Australian Government

Australian Institute of Marine Science

THE AIMS INDEX OF MARINE INDUSTRY 2023

Deloitte Access Economics undertook this analytical work for AIMS. Drawing on experience in developing and updating the AIMS Index of Marine Industry in the past, Deloitte Access Economics also drew on its in-house Deloitte Access Economics Regional Input-Output Model (DAE-RIOM) to estimate the flow-on and total economic contribution of the marine industry.

Front cover photo

A whale shark and a tourism boat at Ningaloo Reef in Western Australia. WA's hard border contributed to a 19% increase in domestic marine tourism expenditure due to a higher proportion of WA holiday-makers visiting destinations within the state instead of interstate or overseas. This is the highest yearly increase in domestic marine tourism experienced by WA in the previous two decades where data was available.

Front cover photo ©AIMS | Jurgen Freund

Contents

Glossary

Acronym	Full name
ABARES	Australian Bureau of Agriculture and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACT	Australian Capital Territory
ADIA	Australian Defence Industry Account
AIMS	Australian Institute of Marine Science
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
ANZSIC	Australian and New Zealand Standard Industrial Classification
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAE-RIOM	Deloitte Access Economics Regional Input-Output Model
EBITDA	Earnings before interest, tax, depreciation, and amortisation
FTE	Full-time equivalent
GDP	Gross Domestic Product
GOS	Gross Operating Surplus
GSP	Gross State Product
IO	Input-Output
IVS	International Visitor Survey
LGA	Local government area
LNG	Liquefied natural gas
LPG	Liquefied petroleum gas
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NSW	New South Wales
NVS	National Visitor Survey
NT	Northern Territory
QLD	Queensland
SA	South Australia
UN	United Nations
VIC	Victoria
WA	Western Australia

Foreword

Australia's marine estate is the third largest EEZ (Exclusive Economic Zone) in the world and a source of significant wealth and prosperity for all Australians.

To quantify the importance of the oceans to Australia's economy, the Australian Institute of Marine Science or AIMS (Australia's national marine science agency) started publishing the AIMS Index of Marine Industry in 2008, with the first edition drawing on data as far back as 2001-02.

The Index tracks employment and total economic output by Australian marine-dependent sectors such as tourism, recreation, shipbuilding, ocean transport, fishing, and offshore oil and gas exploration and production, most of which depend on healthy and sustainably managed marine ecosystems.

With our partners Deloitte Access Economics, I present the ninth edition of the Index, which draws on economic and employment data from 2018-19, 2019-20 and 2020-21, covering the onset and acute phases of the COVID-19 pandemic.

The nine instalments of the Index provide a comprehensive picture of the growth and development of Australia's Blue Economy over two decades. The time series is now of such a length that the impact of environmental and societal events on different blue industries can be monitored to inform economic policy-making specific to marine industry among states and nationally.

Dr Paul Hardisty
Chief Executive Officer, Australian Institute of Marine Science.

Executive summary

Key findings of this Index

1. The marine industry generated $118.5 billion in output in 2020-21.
2. In 2020-21, the marine industry's contribution to GDP was $105.3 billion in value added and it supported 462,000 FTE jobs.
3. Using the same industry sub-sectors as previous Indexes, the marine industry's contribution to GDP slightly increased from 3.7% to 3.8% between 2017-18 and 2020-21.
4. The 2023 edition of the Index incorporates four additional sub-sectors. When including these, the marine industry contribution to GDP in 2020-21 rises to 5.2% making it the 12th largest industry in the Australian economy (out of 19) as measured by direct value added.
5. Due to the impact of COVID-19, Australia experienced a 'two-speed marine economy' in the three years to 2020-21. Two large sub-sectors — offshore natural gas and international marine tourism — experienced polarising changes in economic output resulting in a modest overall change in total marine industry output.
6. Offshore oil and natural gas output increased by 37% in real terms (by $14.4 billion) between 2017-18 and 2020-21. On the other hand, output from the international marine tourism sub-sector declined by 98% (by almost $7.0 billion), mainly tied to reduced economic activity during the COVID-19 pandemic.
7. Output from the marine industry in Western Australia made up almost half (46%) of total marine industry output in 2020-21, at $54.7 billion.
8. The four additional sub-sectors included in this Index generated a combined $31.4 billion in 2020-21 output (26% of total marine industry). These additional sub-sectors include recreational activities other than fishing, water transport support services, defence and sewerage and drainage services.

Overview

Australia's marine environment is important to both the economy and our national identity. The ocean supports the Australian economy through marine-dependent industry activity, and is a key source of food, energy, health, leisure, and transport services.

The AIMS Index of Marine Industry (the Index) was first developed by Deloitte in 2008 to assist AIMS to communicate the value of the marine industry to key stakeholders. This is the ninth edition of the Index. The analysis has been extended to assess recent trends across industry sub-sectors, including during the onset and acute phase of the COVID-19 pandemic. It also includes a qualitative discussion on the future of the marine industry.

In this edition of the Index, a definition of the marine industry is provided to ensure consistency between Indices and for comparison to other analyses, as follows:

The marine industry is the collection of economic activities occurring within saltwater bodies connected to the ocean, including seas, estuaries, rivers, harbours, and associated waterways. It covers goods and services that either rely on the existence of these environments or are produced in these environments, classified according to various sub-sectors.

Study approach

The Index uses publicly available data from the Australian Bureau of Statistics (ABS), IBISWorld, the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) and other industry bodies and government departments. The previous edition of the Index, which was released in 2020, reported on data up to and including 2017-18. This update adds to previous editions of the Index with economic output data from three years: 2018-19, 2019-20 and 2020-21.

This edition of the Index provides a detailed assessment of the economic output and value added contribution of the Australian marine industry based on 2020-21 data, the latest year for which data are published across most major marine sub-sectors.

A refresh of the methodology and access to more data has enabled the inclusion of four additional sub-sectors: recreational activities other than fishing, water transport support services, defence and sewerage and drainage services, in addition to the 14 sub-sectors that are the same as previous editions.

The Index analyses the economic output of the marine industry, which is measured through the income received by the marine industry businesses and organisations. The Index also analyses the direct, indirect, and total economic contribution (value added) of the marine industry to the national economy. This recognises that activities in the marine industry stimulate demand for inputs from the upstream supply chain. The size of these activities is related to factors such as the extent to which domestic inputs are used to produce outputs of the marine industry. By analysing both the marine industry sub-sectors and their supply chain, the Index provides a comprehensive estimate of the overall size and importance of the marine industry.

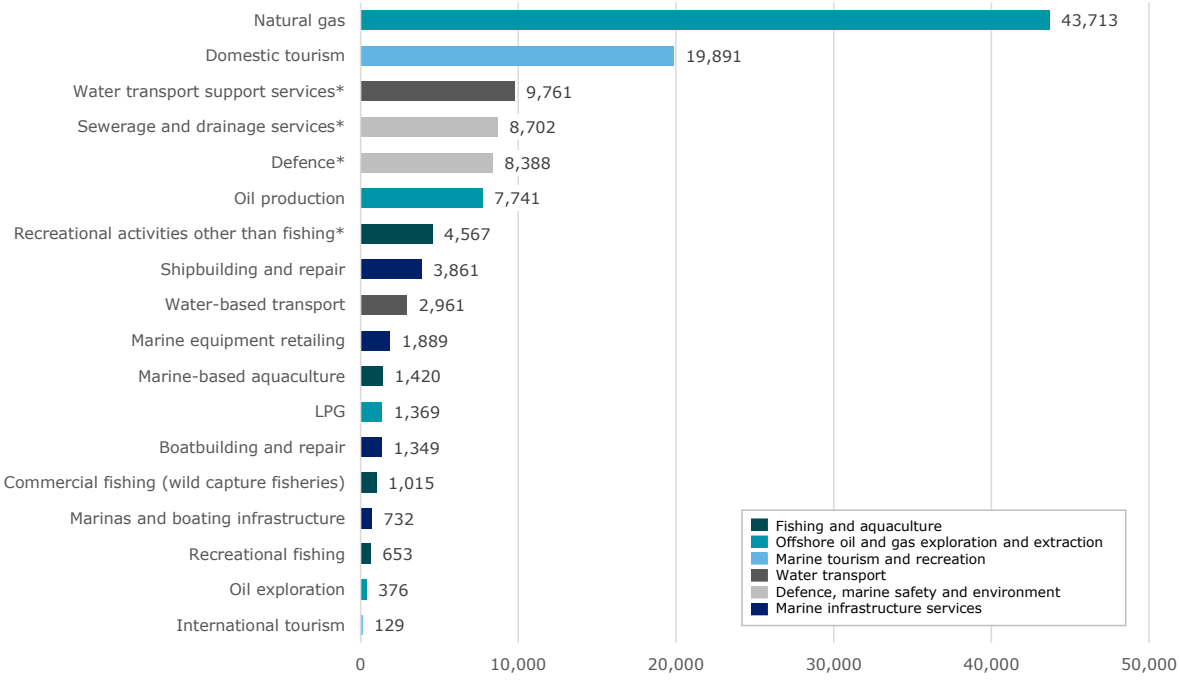
National marine industry output and value added

Economic output from the marine industry is the sum of total revenue received by the businesses and organisations in the sub-sectors. The economic output of the marine industry in Australia was estimated to be $118.5 billion in 2020-21. By way of comparison with land-based industries, in 2020-21:

- The economic output from agriculture, forestry and fishing was $101.5 billion.
- The economic output from accommodation and food services was $104.2 billion.
- The economic output from all electricity, gas, water and waste services in Australia was $135.6 billion.[1]

The economic output of the marine industry in 2020-21 is substantially larger than output reported in the previous Index, at $81.2 billion in 2017-18. This larger size is mostly accounted for by four sub-sectors added to the Index in this edition, which generated $31.4 billion in output. The economic output from marine industry sub-sectors in 2020-2021 is shown in Chart i.

Chart i: Marine industry output by sub-sector, 2020-21 ($ millions)

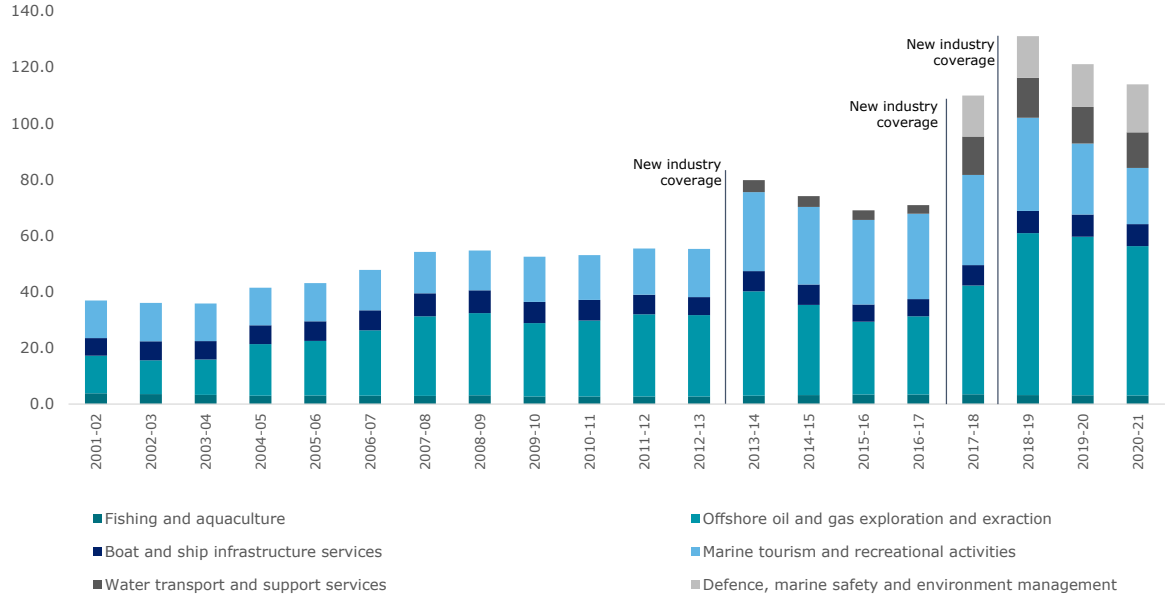


Notes: Sub-sectors with the asterisk are the new sub-sectors added into this edition of the Index.
Source: Deloitte Access Economics

The sub-sector that provided the most marine industry output in 2020-21 was natural gas, at $43.7 billion. This was more than double the output of the second largest sub-sector, domestic tourism, which was impacted by the COVID-19 pandemic in the latter part of 2020-21. The five largest sub-sectors made up 76% of total marine industry output.

The timeseries of economic output from marine industry sub-sectors since 2001-02 is shown in Chart ii. For comparison with the 2020 Index, economic output was back-cast to 2017-18 to incorporate three of the four new sub-sectors (water transport support services, defence; and sewerage and drainage services). Recreational activity other than fishing output was excluded from the timeseries analysis due to limited data availability for historical years (estimated at $4.6 billion in 2020-21). However, it is not expected that inclusion of this sub-sector would affect the trends observed in this analysis, as recreational activity is largely driven by changes in population (which does not change materially year-on-year).

Chart ii: Timeseries of marine industry economic output since 2001-02 ($ millions, 2021 dollars)



Notes: To ensure comparability, the values shown from 2017-18 onwards reflect three of the four new sub-sectors: defence, sewerage and drainage services; and water transport support services. All values are inflation -adjusted to 2021 dollars.

Source: Various government publications and industry reports – see Appendix A.

Australia experienced a 'two-speed marine economy' in the three years to 2020-21. Two large sub-sectors, natural gas and international marine tourism, experienced polarising changes in economic output resulting in a modest overall change in total marine industry output. Changes to economic output of marine sub-sectors from 2017-18 to 2020-21 were, however significant and driven by the following:

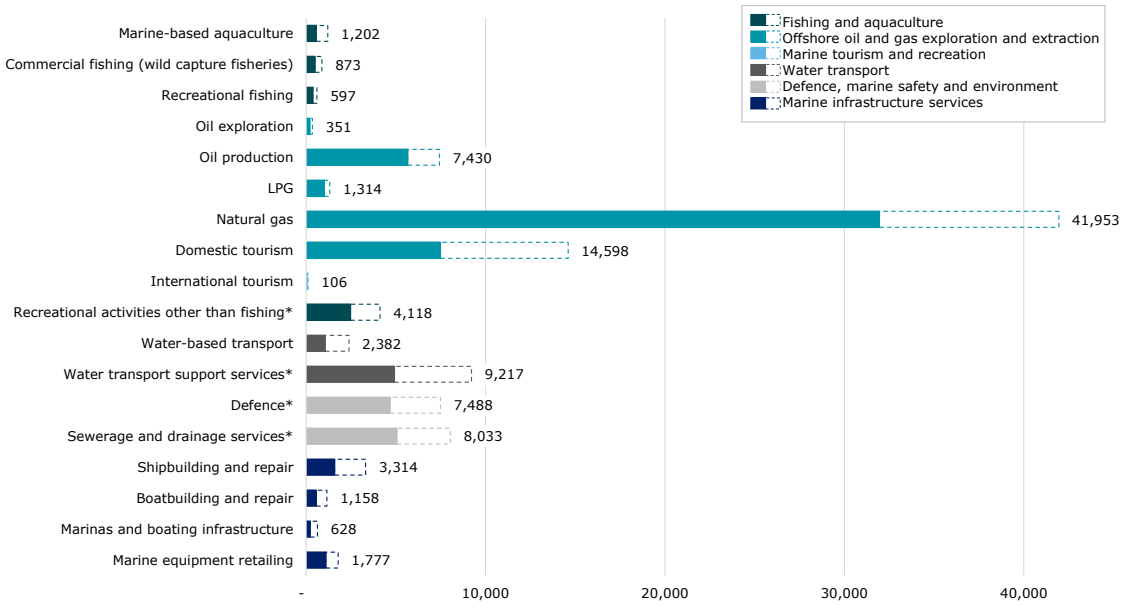
- The international marine tourism sub-sector experienced a sharp decline due to COVID-19 restrictions, where international border closures contributed to a decline in international tourism expenditure of 74% annually on average, from $7.0 billion in 2017-18 to $129 million in 2020-21 (in real terms). This was a key driver of the decline from 2017-18 to 2020-21 shown in Chart ii.
- The commercial fishing (wild capture fisheries) sub-sector experienced a decline in demand from key export markets during the COVID-19 recession and because China imposed trade restrictive measures on rock lobster produce. This contributed to a contraction in output of 19% annually on average, from $1.8 billion in 2017-18 to $1.0 billion in 2020-21 (in real terms).[2]
- The water transport sub-sector experienced significant supply chain disruptions and closure of cruise ship ports during the COVID-19 pandemic, which contributed to a contraction from $3.3 billion in 2017-18 to $2.9 billion in 2020-21 (in real terms).
- The offshore natural gas production sub-sector experienced significant growth despite COVID-19. Output increased 11% per year on average from $31.9 billion in 2017-18 to $43.7 billion in 2020-21 (in real terms).

Another way of analysing the economic footprint of an industry is to look at its value added. Value added is generally preferred as a metric of aggregate economic contribution, because it excludes intermediate input expenditure and therefore does not have the same issues of double counting when aggregated together, as is often the case with output. For this reason, value added is also the metric used in standard aggregate economic indicators such as gross domestic product (GDP) and gross state product (GSP).

In total, the Australian marine industry was estimated to contribute $69.3 billion in direct value added in 2020-21, with a further indirect value added of $36.0 billion. This amounts to a total contribution of $105.3 billion in value added, or 5.2% of gross domestic product. The direct and indirect contribution of marine industry sub-sectors in 2020-21 is shown in Chart iii.

To make a comparison over time we only consider the sub-sectors used in the previous Index edition. On that basis, despite the impact of COVID-19, the marine industry's contribution to GDP slightly increased from 3.7% to 3.8% between 2017-18 and 2020-21.

Chart iii: Direct and indirect value added by sub-sector in 2020-21 ($ millions)



Notes: The direct value added is represented by the solid colour and the indirect value added is represented by the dashed outline. Sub-sectors with the asterisk are the new sub-sectors added into this edition of the Index.

Source: Deloitte Access Economics.

If the marine industry was an industry classified by the ABS in 2020-21, it would be the 12th largest industry in the Australian economy as measured by direct value added.

Additionally, Australia's marine industry directly employed approximately 247,000 full-time equivalent (FTE) workers in 2020-21. The marine industry supported a further 215,000 FTE workers in indirect employment (in upstream industries only), amounting to a total employment contribution of 462,000 FTE workers. In 2017-18, the marine industry supported a total of 339,000 FTE workers (excluding the employment in the new sub-sectors).

The economic contribution of all sub-sectors changes over time, as factors influencing the supply and demand for goods and services also change. For example, while the offshore oil and gas sub-sector was similar in size to the marine tourism and recreation sub-sector in 2001-02, two decades on (prior to the onset of the COVID-19 pandemic) offshore oil and gas was almost twice the size. The composition of marine industry may also change over time as new sub-sectors evolve or data becomes available. In this edition of the Index, the scope of the marine industry has been expanded to include additional activities that rely on, or are required by, the existence of the marine environment such as defence and coastal sewerage and drainage services, and activities for which data has improved such as recreational activities other than fishing. In the future, trends such as adapting to climate change and technology improvements could change the composition of the marine industry further, with inclusion of sub-sectors such as offshore renewable energy, sustainable aquacultural practices and bioproducts that reduce ocean pollution.

1 Mapping the marine industry

1.1 Marine industry definition

As an island nation Australia's marine environment is important to the economy and to the national identity. Its Exclusive Economic Zone is the third largest in the world (8.1 million square kilometres), larger than the 7.7 million square kilometres of Australian mainland.[3] In addition, more than 85% of Australia's population lives within 50 kilometres of the coast.[4] The ocean supports the Australian economy through marine-dependent industry activity, and is a key source of food, energy, health, leisure, and transport services.

Several definitions of the marine industry exist. The OECD defines the marine industry as market-based activities in the public and private sectors that are "of, found in, or produced by the sea".[5] This definition includes established marine sub-sectors such as fisheries, shipping oil and gas and maritime and coastal tourism as well as emerging marine sub-sectors such as ocean renewable energy including offshore wind, marine biotechnology and high-tech marine products and services.

The definition of the marine industry used in the Index is based on the OECD definition but is widened to include activities that rely on the existence of seas and associated waterways (see Box 1). However, it broadly incorporates the same marine industry sub-sectors as the previous Index.

Box 1: Marine industry definition for the AIMS Index of Marine Industry

The marine industry is the collection of economic activities occurring within saltwater bodies connected to the ocean, including seas, estuaries, rivers, harbours, and associated waterways. It covers goods and services that either rely on the existence of these environments or are produced in these environments, classified according to various sub-sectors.

