 2019 for the first time since 2006, Australia imported grains for domestic livestock consumption (from Canada). Exports are likely to return to growth when the Australian drought finally breaks, but this is difficult to predict. Therefore, a fairly conservative estimate has been made for growth over the next decade.

Table 7-2 below summarises the projections for freight rolling stocks, by commodity, based on the commodity growth forecasts.

Table 7-2 Projections of freight carriage stocks, locomotives (2020-2029).

Market	Growth (volume)	Explanation:	Source:
Pilbara iron ore (steel)	3.5%	Estimated growth of Australia's key export markets (China, India, Japan, South Korea)	IMF Outlook Department of Industry Market analysis
Bowen Basin coking coal (steel)	3.5%	Estimated growth of Australia's key export markets (China, India, Japan, South Korea)	IMF Outlook Department of Industry Market analysis
Hunter Valley thermal coal (electricity)	2.0%	Reduction in new thermal coal mine approvals; reduction in growth of coal-fired power stations globally	IMF Outlook Department of Industry Market analysis
Galilee Basin thermal coal (electricity)	5.0%	Ramp-up from zero (new Adani mine and others)	Market analysis
NSW/WA wheat	2.0%	Estimated growth of Australia's key wheat export markets (China, India, Japan, South Korea)	ABARES Market analysis
General commodities (domestic)	2.5%	Estimated Australian growth rate	ABS Treasury Market analysis

Source: Tulipwood Economics analysis. This analysis is based on data and forecasts developed by the International Monetary Fund, the Australian Department of Industry's Office of the Chief Economist, the Australian Bureau of Agricultural and Resources Economics and Science, the Australian Bureau of Statistics and the Australian Treasury Department.

7.5.2 Locomotive balance in 2029

Based on the growth forecasts, by commodity market, developed above the shortfall/excess in locomotives in 2029 have been estimated. Importantly, a prediction of the already planned purchases by freight companies for new locomotives has not been included because much of the data is commercial-in-confidence.

Therefore, the shortfall estimates that have been developed are at the high-end of what would be required in 2029 because purchases already planned have not been added.

Based on the analysis, it is estimated that (Table 7-3):

- the Pilbara iron ore network will require a further 616 locomotives by the end of the next decade. This represents most of the required stock, given that the Pilbara already accounts for two-thirds of freight volumes, and has the (equal) highest estimated growth rate;
- the next largest requirement for new locomotives will be in the Bowen Basin, with an estimated shortfall of 144 locomotives by 2029; and
- a smaller number of locomotives will be required in the Hunter Valley (44), WA/NSW wheat networks (22) and across general commodities transport (14) such as for the new Melbourne-Brisbane inland rail.

Table 7-3 Projections of regional carriage stocks, locomotives.

Market for locomotives	Current stock	2029 Requirement	Shortfall/Excess (carriages) (+/-)
Pilbara iron ore	425	600	-175
Bowen Basin coal	361	509	-148
Hunter Valley coal	219	267	-48
NSW/WA wheat	100	122	-22
General commodities	910	1,165	-255
Total	2,015	2,663	-648

Source: Tulipwood Economics analysis.

Note: It has been difficult to develop a picture of planned locomotive and wagon purchases over the next ten years. Therefore, this has not been included in the analysis.

7.5.3 Wagon balance in 2029

It is difficult to estimate the number of operating wagons in Australia, so this has not been undertaken for this analysis. However, assuming no change in technology that might affect locomotive-wagon ratios, a similar growth for wagons (in percentage terms) across the major freight networks (by commodity) is expected, as for locomotives.

8. Passenger transit bidding processes in Australia

This chapter describes the bidding processes that generally apply for the purchase of infrastructure equipment, such as rail transit equipment, in Australia. It describes:

- the importance of ‘local content rules’;
- the incorporation of overseas bidders in the procurement process;
- the structure of bidding processes in the three largest Australian states; and
- the role of financing and private funding options.

8.1 Local content rules

Generally, Australian state governments will incorporate ‘local content’ manufacturing rules into contracts. These rules are often an integral part of contracts with foreign companies for the provision of transport equipment. Local content rules are not mandated. Rather, various state governments have written down local content procurement guidelines that must be recognised when considering major infrastructure projects.

For example, the QLD Government Procurement Guidelines (Queensland Government 2019, p.2) states that:

“Require the use of local contractors and manufacturers in significant Queensland Government infrastructure projects, worth \$100 million and above, wherever possible.”

For example, the NSW Procurement Policy Framework (NSW Government 2019, p.10) states that:

“You must treat potential suppliers equitably and not discriminate based on business size, location or ownership, except where targeted policy measures or preferences apply (e.g. SME and Regional Procurement Policy).”

“You must not discriminate against suppliers due to foreign affiliation or ownership, or the origin of their goods or services, for procurements covered by international procurement agreements.”

In practice, local content rules are generally strong in states with Labor Governments, such as (currently) in QLD, VIC and WA. In NSW and SA, which have Liberal National Governments, local content rules are weaker, with these governments preferring to source carriages at a lower price than could be produced in Australia. In WA, a recent contract specified a minimum local content rule of 35 per cent; however, the winning bidder (Alstom) proposed a much higher percentage of local content because the tender had a points-based system whereby a higher local content earned the bidder more points. Alstom effectively won the contract because it proposed a 60 per cent local content requirement (Table 8-1).

The Liberal National governments also sometimes specify local content rules, but these are kept to a minimum to keep costs down. For example, a recent contract for bi-modal trains on NSW regional lines required some minor ‘fit-outs’ to be undertaken in Dubbo, NSW.

Table 8-1 Extent of Local Content Rules, by Australian state government.

State government	Local content rule	Type	Percentage
NSW	Yes	Minimal	<10%
Victoria	Yes	Significant	33-60%
Queensland	Yes	Significant	33-50%
Western Australia	Yes	Significant	35%
South Australia	Yes	Minimal	<10%

Source: Tulipwood Economics analysis based on various state government local content and procurement guidelines and publicly available information in relation to existing contracts.

8.2 Foreign bidders

Under the tendering rules in all Australian states, state governments *must* consider the opportunity for private sector involvement, including from foreign bidders. No Australian state excludes the possibility of foreign companies bidding for Australian Government tenders. Indeed, Australia's principal economic advisory body, the Productivity Commission, in its Public Infrastructure Inquiry in 2014, recommended that governments encourage more foreign company involvement to increase competition in the Australian infrastructure market.¹⁶

8.3 Pre-funding approval process

Generally, pre-funding approval from government will take about two to four years. There are a number of stages in the pre-funding approval process before the government will 'go-to-market' with its tender. The stages are summarised in Figure 8-1 below:

Figure 8-1 Pre-funding approval process, by major steps.



Source: Tulipwood Economics analysis based on publicly available state government documents.

Once budget approval is finalised, which may also require securing federal government funding, state governments can then 'go-to-market'. The first step is generally a Registration of Interest (ROI) process, which effectively gauges the market to assess whether the procurement is achievable.

