ACIL ALLEN

September 2023

Report to Gas Energy Australia

The economic contribution of the Australian gas economy in 2021-22

About ACIL Allen

ACIL Allen is a leading independent economics, policy and strategy advisory firm, dedicated to helping clients solve complex issues.

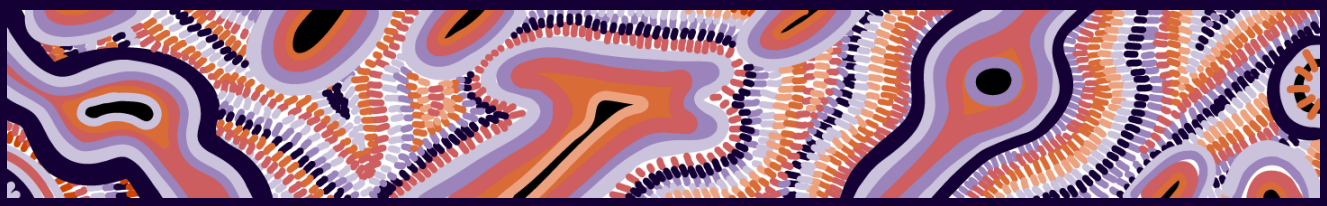
Our purpose is to help clients make informed decisions about complex economic and public policy issues.

Our vision is to be Australia's most trusted economics, policy and strategy advisory firm. We are committed and passionate about providing rigorous independent advice that contributes to a better world.

Suggested citation for this report

ACIL Allen Consulting (2023), Economic contribution of the Australian gas economy in 2021-22 prepared for the Gas Energy Australia (GEA). September 2023.

ACIL Allen acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Custodians of the land and its waters. We pay our respects to Elders, past and present, and to the youth, for the future. We extend this to all Aboriginal and Torres Strait Islander peoples reading this report.



Goomup, by Jarni McGuire

Contents

Contents

Figures

Contents

Tables

Contents

Contents

Boxes

Glossary

ABS	Australian Burau of Statistics
AEAS	Australian Economic Advocacy Solutions
ARENA	Australian Renewable Energy Agency
BP	Basic prices
CNG	Compressed Natural Gas (CNG)
DISR	Department of Industry, Science and Resources
FTE	Full time equivalent
GDP	Gross Domestic Product
GEA	Gas Energy Australia
GHGs	Greenhouse Gases
GJ	Gigajoule
GSP	Gross State Product
H2	Hydrogen
JPDA	Joint Petroleum Development Area
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
ML	Million litres
MT	Million tonnes
PJ	Petajoule
PP	Purchaser prices
REMP	Resources and Energy Major Projects

Executive summary

Gaseous fuels play an important role in the Australian economy involving many businesses and employing many people. This report has provided an indicative estimate of the size of the Australian gas economy with this chapter providing a summary of the key components. In total, it is estimated that in financial year 2021-22, the Australian gas economy contributed at least $121 billion to Australian GDP and supported 258,779 FTE jobs (equivalent to 5.25 per cent and 2.35 per cent, respectively).

Definition of the gas economy

This report provides estimates of the economic and employment contribution of the Australian gas economy for the financial year 2021-22. It is an update of the calculations provided to GEA for the financial years 2020-21. This type of footprint analysis provides the direct and indirect (upstream and downstream) contributions of the gas economy to the Australian and state economies in terms of employment and Gross State Product/Gross Domestic Product (GSP/GDP). The study covers all aspects of the supply and consumption of a range of gaseous fuels, including:

- Natural gas in gaseous form
- LNG for export
- Micro-LNG for domestic use (limited use in 2021-22)
- LPG
- CNG
- Hydrogen

Activities that are deemed to be part of the Australian gas economy include:

1. Production of gaseous fuels
2. Transport, distribution and retailing of gaseous fuels (including imports)
3. Use of natural gas for gas-fired electricity generation
4. Gas-based manufacturing, where gaseous fuels are an essential feedstock or input, including:
    a) Gas feedstock chemicals where the gaseous fuels are an essential feedstock or input for the production of chemicals (such as the use of natural gas and LPG as a feedstock for the production of plastics, ingredients for cleaning products, detergents, crop protection chemicals, explosives, pharmaceuticals and advanced textiles).
    b) High temperature (>800°C) manufacturing, where gaseous fuels are used to produce high temperatures critical to a manufacturing process and where there is little scope to move to non-gaseous fuels as the energy source. Based on an in-depth study on alternative energy options for industrial process heat[1], in Australia natural gas is critical

[1] ITP Thermal Pty Ltd (2019), Renewable energy options for industrial process heat. Report for ARENA, August 2019.

for producing high temperatures required for the manufacturing of alumina, certain other nonferrous metals, bricks and ceramics, and glass and glass products and there is currently little scope for substitution to non-gaseous fuels in the short-term.

5. Other businesses primarily engaged in gas economy-related equipment or services, including:
   a) Gas-related manufacturing. Manufacturing companies primarily made specific equipment necessary for producing, transporting, distributing and using gaseous fuels.
   b) Gas-related services. That is, businesses primarily provide services associated with the production, transportation, distribution and/or use of gaseous fuels (such as installation or consulting).
6. Key investments related to the gas economy (such as upstream drilling and exploration, gas pipeline construction, LNG infrastructure, or other gas appliance and gas equipment investments).

Various constraints on the availability of data in time for this analysis mean that, of the above activities within the Australian gas economy:

— Gas-related manufacturing and gas-related services businesses (5 above) are indirectly included in the calculations through intermediate input demands, but the specific size of these parts of the Australian gas economy have not been separately estimated

— Data limitations have meant that the economic contribution associated with investments related to the gas economy (6 above) has not been estimated by fuel type.

Economic contribution

A summary of the total value-added contribution of the Australian gas economy by state is provided in **Table ES 1**.

In total, it is estimated that the gas economy in Australia contributed at least $121 billion to the Australian economy, which is 5.25 per cent of GDP in 2021-22. Over 80 per cent of the total value-added contribution comes from two gas-producing states: Western Australia and Queensland.

Table ES 1 Total economic contribution of the Australian gas economy by state, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	%
NSW	15	1,280	259	1,602	952	401	**4,509**	**0.65%**
Vic.	1,522	2,049	247	1,360	745	967	**6,890**	**1.34%**
Qld	30,372	2,046	1,364	2,443	1,413	1,253	**38,891**	**8.69%**
SA	397	741	636	314	199	443	**2,731**	**2.12%**
WA	46,162	3,471	2,708	1,660	2,401	2,742	**59,144**	**14.62%**
Tas.	0	96	17	102	37	15	**268**	**0.70%**
NT	7,392	496	359	53	32	348	**8,680**	**27.95%**
ACT	0	42	0	3	12	0	**57**	**0.12%**
Australia	**85,862**	**10,220**	**5,591**	**7,538**	**5,792**	**6,169**	**121,170**	**5.25%**

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

In terms of share of the economy, the gas economy contributed the highest to the Northern Territory in terms of GTP percentage contribution (15.53 per cent), followed by Western Australia (8.76 per cent of GSP) and Queensland (5.94 per cent of GSP).

Table ES 2 Total economic contribution of the Australian gas economy, direct and indirect, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	%
Direct	69,569	5,471	1,764	3,242	4,139	0	**84,184**	**3.65%**
Indirect	16,293	4,748	3,827	4,296	1,653	6,169	**36,987**	**1.60%**
Australia	**85,862**	**10,220**	**5,591**	**7,538**	**5,792**	**6,169**	**121,170**	**5.25%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Table ES 3 Total economic contribution of the Australian gas economy by fuel type, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	%
LNG	68,926	35				ne	ne	ne
Natural gas	14,426	7,653	5,591	7,538*	5,792	ne	ne	ne
LPG	2,483	2,532				ne	ne	ne
CNG	27	0				ne	ne	ne
Hydrogen	0.10	0				ne	ne	ne
Australia	**85,862**	**10,220**	**5,591**	**7,538**	**5,792**	**6,169**	**121,171**	**5.25%**

Notes: * Most feedstock is natural gas but includes some LPG. ne = not estimated. Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Employment contribution

Table ES 4 provides a summary of employment within the gas economy by the state in 2021-22.

In 2021-22, the Australian gas economy supported nearly 258,779 FTE jobs throughout the Australian economy, which was 2.35 per cent of total FTE jobs.

To put this another way, for every 1 million dollars of gas-related activities in the Australian economy, up to 1.8 FTE jobs are supported elsewhere in the Australian economy in 2021-22.

Table ES 4 Total employment contribution of the Australian gas economy by state, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
NSW	43	6,771	832	7,689	4,422	1,991	**21,748**	**0.61%**
Vic	2,199	10,036	800	6,749	3,562	5,340	**28,686**	**0.99%**
Qld	38,285	9,431	4,451	12,418	7,862	7,065	**79,512**	**3.67%**
SA	597	3,377	1,879	1,571	1,002	2,355	**10,781**	**1.51%**
WA	49,405	13,812	10,814	7,434	12,114	11,725	**105,304**	**9.06%**
Tas	1	671	61	603	235	101	**1,672**	**0.81%**
NT	6,414	1,977	1,167	195	114	976	**10,842**	**8.99%**
ACT	4	154	-	15	61	-	**233**	**0.12%**
Australia	**96,948**	**46,228**	**20,004**	**36,674**	**29,372**	**29,553**	**258,779**	**2.35%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Table ES 5 Total employment contribution of the Australian gas economy, direct and indirect, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
Direct	21,970	22,933	2,978	13,636	20,422		**81,940**	0.75%
Indirect	74,977	23,295	17,026	23,038	8,949	29,553	**176,839**	1.61%
Australia	**96,948**	**46,228**	**20,004**	**36,674**	**29,372**	**29,553**	**258,779**	**2.35%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Table ES 6 Total employment contribution of the Australian gas economy by fuel type, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
LNG	77,458	86				ne	ne	ne
Natural gas	16,477	28,463	20,004	36,674*		ne	ne	ne
LPG	2,836	17,679				ne	ne	ne
CNG	176	0				ne	ne	ne
Australia	**96,948**	**46,228**	**20,004**	**36,674**	**29,372**	**29,553**	**258,779**	**2.35%**

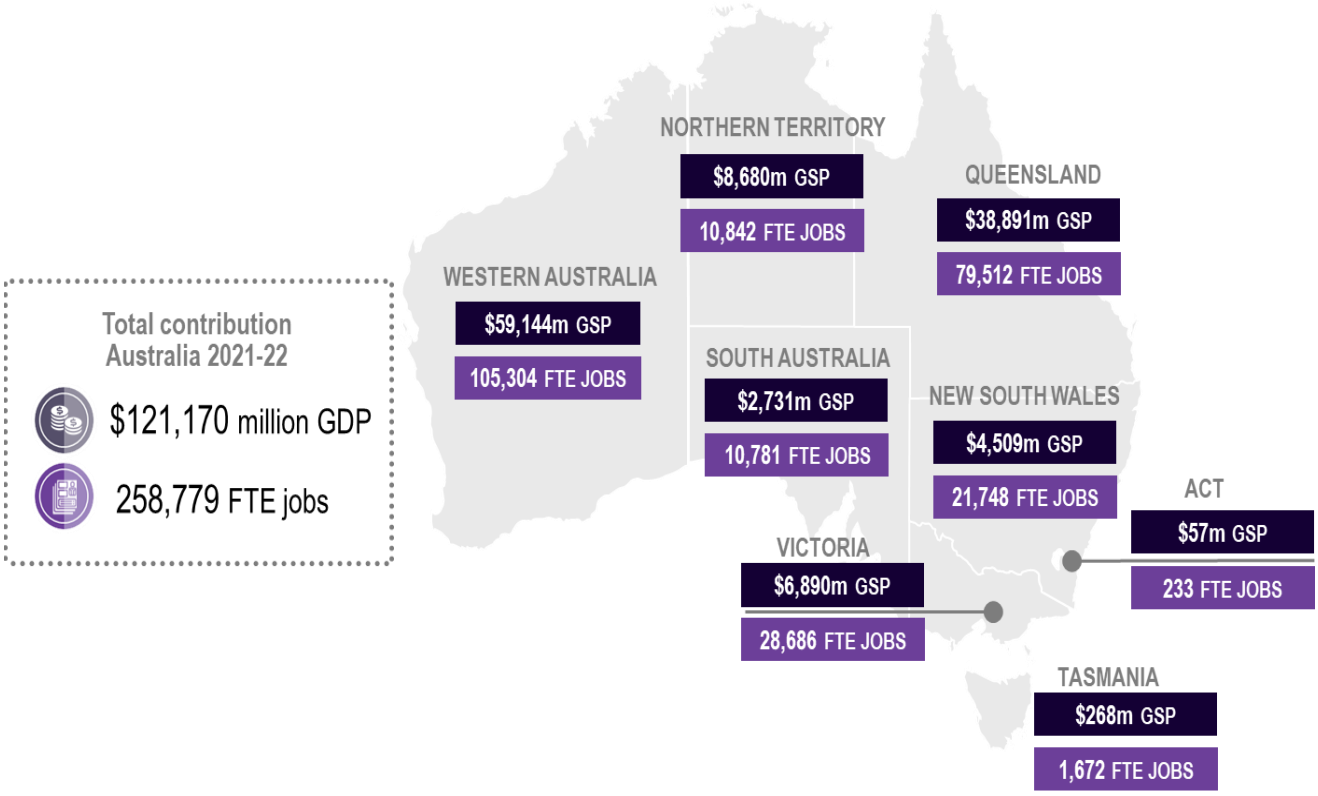
State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of total employment

Notes: * Most feedstock is natural gas but includes some LPG. ne = not estimated. Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

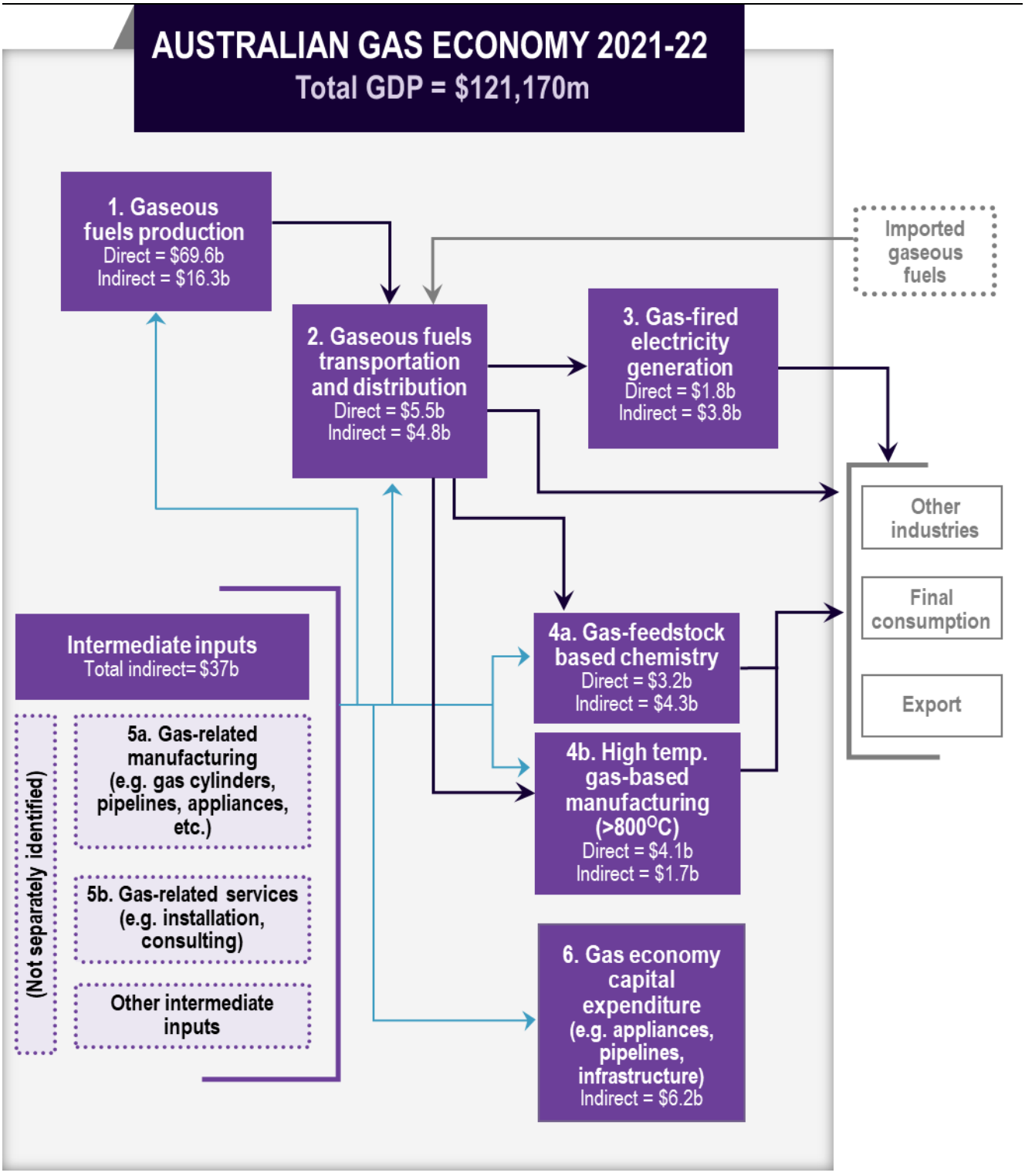
A summary of the estimated Australian gas economy is provided in **Figure ES 1** and **Figure ES 2**.

Figure ES 1 A summary of the gas economy by state, 2021-22



Source: ACIL Allen estimates based on various sources.

Figure ES 2 An overview of the Australian gas economy, 2021-22



Source: ACIL Allen estimates based on various sources.

Total LPG economy

A summary of the estimated total (direct and indirect) economic and employment contributions of the LPG economy (production, transport, and distribution) is provided in **Table ES 7**. LPG contributed about 5.2 per cent of the estimated Australian gas economy. LPG contributed 0.18 per cent of Australia's GDP and 0.15 per cent of employment in 2021-22. This is a conservative

estimate as it is limited to LPG's contribution to the production, transport, and distribution of gaseous fuels. The calculation does not include the contribution of LPG to the gas feedstock chemical industry (which is sometimes used by producers instead of natural gas but has not been disaggregated in this analysis).

Table ES 7 Total economic contribution of the Australian LPG economy by state, 2021-22

	Value-add				Employment			
	Direct	Indirect	Total	%GSP/GDP	Direct	Indirect	Total	% state/national employment
	A$m	A$m	A$m	%	FTE jobs	FTE jobs	FTE jobs	%
NSW	437	281	718	0.10%	3,249	1,474	4,724	0.13%
Vic.	571	292	863	0.17%	3,312	1,642	4,954	0.17%
Qld	935	345	1,280	0.29%	3,252	1,922	5,174	0.24%
SA	184	91	275	0.21%	1,130	537	1,668	0.23%
WA	1,342	386	1,728	0.43%	1,451	1,667	3,117	0.27%
Tas.	49	21	71	0.18%	425	141	567	0.27%
NT	55	13	68	0.22%	168	66	234	0.19%
ACT	10	4	14	0.03%	62	16	78	0.04%
Australia	**3,584**	**1,431**	**5,015**	**0.22%**	**13,050**	**7,466**	**20,516**	**0.19%**

Source: ACIL Allen estimates based on various sources.

1 Introduction

1.1 Background

Gas Energy Australia (GEA) engaged ACIL Allen to quantify the economic contribution of the Australian gas economy, disaggregated by various gaseous fuels, consumers for the Financial Year 2021-22. It is an update of the 2020-21 contribution report.

1.2 Gas Energy Australia

Gas Energy Australia's mission is to improve the nation's energy security and environment and reduce energy costs by maximising the benefits of gaseous fuels to the community. GEA is the national peak body which represents the downstream gaseous fuels industry which covers the following gaseous fuels:

—Liquefied Petroleum Gas (LPG)

—Liquefied Natural Gas (LNG)

—Compressed Natural Gas (CNG)

—Hydrogen (H_2)

In addition, GEA represents major companies and small to medium businesses in the gaseous fuels supply chain, including refiners, fuel marketers, equipment manufacturers, gas transporters, consultants, and other providers of services to the gaseous fuel industry.

GEA focuses on various areas supporting Australia's national interest to achieve energy security and economic prosperity in a lower carbon economy. GEA advocates the value and benefits of the fuels through engagement with the Government, state authorities and consumers.

The Association supports progressive policy development based on sound research, analysis and expert commentary.

Natural gas (gaseous form), LNG, LPG and CNG are alternative fuel options that are versatile, affordable, and used in various residential, commercial, industrial and transport applications. All these gases have lower greenhouse gas emissions (GHGs) than petrol, diesel, and electricity[2] on an energy-equivalent basis. They are a vital energy source for hundreds of millions of people worldwide today.

[2] Based on Scope 1 emissions intensity of grid-connected generators in Australia in 2020-21 (see https://www.cleanenergyregulator.gov.au/NGER/National%20greenhouse%20and%20energy%20reporting%20data/electricity-sector-emissions-and-generation-data/electricity-sector-emissions-and-generation-data-2020-21). The average emission intensity of electricity has been decreasing as coal-fired generation decreases as a share of total generation.

1.3 About this report

This report provides an estimate of the economic and employment contribution of the Australian gas economy for the financial year 2021-22. The footprint analysis provides the gas economy's direct and indirect (upstream and downstream) contributions to the Australian and state economies regarding employment and Gross State Product/Gross Domestic Product (GSP/GDP). The study covers all aspects of the supply and consumption of a range of gaseous fuels, including:

- Natural gas in gaseous form
- LNG for export
- Micro-LNG for domestic use (limited use in 2021-22)
- LPG
- CNG
- Hydrogen (a small pilot project in 2021-22)

These activities are part of the Australian gas economy. They are summarised in **Figure 1.1** and include:

1. Production of gaseous fuels
2. Transport, distribution and retailing of gaseous fuels (including imports)
3. Use of natural gas for gas-fired electricity generation
4. Gas-based manufacturing, where gaseous fuels are an essential feedstock or input, including:
   a) Gas feedstock chemicals where the gaseous fuels are an essential feedstock or input for the production of chemicals (such as the use of natural gas and LPG as a feedstock for the production of plastics, ingredients for cleaning products, detergents, crop protection chemicals, explosives, pharmaceuticals and advanced textiles).
   b) High temperature (>800°C) manufacturing, where high temperatures critical manufacturing processes use gaseous fuels and where there is little scope to move to non-gaseous fuels as the energy source.
      - An in-depth study on alternative energy options for industrial process heat in Australia commissioned by ARENA in 2019.[3] The study finds that natural gas is critical for producing high temperatures required to manufacture alumina, other nonferrous metals, bricks and ceramics, and glass and glass products. The study highlighted that there is currently little scope for substitution to non-gaseous fuels in the short-term.
5. Other businesses primarily engaged in gas economy-related equipment or services, including:
   a) Gas-related manufacturing. Manufacturing companies primarily made specific equipment necessary for producing, transporting, distributing and using gaseous fuels.
   b) Gas-related services. Businesses primarily provide services associated with producing, transporting, distributing and using gaseous fuels (such as installation or consulting).
6. Critical investments related to the gas economy include upstream drilling and exploration, gas pipeline construction, LNG infrastructure, or other gas appliance and equipment investments.

Various constraints on the availability of data in time for this analysis mean that of the above activities within the Australian gas economy:

- Gas-related manufacturing and services businesses (5 above) are indirectly included in the calculations through intermediate input demands. Still, the specific size of these parts of the Australian gas economy have not been separately estimated.

[3] ITP Thermal Pty Ltd (2019), Renewable energy options for industrial process heat. Report for ARENA, August 2019.

— Data limitations have meant that the economic contribution associated with investments related to the gas economy (6 above) has not been estimated by fuel type.

1.4 Structure of the report

Chapter 2 provides a brief methodology and key data sources used in this report.

Chapter 3 provides historical data on **gaseous fuel production,** exports, imports, volume, and value of vital gaseous fuels. It also includes their estimated economic and employment contributions to the state and Australian economies.

Chapter 4 provides the estimated economic and employment contribution of **transport and distribution of gaseous fuels** in the Australian economy.

Chapter 5 provides gas-fired electricity generation's economic and employment contribu**tion** to the state and Australian economies.

Chapter 6 provides the economic and employment contribution of the **gas feedstock chemical industry** to the state and Australian economies.