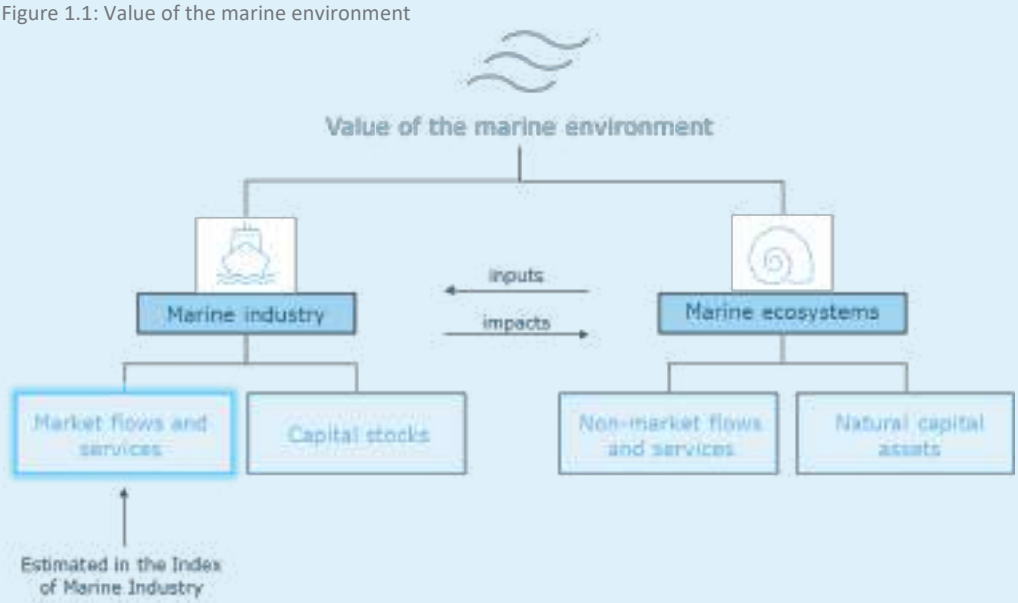
The Index has evolved over time to reflect both wider and more fit-for-purpose data on the marine industry, and a broader interpretation of what economic activities are attributable to the marine environment. In particular, and compared to early editions of the Index, the marine industry scope has expanded to include activities that rely on, or are required by, the existence of the marine environment such as defence and coastal sewerage and drainage services, and activities for which data has improved such as recreational activities other than fishing.

The marine industry versus the marine economy

While no universal definition of the marine industry exists, there is a consensus that marine industry is limited to market–based activities, and does not include non-quantifiable assets, such as goods and services of marine ecosystems.[6]

For example, the OECD distinguishes the 'marine industry' from 'marine ecosystems', with the two components contributing to the value of the marine environment. This broader definition of value recognises the interdependencies between marine ecosystems and the marine industry (Figure 1.1).

Figure 1.1: Value of the marine environment



Source: Adapted from OECD (2016).

The marine industry's contribution to gross domestic product (GDP) relies on expenditure in the economy. The focus of the Index is to estimate the value generated by the marine industry attributable to these expenditure flows. Marine ecosystems provide services that do not have a commercial value, such as storm protection, climate regulation, water purification and amenity. These services are critical to the marine industry. The values of these services, however, have not been captured in this Index as measuring their values is a complex exercise.

The marine industry relies on Inputs from ecosystem services to generate market flows and services and capital stocks, however, it can also impact marine ecosystems through pollution from oil spills and ship wastage discharge. The growth of the marine industry depends on healthy marine ecosystems. According to the United Nations (UN) the 'blue economy' incorporates a range of economic sectors and related policies that limit the impact of industry on marine ecosystems and encourage sustainable ocean resource use.[7] The World Bank, European Commission, the Commonwealth of Nations and the Center for the Blue Economy adopt a similar view, as does the UNESCO Intergovernmental Oceanographic Commission.[8,9]

In 2022, the ABS developed the National Oceans Account to quantify changes in natural stocks and flows of marine ecosystems. The second phase of the National Ocean Account was expanded to cover coastal protection from seagrass in addition to mangroves and salt marsh ecosystems which has been included in phase one. However, ecosystem services that provide inputs into the marine industry remain difficult to quantify.[10]

1.2 Valuation approach

The Index was developed by using an economic contribution framework to value economic activities that rely on Australia's marine assets. Economic contribution studies quantify the value of an industry or firm in terms of value added and employment using data on value flows between industries provided by ABS Input-Output tables. By this measure, economic contribution studies provide an estimate of the value **flows** of the marine industry to the Australian economy at a point in time. This approach is consistent with the National Accounting Framework, which is used to estimate GDP and GSP. The estimates of marine industry (direct) value added, and employment presented in this Index are comparable to (direct) value added and employment figures for other industries in the economy.

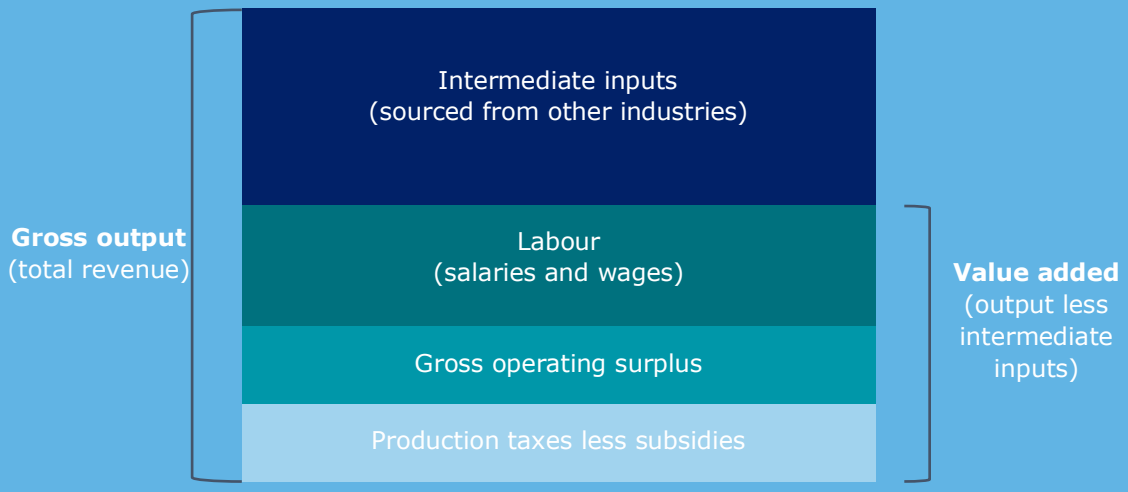
The marine industry market flows and services is one way to estimate the value of Australia's marine asset, however it does not account for the cumulative value of Australia's maritime or marine assets. The **stock** of marine industry capital – such as the value of Navy vessels or oil drilling equipment are not directly incorporated into value added estimates. Rather, value added reflects the value that flows from labour and capital inputs (see Box 2).

Box 2: Gross output, value added and employment

There are several commonly used measures of economic activity. The three measures reported in this analysis are gross output (also referred to as 'output'), value added and employment.

Gross output is total revenue generated by a firm or industry. A firm's revenue could be used as intermediate inputs expenditure, salaries and wages and net taxes on production – with the remaining revenue left over as gross operating surplus, measured in terms of EBITDA or profit.

Value added represents the value of output generated by an industry's factors of production (capital and labour), measured by the income to those factors of production. In simple terms, **value added is the value of gross output less the value of intermediate inputs.**



The sum of all value added across entities in the economy is equal to gross domestic product GDP or gross state product (GSP). This is because intermediate expenditure in one industry or firm contributes to value added and intermediate expenditure in upstream industries or firms. Therefore, the sum of value added across entities eliminates double counting that occurs in the sum of gross output across entities.

Employment is a fundamentally different measure of activity from those above. It measures the number of full-time equivalent (FTE) workers employed by the entity, rather than the value of the workers' output.

1.3 The significance of the marine industry to the Australian economy

This Index estimates that in 2020-21, marine industry generated more than $118.5 billion in output and employed more people than any single company in Australia. The marine industry directly contributed 247,000 FTE jobs in 2020-21, compared to the two largest Australian employers, Woolworths Group and Wesfarmers, which employed 198,000 and 107,000 people respectively in the same year.[11,12] By way of comparison with land-based industries, in 2020-21:

- The economic output from agriculture, forestry and fishing was $101.5 billion.
- The economic output from accommodation and food services was $104.2 billion.
- The economic output from all electricity, gas, water and waste services in Australia was $135.6 billion.[13]

Marine industry output in 2020-21 was substantially larger ($118.5 billion) than output reported in the previous Index, $81.2 billion. This increase in size of $37.3 billion is mostly accounted for by the inclusion of four new sub-sectors to the Index in this edition, which generated $31.4 billion in output.

The National Marine Science Committee adopted a marine industry growth target based on the 2013 Index. Box 3 compares marine industry output reported in this Index to output reported in the 2013 Index using the same industry sub-sectors.

Box 3: The marine industry target

The National Marine Science Plan 2015-2025 outlined a target for the marine industry to generate $100 billion to the economy by 2025 in output per annum.[14] This target is based on the marine industry definition outlined in the 2013 Index, which represented the sum of output from 12 sub-sectors (compared to the 18 sub-sectors included in the Index in 2023).

The 2013 Index reported that the marine industry generated $47.2 billion in output in 2011-12. If the same sub-sectors were included in this Index, marine industry output would be estimated at $82.8 billion in 2020-21 – not accounting for methodological updates to marine tourism that occurred in the 2020 Index. In fact, using the 2013 definition, the marine industry almost reached $100 billion in output prior to the COVID-19 pandemic. In 2018-19, the 12 sub-sectors generated $97.6 billion in output.

In the five years to 2018-19 prior to the COVID-19 pandemic, domestic and international marine tourism combined grew by 3.5% per annum on average. If the sector had continued on this growth path, the marine industry could have experienced greater growth to 2020-21.

In 2020-21, the marine industry contributed $105.3 billion in value added to the economy and supported 462,000 total FTE jobs (direct and indirect).

If the marine industry was an industry classified by the ABS in 2020-21, it would be the 12th largest industry in the Australian economy in direct value added terms (excluding the indirect value added to other industries).

1.4 Marine industry sub-sectors

Marine economic activities include 37 sub-sectors based on the definition outlined in section 1.1. These are listed in Table 1.1. This includes 18 sub-sectors which are quantified in this report and 19 industries that were not quantified in this study due to limited data availability. Of the quantified sub-sectors, 14 are the same as previous editions: water-based transport, domestic and international tourism, marinas and boating infrastructure, boatbuilding and repair, shipbuilding and repair, marine equipment retailing, oil exploration, oil production, liquefied petroleum gas (LPG) production, natural gas production, marine-based aquaculture, commercial fishing (wild capture fisheries), and recreational fishing.

Four new sub-sectors have been added and quantified in this Index: recreational activities other than fishing, water transport support services, defence and sewerage and drainage services.

Table 1.1: Marine industry sub-sectors

Sub-sector	Treatment in this Index	Description
Marine resource activities and sub-subsectors		
Commercial and recreational fishing and aquaculture		
Marine-based aquaculture	Quantitative	Offshore longline and rack aquaculture (such as mussel and oyster faring) and offshore caged aquaculture
Commercial fishing (wild capture fisheries)	Quantitative	Fishing activities from wild capture fisheries such as rock lobster and grab potting, prawn fishing, and fish trawling, seining and netting
Recreational fishing	Quantitative	The capture or attempted capture of aquatic animals in Australian waters (freshwater, estuarine, marine) other than for commercial purposes
Indigenous fishing	Qualitative	Indigenous fishing applies to an Aboriginal or Torres Strait Islander person who has a traditional connection with the area being fished and is fishing for personal, domestic, ceremonial, educational or non-commercial need
Offshore oil and gas exploration and extraction		
Oil exploration	Quantitative	Activities involved in locating potential sites for oil and gas drilling and extraction at offshore locations
Oil production	Quantitative	Activities undertaken to produce crude oil through the extraction of oil and gas deposits at offshore locations
LPG	Quantitative	Activities that refine raw natural gas materials to form condensate and liquefied petroleum gas at offshore locations
Natural Gas	Quantitative	Natural gas extraction and liquified natural gas production activities at offshore locations

Other resource extraction and use		
Desalination	Qualitative	Activities that involve removing mineral components from saline water
Carbon capture	Qualitative	Offshore processes that trap carbon dioxide produced by burning fossil fuels or other chemical or biological processes and storing it in such a way that it is unable to affect the atmosphere, with the aim of mitigating the effects of climate change
Bioprospecting	Qualitative	Activities that involve searching for useful organic compounds in the marine environment, commonly involving the collection and examination of biological samples (plants, animals, microorganisms) for sources of genetic or biochemical resources
Marine and seabed mining	Qualitative	The extraction of submerged minerals and deposits from the sea floor, including deep sea mining which involves the retrieval of deposits from the ocean below 200 metres
Offshore wind NEW	Qualitative	The generation of electricity through wind farms in marine bodies of water
Ocean renewable energy	Qualitative	Other ocean renewable energy involves tidal energy, wave energy, energy from ocean currents and ocean thermal energy conversion
Marine pipeline services	Qualitative	Activities involved in installing, maintaining or repairing pipelines that are laid on the seabed or inside a trench under a seabed
Salt production	Qualitative	Salt production activities that involve the evaporation of seawater
Marine biotechnology	Qualitative	The creation of products and processes from marine organisms through the application of biotechnology, molecular and cell biology
Marine related service activities and sub-sectors		
Marine tourism and recreational activities other than fishing		
Domestic marine tourism	Quantitative	Travel from an Australian residence to take part in activities in or that rely on the marine environment
International marine tourism	Quantitative	Travel from an international residence to take part in activities in or that rely on the marine environment
Aquaria	Qualitative	Aquarium operating activities
Recreational activities other than fishing NEW	Quantitative	Recreational activities by coastal residents including going to the beach, surfing, and boating (excluding fishing)
Water transport, services to water transport and ports		
Water-based transport of passengers and freight	Quantitative	Activities involved in transporting passengers by boat charters and ferries, including water passenger transport services. It also includes transporting sea freight between domestic ports, international ports and ship freight management services
Water transport support services (inc. ports) NEW	Quantitative	Stevedoring services, port and water transport terminal operation operations, tugboat operations, lighterage and navigation services
Defence, marine safety, and environment management[i]		
Defence NEW	Quantitative	Navy capabilities defined by all Navy activities funded by own source revenue
Australian Maritime Safety Authority	Qualitative	An Australian statutory authority responsible for the regulation and safety oversight of Australia's shipping fleet and management of Australia's international maritime obligations
Surf Life Saving Australia NEW	Qualitative	A not-for-profit organisation that provides voluntary lifeguard services and competitive sport
Australian Volunteer Coast Guard	Qualitative	An organisation that provides search and rescue services, vessel tracking, marine radio, and training
Marine Park management	Qualitative	Various state and federal government departments in addition to Traditional Owner Prescribed Body Corporates responsible for marine park operations of Australia's 62 marine parks
National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)	Qualitative	The Australian Government offshore energy regulator responsible for the health and safety, well integrity and environmental management aspects of offshore oil and gas operations in Australian Commonwealth waters
Sewerage and drainage Services	Quantitative	Activities required to operate sewerage or drainage systems or sewage treatment plants that discharge into the marine environment. It includes the sewerage pumping station operation, sewage treatment plant operation, sewerage system operation, stormwater drainage system operation and town drainage system operations

[i] Activity that occurs in these sub-sectors is often spread across several institutes and universities at national, state and local levels of government and non-government sectors. A sample of these institutes is reflected in this table, noting that they are organisations rather than sub-sectors.

Marine scientific research	Qualitative	Activities undertaken in the marine environment to enhance scientific knowledge regarding the nature and natural processes of the seas and oceans, the seabed and subsoil
Dredging	Qualitative	The removal of sediments and debris from the bottom of lakes, rivers, harbors, and other water bodies
Marine estate management	Qualitative	Government organisations that coordinate policies and programs for maintaining and improving the marine environment, including the ocean, estuaries, coastal wetlands and coastlines.
Marine infrastructure activities and sub-sectors		
Boat and ship building and maintenance services, equipment, and infrastructure		
Shipbuilding and repair	Quantitative	Manufacturing or repairing vessels of greater than 50 tonnes displacement
Boatbuilding and repair	Quantitative	Manufacturing or repairing vessels of less than 50 tonnes displacement
Marinas and boating infrastructure	Quantitative	Activities related to marina operations
Marine equipment retailing	Quantitative	Activities including boat retailing (new and used), boat trailer retailing, marine accessory retailing, outboard motor retailing and sailing or yacht retailing

Source: Various government publications and industry reports – see Appendix A.

1.5 Purpose of this study

The Index was first developed by Deloitte in 2008 to assist AIMS communicate the value of the marine industry to key stakeholders. Since its first iteration, seven updates have demonstrated how the marine industry's economic footprint has evolved over time.

The purpose of the Index is to analyse the economic significance of the marine industry, and to assess recent trends that have influenced economic activity of the marine industry, such as the COVID-19 pandemic.

This update represents the ninth edition of the Index, and adds three years of data: 2018-19, 2019-20 and 2020-21. As noted, a refresh of the methodology and access to more data has enabled the inclusion of four additional sub-sectors.

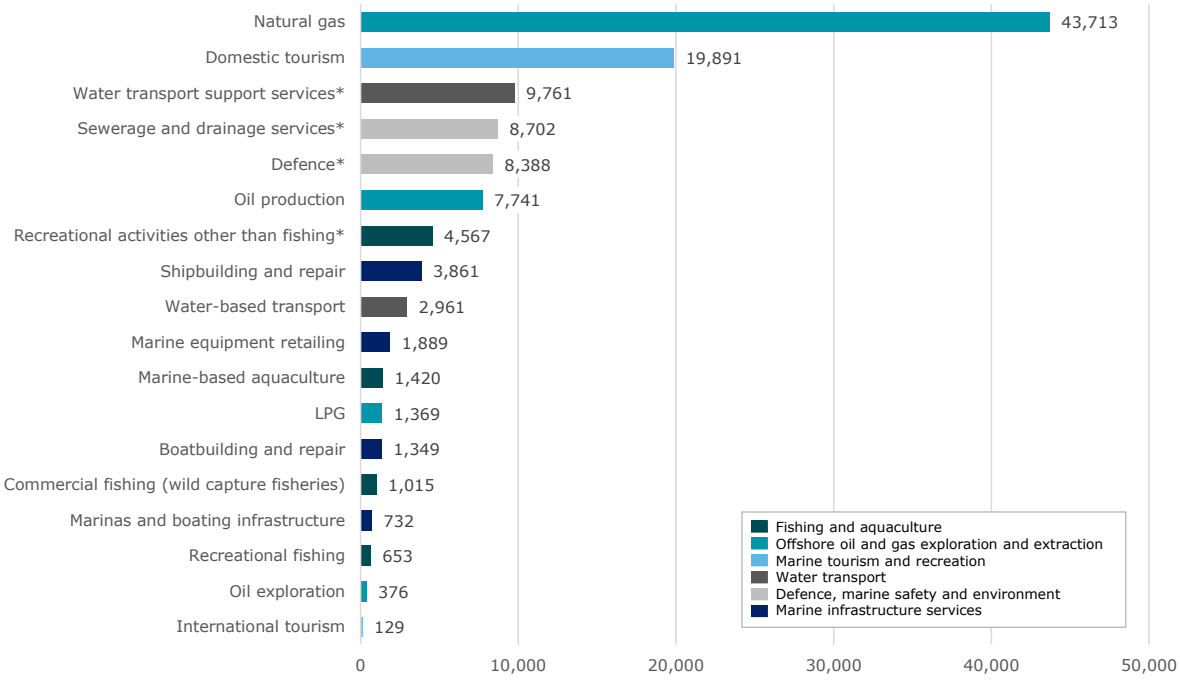
2 Marine industry trends

2.1 Australia's marine industry in 2020-21

Marine industry output is the sum of total revenue received by businesses and organisations in the sub-sectors. In 2020-21, the feature year for this edition of the Index, total marine industry output was $118.5 billion.

The largest sub-sector of the marine industry in 2020-21 was offshore natural gas, valued at $43.7 billion in output. This was more than double the output of the second largest sub-sector, domestic tourism. The five largest sub-sectors made up 76% of total marine industry output (see Chart 2.1).

Chart 2.1: Marine industry output by sub-sector, 2020-21 ($ millions)



Notes: Sub-sectors with the asterisk are the new sub-sectors added into this edition of the Index.

Source: Deloitte Access Economics

2.2 Long term trends

The marine industry has grown strongly over the two decades for which data is available in the Index series. Between 2001-02 and 2020-21, output grew by 4.3% per year on average, from $36.9 billion to $82.8 billion (this adjusts for the effects of inflation, i.e., is in 2021 dollars, and for comparability does not include the 4 new sub-sectors introduced in this Index edition).[ii] Offshore oil and gas exploration and extraction activity was a driver of growth over this period, at 7.5% per year on average, which largely reflects greater production as significant price rises did not occur until 2021-22 (and hence are not reflected in this Index). In comparison, the Australian economy grew at an average rate of 2.8% annually between 2001-02 and 2020-21.