In Australia, the tendering process is a very staged approach whereby interested parties are gradually shortlisted to (usually) three preferred bidders. State governments generally look for a minimum of three bidders, such that if one bidder withdraws there are still two remaining bidders to enforce competition.

Following the selection of the preferred bidders, detailed negotiations begin. Following these negotiations, a winning bidder is selected and contracts are signed.

¹⁶ See Productivity Commission (2014), Public Infrastructure Inquiry Report.

8.4 Bid costs policy

To further encourage competition, state governments will generally partly reimburse companies for their bids. The amount of funding is determined on a case-by-case basis (rather than being a particular percentage figure or guideline).

Generally, bid costs are considered to be borne in the procurement phase of the project, prior to appointment of preferred bidder, that specifically relate to that tender. Bid costs can include:

- design costs;
- technical modelling;
- legal advice;
- specialist reports required to develop a conforming bid;

Costs that are not generally reimbursed include:

- overheads;
- costs incurred after the appointment of the preferred bidder; and
- mobilisation (or 'set-up') costs.

In NSW, bid cost contributions from the state government will not be considered for infrastructure projects valued under \$100 million. The bid reimbursement policy in NSW states as follows (NSW Government, 2019):

“The bid cost contribution should be calculated as a percentage of the estimated bid costs and included as part of costings in the Final Business Case. Unless there is a compelling reason, the percentage of eligible pre-estimated bid costs to be reimbursed should be no more than 50 per cent. The bid cost contribution should be expressed as a capped dollar value. It should be offered to each unsuccessful proponent who meets the Mandatory Conditions.”

8.5 Bidding processes

The core characteristics of the bidding process in NSW, VIC and QLD is an open tender process that is designed to foster competition between domestic and international providers and achieve a high-quality product delivered on time at a reasonable price.

The NSW, VIC and QLD Governments operate very similar open, deliberative, process-driven, transparent and competitive processes when seeking manufacturing partners for rail transit equipment. The smaller states have similar competitive processes, but these tend to be less complex reflecting generally smaller projects in terms of scale and cost. Some states, such as QLD, accept unsolicited proposals from companies, but this is infrequent.

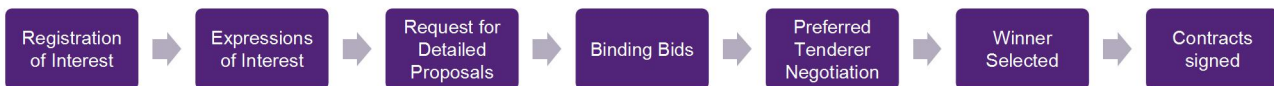
The core characteristics of all state government transit rail tendering processes are:

- the use of expert private manufacturing companies; and
- the use of competition to provide the best service for the lowest price.

Generally, state governments, when seeking to go to market for significant projects, will follow the following structured process:

- First, a call for a ROI to shortlist prospective firms based on capacity and capability. This process is effectively a ‘market sounding’ exercise to determine whether companies will be able to supply to equipment required.
- This is followed by an Expression of Interest (EOI) process where interested firms essentially register their interest with the state government. It would be at this stage that CRRC would need to provide the state government with a detailed capability statement setting out its experience and capacity to deliver on similar projects.
- The state government will generally then request a shortlist of interested parties to submit detailed proposals in the Request for Detailed Proposal state.
- Following an evaluation of detailed proposals, the state government will generally select two bidders to submit their binding bids in terms of exactly what will be delivered and at what cost to the state government.
- At the end of this process, a winning bid is selected and then negotiations begin on making the contract between the parties.
- When contracts are signed, work can begin according to the specifications laid out in the contracts (Figure 8-2).

Figure 8-2 General tendering process in NSW, VIC and QLD.



Source: Tulipwood Economics based on various publicly available state government procurement guidelines.

Essentially, state governments will design the procurement model around the basic structure described above, in order to meet the requirements for the project, and to maintain enough flexibility and options to ‘future proof’ the project.

State government procurement policies also pay close attention to:

- enabling for the timely start and completion of construction;
- certainty in construction and operating costs;
- sufficient market interest, and capacity, to deliver a project with a particular model;
- allowing for stakeholder management;
- ability to accommodate variations due to changing operational needs; and

- ability of the model to achieve innovation, where this is required to achieve project objectives.¹⁷

A procurement workshop is generally held within the government to assess the capacity of different procurement options to meet project requirements. In addition, the workshop will determine whether there is sufficient market interest and capability in the market. At this stage, the outlines of a required financial and economic assessment are developed.

After the selection of two options, based on assessment at the procurement workshop for appropriate projects, the more detailed assessment of these options can take place. The inputs to this assessment would be the detailed economic, financial assessment and public interest assessments at Business Case development stage, and further market sounding based on additional information about the project options under consideration. The more detailed consideration of the two procurement options against the project requirements would lead to a recommendation of a preferred procurement model to accompany the preferred project option.

8.6 Procurement and financing methods

8.6.1 Background

In transport infrastructure delivery, the state governments maintain ownership of the above-rail assets (such as train carriages) and there is at present no political interest in privatising the various heavy rail passenger networks in the near future – because those networks would require a significant taxpayer subsidy to operate anyway. As a result, the public generally support the retention of passenger rail services as a government service. However, governments in Australia are no longer involved in manufacturing. Hence, governments procure products globally based on criteria related to a supplier's previous experience in the Australian (or similar) market, delivery capability, cost, and commitment to the region in terms of local content and jobs.

In NSW and QLD, delivery models with private sector funding and/or financing options (as opposed to solely government funding) must be progressed as the 'preferred delivery model', unless there is demonstrable evidence that this will not deliver the best value for money for government, in which case traditional delivery (government finance only) models may be considered.

8.6.2 Traditional procurement methods

Before the 1980s, Australian state governments would generally design, construct and operate their own infrastructure such as rail networks and carriages. From the 1990s, state governments began to procure (or 'outsource') these roles to private sector companies. The traditional procurement methods first used by state governments in Australia included:

- Construct only;
- Design & Construct;
- Design, Finalisation & Construct;
- Design, Construct & Maintain; and
- Cost Plus.

¹⁷ Various publicly available state government procurement guidelines.

8.6.3 Public Private Partnership (PPP) methods

Public Private Partnership (PPP) procurement methods were developed in the late 1990s and can be defined by how funding and delivery and operational risk is shared between the procuring government and the supplier. Generally, a PPP involves the use of private sector capital to fund a piece of infrastructure that may be initially owned by the private sector and then eventually revert to government ownership.

These newer PPP procurement methods include:

- Build, Own, Operate and Transfer (BOOT);
- Design, Build, Finance and Operate (DBFO);
- Design, Build, Finance and Maintain (DBFM);
- Design, Build, Operate and Maintain (DBOM);
- Design, Construct and Maintain; and
- Market-Led Proposals (see section 8.7 below).

8.6.4 Relationship or Collaborative Contracting methods

There are several other contracting methods used in Australia, which can be classified as ‘relationship’ or ‘collaborative’ approaches. These include:

- Managing Contractor;
- Early Contractor Involvement;
- leading to either traditional contract or relationship/collaborative contracts;
- Framework Agreement;
- Incentivised Target Cost;
- Alliance Agreement;
- Collaborative Client Contractor; and
- Delivery Partner or Construction Management.