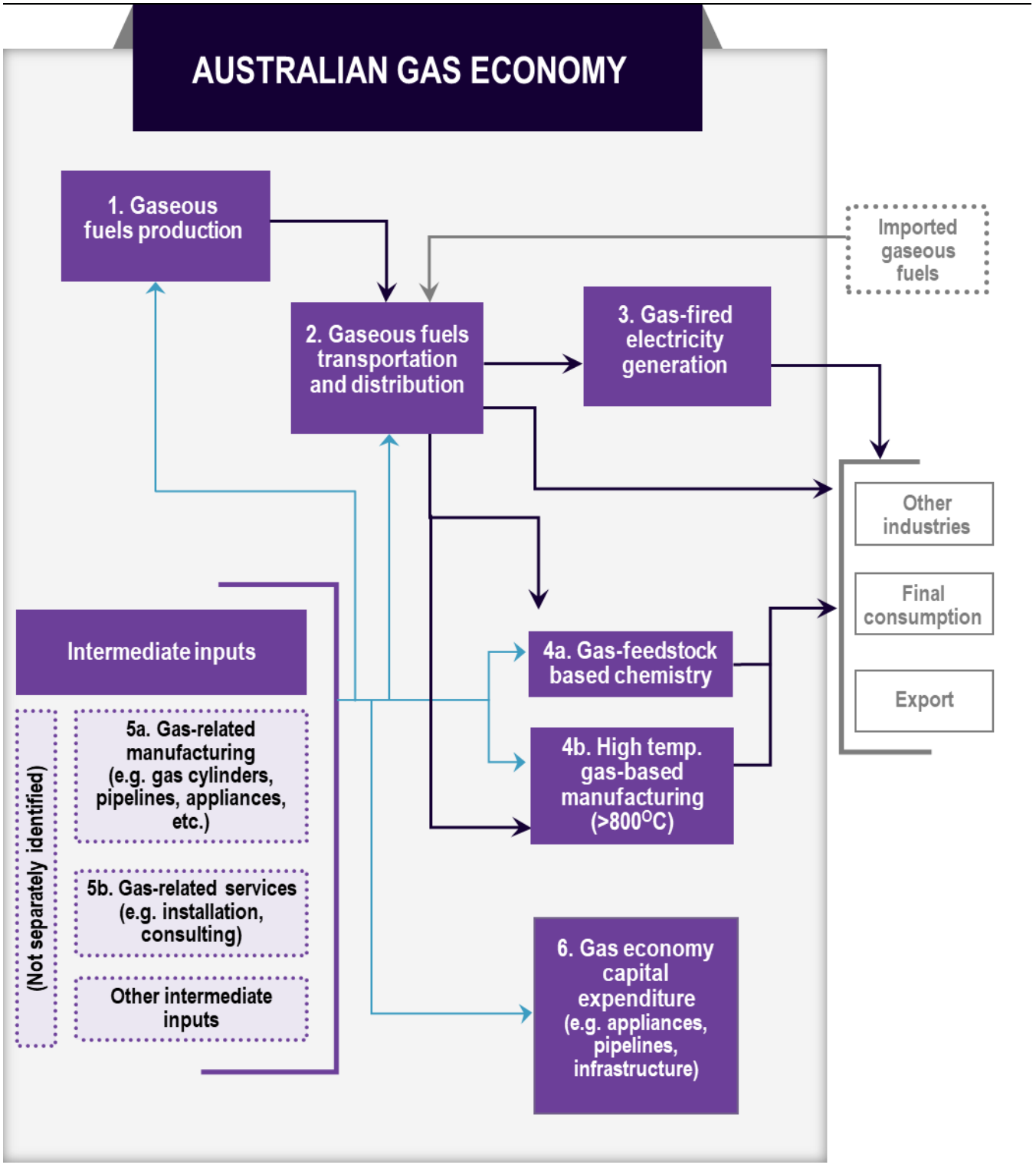
Chapter 7 provides the economic and employment contribution of **high-temperature gas-based manufacturing** to the state and Australian economies.

Chapter 8 provides gas-related capital expenditure's economic and employment contribution to the state and Australian economies.

Chapter 9 summarises the gas economy's total economic and employment contribution to the state and Australian economies.

Appendix A provides input-output multiplier analysis and their limitation in using the estimates for economic impact analysis.

Figure 1.1 Overview of the components of the gas economy



Source: ACIL Allen

Key data sources and methodology 2

2.1 Data sources

There is a range of publicly available estimates of the size and characteristics of Australia's gas economy. Unfortunately, there are often inconsistencies between the various values, which are often aggregated with the other activities. Consequently, ACIL Allen needed to choose between different sources to analyse the contribution of the gaseous economy in this report. Core data at the national and state level included:

- ABS data sources
  - Cat no 8155: Australian Industry, 2020-21 (released May 2022)
  - Cat no 5215.0.55.001: Australian National Accounts: Input-Output Tables (Product Details) 2019-20 (released May 2022)
  - Cat no 5215.0.55.001: Australian National Accounts: Input-Output Tables, 2019-20 (released May 2022)
  - Cat no 5220: Australian National Accounts: State Accounts, 2021-22 (released November 2022)
  - Cat no 8165: Counts of Businesses, 2021-22 (released December 2021)
  - Cat no: 4604: Energy Account, Australia, 2020-21 (released November 2022)
- DISR data sources
  - The Resource and Energy Quarterly, December 2022
  - The Australian Petroleum Statistics, December 2022
  - The Australian Energy Update 2022 (for 2020-21 data)
- IBISWorld
- Others (Western Australian and Queensland Government publications)

The cost structure is obtained from ACIL Allen's state input-output tables database, supplemented with detailed information from the ABS Australian National Accounts: Input-Output Tables (catalogue number 5209.0.55.001), ABS Australian Industry (catalogue number 8155.0), IBISWorld, and other publicly available information.

2.2 Contribution methodology

ACIL Allen has used input-output multiplier analysis to estimate the Australian gas economy's economic footprint (economic contribution). The economic footprint analysis describes:

- The *direct* contributions the activity makes to the economies of each state and Australia as a whole, plus
- The activity's indirect contributions to the economy estimated through their demand for intermediate inputs from other industries (exploration, financial services, construction,

machinery, freight etc.) and through demand stimulated by the wages and salaries of employees.

Simple multipliers are used in this study to estimate the economic contribution. Consequently, the estimates in this report include the direct contribution made by the activity to Australia's GDP and employment, along with the impact embodied in the industry's supply chain. Simple multipliers do *not* include the consumption-induced effect. They do not have the economic outcomes associated with workers within the industry (or its supply chain) spending their after-tax incomes on other Australian goods and services (such as hairdressers, travel, retail trade etc.).

When properly calculated[4], estimates of the industry from simple multipliers are additive with the same values for other non-overlapping sectors (such as beef, milk, petroleum, aluminium, etc.). They will never add to more than Australia's total GDP or employment.

While these estimates of the footprint of the gas economy are helpful for many contexts, they are a conservative estimate of the total economic activity or employment that could be affected by a change in the industry activity.

More direct and indirect contribution (footprint) analysis details are provided below.

2.2.1 Direct contribution methodology

The standard measure of economic contribution is the extent to which it increases the value of goods and services generated by the economy – in other words, the degree to which it increases economic activity as measured by gross domestic product (GDP).

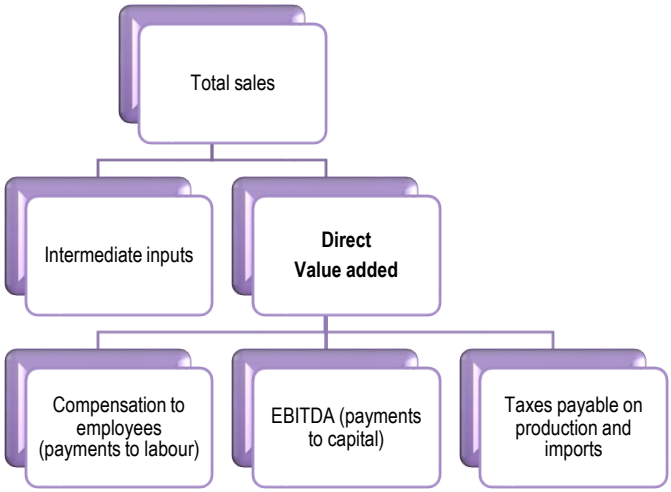
An economy has a range of factors of production (including labour and capital stock) and access to various intermediate inputs. Industries can add value to intermediate inputs by converting them into goods and services more suited for consumers or other sectors.

An industry contribution to GDP measures the total value added. It is defined as the income that an industry generates, less the cost of the inputs it uses to create that income, plus certain taxes paid. Factor payments plus the taxes (less subsidies) payable on production and imports can determine the direct contribution of an industry to the Australian economy.

The direct economic contribution is shown graphically in **Figure 2.1**.

[4] In particular, it is important to avoid double counting related to the intra-sectoral purchases and vertical supply chain activities. For example, when adding the impact of related industries (where industry A supplies to industry B, for example) it is necessary to not include the value of A's sales to B when calculating industry B's contribution. In reality, ensuring that industries are completely non-overlapping is complex and certain simplifying assumptions would generally need to be made.

Figure 2.1 Calculation of direct value added



Source: ACIL Allen

2.2.2 Indirect contribution methodology

Intermediate inputs used by production and distribution can be sourced either from within the Australian economy or from foreign economies. The value added embodied in the input is indirectly associated with the activity of the purchaser if they use domestically sourced inputs. Calculating the indirect contribution becomes complicated as one considers the value-added embodied in the intermediate inputs of the intermediate input.

In a global context, the value-added chain can be measured by the value of the consumed goods and services. In a national context, input-output tables and the associated 'input-output multipliers' can be used to estimate indirect economic contributions. Input-output multipliers are summary measures generated from input-output tables that can be used for predicting the total impact on all industries in the economy of changes in demand for the output of any one sector. The multipliers measure the relative importance of the production chain linkages to different parts of the economy.

Some of the assumptions underpinning input-output multipliers can impede credible analysis. Understanding these assumptions is necessary to prevent the inappropriate application of input-output multipliers – for example, in situations where economic constraints are present or when the profile of a business or project differs substantially from the industry average. The ABS Catalogue number 5246.0[5] provides information on input-output tables and the calculation of multipliers.

[5] ABS 1995, Information Paper, Australian National Accounts: Introduction to Input-Output Multipliers, 1989-90, Cat No: 5246. http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5246.01989-90?OpenDocument

Production of gaseous fuels 3

This chapter presents the historical trends and economic and employment contributions associated with producing gaseous fuels.

3.1 Production

3.1.1 Natural gas

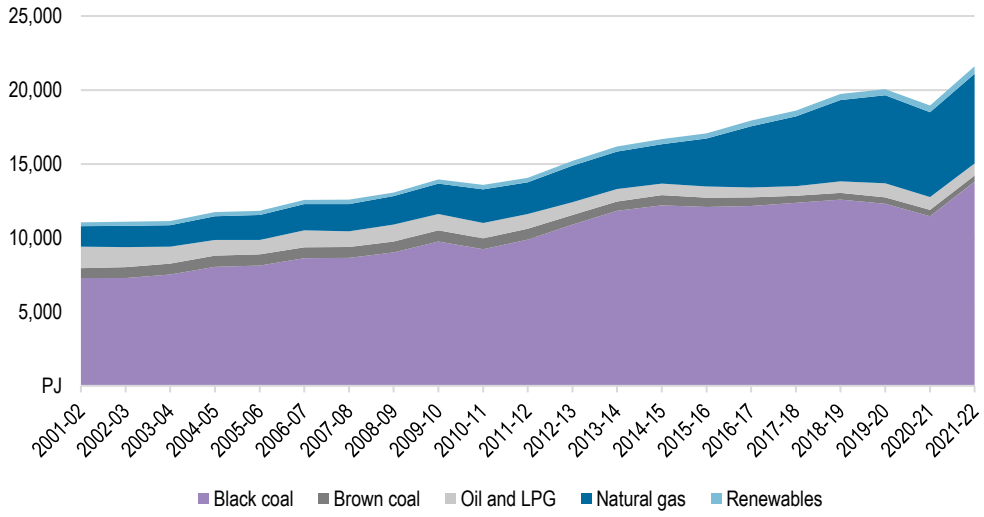
Natural gas is the fastest-growing primary energy source in the world.[6] The global market for natural gas is much smaller than oil because gas transport is difficult and costly due to relatively low energy content with volume. All sectors use natural gas in varying amounts.

Around 6,063 PJ of natural gas was produced in Australia in 2021-22, 5.8 per cent higher than the previous year (**Figure 3.1**), constituting around 28 per cent of total primary energy production in Australia in 2021-22.

Natural gas share of primary energy production increased significantly over the past decade from 16 per cent in 2014-15 to 28 per cent in 2021-22. This is mainly due to the commencement of coal seam gas-based LNG production in Queensland and the significant growth in LNG production in WA.

[6] IEA 2022, World Energy Outlook 2022.

Figure 3.1 Australian primary energy production by fuel type, 2001-02 to 2021-22



Source: Department of Industry, Science and Resources, Resources and Energy Quarterly December 2022, Australian Energy Statistics 2020-21, Table J

Table 3.1 summarises the value of natural gas production, supply and use in Australia over the past few years.

The natural gas in the gaseous state and coal seam gas produced at the wellhead was worth nearly $15 billion in 2021-22. Joint Petroleum Development Area (JPDA) imports constituted around $939 million. Australia's natural gas supply was about $16 billion at basic prices before tax and different margins. Total production taxes paid was approximately $1.3 billion, and all margin activities employed constituted around $7 billion in supplying natural gas to various users in the Australian economy.

Table 3.1 Supply and use of natural gas in gaseous form in Australia, 2014-15-2021-22

	SUPPLY						USE		FINAL DEMAND			
	Production	Imports	Supply, BP	Taxes	Margins	Supply, PP	Industry use, BP	Industry use, PP	Households	Stocks	Export	Demand, PP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m
2014-15	5,384	0	5,384	1,055	5,297	11,736	4,353	8,021	3,704	-54	65	11,736
2015-16	9,249	0	9,249	876	5,125	15,250	5,682	9,133	6,031	1	85	15,250
2016-17	9,033	0	9,033	1,026	5,594	15,653	5,484	9,314	6,393	-154	100	15,653
2017-18	12,101	0	12,101	1,049	6,240	19,390	8,156	12,706	6,789	-221	116	19,390
2018-19	13,412	0	13,412	1,115	6,340	20,867	9,418	14,194	6,998	-457	132	20,867
2019-20	12,547	1,110	13,657	1,152	6,079	20,888	9,378	13,904	7,283	-429	130	20,888
2020-21	12,077	980	13,057	1,101	5,812	19,970	8,966	13,293	6,989	-443	131	19,970
2021-22	**14,695**	**939**	**15,634**	**1,319**	**6,959**	**23,911**	**10,735**	**15,916**	**8,300**	**-436**	**131**	**23,911**

Notes: BP is basic prices. PP is purchaser prices — this includes taxes and margins. The producers pay taxes for using various inputs in their production process. They include import duties, excise duties, non-deductible GST, levies, different govt fees, insurance taxes etc. The taxes reported in this table do not have corporate taxes, production royalties or PRRT, which are part of production costs and value-added.

Source: ACIL Allen estimates based on ABS and DISR data sources.

Key margin activities employed in supplying natural gas in the gaseous form in Australia are:

— Gas margin: 58%

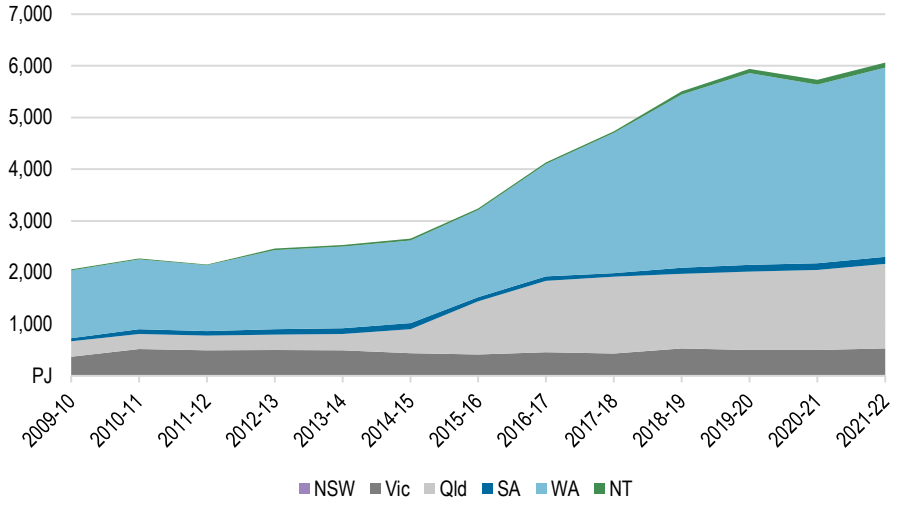
— Pipeline transport margin: 37%
— Road transport margin: 4%
— Rail transport margin: 1%

Figure 3.2 provides natural gas production in Australia by state.

Two states – Western Australia (60.4 per cent) and Queensland (27 per cent) produced the majority of natural gas in Australia in 2021-22. Victoria made around 8.7 per cent or 526 PJ of gas in 2021-22.

Other states produced a small quantity of gas.

Figure 3.2 Production of natural gas by state and territory, 2009-10 to 2021-22



Source: DISR, Australian Energy Statistics 2022, Table Q3 and DISR, Resources and Energy Quarterly, December 2022.

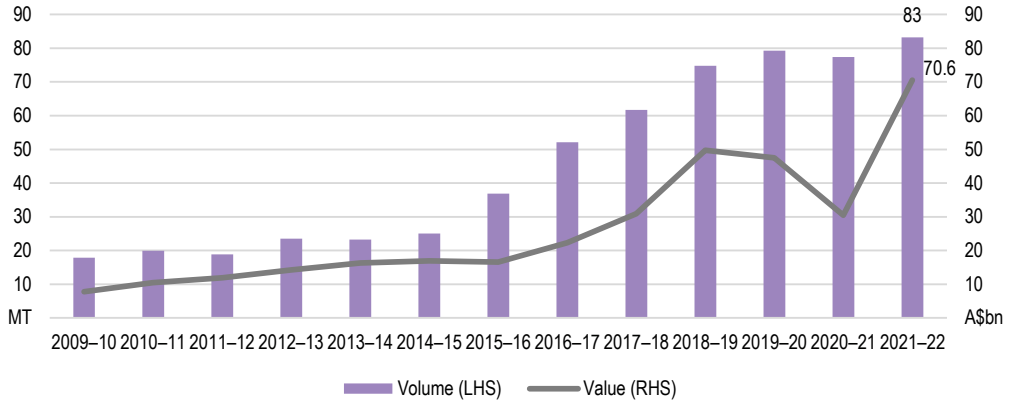
3.1.2 LNG

LNG export volumes reached a record of 83 million tonnes in 2021-22, up 7.5 per cent from 2020-21 (**Figure 3.3**). LNG export earnings rise by 136 per cent amidst tight global energy markets in 2021-22. Australian LNG export earnings reached $70.6 billion, up 136 per cent compared to 2020-2021. The financial year 2021-22 marks the highest annual earnings from Australia's LNG exports.

The forecasted value of Australia's LNG exports in 2022–23 is around $90 billion, driven by high LNG spot prices and high oil prices. However, the forecast value drop to $75 billion in 2023–24, as global energy prices subside and export volumes ease.[7]

[7] DISR (2022), Resources and Energy Quarterly, December 2022.

Figure 3.3 LNG exports, 2009-10 to 2021-22



Source: DISR, Resources and Energy Quarterly, December 2022, Table 1 and Table 2

Table 3.2 summarises LNG revenue, value-added and employment.

Table 3.2 LNG revenue, value-added, wages and employment, 2006-07 to 2021-22

Year	Revenue	Value-added	Per cent of GDP	Wages	Employment
	A$m	A$m	%	A$m	FTE jobs
2008-09	12,722	7,404	0.59%	748	4,896
2009-10	9,727	5,934	0.46%	865	5,303
2010-11	12,259	7,944	0.56%	937	6,038
2011-12	13,791	8,812	0.59%	1,341	8,410
2012-13	16,473	9,571	0.62%	1,543	9,505
2013-14	18,539	10,530	0.66%	2,140	13,402
2014-15	19,333	8,719	0.54%	2,215	13,068
2015-16	19,063	7,854	0.47%	2,658	13,193
2016-17	24,732	9,274	0.53%	2,604	13,773
2017-18	33,634	14,799	0.80%	2,640	15,491
2018-19	52,350	22,458	1.15%	2,992	14,887
2019-20	49,116	19,990	1.01%	2,720	14,255
2020-21	30,541	10,492	0.51%	2,326	13,408
2021-22	70,571	56,002	2.43%	4,578	17,472

Source: ACIL Allen estimates based on ABS, IBISWorld 2022 and DISR Resources and Energy Quarterly, December 2022.

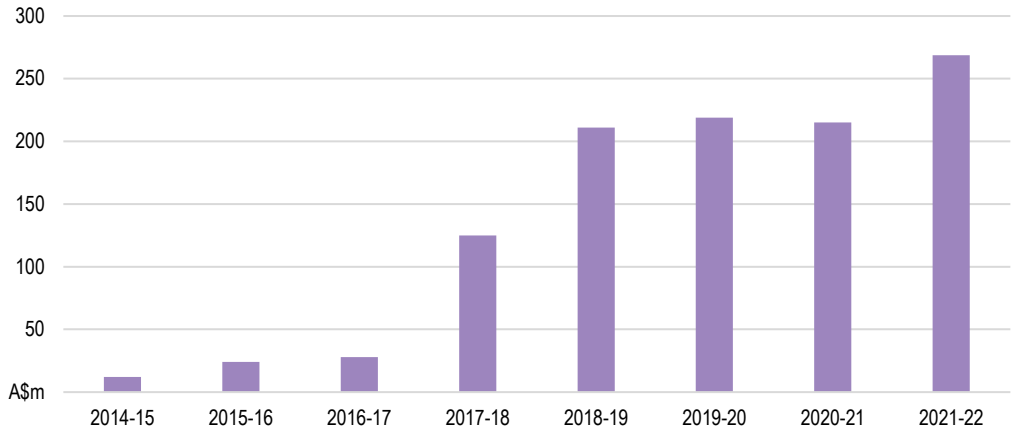
3.1.3 Micro LNG

Other natural gas uses include micro-LNG. It is a small but growing domestic LNG industry distinct from the export LNG industry. Remote area power and customers in the trucking, mining, marine, and industrial sectors that want to replace diesel fuel with less-polluting LNG use micro LNG.

Some data on micro-LNG is available from ABS Input-Output Product Category (IOPC) data on the intermediate use of LNG in Australia (**Figure 3.4**).

In 2021-22, Australia used nearly $270 million value of micro-LNG.

Figure 3.4 An indicative Micro LNG value, 2014-15 to 2021-22



Source: ACIL Allen based on ABS (2022) IOPC data.

3.1.4 CNG

Data on CNG production and use in Australia is difficult to obtain from official data sources.

Many major global car manufacturers produce CNG vehicles ranging from passenger vehicles to vans, buses, and heavy-duty trucks. CNG vehicles in Australia are currently limited to light-duty and heavy-duty vehicles, including buses. CNG vehicles in Australia belong to fleets with private refuelling stations. There are a few publicly accessible CNG refuelling stations across the country. Australia does not have a broad public CNG refuelling network, but it does not exclude fleet operators from using CNG in their fleets. The most viable operations for CNG in Australia are either back-to-base arrangements, where vehicles return to the same depot each day, such as bus fleets, or point-to-point operations between bases. In these situations, the fleet operator may own or lease CNG refuelling equipment or contract a specialist fuel supplier to supply fuel to the vehicles.[8]

Based on the ABS Motor Vehicle Census in 2022 data (see **Table 3.3**), there are around 2,402 registered CNG vehicles in Australia. The remaining gas-operated vehicles use LPG.

Based on the average kilometres travelled and average fuel consumption, it is estimated that the CNG consumed around 29 ML of gas in Australia in 2021-22.

Table 3.3 Number of registered motor vehicles of fuel type of LPG and other gases by state, 2022

Number of vehicles	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
Passenger Vehicles	7,366	21,770	1,745	4,457	15,927	207	21	417	51,910
Panel Vans	231	200	14	150	1021	10	3	4	1,633
Utilities	6,584	17112	2474	1916	7359	226	10	329	36,010
Light Rigid Trucks up to 4.5t GVM	65	114	32	27	107	5	0	3	353
Heavy Rigid Trucks > 4.5t GVM	31	137	3	21	90	3	0	3	288
Prime Movers	0	8	0	0	16	3	0	0	27
Campervans	22	10	3	54	236	0	0	3	328
Buses > 9 seats	362	28	333	82	540	0	0	70	1,415
Total	14,661	39,379	4,604	6,707	25,296	454	34	829	91,964

[8] https://www.energynetworks.com.au/resources/fact-sheets/compressed-natural-gas-for-vehicles-clean-abundant-australian/

Number of vehicles	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Total
Estimated CNG use (ML)	5.09	6.92	3.36	2.07	10.75	0.16	0.00	0.82	29.00
Estimated CNG use ($m)	5.46	7.40	3.59	2.22	11.47	0.18	-	0.88	31.19

Note: The green-shaded vehicles mainly use CNG.

