ACIL ALLEN

1 November 2022

Report Gas Energy Australia

Economic contribution of the Australian gas economy in 2020-21

FINAL REPORT

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Suggested citation for this report

ACIL Allen Consulting (2022), Economic contribution of the Australian gas economy in 2020-21, prepared for the Gas Energy Australia (GEA). November 2022.

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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 2020-21, the Australian gas economy contributed at least $70 billion to Australian GDP and supported 241,646 FTE jobs (equivalent to 3.39 per cent and 2.25 per cent, respectively).

Definition of the gas economy

This report provides estimates of the economic and employment contribution of the Australian gas economy for financial year 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 2020-21)
- LPG
- CNG
- Hydrogen (not traded commodity in 2020-21, therefore not included in this report)

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 for producing high temperatures required for the manufacturing of alumina, certain other

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

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. That is, manufacturing companies that are primarily engaged in making specific equipment necessary for the production, transportation, distribution and/or use of gaseous fuels.
   b) Gas-related services. That is, businesses that are primarily engaged in providing 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 $70 billion to the Australian economy, which is 3.39 per cent of GDP in 2020-21. Further, this year's estimate of economic contribution was impacted by the global pandemic and low gas prices which resulted in the estimated economic contribution being around 20-30 per cent lower than if the sector had not been affected by the pandemic. Nearly 76 per cent of the total value-added contribution comes from two major gas producing states: Western Australia and Queensland.

Table ES 1 Total economic contribution of the Australian gas economy, by state, 2020-21

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	12	954	243	1,676	864	364	**4,113**	**0.64%**
Vic.	1,236	1,659	289	1,392	661	846	**6,083**	**1.28%**
Qld	14,036	1,593	1,193	2,523	1,385	1,010	**21,740**	**5.94%**
SA	306	559	610	302	172	341	**2,290**	**1.95%**
WA	21,547	2,848	1,509	1,696	1,985	2,123	**31,707**	**8.76%**
Tas.	0	70	20	109	33	15	**247**	**0.71%**
NT	2,891	401	246	49	29	280	**3,896**	**15.53%**
ACT	0	33	0	3	11	0	**48**	**0.11%**
Australia	**40,028**	**8,117**	**4,110**	**7,751**	**5,140**	**4,978**	**70,124**	**3.39%**

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, 2020-21

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	20,724	4,603	1,871	3,409	3,638		34,246	1.66%
Indirect	19,304	3,514	2,239	4,342	1,502	4,978	35,879	1.74%
Australia	**40,028**	**8,117**	**4,110**	**7,751**	**5,140**	**4,978**	**70,124**	**3.39%**

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, 2020-21

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	26,613	15			ne	ne	ne	ne
Natural gas	11,566	6,249	4,110	7,751*	ne	ne	ne	ne
LPG	1,824	1,853				ne	ne	ne
CNG	26	0			ne	ne	ne	ne
Hydrogen					ne	ne	ne	ne
Australia	**40,028**	**8,117**	**4,110**	**7,751**	**5,140**	**4,978**	**70,124**	**3.39%**

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

A summary of employment within the gas economy by state is provided in **Table ES 4**.

It is estimated that, in 2020-21, the Australian gas economy supported nearly 241,646 FTE jobs throughout the Australian economy, which was 2.25 per cent of total FTE jobs.

To put this another way, for every 1 million dollars of gas related activities in the Australian economy, there are up to 2.9 FTE jobs that are supported elsewhere in the Australian economy.

Table ES 4 Total employment contribution of the Australian gas economy, by state, 2020-21

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	28	5,519	679	7,135	4,350	2,092	**19,803**	**0.57%**
Vic	2,568	9,090	1,221	6,389	3,072	5,214	**27,553**	**0.98%**
Qld	43,301	7,247	3,142	10,991	6,901	5,289	**76,871**	**3.64%**
SA	547	2,613	1,982	1,252	830	2,056	**9,280**	**1.33%**
WA	54,887	10,027	4,721	6,732	8,668	10,627	**95,662**	**8.44%**
Tas	1	398	61	430	173	89	**1,152**	**0.57%**
NT	7,953	1,494	483	135	140	918	**11,123**	**9.45%**
ACT	2	120	0	10	71	0	**203**	**0.10%**
Australia	**109,284**	**36,508**	**12,289**	**33,074**	**24,205**	**26,285**	**241,646**	**2.25%**

