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# Maritime Transport Infrastructure

Discussion Paper

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June 2020



ENGINEERS  
AUSTRALIA

## MARITIME TRANSPORT INFRASTRUCTURE

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# 1. Purpose

This document has been produced by the Transport Australia society (TAs) of Engineers Australia as a discussion paper with an aim to improve marine transport infrastructure and services in Australia. It does not represent a formal position statement of Engineers Australia but is intended to inform discussion in relation to the important issues and challenges faced in the industry currently and to ensure the industry has the capacity and capability to efficiently harness future growth opportunities from new and expanded industries.

## 2. Background

Ports typically handle around 90% of global trade. However, in Australia, that figure is significantly higher at 98%. "Australia is an island whose place in the international economy and whose productivity, living standards and quality of life depend on trade performance."<sup>1</sup>

Australia is dependent on shipping for international trade, domestic coastal freight movements and in less restricted times, international tourism. Ports are the international trade and tourism gateways that support the growth and resilience of the national and state and territory economies.

There are approximately 70 ports in Australia, all of which are key international trade and tourism gateways that underpin the economic performance and resilience of states and territories and mitigate the risk of downturns and shortages in the global economy.

Major ports are located around Australia near the main population centres for the import and export of manufactured goods and primary produce, and at strategic locations for export of mineral resources and energy products (e.g. iron ore, coal, crude and refined oil and liquefied natural gas (LNG)). Ports are also an integral part of the tourism industry with the passenger cruise ship traffic at tourism destinations around Australia. However, it is expected that the cruise industry will experience significant challenges recovering from pandemic restrictions.

The many islands and major rivers around the country have maritime facilities used by passengers for tourism and commuting to larger centres. Maritime infrastructures such as marinas, jetties, barge and boat ramps and pontoons located around the entire perimeter of our coastline as well as the estuaries and rivers are used by ferry and barge operators, commercial fishers, yachting fraternity and small craft boaties.

Australian exports reached a record \$403.2 billion in 2017-18.<sup>2</sup> The ratio of exports to GDP was 21.3 per cent in FY2017<sup>3</sup>.

Port infrastructure can have a useful economic life of more than 50 years – so transport access and adjacent land use planning and development controls have a significant role to play, particularly as the major cities are frequently experiencing bottlenecks in the access links to and from ports which adversely impact logistics and supply chains for the movement of freight and goods.

Australian port activity can be split into four primary categories:

1. Major capital city import and export ports in each state and territory plus ports close to the capital cities. There are seven capital city ports - Brisbane, Sydney, Melbourne, Adelaide, Hobart, Fremantle and Darwin. Most of these have large container terminals while Newcastle and Port Kembla in NSW and Geelong and Hastings in Victoria are examples of significant ports close to capital cities.
2. Specialised regional bulk export ports, with the largest focusing on iron ore, coal, grain and livestock and energy products. Key example ports in this category are Port Hedland (WA); Dampier (WA); Karratha (WA); Hay Point (Qld); Weipa (Qld); Port Bonython (SA); Whyalla (SA); Port Giles (SA); Port Pirie (SA); Thevenard (SA); Wallaroo (SA).

<sup>1</sup> Infrastructure Australia. 2011. National Ports Strategy. [https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/COAG\\_National\\_Ports\\_Strategy.pdf](https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/COAG_National_Ports_Strategy.pdf)

<sup>2</sup> <https://www.dfat.gov.au/sites/default/files/trade-and-investment-at-a-glance-2019.pdf>

<sup>3</sup> Trade and Investment – Australia's export performance in FY2017, Austrade

3. Regional multi-cargo import and export ports, large and small. Examples of large multi-cargo ports include: Cairns (Qld); Townsville (Qld); Mackay (Qld); Gladstone (Qld); Port Lincoln (SA);
4. Small regional and remote ports such as: Bundaberg (Qld); Eden (NSW); Portland (Vic) Burnie (Tas), Devonport (Tas), Bell Bay (Tas); Klein Point (SA); Ardrossan (SA); Lucky Bay (SA); Esperance (WA); Bunbury (WA); Geraldton (WA); Broome (WA)

Note: Not all ports are listed as examples in the categories above.

Many of the above ports have critical infrastructure for defence (Naval bases), ship building and cruise shipping. Major naval bases are in Sydney, Melbourne, Darwin and Fremantle with the two main ship building facilities located in Adelaide (Osborne) and Fremantle (Henderson). The highest number of cruise ship stops occur at the following ports (in order with the largest first); Sydney (NSW), Brisbane (Qld), Melbourne (Vic) and Cairns/Yorkey's Knob (Qld)<sup>4</sup>.

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<sup>4</sup> <http://crew-center.com/analysis-australia-cruise-statistics-ports-2017>

# 3. National Sea Freight

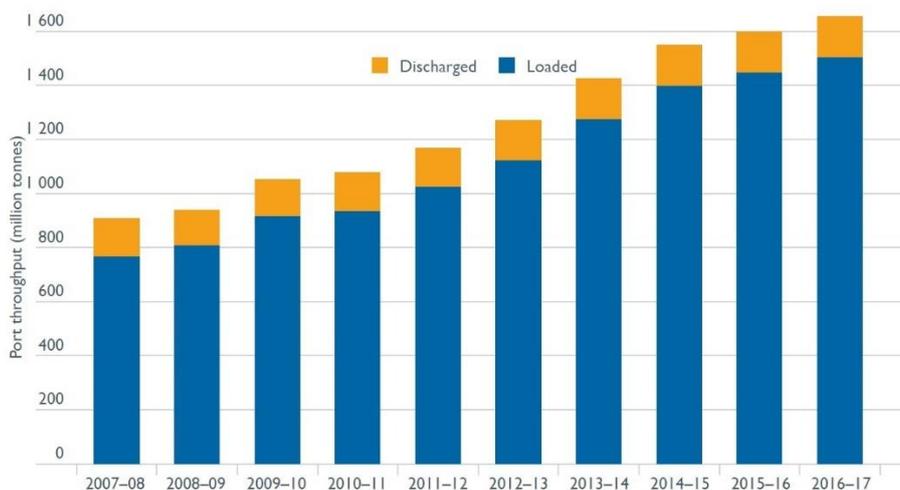
Ports Australia stated that “Australia is an island nation, relying on Ports to connect us with the world”. The raw figures are impressive as every day \$1.2 billion of trade moves throughout Australian ports. In 2019 Australian ports facilitated the import of:

- Motor vehicles valued at \$23 billion
- Computers to the value of \$8 billion
- 20 trillion litres of fuel, and
- Various goods in 8 million shipping containers<sup>1</sup>

According to the Department of Infrastructure, Transport, Cities and Regional Development’s Bureau of Transport Economics report, *Australian Sea Freight 2016-2017 – Statistical Report*, issued 2 October 2019:

- 1,653 million tonnes of cargo were handled across the wharves of all Australian ports combined during 2016-2017. Vessel based freight statistics are expressed using three categories; exports, imports and the coastal shipping trade. During the decade to 2016-2017, the composition of Australian sea freight changed with exports increasing to 87.7% (up from 78%), imports decreasing to 6.0% (reduced from 9.3%), while coastal freight also reduced from 12.7% to 6.3%.
- For the five-year period leading up to 2016-2017, the total number of cargo ships calling at Australian ports increased by 2.5% per annum. A total of 32,801 port calls were made by 5,845 cargo ships.
- Almost 104 million tonnes of coastal freight were handled in total.