Source: ABS 2022, Motor vehicles census.

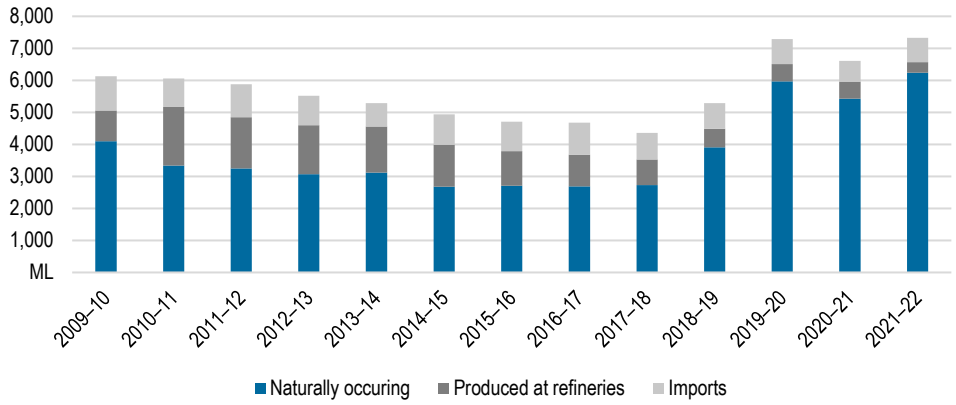
3.1.5 LPG

Australia produced 6,234 ML of naturally occurring LPG and 335 ML of refinery-produced LPG in 2021-22. In the same year, Australia exported 2,577 ML and imported 760 ML of LPG.

Figure 3.5 provides the LPG supply in Australia over the past ten years.

LPG production increased by over 10 per cent between 2020-21 and 2021-22, mainly due to the naturally occurring LPG typically linked to gas production.

Figure 3.5 LPG supply in Australia, 2009-10 to 2021-22



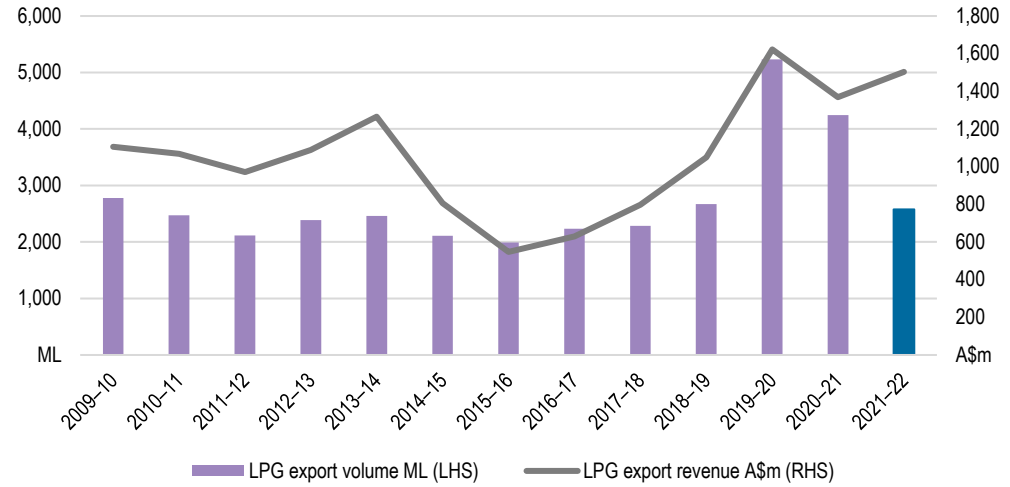
Source: DISR 2022 Resources and Energy Quarterly, December 2022, Table 5, Australian Petroleum Statistics, December 2022.

Australian sales of LPG in 2021-22 amounted to 1,558 ML, of which 270 ML was for automotive use. Whilst it is apparent that Australia, being a substantial exporter, is more than self-sufficient in LPG supplies, Australia is also an importer.

Figure 3.6 summarises the exports of LPG in Australia.

LPG exports generated revenue of A$1.5bn (fob) in 2021-22.

Figure 3.6 Australia's LPG exports, 2009-10 to 2021-22



Source: DISR, Resources and Energy Quarterly, March 2022, Table 1 and Table 2.

Table 3.4 summarises the value of Australian LPG production, imports, industry, household use, and exports. In 2021-22, LPG production value was nearly $2.5 billion. Imports constituted around $371 million. At basic prices before tax and various margins, LPG supply in Australia is around $2.9 billion. Total production taxes paid was about $246 million, and all margin activities employed constitute around $2.6 billion in supplying LPG to various users in the Australian economy.

In 2021-22, nearly 26 per cent of LPG produced in value was exported.

Household demand for LPG was 35 per cent of total demand in 2021-22. While this is lower than share of total demand in 2019-20 and 2020-21, it should be noted that these years had much larger stock withdrawals than usual.

Table 3.4 Supply and use of LPG in Australia, 2014-15 to 2021-22

	SUPPLY						USE		FINAL DEMAND			
	Production	Imports	Supply, BP	Taxes	Margins	Supply, PP	Industry use, BP	Industry use, PP	Households	Stocks	Export	Demand, PP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m	A$m
2014-15	1,901	79	1,980	217	1,318	3,515	1,012	1,157	1,449	-50	959	3,515
2015-16	1,835	56	1,891	336	1,706	3,933	934	1,508	1,779	5	641	3,933
2016-17	1,949	64	2,013	176	1,783	3,972	979	1,415	1,850	-41	748	3,972
2017-18	2,339	76	2,415	195	1,892	4,502	1,217	1,694	1,961	-48	895	4,502
2018-19	2,544	70	2,614	204	2,207	5,025	1,226	1,789	2,004	-77	1,309	5,025
2019-20	2,121	259	2,380	202	2,112	4,694	1,278	1,819	2,078	-846	1,643	4,694
2020-21	1,904	198	2,102	178	1,865	4,146	1,129	1,606	1,870	-700	1,369	4,146
2021-22	**2,529**	**371**	**2,900**	**246**	**2,574**	**5,720**	**1,557**	**2,217**	**2,000**	**0**	**1,504**	**5,720**

	SUPPLY					USE		FINAL DEMAND			
	Production	Imports	Supply, BP	Taxes	Margins	Supply, PP	Industry use, BP	Industry use, PP	Households	Stocks	Export	Demand, PP

Notes: BP is basic prices. PP is purchaser prices — this includes taxes and margins. The producers pay taxes for using various inputs in their production process. They include import duties, excise duties, non-deductible GST, levies, different govt fees, insurance taxes etc. The taxes reported in this table do not have corporate taxes, production royalties or PRRT, which are part of production costs and value-added.

Source: ACIL Allen estimates based on ABS and DISR data sources.

Key margin activities employed in supplying LPG in Australia are:

— Wholesale margin: 13%

— Retail margin: 54%

— Road transport margin: 33%

3.1.6 Hydrogen

The use of hydrogen as a primary fuel is gaining momentum across the globe. It can be produced from various renewable and non-renewable sources. It can be transported using multiple carriers.

Australia's primary demand for hydrogen is for petroleum refining[9] and ammonia production. Fossil fuels have met this demand.

Natural gas produces hydrogen as a feedstock for various chemicals in Australia. Hydrogen as a single atom may not fully replace natural gas as a chemical feedstock since natural gas has both carbon and hydrogen molecules in its composition and is more suited to the various chemicals. Other uses of natural gas as a chemical feedstock generally use the carbon content of the natural gas. Hydrogen combined with carbon dioxide to form methane, which is entirely interchangeable with natural gas as a feedstock. Hydrogen in those applications would require an additional, not necessarily petroleum-based, carbon source.

The Australian Government commissioned a pilot project to export hydrogen to Japan[10] in February 2022. This study includes the economic contribution from this export volume.

Some details on hydrogen projects in Australia are summarised in **Box 3.1**.

[9] Refineries use hydrogen to lower the sulfur content of diesel fuel. Refinery demand for hydrogen has increased as demand for diesel fuel has risen both domestically and internationally, and as sulfur-content regulations have become more stringent. However, the closure of refineries in Australia reduced the demand for hydrogen at refineries.

[10] https://www.austrade.gov.au/international/invest/investor-updates/australia-exports-world-s-first-shipment-of-liquified-hydrogen-to-japan#:~:text=Australia%20is%20sending%20the%20world's,sea%20to%20an%20international%20market.

Box 3.1 Hydrogen

Hydrogen is gaining increasing attention as a clean fuel to help decarbonise economies. Australia's proven track record as an energy exporter — especially our expertise in exporting LNG — combined with our abundant renewable energy and suitable geological storage resources, means that the nation has strong potential to be a major hydrogen producer and exporter. The Australian Government has directly invested more than $1.2 billion in support for the hydrogen industry, including awarding over $100 million to three 10 MW hydrogen electrolyser projects through the Australian Renewable Energy Agency (ARENA) and the $464 million Activating a Regional Hydrogen Industry: Clean Hydrogen Industrial Hubs program, to fund up to seven hydrogen hubs.

The Resources and Energy Major Projects (REMP) 2022 report an estimated $266 billion worth of potential investment across 48 projects. This is a considerable increase on the REMP 2021 report, which had an estimated $133–$185 billion of potential investment in hydrogen projects. To date, however, only one project has been committed, reflecting the high uncertainty for the new industry.

Source: Department of Industry, Science and Resources, Commonwealth of Australia (2022), Resources and Energy Major Projects 2022.

3.2 Natural gas use in Australia

Natural gas is Australia's third largest energy source (after oil and coal). Power stations use it for electricity generation, factories for manufacturing, and homes for heating and cooking. It is a non-renewable source that emits around half the coal emissions when used to generate electricity.

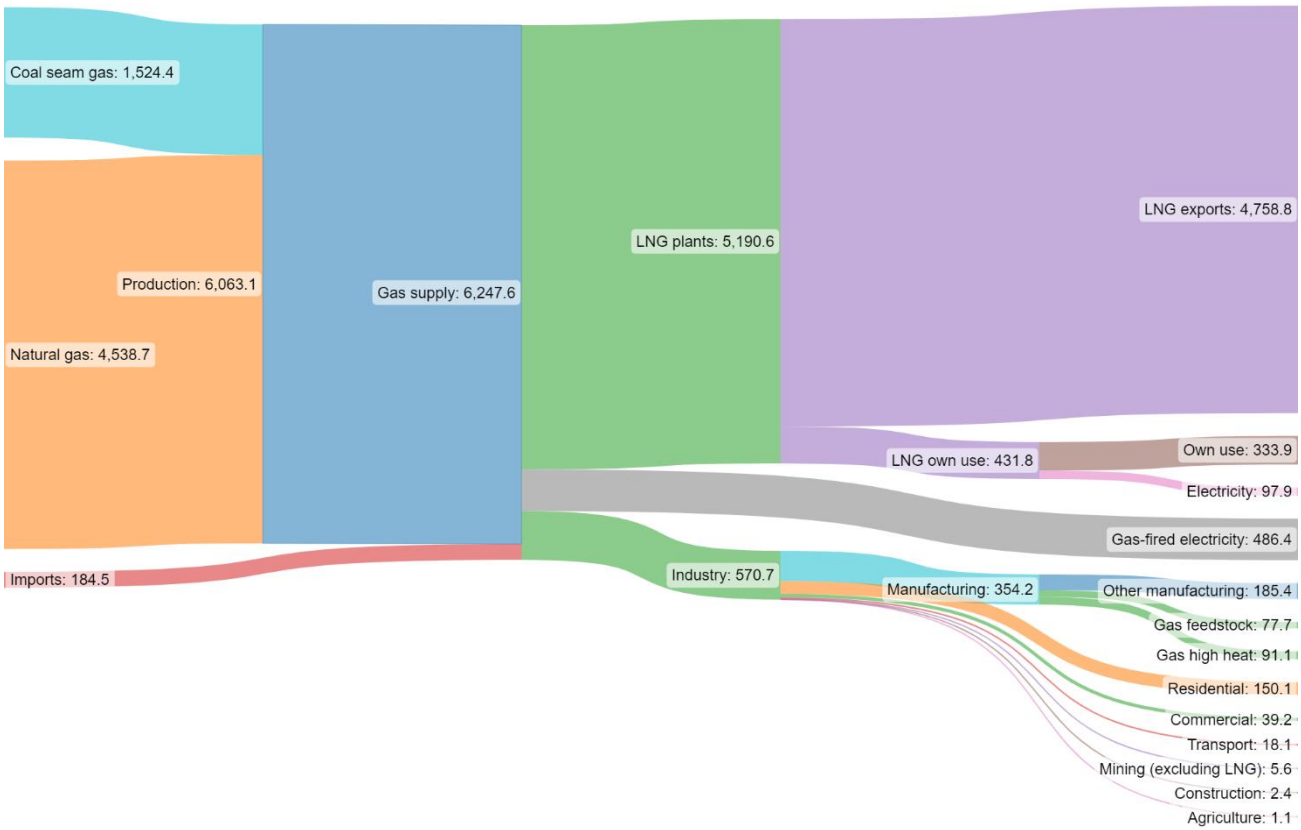
Figure 3.7 shows gas flows (PJ) in 2021-22.

Around 6,063 PJ of natural gas (methane, ethane and coal seam gas) was produced in Australia in 2021-22.

— Exported 83 MT (or 4,759 PJ) as LNG

— Imported 184 PJ from the JDPA.

Figure 3.7 Australia's gas supply and use (PJ) in 2021-22

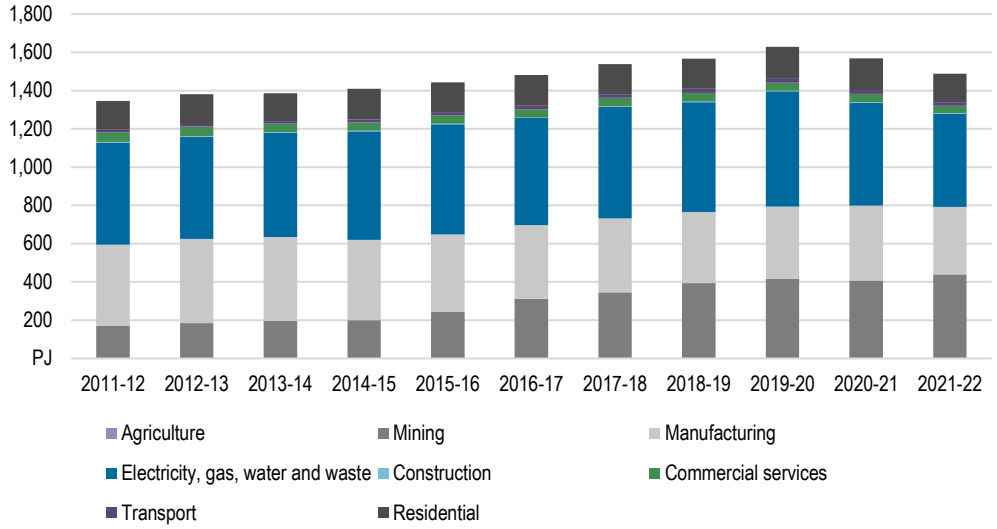


Source: ACIL Allen estimates based on Department of Industry, Science, and Resources (2022), Australian Energy Statistics 2020-21 and Resources and Energy Quarterly, December 2022.

The remaining natural gas (after accounting for losses and discrepancies) demanded in the domestic economy was 1,489 PJ (see **Figure 3.8**). Its main uses were:

- Electricity generation (486.4 PJ)
- LNG own use (432 PJ)
- manufacturing (354 PJ)
  - gas feedstock (78 PJ)
  - high heating gas (91 PJ)
- residential applications, like gas heating and cooking (150 PJ)
- all other sectors in the economy (60 PJ).

Figure 3.8 Natural gas demand by industry in Australia, 2011-12 to 2021-22

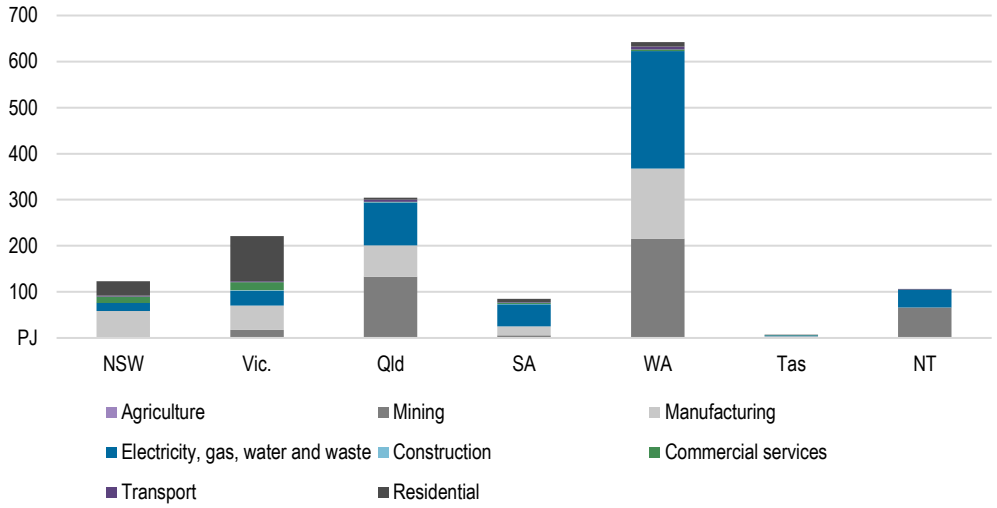


Source: Department of Industry, Science, and Resources (2022), Australian Energy Statistics 2020-21.

Figure 3.9 summarises natural gas demand by sector in each state in 2021-22.

The residential sector was the leading consumer of natural gas in Victoria, while electricity generation was the primary user in WA. In Western Australia, Queensland and the Northern Territory, mining is a significant gas consumer.

Figure 3.9 Natural gas demand by sector by states, 2021-22



Source: DISR (2022), Australian Energy Statistics 2020-21. Table F.

3.3 LPG used in Australia

Figure 3.7 shows Australia's LPG flows (PJ) in 2021-22. The data is estimated based on Australian Energy Statistics and Resources and Energy Quarterly published by DISR.

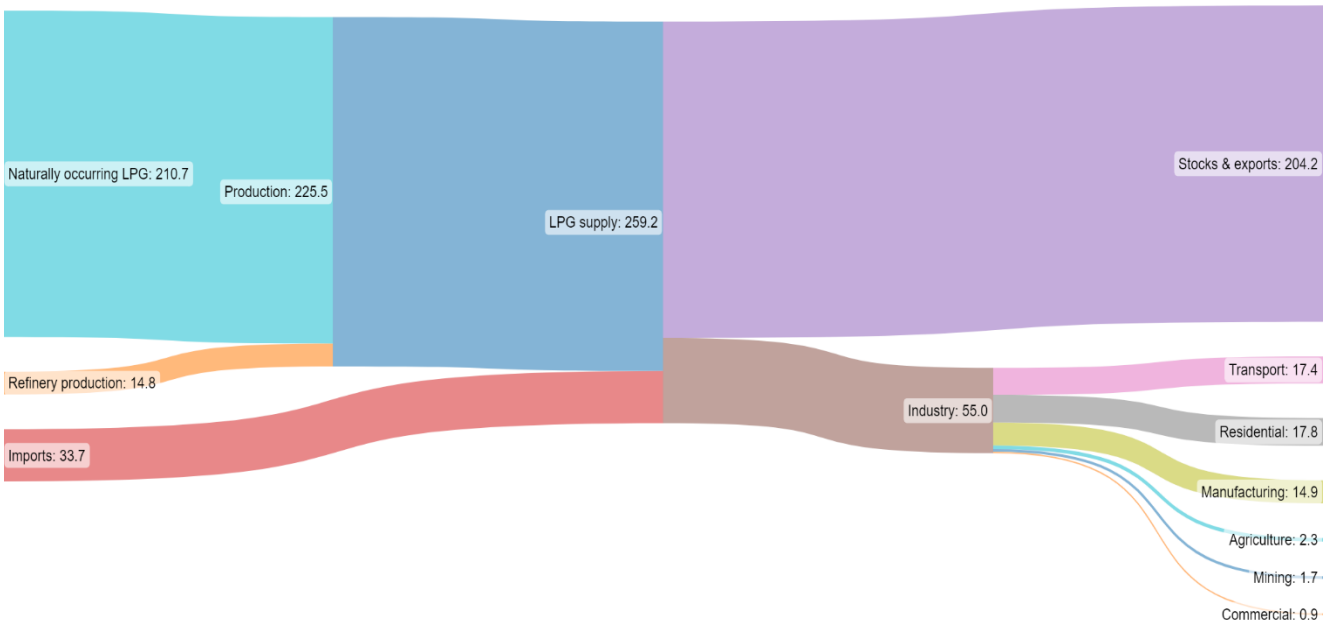
In terms of production from oil fields, crude oils with low gas levels are suitable for LPG production. Natural gas seams containing more of the heavier hydrocarbon fraction can also produce LPG in Australia. In 2021-22, oil fields generated 211 PJ of LPG. Refineries produce LPG while refining crude oil into many different petroleum products. In 2021-22, refineries supplied 15 PJ of LPG.

Import and export terminals around the Australian coast support LPG trade into and out of Australia. Australia exported 80 PJ of LPG in 2021-22. The location of major LPG export facilities in Australia includes Westernport (Victoria), Port Bonython (South Australia), and Kwinana and Dampier (Western Australia). These facilities can handle Very Large Gas Carriers typically used for the international shipping of LPG.

Around 34 PJ of LPG was imported into Australia in 2021-22, mainly through an import facility at Port Botany in New South Wales. With Australia being a net exporter and producing enough LPG to be self-sufficient, these imports occur due to the commercial costs associated with freighting LPG internally.

LPG use by industry was 55 PJ in 2021-22. There are multiple uses for LPG in Australia, which can be categorised into three distinct markets – Traditional, Autogas and petrochemical use. The Traditional market for LPG comprises residential (e.g., water heating, space heating and cooking), recreational, commercial (e.g., forklifts) and industrial uses (e.g., steam-raising, kiln firing and food processing). LPG for the Traditional market is mainly propane to meet domestic and industrial heating specifications. Autogas is a propane and butane mixture. Autogas use in transport and residential use dominates the domestic demand for LPG.

Figure 3.10 Australia's LPG supply and use (PJ) in 2021-22



Source: ACIL Allen estimates based on Department of Industry, Science, and Resources (2021), Australian Energy Statistics 2019-20 and Resources and Energy Quarterly, June 2022.

3.4 Production: Direct economic contribution

This section discusses the economic contribution of four gaseous fuels – natural gas in gaseous form, LNG, LPG and CNG – by the state and Australia.

3.4.1 Value-added

Table 3.5 summarises the estimated revenue associated with the production of gaseous fuels in Australia. The total estimated revenue related to the production of gaseous fuels in Australia in 2021-22 was $87,827 million, an increase of over 90 per cent from the previous year.

Table 3.5 Revenue from gaseous fuels production, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	A$m	A$m	A$m	A$m	A$m
NSW	10	0	2	5	**17**
Vic.	1,275	0	219	7	**1,502**
Qld	3,966	25,465	683	4	**30,117**
SA	335	0	58	2	**395**
WA	8,870	37,523	1,527	11	**47,931**
Tas.	0	0	0	0	**0**
NT	238	7,583	41	0	**7,863**
ACT	0	0	0	1	**1**
Australia	**14,695**	**70,571**	**2,529**	**31**	**87,827**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

The direct value-added of gaseous fuels embodied within this revenue is estimated to have been **$69,569 million** (see **Table 3.6**), mainly comprising pre-tax returns to industry owners and compensation of employees.

In 2021-22, the Australian GDP was $2.309 billion, implying that the direct economic contribution of all gaseous fuel production accounted for 3 per cent of Australia's 2021-22 GDP.

The Northern Territory reported the highest direct GTP contribution from the production of gaseous fuels in 2021-22. It is followed by WA where gaseous fuel production directly contributed 9.1 per cent of state's GSP, and Queensland (5.53 per cent of GSP). These three states are the major gas-producing and exporting states in Australia.