In the four years to 2017-18, Australia experienced a resources investment downturn, where private new capital expenditure in the resources industry declined by an average 22% annually.[15] This was reflected in the previous Index, where offshore oil

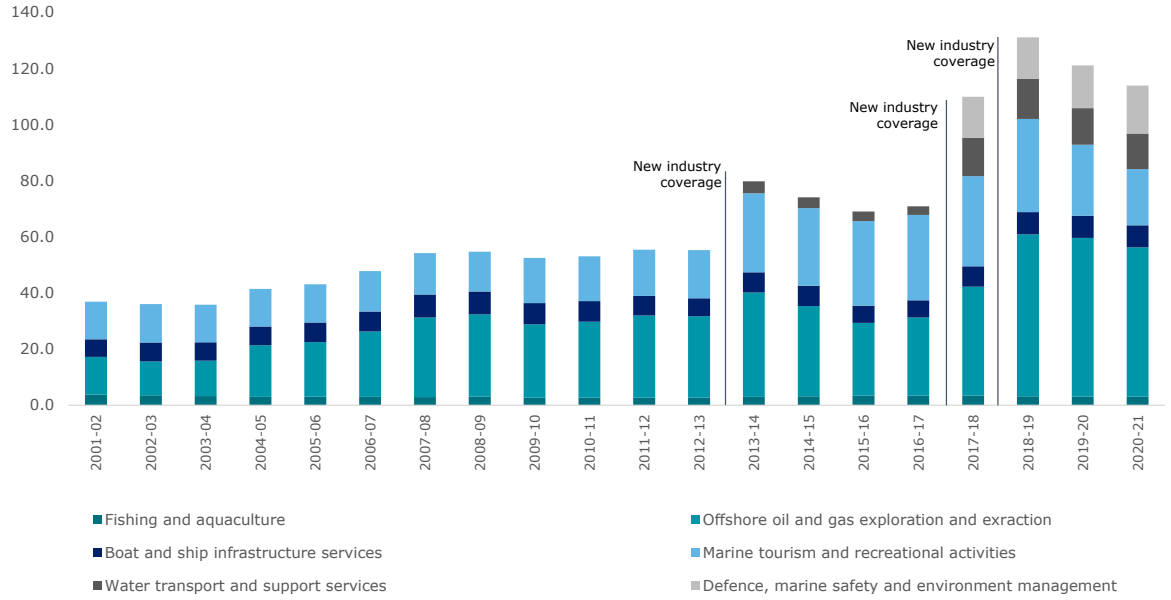
[ii] In the previous editions of the Index, 11 quantifiable sub-sectors have been used. In 2013-14, the recreational fishing, marinas and boating infrastructure and water-based transport of passengers and freight sub-sectors were included. From 2017-18, the water transport support services, defence and sewerage and drainage services sub-sectors were included. And from 2020-21, the recreational activities other than fishing sub-sector was added. Refer to Appendix A.4 for time series data.

exploration declined by 35% per annum over the same period (from $3.9 billion in 2013-14 to $713 million in 2017-18). Whilst the impact of the downturn to the marine industry was partially mitigated by a shift from the investment phase to the extraction phase of the resources boom – resulting in an increase in offshore natural gas production – many other marine sub-sectors such as marine tourism and recreational activities other than fishing, and commercial and recreational fishing and aquaculture experienced an increase in output.[16]

More recently, Australia has experienced a 'two-speed marine economy'. Two large sub-sectors, natural gas, and international marine tourism experienced sharply divergent changes in output. Whilst offshore oil and gas exploration and extraction increased by $14 billion between 2017-18 and 2020-21, international marine tourism declined by 98% from $7.0 billion in 2017-18 to just $129 million in 2020-21 (in real terms) due to the impact of the COVID-19 pandemic.

For comparison with the 2020 Index, economic output was back-cast to 2017-18 to incorporate three of the four new sub-sectors (defence, sewerage and drainage services and water transport support services). Recreational activity other than fishing output was excluded from the timeseries analysis due to limited data availability for historical years.

Chart 2.2: Timeseries of marine industy economic output since 2001-02 ($ billions, real)



Notes: To ensure comparability, the values shown from 2017-18 onwards reflect three of the four new sub-sectors: defence, sewerage, and drainage services; and water transport support services. All values are inflation -adjusted to real terms.
Source: Various government publications and industry reports – see Appendix A.

Appendix A contains a table (A.4) with detailed data of economic output for each marine industry sub-sector from 2001-02 to 2020-21 in real terms (adjusting for inflation over time) and in nominal terms.

2.3 Recent changes in marine industry composition

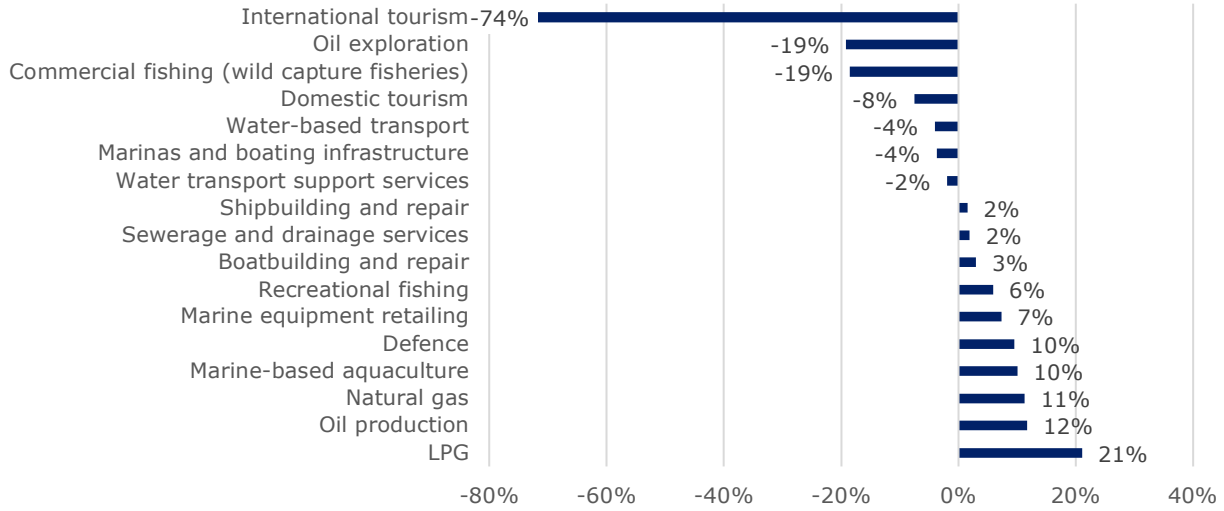
In the three years to 2020-21, a number of key events influenced the economic output of the marine industry. Large scale interventions to address the spread of the COVID-19 pandemic included international and state border closures causing disruptions to international supply chains (which were also impacted by increasing geopolitical tensions), leading to reduced economic activity in some marine industry sub-sectors. In parallel, a shift occurred in the resource investment boom from the investment phase to the extraction phase. Changes to economic output of marine industry sub-sectors from 2017-18 to 2020-21 were driven by the following:

- The international marine tourism sub-sector experienced a sharp decline due to COVID-19, where international border closures contributed to a decline in international tourism expenditure from $7.0 billion in 2017-18 to just $129 million in 2020-21 (in real terms).
- The commercial fishing (wild capture fisheries) sub-sector experienced a decline in demand from key export markets during the COVID-19 pandemic and because China imposed trade restrictive measures on rock lobster produce. This contributed to a contraction in output from $1.8 billion in 2017-18 to $1.0 billion in 2020-21 (in real terms).[17]
- The water transport sub-sector experienced significant supply chain disruptions and cruise ship stoppages during the COVID-19 pandemic, which contributed to a contraction in output from $3.3 billion in 2017-18 to $3.0 billion in 2020-21 (in real terms).

- The offshore natural gas production sub-sector experienced significant increases in offshore gas production despite the impact of COVID-19, rising from $31.9 billion in 2017-18 to $43.7 billion in 2020-21 (in real terms).

In the absence of the new marine sub-sectors, the total output in 2020-21 would be $82.8 billion – that is $2.5 billion larger than the total output reported in the previous Index ($80.1 billion in real terms).

Chart 2.3: Annual average change in output from 2017-18 to 2020-21



Notes: To ensure comparability, the values shown from 2017-18 onwards reflect three of the four new sub-sectors: defence, sewerage and drainage services; and water transport support services.
Source: Deloitte Access Economics analysis of various government publications and industry reports – see Appendix A.

2.3.1 Commercial and recreational fishing and aquaculture trends

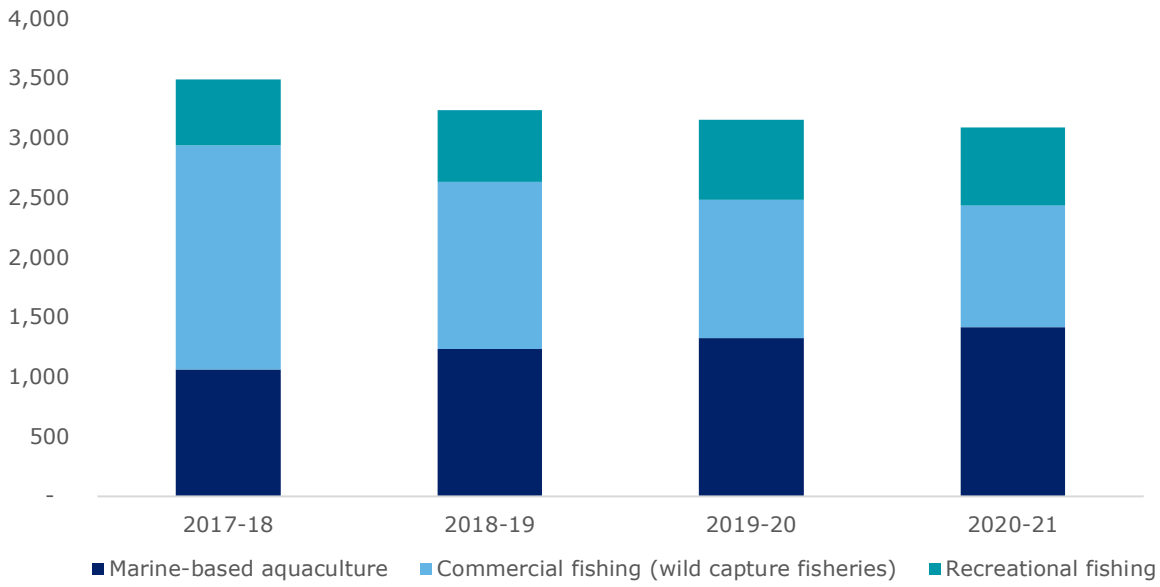
In the three years to 2020-21, the economic output of wild caught fisheries in Australia declined by 19% annually on average, from $1.9 billion in 2017-18 to $1.0 billion in 2020-21 (in real terms). Greater competition from the aquaculture industry, low-cost imports from Asia and government-imposed quotas that restrict the volume of seafood caught have contributed to constrained growth in the commercial fishing industry over the past five years.[18]

The quality of Australian-caught fish and seafood is recognised in international markets and reflected in the high-value of products such as rock lobster, prawns, and abalone.[19] At the onset of the COVID-19 pandemic, demand from key export markets such as China, Japan and Hong Kong declined. Rock lobster production decreased from $549 million 2019-20 to $490 million in 2020-21.[20,21]

In contrast, marine-based aquaculture increased by 11% annually on average, from $1.1 billion in 2017-18 to $1.4 billion in 2020-21 (in real terms). For the first time, in 2019-20 aquaculture output surpassed that of commercial fishing. More recently, the aquaculture sub-sector has been broadening the composition of species produced – with increased emphasis on prawns, abalone, oysters and finfish varieties, including barramundi and kingfish.[22]

Recreational fishing activity increased by 6% annually on average, from $550 million in 2018-19 to $653 million in 2020-21 (in real terms). The Australian Government and the Fisheries Research and Development Corporation collected data between 2018 and 2021 to inform an updated National Recreational Fishing Survey.[23] The outcome of the survey will provide data at the national level outlining fishing activity during the COVID-19 pandemic.[24] Growth in recreational fishing activity in this Index reflects an increase in the share of non-tourist recreational fishing participants over this time. This is supported by preliminary qualitative studies, which suggest recreational fishing activity increased during the COVID-19 pandemic.[25]

Chart 2.4 Commercial and recreational fishing and aquaculture output, 2017-18 to 2020-21 ($ million, real)



Source: Deloitte Access Economics, Department of Agriculture, Fisheries and Forestry (2022).

2.3.2 Offshore oil and gas exploration and production trends

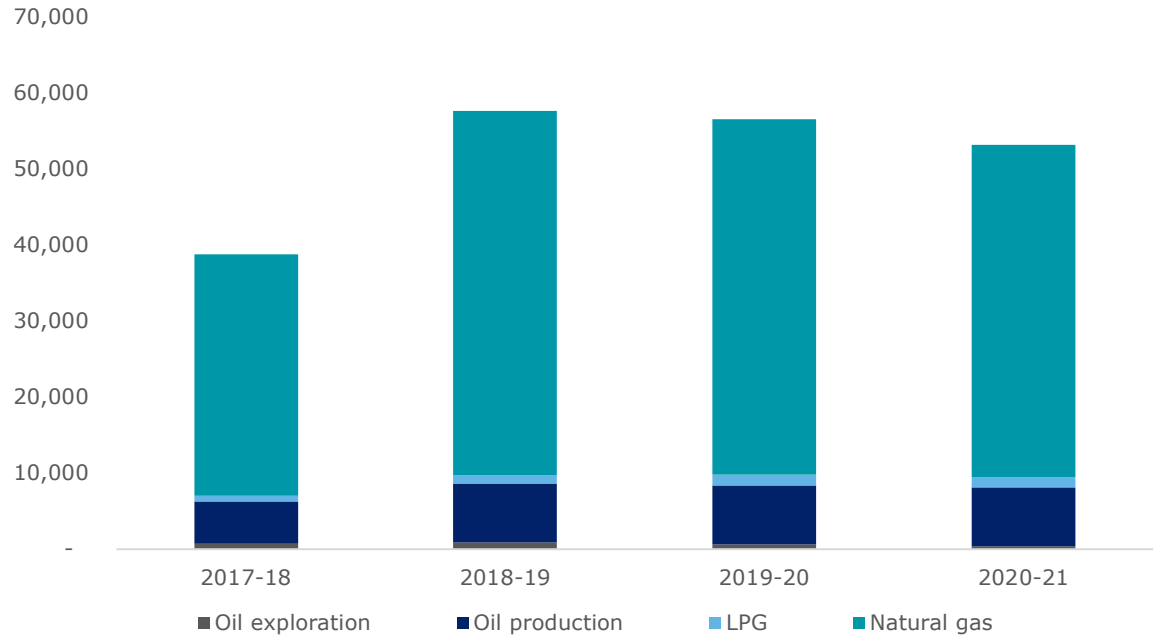
In the year to 2018-19, the economic output of natural gas and oil increased by 51% and 40%, from $31.7 billion to $48.0 billion and $5.6 billion to $7.8 billion, respectively (in real terms). LPG production also grew significantly, by 20% from $771 million to $1.1 billion.

In the two years following to 2020-21, output of natural gas declined by 5% per year (to $43.7 billion in real terms) and oil production by around 1% per year (to $7.7 billion in real terms). LPG production continued to increase by 12% on average per year over the same period, to $1.4 billion.

Investment in oil and gas exploration projects from 2007 to 2014 led to a significant increase in production capacity to meet demand at high commodity prices.[26] A key driver of output growth from 2017-18 to 2018-19 was the increase in offshore production volumes, as two significant offshore gas projects in WA, Ichthys and Prelude LNG shipped their first cargoes.[27] Natural gas production volumes increased by 25% in one year – from 2,783 petajoules to 3,291 petajoules.[28]

While the COVID-19 pandemic had a limited impact on offshore oil and gas production, it had a more significant impact on oil and gas exploration. In the three years to 2020-21, oil and gas exploration declined by 19% annually on average from $713 million in 2017-18 to $376 million in 2020-21 (in real terms). Uncertain conditions during the COVID-19 pandemic delayed firms' investment decisions. Private mining new capital expenditure declined by 12% from 2017-18 to 2019-20.[29] At the time, declines in oil and gas prices also contributed to delayed investment decisions, whereby the average realised price of oil and gas declined significantly in recent years, from AU$86 per barrel of oil equivalent in 2014 to AU$43 per barrel of oil equivalent in 2017.[30] While prices recovered to around AU$65 per barrel of oil equivalent in 2020, investment decision-making has lagged. Global energy demand declines and rising concerns over environmental issues were also contributing factors (noting the impacts of the Ukraine conflict in 2022 are not reflected in this period of analysis).[31]

Chart 2.5: Offshore oil and gas exploration and production output, 2017-18 to 2020-21 ($ million, real)



Source: Deloitte Access Economics, ABS (2022), APPEA (2022).

2.3.3 Boat and ship building and maintenance services, equipment, and infrastructure trends

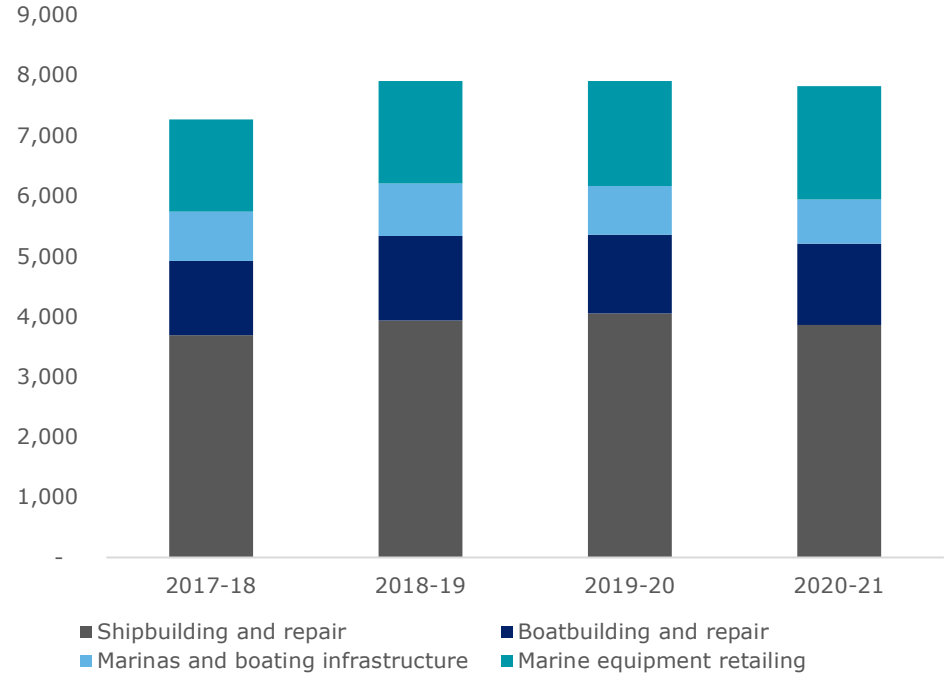
In the three years to 2020-21, the economic output of shipbuilding and repair services increased by 2% annually on average, from $3.7 billion in 2017-18 to $3.9 billion in 2020-21 (in real terms), with most of this occurring in the first year. Several Federal Government contracts to build ships for the Royal Australian Navy (Navy) maintained demand for services and has driven defence shipbuilding activity.[32] However, strong price competition from foreign shipbuilders has limited the growth of the civil shipbuilding activity.

Over the same period to 2020-21, boatbuilding and repair services increased by 3% annually on average, from $1.2 billion in 2017-18 to $1.3 billion in 2020-21 (in real terms). Uncertain economic conditions in the first stages of the COVID-19 pandemic discouraged large consumer purchases, reflected in a 3% contraction of boatbuilding and repair output in the year to 2019-20 (from $1.4 billion to $1.3 billion). However, some households redirected consumption of international tourism activities to recreational purchases, with some purchasing boats for the first time.[33] Boatbuilding activity and repair recovered in the following year by 3%.

For similar reasons to boatbuilding and repair during the pandemic, marine equipment retailing increased by 7% annually from $1.5 million in 2017-18 to $1.9 million in 2020-21 (in real terms). The COVID-19 pandemic resulted in a 'homegrown nautical boom' which increased the demand for marine equipment.[34] The average weekly hours worked by all Australians declined in the past five years to 2020,[35] which was exacerbated during the COVID-19 pandemic as many businesses closed. However, JobKeeper payments enabled many Australians to remain employed while working fewer hours, allowing some consumers to allocate more leisure time towards recreational marine-based activities.[36]

Marine and boating infrastructure output contracted by 4% annually on average from $820 million in 2017-18 to $732 million in 2020-21 (in real terms). The COVID-19 pandemic impacted marinas differently. Marinas that relied on tourist boats, events revenues, food and beverage, fuel sales were impacted by social distancing and travel restrictions. Other marinas that relied more on recreation storage for revenue were more resilient, as many of these marinas were fully occupied and even had waitlists.

Chart 2.6: Boat and shipbuilding repair infrastructure output, 2017-18 to 2020-21 ($ million, real)



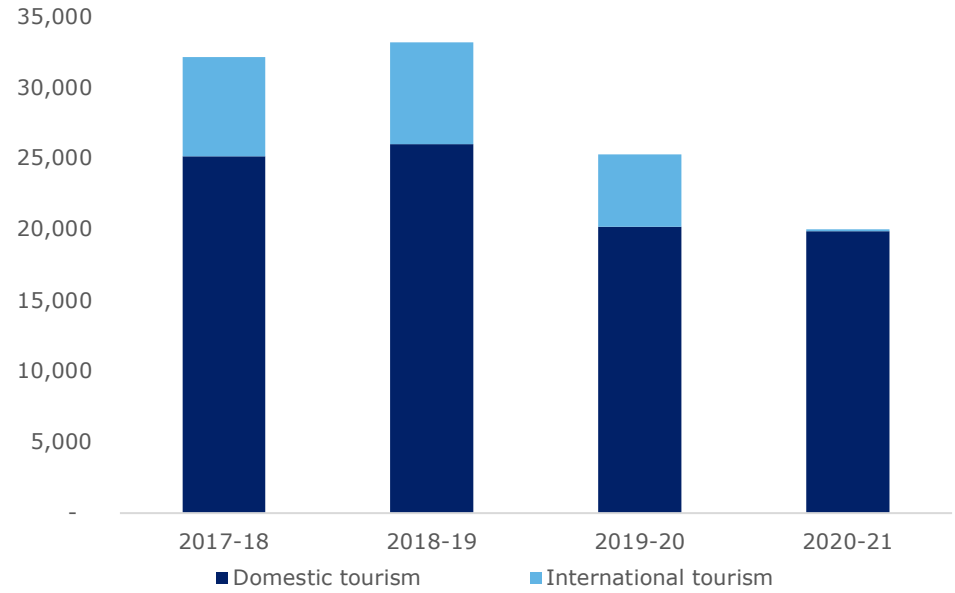
Source: Deloitte Access Economics, ABS (2022), Health of the Australian Marina Industry Report (2022).