The graph in Figure 1 below depicts the increase in total throughput at Australian ports to 2016-2017. *Source: “Australian Sea Freight 2016-2017 – Statistical Report.”*



Note: “Loaded” includes tonnage of international exports and tonnage of loaded coastal freight. “Discharged” includes tonnage of international imports and tonnage of discharged coastal freight.

Sources: ABS (2017a), BITRE (2019).

**Figure 3.1 – Total Throughput at Australian Ports**

Further details relating to commodities handled at Australian ports is contained in Annexure A.

## 4. Current Industry Challenges

### 4.1 Vessel sizes

All global shipping is gradually increasing in size including the basic overall ship dimensions, allowable tonnage and cargo quantities able to be accommodated. Increases in container vessel sizes in Australia are driven by global factors, not necessarily domestic demand. This puts greater stress on current infrastructure and eventually requires expensive upgrades to berthing and mooring infrastructure on wharves and shipping navigation channels with dredging and dredged material relocation sites required to provide deeper and wider shipping channels and vessel turning basins. The outreach on existing container cranes may be inadequate for the wider beam ship hence requiring crane replacement.

In the absence of infrastructure upgrades, larger ships increase the risk profile for manoeuvring the vessels in channels and harbours. This requires more in-depth risk assessments, better training, greater expertise and increased use of available technologies such as dynamic underkeel clearance systems.

### 4.2 Road and rail access to ports

Many capital city ports are adding to the suburban road congestion due to inadequate rail infrastructure and insufficient capacity for freight trains to and from the ports. This is primarily due to the higher cost of railing port freight and the conflict between freight and passenger trains. Port freight, particularly in multi truck combination requires designated and approved access routes to the port from the interstate and intrastate road network. High performance vehicles accredited under the national Performance Based Standard (PBS) Scheme are progressively replacing older, heavier vehicle fleets. These high-performance vehicles still require approved road access.<sup>5</sup> The configuration of these vehicles makes it typically impossible for them to manoeuvre through city streets to access ports.

With the anticipated growth in autonomous vehicles and vehicle platooning, the location of ports is a strategic consideration as is consideration for journey start points and final destinations. These last mile efficiencies are vitally important to maximising the efficiency of the supply chain.

Major passenger rail infrastructure upgrade projects in Sydney and Melbourne may alleviate this issue for those cities and provide more freight train paths and facilitate better interaction with passenger trains. Both road and rail freight access to ports is limited by land use and development controls in force along road and rail corridors linking ports. The significant Inland Rail Project which is not connected via dedicated port connections misses a significant supply chain improvement opportunity.

### 4.3 Port planning

Many ports are being constrained from further expansion due to environmental restrictions on further development, urban encroachment, lack of industrial land for port associated industries, lack of spare capacity in linear infrastructure corridors for road and rail access and services such as electricity transmission and pipelines.

The National Ports Strategy<sup>6</sup> (2012) looked to address Australia's port and infrastructure needs and recommended the development of 15 to 30-year plans acknowledging expected growth and considering other factors such as freight corridors, security, community impact, biosecurity and tourism. It is evident that very little integration in subsequent infrastructure planning incorporated the principles in the Strategy and the Strategy has not been sufficiently reflected in the National Freight and Supply Chain Strategy. Longer-term planning up to 50 years is required due to demonstrated complexity and to the necessity of broader planning frameworks integration

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<sup>5</sup> <https://www.nhvr.gov.au/road-access/performance-based-standards>

<sup>6</sup> Infrastructure Australia. 2011. National Ports Strategy. [https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/COAG\\_National\\_Ports\\_Strategy.pdf](https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/COAG_National_Ports_Strategy.pdf)

## 4.4 National freight and supply chain strategy

The Australian and all state and territory governments have agreed to a national approach for freight and supply chains with the National Freight and Supply Chain Strategy. The Strategy recognises previous output from the Council of Australian Governments, (COAG) particularly the National Ports Strategy (2011), National Land Freight Strategy, (2013) and National Freight and Supply Chain Strategy and Action Plan (2019). A champion is needed at a national level to ensure a focus on delivering the Strategies and Action Plan. The National Transport Commission could have its role expanded to include a focus on maritime transport. For this expanded role to be effective and avoid repeating the many years of limited adoption of National Ports Strategy recommendations, governments would need to increase the Commission's annual funding.

The National Ports Strategy outlined a set of sound recommendations and a list of implementation actions, which remain relevant. An evaluation and review of the status of the Strategy's recommendations and its Implementation Plan is timely and would facilitate the development of a new National Strategy with a 50-year horizon.

## 4.5 Cruise shipping

Over the past decade there has been a significant expansion in the cruise shipping industry with major passenger terminals established in Fremantle, Adelaide, Darwin, Cairns, Hobart, Brisbane, Sydney and Melbourne. However, the expansion of the cruise shipping industry in the ports of Sydney and Brisbane have been constrained due to the height of bridges – the Sydney Harbour Bridge and the twin Gateway Bridges in Brisbane. Brisbane expects to complete its new International Cruise Ship Terminal downstream of the gateway bridges during 2020, whilst Sydney is still considering its options.

## 4.6 Professional and technical capability

Skilled labour as well as qualified maritime experience for port management and operations is becoming harder to find in Australia and is often required to be imported from overseas on work visa arrangements. The University of Tasmania's Australian Maritime College offers a range of courses from vocational training through to doctorates relating to maritime engineering, business, hydrodynamics, seafaring (ocean and coastal) and logistics.<sup>7</sup> Many of these courses would be highly regarded for port infrastructure development, asset management, operations and logistics roles.

South Australia's Logistics Information and Navigation Centre (LINC) suggests there is evidence an increase in productivity resulting from targeted training can yield a return on investment of more than 30 percent.

The South Australian Freight Council's Skills and Careers Management Team investigations conclude that a company's bottom line is generally improved through training with positive impacts demonstrated in the following areas:

- Safety
- Profitability/ Productivity
- Morale/ increased Employee Motivation
- Customer Satisfaction
- Market Share
- Company Reputation and Profile

There is a need for better promotion and encouragement of education and training opportunities aimed at improving port management, planning and development skills.

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<sup>7</sup> Australian Maritime College website: <https://www.amc.edu.au/about-amc>

## 4.7 Innovation and automation

The first automated container port was developed in Europe in the 1990s. Since then over US\$10 billion has been expended automating 40 container ports around the world. This is expected to accelerate with a further \$10-\$15 billion of allocated funds over the next five years.<sup>8</sup>

In Australia, entire container terminals, including terminal yards and vessel unloading facilities are undergoing automated transformation – examples are the Port of Brisbane, Webb Dock at Port of Melbourne and Sydney's Patrick Terminal. The Port of Brisbane has been the first port in the world to implement a vessel operating system, including under keel clearance system, which has the same level of accuracy as a full bridge simulator.

Blockchain technologies can be used to simplify complex freight supply chains to track freight on its end to end journey. Australia has dropped 60 places globally on the world's *Ease of Trading Across Borders Index* since 2012. *Trade Community System* is one such national platform aiming to unlock significant value for exporters, importers and logistics companies.<sup>9</sup>

It is expected that further automation of ports to improve efficiencies and lower operational costs will continue well into the future. The trend towards greater automation of port operations to achieve increased productivity will increasingly require higher levels of skill and competencies in all levels of the workforce.

To maintain international competitiveness in asset management and operations, ports need to position and leverage off the fourth industrial revolution drivers using blockchain, artificial intelligence, augmented and virtual reality and robotics – the internet of things.