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, 2020-21

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	16,656	19,577	3,321	10,046	16,233		65,835	0.61%
Indirect	92,628	16,931	8,968	23,028	7,972	26,285	175,812	1.64%
Australia	**109,284**	**36,508**	**12,289**	**33,074**	**24,205**	**26,285**	**241,646**	**2.25%**

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, 2020-21

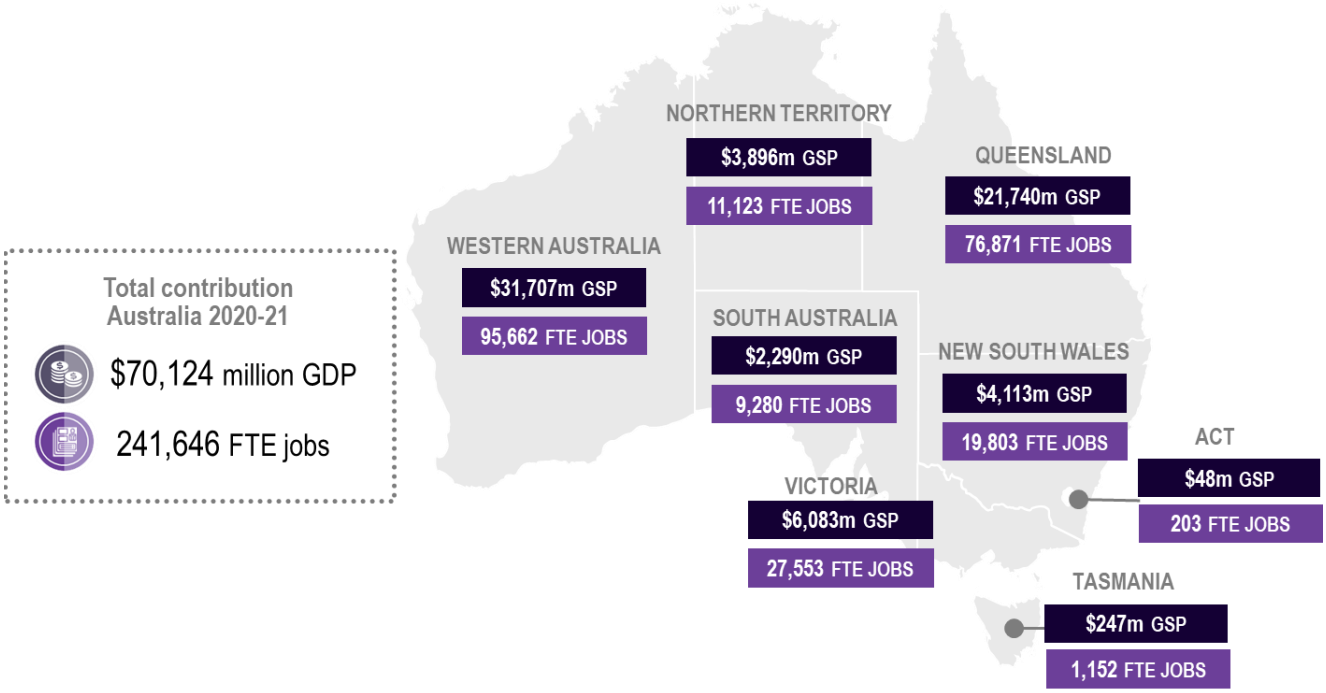
State	Production of gaseous fuels	Transport & distribution of gaseous fuels	Gas fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas related capital expenditure	TOTAL	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
LNG	91,639	38			ne	ne	ne	ne
Natural gas	15,158	22,706	12,289	33,074*	ne	ne	ne	ne
LPG	2,390	13,764				ne	ne	ne
CNG	97	0			ne	ne	ne	ne
Australia	**109,284**	**36,508**	**12,289**	**33,074**	**24,205**	**26,285**	**241,646**	**2.25%**

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.