2.3.4 Marine tourism

International and domestic marine tourism was significantly impacted by the COVID-19 pandemic. International tourism collapsed from $7.1 billion in 2018-19 to $129 million in 2020-21 (in real terms). International border closures imposed from March 2020 limited international expenditure, which declined by 98% in the year to 2020-21.[37] This trend was consistent across all states.

Domestic tourism was not as significantly impacted by the COVID-19 pandemic compared to international tourism, as domestic marine tourism declined by 13% yearly on average from $26.0 billion in 2018-19 to $19.9 billion 2020-21 (in real terms). Public health restrictions, state border closures and prolonged city-wide lockdowns in Melbourne and Sydney contributed to the decline.[38]

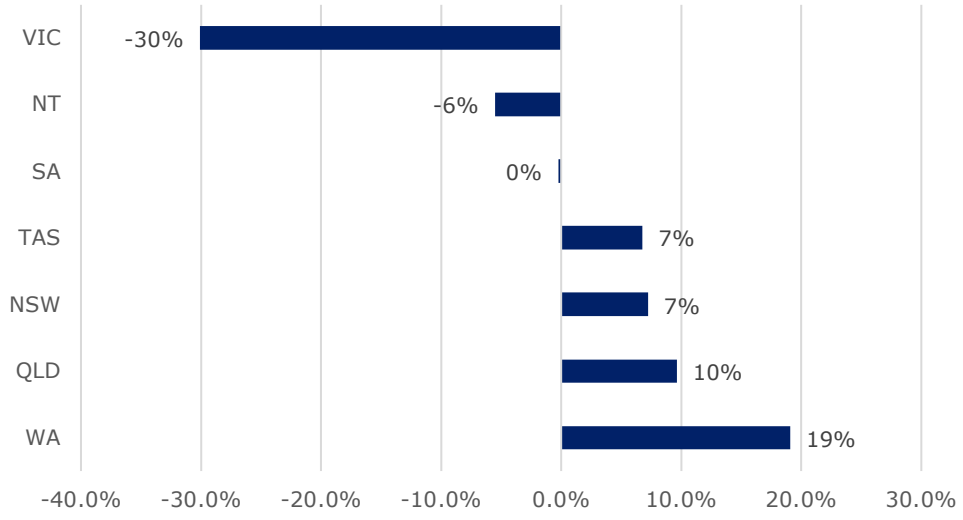
Chart 2.7: Marine tourism and recreation output, 2017-18 to 2020-21 ($ million, real)



Source: Deloitte Access Economics, Tourism Research Australia (2022).

Changes in tourism expenditure among states and territories varied significantly. Victoria's COVID-19 pandemic lockdowns, which included a five-kilometre distance restriction contributed to a 30% decline in expenditure in the year to 2019-20. Meanwhile, Western Australia's hard border restrictions with all other states resulted in a higher proportion of WA holidaymakers visiting destinations within the state instead of interstate or overseas. This contributed to a 19% increase in domestic tourism expenditure – the highest yearly increase in domestic marine tourism expenditure experienced by the state in the previous two decades where data was available.

Chart 2.8: Changes in marine domestic tourism output, year to 2020-21



Source: Deloitte Access Economics, Tourism Research Australia (2022)

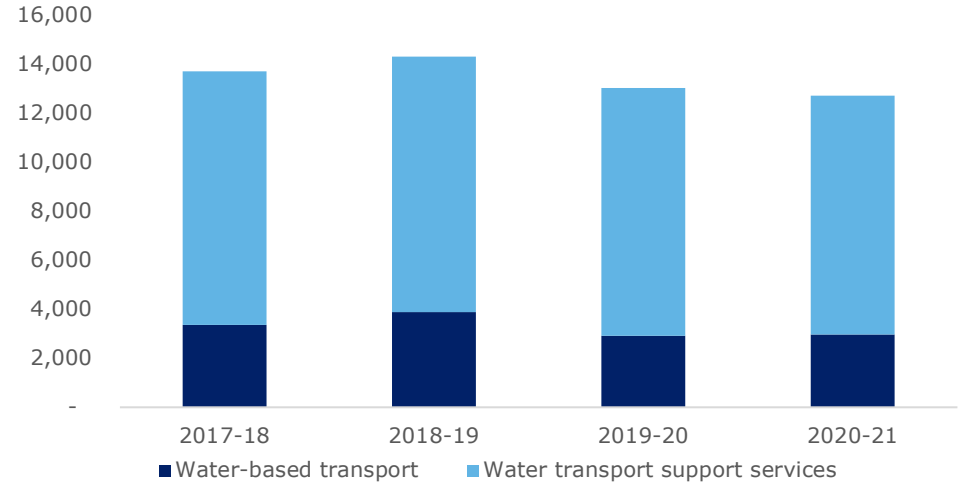
Despite Australian international borders reopening in 2021, the ongoing effects of the COVID-19 pandemic on global tourism travel have limited the rate of recovery for the industry and many operators have struggled to rebuild capacity.[39]

2.3.5 Water transport, services to water transport and ports trends

Following a year of growth from $3.3 billion in 2017-18 to $3.9 billion in 2018-19 (16%), water-based transport output declined 9% annually on average to $3.0 billion in the two years to 2020-21. Intermittent COVID-19 outbreaks caused ports to limit operations and required infected workers to isolate for periods of time. These closures resulted in significant delays, where only 10% of vessels arrived in their designated berth windows – the lowest on record.[40] This in turn reduced port capacity and industry revenue. Moreover, the close proximity of cruise ship passengers amplified the transmission of COVID-19 on cruise ships. Many ports closed to these ships to contain the spread of the virus, and as such, revenue earned by cruise ports declined.[41]

For similar reasons, water-based transport support services also declined by 2% annually on average from $10.3 billion in 2017-18 to $9.8 billion in 2020-21.

Chart 2.9: Water transport, services to water transport and ports output, 2017-18 to 2020-21 ($ millions, real)

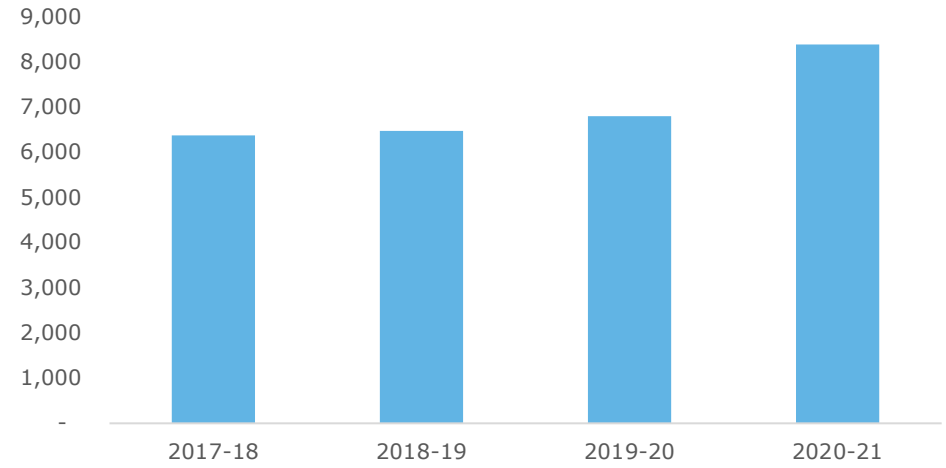


Source: Deloitte Access Economics, ABS (2022), IBISWorld (2022).

2.3.6 Defence

In the three years to 2020-21, Navy output increased by 10% per annum on average from $6.4 billion in 2017-18 to $8.4 billion in 2020-21. Navy capabilities as a share of the total defence budget in the five years to 2020-21 increased from around 14% to 18% of total department resources.[42] Greater expenditure on maritime protection operations such as Operation Resolute and Operation Sovereign Borders supported this increase in output – increasing 28% in the year to 2020-21.[43] The Naval Shipbuilding Plan, released in May 2017, has also resulted in increased Navy capabilities over the period.[44]

Chart 2.10: Navy output, 2017-18 to 2020-21 ($ millions, real)

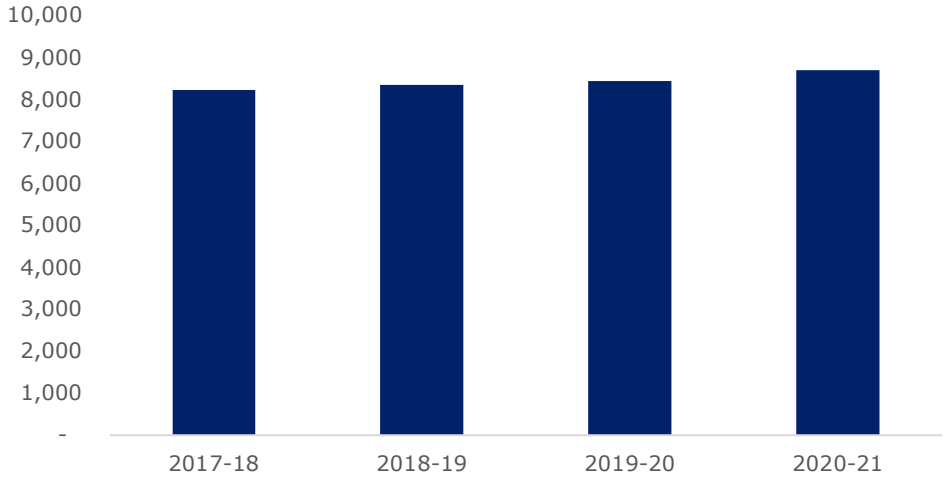


Source: Deloitte Access Economics, ABS (2022), IBISWorld (2022).

2.3.7 Sewerage and drainage services

In the three years to 2020-21, sewage and drainage output increased by 2% per annum from $8.4 billion in 2017-18 to $8.7 billion in 2020-21. The industry generates a relatively consistent flow of income from households and industry and increases in output largely reflect changes in coastal population over time.[45]

Chart 2.11: Sewage and drainage output, 2017-18 to 2020-21 ($ millions, real)



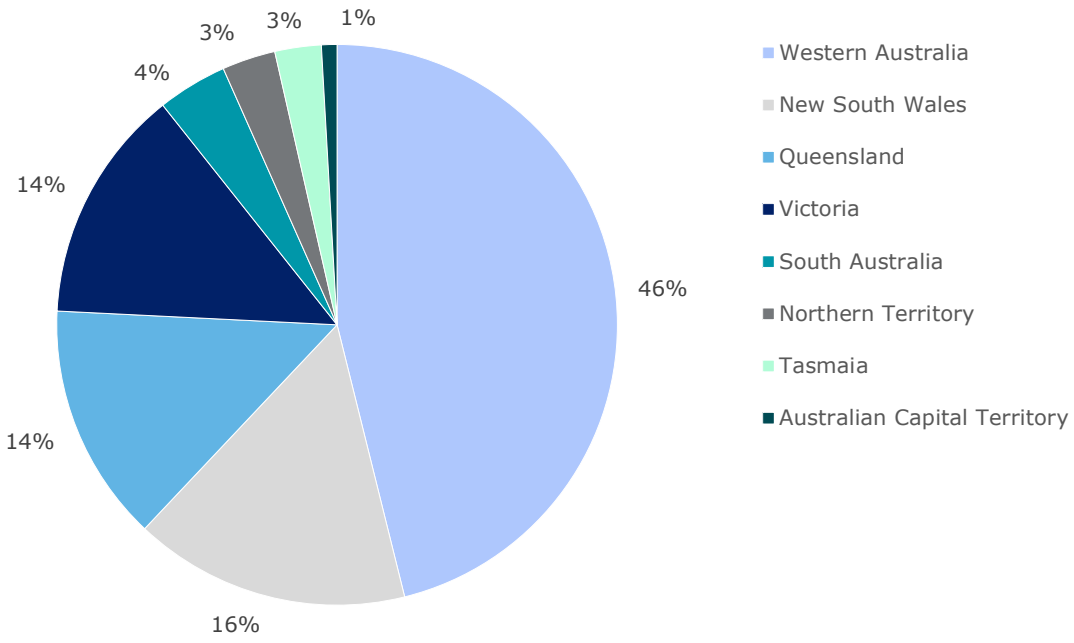
Source: Deloitte Access Economics, ABS (2022), IBISWorld (2022).

3 Geography of Australia's marine industry

3.1 National economic output in 2020-21

The output of 18 sub-sectors by Australian state and territory jurisdictions, and the methodology used to estimate each sub-sector is presented in this Chapter. Of the total estimated output of the Australian marine industry ($118.5 billion) in 2020-21, almost half was produced in Western Australia, equivalent to $54.7 billion (see Chart 3.1). This was primarily due to offshore natural gas output valued at $37.3 billion in output, which comprised 68% of total Western Australian marine industry output. New South Wales, Queensland and Victoria also accounted for a large share of the total output of the marine industry in 2020-21, with their respective outputs being valued at $18.8 billion, $16.2 billion and $16.0 billion.

Chart 3.1: Share of marine industry output by state, 2020-21



Source: Deloitte Access Economics.

Economic output estimates for sub-sectors such as marine carbon capture storage and ocean renewable energy are not included in the total economic output estimate due to their small size and limitations in data availability.

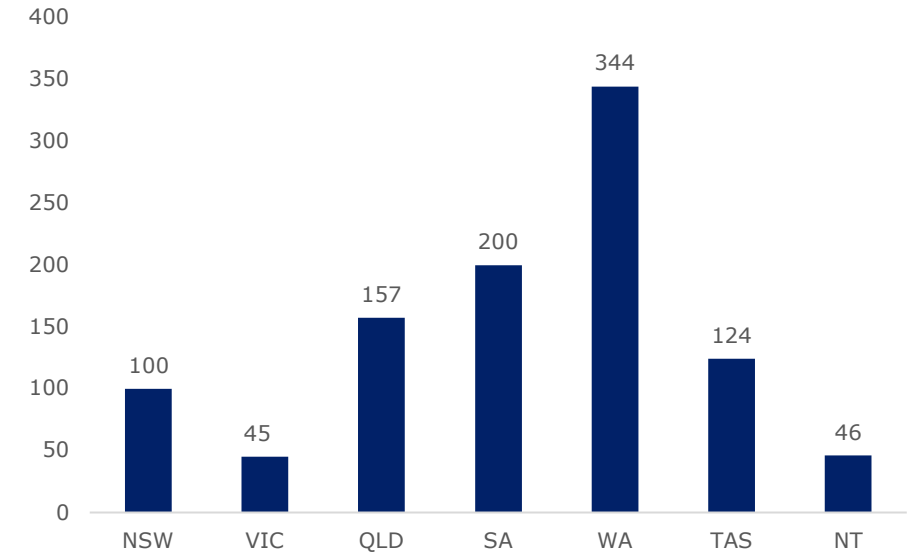
3.2 State economic output

3.2.1 Commercial fishing and aquaculture

Commercial fishing refers to commercial fishing for commercial profit, largely from wild fisheries. The economic output of marine-based commercial fishing is determined by gross value of production of wild caught fisheries, as set out in the *Fisheries and Aquaculture Statistics 2021*.

The three-leading wild-catch jurisdictions in 2020-21 in terms of value of production were Commonwealth marine areas ($374 million), Western Australia ($344 million) and South Australia ($200 million). Commonwealth marine areas include sea area within Australia's exclusive economic zone and over the continental shelf of Australia, the rights of which have not been vested in a State or in the Northern Territory.

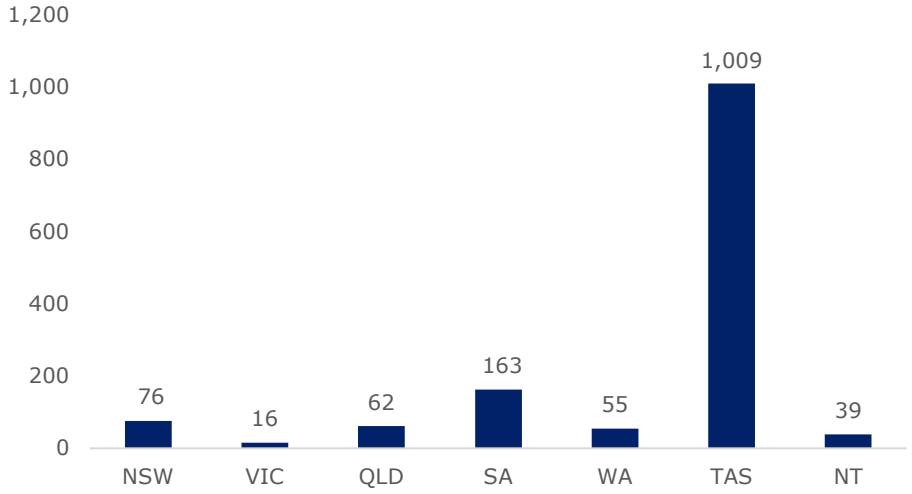
Chart 3.1: State-based commercial fishing (wild capture fisheries) output in 2020-21 ($ millions)



Source: Deloitte Access Economics, DAFF (2022).

Aquaculture in Australia can be undertaken in freshwater, brackish water or marine water; however, this analysis is limited to marine-based aquaculture (brackish and marine water). Aquaculture is defined by the Food and Agriculture Organization of the United Nations as the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants with some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding and protection from predators.[46] The economic output of marine-based aquaculture is determined by the product of aquaculture production, as set out in the *Fisheries and Aquaculture Statistics 2021,* and the share of offshore aquaculture employment, determined by *the Census*. In 2020-21, the economic output of aquaculture in Australia was estimated at $1.4 billion. Tasmania was the largest aquaculture producing state or territory jurisdiction, with economic output of $1 billion, ahead of South Australia ($163 million).

Chart 3.2: Marine-based aquaculture output in 2020-21 ($ millions)



Source: Deloitte Access Economics, Department of Agriculture Fisheries and Forestry (2022).

3.2.2 Recreational fishing

Quantifying the economic value of recreational fishing activities is challenged by difficulties in collecting and comparing data about activities which occur in a relatively informal way and across a disparate sector where market transactions do not always occur. For example, the fish caught by recreational fishers represent a value to them – as recreational enjoyment or food – but they are often not fully part of a market transaction. Hence, the full value of recreational fishing is not reflected in this economic valuation of the sub-sector.

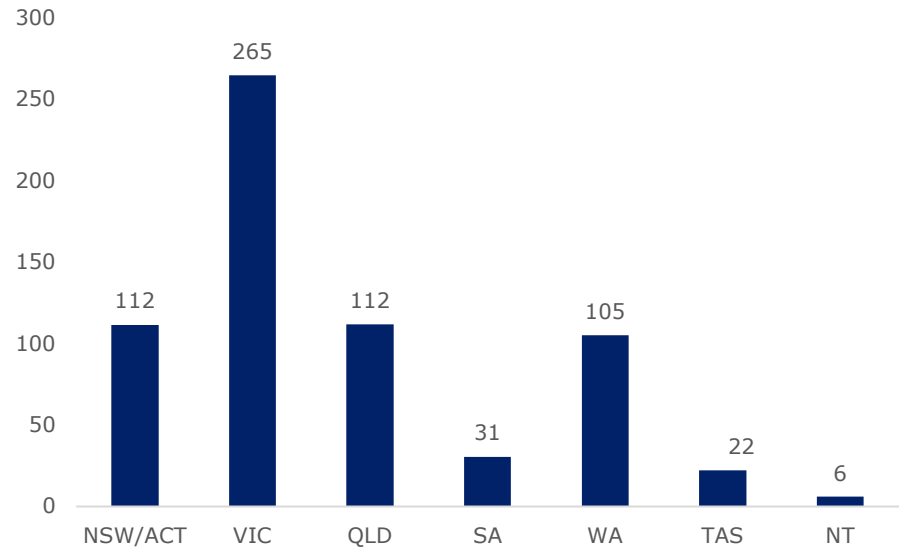
Prior to the 2020 Index, recreational fishing expenditure was estimated using the *2003 National Recreational and Indigenous Fishing Survey* and adjusted to account for inflation.[47] This edition of the Index adopts a similar approach to the 2020 Index, which includes updated data to better reflect changes to fishing preferences, national population and wage increases in Australia.

Although the *2003 National Recreational and Indigenous Fishing Survey* was the last national level survey that estimated the value of recreational fishing, several more recent studies exist; however, these studies present state or region level data at different time periods. Recent reports for Victoria and Western Australia provide updated participation data. The data suggests Victorian recreational fishing activity involved 1,113,506 participants in 2018-19 compared to 838,119 in 2013-14.[48] For the first time since the National Recreational and Indigenous Fishing survey was released, Western Australian participant data became available for 2018-19 – estimated at 630,000.[49] Participant estimates were adjusted for changes in population at the state level.

Marine fishing, which includes activity undertaken offshore, in coastal regions and in estuaries, accounted for 82% of total recreational fishing expenditure.[50] The final expenditure estimate has been adjusted to exclude non-marine recreational expenditure from state output estimates.

The economic output of recreational fishing in Australia was estimated at $653 million. The largest marine-based recreational fishing states and territories in 2020-21 were Victoria ($265 million), New South Wales/Australian Capital Territory ($112 million), and Queensland ($112 million) and Western Australia ($105 million).

Chart 3.3: Recreational fishing output in 2020-21 ($ millions)



Source: Deloitte Access Economics and DAFF (2003).