## 4.8 Environmental regulations

Tighter environmental regulations continue to be implemented in Australia limiting the development of new port sites along the Australian coastline and the ability of existing ports to expand. As an example, the Queensland government implemented new legislation in 2015 – *Sustainable Ports Development Act 2015* which limits new developments in ports other than the five nominated priority ports in order to better protect the Great Barrier Reef.

Climate change is also having clear impacts on ports infrastructure and these effects will continue to increase until emissions are reduced to sustainable levels.

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<sup>8</sup> "The Future of Port Automation," McKinsey and Company, 2018. <https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/the-future-of-automated-ports>

<sup>9</sup> Trade Community System - <https://www.tradecommunitysystem.com.au/>

# 5. Future opportunities

## 5.1 Global megatrends

In 2012 CSIRO produced its report on global megatrends, *Our future world. Global megatrends that will change the way we live*. The report outlines six interrelated megatrends that relate to:

- The earth's limited supplies of resources - natural minerals, energy, water and food
- Habitats and plant and animal species in decline
- The world's economy shifting from west to east and north to south
- The world's aging population
- Increased connectivity and immersion in the virtual world
- The rising demand for experiences over products and the importance of social relationships.

Australia is well positioned to benefit from the global economy shift to the south and east to supply renewable energy, natural minerals (including critical minerals for renewable energy storage) and increased food to the globe through our ports.

The nation's tourism industry caters for the increasing desire for experiences and ports will play a role through cruise ships. However, the impacts of climate change could hamper our ability to respond effectively to the megatrends with sustained droughts affecting food production and the increased frequency and severity of natural disasters associated with climate change.

## 5.2 Port preparedness for the changing nature of industries

The response of ports to the changing nature of industry is vitally important. This can be seen from the changing nature of fuel for energy. During the twentieth century Australia constructed port infrastructure to ship thermal coal for overseas power generation. The ports of Newcastle (NSW) and Hay Point (Qld) along with the port of Richards Bay in South Africa have for decades maintained their position as the three largest coal ports in the world. Overlapping with the coal terminal developments, Western Australia started exporting liquefied natural gas, LNG and is now competing with Qatar as the world's largest exporter of LNG. This comes after several major projects for new and expanded liquefaction and exporting terminals on both sides of the country over the last 20 years.

In a similar way, hydrogen is looming as the next major energy industry for which Australia is positioning to become a major global exporter. Port infrastructure owners now need to turn their attention to the export of renewable hydrogen as the world's new source of renewable energy. To be successful in this endeavour, port and industrial land planners will need to collaborate closely with major project approval agencies.

While ports may be hesitant to invest early to facilitate the hydrogen industry, further consideration should be given to the use of liquid ammonia as the vehicle to transport hydrogen by sea and use technologies such as CSIRO's membrane system to transform the ammonia into hydrogen in the receiving countries. While highly toxic, the land and sea transportation of liquid ammonia is well understood and proven to be safe.

Australian ports are starting to invest in wind, wave, current and solar renewable energy, leveraging the large roof areas associated with port warehouses and their proximity along coastlines.

## 5.3 Blue economy

The notion of the "Blue Economy" is a term used to recognise the economic, social and environmental value of oceans and is gaining momentum. According to the Blue Economy Cooperative Research Centre, Australia has the third largest Exclusive Economic Zone with over 80% being classified as offshore. Australia's offshore engineering

expertise from the sectors of defence, shipping, and oil and gas can be applied in the generation of renewable electricity from wind, waves and currents and for offshore aquaculture industries.<sup>10</sup>

Oceans are also an important carbon sink to help mitigate the impacts of climate change. Ports can play a role facilitating sustainable maritime energy, ocean and coastal tourism and increased marine fisheries which currently contribute US\$270 billion to global GDP.

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<sup>10</sup> Blue Economy Cooperative Research Centre - <https://blueeconomycrc.com.au/>

## 6. Recommendations

The following are offered as options for discussion, to improve maritime transport infrastructure planning, development and operations in the Australian industry.

1. There is a need for an appropriately funded body, such as the National Transport Commission, to focus on the advancement of ports nationally. The body would have strong relationships with all State and Territory governments, private sector port operators, key onshore stakeholders that include freight companies and port related industrial land and linear infrastructure owners.

The body would need to be outcomes focused and:

- (i) Develop a long term (50 year) National Ports Strategy to support economic development and defence needs. The strategy would nominate the future role of the major ports, outline port expansions, ports which should be closed or change function and if and where new ports need to be established. The strategy would also build on the achievements and lessons learnt from the previous Strategy (2011).
  - (ii) Ensure all jurisdictions initiate master planning at appropriate intervals for their key ports, to guide sustainable development whilst balancing long term economic growth, job creation, environmental protection and community interests. These master plans would need to be integrated with the jurisdictions' relevant long-range strategic transport and infrastructure plans.
  - (iii) Establish and maintain a governance framework including industry and legislative support and incentives to ensure alignment of all parties, governments and private industry, towards the delivery of the national maritime strategy, particularly for ports of national interest.
  - (iv) Whilst acknowledging the diversity of Australian ports, establish and maintain clear and consistent national port guidelines and minimum standards for efficiencies, productivity improvements, funding, pricing (where appropriate), investment, safety and environment. The guidelines and standards would need to be digitally focused, nationally consistent and integrated to ensure supply chain efficiencies can be realised given shipping lines typically visit more than one Australian port on each voyage.
2. To ensure a stable pipeline of people with the skills necessary for the maritime industry, there is a need to promote education and training opportunities relating to broader port management and development professions, paraprofessionals and trades (maritime, structures, pavement, traffic, asset management, data scientists, cyber security experts, supply chain and logistics.)

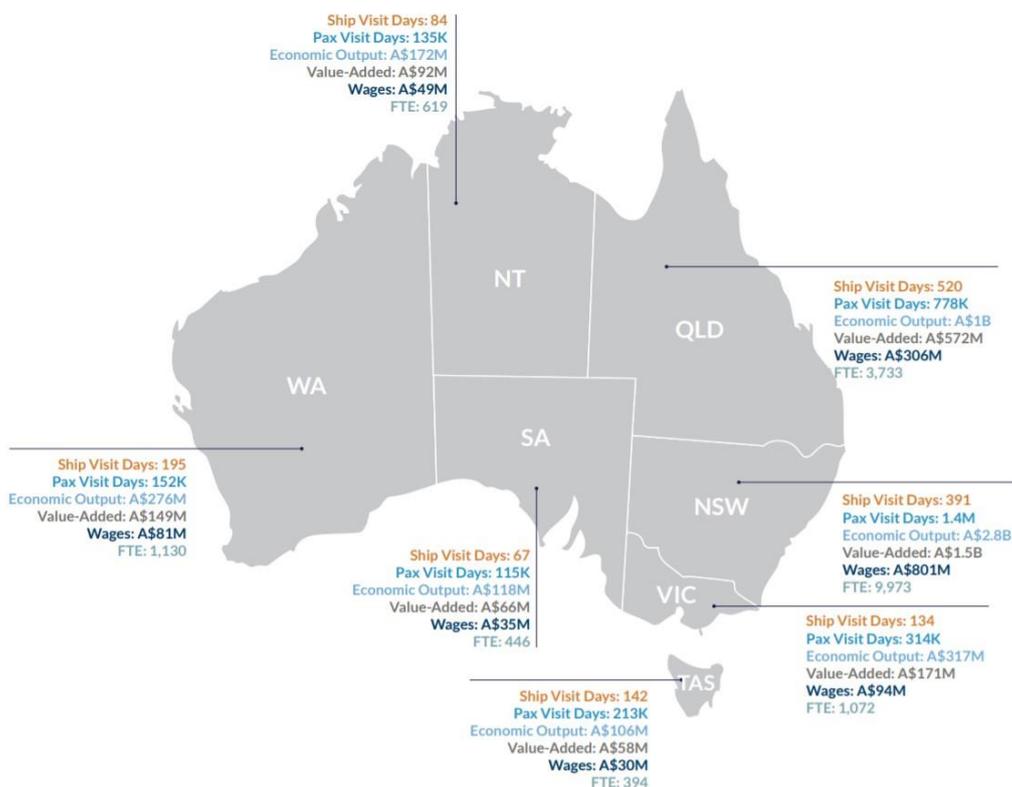
# 7. Annexure A – Australia’s major ports and industry