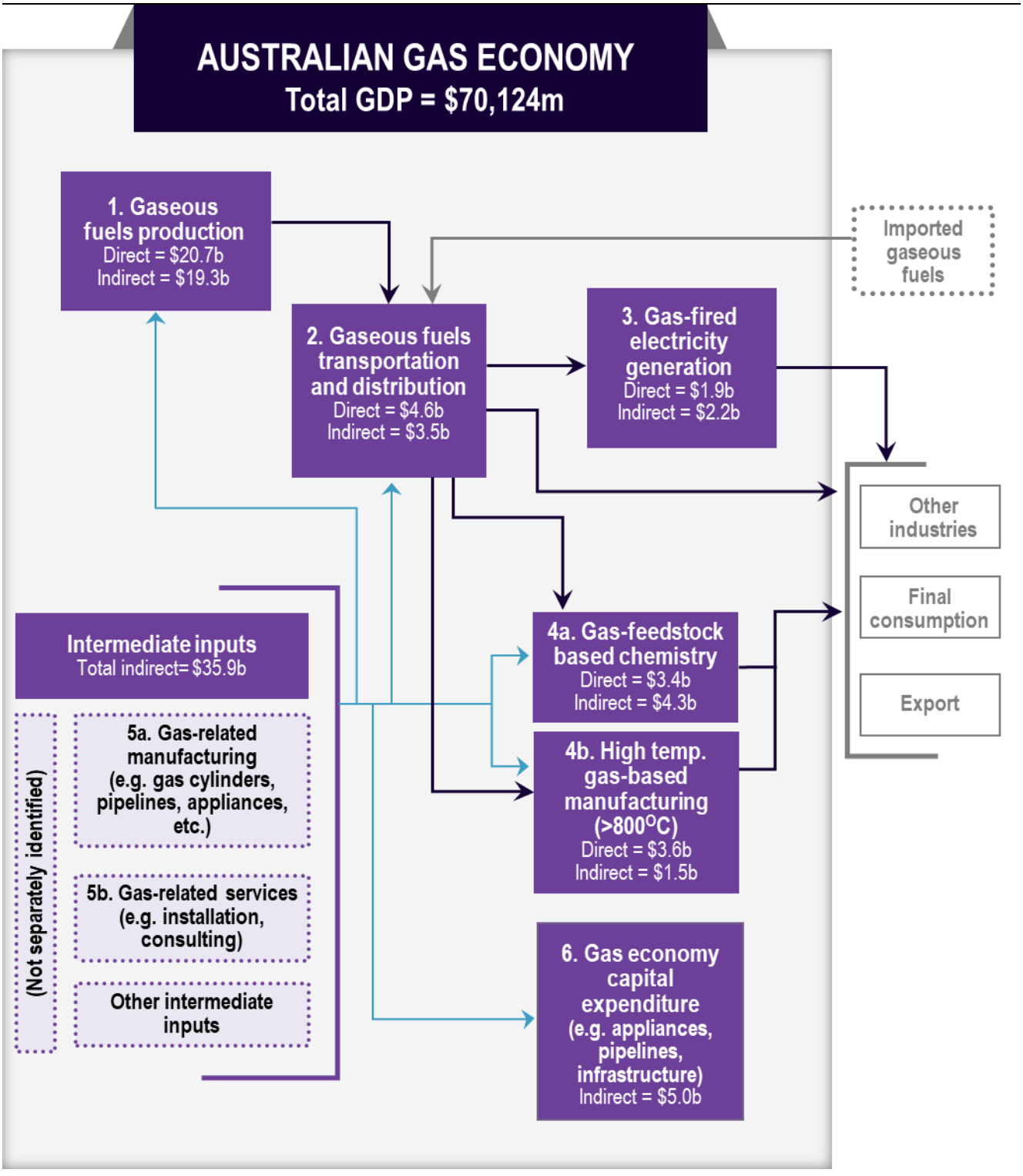
A summary of the estimated Australian gas economy is provided in **Figure ES 1** and **Figure ES 2**.

Figure ES 1 A summary of estimated gas economy by state, 2020-21



Source: ACIL Allen estimates based on various sources.

Figure ES 2 A summary of the Australian gas economy, 2020-21



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, and transport and distribution) is provided in **Table ES 7**. About 5.2 per cent of the total estimated Australian gas economy was contributed to by LPG. LPG contributed 0.18 per cent of Australia's GDP and 0.15 per cent of employment in 2020-21. This is a

conservative estimate as it is limited to the contribution of LPG to the production, and transport and distribution of gaseous fuels and 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, 2020-21

	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	288	197	485	0.08%	2,722	978	3,699	0.11%
Vic.	441	258	699	0.15%	3,072	1,326	4,398	0.16%
Qld	636	287	924	0.25%	2,366	1,329	3,696	0.18%
SA	125	62	187	0.16%	825	304	1,129	0.16%
WA	990	288	1,278	0.35%	1,523	1,183	2,705	0.24%
Tas.	35	13	47	0.14%	262	64	326	0.16%
NT	39	8	46	0.18%	119	24	143	0.12%
ACT	8	3	10	0.02%	50	10	59	0.03%
Australia	**2,561**	**1,116**	**3,677**	**0.18%**	**10,938**	**5,217**	**16,154**	**0.15%**

Source: ACIL Allen estimates based on various sources.