The Australian Government and the Fisheries Research and Development Corporation collected data between 2018 and 2021 to inform an updated National Recreational Fishing Survey. The study surveyed 20,368 people and collected data on a range of economic and demographic indicators. The findings from the survey are to be released in a forthcoming report and outcomes will be reflected in future editions of this Index.[51]

3.2.3 Indigenous fishing

Indigenous fishing is linked to core cultural values and beliefs in Aboriginal and Torres Strait Islander communities. While Indigenous people are included in the population basis used to calculate the number of recreational anglers, Indigenous fishers that live in Indigenous communities and fish for cultural or food reasons are not included in the estimates of the recreational and commercial fishing industries of this study. The 2003 survey remains the most recent source for data on Indigenous fishing, which estimated that there were 37,000 Indigenous fishers who spent 420,000 days fishing in 1999-2000.[52]

A more recent Fisheries Research and Development Corporation study, jointly combined with the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS), assessed the value of Indigenous fishing to Aboriginal people in South Australia, Northern Territory and New South Wales. A key finding included that subsistence fishing and the trade and barter

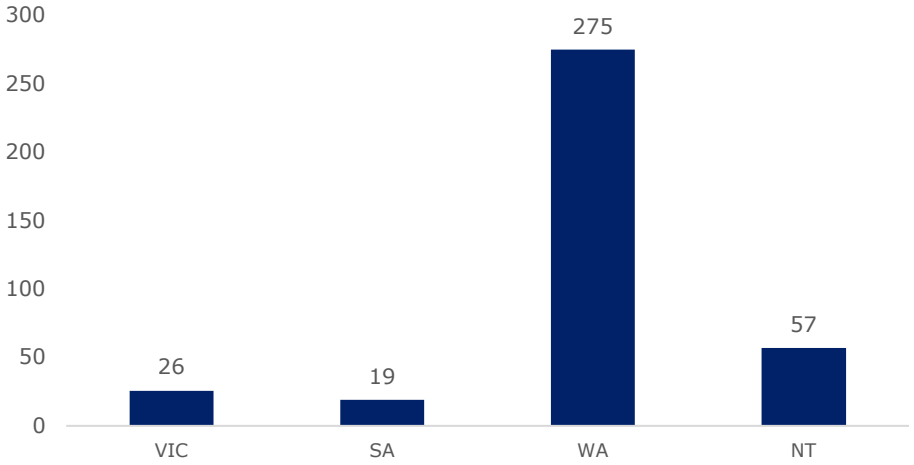
of catch increased discretionary incomes by substituting purchased goods for Aboriginal people.[53] Sharing catch was also found to creates a social safety net that supports vulnerable members of the community.

3.2.4 Offshore oil and gas exploration and production

The offshore exploration and production of oil, LPG, and natural gas was the largest contributor to economic output of the marine industry in 2020-21. Activity is largely driven by domestic or export sales, which is reliably reflected in production statistics. However, there is also activity generated through exploration and the development and ongoing maintenance of infrastructure.

The offshore expenditure component is delineated in the ABS *Mineral and Petroleum Exploration statistics*.[54] The value of offshore oil exploration was $376 million in 2020-21, with most of the economic output attributable to Western Australia ($275 million), followed by small amounts in the Northern Territory ($57 million), Victoria ($26 million) and South Australia ($19 million).

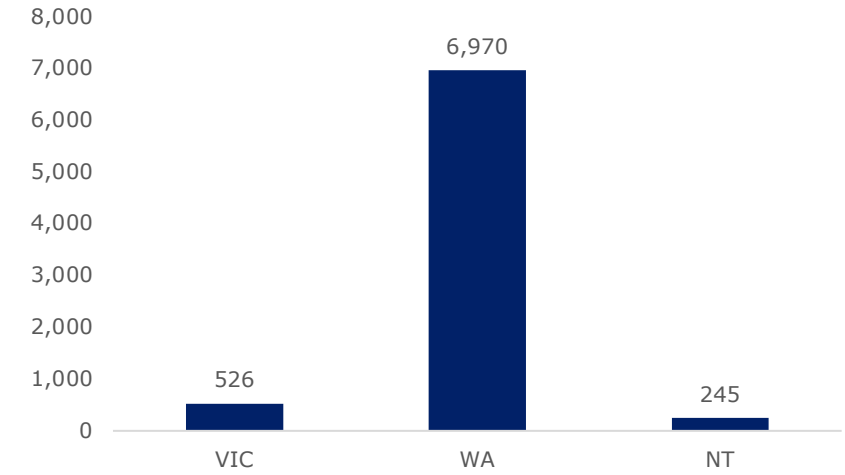
Chart 3.4: Economic output of offshore oil exploration in 2020-21 ($ millions)



Source: Deloitte Access Economics, Australian Bureau of Statics (2022).

Consistent with the previous Index, estimates for offshore oil production are derived from using the *Annual Financial Survey 2020-21* for $AUD/barrel and the *Australian Petroleum Statistics* for offshore production volume (in barrels).[55,56] Production is attributed to particular basins enabling broad delineation of offshore production by state and territories. In 2020-21, offshore Australian oil production was valued at $7.7 billion. Western Australia was the key contributor to offshore oil production in 2020-21 ($7.0 billion), followed by Victoria ($526 million) and the Northern Territory ($245 million).

Chart 3.5: Economic output of offshore oil production in 2020-21 ($ millions)

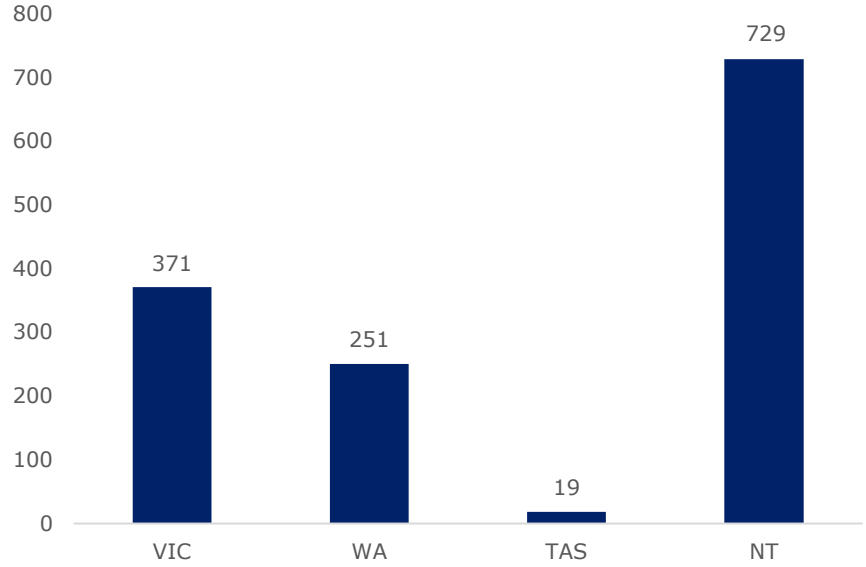


Source: Deloitte Access Economics, Australian Bureau of Statics (2022).

The LPG production attributable to states or territories was determined by the shares of Australian conventional gas production volume from the *Australian Energy Update*.[57] Based on production volumes at the offshore basin level, the value

of offshore LPG extraction is estimated at $1.4 billion. The Northern Territory was the largest contributor to offshore LPG production in Australia in 2020-21, contributing $729 million, while Victoria contributed $371 million and Western Australia contributed $251 million.

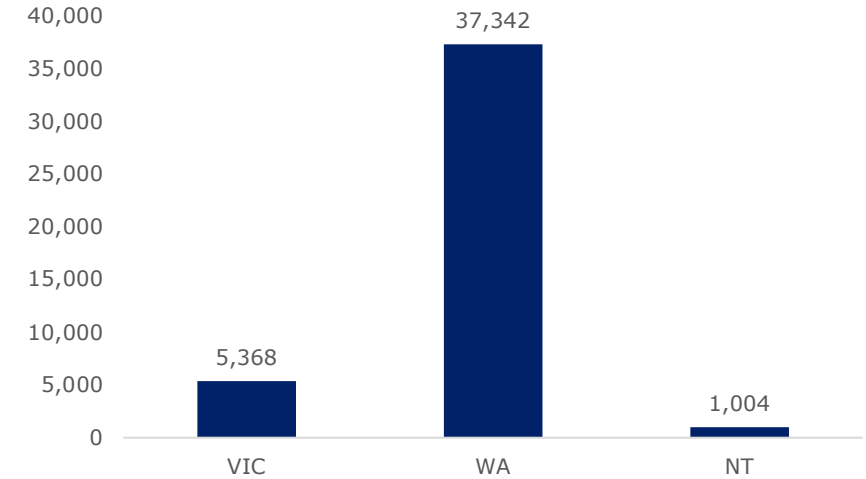
Chart 3.6: Economic output of offshore LPG in 2020-21 ($ millions)



Source: Deloitte Access Economics, Australian Bureau of Statistics (2022).

Natural gas production attributable to states or territories was determined by production volume share per offshore basin in Australia from the *Australia Energy Update 2022*.[58] The value of offshore natural gas production was estimated at $43.7 billion. Western Australia was the largest contributor to natural gas production in Australia, with production valued at $37.3 billion. Significant production volumes are attributed to Prelude and Ichthys projects in the North West Shelf, which shipped their first cargoes in 2018-19.[59] In addition, Victoria and the Northern Territory contributed $5.4 billion and $1.0 billion respectively.

Chart 3.7: Economic output of offshore natural gas production in 2020-21 ($ millions)



Source: Deloitte Access Economics, Australian Bureau of Statistics (2022).

3.2.5 Other resource extraction and use

A number of existing and emerging marine activities have been identified but are not reflected in total economic output due to limited available data or their relatively small size. These activities include desalination, carbon capture, bioprospecting, marine and seabed mining, marine pipeline services and salt production, offshore wind, ocean renewable energy and offshore hydrogen (see Appendix A).

The Offshore Electricity Infrastructure Act 2021 was recently established to provide a framework for the licensing, development and construction of offshore wind projects. More than 40 Australian-based proposals have been publicly

announced, totalling 40GW, although they remain several years away from becoming operational.[60] Australia's first offshore wind development zone was announced on 19 December 2022, covering an area in the Bass Strait adjacent to Gippsland.[61]

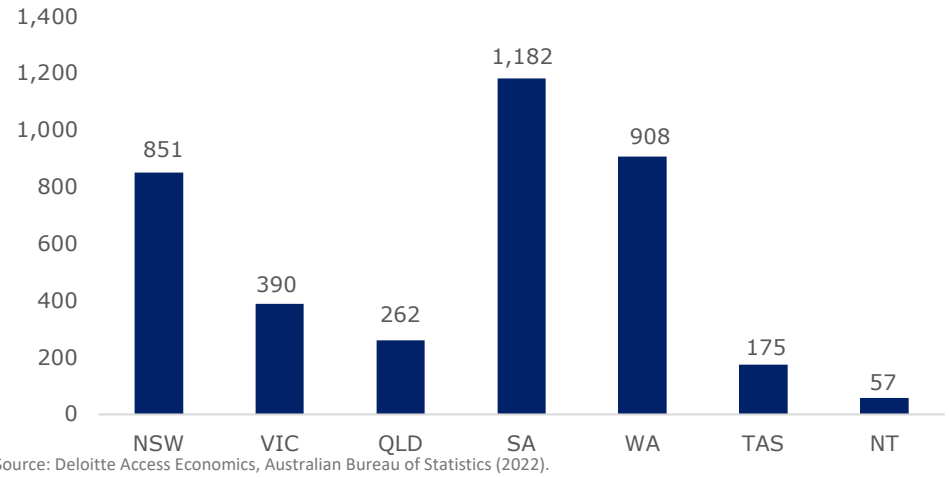
In 2020-21, The Australian Government announced the *2021 Offshore Greenhouse Gas Storage Acreage Release* areas, [62,63] which enables carbon capture and storage in Commonwealth waters. The announcement included areas across three offshore basins: Bonaparte, Browse and Northern Carnarvon Basins in Norther Territory and Western Australia.[64] Since the announcement, two carbon capture storage projects were approved. The Northern Territory facility (Bonaparte Basin) has the potential to store up to 15.9 gigatons of CO_2, and the Western Australia facility (Browse Basin) has potential to store up to 7 gigatons of CO_2.[65,66,67]

3.2.6 Boat and ship building and maintenance services, equipment and infrastructure

Shipbuilding manufacturing or repair services (civil and defence) refer to vessels with a displacement tonnage of 50 or greater, where output was estimated using ABS *Australian Industry* data.[68] State- or territory-based attribution of economic outputs for shipbuilding and repair services was estimated using services employment collected in *the Census.* In 2020-21, the output of shipbuilding and repair services was valued at $3.9 billion, with output being the largest in South Australia ($1.2 billion), followed by Western Australia ($908 million) and New South Wales ($851 million).

South Australia has a history of delivering major defence projects due to the location of the Naval Shipbuilding College, which provides the State with a pipeline of workers with skills and industry knowledge.[69] Western Australia and New South Wales had the second and third highest shipbuilding output in 2020-21. New South Wales's Fleet Base East and Western Australia's Garden Island each host naval bases for the maintenance and the sustainment of naval capabilities.[70]

Chart 3.8: Economic output of shipbuilding and repair activities in 2020-21 ($ millions)



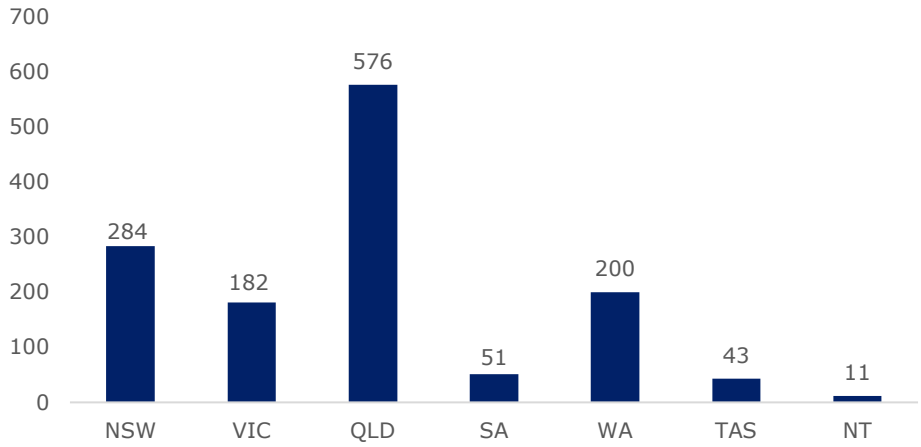
Source: Deloitte Access Economics, Australian Bureau of Statistics (2022).

Boatbuilding manufacturing or repair services refers to vessels with a displacement tonnage less than 50. Similar to shipbuilding, state or territory-based attribution of economic output for boatbuilding and repair services was estimated using ABS *Australian Industry* data and employment data collected in *the Census.* [71] In 2020-21, the production of boatbuilding and repair services was valued at $1.3 billion, with output being the largest in Queensland ($576 million), New South Wales ($284 million) and Western Australia ($200 million).

The greatest share of boatbuilding industry output is contributed by Queensland. Australia's largest recreational boating precinct, the Gold Coast Marine Precinct, attracts a significant volume of recreational boats per year – around 50,000 vessels are serviced and repaired.[72] The two major Australian industry boatbuilding and repair organisations are based in the region, generating $287.9 million revenue in 2020-21.[73] Large commercial boating facilities also exist in New South Wales and Western Australia. For example, the Harwood Marine facilities are based in New South Wales and the purpose-built facilities for building bespoke luxury superyachts by Australian company Echo Yachts are based in Western Australia.[74]

While South Australia had the highest economic output for shipbuilding and repair activities, it had one of the lowest for boatbuilding and repair services. This is partly because of its smaller population compared to other states; however, South Australia also had the lowest average marina occupancy rate in Australia at 75%. [75]

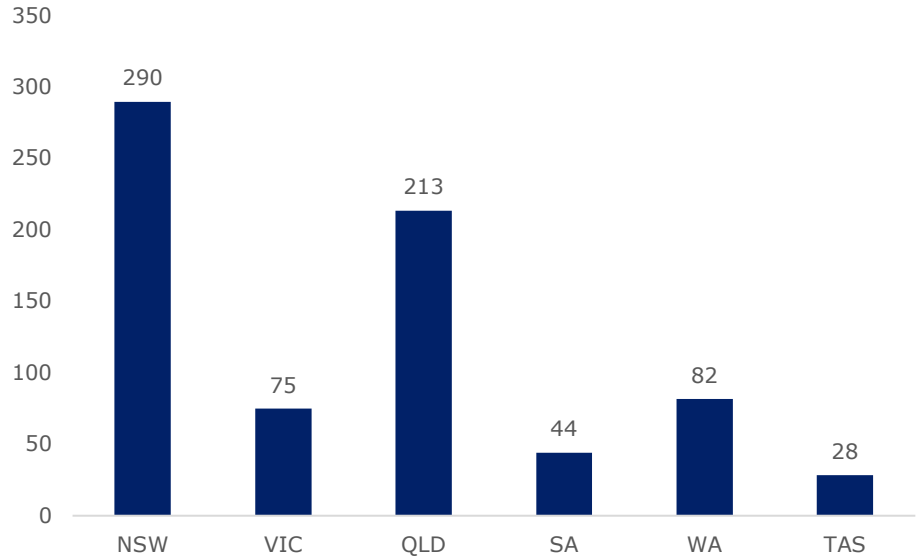
Chart 3.9: Economic output of boatbuilding and repair services in 2020-21 ($ millions)



Source: Deloitte Access Economics, Australian Bureau of Statics (2022)

The economic output from the marinas and boating infrastructure industry in 2020-21 was estimated at $732 million, according to the *2021 Health of Australian Marina Industry Survey*. Economic output is recorded by state and territories, where New South Wales and Queensland contributed the greatest value of economic output to this sub-sector at $290 million and $213 million respectively, followed by Western Australia ($82 million) and Victoria ($75 million). Even though New South Wales had almost double the number of marinas compared to the second largest contributing state, Queensland, New South Wales marina economic output was only a third greater. Differences in financial performance are influenced by the size of marinas, where larger marinas generate greater revenues. Only 15 (14%) of New South Wales's marinas are considered 'large', containing more than 250 storage spaces. In comparison, more than half (57%) of Queensland marinas were of this size.[76]

Chart 3.10: Economic output of marinas and boating infrastructure activities in 2020-21 ($ millions)

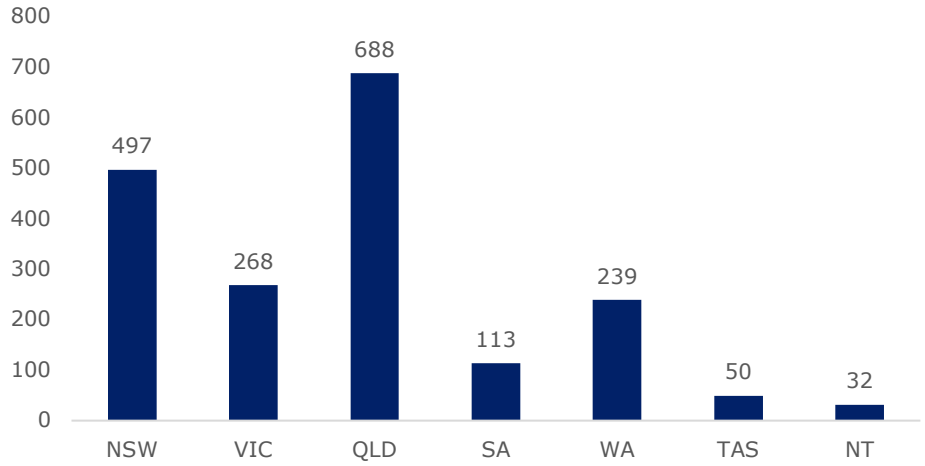


Notes: The value of marinas and boating infrastructure at the national level also includes marinas in the Northern Territory and the Australian Capital Territory. Both territories were excluded from the state breakdown for confidentiality reasons.
Source: Deloitte Access Economics, Marine Industry Survey (2021).

Marine equipment retailing is the largest contributor to this sub-sector and consists of retailing related to new or used boats and boating accessories. In 2020-21, the value of marine equipment retailing in Australia was $1.9 billion. The state and territory output was estimated by assessing marine equipment retailing employment collected in *the Census*.

In 2020-21, Queensland was the largest retailer of marine equipment ($688 million), followed by New South Wales ($497 million) and Victoria ($268 million). As reflected in boatbuilding and repair services and marinas and boating infrastructure activity, Queensland and New South Wales are hubs for marine recreational activity involving boating, which generates demand for marine equipment.[77] Large marine equipment retail outlets in these states provide new or used boats and products for boats, yachts, sailing and outboard motors.[78]

Chart 3.11: Economic output of marine equipment retailing in 2020-21 ($ millions)



Source: Deloitte Access Economics, IBISWorld (2022), Australia Bureau of Statistics (2022).

3.2.7 Marine tourism and recreational activities other than fishing

A universal definition of marine tourism and recreational activities does not exist in the literature. However, a common theme among existing definitions is that marine tourism involves travel away from a residence to take part in activities in or that rely on the marine environment.[79] Though it has not been previously stated, this definition is consistent with the previous Index.

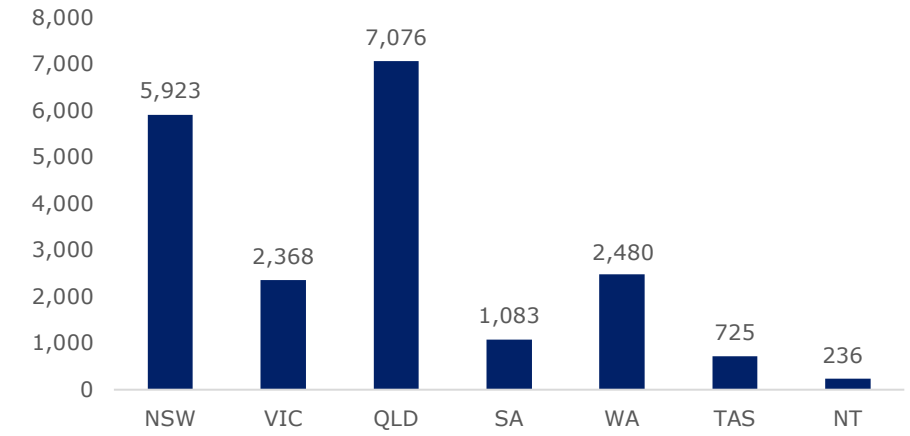
This edition of the Index uses the same approach to estimate marine tourism output as the 2020 Index. Domestic and international marine tourism expenditure was valued based on trips that involved marine activities in coastal tourism regions.[80] Marine activities include going to the beach, whale or dolphin watching, fishing, snorkelling, scuba diving, surfing, boat or ferry charters and visiting or staying on an island.[81]

Domestic marine tourism includes both domestic overnight marine tourism and domestic day trip marine tourism, whereas international tourism only includes visitor nights by international visitor trips. This distinction is made as different types of visitors have different expenditure profiles.