## 7.1 Cruise shipping

In 2017, cruise ships called at 41 regional ports and anchorages around the Australian coastline. Those ships accommodated 1.34 million passengers embarked on an ocean cruise in Australasia (including 1 in 18 Australians)<sup>11</sup>. The highest nationalities represented on the cruises are represented in the total below:

Region	No. of Passengers
Australia	1,000,000
USA	87,000
New Zealand	63,000
United Kingdom	21,000
Europe	19,000
Canada	14,000
Asia	7,000

Cruise Lines International Association and the Australian Cruise Association combined to complete an assessment of the economic impact of the Australian Cruise Industry for 2017/2018 and found that the total direct and indirect economic output was \$4.8 billion.<sup>12</sup>



<sup>11</sup> "Cruise Industry Ocean Source Market Report Australia 2017", Cruise Line International Association.

<sup>12</sup> Cruise Lines International Association and the Australian Cruise Association. <https://www.australiancruiseassociation.com/sites/default/files/17-18-eia-infographic-final.pdf>

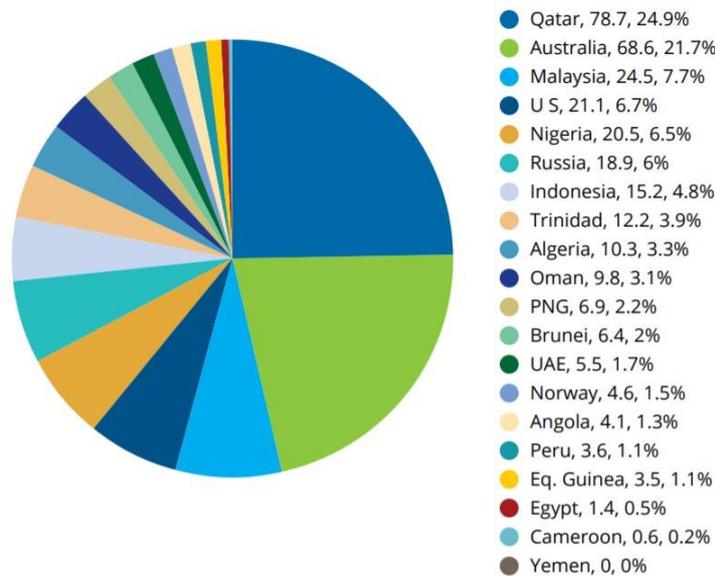
**Figure A1 – Australian Cruise Shipping Statistics 2017/2018 Financial Year** <sup>13</sup>

**Cairns Cruise Shipping Case Study:**

In late February 2020 the Port of Cairns welcomed Cunard’s Queen Elizabeth cruise ship which has over 3,000 passengers and crew onboard. This is the largest ship of any type to sail into Cairns port. Prior to completing the \$127 million Cairns Shipping Development Project which consisted of shipping channel and swing basin dredging and wharf upgrades in 2019/2020, Cairns could not accommodate such large vessels. During 2018, Cairns doubled its cruise ship arrivals to 53. With the expanded and upgraded infrastructure, the port envisages 150 cruise ship visits per year by 2031.

## 7.2 Liquefied natural gas

Over several decades Australia has developed liquefied natural gas processing and export facilities at ports in Western Australia, Queensland and the Northern Territory and now competes with Qatar for the country with the largest LNG exports. Refer Figure A2 below for the global LNG exporters ranked by total annual export in million tonnes per annum and their percentage of global trade.



*Note: Numbers in the legend represent total 2018 exports in MT, followed by market share.*  
 Sources: IHS Markit, IGU

**Figure A2 – Global LNG Exporting Countries** <sup>14</sup>

<sup>13</sup> Australian Cruise Association Infographic. <https://www.australiancruiseassociation.com/sites/default/files/17-18-eia-infographic-final.pdf>

<sup>14</sup> International Gas Union – 2019 World LNG Report. [https://www.igu.org/sites/default/files/node-news\\_item-field\\_file/IGU%20Annual%20Report%202019\\_23%20loresfinal.pdf](https://www.igu.org/sites/default/files/node-news_item-field_file/IGU%20Annual%20Report%202019_23%20loresfinal.pdf)

## 7.3 Iron ore

Australia commenced iron ore exports in 1960 with the very first shipment to Japan. Fast forward to 2017 when Australia’s iron ore industry generated the country’s largest source of export revenue shipping 828 million tonnes with a value of \$63 billion. Expansions to existing port facilities and the construction of new export terminals in Western Australia have facilitated Australia’s iron ore exports increasing by 200% over the decade to 2017. <sup>15</sup>

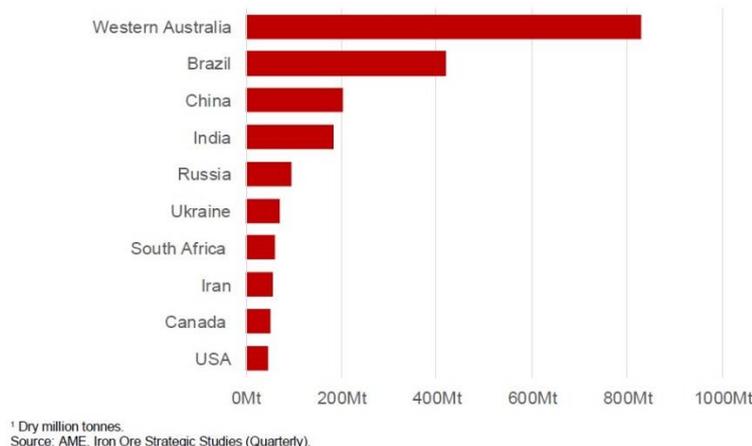


Figure A3 - Global Iron Ore Exporters<sup>16</sup>

## 7.4 Coal

The International Energy Association states that Australia is the second largest global exporter of coal on a tonnage basis representing 26.9% of the seaborne coal trade in 2018. Indonesia is the largest exporter with 30.9% of the trade.<sup>17</sup>

The following table summarises the Australian coal export market in 2018<sup>18</sup>. Queensland (Brisbane, Gladstone, Hay Point, Abbot Point) and New South Wales (Newcastle and Port Kembla) are the predominant coal export ports in Australia.