1 Introduction

1.1 Background

ACIL Allen was engaged by Gas Energy Australia (GEA) to quantify the economic contribution of the Australian gas economy, disaggregated by various gaseous fuels, consumers and by state.

In undertaking this work, it is important to note that GEA was recently part of a consortia that funded the delivery of the recent '*Economic and Employment Contribution of the Australian Gas Industry Supply Chain: 2020-21*' report commissioned through the Australian Gas Industry Trust and undertaken by Australian Economic Advocacy Solutions (AEAS). The work is to complement and extend the AEAS report and specifically to include:

- Separation (as best as possible) of GEA's areas of advocacy.
- Explicit inclusion of the contribution of exports.
- Extension of the analysis to include the indirect economic contributions of the complete supply chain of producing and consuming the various gaseous fuels.
  - For example, to include the purchase of machinery, electricity, financial services, insurances, etc. associated with the production, transportation, or consumption of the various gaseous fuels.
  - In doing this, ACIL Allen considers that there is no double counting of various parts of the value-adding chain.
- Correction of the state-based breakdowns to comprise the summation of the component sub-sectors/activities rather than top-down disaggregation of the Australian totals.

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 gas 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 industry. GEA focuses on a range of areas in support of 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 government, state authorities and consumers. The Associations' stakeholder engagement is supported by progressive policy development based on sound research, analysis and expert commentary, the on-going development of national standards and innovative products and technology, proactive media and communications, and the development of the industry's specialist workforce.

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

1.3 About this report

This report provides an estimate of the economic and employment contribution of the Australian gas economy for financial year 2020-21. The 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 2020-21)
- LPG
- CNG
- Hydrogen (not traded commodity in 2020-21, therefore not included in this study)

Activities that are deemed to be part of the Australian gas economy 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 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[3], in Australia natural gas is critical for producing high temperatures required for the manufacturing of alumina, certain other

[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.

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

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. That is, manufacturing companies that are primarily engaged in making specific equipment necessary for the production, transportation, distribution and/or use of gaseous fuels.
   b) Gas-related services. That is, businesses that are primarily engaged in providing 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 has meant that the economic contribution associated with investments related to the gas economy (6 above) has been not been estimated by fuel type.

Future analyses will seek to separately quantify all aspects of the Australian gas economy.

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 key 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 economic and employment contribution of **gas fired electricity generation** to the state and Australian economies.

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

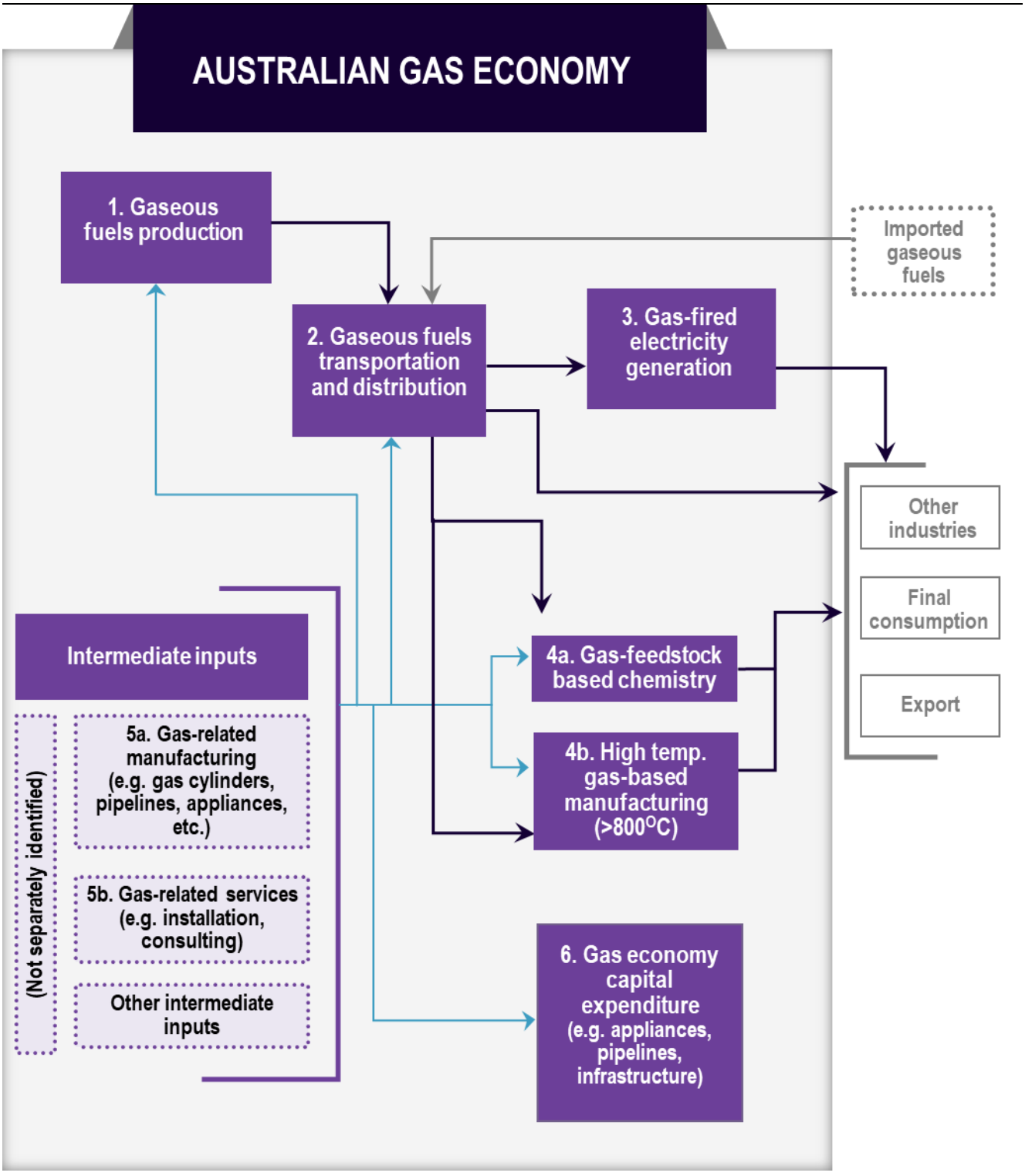
Chapter 7 provides economic and employment contribution of **high temperature gas-based manufacturing** to the state and Australian economies.