Data used to quantify tourism activity are drawn from Tourism Research Australia's National Visitor Survey (NVS), International Visitor Survey (IVS), and Regional Expenditure (REX) database. Total expenditure by marine tourists is the product of the estimated number of visitors or visitor nights (based on NVS and IVS data) and the estimated expenditure per visitor or visitor night (based on REX data).

The total value of marine tourism output in 2020-21 was $19.9 billion. The greatest combined domestic and international marine tourism output was attributable to Queensland ($7.1 billion and $29.0 million), New South Wales ($5.9 billion and $48.0 million) and Victoria ($2.4 billion and $20.0 million).

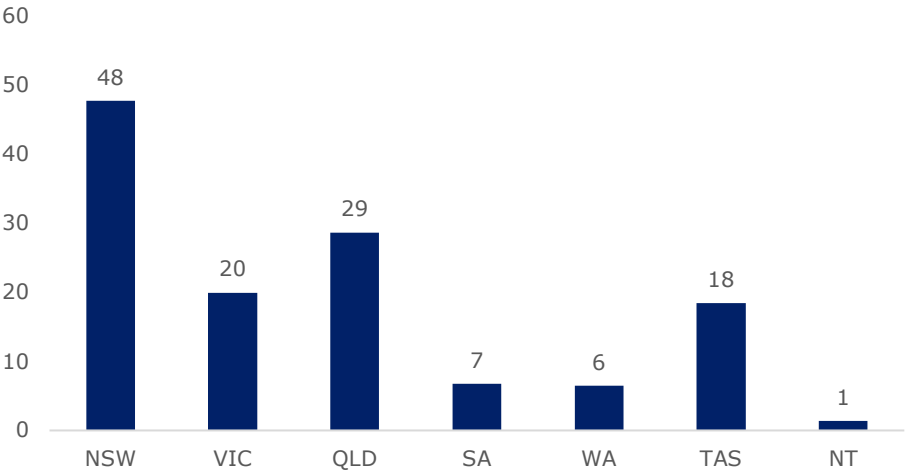
Chart 3.12: Domestic marine tourism output in 2020-21 ($ millions)



Source: Deloitte Access Economics, Tourism Research Australia (2022).

International tourism expenditure was significantly lower than domestic tourism in 2020-21 due to COVID-19 pandemic border closures. To illustrate, the sum of international marine tourism output across all states ($129 million) is equivalent to around half of the Northern Territory's domestic marine tourism output in 2020-21 – which had the lowest domestic marine tourism output of all coastal states and territories.

Chart 3.13: International marine tourism output in 2020-21 ($ millions)



Source: Deloitte Access Economics, Tourism Research Australia (2022).

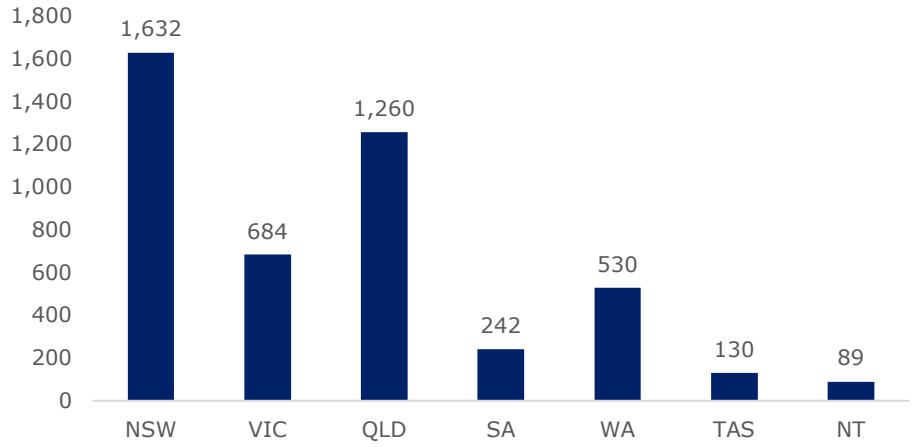
A new sub-sector included in this edition of the Index is marine recreational activities other than fishing. It includes expenditure from surfing visits, boating activities (excluding recreational activities) and beach-related activities undertaken by coastal residents.

It is possible that other activities such as visiting estuaries, snorkelling and diving could be included in this sub-sector, however it is difficult to distinguish domestic daytrip tourism activity from coastal resident activity. As such, a conservative approach to estimating recreational activities other than fishing has been adopted.

The average number of annual beach visits and the average number of trips by frequent surfers were derived from average monthly estimates of beach and surfing visits by state.[82] Overnight visitor trips for each of these activities from the NVS database were subtracted from Surf Life Saving activity estimates to ensure activity was attributable to coastal residents. Boating trips were based on the number of registered recreational vessels in each state applied to an estimated number of trips per year.[83] Output generated from these activities is estimated as the product of trips and the average cost per trip for each type of activity.

In 2020-21, non-fishing marine recreational activities generated $4.5 billion in output. The greatest recreational activity expenditure occurred in New South Wales ($1.6 billion), followed by Queensland ($1.3 billion) and Victoria ($684 million).

Chart 3.14: Other recreational activities output in 2020-21 ($ millions)



Source: Deloitte Access Economics, Surf Life Saving Australia (2022)

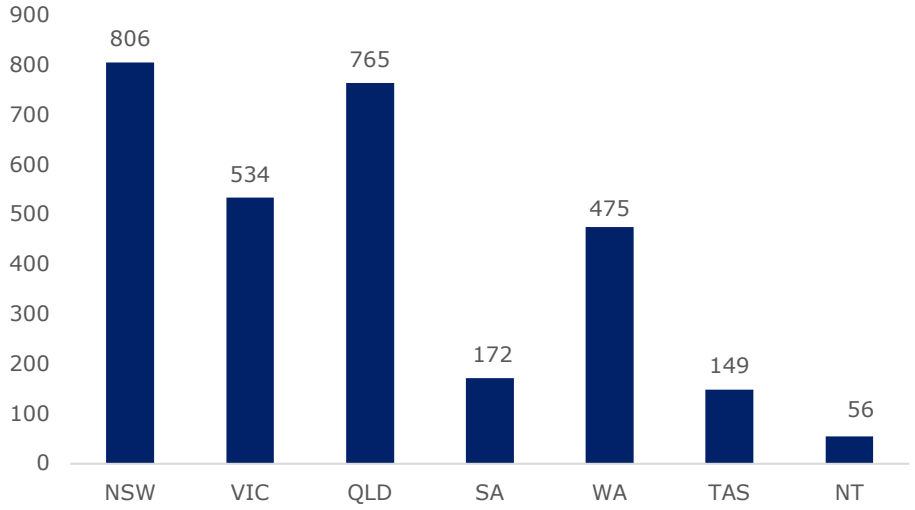
3.2.8 Water transport, services to water transport and ports

There is a significant challenge in capturing and appropriately attributing the value of all water-based passenger and freight transport activity that occurs in Australia or Australian waters due to the multinational nature of transport operators. For the purposes of the Index this sector includes only the industry sub-sectors for which the ABS collects and publishes data on the gross value of production.[84]

Water transport services includes coastal sea freight services between domestic ports, international sea freight transport between domestic ports and international ports, harbour and ferry freight and river transport. Direct port activity is considered a supporting activity of water transport and is included in water transport support services. The economic output of water-based transport is published by the *ABS Industry Statistics* and state-and-territory output is determined by the share of water transport employment by state or territory collected in *the Census*.[85]

In 2020-21, water-transport of passengers and freight was greatest in New South Wales ($806 million), Queensland ($765 million) and Victoria ($534 million). Containerised ports in New South Wales and Queensland generated the greatest output as a result of the large volume of mining commodity exports – specifically, coal. In addition, the location of the Sydney Harbour Network and the Great Barrier Reef generate significant activity in passenger ferry terminals. Victoria's output is also significant, where the Port of Melbourne is considered Australia's busiest containerised port.[86]

Chart 3.15: Water-based transport of passengers and freight output in 2020-21 ($ millions)



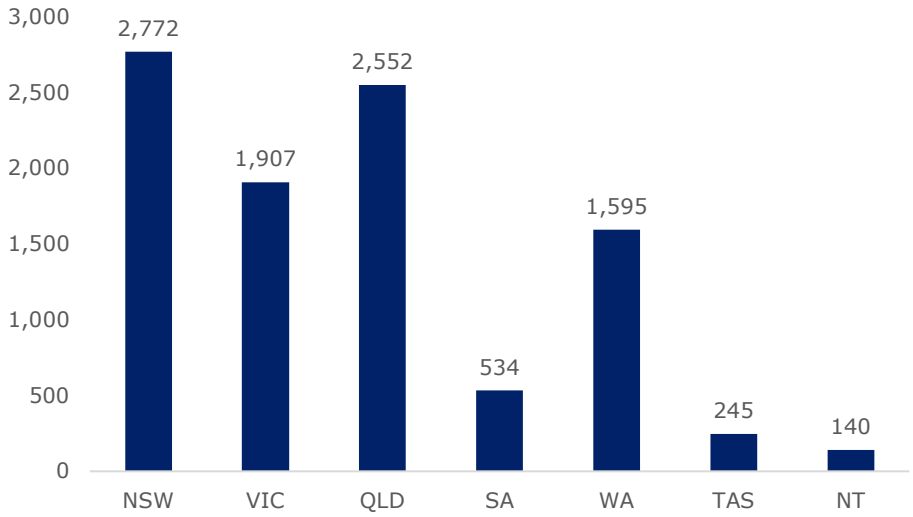
Sources: Deloitte Access Economics, Australian Bureau of Statistics (2022).

This Index includes the quantification of water transport support services, which was previously excluded due to data availability. Water transport support services including ports captures water transport support services that are not elsewhere classified. The primary activities included in this category are lighterage services to transfer cargo between vessels, stevedoring services, navigation related to water transport, pilotage services, salvage services, marine ship registration and agency services, towboat and tugboat operation; and water vessel towing services.[87]

In 2020-21, the water transport support industry was valued at $9.8 billion according to IBISWorld revenue estimates, which reflect the sum of industry revenues for port and water transport terminal operations, stevedoring services and navigation and towage and services to water transport. [88] State-or-territory-based attribution of economic output is estimated using employment reported in *the Census*. [89]

In 2020-21, water transport support services including ports was largest in NSW ($2.8 billion), followed by QLD ($2.6 billion) and Victoria ($1.9 billion). Cargo ships use container ports and hybrid ports located close to capital cities for merchandise and cargo imports distributed to retailers and wholesalers.[90] In contrast, exports are dominated by mining activity which uses custom-built ships operated from specialised bulk facilities located close to mining activity and bulk rail transport.[91]

Chart 3.16: Water-transport support services, including ports ($ millions, 2020-21)



Sources: Deloitte Access Economics, Australian Bureau of Statistics (2022).

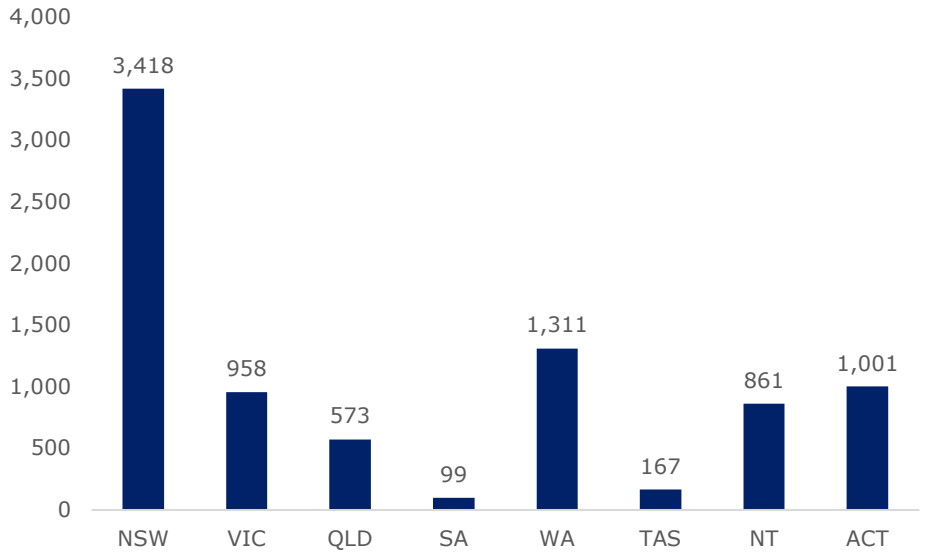
3.2.9 Defence

Another inclusion in this edition of the Index is defence, specifically Royal Australian Navy (Navy) activity. While many marine industry studies do not include Navy activity, a recent report recognises the importance of maritime security as an enabler of and a sector within the Blue Economy.[92] The sector enables the Blue Economy by safeguarding navigation channels, providing oceanographic data to marine industries and controls Illegal Unreported and Unregulated fishing. In addition, it stimulates economic activity through the development of surveillance technologies and defence activities.

Navy outputs are reported in the *Defence Budget Portfolio Statement 2021-22*, which provide estimates for Navy expenditure from own source revenue in 2020-21.[93] Department of Defence annual reports also detail Navy employment by permanent and reserve workforce status, which was used to estimate state-and-territory output. [94] There could be other marine defence activity not captured as Navy capability – for example, Army watercraft – and therefore the $8.4 billion in total output may represent a conservative estimate.

The highest defence output exists in New South Wales ($3.4 billion), which hosts six out of 17 Navy bases and establishments – four of which are located in Sydney Harbour. Western Australia ($1.3 billion) and the Australian Capital Territory ($1.0 billion) are also significant contributors to defence output. The HMAS Stirling Naval Base in Western Australia is one of the nation's largest bases – the only naval base of Australia's west coast and host to the only Submarine Escape Training Facility in the southern hemisphere in 2020-21.[95] In addition to Jervis Bay navy activities, the Australian Department of Defence head office located in Canberra is a significant place of employment for senior Navy officials and administration.

Chart 3.17: Defence output in 2020-21 ($ millions)



Sources: Deloitte Access Economics, Department of Defence (2022).

3.2.10 Sewerage and drainage services, environment management and marine safety

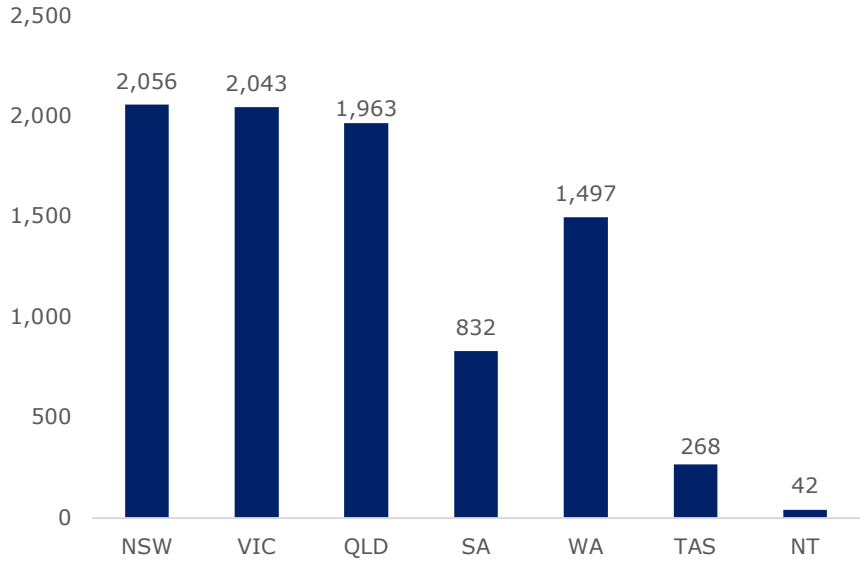
Sewerage and drainage services in the Index are defined by activities required to operate sewerage or drainage systems or sewage treatment plants that discharge into the marine environment. It includes the sewerage pumping station operation, sewage treatment plant operations, sewerage system operations, stormwater drainage system operations and town drainage system operations.[96]

In 2020-21, 93% of Australian households were connected to a wastewater treatment plant.[97] However, not all of the stormwater or wastewater treatment is discharged into the ocean – some treated effluent is recycled for agricultural or recreational use, or discharged into wetlands and river systems - from which some may eventually discharge into the ocean.

It is impractical to examine each sewerage and drainage system in Australia to determine the use of the marine environment in each system's operations. As such, the size of the marine sewerage and drainage sector was estimated by applying the proportion of sewerage and drainage employment that occurs in coastal local government area (LGA) regions.[98] The product of marine employment by local government area and IBISWorld sewerage and drainage industry revenue generated an estimate of sub-sector output for 2020-21, which was aggregated to the state and national level.[99]

Coastal sewage and drainage services generated $8.7 billion in 2020-21. Population distribution, urbanisation and business activity are major factors that influence industry revenue flows. As such, New South Wales ($2.1 billion), Victoria ($2.0 billion), and Queensland ($2.0 billion) were the largest sources of coastal sewerage and drainage service revenue.

Chart 3.18: Coastal sewerage and drainage services output in 2020-21 ($ millions)



Source: Deloitte Access Economics, Australian Bureau of Statistics (2022).

Other activities not quantified also provide safety and management services for the marine environment, including scientific research and knowledge transfer, the establishment of environmental activities and marine safety activities (such as surf lifesaving). Activity that occurs in these sub-sectors is often spread across several institutes and universities at national, state and local levels of government and non-government sectors. The operating budgets of some of these institutes are included in Appendix A.

4 Economic contribution of the marine industry

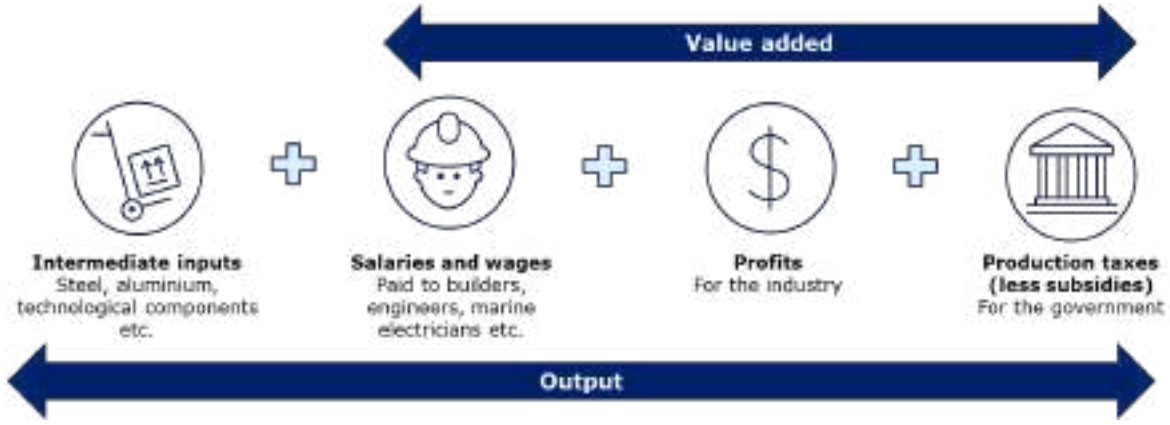
4.1 Economic contribution analysis

Another way of analysing the economic footprint of an industry is to look at its value added. Value added analysis avoids issues with double counting that can occur when aggregating output across industries. Indeed, value add is the metric used in aggregate economic indicators such as GDP and GSP.

Value added is an industry's returns to labour (in the form of salaries and wages), capital (in the form of gross operating surplus – or profit) and net taxes on production. It can also be calculated by subtracting intermediate expenditure – inter-industry flows – from the total economic output, which is what was covered in Chapters 2 and 3. See Figure 4.1 for an example of how value added is related to output, in this case for the boatbuilding and repairs industry. The value added of an industry represents its economic contribution. The sum of value added across all industries is equal to GDP at a national level, or GSP at a state level.

Given the relationship between value added and output, state trends in economic output are similar to the state trends in value added. Therefore, value added has only been estimated at the national level.

Figure 4.1: Output versus value added for the boatbuilding and repairs industry



Source: Deloitte Access Economics

4.2 Methodology

The value added contribution of the marine industry can be divided into direct and indirect components. This includes:

- The *direct* economic contribution is the value add within the marine industry itself.
- The *indirect* economic contribution is a measure of the value add in other parts of the economy, because of the marine industry. Estimation of the indirect economic contribution is undertaken using ABS Input-Output (IO) tables.[100]
- The total economic contribution to the economy is the sum of the direct and indirect economic contributions.

The IO tables provide information about each sub-sector's expenditure to ABS industries, which can be used to estimate the ratio of upstream industry expenditure as a share of total output. These ratios are used to estimate sub-sector intermediate expenditure that occurred in each upstream ABS industry. The intermediate expenditure profile is used to estimate the indirect contribution of the sub-sector by calculating the relationships between value added and output using the IO tables. A discussion of the methodology is provided in Appendix C.