Metric	Thermal Coal	Metallurgical Coal
Total exports (million tonnes per annum, mtpa)	203	179
Value (AUD\$ billion)	22.6	37.8

<sup>15</sup> Iron Ore: Supplying High Grade Product to the World. Minerals Council of Australia <https://minerals.org.au/minerals/ironore>

<sup>16</sup> Western Australia Iron Ore Profile - Government of Western Australia, February 2019. [https://www.itsi.wa.gov.au/docs/default-source/default-document-library/wa-iron-ore-profile---february-2019.pdf?sfvrsn=3f38731c\\_4](https://www.itsi.wa.gov.au/docs/default-source/default-document-library/wa-iron-ore-profile---february-2019.pdf?sfvrsn=3f38731c_4)

<sup>17</sup> Coal Information Overview 2019 – International Energy Agency [https://iea.blob.core.windows.net/assets/c40f0317-f8e6-4f00-b183-27a24c7b6a8f/Coal\\_Information\\_2019\\_Overview.pdf](https://iea.blob.core.windows.net/assets/c40f0317-f8e6-4f00-b183-27a24c7b6a8f/Coal_Information_2019_Overview.pdf)

<sup>18</sup> Coal: Building Australia’s Future – Minerals Council of Australia <https://minerals.org.au/minerals/coal>

## 7.5 Agricultural exports

Agricultural exports represented 14% of the country's total goods and services exports in 2016 with a total value of \$44.7 billion.<sup>19</sup> Following is a range of statistics relating to Australia's agricultural exports from, "The State of Australian Agricultural Exports," Department of Foreign Affairs and Trade.

### The state of Australian agricultural exports

Australia's top 10 agricultural exports by value (A\$ million, 2016)

Major agriculture export products	A\$m in 2015	Share of total (%)
Beef	7,401	16.6
Wheat	4,853	10.9
Meat (excluding beef)	3,575	8.0
Wool	3,021	6.8
Alcoholic beverages	2,587	5.8
Sugars, molasses and honey	2,332	5.2
Vegetables	2,260	5.1
Dairy	2,216	5.0
Live animals (excluding seafood)	1,875	4.2
Fruit and nuts	1,762	3.9

### Who buys our agricultural exports?

China is by far the largest importer of Australian agricultural products, accounting for 21 per cent of our total agricultural exports in 2015.

Australia's major agriculture export markets (A\$ million, 2016)

Major agriculture export markets	CY2015 A\$m	Share of total (%)
China	8,906	19.9
Japan	4,500	10.1
United States	3,893	8.7
Republic of Korea	3,410	7.6
Indonesia	3,312	7.4

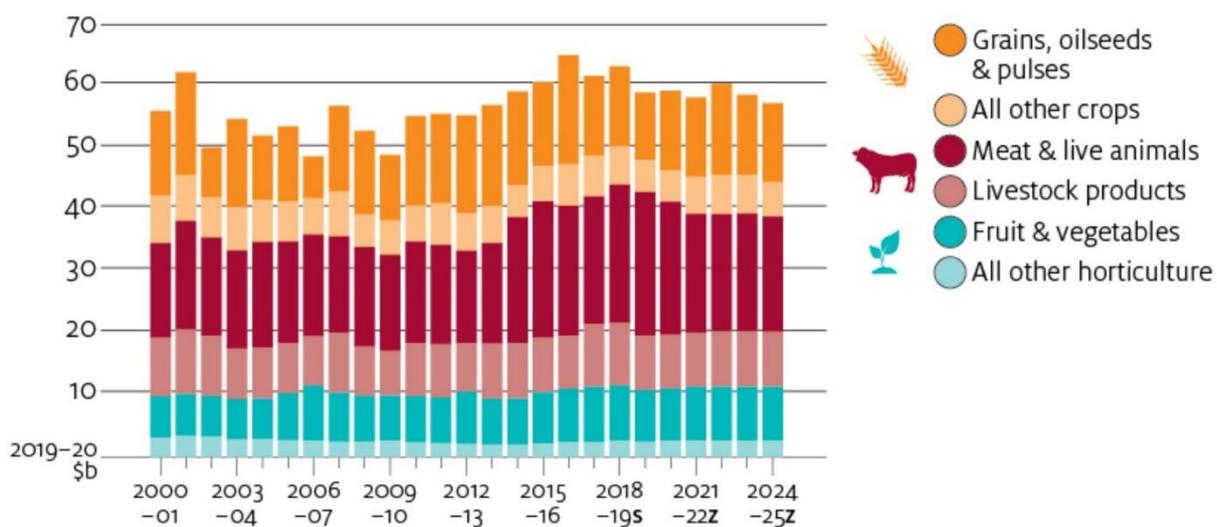
<sup>19</sup> The State of Australian Agricultural Exports, Department of Foreign Affairs and Trade <https://www.dfat.gov.au/trade/organisations/wto/Pages/agricultural-trade>

Australia's major agriculture export markets (A\$ million, 2016)

Major agriculture export markets	CY2015 A\$m	Share of total (%)
India	1,881	4.2
New Zealand	1,537	3.4
Vietnam	1,504	3.4
Hong Kong (SAR of China)	1,283	2.9
Singapore	1,190	2.7

Source: DFAT STARS Database. Based on ABS Cat No 5368.0, June 2017 data; ABS Special Data Service.

Figure A5 below shows the gross value of agricultural production in Australia by sector including a forecast to 2024/2025.



s ABARES estimate. f ABARES forecast z ABARES projection.  
Sources: ABARES; ABS

**Figure A5 - Gross value of production, by sector, 2000-01 to 2024-25<sup>20</sup>**

<sup>20</sup> ABARES - Agricultural overview: March quarter 2020, <https://www.agriculture.gov.au/abares/research-topics/agricultural-commodities/mar-2020/agriculture-overview>

# 8. Annexure B – Background to industry challenges

## 8.1 Vessel sizes

All global shipping is gradually increasing in size including the basic overall ship dimensions, allowable tonnage and cargo quantities able to be accommodated. This puts greater stress on current infrastructure and eventually requires expensive upgrades to berthing and mooring infrastructure on wharves and shipping navigation channels with dredging and dredged material relocation sites required to provide deeper and wider shipping channels and vessel turning basins.

The larger ships (in the absence of infrastructure upgrades) increase the risk profile for manoeuvring the vessels in channels and harbours. This requires greater risk assessments, better training, more experience and greater use of available technologies such as dynamic underkeel clearance systems.

Without adequate infrastructure to accommodate such vessels, ship owners are unwilling to include such ports in their sailing schedules or increase the frequency of ship calls to such ports.

Figure B1 below depicts the significant growth in container vessels over the period from 2001 to 2016. In 2003 there were no vessels with a capacity greater than 8,000 TEU. Table B1 below shows that vessels over 8,000 TEU now comprise over 45% of vessels in the global trade. In 2017, 82.7% of the 175 new container vessels on order to be commissioned into the global trade were to have a capacity greater than 8,000 TEU.