Table 3.6 Direct value-added from gaseous fuels production, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total	Per cent of GSP/GTP/ GDP
	A$m	A$m	A$m	A$m	A$m	%
NSW	8	0	1	2	12	**0.00%**
Vic.	1,030	0	177	2	1,209	**0.23%**
Qld	3,258	20,918	561	1	24,737	**5.53%**
SA	261	0	45	1	306	**0.24%**
WA	6,813	28,820	1,173	4	36,809	**9.10%**
Tas.	0	0	0	0	0	**0.00%**
NT	197	6,264	34	0	6,495	**20.92%**
ACT	0	0	0	0	0	**0.00%**
Australia	**11,566**	**56,002**	**1,991**	**10**	**69,569**	**3.01%**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

3.4.2 Employment

The estimated direct FTE employment in the gaseous fuel production industry in 2021-22 was 21,968 (see **Table 3.7**). Employment patterns follow the production pattern of states.

Table 3.7 Direct employment from gaseous fuels production, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	3	0	1	21	**25**
Vic.	545	0	94	29	**667**
Qld	1,252	8,039	215	14	**9,520**
SA	119	0	21	9	**148**
WA	1,751	7,406	301	45	**9,503**
Tas.	0	0	0	1	**1**
NT	64	2,028	11	0	**2,103**
ACT	0	0	0	1	**1**
Australia	**3,734**	**17,473**	**643**	**119**	**21,968**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

3.5 Production: Indirect economic contribution

Purchasing intermediate inputs or spending on income from the activity will lead to further indirect contributions.

In addition to the direct value added by sectors, there are two indirect channels through which a sector contributes indirectly to the economy. These are:

- Purchases of intermediate inputs by industry: The sector or industry purchases goods and services from various regional businesses to produce its output, e.g., diesel, electricity use, other related chemicals within the sector, or services from different sectors. These goods and service purchases create demand for those services and further stimulate the region's economic activity.
- Employees spend: The income received by the industry employees spend on purchasing various goods and services in the region. This additional spend generates additional economic activity.

As discussed in Appendix A, the supply chain information embodied in input-output tables (and the associated 'input-output multipliers') of the Australian and state economies captures the above two effects. The indirect economic contribution can be measured using the relevant multipliers. Based on information from the ABS, ACIL Allen has developed (and regularly updates) detailed input-output tables for Australia and each state and territory (along with various regional areas, when necessary). ACIL Allen has calculated a range of multipliers from these tables to facilitate economic analysis for this study. By allocating the Australian intermediate inputs to their corresponding input-output industries and applying the appropriate multipliers for the Australian value added and employment data, it is possible to estimate the total Australian value added and employment contribution embodied in the Australian produced inputs and services demanded by gaseous fuels production, transportation and distribution.

3.5.1 Value-added

In 2020-21, the Australian production of gaseous fuels spent approximately $20,311 million on intermediate goods and services. About 88 per cent of these expenses were from domestically produced goods and services comprising various intermediate inputs. The domestic spend of

$17,887 million associated with producing gaseous fuels indirectly contributed $16,293 million (see **Table 3.8**) to the Australian economy, which is between 0.71 per cent of GDP in 2021-22.

This indirect contribution is in addition to the direct economic contribution of gaseous fuel production contribution of 3 per cent reported in **Table 3.6**.

Table 3.8 Indirect value-added from gaseous fuels production, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total	Per cent of GSP/GTP/ GDP
	A$m	A$m	A$m	A$m	A$m	%
NSW	2	0	0	1	**3**	**0.00%**
Vic.	265	0	46	2	**313**	**0.06%**
Qld	737	4,769	127	3	**5,635**	**1.26%**
SA	77	0	13	1	**91**	**0.07%**
WA	1,752	7,291	302	9	**9,354**	**2.31%**
Tas.	0	0	0	0	**0**	**0.00%**
NT	28	864	5	0	**897**	**2.89%**
ACT	0	0	0	0	**0**	**0.00%**
Australia	**2,860**	**12,924**	**492**	**17**	**16,293**	**0.71%**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

3.5.2 Employment

In 2021-22, gaseous fuel production activities in the Australian economy indirectly supported 75,000 (**Table 3.9**) FTE jobs.

Table 3.9 Indirect employment from gaseous fuels production, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	8	0	1	8	**18**
Vic.	1,296	0	223	12	**1,531**
Qld	3,697	24,424	636	8	**28,765**
SA	378	0	65	5	**448**
WA	7,239	31,398	1,246	20	**39,902**
Tas.	0	0	0	0	**0**
NT	126	4,163	22	0	**4,311**
ACT	0	0	0	1	**1**
Australia	**12,744**	**59,985**	**2,194**	**54**	**74,977**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

3.6 Production: Total contribution

3.6.1 Value-added

Adding the direct and indirect value-added economic contributions from Sections 3.4 and 3.5 provides the total economic footprint of the gaseous fuels production in 2021-22.

Table 3.10 summarises total (direct and indirect) value-added contributions from gaseous fuel production by the state.

Table 3.10 Total value-added contribution from gaseous fuel production by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	12	3	15	0.00%
Vic.	1,209	313	1,522	0.30%
Qld	24,737	5,635	30,372	6.79%
SA	306	91	397	0.31%
WA	36,809	9,354	46,162	11.41%
Tas.	0	0	0	0.00%
NT	6,495	897	7,392	23.81%
ACT	0	0	0	0.00%
Australia	**69,569**	**16,293**	**85,862**	**3.72%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

The estimated total (direct and indirect) value-added contribution from gaseous fuel production by fuel is provided in **Table 3.11**.

Table 3.11 Total value-added contribution from gaseous fuel production by gas, 2021-22

	Direct	Indirect	Total	Total (%GDP)
	A$m	A$m	A$m	%

	Direct	Indirect	Total	Total (%GDP)
Natural gas	11,566	2,860	14,426	0.62%
LNG	56,002	12,924	68,926	2.99%
LPG	1,991	492	2,483	0.11%
CNG	10	17	27	0.00%
Australia	**69,569**	**16,293**	**85,862**	**3.72%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

3.6.2 Employment

Table 3.12 summarises total (direct and indirect) employment contributions from gaseous fuel production in Australia by state.

Table 3.12 Total employment contribution from gaseous fuel production by state, 2021-22

	Direct	Indirect	Total	% Total employment
	FTE jobs	FTE jobs	FTE jobs	%
NSW	25	18	43	0.001%
Vic.	667	1,531	2,198	0.076%
Qld	9,520	28,765	38,285	1.769%
SA	148	448	597	0.083%
WA	9,503	39,902	49,405	4.252%
Tas.	1	0	1	0.000%
NT	2,103	4,311	6,414	5.315%
ACT	1	1	2	0.001%
Australia	**21,968**	**74,977**	**96,945**	**0.882%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

Table 3.13 summarises total (direct and indirect) employment contributions from gaseous fuel production by gas in 2021-22.

Table 3.13 Total employment contribution from gaseous fuel production by gas, 2021-22

	Direct	Indirect	Total
	FTE jobs	FTE jobs	FTE jobs
Natural gas in gaseous form	3,734	12,744	16,477
LNG	17,473	59,985	77,458
LPG	643	2,194	2,836
CNG	119	54	173
Australia	**21,968**	**74,977**	**96,945**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

3.6.3 Australian economy

Figure 3.11 summarises total (direct and indirect) Australian economic contribution of gaseous fuel production in 2021-22.

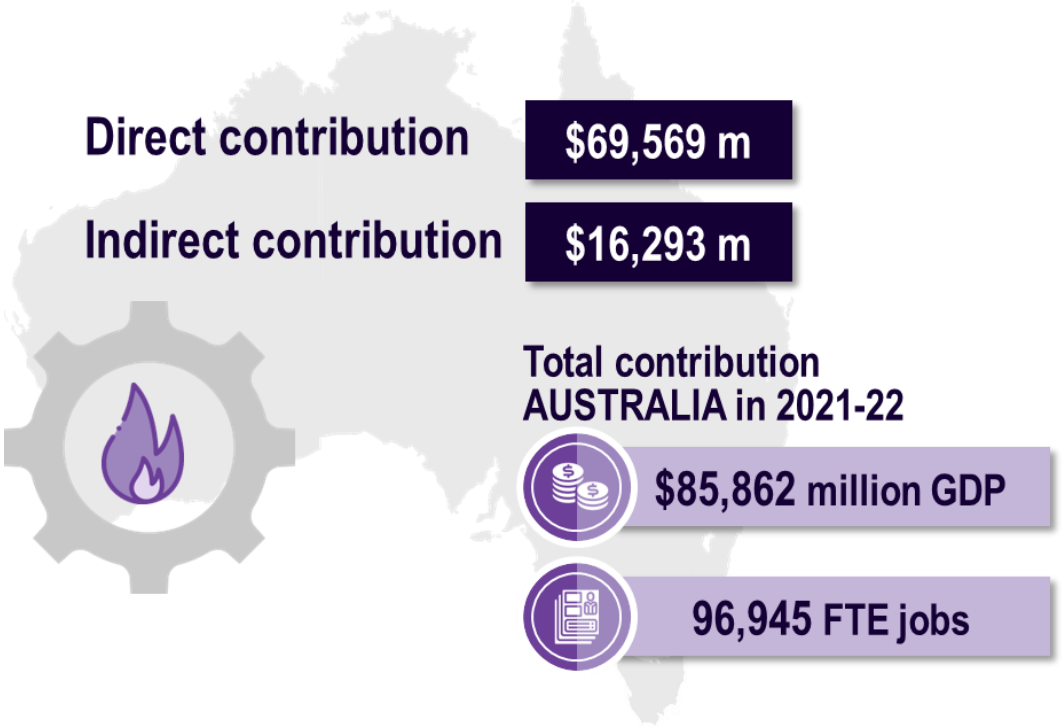
In 2021-22, gaseous fuel production in Australia had:

— a *total* contribution of $85,862 million to the Australian GDP, comprising $69,569 million directly from the gaseous fuel production activities (direct value-added contribution) and $16,293 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 3.72 per cent to the Australian GDP in 2021-22.

— a *total* employment contribution of 96,945 FTE jobs throughout Australia. To put this another way, for every one million dollars of revenue received by the Australian gaseous fuel production activities, up to 2.4 FTE jobs are supported elsewhere in the Australian economy.

In understanding the estimated number of jobs supported by gaseous fuel production, they are calculated as full-time-equivalent jobs. In reality, they represent the summation of many shares of individual positions or include part-time and casual jobs. Consequently, the number of people whose employment is supported (partially or wholly) by the activities of gaseous fuel production, use, transport and distribution will be greater than the estimated number of FTE jobs.

Figure 3.11 Contribution of gaseous fuel production to the Australian economy, 2021-22



Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.
Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data.

3.6.4 State economies

Figure 3.12 summarises the total (direct and indirect) economic contribution of gaseous fuel production to state economies in 2021-22.

New South Wales

In 2021-22, gaseous fuel production in New South Wales had:

— a *total* contribution of $15 million to New South Wales GSP, comprising $12 million directly from the gaseous fuel production activities (direct value-added contribution) and $3 million indirectly from its input demand sources (indirect contribution). It contributed at least 0.0021 per cent to New South Wales GSP in 2021-22.

— a *total* employment contribution of 43 FTE jobs throughout Victoria. To put this another way, for every one million dollars of revenue received by the New South Wales gaseous fuel production activities, up to 2.5 FTE jobs are supported elsewhere in the New South Wales economy.

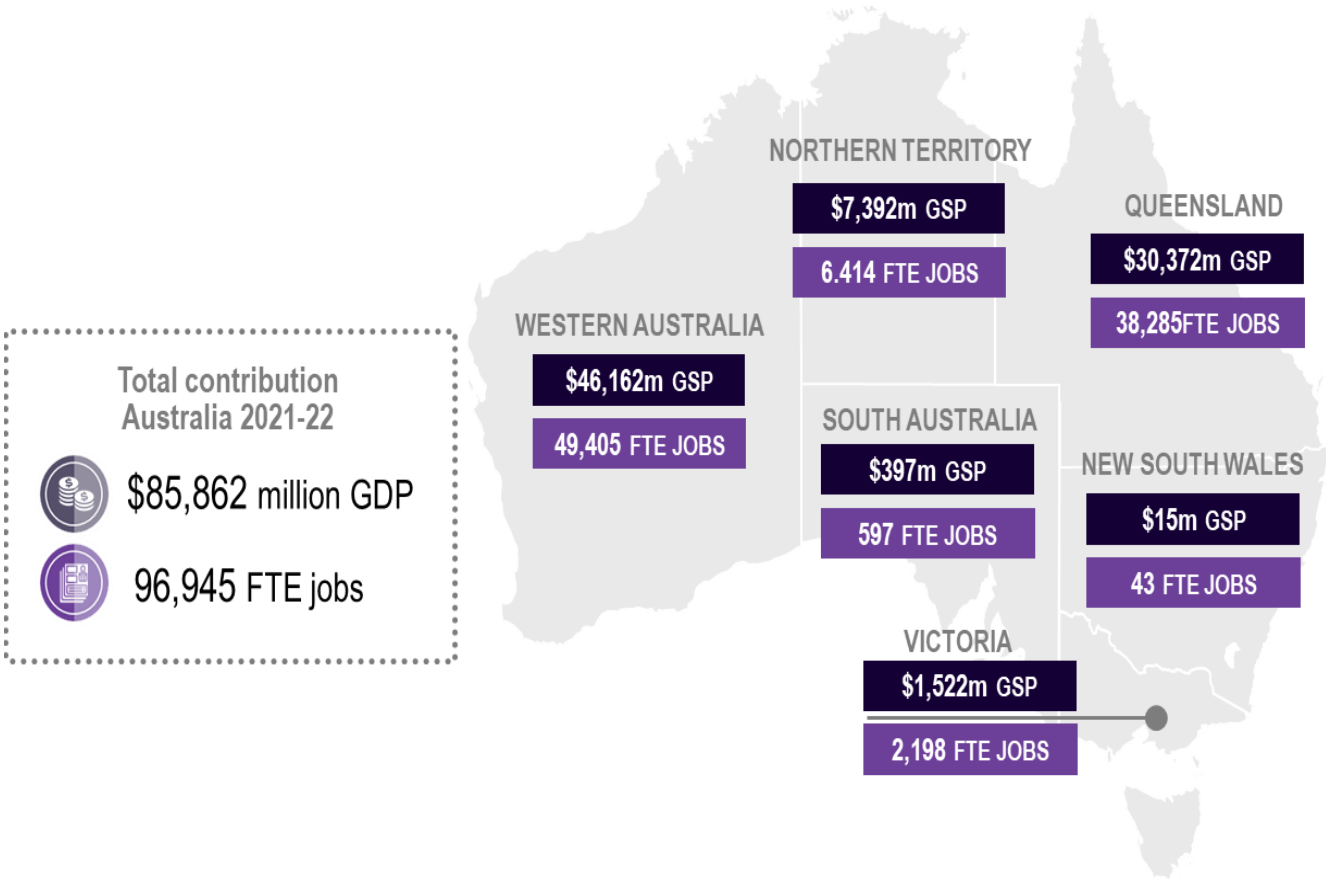
Victoria

In 2021-22, gaseous fuel production in Victoria had:

— a *total* contribution of $1,522 million to Victorian GSP, comprising $1,209 million directly from the gaseous fuel production activities (direct value-added contribution) and $313 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.30 per cent to Victorian GSP in 2021-22.

— a *total* employment contribution of 2,198 FTE jobs throughout Victoria. To put this another way, for every one million dollars of revenue received by the Victorian gaseous fuel production activities, up to 1.46 FTE jobs are supported elsewhere in the Victorian economy.

Figure 3.12 Contribution of gaseous fuel production to state economies, 2021-22



Source: ACIL Allen estimates based on ABS, DISR, and IBISWorld data.

Queensland

In 2021-22, gaseous fuel production in Queensland had:

— a *total* contribution of $30,372 million to Queensland GSP, comprising $24,737 million directly from the gaseous fuel production activities (direct value-added contribution) and $5,635 million indirectly from its input demand sources (indirect contribution). It contributed at least 6.79 per cent to Queensland GSP in 2021-22.

— a *total* employment contribution of 38,285 FTE jobs throughout Queensland. To put this another way, for every one million dollars of revenue received by the Queensland gaseous fuel production activities, up to 1.3 FTE jobs are supported elsewhere in the Queensland economy.

South Australia

In 2021-22, gaseous fuel production in South Australia had:

— a *total* contribution of $397 million to South Australia GSP, comprising $306 million directly from the gaseous fuel production activities (direct value-added contribution) and $91 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.31 per cent to South Australia GSP in 2021-22.

— a *total* employment contribution of 597 FTE jobs throughout South Australia. To put this another way, for every one million dollars of revenue received by the South Australian gaseous fuel production activities, up to 1.5 FTE jobs are supported elsewhere in the South Australian economy.

Western Australia

In 2021-22, gaseous fuel production in Western Australia had:

— a *total* contribution of $46,162 million to Western Australia's GSP, comprising $36,809 million directly from the gaseous fuel production activities (direct value-added contribution) and $9,354 million indirectly from its input demand sources (indirect contribution). It contributed at least 11.41 per cent to Western Australia's GSP in 2021-22.

— a *total* employment contribution of 49,405 FTE jobs throughout Western Australia. To put this another way, for every one million dollars of revenue received by the Western Australian gaseous fuel production activities, up to 1 FTE jobs are supported elsewhere in the Western Australian economy.

Northern Territory

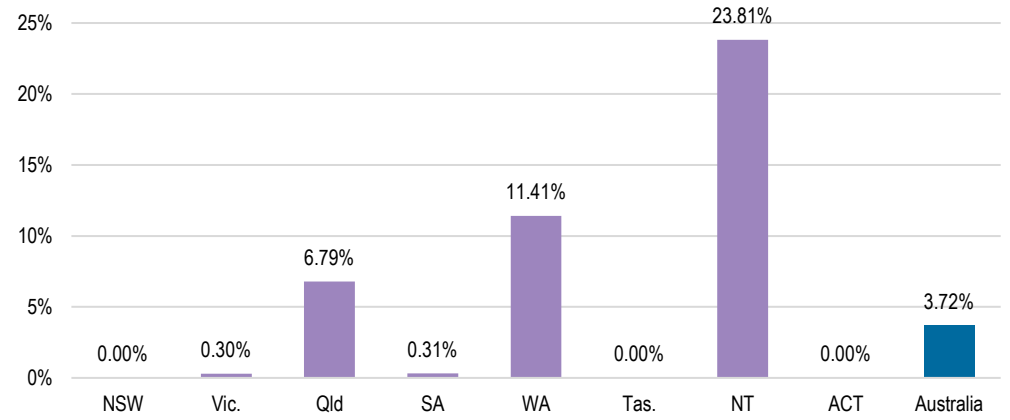
In 2021-22, gaseous fuel production in the Northern Territory had:

— a *total* contribution of $7,392 million to the Northern Territory's GTP, comprising $6,495 million directly from the gaseous fuel production activities (direct value-added contribution) and $897 million indirectly from its input demand sources (indirect contribution). It contributed at least 23.81 per cent to the Northern Territory's GTP in 2021-22.

— a *total* employment contribution of 6,414 FTE jobs throughout the Northern Territory. To put this another way, for every one million dollars of revenue received by the Northern Territory gaseous fuel production activities, up to 0.8 FTE jobs are supported elsewhere in the Northern Territory economy.

Figure 3.13 summarises gaseous fuel production activities to state GSPs in 2021-22.

Figure 3.13 Gaseous fuel production activities to State GSPs, 2021-22



Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

Contribution of transport and distribution of gaseous fuels

4

This chapter provides the economic contribution estimates of gaseous fuels transportation and distribution by state and fuel type. These estimates are based on various data sources using input-output multiplier analysis. For CNG, there are no transport and distribution activities involved.

4.1 Transport and distribution: Direct contribution

4.1.1 Value-added

Table 4.1 summarises the estimated revenue from the transportation and distribution of gaseous fuels in Australia. This revenue includes transportation and distribution of imported LPG.

The total estimated revenue (margins and taxes) of the Australian gaseous fuels transport and distribution in 2021-22 was $11,051 million.

Table 4.1 Revenue from gaseous fuels transport and distribution, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	A$m	A$m	A$m	A$m	A$m
NSW	634	0	753	0	1,387
Vic.	1,424	0	682	0	2,106
Qld	1,567	13	647	0	2,227
SA	547	0	242	0	790
WA	3,485	19	292	0	3,796
Tas.	34	0	84	0	118
NT	553	2	23	0	578
ACT	34	0	17	0	50
Australia	**8,278**	**34**	**2,740**	**0**	**11,051**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

The direct economic contribution or direct value-added of gaseous fuels transport and distribution embodied within this revenue is estimated to have been **$5,471 million** (see **Table 4.2**), mainly comprising wages, taxes and subsidies.

In 2021-22, the Australian GDP was $2,309 billion, implying that the direct economic contribution of all gaseous fuels, transport and distribution accounted for 0.237 per cent of Australia's 2021-22 GDP.

Table 4.2 Direct value-added from gaseous fuels transport and distribution, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	%
NSW	288	0	435	0	**724**	0.104%
Vic.	652	0	394	0	**1,045**	0.203%
Qld	731	9	375	0	**1,114**	0.249%
SA	259	0	139	0	**398**	0.310%
WA	1,638	14	169	0	**1,821**	0.450%
Tas.	15	0	49	0	**65**	0.168%
NT	251	3	21	0	**275**	0.887%
ACT	18	0	10	0	**28**	0.061%
Australia	**3,853**	**26**	**1,593**	**0**	**5,471**	**0.237%**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

4.1.2 Employment

The direct employment (**Table 4.3**) associated with the transport and distribution of gases was 22,933 FTE jobs in 2020-21.

Table 4.3 Direct employment from gaseous fuels transport and distribution, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	755	0	3,249		**4,004**
Vic.	1,771	0	3,219		**4,990**
Qld	1,712	13	3,037		**4,761**
SA	592	0	1,110		**1,701**
WA	4,856	17	1,149		**6,023**
Tas.	45	0	425		**470**
NT	717	4	157		**879**
ACT	42	0	62		**104**
Australia	**10,492**	**34**	**12,407**		**22,933**

Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

4.2 Transport and distribution: Indirect contribution

4.2.1 Value-added

The Australian all gaseous fuels transportation and distribution spent $9,554 million on domestic margins in transporting and distributing gaseous fuels in 2021-22 comprising:

- $4,025 million in gas distribution margins
- $3,801 million in transport margins
- $1,728 million in wholesale and retail trade margins

The domestic spend of $9,554 million by all gaseous fuels transport and distribution indirectly contributed $4,748 million (see **Table 4.4**) to the Australian economy, which is 0.206 per cent of GDP in 2021-22. This contribution is in addition to the direct gaseous fuels' transportation and distribution contribution of 0.237 per cent reported in **Table 4.2**.

Table 4.4 Indirect value-added from gaseous fuels transport and distribution, 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	%
NSW	275	0	281		**556**	0.080%
Vic.	757	0	246		**1,003**	0.195%
Qld	710	4	218		**932**	0.208%
SA	264	0	78		**342**	0.266%
WA	1,561	5	84		**1,650**	0.408%
Tas.	10	0	21		**32**	0.082%
NT	212	1	8		**221**	0.711%
ACT	10	0	4		**13**	0.029%
Australia	**3,800**	**9**	**939**	**0**	**4,748**	**0.206%**

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

4.2.2 Employment

The Australian economy's gaseous fuel transport and distribution activities are estimated to support 23,295 (**Table 4.5**) FTE jobs indirectly.

Table 4.5 Indirect employment from gaseous fuels transport and distribution, a lower bound 2021-22

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	1,294	0	1,473		**2,767**
Vic.	3,627	0	1,419		**5,046**
Qld	3,361	23	1,285		**4,669**
SA	1,204	0	472		**1,676**
WA	7,343	25	421		**7,789**
Tas.	59	0	141		**201**
NT	1,050	5	44		**1,098**
ACT	33	0	16		**50**
Australia	**17,971**	**52**	**5,272**		**23,295**

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

4.3 Transport and distribution: Total contribution

4.3.1 Value-added

Adding the direct and indirect value-added economic contributions from Sections 4.1 and 4.2 provides the total economic footprint of the gaseous fuels transport and distribution in 2021-22. **Table 4.6** summarises the total (direct and indirect) value-added contribution from gaseous fuel transport and distribution by the state.

Table 4.6 Total value-added contribution from gaseous fuel transport and distribution by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	724	556	1,280	0.18%
Vic.	1,045	1,003	2,049	0.40%
Qld	1,114	932	2,046	0.46%
SA	398	342	741	0.58%
WA	1,821	1,650	3,471	0.86%
Tas.	65	32	96	0.25%
NT	275	221	496	1.60%
ACT	28	13	42	0.09%
Australia	**5,471**	**4,748**	**10,220**	**0.44%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.
Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

Table 4.7 summarises the total (direct and indirect) value-added contribution from gaseous fuel production by gas.