8.7 Unsolicited proposals

Australia’s largest states – NSW, VIC and QLD – encourage unsolicited proposals from the private sector. Unsolicited proposals are designed to encourage companies to approach government with commercial proposals, where the government has not requested a proposal and the proponent may be uniquely placed to provide a value-for-money solution.¹⁸

Currently, unsolicited proposals are not common in transport infrastructure delivery. The method is more common in other areas of state government procurement, such as in tourism and hospitality. However, it is

¹⁸ The NSW unsolicited proposal guidelines can be found here: <https://static.nsw.gov.au/nsw-gov-au/1505101800/Unsolicited-Proposals-Guide-2017.pdf>

believed that in the future, unsolicited proposals are likely to become more common as companies can provide design and engineering expertise that governments do not generally maintain internally. The core stages of the unsolicited proposal process are as follows:

- pre-submission concept review;
- Stage 1a Initial submission and preliminary assessment;
- Stage 1b Strategic assessment of the initial submission;
- Stage 2 Detailed Proposal submitted; and
- Stage 3 Negotiation of the Final Binding Offer (FBO).

8.8 Private sector freight tendering processes

Above rail freight operations in Australia are operated by privately owned or publicly listed (i.e. listed on the stock exchange) companies. Governments no longer own and operate above rail freight services in Australia. As such, these rail freight companies, such as Aurizon and PN, and those mining companies that operate their own freight businesses (such as Rio Tinto in the Pilbara), can elect to deal directly with a preferred manufacturer or undertake a tender process to encourage competition.

Private companies, especially those listed on the stock exchange, have an obligation to shareholders to minimise costs. Therefore, the larger freight companies often undertake a competitive tender process for new rolling stock.

9. Major findings and recommendations

9.1 Introduction

CRRC has requested that UQ make recommendations in relation to this study. In this chapter the major findings are presented first, and secondly, a number of recommendations are provided.

9.2 Findings

9.2.1 Finding 1

As part of this study, a set of forecasts were developed for each of the capital city heavy rail markets based on a transparent formula that incorporates the main drivers of passenger demand growth, namely: population growth, economic growth, and previous passenger demand growth.

These initial growth forecasts were then adjusted by accounting for other factors, such as whether or not there would be likely network expansion, whether the network was currently overcrowded, public transport policies and cyclical economics factors.

Importantly, these forecasts are based on current and future planned network expansion. As noted in the report, it is likely that some state governments will expand their heavy and light rail networks sometime in the next decade. If networks are expanded then demand growth will be stronger than is forecast in Table 9-1 (below).

In general terms, it was found that passenger demand growth will range between two to three per cent per year, on average, over the next decade, apart from Brisbane which will see slightly low growth at 1.7 per cent per year. Each market is different, in terms of size, likely population and economic growth potential, and government plans and policies to expand the network.

It is believed that the strongest candidate for growth is Melbourne, where the growth was forecast to be 2.7 per cent per year on average over the ten years to 2029. There are plans to expand the existing Melbourne network, most notably with a new link to Melbourne Airport. Melbourne has also enjoyed relatively strong population and economic growth over the last few years and, it is believed that this is likely to continue into the next decade.¹⁹

Sydney is also expected to continue to expand its passenger rail network, most notably with the new Sydney Metro system. This expansion should induce further growth in demand and lead to a shortfall of carriages towards the end of the next decade.

Growth in Brisbane is expected to be subdued for a number of reasons. First, in general terms population growth has slowed in QLD over the years after the mining boom. The reduction has been driven both by slowing net interstate migration (i.e. people moving north from Melbourne and Sydney) and also slowing overseas migration. Further job growth in the CBD and inner-city areas has slowed in recent years, with most of the job growth occurring at the edge of the CBD and in the industrial centres to the north and southwest of Brisbane. Finally, a series of public transport fare increases in the early part of this decade slowed passenger demand growth, which has not recovered. On the positive side, the commencement of the new Cross River Rail metro system and the introduction of the ETCS on the central part of the network should induce new demand growth as train services increase and become more reliable.

¹⁹ The Victorian Government has also recently announced (in October 2019) a major investment agreement with China as part of the Belt and Road infrastructure initiative. See here: <https://www.premier.vic.gov.au/victoria-and-china-take-partnership-to-the-next-level/>

Table 9-1 Heavy rail passenger annual growth forecasts, 2020 to 2029.

Capital city market	Initial market demand	Accounting for additional factors				Final market demand forecast
		Planned major network expansion?	Currently overcrowded network?	Pro-PT policies	Cyclical economic factors?	
Sydney	1.9%	+0.2	+0.2	+0.2	No	2.5%
Melbourne	2.1%	+0.2	+0.2	+0.2	No	2.7%
Brisbane	1.5%	+0.2	No	+0.2	-0.2	1.7%
Perth	2.1%	No	No	+0.2	-0.2	2.1%
Adelaide	2.0%	No	No	+0.2	No	2.2%
Average (un-weighted)	1.9%	-	-	-	+0.3	2.2%

Source: Tulipwood Economics analysis.

9.2.2 Finding 2

However, it was noted that there will be a significant shortfall in the number of rail transit carriages beyond 2025, especially in Sydney and Melbourne. In Sydney, the shortfall is estimated to be 312 carriages, whereas in Melbourne, the shortfall is estimated to be 486 carriages. In Brisbane and Adelaide, it is estimated that there will be an equilibrium in the supply-demand balance for carriages in 2029. Finally, in Perth it is estimated that there will be an oversupply of carriages (of +74) given our central growth demand forecasts (Table 10-1).

Table 10-1 Projections of rail carriage stocks, by capital city market.

Market	Current stock (carriages)	2029 stock* (carriages)	Based on Central Case growth forecasts	
			2029 Requirement	Shortfall/Excess (carriages) (+/-)
Sydney	1,751	1,760	2,072	-312
Melbourne	1,374	1,307	1,793	-486
Brisbane	813	963	962	+1
Perth	330	480	406	+74
Adelaide	136	172	169	+3
Total	4,404	4,682	5,402	-

Source: Tulipwood Economics analysis.

Notes: *2029 stock incorporates new rolling stock planned for and ordered, as well as retirements and likely refurbishments. Also note, the estimated shortfall for Sydney does not include the additional carriages for the Sydney Metro.

9.2.3 Finding 3

Demand for light rail passenger services in Australia is, generally, growing at above population and economic growth rates, especially in the new networks of Canberra and the Gold Coast. Increased purchases from state governments are expected for light rail vehicles by the middle of the next decade as passenger number grow and networks expand.

Table 9-3 Projections of light rail carriage stocks, by capital city market.

Market	Current stock (carriages)	2029 stock* (carriages)	Based on Central Case growth forecasts	
			2029 Requirement	Shortfall/Excess (carriages) (+/-)
Sydney	12	91	102	-11
Melbourne	501	506	660	-154
Brisbane	18	29	23	+6
Adelaide	24	24	28	-4
Canberra	14	17	18	-1
Total	569	667	831	-170**

Source: Tulipwood Economics analysis.