Box 5: The ABS Australian Defence Industry Account

The ABS recently published Australian Defence Industry Account (ADIA) experimental estimates which measure the first-round economic activity that defence spending contributes to the Australian economy. The scope of the ADIA is limited to Australian organisations that have directly received payments from defence and have produced the good and/or services that they deliver to the defence sector within Australia. These estimates do not include payments to defence's factors of production (such as payments to defence employees).

In comparison, the Index estimates the direct value added from the Navy's factors of production (the direct contribution), and the indirect value added from Navy spending, which includes the first and subsequent rounds of economic activity (the indirect contribution).

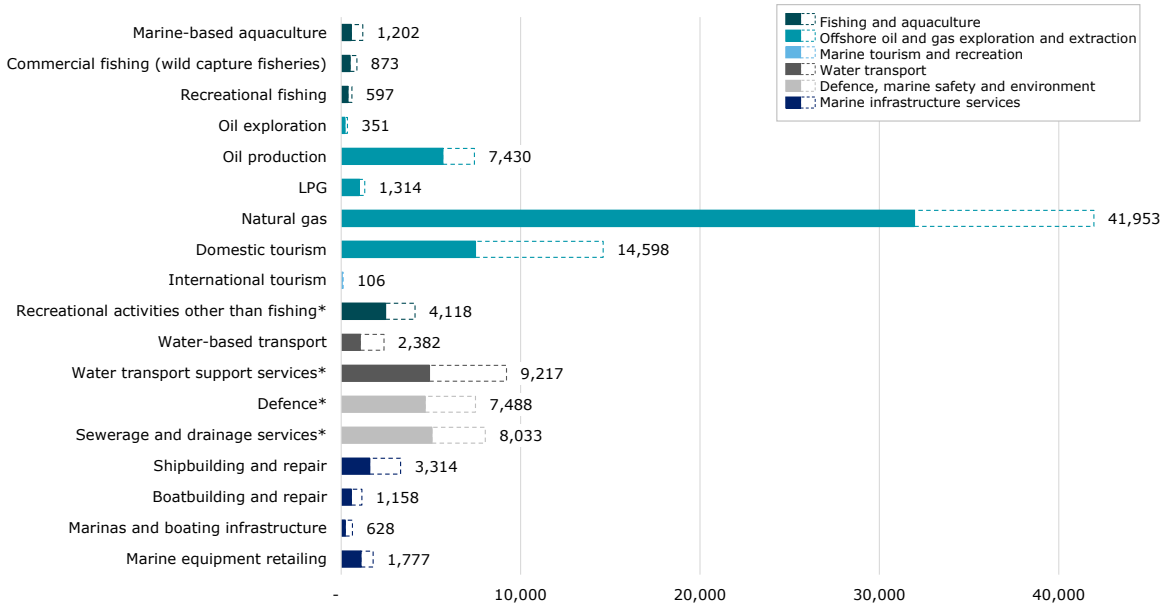
4.3 Economic contribution results

4.3.1 Value added

The total direct and indirect value added for each industry sub-sector is presented in Chart 4.1. Natural gas production represents the largest share of value added, driven by large industry profits.

The values presented in Chart 4.1 do not add to the total value added of the marine industry because many sub-sectors supply to each other. For example, the shipbuilding and repair sub-sector provides services to defence (specifically, the Navy). The indirect value added of the defence sub-sector therefore includes some of the direct value added of the shipbuilding industry.

Chart 4.1: Direct and indirect value added by sub-sector in 2020-21 ($ millions)



Notes: The direct value added is represented by the solid colour and the indirect value added is represented by the dashed outline. Sub-sectors with the asterisk are the new sub-sectors added into this edition of the Index.

Source: Deloitte Access Economics.

Some sub-sectors, especially those involved in extraction of natural resources such as oil, natural gas, and commercial fishing, have a large direct to indirect value add component – in other words, most of their value add is captured within those sub-sectors directly. This reflects the typical structure of primary industries, in which expenditure on upstream suppliers per unit of output is usually less than that in other sub-sectors. By comparison, other secondary and tertiary sub-sectors such as tourism, transport and manufacturing (e.g., shipbuilding and repair), see a larger share of their value added as indirect. This is because, for every dollar they earn, they spend more buying from other sectors which, in turn, stimulates value added in those other sectors. Having a large or small indirect contribution mostly relates to where an industry is in the supply chain.

The total contribution of the marine industry in aggregate was estimated using an additional step to remove double-counting. The proportion of industry expenditure that contributed to direct value added in other marine sub-sectors was estimated using the ABS IO tables. This portion was removed from the intermediate expenditure bundles to create new 'adjusted' expenditure bundles, which were modelled to calculate indirect value added.

In total, the Australian marine industry was estimated to contribute $69.3 billion in direct value added in 2020-21, with a further indirect value added of $35.9 billion. This amounts to a total contribution of $105.3 billion in value added (see Table 4.1). This represents 5.2% of national GDP in 2020-21.

To make a comparison over time we must only consider the sub-sectors used in the previous edition. On that basis, despite the impact of COVID-19, the marine industry's contribution to GDP slightly increased from 3.7% to 3.8% between 2017-18 and 2020-21.

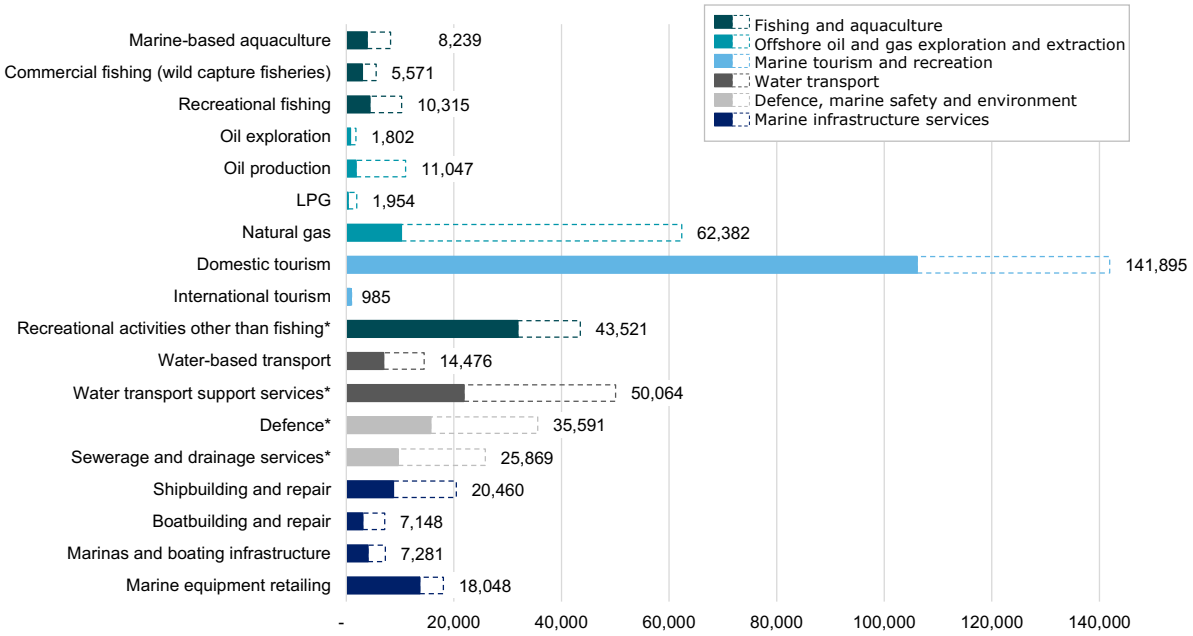
Table 4.1: Economic output and contribution of the Australian marine industry, 2020-21 ($ million)

	Value of production (output)	Direct value added	Indirect value added	Total value added
The marine industry	118,518	69,345	35,967	105,312

4.3.2 Employment

In addition to value add, the other key metric of economic contribution is contribution to employment. The direct and indirect employment contribution of each industry sub-sector is presented in Chart 4.2. Domestic marine tourism accounts for the largest share of employment, reflecting the relatively labour-intensive nature of tourism-related sub-sectors. Accommodation services and food and beverage services, for example, rely on volume of employees to meet consumer demand and generate revenue. Similar to indirect value added, the indirect employment in the different sub-sectors presented in Chart 4.2 are not additive.

Chart 4.2: Direct and indirect employment by sub-sector in 2020-21 (FTE)



Notes: The direct employment is represented by the solid colour and the indirect employment is represented by the dashed outline. Sub-sectors with the asterisk are the new sub-sectors added into this edition of the Index.
Source: Deloitte Access Economics.

The adjusted expenditure bundles were also used to estimate the employment contribution. In total, Australia's marine industry directly employed approximately 247,000 FTE workers in 2020-21. The marine industry supported a further 215,000 FTE workers in indirect employment (in upstream industries only), amounting to a total employment contribution of 462,000 FTE workers (Table 4.2). In 2017-18, the marine industry supported a total of 339,000 FTE workers (excluding the employment in the new sub-sectors).

Table 4.2: Indirect and direct employment contribution of Australia's marine industry in 2020-21 (FTE)

	Direct FTE	Indirect FTE	Total FTE
The marine industry	246,563	214,967	461,531

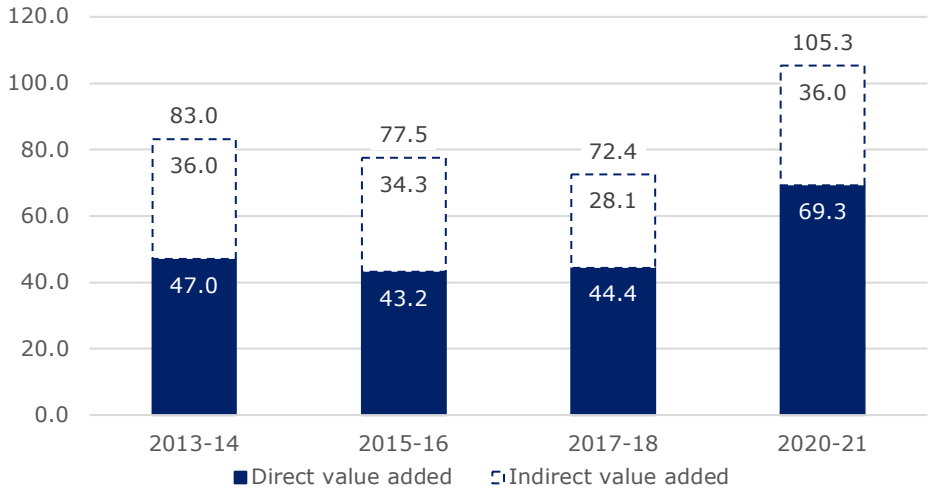
While the offshore oil and gas exploration and extraction sector generates the largest value added in monetary terms, the marine tourism and recreation sector generates the most employment. Large industry profits and subsequent taxes on production generated by a few large industry players are a significant contributor to the value added from the offshore oil and gas sector exploration and extraction sector. As such, the value added for each dollar of output generated in the oil and gas sector is significant. Expenditure on salaries and wages are a much smaller component of value added, and as such, fewer employees are required per unit of output (or revenue). In contrast – service-driven tourism industries such as food and beverage services operate in a competitive industry environment. Many industry players operate on small profit margins yet require significant expenditure towards salaries and wages given the service-driven nature of the sector. Comparatively more FTE employees are required for each unit of output (or revenue) in marine tourism compared to offshore oil and gas exploration and production.

4.3.3 Economic contribution timeseries

The value of output of the marine industry was reported in the first Index in 2008 and back cast for every year to 2000-01. The economic contribution in terms of value added and employment was reported every second year since 2013-14 (with the exception of this Index in which value added was reported three years after the previous Index).

As shown in Chart 4.3, the direct value added as a share of the total value added has grown over time, from 57% of total value added in 2013-14 to 66% in 2020-21. A key driver of this trend is increased profits earned by offshore oil and gas, which has increased significantly relative to its expenditure on intermediate inputs (which underpins the indirect value added) between 2017-18 and 2020-21 (see section 2.3.2).

Chart 4.3: Value added timeseries (2021 dollars)



Notes: Values are based on value added reported in previous AIMS Indexes and adjusted to 2021 dollars. 2017-18 does not include value added of the four new industries

Source: Deloitte Access Economics analysis based on previous AIMS Indexes

5 Future of the marine industry

The economic contribution of all sub-sectors changes over time, as factors influencing the supply and demand for goods and services also change. The marine industry's composition has also changed over time. For example, while the oil and gas sub-sector was similar in size to the marine tourism sub-sector in 2001-02, two decades on it was almost twice as big (pre-COVID-19 pandemic). While it is impossible to say exactly how the industry will change in the long term, there are some drivers of supply and demand that will impact the marine industry.

In 2022, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) outlined seven global megatrends that are expected to shape the 21st century, which include:

- **Adapting to climate change** – the Australian economy's response to a more volatile climate, characterised by significant weather events.
- **Leaner, cleaner and greener** – an increased focus on potential solutions to resource constraints through synthetic biology, adapt the agricultural sector to produce alterative proteins, advanced recycling and the net-zero transition.
- **The escalating health imperative** – an ageing population and growing burden of chronic disease, which could increase health risks to Australia.
- **Geopolitical shifts** – geopolitical tensions, changes in global trade patterns and growing investment in defence could increase uncertainty.
- **Diving into digital** – digital activities that could become mainstream, including teleworking, telehealth, online shopping, and digital currencies.
- **Increasingly autonomous** – the rise of the use of artificial intelligence.
- **Unlocking the human dimension** – strong consumer and citizen push to improve trust, transparency, fairness, and environmental and social governance.

These megatrends will clearly impact the marine industry. For example, adapting to climate change could be an important factor in the development of marine industry sectors that are dependent on a healthy ocean. The State of the Environment report found that Australia's oceans experienced several major marine heatwaves during the 5 years to 2021, resulting in an overall deteriorating trend for our marine environment.[101] The consequences range from changing fish stock distribution, ocean warming and sea level rise impacting coral reefs and the higher frequency and intensity of severe weather events could amplify these impacts on marine dependent industries, disrupt offshore oil and gas production and create shipping delays.

While megatrends present risks for the marine industry, they could also drive opportunities. Marine-dependent renewable energy is poised to play an important role in future energy systems and is considered an attractive renewable resource because of its energy density, predictability, and persistence.[102] As noted in section 3.2.5, Australia's first offshore wind development zone was announced in late 2022. Other possible growth areas for Australia include wave and tidal energy, where recent feasibility assessments of wave power and tidal energy identified potential sources of offshore energy. Australia's southern coastline could contribute up to 11% of Australia's energy in wave energy. [103,104]

In addition to ocean renewable energy, sustainable ocean protein consumption could improve the sustainability of food sources as the global population grows – particularly in key Asian markets. As discussed in Chapter 2, the value of aquacultural production surpassed that of commercial fishing in 2018-19. Aquaculture produces fewer emissions and requires fewer inputs such as feed and land compared to traditional livestock farming, as most nutrients for aquacultural stock are sourced from the ocean.[105]

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Appendix A Data tables

A.1. Summary statistics for Australian marine sub-sectors

A summary of the major and most recent available data regarding marine industry activities in Australia, from publicly available sources, is outlined in Table A.1 below.

The information summarised in the table shows that there are a number of categories for which there is no suitable data available (shown as n/a). For sub-sectors where data is available, comparable and reliable, the values have been aggregated to provide a total measurable value for 2020-21.

Table A.1: Direct and indirect value added by marine sub-sectors in 2020-21 ($ million)

	Industry Value added (2020-21, $m)	Value of production (2020-21, $m)	Industry Employment (2020-21)	Other
Marine resource activities and sub-sectors				
Commercial and recreational fishing and aquaculture				
Marine-based aquaculture[iii]	n/a	1,420	n/a	-
Commercial fishing (wild capture fisheries)[iv]	n/a	1,015	n/a	-
Recreational fishing experience	n/a	653	n/a	-
Indigenous fishing[v]	n/a	n/a	In 2000-01, around 37,000 Indigenous people participated	2000-01 harvest: 1.89 million fish, 0.84 million crustaceans, 1.15 million molluscs, 0.93 million others
Offshore oil and gas exploration and extraction				
Oil exploration	n/a	376	n/a	-
Oil production	n/a	7,741	n/a	-
LPG	n/a	1,369	n/a	-
Natural gas	n/a	43,713	n/a	-
Other resource extraction and use				
Carbon capture - offshore only[vi]	n/a	n/a	n/a	Two offshore carbon capture facilities in the Browse Basin (WA) and Bonaparte Basin (NT) were approved in 2022, in addition to the Gippsland Basin (VIC) in 2014.
Bio-prospecting	n/a	n/a	n/a	-
Marine and seabed mining	n/a	n/a	n/a	-
Ocean renewable energy (tidal and wave) [vii]	n/a	n/a	n/a	More than 200 wave energy devices in various areas of

[iii] Department of Agriculture, Fisheries and Forestry ABARES. (2022). *Australian fisheries and aquaculture Statistics* . Australian Government.
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				testing and demonstration in Australia.
Marine pipeline services	n/a	n/a	n/a	-
Offshore wind	n/a	n/a	3000-4000 by 2030	-
Salt production	n/a	n/a	n/a	-
Desalination[viii,ix]	n/a	n/a	SA Water: 1,500 employees	Desalination plants reported up to 125 GL produced (Victorian Desalination Plant)
Offshore hydrogen	n/a	n/a	n/a	-
Marine biotechnology	n/a	n/a	n/a	-
Marine related service activities and sub-sectors				
Marine tourism and recreational activities other than fishing				
Domestic marine tourism	n/a	19,891	n/a	-
International marine tourism	n/a	129	n/a	-
Aquaria[x]	n/a	n/a	n/a	The ornamental fish industry in Australia is estimated to be worth $350 million annually.
Recreational activities other than fishing **NEW**	n/a	4,567	n/a	-
Water transport, services to water transport and ports				
Water-based transport of passengers and freight[xi]	1,053	2,961	7,000 employees	-
Water transport support services (inc. ports)[xii,xiii]	n/a	9,761	14,183 employees	$12.9 billion income from sales
Defence, marine safety and environment management				
Defence	n/a	8,388	19,217 employees (reserve and permanent)	-
Australian Maritime Safety Authority[xiv]	n/a	n/a	368 employees	Other: Operating expenditure $242.4 million
Surf Life Saving Australia[xv]	n/a	n/a	44.8 employees	$64.9 million in operating expenditure
Australian Volunteer Coast Guard	n/a	n/a	n/a	-
Great Barrier Reef Marine Park Authority[xvi]	n/a	n/a	226 employees	Other: Operating expenditure $79.3 million

[viii] Trility. (n.d). Adelaide Desalination Plant.
[ix] Aquasure. (n.d). The Victorian Desalination Project.
[x] Australian Trade Commission. (2015). *Aquaculture and Fisheries*. Australian Government.
[xi] Australian Bureau of Statistics. (2022). *Australian industry*: *transport, postal and warehousing.*
[xii] IBISWorld. (2022). *Port and Water Transport Terminal Operations in Australia*; Stevedoring Services in *Australia and Navigation, Towing and Services to Water Transport in Australia.*
[xiii] Australian Bureau of Statistics. (2022). *Australian industry*.
[xiv] Australian Maritime Safety Authority. (2020). *Annual Report*. Australian Government.
[xv] Surf Life Saving Australia. (2021). *Annual Report*.
[xvi] Great Barrier Reef Marine Park Authority. (2020). *Annual Report*. Australian Government.