Table 4.7 Total value-added contribution from gaseous fuel transport and distribution by gas, 2021-22

	Direct	Indirect	Total	Total (%GDP)
	A$m	A$m	A$m	%
Natural gas	3,853	3,800	7,653	0.33%
LNG	26	9	35	0.00%
LPG	1,593	939	2,532	0.11%
CNG	0	0	0	0.00%
Australia	**5,471**	**4,748**	**10,220**	**0.44%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.
Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

4.3.2 Employment

Table 4.8 provides the total (direct and indirect) employment contribution from gaseous fuel transport and distribution.

Table 4.8 Total employment contribution from gaseous fuel transport and distribution by state, 2021-22

	Direct	Indirect	Total	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	%
NSW	4,004	2,767	6,771	0.19%
Vic.	4,990	5,046	10,036	0.35%
Qld	4,761	4,669	9,431	0.44%
SA	1,701	1,676	3,377	0.47%
WA	6,023	7,789	13,812	1.19%
Tas.	470	201	671	0.32%
NT	879	1,098	1,977	1.64%
ACT	104	50	154	0.08%
Australia	**22,933**	**23,295**	**46,228**	**0.42%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

4.3.3 Australian economy

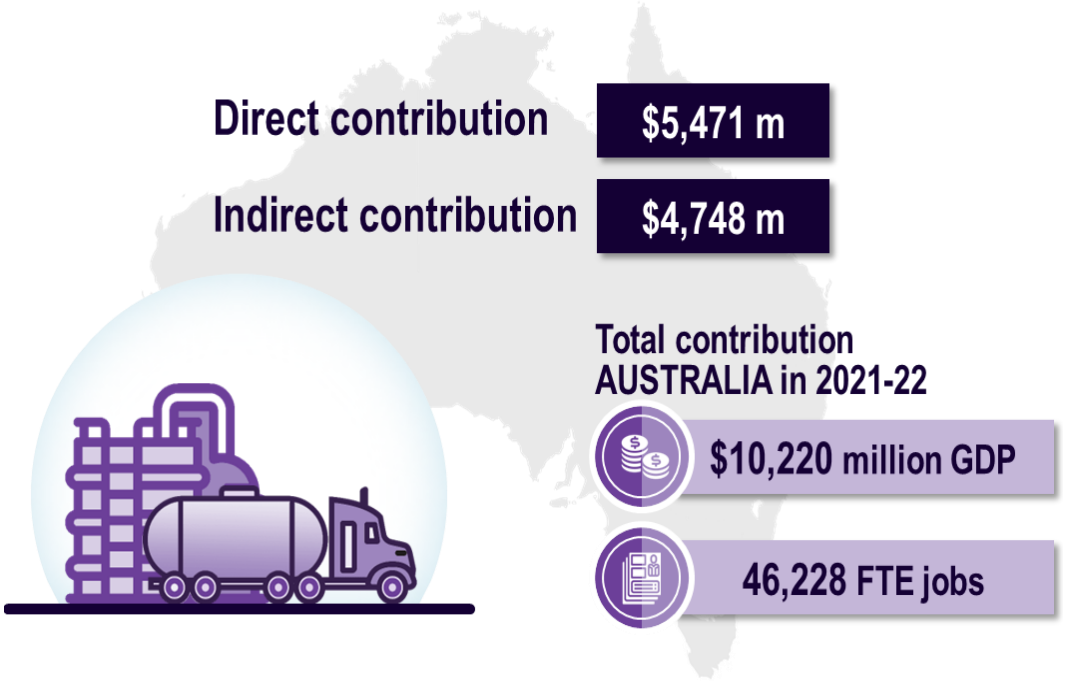
Figure 4.1 summarises the Australian economic contribution of gaseous fuel transport and distribution in 2021-22.

In 2021-22, gaseous fuel transport and distribution in Australia had:

— A *total* contribution of $10,220 million to the Australian GDP, comprising $5,471 million directly from the gaseous fuel production activities (direct value-added contribution) and $4,748 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.443 per cent to the Australian GDP in 2021-22.

— a *total* employment contribution of 46,228 FTE jobs throughout Australia. To put this another way, for every one million dollars of revenue received by the Australian gaseous fuel transport and distribution activities, up to 4.2 FTE jobs are supported elsewhere in the Australian economy.

Figure 4.1 Total contribution of gaseous fuel transport and distribution to the Australian economy, 2021-22

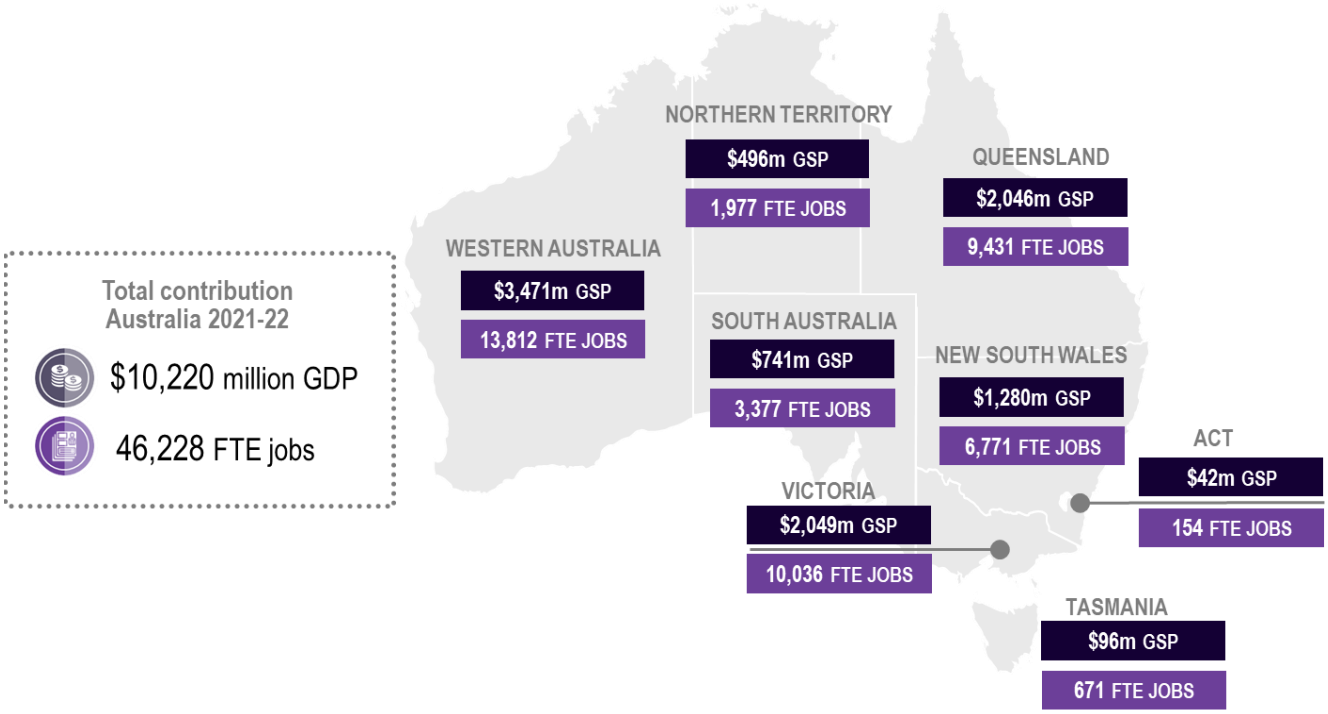


Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

4.3.4 State economies

Figure 4.2 summarises the total economic contribution of gaseous fuel transport and distribution to the state economies in 2021-22.

Figure 4.2 Estimated total contribution of gaseous fuel transport and distribution to state economies, 2021-22



Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

New South Wales

In 2021-22, gaseous fuel transport and distribution in New South Wales had:

— a *total* contribution of $1,280 million to New South Wales GSP, comprising $724 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $556 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.183 per cent to New South Wales GSP in 2021-22.

— a *total* employment contribution of 6,771 FTE jobs throughout New South Wales. To put this another way, for every one million dollars of revenue received by the New South Wales gaseous fuel transport and distribution activities, up to 4.9 FTE jobs are supported elsewhere in the New South Wales economy.

Victoria

In 2021-22, gaseous fuel transport and distribution in Victoria had:

— a *total* contribution of $12,049 million to Victorian GSP, comprising $1,045 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $1,003 million indirectly from its input demand sources (indirect contribution). It contributed at least 0.398 per cent to Victorian GSP in 2021-22.

— a *total* employment contribution of 10,036 FTE jobs throughout Victoria. To put this another way, for every one million dollars of revenue received by the Victorian gaseous fuel transport and distribution activities, up to 4.8 FTE jobs are supported elsewhere in the Victorian economy.

Queensland

In 2021-22, gaseous fuel transport and distribution in Queensland had:

— a *total* contribution of $2,046 million to Queensland GSP, comprising $1,114 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $932 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.457 per cent to Queensland GSP in 2021-22.

— a *total* employment contribution of 9,431 FTE jobs throughout Queensland. To put this another way, for every one million dollars of revenue received by the Queensland gaseous fuel transport and distribution activities, up to 4.2 FTE jobs are supported elsewhere in the Queensland economy.

South Australia

In 2021-22, gaseous fuel transport and distribution in South Australia had:

— a *total* contribution of $741 million to South Australia GSP, comprising $398 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $342 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.576 per cent to South Australia GSP in 2021-22.

— a *total* employment contribution of 3,377 FTE jobs throughout South Australia. To put this another way, for every one million dollars of revenue received by the South Australia gaseous fuel transport and distribution activities, up to 4.3 FTE jobs are supported elsewhere in the South Australia economy.

Western Australia

In 2021-22, gaseous fuel transport and distribution in Western Australia had:

— a *total* contribution of $3,471 million to Western Australia's GSP, comprising $1,821 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $1,650 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.858 per cent to Western Australia's GSP in 2021-22.

— a *total* employment contribution of 13,812 FTE jobs throughout Western Australia. To put this another way, for every one million dollars of revenue received by the Western Australia gaseous fuel transport and distribution activities, up to 3.6 FTE jobs are supported elsewhere in the Western Australia economy.

Tasmania

In 2021-22, gaseous fuel transport and distribution in Tasmania had:

— a *total* contribution of $96 million to Tasmania's GSP, comprising $65 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $32 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.251 per cent to Tasmania's GSP in 2021-22.

— a *total* employment contribution of 671 FTE jobs throughout Tasmania. To put this another way, for every one million dollars of revenue received by the Tasmania gaseous fuel transport and distribution activities, up to 5.7 FTE jobs are supported elsewhere in the Tasmanian economy.

Northern Territory

In 2021-22, gaseous fuel transport and distribution in the Northern Territory had:

— a *total* contribution of $496 million to the Northern Territory's GTP, comprising $275 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $221 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 1.60 per cent to the Northern Territory's GTP in 2021-22.

— A *total* employment contribution of 1,977 FTE jobs throughout the Northern Territory. To put this another way, for every one million dollars of revenue received by the Northern Territory gaseous fuel transport and distribution activities, up to 3.4 FTE jobs are supported elsewhere in the Northern Territory economy.

Australian Capital Territory

In 2021-22, gaseous fuel transport and distribution in the ACT had:

— a *total* contribution of $42 million to the ACT's GTP, comprising $28 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $13 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.09 per cent to the ACT's GTP in 2021-22.

— a *total* employment contribution of 164 FTE jobs throughout ACT. To put this another way, for every one million dollars of revenue received by the ACT gaseous fuel transport and distribution activities, up to 3.1 FTE jobs are supported elsewhere in the ACT economy.

Figure 4.3 summarises gaseous fuel transport and distribution activities to state GSPs.

Figure 4.3 Gaseous fuel transport and distribution activities to State GSPs, 2021-22

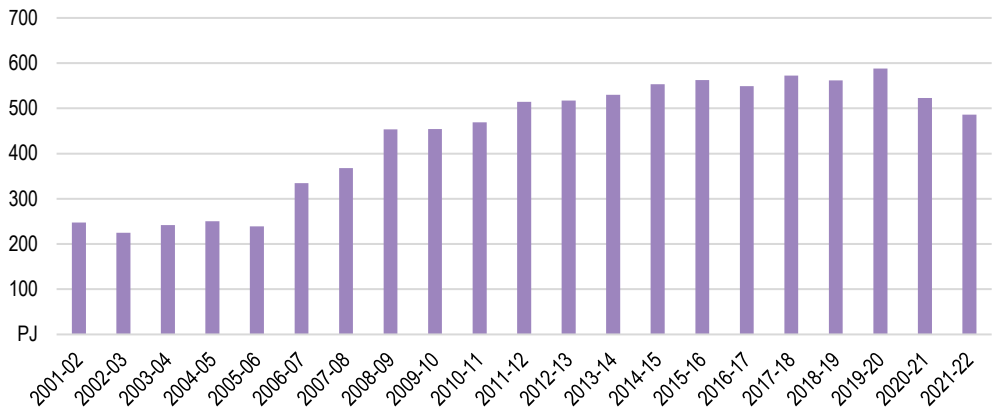
Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

Contribution of gas-fired electricity generation 5

5.1 Gas-fired electricity generation

Figure 5.1 shows the quantity of gas used to generate electricity in Australia. In 2021-22, Australia used 486 PJ of natural gas to generate electricity. The electricity generation sector demanded nearly 33 per cent of natural gas (excluding LNG use) produced in Australia.

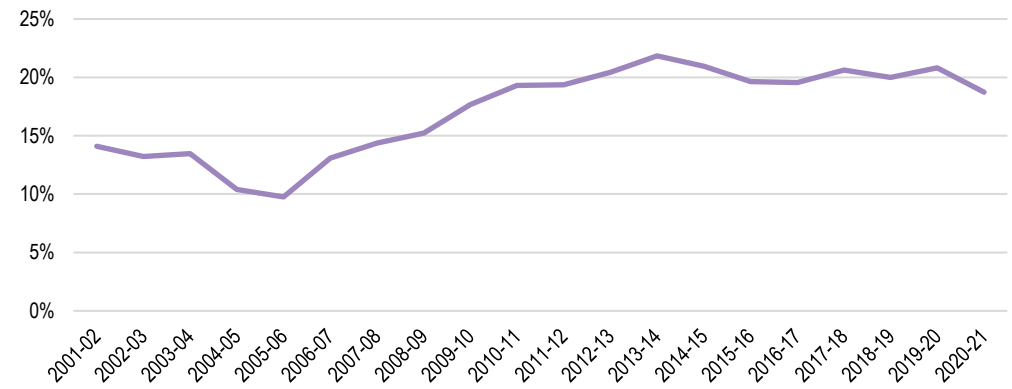
Figure 5.1 Natural gas use in electricity generation, 2001-02 to 2021-22



Source: DISR 2022, Australian Energy Statistics, Table F.

As shown in **Figure 5.2**, the natural gas share in electricity generation was 19 per cent in 2020-21.

Figure 5.2 Natural gas share in electricity generation, 2001-02 to 2020-21



Source: DISR 2022, Australian electricity generation, by fuel type, physical units, financial year, Table O

Figure 5.3 summarises the gas share in electricity generation in 2020-21 by the state. Nearly 85 per cent of electricity in the NT was generated from using natural gas. In WA, this was 59 per cent. In SA, it was 38 per cent, and in Queensland, it was 15 per cent.

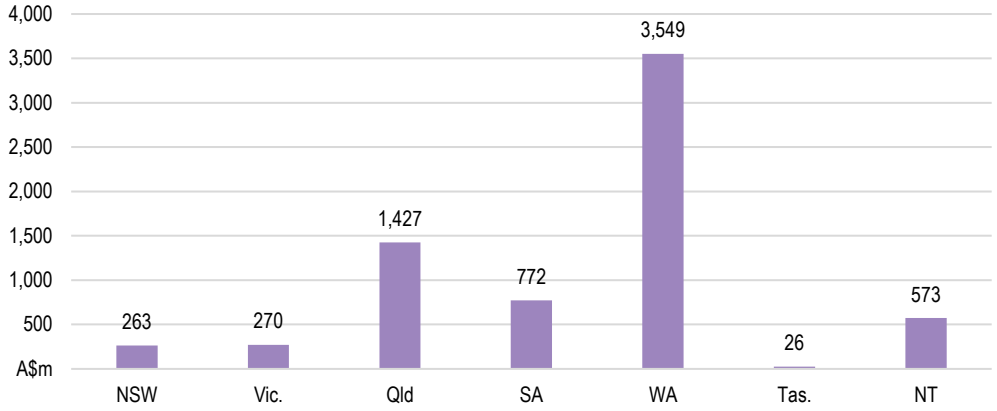
Figure 5.3 Australian electricity generation by natural gas, 2020-21

Source: DISR 2022, Australian electricity generation, by fuel type, physical units, financial year, Table O

5.2 Gas-fired electricity generation: Direct contribution

The total estimated revenue of the Australian gas-fired electricity generation industry in 2021-22 was $6,881 million (**Figure 5.4**).

Figure 5.4 Revenue of gas-fired electricity generation by state, 2021-22



Source: ACIL Allen based on ABS IOPC data for 2019-20 and DISER 2022.

The direct value-added of electricity generated from natural gas embodied within this revenue is estimated to have been **$1,764 million** (see **Figure 5.5**), primarily gross operating surplus and wages and salaries of employees.

Figure 5.5 Direct value-added of gas-fired electricity generation by state, 2021-22

Source: ACIL Allen based on ABS IOPC data for 2019-20. ACIL Allen data.

In 2021-22, Australian GDP was $2,309 billion, implying that the direct economic contribution of electricity from natural gas accounted for 0.076 per cent of Australia's 2021-22 GDP.

The estimated direct employment in the gas-fired electricity generation industry in 2021-22 was 2.978 FTE jobs.

5.3 Gas-fired electricity generation: Indirect contribution

The Australian gas-fired electricity generation industry spent $5,160 million on gas, other goods and services in producing electricity in 2021-22. Of this, $4,203 million was spent on domestically produced goods and services comprising:

- $1,889 million on gas
- $898 million on business, finance and insurance services
- $839 million on electricity transmission and distribution and marketing operations
- $578 million on other inputs and services.

The domestic spend of $4,203 million by the gas-fired electricity generation industry indirectly contributed $3,827 million to the Australian economy, which is 0.166 per cent of GDP in 2021-22. This indirect contribution is in addition to the direct contribution of 0.076 per cent.

The gas-fired electricity generation industry activities in the Australian economy indirectly supported up to 17,026 FTE jobs.

5.4 Gas-fired electricity generation: Total contribution

Adding the direct and indirect economic contributions from Sections 5.2 and 5.3 provides lower and upper bound estimates of the total economic footprint of the Australian gas-fired electricity generation industry in 2021-22.

5.4.1 Value- added

Table 5.1 provides total (direct and indirect) value-added contributions from gas-fired electricity generation.

Table 5.1 Total value-added contribution from gas-fired electricity generation by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	62	197	259	0.037%
Vic.	67	180	247	0.048%
Qld	361	1,003	1,364	0.305%
SA	212	425	636	0.495%
WA	924	1,784	2,708	0.670%
Tas.	6	11	17	0.045%
NT	132	227	359	1.156%
ACT	0	0	0	0.000%
Australia	**1,764**	**3,827**	**5,591**	**0.242%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR.

5.4.2 Employment

Table 5.2 provides total (direct and indirect) employment contributions from gas-fired electricity generation.

Table 5.2 Total employment contribution from gas-fired electricity generation by state, 2021-22

	Direct	Indirect	Total	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	
NSW	115	717	832	0.024%
Vic.	95	706	800	0.028%
Qld	579	3,872	4,451	0.206%
SA	295	1,584	1,879	0.263%
WA	1,642	9,172	10,814	0.931%
Tas.	11	50	61	0.029%
NT	242	926	1,167	0.967%

	Direct	Indirect	Total	Per cent of total employment
ACT	0	0	0	0.000%
Australia	**2,978**	**17,026**	**20,004**	**0.182%**

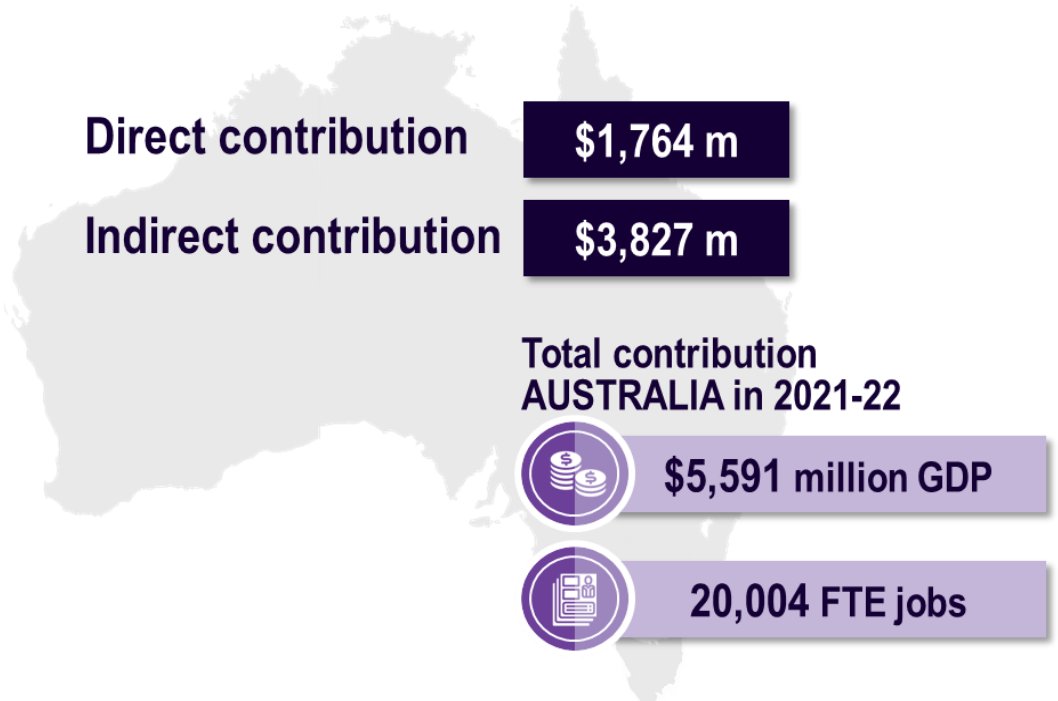
Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.
Source: ACIL Allen estimates based on ABS and DISR

5.4.3 Australian economy

Figure 5.6 summarises the total economic contribution of the gas-fired electricity generation industry in 2021-22. The gas-fired electricity generation in Australia resulted in a *total* contribution of $5,591 million to the Australian GDP, comprising $1,764 million directly from the industry (direct value-added) and $3,827 million indirectly from its input demand sources (indirect contribution). The gas-fired electricity generation industry contributed at least 0.242 per cent to the Australian GDP in 2021-22.

The gas-fired electricity generation in Australia supported a *total* employment of 12,289 FTE jobs throughout Australia. To put this another way, for every one million dollars of revenue, the Australian gas-fired electricity generation industry receives, up to 2.9 FTE jobs are supported elsewhere in the Australian economy.

Figure 5.6 Estimated contribution of gas-fired electricity generation to the Australian economy, 2021-22



Source: ACIL Allen estimates based on ABS and DISR

5.4.4 State economies

Figure 5.7 summarises the total economic contribution of gas-fired electricity generation to state economies in 2021-22.