Notes: * 2029 stock incorporates new rolling stock planned for and ordered, as well as retirements and likely refurbishments. ** This figure is the sum of the negative numbers. This is because it would not be realistic to expect trading of light rail transit stock between jurisdictions. Hence, the negative figure represents the total forecast shortfall of light rail transit stock in Australia in 2029.

9.2.4 Finding 4

The demand for freight locomotives and wagons continues to grow strongly in Australia, driven by record volumes of iron ore and coal being exported to China, Japan and South Korea. Although the mining investment boom has peaked and Australia's terms of trade has declined from record levels, the permanent increase in the size of Australia's freight rail network has allowed for record volumes of iron ore and coking and thermal coal exports.

In relation to locomotives, Australian freight companies seek quality and reliability over price. Accordingly, there is an opportunity for CRRC to invest in developing higher-quality locomotives that could potentially compete with US-made locomotives that are now often subcontracted to India and Kazakhstan to keep costs down.

Table 7-3 Projections of regional carriage stocks, locomotives.

Market for locomotives	Current stock	2029 Requirement	Shortfall/Excess (carriages) (+/-)
Pilbara iron ore	425	600	-175
Bowen Basin coal	361	509	-148
Hunter Valley coal	219	267	-48
NSW/WA wheat	100	122	-22
General commodities	910	1,165	-255
Total	2,015	2,663	-648

Source: Tulipwood Economics analysis.

Note: It has been difficult to develop a picture of planned locomotive and wagon purchases over the next ten years. Therefore, this has not been included in the analysis.

9.3 Recommendations

9.3.1 Recommendation 1

CRRC Limited actively pursues commercial opportunities in the Australian passenger and freight rail market, particularly in the Sydney and Melbourne heavy rail passenger transit market, and the light rail market in all jurisdictions. In our view, the Australian light market represents a significant opportunity for CRRC Limited.

As part of this, CRRC consider undertaking an Australian 'roadshow' of senior officials in the various state transport departments and network operators to advertise its capability, size, quality, innovative technology, local knowledge and international experience. This 'roadshow' would augment current industry engagement activities, such as CRRC Limited's significant contribution to the annual ARA Conference and other activities associated with the ARA.

9.3.2 Recommendation 2

CRRC Limited consider establishing an Australian legal entity to undertake maintenance and refurbishment work on carriages built and supplied by CRRC and also other firms. This type of work is significant and likely profitable, as state governments and companies often first seek to extend the life of rolling stock before ordering new fleets.

CRRC Limited could consider partnering with, or purchasing, an existing Australian rail equipment manufacturer to make it easier to meet tendering rules, including any local content requirements specified by state governments.

9.3.3 Recommendation 3

CRRC should investigate opportunities in the Australian rail freight market. The rail freight market is large in Australia and is undergoing profound technological change with the development of driverless carriages that can operate on networks with and without electricity.

As part of this, CRRC could invest further in locomotive-related R&D to develop products that would suit Australian conditions.

9.3.4 Recommendation 4

CRRC could collaborate with an Australian-based university to develop a research program that could be beneficial to both the Australian university and CRRC.

CRRC could benefit from ongoing research into the Australian passenger rail transit market, light rail, regional rail, and rail freight market. The research would also boost awareness of CRRC in Australia and its reputation as a good corporate citizen.

The university could benefit with this research funding to contribute to the discussion in Australia around public transport use, urban development and cities policy more generally.

End.

Picture 2 CRRC Limited Double-Decker EMU operating on the Sydney Rail Network.



Source: CRRC Limited website.

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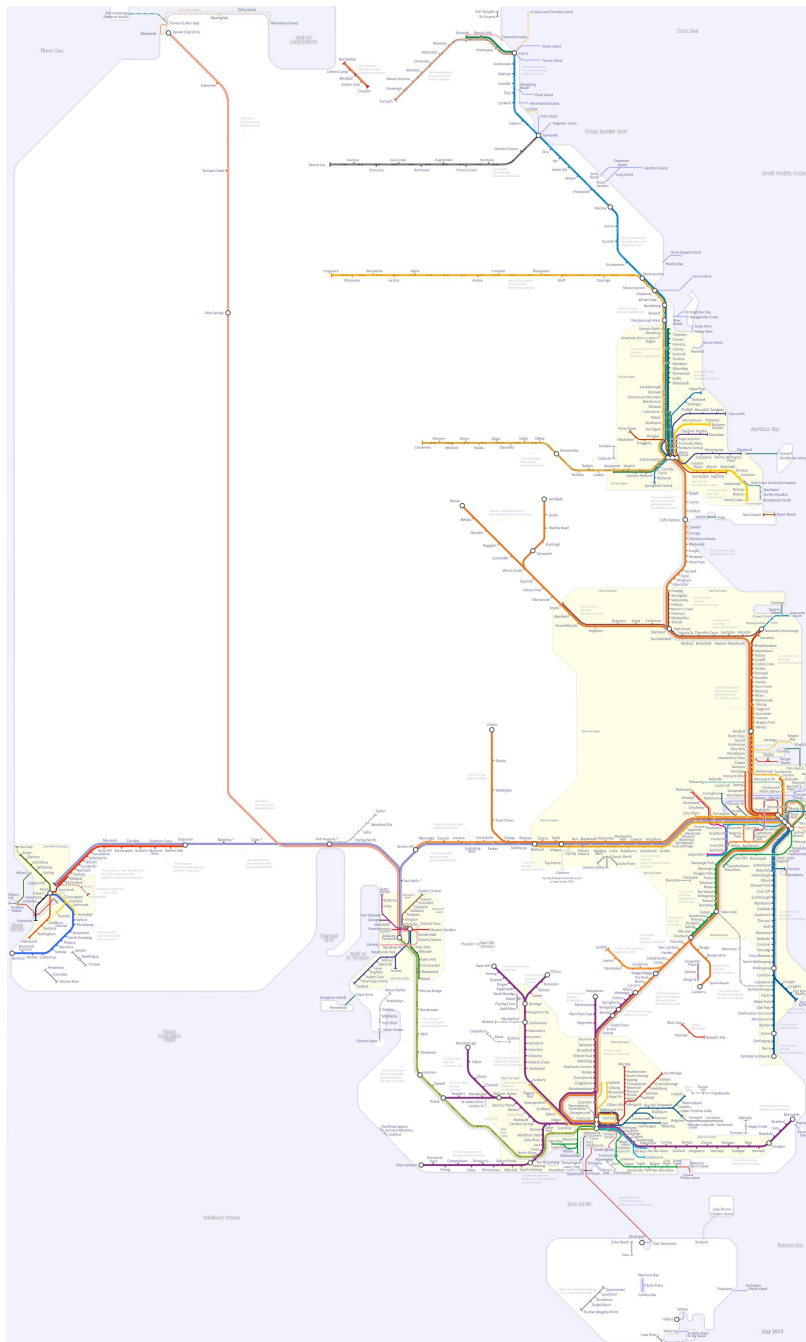
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Appendix A Light rail and regional rail maps