Chapter 8 provides economic and employment contribution of **gas related capital expenditure** to the state and Australian economies.

Chapter 9 provides a summary of the total economic and employment contribution of the **gas economy** to the state and Australian economies.

Appendix A provides details on 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

2 Key data sources and methodology

2.1 Data sources

There are a range of publicly available estimates of the size and characteristics of Australia's gas economy. Unfortunately, there are often inconsistencies between the various estimates and they are often aggregated with the other activities. Consequently, it was necessary for ACIL Allen to choose between different sources to undertake the analysis for 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, 2020-21 (released November 2021)
  - Cat no 8165: Counts of Businesses, 2020-21 (released December 2021)
  - Cat no: 4604: Energy Account, Australia, 2019-20 (released November 2021)
- DISR data sources
  - The Resource and Energy Quarterly, June 2022
  - The Australian Petroleum Statistics, June 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 own database of state input output tables, 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 economic footprint (economic contribution) of the Australian gas economy. This is a methodology that is frequently used to understand the full linkages of an activity or industry throughout the economy. The economic footprint analysis describe:

- the *direct* contributions the industry makes to the economies of each state and to Australia as a whole, plus

— the full extent of the *indirect* contributions the industry makes to each economy through their demand for intermediate inputs from other industries (exploration, financial services, construction, machinery, freight etc.) as well as through demand stimulated by the wages and salaries of employees.

For this analysis, the estimates of the economic footprint of the industry have been estimated using what are known as 'Simple multipliers'. Consequently, the estimates in this report include the direct contribution made by the industry to Australia's GDP and employment along with the contribution embodied in the industry's supply chain. They do *not* include what is referred to as the 'Consumption-induced effect'. That is, they do not include the economic effects 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 estimates for other non-overlapping industries (such as beef, milk, petroleum, aluminium, etc.) and will never add to more than Australia's total GDP or employment. While these estimates of the footprint of the gas economy are useful 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.

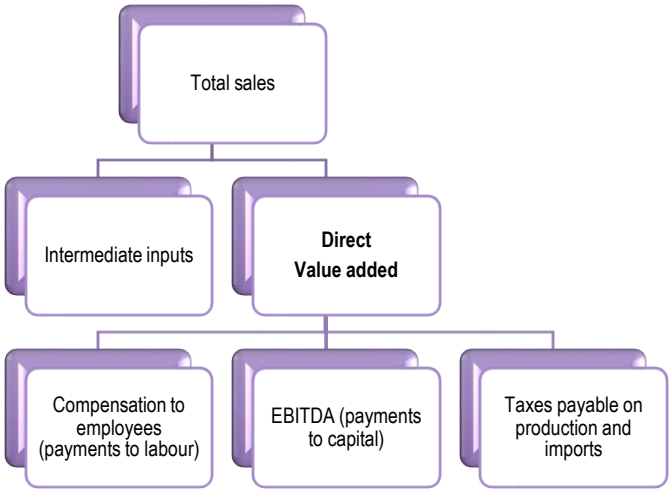
More details of direct and indirect contribution (footprint) analysis are provided below.