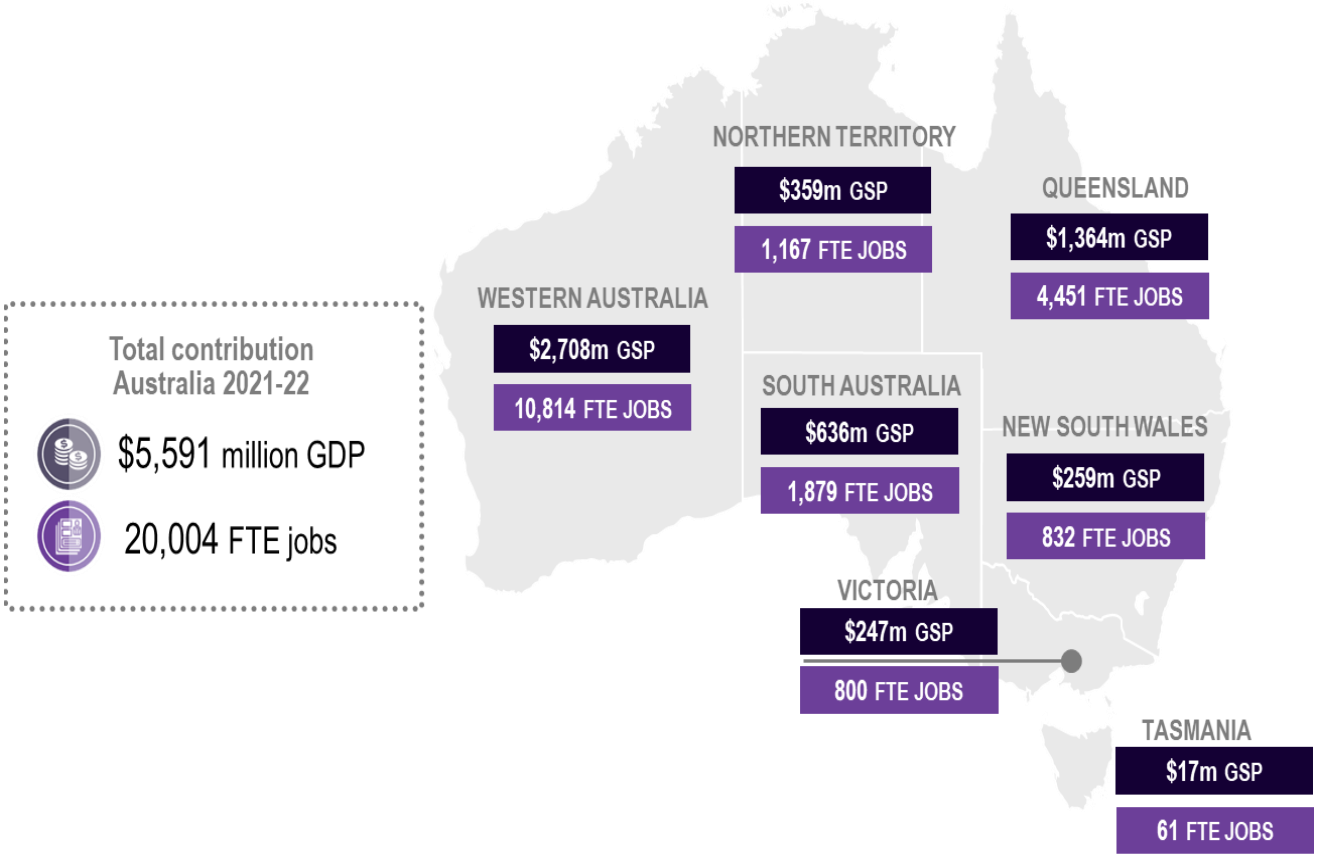
New South Wales

In 2021-22, the gas-fired electricity generation in New South Wales had:

— a *total* contribution of $259 million to New South Wales GSP, comprising $62 million directly from the gas-fired electricity generation activities (direct value-added contribution) and $197 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.037 per cent to New South Wales GSP in 2021-22.

— The gas-fired electricity generation activities in NSW supported up to 832 FTE jobs. To put this another way, for every one million dollars of revenue received by the New South Wales gas-fired electricity generation, up to 3.2 FTE jobs are supported elsewhere in the New South Wales economy.

Figure 5.7 Estimated contribution of gas-fired electricity generation to state economies, 2021-22



Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

Victoria

In 2021-22, the gas-fired electricity generation in Victoria had:

— a *total* contribution of $247 million to Victorian GSP, comprising $67 million directly from the gas-fired electricity generation activities (direct value-added contribution) and $180 million indirectly from its input demand sources (indirect contribution). It contributed at least 0.048 per cent to Victorian GSP in 2021-22.

— a *total* employment contribution of 800 FTE jobs throughout Victoria. To put this another way, for every one million dollars of revenue received by the Victorian gas-fired electricity generation activities, up to 3 FTE jobs are supported elsewhere in the Victorian economy.

Queensland

In 2021-22, the gas-fired electricity generation in Queensland had:

— a *total* contribution of $1,364 million to Queensland GSP, comprising $361 million directly from the gas-fired electricity generation activities (direct value-added contribution) and $1,003 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.305 per cent to Queensland GSP in 2021-22.

— a *total* employment contribution of 4,451 FTE jobs throughout Queensland. To put this another way, for every one million dollars of revenue from the Queensland gas-fired electricity generation activities, up to 3.1 FTE jobs are supported elsewhere in the Queensland economy.

South Australia

In 2021-22, the gas-fired electricity generation in South Australia had:

— a *total* contribution of $636 million to South Australia GSP, comprising $212 million directly from the gas-fired electricity generation activities (direct value-added contribution) and $425 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.495 per cent to South Australia GSP in 2021-22.

— a *total* employment contribution of 1,982 FTE jobs throughout SA. To put this another way, for every one million dollars of revenue from the SA gas-fired electricity generation activities, up to 2.4 FTE jobs are supported elsewhere in the SA economy.

Western Australia

In 2021-22, the gas-fired electricity generation in Western Australia had:

— a *total* contribution of $2,708 million to Western Australia's GSP, comprising $924 million directly from the gas-fired electricity generation activities (direct value-added contribution) and $1,784 million indirectly from its input demand sources (indirect contribution). It contributed at least 0.67 per cent to Western Australia's GSP in 2021-22.

— a *total* employment contribution of 10,814 FTE jobs throughout Western Australia. To put this another way, for every one million dollars of revenue received by the Western Australia gas-fired electricity generation activities, up to 3 FTE jobs are supported elsewhere in the Western Australia economy.

Tasmania

In 2021-22, the gas-fired electricity generation in Tasmania had:

— a *total* contribution of $17 million to Tasmanian GSP, comprising $6 million directly from the gas-fired electricity generation activities (direct value-added contribution) and $11 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.045 per cent to Tasmanian GSP in 2021-22.

— a *total* employment contribution of 61 FTE jobs throughout Tasmania. To put this another way, for every one million dollars of revenue received by the Tasmanian gas-fired electricity generation activities, up to 2.4 FTE jobs are supported elsewhere in the Tasmanian economy.

Northern Territory

In 2021-22, the gas-fired electricity generation in the Northern Territory had:

— a *total* contribution of $359 million to the Northern Territory's GTP, comprising $132 million directly from the gas-fired electricity generation activities (direct value-added contribution) and

$227 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 1.16 per cent to Northern Territory's GTP in 2021-22.

— a *total* employment contribution of 1,167 FTE jobs throughout the Northern Territory. To put this another way, for every one million dollars of revenue received by the Northern Territory gas-fired electricity generation activities, up to 2 FTE jobs are supported elsewhere in the Northern Territory economy.

Figure 5.8 provides a summary of gas-fired electricity generation activities to state GSPs.

Figure 5.8 Contribution of gas-fired electricity generation to State GSPs, 2021-22

Source: ACIL Allen estimates based on ABS and DISR

Contribution of gas feedstock chemical sector

6

The chemical industry comprises the firms and businesses that produce industrial chemicals and plastics. The chemical industry converts raw materials such as oil, natural gas, air, water, metals and minerals into different products.

In the chemical industry, natural gas is consumed in two ways — as energy to drive processes; and as feedstock. Processing energy consumption in the chemical industry is similar to other industrial sectors — fuels are consumed to provide direct heat, steam and electricity to drive the industry's processes, equipment and facilities. The use of gas as feedstock is unique to the chemical industry.

Feedstock uses various gas, fuels or other materials as a material input. Akin to iron ore inputs to the iron and steel industry or alumina inputs to the aluminium industry, the chemical feedstock is the source of carbon and hydrogen used to constitute a range of intermediate and finished chemical products. Feedstock is quantified in energy units because, before use, it is indistinguishable from the same energy products used as fuels. However, once feedstock transforms the chemical industry, it is easier to think of it as a material, with its carbon and hydrogen atoms rearranged physically to constitute the plastics and other chemical products manufactured within the industry.

Key aspects of gas feedstock demand are that it is non-switchable, non-substitutable, operates within a narrow band of operational tolerances and is energy intensive.

Since the reforming of gas to produce syngas (a mixture of hydrogen and carbon monoxide) was discovered, the importance of natural gas as a chemical industry feedstock has become a more cost-effective way of making chemical products.

Natural gas is an essential feedstock input for the chemicals and plastics sector. More importantly, it is vital for transformation into high-value chemicals such as advanced engineering plastics, ingredients for cleaning products, detergents and crop protection chemicals, explosives, pharmaceuticals and advanced textiles. Therefore, access to natural gas is a critical issue for the competitiveness of the Australian chemical industry.

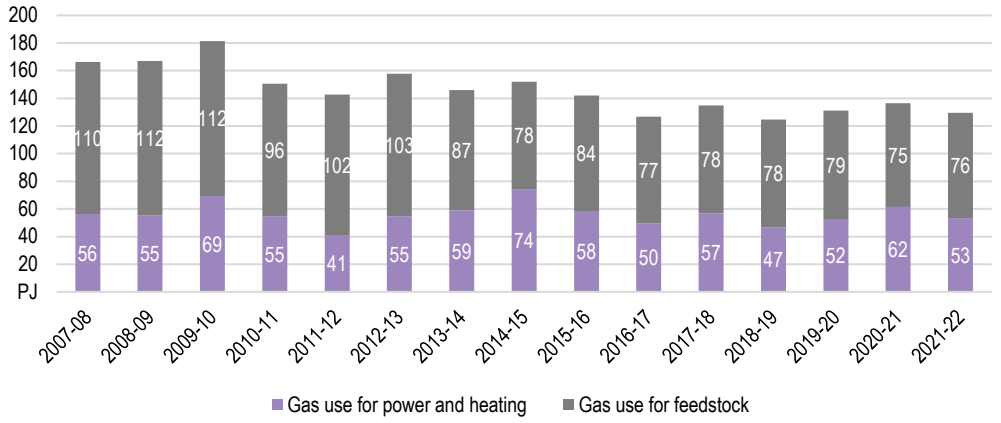
6.1 Gas use as feedstock

The chemical industry transforms millions of tons of natural raw materials from the earth, water and air into valuable products. It is an energy-intensive sector, the second largest energy user in the manufacturing sector after petroleum and coal products in Australia. The chemical industry relies upon natural gas inputs as fuel and power for its operations and as raw materials in manufacturing its many products.

The chemical industry in 2021-22 used 129 PJ of gas, of which 53 PJ was for fuel and power and 76 PJ for feedstock (**Figure 6.1**). Feedstock gas use in the whole chemical industry constitutes just over 59 per cent of the total use of gas in the industry.

The total chemical industry's gas use in physical units (PJ) in 2020-21 was approximately 8 per cent of Australian total final gas use and around 35 per cent of final gas use by the manufacturing sector.

Figure 6.1 Estimated gas use by the chemical sector, 2007-08 to 2021-22



Note: 2021-22 data is estimated based on energy accounts data and Energy Quarterly data. Chemical industry feedstocks are not separately identified in the Australian Energy Statistics published by DISR and have been sourced from the National Greenhouse Gas Inventory (NGGI).

Source: DISR (2022), Australian Energy Statistics 2019-20 and DISR 2022 Resources and Energy Quarterly, December 2022, and Australia's National Inventory submission 2021 CRF reporting tables. https://unfccc.int/documents/478998

In theory, there is a wide range of alternative energy sources to generate power or heat. Consequently, gas use for heat could be substitutable with non-gas energy sources (such as electricity), depending on the economics. An exception may be specific uses by certain manufacturing sectors (or any other economy sector) which require particular heat properties (exceptionally high-temperature heat) that aren't easily obtained from non-gaseous fuels.

Gas used by the chemical sector for feedstock is largely non-substitutable for non-gaseous inputs (for chemistry reasons). The feedstocks are the foundation of the chemistry of plastics, fertilisers and thousands of other products, which are part of the overall gas economy. For the key sectors that use gas as feedstock, approximately 85 per cent of their total gas use was for feedstock and the remainder for heat and energy.

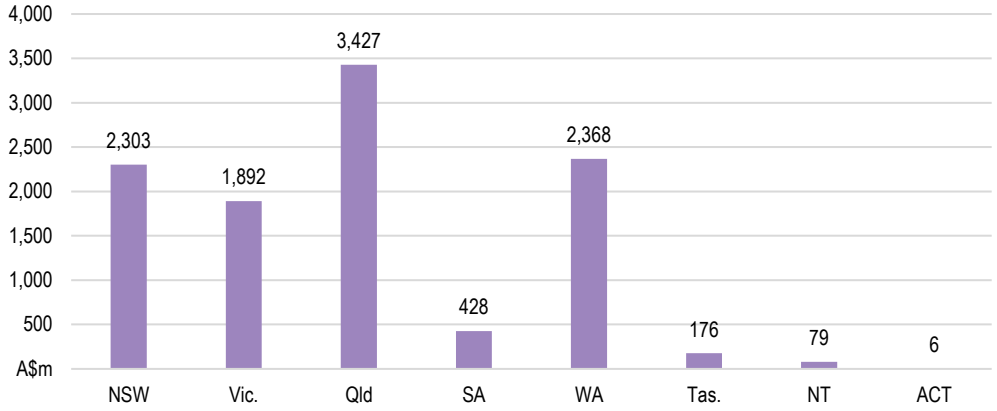
The following four-digit ANZSIC class activities consume gas as their feedstock:

- 1811 Industrial gas manufacturing
- 1829 Other basic polymer manufacturing
- 1831 Fertiliser manufacturing
- 1892 Explosive manufacturing

6.2 Gas feedstock chemicals: Direct contribution

The total estimated revenue of the Australian gas-feedstock chemical sector in 2021-22 was $10,679 million (**Figure 6.2**).

Figure 6.2 Revenue of gas-feedstock chemical sector by state, 2021-22



Source: ACIL Allen based on ABS IOPC data for 2019-20.

The direct value-added of chemicals from natural gas embodied within this revenue is estimated to have been $3,242 million (see **Figure 6.3**), primarily gross operating surplus and wages and salaries of employees.

In 2021-22, the Australian GDP was $2,309 billion, implying that the direct economic contribution of the gas-feedstock chemical sector accounted for 0.14 per cent of Australia's 2021-22 GDP.

The estimated direct employment in the gas-feedstock chemical sector in 2021-22 was 13,636 FTE jobs.

Figure 6.3 Direct value-added of the gas-feedstock chemical sector by state, 2021-22

Source: ACIL Allen based on ABS IOPC data for 2019-20.

6.3 Gas feedstock chemicals: Indirect contribution

The Australian gas-feedstock chemical sector spent $7,485 million on goods and services in producing various chemicals in 2021-22. Of this, $4,831 million was spent on domestically produced goods and services comprising:

- $2,023 million on gas
- $901 million transport
- $895 million on business, finance and insurance services
- $702 million wholesale and retail trade

— $246 million on electricity transmission and distribution and marketing operations

— $63 million on other inputs and services.

The domestic spend of $4,831 million by the gas-feedstock chemical sector indirectly contributed $4,296 million to the Australian economy, which is 0.19 per cent of GDP in 2021-22. This indirect contribution is in addition to the direct contribution of 0.14 per cent.

The gas-feedstock chemical sector activities in the Australian economy indirectly supported 23,038 FTE jobs.

6.4 Gas feedstock chemicals: Total contribution

Adding the direct and indirect economic contributions from Sections 6.2 and 6.3 provides the total economic footprint of the Australian gas-feedstock chemical sector in 2021-22.

6.4.1 Value- added

Table 6.1 provides the total (direct and indirect) value-added contribution from the gas-feedstock chemical sector.

Table 6.1 Total value-added contribution of the gas-feedstock chemical sector by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	697	906	1,602	0.230%
Vic.	590	771	1,360	0.264%
Qld	1,027	1,416	2,443	0.546%
SA	154	161	314	0.244%
WA	694	966	1,660	0.411%
Tas.	50	52	102	0.265%
NT	29	23	53	0.169%
ACT	2	1	3	0.007%
Australia	**3,242**	**4,296**	**7,538**	**0.326%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR.

6.4.2 Employment

Table 6.2 provides the total (direct and indirect) employment contribution from the gas-feedstock chemical sector by state.

Table 6.2 Total employment contribution from the gas-feedstock chemical sector by state, 2021-22

	Direct	Indirect	Total	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	
NSW	2,947	4,742	7,689	0.217%
Vic.	2,462	4,287	6,749	0.234%
Qld	4,405	8,012	12,418	0.574%
SA	660	911	1,571	0.220%

	Direct	Indirect	Total	Per cent of total employment
WA	2,801	4,633	7,434	0.640%
Tas.	268	335	603	0.291%
NT	82	112	195	0.161%
ACT	10	5	15	0.008%
Australia	**13,636**	**23,038**	**36,674**	**0.334%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR.

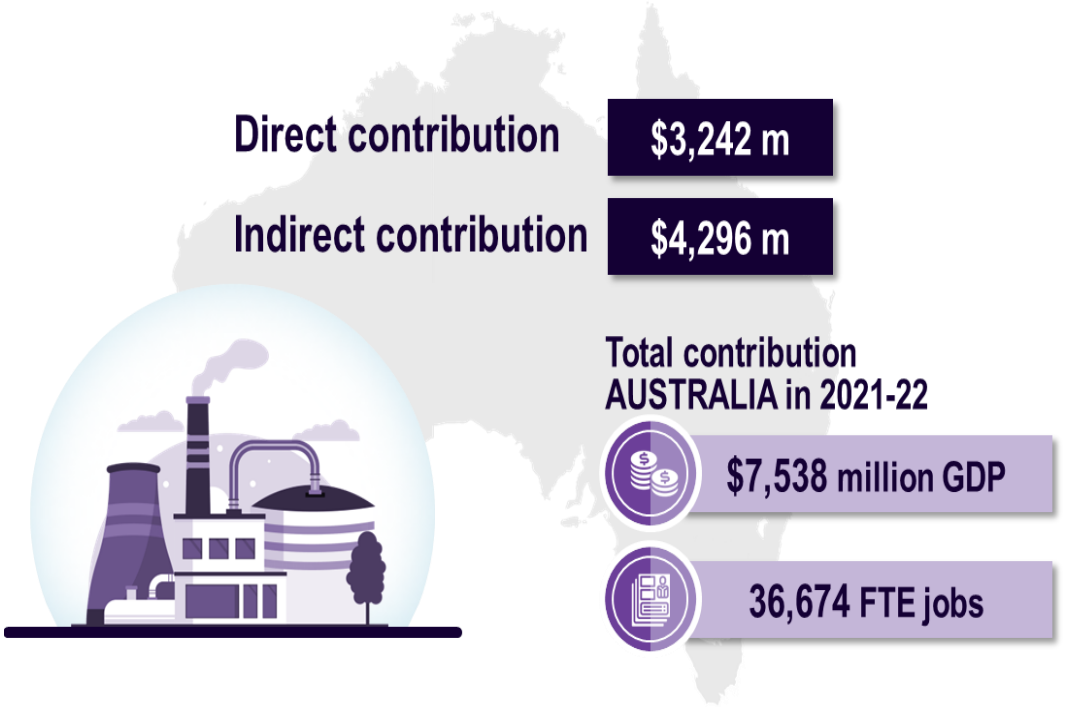
6.4.3 Australian economy

Figure 6.4 summarises the total economic contribution of the gas-feedstock chemical sector in 2020-21. The gas-feedstock chemical sector in Australia resulted in:

— a *total* contribution of $7,538 million to the Australian GDP, comprising $3,242 million directly from the industry (direct value-added) and $4,296 million indirectly from its input demand sources (indirect contribution). The gas-feedstock chemical sector contributed at least 0.326 per cent to the Australian GDP in 2021-22.

— the gas-feedstock chemical sector in Australia supported up to 36,674 FTE jobs in 2021-22. To put this another way, for every one million dollars of revenue the Australian gas-feedstock chemical sector receives, up to 3.4 FTE jobs are supported elsewhere in the Australian economy.

Figure 6.4 Estimated contribution of the gas-feedstock chemical sector to the Australian economy, 2021-22

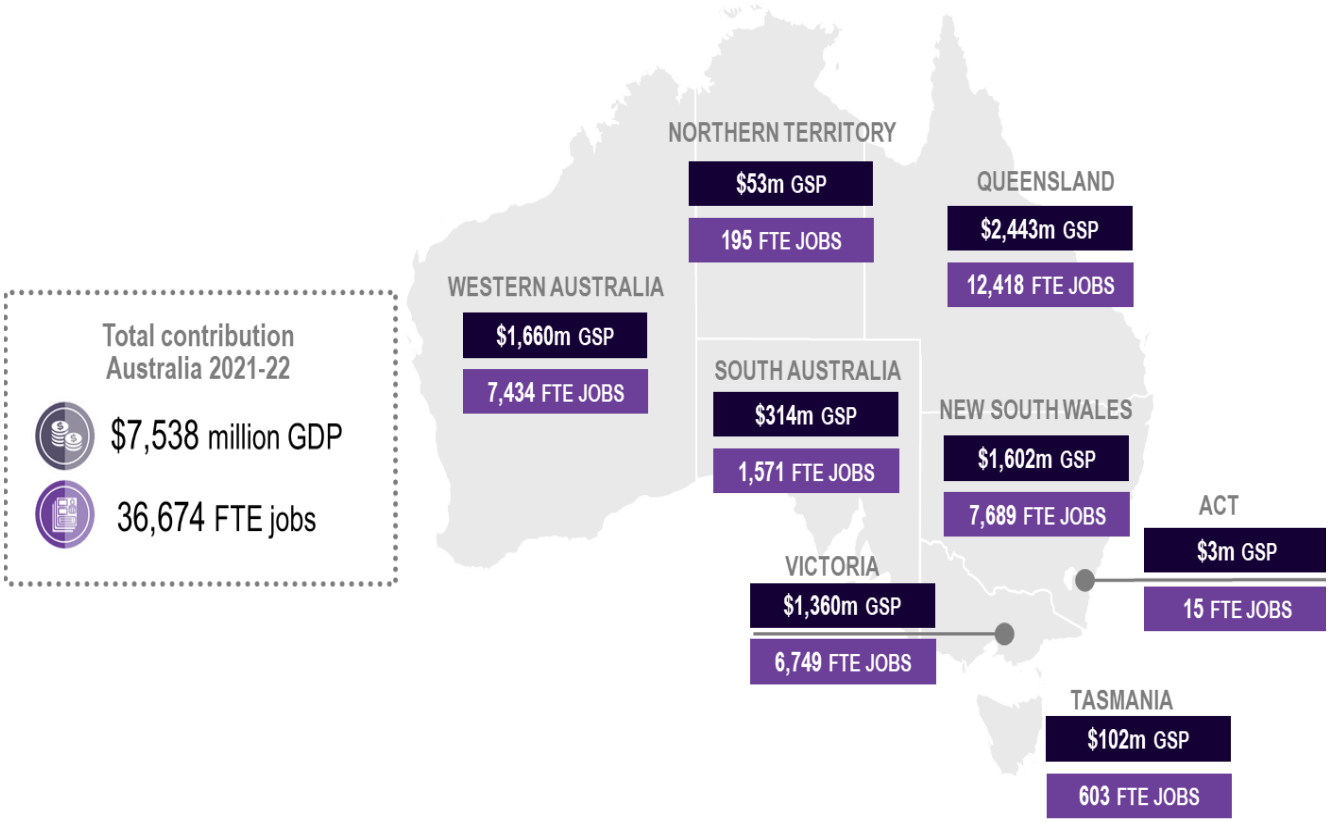


Source: ACIL Allen estimates based on ABS and DISR

6.4.4 State economies

Figure 6.5 summarises the contribution of the entire gas-feedstock chemical sector to state economies in 2021-22.

Figure 6.5 Estimated contribution of the gas-feedstock chemical sector to state economies, 2021-22



Source: ACIL Allen estimates based on ABS, DISR, IBISWorld data

New South Wales

In 2021-22, the entire gas-feedstock chemical sector in New South Wales had:

- a *total* contribution of $1,602 million to New South Wales GSP, comprising $697 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $906 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.23 per cent to New South Wales GSP in 2021-22.
- the total gas-feedstock chemical sector activities in New South Wales supported up to 7,689 FTE jobs. To put this another way, for every one million dollars of revenue received by the New South Wales gas-feedstock chemical sector, up to 3.3 FTE jobs are supported elsewhere in the New South Wales economy.

Victoria

In 2021-22, the entire gas-feedstock chemical sector in Victoria had:

- a *total* contribution of $1,360 million to Victorian GSP, comprising $590 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $771 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.26 per cent to Victorian GSP in 2021-22.
- The gas-feedstock chemical sector in Victoria supported up to 6,749 FTE jobs. To put this another way, for every one million dollars of revenue received by the Victorian gas-feedstock chemical sector activities, up to 3.6 FTE jobs are supported elsewhere in the Victorian economy.