A-1 Queensland

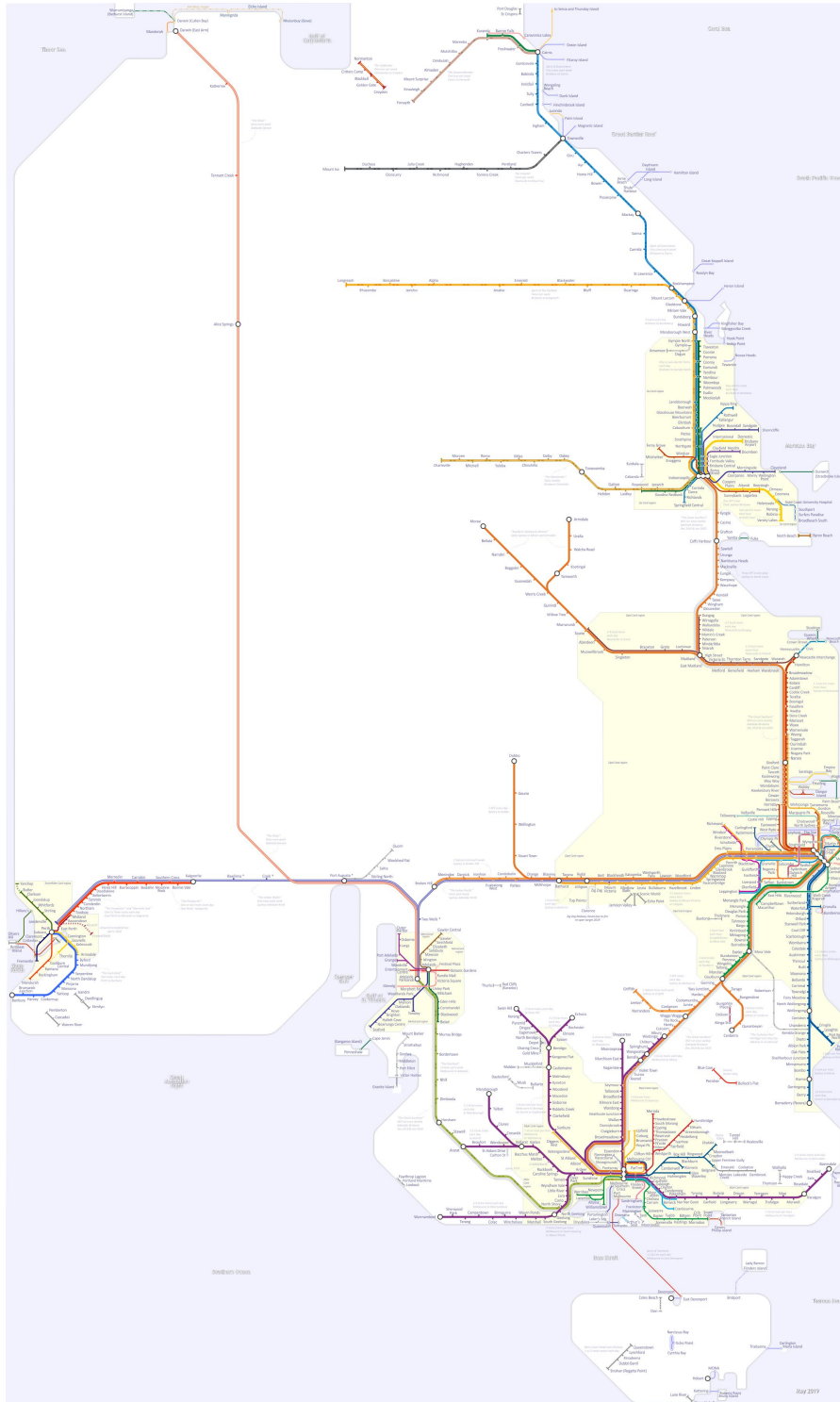
Figure A-1 Rail map of Queensland



Source: Australian rail maps; <https://www.railmaps.com.au/austrail.htm>.

A-2 Northern NSW

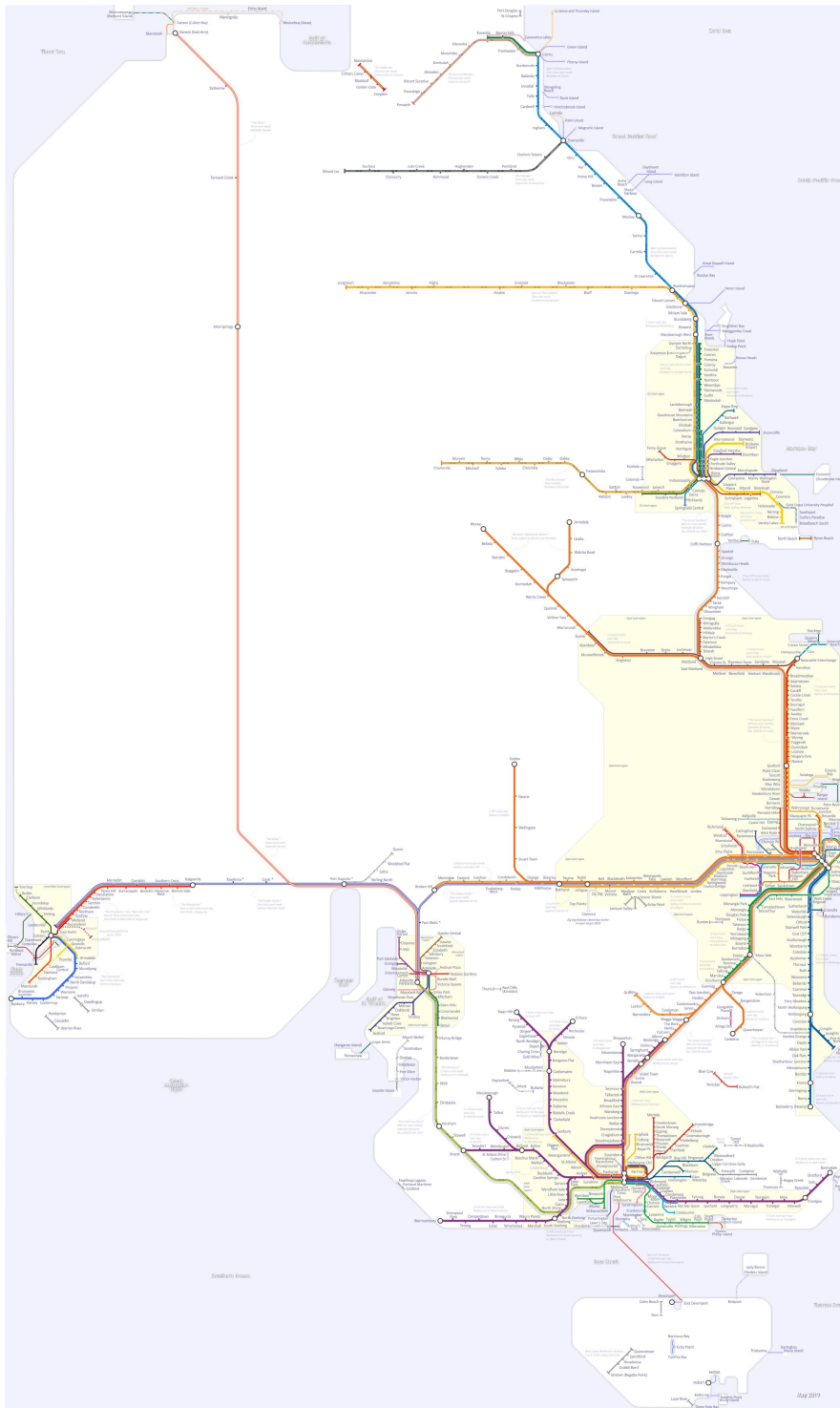
Figure A-2 Rail map of Northern NSW.