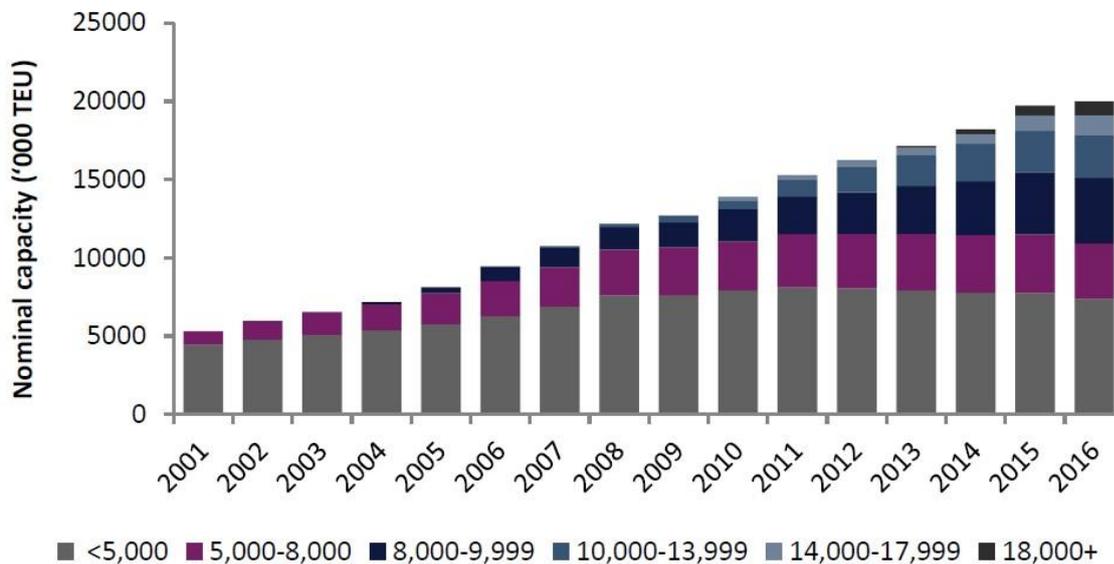


Figure B1 – Growth is Size of Container Vessels by TEU<sup>21</sup>

<sup>21</sup> [https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Drewry\\_Container\\_Ship\\_Fleet\\_Forecast\\_and\\_Maritime\\_Economic\\_Assessment-2.pdf](https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Drewry_Container_Ship_Fleet_Forecast_and_Maritime_Economic_Assessment-2.pdf)

"Container ship fleet forecast and maritime economic assessment," Drewry Maritime Advisors for Infrastructure Victoria, March 2017.

Size range TEU	Number of vessels	Share %	Capacity '000teu	Share %	Average age
<500	329	6.4%	98	0.5%	21.5
500-999	705	13.7%	531	2.7%	14.3
1,000-1,499	700	13.6%	814	4.1%	12.7
1,500-1,999	546	10.6%	937	4.7%	12.3
2,000-2,499	260	5.0%	603	3.0%	14.2
2,500-2,999	358	6.9%	961	4.8%	10.9
3,000-3,999	249	4.8%	861	4.3%	10.8
4,000-4,999	583	11.3%	2,578	12.9%	9.7
5,000-5,999	308	6.0%	1,670	8.4%	11.3
6,000-6,999	230	4.5%	1,507	7.5%	9.9
7,000-7,999	50	1.0%	365	1.8%	10.3
8,000-9,999	478	9.3%	4,185	20.9%	6.7
10,000-13,999	228	4.4%	2,768	13.9%	4.4
14,000-17,999	83	1.6%	1,227	6.1%	3.3
18,000+	47	0.9%	881	4.4%	1.6
<b>Grand Total</b>	<b>5,154</b>	<b>100.0%</b>	<b>19,985</b>	<b>100.0%</b>	<b>11.6</b>

**Table B1 – World Container Vessel Fleet By Size Range (January 2017)<sup>22</sup>**

It is common for container vessels to visit multiple Australian ports before continuing to other countries. Therefore, the size of container vessels deployed for multi-port visits will be limited by the port which has the smallest maximum vessels size. For east coast Australia the limiting port is Melbourne at 7,500 TEU approximately due to its 300m wide vessel turning basin and other constraints in the Yarra Channel<sup>23</sup>. Sydney can accommodate 10,000 TEU vessels and more recently, Brisbane can now allow 9,500 TEU vessels due to a recently implemented underkeel clearance system, while modelling has indicated Brisbane can now receive a vessel 366m long, which is typically the length of 14,000 TEU vessel. Ideally, Australia's container terminals and ports should expand contemporaneously to accommodate multi-port visits. A national approach to planning and the consideration of whether rail freight could play a vital role where an imbalance exists between ports, like with Inland Rail.

## 8.2 Productivity measures at container ports

Over the past few decades there has been significant reform in the nation's ports industry. These reforms have improved productivity at the five major Australian container ports of Brisbane, Sydney, Melbourne, Adelaide and Fremantle.

The following table incorporates typical container terminal productivity measures (aggregated figures for the five major Australian container ports) and compares data from 1999 and 2019:

<sup>22</sup> [https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Drewry\\_Container\\_Ship\\_Fleet\\_Forecast\\_and\\_Maritime\\_Economic\\_Assessment-2.pdf](https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Drewry_Container_Ship_Fleet_Forecast_and_Maritime_Economic_Assessment-2.pdf)

"Container ship fleet forecast and maritime economic assessment," Drewry Maritime Advisors for Infrastructure Victoria, March 2017.

<sup>23</sup> [https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Drewry\\_Container\\_Ship\\_Fleet\\_Forecast\\_and\\_Maritime\\_Economic\\_Assessment-2.pdf](https://www.infrastructurevictoria.com.au/wp-content/uploads/2019/04/Drewry_Container_Ship_Fleet_Forecast_and_Maritime_Economic_Assessment-2.pdf)

"Container ship fleet forecast and maritime economic assessment," Drewry Maritime Advisors for Infrastructure Victoria, March 2017.

Productivity Measure	June Quarter 1999 <sup>24</sup> (Containers/hour)	June Quarter 2019 <sup>25</sup> (Containers/hour)
Number of container ships handled	958	1054
Number of containers handled	469,742	1,233,600
Crane rate	20.3	31.1
Elapsed labour rate	24.0	52.0
Ship rate	29.0	65.7

**Table B2 – Container Terminal Productivity Measures**

**Measure Definitions:**

**Crane Rate:** Total number of containers handled divided by the total crane time.

**Elapsed labour Rate:** Total number of containers handled divided by the total elapsed labour time.

**Ship Rate:** Average number of containers moved on or off a ship in one hour.

Table B2 above shows how most container terminal productivity measures have improved dramatically over the twenty-year period to 2019.

## 8.3 Freight on rail

Many capital city ports are adding to the suburban road congestion because of a lack of train paths for freight trains to and from the ports. Port freight is utilising High Productivity Vehicles (HPV) in the major ports like B-Double and B-Triple truck combinations as the main road transport modes which require designated HPV access routes to and from the port from the interstate and intrastate road network. Major passenger rail infrastructure upgrade projects in Sydney and Melbourne may alleviate this issue for those cities and provide more freight train paths and facilitate better interaction with passenger trains. Rail access to other ports like Fremantle, Adelaide and Brisbane is also very constrained and under less stress, freight rail access is adversely impacted by land use and development controls in force along rail corridors linking ports.

As an example, the existing rail connection between Acacia Ridge Freight Intermodal Terminal (ARFIT) and the Port of Brisbane (PoB) will face progressive challenges over time in meeting both freight and passenger demand. Analysis undertaken estimates that a new dedicated freight rail link to the PoB would be needed beyond the next decade, as identified by Infrastructure Australia. Rail access from ARFIT to the PoB has the following challenges: no unfettered rail access to the terminal or the port due to competing passenger priority on shared networks; network access constraints such as rail line tonne axle load and lack of vertical clearance that limit the size of the reference train.

Capacity issues, however, could emerge due to the expected growth of containerised trade through the Port, and the potential for population growth and more frequent passenger services. To support the long-term planning of this critical freight connection to the Port, the Commonwealth Government and Queensland Government (Department of Transport and Main Roads) in 2019 agreed to undertake a joint study to assess the demand for, and timing of, a new dedicated freight rail link to the Port, as well as options to upgrade existing infrastructure.