Queensland

In 2021-22, the gas-feedstock chemical sector in Queensland had:

— a *total* contribution of $2,443 million to Queensland GSP, comprising $1,027 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $1,416 million indirectly from its input demand sources (indirect contribution). Overall, it contributed a minimum of 0.55 per cent to Queensland GSP in 2021-22.

— the total gas-feedstock chemical sector in Queensland supported up to 12,418 FTE jobs. To put this another way, for every one million dollars of revenue the Queensland gas-feedstock chemical sector receives, up to 3.6 FTE jobs are supported elsewhere in the Queensland economy.

South Australia

In 2021-22, the total gas-feedstock chemical sector in South Australia had:

— a *total* contribution of $314 million to South Australia GSP, comprising $154 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $161 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.24 per cent to South Australia GSP in 2021-22.

— the gas-feedstock chemical sector in South Australia supported up to 1,571 FTE jobs. To put this another way, for every one million dollars of revenue received by the South Australia gas-feedstock chemical sector activities, up to 3.7 FTE jobs are supported elsewhere in the South Australia economy.

Western Australia

In 2021-22, the total gas gas-feedstock chemical sector in Western Australia had:

— a *total* contribution of $1,660 million to Western Australia's GSP, comprising $694 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $966 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.41 per cent to Western Australia's GSP in 2021-22.

— the gas-feedstock chemical sector in Western Australia supported up to 7,434 FTE jobs. To put this another way, for every one million dollars of revenue received by the Western Australia gas-feedstock chemical sector activities, up to 3.1 FTE jobs are supported elsewhere in the Western Australia economy.

Tasmania

In 2021-22, the gas-feedstock chemical sector in Tasmania had:

— a *total* contribution of $102 million to Tasmanian GSP, comprising $50 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $52 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.34 per cent to Tasmanian GSP in 2021-22.

— the gas-feedstock chemical sector in Tasmania supported up to 603 FTE jobs. To put this another way, for every one million dollars of revenue received by the Tasmanian gas-feedstock chemical sector activities, up to 3.4 FTE jobs are supported elsewhere in the Tasmanian economy.

Northern Territory

In 2021-22, the gas-feedstock chemical sector in the Northern Territory had:

— a *total* contribution of $53 million to the Northern Territory's GTP, comprising $29 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $23 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.17 per cent to the Northern Territory's GTP in 2021-22.

— the gas-feedstock chemical sector in the Northern Territory supported up to 195 FTE jobs. To put this another way, for every one million dollars of revenue received by the Northern Territory gas-feedstock chemical sector activities, up to 2.5 FTE jobs are supported elsewhere in the Northern Territory economy.

Australian Capital Territory

In 2021-22, the gas-feedstock chemical sector in the ACT had:

— a *total* contribution of $3 million to ACT GTP, comprising $2 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $1 million indirectly from its input demand sources (indirect contribution). It contributed a minimum of 0.007 per cent to ACT GTP in 2021-22.

— the total gas-feedstock chemical sector in the ACT supported up to 15 FTE jobs. To put this another way, for every one million dollars of revenue received by the ACT gas-feedstock chemical sector activities, up to 1.5 FTE jobs are supported elsewhere in the ACT economy.

Figure 6.6 summarises the gas-feedstock chemical sector to state GSPs.

Figure 6.6 Contribution of the gas-feedstock chemical sector to State GSPs, 2021-22

Source: ACIL Allen estimates based on ABS and DISR

Contribution of high-temperature gas-based manufacturing 7

A range of manufacturing processes requires gaseous fuels for obtaining high temperatures (>800°C). For this analysis, the economic contributions of three critical sub-sectors within the manufacturing sector are estimated:

— Alumina
— Bricks and ceramics
— Glass and glass products

7.1 Alumina

Australia is the world's largest producer of bauxite and the world's largest exporter of alumina. Alumina is produced by applying the Bayer process to bauxite. Electricity is a vital input in the Bayer process, which converts bauxite into alumina, and is also used for smelting alumina into aluminium. The alumina production industry is highly concentrated and has only three major players in Australia in 2020-21 (Alcoa (38%), Rio Tinto (26.2%) and South32 (18.8%)). Australia's alumina refineries are responsible for a large share of process heat use.

Production of alumina from bauxite, the primary aluminium-containing ore, using the Bayer process involves two significant energy-intensive steps. The first process consists of the digestion of bauxite in a sodium hydroxide solution to produce aluminium hydroxide. This process requires steam at around 200°C and consumes about two-thirds of the thermal energy input to the alumina refining process. The remaining one-third is needed in the second step, the calcination of aluminium hydroxide to produce alumina (anhydrous aluminium oxide). The calcination occurs at temperatures above 800°C, and heat is generally provided directly to the reactor by natural gas or coal combustion. The energy intensity of alumina refining in Australia is between 4 and 8 GJ/t. The exact energy demand depends on the quality of the bauxite and the refinery's energy efficiency. The theoretical minimum is approximately 1.3 GJ/t.[11] This equates to around 26.2 PJ of gas used for heating in Alumina refining in 2021-22.

In calculating the indirect contribution of alumina, the value of the natural gas consumed has not been included since it has already been included in the gas economy estimates in Chapters 3 and 4.

7.1.1 High-temperature gas-based manufacturing — Alumina: Direct contribution

The total alumina production in 2021-22 was 20.138MT, valued at around $10.2 billion. Two states produce alumina — Western Australia and Queensland. The direct value-added of alumina from natural gas embodied within this revenue is estimated to have been $2,138 million ($1,654 million in Western Australia and $484 million in Queensland).

[11] ARENA (2019), Renewable energy options for industrial process heat. Prepared by ITP Thermal Pty Ltd

The sector directly employed 12,263 FTEs in 2021-22.

7.1.2 High-temperature gas-based manufacturing — Alumina: Indirect contribution

The Australian alumina sector spent $632 million on goods and services (excluding natural gas and electricity) from Australia in producing alumina in 2021-22. The domestic spending of $632 million indirectly contributed $508 million to the Australian economy.

The alumina production sector in the Australian economy indirectly supported 2,425 FTE jobs.

7.1.3 High-temperature gas-based manufacturing — Alumina: total contribution

Adding the direct and indirect economic contributions provides the total economic footprint of the Australian alumina sector's high heat gas use contribution in 2021-22 (**Table 7.1**). These contribution estimates are additive to the components of the Australian gas economy.

Table 7.1 Total value-added contribution of gas-based high heat alumina sector by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
Value-added	A$m	A$m	A$m	%
Qld	484	404	888	0.20%
WA	1,654	104	1,757	0.43%
Australia	2,138	508	2,645	0.11%
Employment	FTE	FTE	FTE	%
Qld	3,234	1,984	5,218	0.24%
WA	9,029	440.976563	9,470	0.81%
Australia	**12,263**	**2,425**	**14,687**	**0.13%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, ARENA 2019 and DISR.

7.2 Bricks and ceramics

More than 75 per cent of the energy consumed in brickmaking is thermal energy for the firing process.[12] Brick firing often occurs in long tunnel kilns, moving bricks steadily over 40 to 70 hours. The bricks are heated to a maximum temperature of 1040°C, but heating and cooling must occur slowly to avoid damaging the bricks. There may be some alternative fuels available for brick and ceramics manufacturing. Bricks and ceramics used around 16 PJ of gas in 2021-22.

7.2.1 High-temperature gas-based manufacturing — Bricks and ceramics: Direct contribution

The bricks and ceramics production was around $1,700 million in 2021-21. The direct value-added of bricks and ceramics from natural gas embodied within this revenue is estimated to have been $1,013 million. The sector directly employed 3,525 FTEs in 2021-22.

7.2.2 High-temperature gas-based manufacturing — Bricks and ceramics: Indirect contribution

The Australian bricks and ceramics sector spent $528 million on goods and services (excluding gas and electricity) from Australia in producing bricks and ceramics in 2021-22. The domestic spending

[12] Carbon Trust (2008), Industrial Energy Efficiency Accelerator - Guide to the Brick Sector. Retrieved from https://www.carbontrust.com/media/206500/ctg062-metalforming-industrial-energy-efficiency.pdf

of $528 million indirectly contributed $475 million to the Australian economy. The Australian high-temperature gas-based bricks and ceramics production sector indirectly supported 2,813 FTE jobs.

7.2.3 High-temperature gas-based manufacturing — Bricks and ceramics: total contribution

Adding the direct and indirect economic contributions provides the total economic footprint of the Australian bricks and ceramics sector's high heat gas use contribution in 2021-22 (see **Table 7.2**).

Table 7.2 Total value-added contribution of gas-based high heat bricks and ceramics sector by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	305	138	443	0.063%
Vic.	204	92	296	0.058%
Qld	108	54	162	0.036%
SA	51	20	71	0.055%
WA	329	164	494	0.122%
Tas.	14	7	21	0.054%
NT	0	0	0	0.000%
ACT	1	0	2	0.004%
Australia	**1,013**	**475**	**1,488**	**0.064%**

Source: ACIL Allen estimates based on ABS, ARENA 2019 and DISR.

Adding the direct and indirect employment contributions provides the total employment footprint of the Australian bricks and ceramics sector's high heat gas use contribution in 2021-22.

Table 7.3 Total value-added contribution of gas-based high heat bricks and ceramics sector by state, 2021-22

	Direct	Indirect	Total	Total (%employment)
	FTE	FTE	FTE	%
NSW	1,079	814	1,892	0.053%
Vic.	706	583	1,289	0.045%
Qld	391	358	749	0.035%
SA	182	144	326	0.046%
WA	1,089	858	1,946	0.168%
Tas.	74	55	129	0.062%
NT	0	0	0	0.000%
ACT	6	2	8	0.004%
Australia	**3,526**	**2,813**	**6,339**	**0.058%**

Source: ACIL Allen estimates based on ABS, ARENA 2019 and DISR.

7.3 Glass and glass products

Glass and glass products used around 10 PJ of gas in 2021-22. The most energy-intensive step in glass making is melting the raw materials, which accounts for around 75 per cent of the energy

requirement. Globally, many modern gas-fired glass melting furnaces are fitted with electric boosting, contributing 5-20 per cent of the heat.[13]

7.3.1 High-temperature gas-based manufacturing — Glass and glass products: Direct contribution

The production value of glass and glass products was around $2,018 million in 2021-22. The direct value-added of glass and glass products from natural gas embodied within this revenue is estimated to have been $9876 million. The sector directly employed 4,634 FTEs in 2021-22.

7.3.2 High-temperature gas-based manufacturing — Glass and glass products: Indirect contribution

The Australian glass and glass products sector spent $752 million on goods and services (excluding gas and electricity) from Australia in producing glass and glass products in 2021-22. The domestic spending of $752 million indirectly contributed $671 million to the Australian economy.

3.370 FTE jobs were indirectly supported by the Australian economy's glass and glass products production sector.

7.3.3 High-temperature gas-based manufacturing — Glass and glass products: total contribution

Adding the direct and indirect economic contributions provides the total economic footprint of the Australian glass and glass products sector's high heat gas use contribution in 2021-22 (see **Table 7.4**).

Table 7.4 Total value-added contribution of gas-based high heat glass and glass products sector by state, 2021-22

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	302	207	509	0.073%
Vic.	267	183	449	0.087%
Qld	208	154	362	0.081%
SA	82	47	128	0.100%
WA	88	62	150	0.037%
Tas.	10	6	16	0.042%
NT	23	9	32	0.104%
ACT	8	2	10	0.022%
Australia	**987**	**671**	**1,658**	**0.072%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS, ARENA 2019 and DISR.

Adding the direct and indirect employment contributions provides the total employment footprint of the Australian glass and glass products sector's high heat gas use contribution in 2021-22.

[13] Worrell, E., Galitsky, C., Masanet, E., & Graus, W. (2008). Energy Efficiency Improvement and Cost Saving Opportunities for the Glass Industry. https://doi.org/LBNL-4779E.

Table 7.5 Total value-added contribution of gas-based high heat glass and glass products sector by state, 2021-22

	Direct	Indirect	Total	Total (%employment)
	FTE	FTE	FTE	%
NSW	1,431	1,099	2,530	0.072%
Vic.	1,242	1,031	2,273	0.079%
Qld	1,001	894	1,895	0.088%
SA	391	285	676	0.095%
WA	394	303	698	0.060%
Tas.	63	43	106	0.051%
NT	69	45	114	0.095%
ACT	42	11	53	0.027%
Australia	**4,634**	**3,711**	**8,345**	**0.076%**

Note: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity.

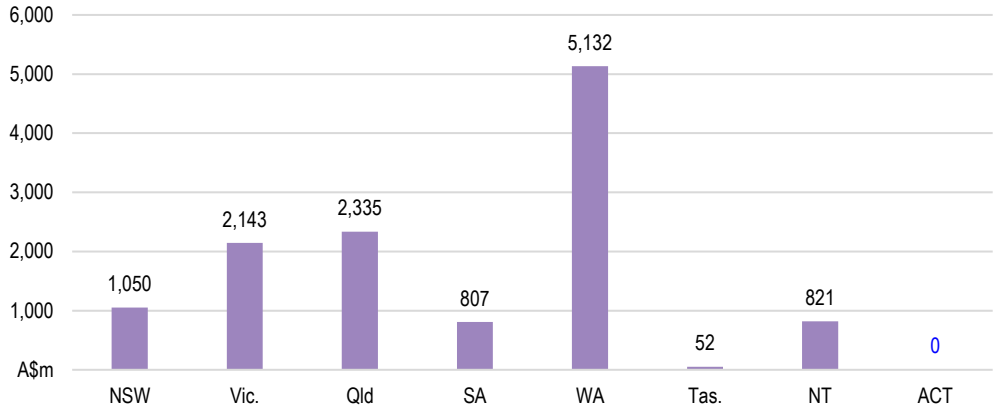
Source: ACIL Allen estimates based on ABS, ARENA 2019 and DISR.

Contribution of capital expenditure 8

8.1 Capital expenditure: Direct contribution

The total estimated gas appliances and gas-related capital expenditures in 2021-22 was $12,339 million (**Figure 8.1**). This investment primarily occurred in Western Australia ($5.1 billion) and Queensland ($2.3 billion), two major gas-producing states.

Figure 8.1 Capital expenditure by state, 2021-22



Source: AEAS 2022., Table 11, Page 15, ABS National Accounts 2021-22.

8.2 Capital expenditure: Indirect contribution

In 2021-22, the Australian gas-related industry made $12,339 million in capital investment. Of this, $7 billion was spent on domestically produced appliances, machinery and services.

The gas sector's domestic capital expenditure of $7 billion indirectly contributed $6,169 million to the Australian economy, which is 0.27 per cent of GDP in 2021-22.

The capital expenditure supported 29,553 FTE jobs in the Australian economy.

8.3 Capital expenditure: Total contribution

Table 8.1 provides value-added and employment contributions from capital expenditure.

Table 8.1 Total value-added contribution of capital expenditure by state, 2021-22

	Value-added		Employment	
	Total	Total (%GSP)	Total	Total (%)
	A$m	%	FTE jobs	%
NSW/ACT	401	0.06%	1,991	0.06%
Vic.	967	0.19%	5,340	0.18%
Qld	1,253	0.28%	7,065	0.33%
SA	443	0.34%	2,355	0.33%
WA	2,742	0.68%	11,725	1.01%
Tas.	15	0.04%	101	0.05%
NT	348	1.12%	976	0.81%
Australia	**6,169**	**0.27%**	**29,553**	**0.27%**

Notes: Interstate trade activity in the regional contribution estimates is included based on their share of underlying activity. ACT capital expenditure not separately identified in the AEAS report.

Source: ACIL Allen estimates based on AEAS and ABS Australian and State National Accounts 2021-22.

8.3.1 Australian economy

In 2021-22, the gas-related capital expenditure in Australia resulted in:

— a *total* contribution of $6,169 million to the Australian GDP. The capital expenditure contributed a minimum of 0.27 per cent to the Australian GDP in 2021-22.

— the capital expenditure supported up to 29,553 FTE jobs in 2021-22. To put this another way, for every one million dollars of capital expenditure, up to 2.4 FTE jobs are supported elsewhere in the Australian economy.

8.3.2 State economies

New South Wales

In 2021-22, the gas-related capital expenditure in New South Wales had:

— a *total* contribution of $401 million indirectly from its input demand sources. It contributed a minimum of 0.06 per cent to New South Wales GSP in 2021-22.

— the capital expenditure activities in New South Wales supported up to 1,991 FTE jobs. To put this another way, for every 1 million dollars of capital expenditure in New South Wales, up to 1.9 FTE jobs are supported elsewhere in the New South Wales economy.

Victoria

In 2021-22, the gas-related capital expenditure in Victoria had:

— a *total* contribution of $967 million indirectly from its input demand sources. It contributed a minimum of 0.18 per cent to Vic GSP in 2021-22.

— the capital expenditure activities in Victoria supported up to 5,340 FTE jobs. To put this another way, for every one million dollars of capital expenditure spent in Victoria, up to 2.5 FTE jobs are supported elsewhere in the Victorian economy.

Queensland

In 2021-22, the gas-related capital expenditure in Queensland had:

— a *total* contribution of $1,253 million indirectly from its input demand sources. Overall, it contributed a minimum of 0.33 per cent to Queensland GSP in 2021-22.

— the capital expenditure activities in Queensland supported up to 7,065 FTE jobs. To put this another way, for every one million dollars of capital expenditure in Queensland, up to 3 FTE jobs are supported elsewhere in the Queensland economy.

South Australia

In 2021-22, the gas-related capital expenditure in South Australia had:

— a *total* contribution of $443 million indirectly from its input demand sources. Overall, it contributed a minimum of 0.34 per cent to South Australia GSP in 2021-22.

— the capital expenditure activities in South Australia supported up to 2,355 FTE jobs. To put this another way, for every one million dollars of capital expenditure in South Australia, up to 2.9 FTE jobs are supported elsewhere in the South Australian economy.

Western Australia

In 2021-22, the gas-related capital expenditure in Western Australia had:

— a *total* contribution of $2,742 million indirectly from its input demand sources. It contributed a minimum of 0.68 per cent to Western Australia's GSP in 2021-22.

— the capital expenditure activities in Western Australia supported up to 11,725 FTE jobs. To put this another way, for every one million dollars of capital expenditure in Western Australia, up to 2.3 FTE jobs are supported elsewhere in the Western Australia economy.

Tasmania

In 2021-22, the gas-related capital expenditure in Tasmania had:

— a *total* contribution of $15 million indirectly from its input demand sources. It contributed a minimum of 0.04 per cent to Tasmanian GSP in 2021-22.

— the capital expenditure activities in Western Australia supported up to 101 FTE jobs. To put this another way, for every one million dollars of capital expenditure in Tasmania, up to 1.9 FTE jobs are supported elsewhere in the Tasmanian economy.

Northern Territory

In 2021-22, the gas-related capital expenditure in the Northern Territory had:

— a *total* contribution of $348 million indirectly from its input demand sources. It contributed a minimum of 1.12 per cent to the Northern Territory's GTP in 2021-22.

— the capital expenditure activities in the Northern Territory supported up to 976 FTE jobs. To put this another way, for every one million dollars of capital expenditure in NT, up to 1.2 FTE jobs are supported elsewhere in the Northern Territory economy.

Figure 8.2 summarises capital expenditure contribution to the state GSPs.

Figure 8.2 Contribution of capital expenditure to State GSPs, 2021-22

Note: ACT capital expenditure is not separately identified in the AEAS report.

Source: ACIL Allen estimates based on ABS and DISR

The economic contribution of the Australian gas economy

9

Gaseous fuels play an essential role in the Australian economy involving many businesses and employing many people. This report has provided an indicative estimate of the size of the Australian gas economy, with this chapter providing a summary of its components. In 2021-22, the Australian gas economy contributed at least $121 billion to the Australian GDP and 258,779 FTE jobs (equivalent to 5.25% and 2.35%, respectively).

9.1 Gas production

Table 9.1 summarises direct and indirect economic and employment contributions of gaseous fuel production in Australia by the state. Over 70 per cent of the estimated gas economy was associated with the production of gaseous fuels in Australia in 2021-22. The production of gaseous fuels contributed 3.72 per cent of Australia's GDP and nearly 1 per cent of employment in 2021-22.

Table 9.1 Total contribution of production of gases, 2021-22

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	15	0.00%	43	0.00%
Vic.	1,522	0.30%	2,199	0.08%
Qld	30,372	6.79%	38,285	1.77%
SA	397	0.31%	597	0.08%
WA	46,162	11.41%	49,405	4.25%
Tas.	0	0.00%	1	0.00%
NT	7,392	23.81%	6,414	5.32%
ACT	0	0.00%	4	0.00%
Australia	**85,862**	**3.72%**	**96,948**	**0.88%**

Source: ACIL Allen estimates based on various sources.

9.2 Gas transport and distribution

Table 9.2 summarises the total (direct and indirect) economic and employment contributions of transport and distribution of gaseous fuels in Australia. About 8.4 per cent of the estimated gas economy was from the transport and distribution of gaseous fuels in 2020-21. The transportation and distribution of gaseous fuels contributed nearly 0.44 per cent of Australia's GDP and about 0.42 per cent of employment in 2021-22.

Table 9.2 Total contribution of transport and distribution of gaseous fuels, 2021-22

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	1,280	0.18%	6,771	0.19%
Vic.	2,049	0.40%	10,036	0.35%
Qld	2,046	0.46%	9,431	0.44%
SA	741	0.58%	3,377	0.47%
WA	3,471	0.86%	13,812	1.19%
Tas.	96	0.25%	671	0.32%
NT	496	1.60%	1,977	1.64%
ACT	42	0.09%	154	0.08%
Australia	**10,220**	**0.44%**	**46,228**	**0.42%**

Source: ACIL Allen estimates based on various sources.

9.3 Gas-fired electricity generation

Table 9.3 summarises the total (direct and indirect) economic and employment contributions of gas-fired electricity generation. About 5.9 per cent of the gas economy was contributed by gas-fired electricity generation in 2021-22. Gas-fired electricity generation contributed 0.24 per cent of Australia's GDP and 0.18 per cent of employment in 2021-22.

Table 9.3 Total contribution of gas-fired electricity generation, 2021-22

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	259	0.04%	832	0.02%
Vic.	247	0.05%	800	0.03%
Qld	1,364	0.30%	4,451	0.21%
SA	636	0.49%	1,879	0.26%
WA	2,708	0.67%	10,814	0.93%
Tas.	17	0.04%	61	0.03%
NT	359	1.16%	1,167	0.97%
Australia	**5,591**	0.24%	**20,004**	0.18%

Source: ACIL Allen estimates based on various sources

9.4 Gas feedstock chemicals

Table 9.4 summarises gas feedstock chemicals' total (direct and indirect) economic and employment contributions. Gas feedstock chemicals contributed about 6.2 per cent of the estimated gas economy in 2021-22. Gas feedstock chemicals contributed 0.33 per cent of Australia's GDP and 0.33 per cent of employment in 2021-22.

Table 9.4 Total contribution of gas feedstock chemicals, 2021-22

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	1,602	0.23%	7,689	0.22%
Vic.	1,360	0.26%	6,749	0.23%
Qld	2,443	0.55%	12,418	0.57%
SA	314	0.24%	1,571	0.22%
WA	1,660	0.41%	7,434	0.64%
Tas.	102	0.26%	603	0.29%
NT	53	0.17%	195	0.16%
ACT	3	0.01%	15	0.01%
Australia	**7,538**	**0.33%**	**36,674**	**0.33%**

Source: ACIL Allen estimates based on various sources

9.5 High-temperature gas-based manufacturing

This estimate includes the contribution of selected manufacturing activities dependent on gaseous fuels for high-temperature (>800°C) processes.

Table 9.5 summarises the total (direct and indirect) economic and employment contributions of industrial gas process high heat. Gaseous fuels contributed about 4.8 per cent of the gas economy for high-temperature industrial processes. Gas-based industrial process heat contributed 0.25 per cent of Australia's GDP and 0.27 per cent of employment in 2021-22.

Table 9.5 Total contribution of high-temperature gas-based manufacturing, 2021-22

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	952	0.63%	4,422	0.12%
Vic.	745	0.69%	3,562	0.12%
Qld	1,413	1.76%	7,862	0.36%
SA	199	0.78%	1,002	0.14%
WA	2,401	3.00%	12,114	1.04%
Tas.	37	0.61%	235	0.11%
NT	32	0.37%	114	0.09%
ACT	12	0.13%	61	0.03%
Australia	**5,792**	**1.27%**	**29,372**	**0.27%**

Source: ACIL Allen estimates based on various sources

9.6 Gas-related capital expenditure

Table 9.6 summarises gas-related capital expenditure's total (direct and indirect) economic and employment contributions. About 7.1 per cent of t**he** estimated gas economy was contributed by gas-related capital expenditure. Gas-related capital expenditure contributed 0.27 per cent of Australia's GDP and 0.27 per cent of employment in 2021-22.