National Offshore Petroleum Safety and Environmental Management Authority[xvii]	n/a	n/a	125 employees	Other: Total expenditure $36.8 million
Sewerage and Drainage Services[xviii]	n/a	8,702	24,340 employees	-
Dredging[xix]	72.3	229	350 employees	-
Marine estate management[xx]	n/a	n/a	n/a	Revenue $15 million (NSW)
Marine scientific research institutes				
SIMS: Sydney Marine Institute of Marine Science[xxi]	n/a	n/a	29 employees	Total expenditure $8.4m
CSIRO Marine National Facility[xxii]	n/a	n/a	n/a	Total expenditure $31.6 million
Western Australian Marine Science Institute	n/a	n/a	n/a	-
Australian Institute of Marine Science[xxiii]	n/a	n/a	231 employees	Total Expenditure $72 million
Boat and ship building and maintenance services, equipment and infrastructure				
Ship building and repair (civil and defence) [xxiv]	1,043	3,861	9,576 employees	-
Boatbuilding and repair [xxv]	450	1,349	5,155 employees	-
Marinas and boating infrastructure[xxvi]	n/a	732	3,302 employees	-
Marine equipment retailing[xxvii]	n/a	1,889	2,817 employees	-

[xvii] NOPSEMA. (2020). *Annual Report 19-20*. Australian Government.
[xviii] Australian Bureau of Statistics. (2022). *Census 2021.*
[xix] Allday,A. (2022). *Dredging Services in Australia*. IBIS World.
[xx] Marine Estate Management Authority. Annual Report 2019-20. Australian Government.
[xxi]Australian Charities and Not-for-profits Commission. (2020). *Annual Information Statement 2020*. Sydney Institute of Marine Science and the Australian Government.
[xxii]CSIRO Marine National Facility (2021). *Year in Review 2020-21*
[xxiii] AIMS. (2021). *Annual report 2020-2021;* ACNC. (2022). Australian Institute of Marine Science, Annual Information Statement.
[xxiv] Australian Bureau of Statistics. (2022). *Australian industry*.
[xxv] Ibid.
[xxvi] Marina's Industry Association. (2021). *Health of the Marina Industry Survey.*
[xxvii] IBISWorld. (2022). *Marine equipment retailing.*

A.2. Economic contribution results – Value added

Table A.2: Direct and indirect value added by marine sub-sectors in 2020-21 ($ million)

	Value of production ($m)	Direct value added ($m)	Indirect value added ($m)	Total value added ($m)
Marine resource activities and sub-sectors				
Commercial and recreational fishing and aquaculture				
Marine-based aquaculture	1420	553	649	1202
Commercial fishing (wild captures fisheries)	1015	488	385	873
Recreational fishing experience	653	371	227	597
Offshore oil and gas exploration and extraction				
Oil exploration	376	197	154	351
Oil production	7,741	5,657	1,772	7,430
LPG	1,369	1,001	313	1,314
Natural gas	43,713	31,946	10,007	41,953
Marine-related service activities and sub-sectors				
Boat and ship building and maintenance services, equipment and infrastructure				
Ship building & repair (civil and defence)	3,861	1,581	1,733	3,314
Boatbuilding & repair (including recreational vessels)	1,349	552	606	1,158
Marinas and boating infrastructure	732	224	404	628
Marine equipment retailing	1,889	1,090	687	1,777
Marine tourism and recreational activities other than fishing				
Domestic tourism expenditure	19,891	7,478	7,120	14,598
International tourism expenditure	129	55	51	106
Recreational activities other than fishing NEW	4,567	2,462	1,656	4,118
Water transport, services to water transport and ports				
Water-based transport of passengers and freight	2,961	1,053	1,329	2,382
Water transport support services (inc. ports) NEW	9,761	4,911	4,306	9,217
Defence, marine safety and environment management				
Defence NEW	8,388	4,676	2,812	7,488
Sewerage and drainage services NEW	8,702	5,052	2,981	8,033

Notes: Each sub-sector was analysed separately. Consequently, the values in the 'indirect value added' column are not additive. Total indirect value added was estimated by removing activity associated with marine sub-sectors to avoid double-counting.
Source: Deloitte Access Economics

Table A.3: Direct and indirect value added by the marine industry 2020-21 ($ million)

	Value of production ($m)	Direct value added ($m)	Indirect value added ($m)	Total value added ($m)
Total marine industry employment contribution	118,518	69,345	35,967	105,312

Source: Deloitte Access Economics

A.3. Economic contribution results – Employment

Table A.4: Direct and indirect employment by marine sub-sectors in 2020-21 (FTE)

	Direct employment (FTE)	Indirect employment (FTE)	Total (FTE)
Marine resource activities and sub-sectors			
Commercial and recreational fishing and aquaculture			
Marine-based aquaculture	3,859	4,380	8,239
Commercial fishing (wild captures fisheries)	2,946	2,625	5,571
Recreational fishing expenditure	4,373	5,942	10,315
Offshore oil and gas exploration and extraction			
Oil exploration	733	1,069	1,802
Oil production	1,811	9,236	11,047
LPG	320	1,634	1,954
Natural gas	10,228	52,154	62,382
Marine-related service activities and sub-sectors			
Boat and ship building and maintenance services, equipment and infrastructure			
Ship building & repair (civil and defence)	8,745	11,715	20,460
Boatbuilding & repair (including recreational vessels)	3,055	4,093	7,149
Marinas and boating infrastructure	4,021	3,260	7,281
Marine equipment retailing	13,643	4,405	18,048
Marine tourism and recreational activities other than fishing			
Domestic tourism expenditure	106,108	35,787	141,895
International tourism expenditure	727	259	985
Recreational activities other than fishing NEW	31,868	11,652	43,521
Water transport and support services			
Water-based transport of passengers and freight	6,924	7,552	14,476
Water transport support services (inc. ports) NEW	21,869	28,195	50,064
Defence, marine safety and environment management			
Defence NEW	15,678	19,913	35,591
Sewerage and drainage services NEW	9,653	16,216	25,869

Notes: Each sub-sector was analysed separately. Consequently, the values in the 'indirect employment' column are not additive. Total indirect employment was estimated by removing activity associated with marine sub-sectors to avoid double-counting.
Source: Deloitte Access Economics

Table A.5: Direct and indirect employment by the marine industry 2020-21

	Direct employment (FTE)	Indirect employment (FTE)	Total (FTE)
Total marine industry employment contribution	246,563	214,967	461,531

Source: Deloitte Access Economics

A.4. Changes in output over time

Table A.6: Economic output from marine-related activities, 2001-02 to 2020-21 ($ millions, nominal terms)

Marine activities and industries																	New figures			
	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Commercial and recreational fishing and aquaculture																				
Marine-based aquaculture	731	709	725	634	742	806	868	867	878	954	1,054	1,053	744	872	969	1,002	1,017	1,199	1,303	1,420
Commercial fishing	1,784	1,656	1,499	1,490	1,461	1,446	1,363	1,393	1,335	1,317	1,302	1,361	1,514	1,616	1,749	1,742	1,793	1,358	1,140	1,015
Total fishing	2,515	2,364	2,224	2,125	2,203	2,252	2,231	2,470	2,213	2,271	2,356	2,356	2,713	2,961	3,209	3,253	3,335	3,142	3,103	3,088
Offshore oil and gas exploration and extraction																				
Oil exploration	720	922	791	830	938	1,727	2,541	3,318	2,746	2,559	2,246	3,430	3,512	2,537	1,278	949	681	823	585	376
Oil production	4,441	3,473	4,899	7,867	7,570	9,230	12,124	8,638	9,412	8,465	9,708	6,978	9,509	7,254	4,968	3,907	5,305	7,555	7,691	7,741
LPG	856	981	717	861	1,037	1,038	1,182	1,044	1,105	1,068	971	1,088	960	816	699	604	737	1,067	1,413	1,369
Natural gas	2,613	2,607	2,174	3,199	4,416	5,220	5,854	10,079	7,789	10,437	11,950	13,741	19,239	18,589	16,936	20,652	30,302	46,566	45,939	43,713
Total offshore oil & gas	8,630	7,983	8,581	12,757	13,961	17,215	21,701	23,078	21,051	22,529	24,875	25,238	33,220	29,195	23,882	26,113	37,025	56,011	55,629	53,200
Boat and ship building and maintenance services, equipment and infrastructure																				
Shipbuilding and repair	1,796	1,839	1,696	1,721	1,797	1,777	1,954	1,997	2,724	2,722	2,825	3,098	2,966	3,231	2,251	2,285	3,524	3,817	3,988	3,861
Boatbuilding and repair	818	1,037	1,108	1,251	1,488	1,688	1,829	1,869	1,207	1,203	1,055	1,048	1,235	1,138	1,154	1,176	1,179	1,369	1,283	1,349
Marinas and boating infrastructure													699	712	719	767	783	841	799	732
Marine equipment retailing	1,412	1,633	1,670	1,710	1,744	1,805	2,487	2,559	2,167	2,149	2,055	1,460	1,538	1,516	1,502	1,480	1,459	1,659	1,717	1,889
Total boat/ship services	4,026	4,509	4,474	4,682	5,029	5,270	6,270	6,426	6,098	6,074	5,935	5,606	6,438	6,597	5,627	5,708	6,945	7,686	7,787	7,831
Marine tourism and recreation activities other than fishing																				
Domestic marine tourism	7,337	7,784	7,726	7,909	8,326	9,012	9,554	9,345	11,048	11,236	11,949	12,639	20,241	19,752	21,668	22,182	24,040	25,259	19,858	19,891
International marine tourism	1,272	1,292	1,377	1,420	1,469	1,612	1,725	1,799	1,964	204	2,065	2,294	4,886	5,361	6,097	6,334	6,675	6,968	5,022	129
Recreational activities other than fishing [NEW]																				4,567
Total tourism	8,609	9,076	9,102	9,329	9,795	10,624	11,279	11,143	13,011	13,279	14,013	14,933	25,127	25,113	27,765	28,516	30,715	32,227	24,881	24,588
Water transport, services to water transport and ports																				
Water-based transport of passengers and freight													3,817	3,481	3,142	2,903	3,199	3,779	2,875	2,961
Water transport support services [NEW]																	9,889	10,106	9,948	9,761
Total water transport													3,817	3,481	3,142	2,903	13,088	13,885	12,823	12,722
Defence, marine safety and environment management																				
Defence [NEW]																	6,094	6,293	6,701	8,388
Sewerage and drainage services [NEW]																	7,854	8,109	8,304	8,702
Total Defence, marine safety and environment management																	13,947	14,403	15,005	17,091
TOTAL	**23,780**	**23,932**	**24,381**	**28,892**	**30,988**	**35,361**	**41,480**	**43,118**	**42,373**	**44,153**	**47,179**	**48,133**	**71,315**	**67,347**	**63,625**	**66,492**	**105,055**	**127,354**	**119,228**	**118,518**

Notes: The data from 2017-18 to 2020-21 reflect methodological updates to the structure of the marine industry since the 2020 Index. Values presented do not account for inflation.
Source: Deloitte Access Economics

Table A.7: Economic output from marine-related activities, 2001-02 to 2020-21 ($ millions, 2021 dollars)

Marine activities and industries																	New figures			
Value of output ($m, real)	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**	**2006-07**	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**	**2019-20**	**2020-21**
Commercial and recreational fishing and aquaculture																				
Marine-based aquaculture	1,135	1,068	1,066	911	1,034	1,090	1,136	1,100	1,088	1,148	1,239	1,210	832	959	1,052	1,069	1,065	1,235	1,324	1,420
Commercial fishing	2,770	2,495	2,207	2,142	2,034	1,955	1,783	1,767	1,655	1,583	1,531	1,564	1,694	1,778	1,898	1,859	1,877	1,398	1,158	1,015
Recreational fishing	-	-	-	-	-	-	-	-	-	-	-	-	510	521	533	543	550	602	671	653
Total fishing	3,905	3,564	3,273	3,054	3,068	3,045	2,919	3,134	2,744	2,731	2,770	2,708	3,036	3,257	3,483	3,470	3,491	3,236	3,153	3,088
Offshore oil and gas exploration and extraction																				
Oil exploration	1,117	1,390	1,165	1,193	1,306	2,336	3,325	4,210	3,405	3,077	2,640	3,943	3,930	2,791	1,387	1,013	713	848	594	376
Oil production	6,895	5,234	7,210	11,306	10,541	12,483	15,862	10,960	11,671	10,180	11,413	8,021	10,641	7,980	5,391	4,169	5,553	7,780	7,816	7,741
LPG	1,329	1,479	1,056	1,238	1,444	1,404	1,547	1,324	1,370	1,284	1,142	1,251	1,074	898	759	645	771	1,099	1,436	1,369
Natural gas	4,057	3,929	3,200	4,598	6,149	7,060	7,659	12,788	9,658	12,552	14,047	15,794	21,528	20,450	18,379	22,035	31,719	47,953	46,684	43,713
Total offshore oil & gas	13,398	12,032	12,630	18,334	19,441	23,282	28,393	29,282	26,104	27,094	29,242	29,008	37,173	32,120	25,916	27,861	38,756	57,679	56,531	53,200
Boat and ship building and maintenance services, equipment and infrastructure																				
Shipbuilding and repair	2,789	2,772	2,496	2,473	2,502	2,403	2,557	2,534	3,378	3,274	3,321	3,561	3,319	3,555	2,443	2,438	3,689	3,931	4,053	3,861
Boatbuilding and repair	1,270	1,563	1,631	1,798	2,072	2,283	2,393	2,372	1,497	1,447	1,240	1,205	1,382	1,252	1,252	1,255	1,234	1,410	1,304	1,349
Marinas and boating infrastructure	-	-	-	-	-	-	-	-	-	-	-	-	783	783	781	819	820	866	812	732
Marine equipment retailing	2,192	2,461	2,458	2,457	2,428	2,441	3,254	3,247	2,687	2,584	2,415	1,678	1,720	1,668	1,630	1,579	1,527	1,708	1,745	1,889
Total boat/ship services	6,250	6,796	6,585	6,728	7,002	7,127	8,203	8,153	7,562	7,304	6,977	6,443	7,204	7,258	6,106	6,090	7,270	7,915	7,913	7,831
Marine tourism and recreation activities other than fishing																				
Domestic marine tourism	11,390	11,732	11,371	11,367	11,594	12,189	12,500	11,857	13,699	13,512	14,046	14,527	22,650	21,730	23,513	23,667	25,164	26,011	20,180	19,891
International marine tourism	1,975	1,948	2,026	2,040	2,045	2,180	2,257	2,282	2,435	245	2,427	2,637	5,468	5,898	6,617	6,758	6,987	7,176	5,104	129
Recreational activities other than fishing [NEW]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,567
Total tourism	13,365	13,679	13,397	13,407	13,639	14,368	14,757	14,139	16,135	15,970	16,473	17,164	28,118	27,628	30,130	30,425	32,151	33,187	25,284	24,588
Water transport and support services																				
Water-based transport of passengers and freight	-	-	-	-	-	-	-	-	-	-	-	-	4,271	3,830	3,410	3,097	3,349	3,892	2,922	2,961
Water transport support services (inc. ports) [NEW]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,351	10,407	10,109	9,761
Total water transport	-	-	-	-	-	-	-	-	-	-	-	-	4,271	3,830	3,410	3,097	13,700	14,299	13,031	12,722
Defence, marine safety and environment management																				
Defence [NEW]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6,379	6,481	6,810	8,388
Sewerage and Drainage services [NEW]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,221	8,351	8,439	8,702
Total Defence, marine safety and environment management	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14,600	14,832	15,249	17,091
TOTAL	**36,918**	**36,071**	**35,885**	**41,523**	**43,150**	**47,822**	**54,272**	**54,709**	**52,544**	**53,099**	**55,461**	**55,323**	**79,803**	**74,093**	**69,044**	**70,944**	**109,967**	**131,148**	**121,161**	**118,518**

Notes: The data from 2017-18 to 2020-21 reflect methodological updates to the structure of the marine industry since the 2020 Index. Values presented are adjusted for inflation using changes in the consumer price index (CPI) published by the ABS.

Source: Deloitte Access Economics

Appendix B
Methodology updates to output estimates

To ensure the Index is as accurate and up to date as possible, new data sources and approaches are reviewed as they become available to estimate the contribution of the Australian marine industry. No new methodological updates were made to existing sub-sectors since the previous Index. However, new methodologies were established in four new industries, summarised below.

Table C.1: Detailed description output estimation for four new industries

Sub-sector	Description
Recreational activities other than fishing	The average number of annual beach visits and the average number of visits by frequent surfers were derived from average monthly estimates of beach and surfing visits by state, according to the *National Coastal Safety Report* by Surf Life Saving Australia. However, recreational beach activity was not reported in detail prior to 2020-21 and therefore was not included in the analysis. Overnight visitor trips for each of these activities from the National Visitor Survey database were subtracted from Surf Life Saving activity figures to estimate activity from coastal residents. Output generated from these activities is estimated as the product of trips and the average cost per trip for each type of activity according to a study of *Economic and social values of beach recreation on the Gold Coast* and adjusted to 2021 dollars. Recreational boating trip output (excluding fishing) was estimated as the sum of boating activity expenditure and licencing costs per year. Recreational boating expenditure was estimated according to a *Recreational Boating Participation* report for Transport for NSW and adjusted to 2021 dollars. Boating activity expenditure was estimated as the product of expenditure by type of trip (day trip or overnight trip), the number of registered recreational vessels in each state applied to an estimated number of trips per year. Licencing costs were derived from a comparison of jet ski and personal watercraft licence fees reported by *WatercraftZone* in 2021, which was applied to an estimated number of trips in each state.
Water transport support services	The sub-sector was previously excluded from the analysis due to limited data availability, where the value of sales of water transport support services could not be disaggregated from land transport support services. Since the previous Index, the ABS published a separate catalogue containing transport, postal and warehousing industry estimates, with detailed income data for port and water transport terminal operations, stevedoring services, and other water transport support services. In addition, IBISWorld released a series of reports in March 2022 which provide revenue estimates for the same services. The 2020-21 output measures of ABS and IBISWorld estimates are comparable; however, IBISWorld estimates have been used to incorporate 2017-18 to 2020-21 data whereas ABS only provides data for 2020-21. Water transport support service output is the sum of industry revenues for port and water transport terminal operations, stevedoring services and navigation and towage and services to water transport. These estimates were applied to employment estimates from *Census* to calculate the output at the State level.
Sewerage and drainage	IBISWorld provides estimates of sewerage and drainage industry revenue for 2017-18 to 2020-21 in real terms. Analysis of ABS Local Government Areas (LGAs) determined that 294 of 566 LGAs in Australia were adjacent to the coast. The size of the marine sewerage and drainage sector was pragmatically estimated by applying the proportion of sewerage and drainage employment that occurs in coastal LGA regions, aggregated at the state level.
Defence	The *Defence Budget Portfolio Statement 2021-22* provides estimated actuals for Navy expenditure from own source revenue in 2020-21 (that is, expenditure on Navy capabilities independent of external revenue sources). The Department of Defence *Annual Report 2021* also details Navy employment by permanent and reserve workforce status. The share of employment by state was applied to each state and territory to estimate Navy output by state.

Appendix C
Economic contribution framework

Economic contribution studies are intended to quantify measures such as value added and employment associated with a given industry or firm, in an historical reference year.

C.1. Value added

Value added is the most appropriate measure of a firm or industry's economic contribution to GDP at the national level. The value added of each industry in the value chain can be added without the risk of double counting across industries, which is caused by including the value added by other industries earlier in the production chain.

C.2. Measuring economic contribution

There are several commonly used measures of economic activity, each of which describes a different aspect of an industry's economic contribution:

- **Value added** measures the value of output (i.e., goods and services) generated by the entity's factors of production (i.e., labour and capital) as measured in the income to those factors of production. The sum of value added across all entities in the economy equals gross domestic product. Given the relationship to GSP, the value added measure can be thought of as the increased contribution to welfare. Value added is the sum of:
  - Gross operating surplus (GOS) – GOS represents the value of income generated by the entity's direct capital inputs, generally measured as the earnings before interest, tax, depreciation and amortisation (EBITDA)
  - Tax on production less subsidy provided for production – This generally includes company taxes and taxes on employment. Note: Given the returns to capital before tax (EBITDA) are calculated, company tax is not included, or this would double count that tax
  - Labour income is a subcomponent of value added. It represents the value of output generated by the entity's direct labour inputs, as measured by the income to labour.
- **Employment** is a fundamentally different measure of activity from those above. It measures the number of workers employed by the entity, rather than the value of the workers' output.

Gross output is the sum of value added and the value of intermediate inputs. Value added can be calculated directly by adding the payments to the primary factors of production, labour (i.e., salaries) and capital (i.e., GOS, or profit), as well as production taxes less subsidies. The value of intermediate inputs can also be calculated directly by adding up expenses related to non-primary factor inputs.

C.3. Direct and indirect contributions

The direct economic contribution is a representation of the flow from labour and capital involved in the economic activity itself. The indirect economic contribution is a measure of the demand for goods and services produced in other sectors as a result of demand generated by economic activity associated with the marine industry. Estimation of the indirect economic contribution is undertaken in an input-output (IO) framework using Australian Bureau of Statistics input-output tables that report the inputs and outputs of specific sectors of the economy. The total economic contribution to the economy is the sum of the direct and indirect economic contributions.

While describing the geographic origin of production inputs may be a guide to a firm or activity's linkages with the local economy, it should be recognised that these are the type of normal industry linkages that characterise all economic activities.

Unless there is significant unused capacity in the economy (such as unemployed labour) there is only a weak relationship between a firm's economic contribution as measured by value added (or other static aggregates) and the welfare or living standard of the community. Indeed, the use of labour and capital by demand created from the industry comes at an opportunity cost as it may reduce the amount of resources available to spend on other economic activities.

This is not to say that the economic contribution, including employment, is not important. As stated by the Productivity Commission in the context of Australia's gambling industries:[28]

Value added, trade and job creation arguments need to be considered in the context of the economy as a whole … income from trade uses real resources, which could have been employed to generate benefits elsewhere. These arguments do not mean that jobs, trade and activity are unimportant in an economy. To the contrary they are critical to people's well-being. However, any particular industry's contribution to these benefits is much smaller than might at first be thought, because substitute industries could produce similar, though not equal gains.

In a fundamental sense, economic contribution studies are simply historical accounting exercises. No 'what-if', or counterfactual inferences – such as 'what would happen to living standards if this economic activity disappeared?' – should be drawn from them.

The analysis – as discussed in the report – relies on a national input-output table modelling framework and there are some limitations in this modelling framework. The analysis assumes that goods and services provided to the sector are produced by factors of production that are located completely within the state or region defined and that income flows do not leak to other states.

The IO framework and the derivation of the multipliers also assume that the relevant economic activity takes place within an unconstrained environment. That is, an increase in economic activity in one area of the economy does not increase prices and subsequently crowd out economic activity in another area of the economy. As a result, the modelled total and indirect contribution can be regarded as an upper-bound estimate of the contribution made by the supply of intermediate inputs.

Similarly, the IO framework does not account for further flow-on benefits as captured in a more dynamic modelling environment like a CGE model.

C.4. Input-output analysis

The economic contribution was estimated using the Deloitte Access Economics Regional Input-Output Model (DAE-RIOM). The model uses input-output tables to account for the intermediate flows between sectors. These detailed intermediate flows can be used to derive the total change in economic activity associated with a given change in activity for a sector.

A widely used measure of the spill-over of activity from one sector to another is captured by input-output 'multipliers'. This estimate is the ratio of the total change in economic activity to the change in economic activity for a given sector. A multiplier greater than one implies that the change in economic activity for a given sector has a greater impact on the economy than the value or the activity itself, in value added (monetary) or employment terms.

The input-output matrix used for Australia is derived from the 2019-20 Australian Bureau of Statistics Input-Output Tables. The industry classification used for input-output tables is based on the Australian and New Zealand Standard Industrial Classification (ANZSIC), with 114 sectors in the modelling framework, 18 of which are used to delineate marine industry.

[28] Productivity Commission (1999), Australia's Gambling Industries, Report No. 10, AusInfo, Canberra (page 419).

Limitation of our work

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