This study was required to consider significant planned or potential changes to the Brisbane transport network including Inland Rail and Cross River Rail, together with other changes in passenger rail services which may include a new Salisbury/Beaudesert passenger service. Continued operation of rail freight services currently operating to

<sup>24</sup> Bureau of Infrastructure, Transport and Regional Economics 1999, *Waterline September 1999, issue Number 20*. Statistical Report, Canberra, ACT

<sup>25</sup> Bureau of Infrastructure, Transport and Regional Economics 2019, *Waterline 65*, Statistical Report, Canberra, ACT  
[https://www.bitre.gov.au/sites/default/files/publications/water\\_065.pdf](https://www.bitre.gov.au/sites/default/files/publications/water_065.pdf)

and from the PoB also needed to be considered. The study is to provide a recommendation as to whether the project proceeds to a Business Case with the intention to preserve land for a corridor.

There are significant benefits to increasing the use of rail freight in Greater Sydney, particularly in the face of growing road congestion. One freight train is equivalent to around 54 trucks. Transporting more freight to and from Port Botany by rail, for example, will place additional demands on the existing Botany Line, particularly the single line section of track, which is already an existing constraint to this section of the wider freight network.

The Botany Rail Duplication Project aims to improve rail capacity, flexibility and reliability for freight customers who use the existing Botany Line and to meet the anticipated future increase in freight train movements. The Botany Duplication Project is expected to allow for increased freight movement on the Botany Line from the current average of about 20 trains per day (per direction) up to around 45 trains per day (per direction) by 2030, based on current and predicted operational requirements identified by ARTC.

## 8.4 Port planning

Many ports are being constrained from further expansion due to environmental restrictions on further development, urban encroachment, lack of industrial land for port associated industries, lack of spare capacity in linear infrastructure corridors for road and rail access and services such as electricity transmission and pipelines.

State governments typically have responsibility for land use planning for ports and adjacent areas and providing connecting road and rail transport systems. Historically state governments have owned and controlled port authorities, but there has been a trend toward corporatisation and privatisation of ports. The common methodology for privatisation is a long-term arrangement to encourage productivity and efficiency through competition. This has resulted in governments having less direct control over the timing and scope of port expansions. Consequently, the planning and coordination of port and broader supply chain infrastructure has become more challenging with the addition of private sector stakeholders needing to protect future pathways for return on significant long-term investments. The private sector, however, is the major player in port operations and investment, within the regulatory framework set by government. Private port owners can sometimes have competing objectives to those of governments.

### Case Study –: *Sustainable Ports Development Act 2015*

The state of Queensland's *Sustainable Ports Development Act 2015* includes provisions for port master planning in priority ports to be led by a government Minister. The process has a long-term outlook and includes multiple community consultation processes and encompassing all stakeholders that relate to ports and port associated infrastructure. The process requires a master planning boundary to be established which can extend beyond the traditional port boundaries to include supply chain infrastructure.

The 2012 National Ports Strategy<sup>26</sup> looked to address Australia's port and infrastructure needs and recommended the development of 15 to 30-year plans that acknowledge expected growth and consider other factors such as freight corridors, security, community impact, biosecurity and tourism. The Transport and Infrastructure Council endorsed a National Freight and Supply Chain Strategy and National Action Plan in 2019, which aims to build on previous reforms including the National Ports Strategy.

## 8.5 National freight and supply chain strategy

The Australian and all state and territory governments have agreed to a national approach for freight and supply chains with the National Freight and Supply Chain Strategy. The Strategy recognises previous output from the

<sup>26</sup> Infrastructure Australia. 2011. National Ports Strategy. [https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/COAG\\_National\\_Ports\\_Strategy.pdf](https://www.infrastructureaustralia.gov.au/sites/default/files/2019-06/COAG_National_Ports_Strategy.pdf)

Council of Australian Governments, (COAG) particularly the National Ports Strategy (2011) and National Land Freight Strategy, (2013).

Associated with the Strategy is a National Action Plan based on four action areas:

- smarter and targeted infrastructure
- enable improved supply chain efficiency
- better planning, coordination and regulation
- better freight location and performance data

The objective of the Strategy is for the “coordinated and well-planned government and industry actions across all freight modes for the next 20 years and beyond.” The freight modes include ship, truck, train and plane. <sup>27</sup>

The Commonwealth Government and each State and Territory have developed action plans associated with the National Strategy to be delivered over the first five-year period which will coincide with a review. The objectives of the initial actions are to:

- “deliver early action on immediate priorities
- lay the foundation for further reforms over the medium and long-term.”<sup>28</sup>

Each State and Territory Government have prepared their own detailed companion Action Plans.

## 8.6 Cruise shipping

Over the past decade there has been a significant expansion in the cruise shipping industry with major passenger terminals established in Fremantle, Adelaide, Darwin, Cairns, Hobart, Brisbane, Sydney and Melbourne. However, the expansion of the cruise shipping industry in the ports of Sydney and Brisbane have been constrained due to the height of bridges – the Sydney Harbour Bridge and the twin Gateway Bridges in Brisbane. Brisbane expects to complete its new International Cruise Ship Terminal downstream of the gateway bridges during 2020 however Sydney is still considering its options.

Current issues raised by the Cruise Shipping industry include cruise shipping infrastructure development not keeping pace with demand and some existing terminals being at capacity during the peak cruise season.

### Case Study: Sydney Cruise Ship Terminal

In Sydney, the cruise shipping industry has proposed replacing at least part of the Garden Island Naval facility in Sydney Harbour. The Navy is reluctant to move. All over the world military installations avoid being in the heart of a major city for security reasons. The current large facility for cruise ships is in White Bay, so vessels must pass under the Sydney Harbour Bridge. No cruise vessel being built in the world today, or for the last few years, can fit under the Sydney Harbour Bridge. The proposed solution is to move the large cruise vessels to Botany Bay. Opponents to the Botany Bay proposal cite environmental concerns, the impacts on planes landing at Sydney airport and the impact on Indigenous cultural practices.

## 8.7 Aging infrastructure

A significant amount of port infrastructure in Australia was constructed in the mid to late 1,900s and is therefore 30 to 70 years old. There are examples in Australia of port infrastructure built earlier in the 1,900s which is now

<sup>27</sup> Transport and Infrastructure Council, “National Freight and Supply Chain Strategy,” August 2019. <https://www.freightaustralia.gov.au/sites/default/files/documents/national-freight-and-supply-chain-strategy.pdf>

<sup>28</sup> Transport and Infrastructure Council, “National Freight and Supply Chain Strategy, National Action Plan” August 2019. <https://www.freightaustralia.gov.au/sites/default/files/documents/national-action-plan-august-2019.pdf>

heritage listed with demolition and upgrade restrictions. Innovative approaches are required to prolong the usable life of aged infrastructure and upgrading certain components such as piled substructures and mooring and berthing structures for it to maintain its fitness for purpose.

## 8.8 Professional and technical capability

Skilled labour as well as qualified maritime experience is becoming harder to find in Australia and is often required to be imported from overseas on work visa arrangements.

In 2014, Ports Australia identified the need for better education and training aimed at improving overall understanding and suggested:

- Improved education and training on freight, logistics and nodal and corridor protection in planning curriculums at universities, and
- Advancing industrial planning as a key element of the Australian planning community adding that:
  - Traditionally most of the focus in the Australian planning community has been on residential, commercial, urban design and the social planning elements.
  - Transport planning has largely been focused on public transport and transit-oriented developments however, the critical need for improved freight and industrial planning at major activity centres and along relevant corridors has been seldom addressed.