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 as a whole – in other words, the extent 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. By using the factors of production appropriately industries can add value to intermediate inputs by converting them into a range of goods and services more suited for use by consumers or other industries. An industry or business' contribution to GDP measures the total value added and is defined as the income that an industry or business generates, less the cost of the inputs that it uses to generate that income, plus certain taxes paid. The direct contribution of an industry or a company to the Australian economy can therefore be estimated by determining their payments to the factors of production plus the taxes (less subsidies) payable on production and imports. 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. If purchased from within the Australian economy, then the portion of value added embodied in the intermediate input is indirectly associated with the activity of the purchaser. The calculation of the indirect contribution quickly becomes difficult as one considers that value-added embodied in the intermediate inputs of the intermediate input.

In a global context, the value-added chain can simply be measured by the value of the final goods and services consumed. In a national context, input-output tables and the associated 'input-output multipliers' can be used to estimate the 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 industry. The tables and multipliers can also be used to measure the relative importance of the production chain linkages to different parts of the economy.

It should be noted that some of the assumptions underpinning input-output multipliers can be an impediment to 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. We do not consider that these conditions apply for the purpose of this analysis and that the use of input-output multipliers to estimate the economic footprint of the gas economy is appropriate. Further information on input-output tables and the calculation of multipliers can be found in ABS Catalogue number 5246.0.[5]

[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 the production of gaseous fuels.

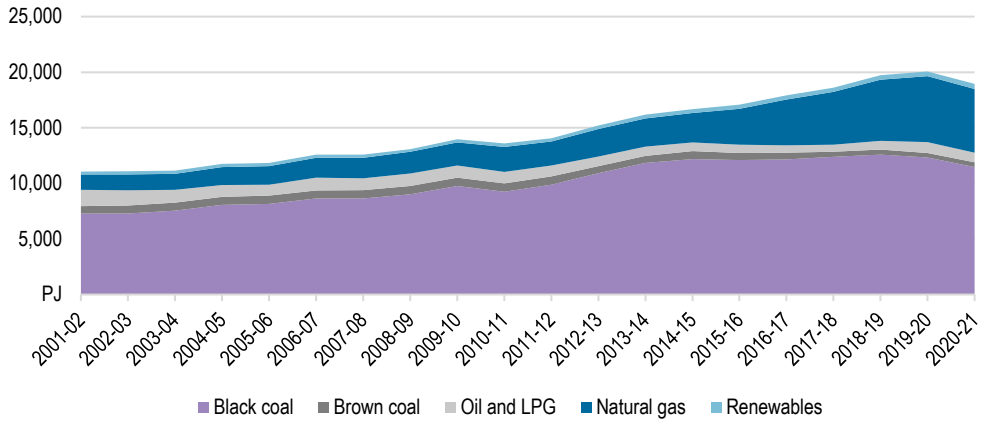
3.1 Production

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 for oil because gas transport is difficult and costly due to relatively low energy content in relation to volume. Natural gas is used across all sectors in varying amounts. It is estimated that around 5,730 PJ of natural gas was produced in Australia in 2020-21 (**Figure 3.1**), which constituted around 30 per cent of total primary energy production.

Natural gas' share of primary energy production increased significantly over the past decade from 16 per cent in 2014-15 to over 30 per cent in 2020-21. This is mainly due to the commencement of production of coal seam gas-based LNG in Queensland and the large growth in LNG production in WA.

Figure 3.1 Australian primary energy production by fuel type, 2000-01 to 2020-21



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

The value of natural gas production, supply and use in Australia over the past few years is summarised in **Table 3.1**. It is estimated that natural gas in gaseous state and coal seam gas produced at the well head was worth over $12 billion in 2020-21. Joint Petroleum Development Area (JPDA) imports constituted around $1 billion. At basic prices before tax and various margins,

[6] IEA 2021, World Energy Outlook 2021.

natural gas supply in Australia was therefore around $13 billion. Total production taxes paid was around $1.1 billion and all margin activities employed constituted around $5.8 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, 2014-15-2020-21

	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**

Note: BP is basic prices, PP is purchaser prices which is inclusive of taxes and margins. Taxes paid by the producers on using various inputs in their production process. They include import duties, excise duties, non-deductible GST, levies, various govt fees, insurance taxes etc. The taxes reported in this table don't include corporate taxes, production royalties or PRRT which are part of production costs and production value added.