Table 9.6 Total contribution of gas-related capital expenditure, 2021-22

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	401	0.06%	1,991	0.06%
Vic.	967	0.19%	5,340	0.18%
Qld	1,253	0.28%	7,065	0.33%
SA	443	0.34%	2,355	0.33%
WA	2,742	0.68%	11,725	1.01%
Tas.	15	0.04%	101	0.05%
NT	348	1.12%	976	0.81%
ACT	0	0.00%	0	0.00%
Australia	**6,169**	**0.27%**	**29,553**	**0.27%**

Source: ACIL Allen estimates based on various sources

9.7 Total LPG economy

Table 9.7 summarises the total (direct and indirect) economic and employment contributions of the LPG economy (production, transport and distribution). LPG contributed about 4.1 per cent of the estimated Australian gas economy. LPG contributed 0.22 per cent of Australia's GDP and 0.19 per cent of employment in 2021-22.

This estimate is conservative as it is limited to the contribution of LPG to the production, transport, and distribution of gaseous fuels. The calculations do not include the contribution of LPG to the gas feedstock chemical industry (which is sometimes used by producers instead of natural gas but has not been disaggregated in this analysis).

Table 9.7 Total economic contribution of the Australian LPG economy by state, 2021-22

	Value-add				Employment			
	Direct	Indirect	Total	%GSP/GDP	Direct	Indirect	Total	% state/national employment
	A$m	A$m	A$m	%	FTE jobs	FTE jobs	FTE jobs	%
NSW	437	281	718	0.10%	3,249	1,474	4,724	0.13%
Vic.	571	292	863	0.17%	3,312	1,642	4,954	0.17%
Qld	935	345	1,280	0.29%	3,252	1,922	5,174	0.24%
SA	184	91	275	0.21%	1,130	537	1,668	0.23%
WA	1,342	386	1,728	0.43%	1,451	1,667	3,117	0.27%
Tas.	49	21	71	0.18%	425	141	567	0.27%
NT	55	13	68	0.22%	168	66	234	0.19%
ACT	10	4	14	0.03%	62	16	78	0.04%
Australia	**3,584**	**1,431**	**5,015**	**0.22%**	**13,050**	**7,466**	**20,516**	**0.19%**

Source: ACIL Allen estimates based on various sources.

9.8 Total gas economy

9.8.1 Economic contribution

Table 9.8 summarises the state's total value-added contribution to the Australian gas economy.

Table 9.8 Total economic contribution of the Australian gas economy by state, 2021-22

State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	%
NSW	15	1,280	259	1,602	952	401	4,509	0.65%
Vic.	1,522	2,049	247	1,360	745	967	6,890	1.34%
Qld	30,372	2,046	1,364	2,443	1,413	1,253	38,891	8.69%
SA	397	741	636	314	199	443	2,731	2.12%
WA	46,162	3,471	2,708	1,660	2,401	2,742	59,144	14.62%
Tas.	0	96	17	102	37	15	268	0.70%
NT	7,392	496	359	53	32	348	8,680	27.95%
ACT	0	42	0	3	12	0	57	0.12%
Australia	**85,862**	**10,220**	**5,591**	**7,538**	**5,792**	**6,169**	**121,170**	**5.25%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

In total, the gas economy in Australia contributed at least $121 billion to the Australian economy, which is 5.25 per cent of GDP in 2021-22. Further, 2020-21 economic contribution was impacted by the global pandemic and low gas prices. The estimated economic contribution was around 20-30 per cent lower than if the pandemic had not affected the sector. Over 80 per cent of the total value-added contribution comes from two gas-producing states, Western Australia and Queensland. In terms of share of the economy, the gas economy contributed the highest to the Northern Territory

in terms of GTP percentage contribution (27.95 per cent), followed by Western Australia (14.63 per cent of GSP) and Queensland (8.69 per cent of GSP).

Table 9.9 Total economic contribution of the Australian gas economy, direct and indirect, 2021-22

	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	%
Direct	69,569	5,471	1,764	3,242	4,139	0	84,184	3.65%
Indirect	16,293	4,748	3,827	4,296	1,653	6,169	36,987	1.60%
Australia	**85,862**	**10,220**	**5,591**	**7,538**	**5,792**	**6,169**	**121,170**	**5.25%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Table 9.10 Total economic contribution of the Australian gas economy by fuel type, 2021-22

State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	A$m	A$m	A$m	A$m	A$m	A$m	A$m	%
LNG	68,926	35				ne	ne	ne
Natural gas	14,426	7,653	5,591	7,538*	5,792	ne	ne	ne
LPG	2,483	2,532				ne	ne	ne
CNG	27	0				ne	ne	ne
Hydrogen	0.10	0				ne	ne	ne
Australia	**85,862**	**10,220**	**5,591**	**7,538**	**5,792**	**6,169**	**121,171**	**5.25%**

Notes: * Most feedstock is natural gas but includes some LPG. ne = not estimated. Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

9.8.2 Employment contribution

Table 9.11 summarises employment within the gas economy by the state.

In 2021-22, the Australian gas economy supported nearly 258,779 FTE jobs throughout the Australian economy, which was 2.35 per cent of total FTE jobs.

Table 9.11 Total employment contribution of the Australian gas economy by state, 2021-22

State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
NSW	43	6,771	832	7,689	4,422	1,991	**21,748**	0.61%

State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of total employment
Vic.	2,199	10,036	800	6,749	3,562	5,340	**28,686**	0.99%
Qld	38,285	9,431	4,451	12,418	7,862	7,065	**79,512**	3.67%
SA	597	3,377	1,879	1,571	1,002	2,355	**10,781**	1.51%
WA	49,405	13,812	10,814	7,434	12,114	11,725	**105,304**	9.06%
Tas.	1	671	61	603	235	101	**1,672**	0.81%
NT	6,414	1,977	1,167	195	114	976	**10,842**	8.99%
ACT	4	154	-	15	61	-	**233**	0.12%
Australia	**96,948**	**46,228**	**20,004**	**36,674**	**29,372**	**29,553**	**258,779**	**2.35%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Table 9.12 Total employment contribution of the Australian gas economy, direct and indirect, 2021-22

State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
Direct	21,970	22,933	2,978	13,636	20,422		81,940	0.75%
Indirect	74,977	23,295	17,026	23,038	8,949	29,553	176,839	1.61%
Australia	**96,948**	**46,228**	**20,004**	**36,674**	**29,372**	**29,553**	**258,779**	**2.35%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

Table 9.13 Total employment contribution of the Australian gas economy by fuel type, 2021-22

State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
LNG	77,458	86				ne	ne	ne
Natural gas	16,477	28,463	20,004	36,674	29,372	ne	ne	ne
LPG	2,836	17,679				ne	ne	ne
CNG	176	0				ne	ne	ne
Hydrogen	0	0				ne	ne	ne
Australia	**96,948**	**46,228**	**20,004**	**36,674**	**29,372**	**29,553**	**258,779**	**2.35%**

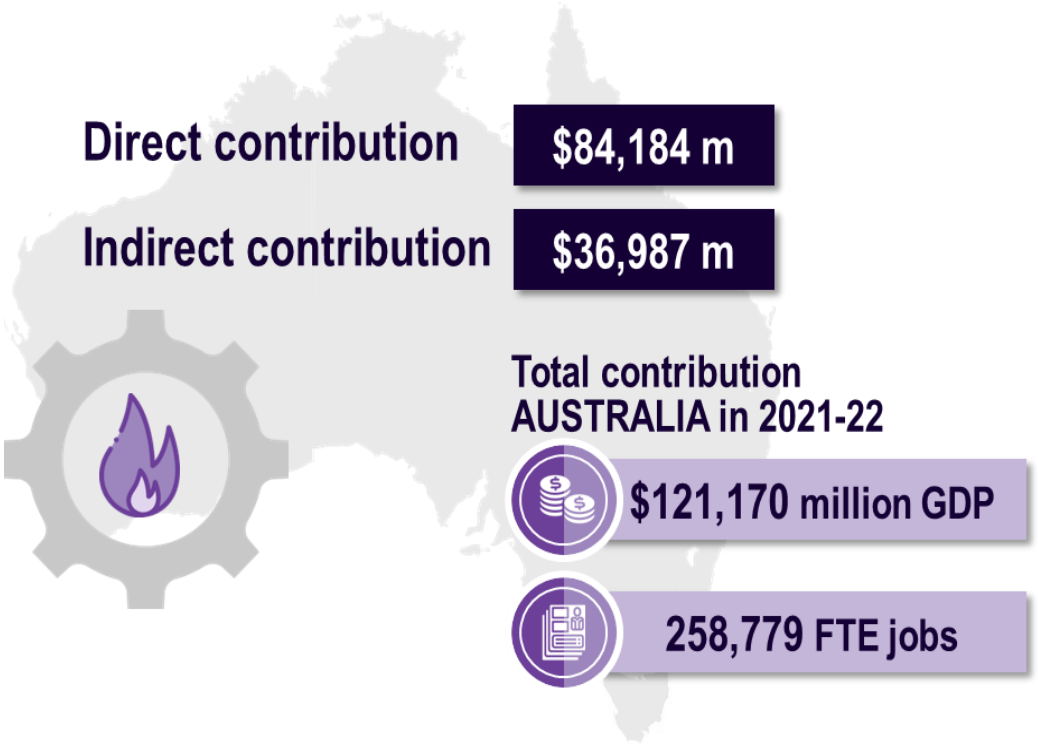
State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas-fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas-related capital expenditure	TOTAL	Per cent of GSP/GDP

Notes: * Most feedstock is natural gas but includes some LPG. ne = not estimated. Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

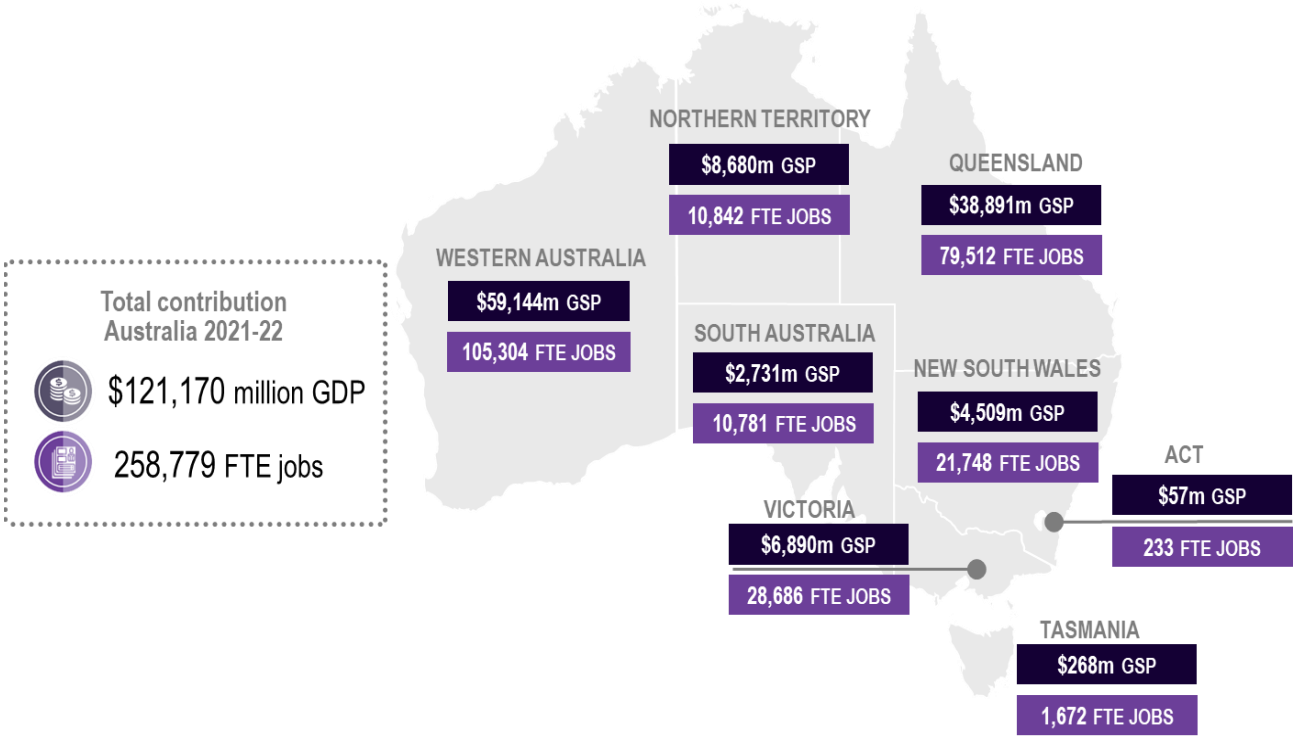
Figure 9.1, **Figure 9.2** and **Figure 9.3** provide a summary of the Australian gas economy in 2021-22.

Figure 9.1 Estimated total contribution of the gas economy to the Australian economy, 2021-22



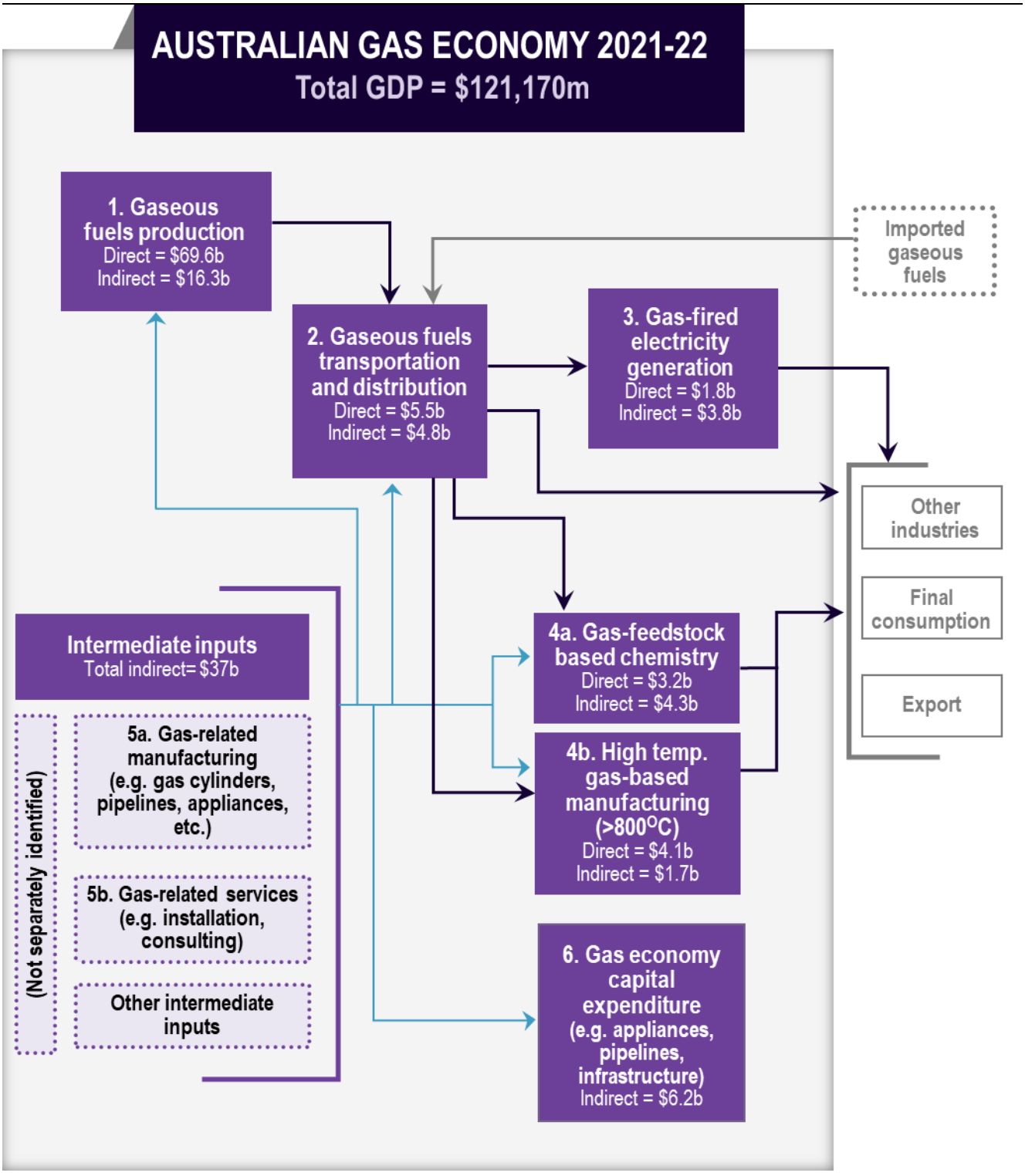
Source: ACIL Allen estimates based on various sources.

Figure 9.2 A summary of the estimated gas economy by state, 2021-22



Source: ACIL Allen estimates based on various sources.

Figure 9.3 Summary of the Australian gas economy, 2021-22



Source: ACIL Allen estimates based on various sources.

ACIL ALLEN

Appendices

Appendix heading A

A.1 Overview

Input-output tables provide a snapshot of an economy at a particular time. The tables used in this analysis were for the 2020-21 financial year.

Input-output tables can be used to derive input-output multipliers. These multipliers show how changes to a given part of an economy impact on the economy as a whole. A full set of input-output multipliers for Australia and Australian states were estimated for the purpose of this analysis.

The input-output multipliers allow analysis of the economic footprint of a particular industry or event for the region of interest. Although input-output multipliers may also be suitable tools for analysing the impact of various types of economic change, caution needs to be adopted in their application for this purpose.

Misuse of input-output multipliers for the purpose of impact analysis has led to scepticism of their general use in favour of other tools such as computable general equilibrium (CGE) modelling.

Notwithstanding this, they are still eminently suitable for understanding the economic linkages between a given industry to gain an appreciation of the wider interactions of the industry beyond its direct contribution.

A.2 Multiplier types

Input-output multipliers estimate the economic impact on a region's economy from a one dollar change in the final demand for the output of one of the region's industries. Generally, four types of multipliers are used:

— Output – measures the impact on the output of all industries in the economy
— Income – measures the effect on the wages and salaries paid to workers within the economy
— Employment – measures the jobs creation impact
— Value-added – measures the impact on wages and salaries, profits and indirect taxes.

The sum of wages and salaries, profits and indirect taxes for a given industry provides a measure of its contribution to the size of the economy – its contribution to gross state product (GSP). The value added multiplier can therefore also be considered to be the GSP multiplier.

Input-output multipliers are a flexible tool for economic analysis. Their flexibility stems from the different forms of each multiplier type. For each region, multipliers were estimated in the following forms:

— initial effects
— first round effects

- industrial support effects
- production induced effects
- consumption induced effects
- simple multipliers
- total multipliers
- type 1A multipliers
- type 1B multipliers
- type 2A multipliers
- type 2B multipliers.

A.3 Multiplier effects

When additional sales to final demand are made, for example through increased exports or sales to the public, production increases to meet the increased demand, and this is the initial effect. Since production increases to exactly match the increased final demand, the increase is always equal to one (noting that the multipliers are defined in terms of a one dollar increase in final demand).

The industry producing the additional output makes purchases to enable itself to increase production, these new purchases are met by production increases in other industries and these constitute the first round effect. These first round production increases cause other industries to also increase their purchases, and these purchases cause other industries to increase their production, and so on. These 'flow-on' effects eventually diminish, but when 'added together constitute the industrial support effect.

The industrial support effect added to the first round effect is known as the production induced effect. So far this chain of events has ignored one important factor, the effect on labour and its consumption. When output increases, employment increases, and increased employment translates to increased earnings and consumption by workers, and this translates to increased output to meet the increased consumption. This is the consumption effect.

To understand the contribution that the sector makes to the economy from its activities, ACIL Allen employed input-output modelling. Input-output modelling is useful to describe the economic footprint of an economic activity.

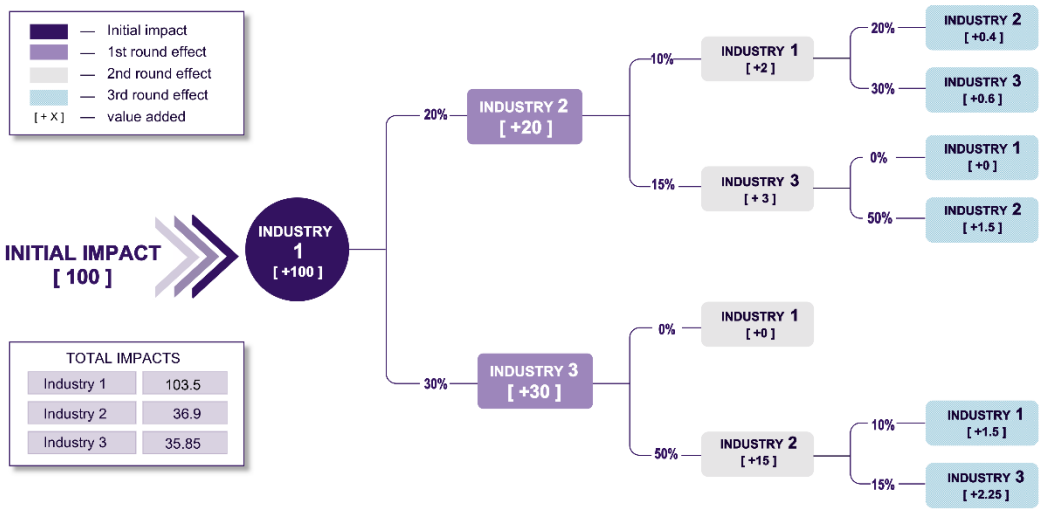
Input output models capture the direct and indirect effects of expenditure by capturing, for each industry, the industries it purchases inputs from and also the industries it sells its outputs to. For example, the Input-Output model for Western Australia captures purchases from and sales to industries located in Western Australia, as well as imports from outside of Western Australia.

The **Figure A.1** depicts how an impact is traced through a (very simple) economy with three industries (1, 2, and 3), and is described below.

- The initial impact occurs in industry 1 where an additional 100 units of value are added to its output. To generate this additional output, industry 1 requires additional inputs from industry 2 and industry 3.
- Therefore, industry 2 and 3 increase their output as well. This in turn requires input from industry 1 and 3 and industry 1 and 2 respectively which increase their output to satisfy this additional demand, and so on.
- The impacts grow smaller with each iteration and ultimately converge to zero. This is because they always only share the impact that occurred in the preceding iteration.

Input output modelling allowed ACIL Allen to understand how the gaseous fuel sector interact with other industries in the economy through the purchases and sales it makes to those industries in Australia.

Figure A.1 "Trace Through" of an Input-output model



Source: ACIL Allen

A.4 Multipliers

The simple and total multipliers are derived by summing the effects. The simple multiplier is the sum of the initial and production induced effects. The total multiplier is larger because it also adds in the consumption effect. All the effects and multipliers listed have had one thing in common, they all measure the impact on the economy of the initial increase in final demand.

The remaining multipliers take a different point of view, they are ratios of the above multiplier types to the initial effect. The type 1A multiplier is calculated as the ratio of the initial and first round effects to the initial effect, while the type 1B multiplier is the ratio of the simple multiplier to the initial effect. The type 2A multiplier is the ratio of the total multiplier to the initial effect, while the type 2B multiplier is the ratio of the total multiplier less the initial effect to the initial effect.

Given the large number of multiplier types to choose from, output, income, employment and value-added multipliers, and each with numerous variations (simple, total, type 2A, etc.) it is important that the analysis uses the most appropriate multipliers. Usually, the multipliers that include consumption effects (i.e. the added impact that comes from wage and salaries earners spending their income) are used. These are the total and type 2A multipliers. The total and type 2A multipliers will generally provide the biggest projected impact. Simple or type 1B (which omit the consumption effect) may be used to provide a more conservative result.

Melbourne
Suite 4, Level 19; North Tower
80 Collins Street
Melbourne VIC 3000 Australia
+61 3 8650 6000

Sydney
Suite 603, Level 6
309 Kent Street
Sydney NSW 2000 Australia
+61 2 8272 5100

Brisbane
Level 15, 127 Creek Street
Brisbane QLD 4000 Australia
+61 7 3009 8700

Canberra
Level 6, 54 Marcus Clarke Street
Canberra ACT 2601 Australia
+61 2 6103 8200

Perth
Level 12, 28 The Esplanade
Perth WA 6000 Australia
+61 8 9449 9600

Adelaide
167 Flinders Street
Adelaide SA 5000 Australia
+61 8 8122 4965

ACIL Allen Pty Ltd
ABN 68 102 652 148

acilallen.com.au