Source: Australian rail maps; <https://www.railmaps.com.au/austrail.htm>.

A-3 Victoria, South Australia and Southern NSW

Figure A-3 Rail map of VIC, SA and Southern NSW.



Source: Australian rail maps; <https://www.railmaps.com.au/austrail.htm>.

Appendix B 10-year Sydney rail market demand

Carriage Model	Carriages ordered	Year built	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
S.L.&R Cars	192	1972-19800	Last SL&R set retired in 2019.										
K Sets	160	1981-1985	160	160	88	24	Past design life. K-Sets and C-Sets were refurbished (modest upgrades) to keep operating. Tangara to be refurbished before 2025. Technical upgrade is underway, currently testing new electrical equipment and driver's desk.						
C Sets	56	1986-1987	56	56	56	56	56	56	56	56	56	56	56
Tangara	444	1988-1995	444	444	444	444	444	444	444	444	444	444	444
Millennium	141	2002-2005	141	141	141	141	141	141	141	141	141	141	141
Waratah A	626	2011-2014	626	626	626	626	626	626	626	626	626	626	626
Waratah B	192	2018-2019	192	192	192	192	192	192	192	192	192	192	192
Waratah C	136	2020-2021	48	136	136	136	136	136	136	136	136	136	136
Oscar (Suburban)	221	2021-2023	32	160	221	221	221	221	221	221	221	221	221
Total Fleet			1,619	1,667	1,715	1,779	1,816	1,816	1,760	1,760	1,760	1,760	1,760
<i>Demand Growth (+2.5%)</i>			1,619	1,659	1,701	1,743	1,787	1,832	1,878	1,924	1,973	2,022	2,072
<i>Excess / Shortfall (+/-)</i>			0	8	14	36	29	-16	-118	-164	-213	-262	-312

Source: NSW Government publications, news articles and Tulipwood Economics analysis.

Appendix C 10-year Sydney Metro market demand

Carriage Model	Carriages ordered	Year built	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
SM NW	132	Current	132	132	132	132	132	132	132	132	132	132	132
SM City SW	120	Current				120	120	120	120	120	120	120	120
SM South West	140												140
SM Great West	30							30	30	30	30	30	30
Total Fleet			132	132	132	252	252	282	282	282	282	282	422
Demand Growth (0.0%)			132	132	132	252	252	282	282	282	282	282	422
Excess / Shortfall (+/-)			0	0	0	0	0	0	0	0	0	0	0

Sydney Metro (SM) North West Link began operating in 2019. Trains for SM West and SM Great West are yet to be tendered. SM Great West tender will be in 2020. SM City and SM South West to open in 2024. SM to new Airport to open 2025-26.

Source: NSW Government publications, news articles and Tulipwood Economics analysis.

Notes: Sydney Metro is scheduled to begin operations in 2024. For this analysis, it was assumed that the planned supply of carriages will meet market demand until the end of the decade. SM NW and SM City SW tenders were awarded to Alstom. SM Great West tender will be issued in 2020.

Appendix D 10-year Sydney light rail market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
CBD	60 2019	60	60	60	60	60	60	60	60	60	60	60
Sydney Hill Dulwich Hill	12 2014-2015	12	12	12	12	12	12	12	12	12	12	12
Parramatta Stage 1	13 2023					13	13	13	13	13	13	13
Newcastle	6 2019	6	6	6	6	6	6	6	6	6	6	6
Total Fleet		78	78	78	78	91	91	91	91	91	91	91
Demand Growth (+2.7%)		78	80	82	84	87	89	92	94	97	99	102
Excess / Shortfall (+/-)		0	-2	-4	-6	4	2	-1	-3	-6	-8	-11

Source: NSW Government publications, news articles and Tulipwood Economics analysis.

Notes: Sydney light rail demand forecasts are based on forecast employment growth in the Sydney CBD derived from estimates in the Sydney Metro Business Case.

Appendix E 10-year Regional NSW market demand

Carriage Model	Carriages ordered	Year built	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Intercity Camshaft	204	1977-1987	204	80									
Oscar (Outer Suburban)	221	2006-2009	221	221	189	61							
NIF	554	2020-2023		140	270	410	554	554	554	554	554	554	554
XPT (L19+C60)	60	1984-1989	60	60	48								
Endeavour DMU	28	1994	28	28	28	28	28	8	8	8	8	8	8
Xploere DMU	23	1993	23	23	23	23	23						
Hunter DMU	14	2006-207	14	14	14	14	14	14	14	14	14	14	14
Regional Rail Fleet	117	2022-2023				16	66	117	117	117	117	117	117
Total Fleet			550	566	584	600	685	693	693	693	693	693	693
<i>Demand Growth (+2.2%)</i>			550	562	574	587	600	613	627	640	655	669	684
<i>Excess / Shortfall (+/-)</i>			0	4	10	13	85	80	66	53	38	24	9

Source: NSW Government publications, news articles and Tulipwood Economics analysis. Notes: NSW regional passenger rail demand is based on regional population and economic growth forecasts and historical passenger demand.

Appendix F 10-year Melbourne market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Comeng	570 1981-1988	558	520	466	408	408	408	408	408	408	408	408
Siemens Nexus	216 2002 - 2005	216	216	216	216	216	216	216	216	216	216	216
X'Trapolis 100	636 2004- 2020	600	636	636	636	636	636	636	636	636	636	636
HCMT	455 2019-2023	0	40	140	240	340	450	455	455	455	455	455
Total Fleet		1,374	1,412	1,458	1,500	1,600	1,710	1,715	1,715	1,715	1,715	1,307
Demand Growth (+2.7%)		1,374	1,411	1,449	1,488	1,529	1,570	1,612	1,656	1,700	1,746	1,793
Excess / Shortfall (+/-)		0	1	9	12	71	140	103	59	15	-31	-486

Source: VIC Government publications, news articles and Tulipwood Economics analysis.