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

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

— Gas margin: 58%

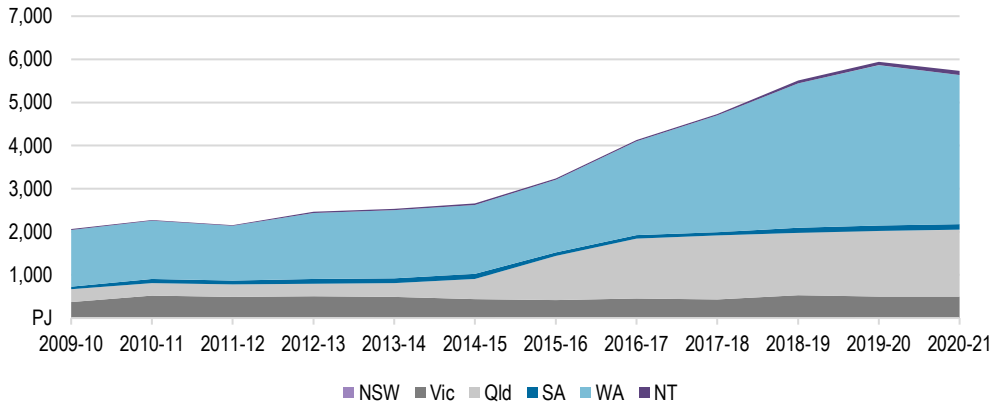
— Pipeline transport margin: 37%

— Road transport margin: 4%

— Rail transport margin: 1%

Natural gas production in Australia by state is provided in **Figure 3.2**.

Figure 3.2 Australian production of natural gas, by state and territory, 2009-10 to 2020-21



Source: DISR, Australian Energy Statistics 2022, Table Q3 and DISR, Resources and Energy Quarterly, June 2022, Table 5

Two states – Western Australia (60.4 per cent) and Queensland (27 per cent) produced the majority of natural gas in Australia in 2020-21. Victoria produced around 8.7 per cent or 497 PJ of gas in 2020-21. A small quantity of gas is produced in other states

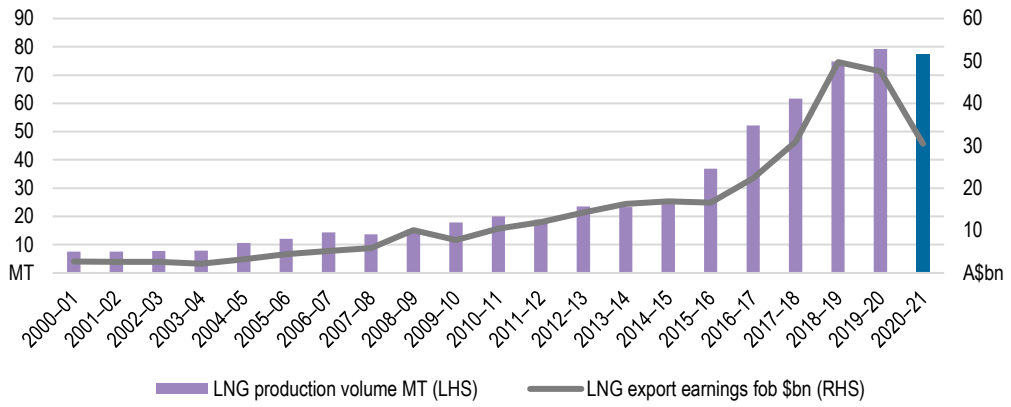
3.1.2 LNG

Natural gas produced in Australia is mainly exported in the form of LNG. Australia's LNG export volumes reached a record high of 79 million tonnes in 2019-20, up 5.9 per cent on 2018-19. This represents an average utilisation of 93 per cent of nameplate capacity. The strong result comes off the back of the resolution of technical issues from 2020 at Gorgon and Prelude, as well as suppliers responding to higher prices.

Australia's LNG export volumes fell slightly in 2020-21 to 77 million tonnes, a decline of 2.3 per cent from 2019-20 (**Figure 3.3**).