The following engineering disciplines that are commonly involved in the planning and delivery of various port infrastructure and export industries that are located at ports or ship through ports are eligible for visas under the Commonwealth Government's skills shortage visa alternatives<sup>29</sup>:

- Civil, Electrical, Electronic, Mechanical, Engineers Engineering Technicians and Engineering Draftspersons
- Transport Engineers
- Structural Engineers
- Industrial Engineers
- Material Engineers
- Chemical Engineers
- Engineering Managers
- Environmental Engineer
- Engineering Technologist
- Geotechnical Engineer
- Computer Network and Systems Engineer

Urban and regional planning was also an occupation listed by the Department of Immigration and Home Affairs with skills shortages in Australia.

South Australia's Logistics Information and Navigation Centre, (LINC) suggests that there is evidence that an increase in productivity resulting from targeted training can yield a return on investment of more than 30 percent.

The South Australian Freight Council's Skills and Careers Management Team investigations conclude that a company's bottom line is generally improved through training with positive impacts demonstrated in the following areas:

- Safety
- Profitability/ Productivity
- Morale/ increased Employee Motivation
- Customer Satisfaction
- Market Share
- Company Reputation and Profile

<sup>29</sup> Commonwealth Department of Immigration and Home Affairs <https://immi.homeaffairs.gov.au/visas/working-in-australia/skill-occupation-list#>

For example, Flinders Adelaide Container Terminal (FACT), the operators of Adelaide's only international container terminal is committed to maintaining a quality workforce that is well trained in the specific areas of operation (noting that stevedoring is a specialised skill that is not readily available in the market and therefore training is necessary).

FACT is a Registered Training Organisation (RTO) through a licence agreement with the Construction Industry Training Centre offering training programs from entry level trainees through Forklift, Crane and Reach Stacker training all the way to skills development for upper management.

To cater for the emerging need in the ports, maritime and logistics industries for a highly qualified and skilled workforce at operational, management and planning levels there is clear requirement for Australian universities and TAFEs to develop and implement improved (specialised) curricula for training and development for the workforce in those industries.

## 8.9 Innovation and automation

The first automated container port was developed in Europe in the 1990s. Since then over US\$10 billion has been expended automating 40 container ports around the world. This is expected to accelerate with a further \$10-\$15 billion to be expended over the next five years.<sup>30</sup> In Australia, the entire container terminals (terminal yards and vessel unloading as in Port of Melbourne/ Webb Dock; Patrick Terminal in Sydney) are being fully automated.

A high degree of automation in bulk ports has existed since the 1990s with limited personnel needed to operate the rail loaders, stacker and reclaimer machines and the shiploaders. Technology changes (including disruptors, data integration, analysis, visualisation and quality) are driving the professionalisation of the industry.

As more functions are performed or controlled by machines; the number of blue-collar stevedores required will continue to decline as will many white-collar functions. The impacts of technology will prompt a wider variety of specialised skills needed in ports and their supply chains e.g. data scientists, supply chain and logistics specialists and automation engineers etc.

## 8.10 Environmental regulations

Tighter environmental regulations continue to be implemented in Australia limiting the development of new port sites along the Australian coastline and the ability of existing ports to expand. As an example, the Queensland government implemented new legislation in 2015 – *Sustainable Ports Development Act 2015* which limits new developments in ports other than the five nominated "Priority Ports" in order to better protect the Great Barrier Reef. Similarly, the Queensland government has more recently prohibited bulk transshipment activities in the Great Barrier Reef World Heritage Area. New major export projects now need to factor into their economics, land transporting their product many hundreds of kilometres to the closest Priority Port for export.

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<sup>30</sup> "The Future of Port Automation," McKinsey and Company, 2018. <https://www.mckinsey.com/industries/travel-transport-and-logistics/our-insights/the-future-of-automated-ports>

# 9. Annexure C – Case study

## 9.1 Western Australia -Westport options analysis

### Fremantle Inner Harbour – Long-term (2068) viability

The Fremantle Inner Harbour has been, and continues to be, an important economic asset for Western Australia since it first officially opened on 4 May 1897. Thanks to the visionary foresight and design work of State Engineer C.Y. O'Connor, the Inner Harbour has serviced the freight needs of Perth and surrounding regions for more than 120 years.

Over the years, the Fremantle Inner Harbour has undergone many enhancements and upgrades as shipping trends and trades changed. It most significantly played a pioneering role for Australia when the international shipping container trade commenced 50 years ago in 1969. While the Inner Harbour itself has been able to adapt as required and continues to be one of Australia's most efficient container-handling ports, external factors outside of the port's control are likely to impact on the extent it is able to grow and operate efficiently. The prime coastal and riverfront land surrounding the port has become increasingly populated with residential development. While a positive for the area, this growing population has not only constrained the ability of the port to grow, it has led to vast increases in the number of passenger vehicles sharing the port's feeder roads with freight vehicles. Meanwhile, commuter trains have limited the number of freight trains that can cross the shared rail bridge to the port each day.

A comprehensive report by an independent consultancy in 2014, suggested that the capacity of the Inner Harbour could reach 2.1 million TEU (containers) without requiring major works to the port itself, but with some improvement in the heavy vehicle corridor serving it. With the Inner Harbour currently only handling just over a third of that amount – 770,000 TEU in 2017/18 – it would be easy to assume that the port's capacity would be adequate for many decades to come.

To ensure the best use of limited infrastructure funding dollars, it is important that Western Australia invest in assets that will be sustainable for the long-term. Westport is planning for a port that can handle between 3.8 million TEU and 5.4 million TEU by 2068. Even if the Inner Harbour can accommodate the previously mentioned 2.1 million TEU, that still leaves it several million containers short of where it needs to be in the long-term. To determine whether the Inner Harbour could meet Perth's long-term freight needs as a stand-alone port, Westport investigated and then assessed in MCA-1:

- the scalability of the port's footprint;
- current and maximum road capacity;
- current and maximum rail capacity;
- other modes of transport that could be used;
- supply chain operational enhancements;
- likely social and amenity impacts on surrounding communities; and
- estimated capital expenditure.

Several options were assessed including retaining the status quo. Assuming the supply chain constraints could be addressed, expanding the Inner Harbour's berth-face capacity from 2.1 million TEU to handle between 3.8 million and 5.4 million TEU would also pose significant challenges. As with all options, it would need to accommodate many more ships and require water depths of up to 18 metres to handle the big ships of the future, as well as the ability to increase its throughput if container growth exceeds the forecasts.

To determine the impacts of continuing to channel freight vehicles to the Inner Harbour through highly urbanised areas, Westport partnered with Main Roads WA (MRWA) to forecast the growth of both freight and passenger vehicles for the next 20 years, and then model the impacts on the Fremantle road network. The MRWA model demonstrates that, using current circumstances and assuming average annual growth, even with construction of the six assumed road projects, road network servicing the Inner Harbour reaches unacceptable inefficiency by the mid-2030s. At certain times of day, journey times to the Inner Harbour may even triple. For the freight industry, this is an unworkable situation. In combination with the growing community concerns over safety and amenity, this highlights that the status quo will become untenable in the foreseeable future.

It makes more sense to redirect the freight traffic away from residential areas, and channel it to an industrial zone instead. This will deliver better outcomes for both the community and freight industry. This reasoning partially explains why the Kwinana options scored better than Fremantle in Westport's MCA process.

For further details please read the Beacons series at <https://www.transport.wa.gov.au/projects/westport.asp>



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