Appendix G 10-year Melbourne light rail market demand

Carriage Model	Carriages ordered	Year built	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
W Class	13	1951-56	13	13	13	13	13	13	13	13	13	13	13
Z Class	114	1975-84	114	114	114	114	114	114	114	114	114	114	114
A Class	69	1984-86	69	69	69	69	69	69	69	69	69	69	69
B Class	130	1984-94	130	130	130	130	130	130	130	130	130	130	130
C1 Class	36	2001-02	36	36	36	36	36	36	36	36	36	36	36
C2 Class	5	2008	5	5	5	5	5	5	5	5	5	5	5
D1 Class	38	2002-03	38	38	38	38	38	38	38	38	38	38	38
D2 Class	21	2003-04	21	21	21	21	21	21	21	21	21	21	21
E Class	80	2013-19	80	80	80	80	80	80	80	80	80	80	80
Total Fleet			506	506	506	506	506	506	506	506	506	506	506
Demand Growth (+2.7%)			506	520	534	548	563	578	594	610	626	643	660
Excess / Shortfall (+/-)			0	-14	-28	-42	-57	-72	-88	-104	-120	-137	-154

Source: VIC Government publications, news articles and Tulipwood Economics analysis.

Appendix H 10-year Regional Victoria market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
VLocity	241 2004 present	- 210	241	241	241	241	241	241	241	241	241	241	
VLocity	54 2021-2023			12	36	54	54	54	54	54	54	54	
H Carriages	Type 59 1983	54	54	42	18	0	<div style="border: 1px solid black; padding: 5px;"> Past design life. Minor upgrades undertaken or planned. Z-Type carriages to be retired in 2019. </div>						
N Carriages	Type 57 1981	56	56	56	56	56							
Z Type Carriages	15 1957	22											
NGRT	TBC	<div style="border: 1px solid black; padding: 5px;"> Tender planned for 2020, when quantity will be determined. </div>											
Total		342	351	351	351	351	295	295	295	295	295	295	
Demand Growth (+2.2%)		342	350	357	365	373	381	390	398	407	416	425	
Excess / Shortfall (+/-)		0	1	-6	-14	-22	-86	-95	-103	-112	-121	-130	

Source: VIC Government publications, news articles and Tulipwood Economics analysis. Regional VIC demand forecasts based on historical population, employment and passenger demand growth.

Appendix I 10-year Brisbane market demand

Carriage Model	Carriages ordered	Year built	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	
EMU00	40	1979-1987	EMU00 retired in August 2019.					Past design life. ICE150 minor upgrades scheduled for 2020. Assume same for SMU200, IMU100 and SMU220.						
ICE150	20	1988-1989	18	18	18	18	18							
SMU200	36	1994-1995	36	36	36	36	36	36	36	36	36	36	36	
IMU100	36	1996-1997	36	36	36	36	36	36	36	36	36	36	36	
SMU220	90	1999-2001	90	90	90	90	90	90	90	90	90	90	90	
IMU120	12	2001-2001	12	12	12	12	12	12	12	12	12	12	12	
IMU160	84	2006-2011	84	84	84	84	84	84	84	84	84	84	84	
SMU260	105	2008-2011	105	105	105	105	105	105	105	105	105	105	105	
NGR700	450	2015-2020	432	450	450	450	450	450	450	450	450	450	450	
NGR700 <u>Option</u>	150	2024-2025						50	100	150	150	150	150	
Total			813	831	831	831	831	863	913	963	963	963	963	
Demand Growth (+1.7%)			813	827	841	855	870	884	900	915	930	946	962	

Excess / Shortfall (+/-)	0	4	-10	-24	-39	-21	13	48	33	17	1
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Source: QLD Government publications, news articles and Tulipwood Economics analysis.

Appendix J 10-year Gold Coast light rail market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Gold Stage 1	Coast 14 2014	14	14	14	14	14	14	14	14	14	14	14
Gold Stage 2	Coast 4 2017	4	4	4	4	4	4	4	4	4	4	4
Gold Stage 3, 3A,	Coast 5 2023						5	5	5	5	5	5
Gold Stage 3B	Coast 6 2030											6
Total Fleet		18	18	18	18	18	23	23	23	23	23	29
Demand Growth (+2.4%)		18	18	19	19	20	20	21	21	22	22	23
Excess / Shortfall (+/-)		0	0	-1	-1	-2	3	2	2	1	1	6

Source: QLD Government publications, news articles and Tulipwood Economics analysis.

Notes: Passenger demand forecasts are based on historical population and economic growth rates in the Gold Coast region, a ramp-up in passenger demand for the relatively new network, and a reduction in road supply on the Gold Coast.

Appendix K 10-year regional Queensland market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Electric tilt train	12 1997	12	12	12	12	12	12	12	12	12	12	12
Diesel Tilt train	21 2003	21	21	21	21	21	21	21	21	21	21	21
SX Carriages	7 1961	7	7	7	7	7	7	7	7	7	7	7
Total Fleet	SX Carriages are currently being refurbished.		40	40	40	40	40	40	40	40	40	40
Demand Growth (+0.5% per year)		40	40	40	41	41	41	41	41	42	42	42
Excess / Shortfall (+/-)		0	0	0	-1	-1	-1	-1	-1	-2	-2	-2

Source: QLD Government publications, news articles and Tulipwood Economics Analysis.

Notes: Regional QLD market demand forecasts are based on regional population and economic growth forecasts and QLD Government policies in relation to regional passenger train network expansion.

Appendix L 10-year Perth market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
A Series 1st	86 1990	86	86	86	56	36	16	A Series 1 st planned refurbishment in 2020.				
A Series 2nd	10 1998	10	10	10	10	10	10	10	10	10	10	10
B Series 1st	93 2004	93	93	93	93	93	93	93	93	93	93	93
B Series 2nd	45 2009	45	45	45	45	45	45	45	45	45	45	45
B Series 3rd	66 2013-2015	66	66	66	66	66	66	66	66	66	66	66
B Series 4th	30 2018- 2019	30	30	30	30	30	30	30	30	30	30	30
C Series	246 2020-2028		6	36	66	96	126	156	186	216	246	246
Total Fleet		330	336	366	366	376	386	400	430	460	490	480
Demand Growth (+2.1%)		330	337	344	351	359	366	374	382	390	398	406
Excess / Shortfall (+/-)		0	-1	22	15	17	20	26	48	70	92	74

Source: WA Government publications, news articles and Tulipwood Economics analysis.

Appendix M 10-year regional Western Australia market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Australind	5 1987	5	5	5								
Prospector	7 2004	7	7	7	7	7	7	7	7	7	7	7
AvonLink MerrdinLink	2 2005	2	2	2	2	2	2	2	2	2	2	2
C Series DMU					6	6	6	6	6	6	6	6
Total Fleet		14	14	14	15	15	15	15	15	15	15	15
Demand Growth (+0.5%)		14	14	14	14	14	14	14	14	15	15	15
Excess / Shortfall (+/-)		0	0	0	1	1	1	1	1	0	0	0

Source: WA Government publications, news articles and Tulipwood Economics analysis.

Notes: Regional WA market demand forecasts are based on regional population and economic growth forecasts and WA Government policies in relation to regional passenger train network expansion.

Appendix N 10-year Adelaide market demand

Carriage Model	Carriages ordered	Year built	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
3000/3001 DMU (Comeng)	20	1979-1987	20	20	20	20	20	20	20	20	20	20	20
				Life extension in 2018.									
3000/3001 DMU (Clyde)	50	1992-1996	50	50	50	50	50	50	50	50	50	50	50
				Life extension in 2018.									
4000 EMU 1st Series	66	2014- 2015	66	66	66	66	66	66	66	66	66	66	66
				Gawler Line electrification.									
4000 EMU 2nd Series	36	2020-2021		18	36	36	36	36	36	36	36	36	36
Total			136	154	172	172	172	172	172	172	172	172	172
Demand Growth (+2.2%)			136	139	142	145	148	152	155	158	162	165	169
Excess / Shortfall (+/-)			0	15	30	27	24	20	17	14	10	7	3

Source: SA Government publications, news articles and Tulipwood Economics analysis.

Notes: Adelaide light rail market demand forecasts are based on forecast population and employment growth in the Adelaide CBD.

Appendix O 10-year Adelaide light rail market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Flexity	11 2006-2007	11	11	11	11	11	11	11	11	11	11	11
Flexity	4 2012	4	4	4	4	4	4	4	4	4	4	4
Alstom Citadis	6 2009	6	6	6	6	6	6	6	6	6	6	6
Alstom Citadis	3 2017	3	3	3	3	3	3	3	3	3	3	3
Total Fleet		24	24	24	24	24	24	24	24	24	24	24
Demand Growth (+1.6%)		24	24	25	25	26	26	26	27	27	28	28
Excess / Shortfall (+/-)		0	0	-1	-1	-2	-2	-2	-3	-3	-4	-4

Source: SA Government publications, news articles and Tulipwood Economics analysis.

Notes: Adelaide light rail market demand forecasts are based on forecast population and employment growth in the Adelaide CBD.

Appendix P 10-year regional South Australian market demand

Carriage Model	Carriages Year built ordered	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Ghan & Indian Pacific	90 1974	90	90	90	90	90	90	90	90	90	90	90
Overlander	20 1965	20	20	20	20	20	20	20	20	20	20	20
Total Fleet		110	110	110	110	110	110	110	110	110	110	110
Demand Growth (+0.0%)		110	110	110	110	110	110	110	110	110	110	110
Excess / Shortfall (+/-)		0	0	0	0	0	0	0	0	0	0	0

Source: Ghan & Indian Pacific (Adelaide Darwin), and Overlander (Adelaide-Melbourne) company publications, and Tulipwood Economics analysis.

Notes: There is significant excess capacity on these tourist rail networks. Any augmentation of capacity over the next decade is not envisaged.

Appendix Q 10-year Australian locomotive demand

Market for locomotives	Current stock	2029 Requirement	Shortfall/Excess (carriages) (+/-)
Pilbara iron ore	425	600	-175
Bowen Basin coal	361	509	-148
Hunter Valley coal	219	267	-48
NSW/WA wheat	100	122	-22
General commodities	910	1,165	-255
Total	2,015	2,663	-648

Source: Tulipwood Economics analysis.

Note: It has been difficult to develop a picture of planned locomotive and wagon purchases over the next ten years. Therefore, this has not been included in the analysis.

Appendix R Australian locomotives and wagons, by company

COMPANY	FLEET LOCOMOTIVES	FLEET WAGONS	BUILD DATE	NOTES
Rio Tinto	200 locos	11,760	unknown	49 x 240 consists, 36 tonne axle
Fortescue Metals Group	45 locos	3,244	unknown	Fleet numbers as at February 2015, from Wikipedia. 40t axle
BHP Billiton	159 locos	(9,000) est.	unknown	72 in 1995 + 97 since 2007 Hamersley & Robe River railway
Roy Hill	21 locos	(5,000) est.	unknown	21 in 2015
Aurizon	650 locos Approx. split 336 Coal 314 Bulk/General	8,724 coal 2,510 bulk	Locomotives: 18 built between 1960-69 89 built between 1970-79 76 built between 180-89 133 built between 1990-99 334 built between 2000-2019	300 coal locos (Aurizon website) 650 locos (Wikipedia estimate) From Annual Report: Additional 66 locomotives built between 1960-1999 are in storage. 20% use standard gauge 80% use narrow gauge.

COMPANY	FLEET LOCOMOTIVES	FLEET WAGONS	BUILD DATE	NOTES
Pacific National	570 active locos Approx. split 244 Coal 326 Bulk/General	unknown	Locomotives: 87 built between 1957-75 123 built between 1979-91 219 built between 1992-2000 197 built between 2002-19	Additional 58 locomotives built between 1957-1991 are in storage. Coal 96 narrow gauge In addition, Pacific National leases locomotives from CFCL Australia and operates three WH class locomotives on behalf of Whitehaven Coal. Rural and bulk: 30% use standard gauge 8% use broad gauge Intermodal (37% of locos) use standard gauge Coal (21% of locos) use standard gauge Pacific National Qld (14% of locos) use narrow gauge.
SCT Logistics	40 locos Bulk/ General	unknown	Locomotives: 27 built between 2007-11 11 built between 1955-9 2 built in 1974	Additional 3 locomotives built between 1955/69 are in storage
QUBE	32 locos Bulk/General	unknown	Locomotives: 14 built between 2011-15 10 built between 1971-74 7 built between 1980-89 1 built in 1994	Additional 10 locomotives built between 1960-74 are in storage Were intermodal and bulk. Now supply maintenance and infrastructure work trains.
SSR Southern Short haul Railroad	46 locos Bulk/General	unknown	Locomotives: 10 built between 2012-15 9 built between 1978-89 27 built between 1951-72	Additional 8 locomotives built between 1959-68 are stored. Also operates another 14 locomotives on behalf of other owners.
GWS (and Freightliner)	101 locos Bulk/General	unknown	Locomotives: 21 built between 1956-68 22 built between 1970-77 58 built between 2003-12	Locomotive numbers are as at October 2014. Additional 24 locomotives built between 1960-72 are stored. Being sold to Macquarie Bank
CFCL Australia	91 locos Bulk/General	1,700	unknown	Leases locos and wagons in Australia 13% use broad gauge 87% use narrow gauge. Marubeni partnership could be over. New partner required

COMPANY	FLEET LOCOMOTIVES	FLEET WAGONS	BUILD DATE	NOTES
GrainCorp	18 locos Bulk/General	unknown	unknown	-
Junee Rail	unknown	unknown	unknown	Lease. maintain and own small loco fleet
Manildra Group	unknown	unknown	unknown	Hook and pull deal with Pacific National
V/Line Passenger	unknown	unknown	unknown	Covered in Passenger Report
TasRail	17 locos Bulk/General	293	unknown	Loco 2011-2015 Progress Rail wagons 2012-14 Mongolia/UGL
Watco	25 Locos Bulk/General	unknown	unknown	Operating in WA and Qld. CBH. New NREC loco 2019
Mineral Resources	10	unknown	unknown	GE C44 (Cliffs)

Sources: Company Annual Reports and other publications, company website information, news articles, market intelligence and Tulipwood Economics Analysis.



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