In contrast to the volume of production, the value of production fell by 38 per cent in 2020-21 (down to $30.5 billion from $47.5 billion in 2018-20 and $48.9 billion in 2018-19). This fall coincided with the international price of oil during the height of the COVID19-related travel restrictions imposed around the world. Australia's LNG export earnings are expected to recover noticeably in 2021-22 off the back of strong oil prices in recent months.

Figure 3.3 Australia's LNG exports, 2000-01 to 2020-21



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

Export earnings were supported by both low LNG spot prices, averaging US$32 MMBtu in 2020-21 and around 80 per cent of Australian LNG is sold via long-term contracts that link the price of LNG to the price of oil with a lag of around three to six months, depending on contractual arrangements. LNG contract prices in the December 2021 quarter reflect Brent oil prices from the June (US$69 a barrel) and September (US$80 a barrel) quarters, which are considerably higher than corresponding quarters in 2020.

Therefore, the value of LNG exports in 2021-22 will be higher than the 2020-21 values, with DISR expecting they will be over $70bn in 2021-22.

LNG revenue, industry value-added and employment are summarised in **Table 3.2**.

Table 3.2 LNG revenue, value-added, wages and employment, 2006-07 to 2020-21

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

Source: ABS, IBISWorld 2022 and DISR.

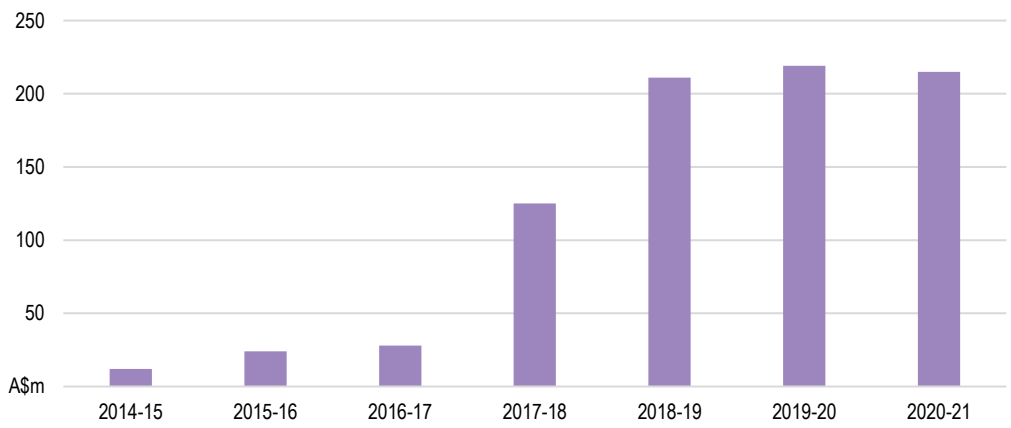
3.1.3 Micro LNG

Other natural gas uses include micro-LNG, which is a small but growing domestic LNG industry distinct from the export LNG industry. Micro-LNG is used for a variety of purposes including for remote area power and customers in the trucking, mining, marine, and industrial sectors that want to replace diesel fuel with less-polluting LNG.

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

It is estimated that over $200 million of micro-LNG was used in Australia in 2020-21.

Figure 3.4 An indicative Micro LNG value, 2014-15 to 2020-21



Source: 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 global major car manufacturers produce CNG vehicles ranging from passenger vehicles to vans to buses to heavy duty trucks. The availability of CNG vehicles in Australia is currently limited to light duty and heavy-duty vehicles, including buses. Most CNG vehicles in Australia belong to fleets that have their own private refuelling stations. There are a small number of publicly accessible CNG refuelling stations across the country. Though Australia does not have a broad public CNG refuelling network, this does not exclude fleet operators from using CNG in their fleets. The most viable operations for CNG in Australia are currently 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.[7]

Based on ABS Motor Vehicle Census in 2021 data (see **Table 3.3**), there are around 2,411 registered CNG vehicles in Australia. The remaining gas operated vehicles use LPG.

It is estimated based on the average kilometres travelled and average fuel consumption, the CNG produced and consumed in Australia in 2020-21 was around 30 ML.

Table 3.3 Number of registered motor vehicles of fuel type of LPG and other gases by state, 2021

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
Estimated CNG use (ML)	**5.09**	**6.92**	**3.36**	**2.07**	**10.75**	**0.16**	**0.00**	**0.82**	**29.18**
Estimated CNG use ($m)	**5.19**	**7.01**	**3.41**	**2.11**	**10.89**	**0.17**	**0.00**	**0.84**	**29.62**

Note: It is assumed that the green shaded vehicles mainly use CNG.

Source: ABS 2021, Motor vehicles census.

3.1.5 LPG

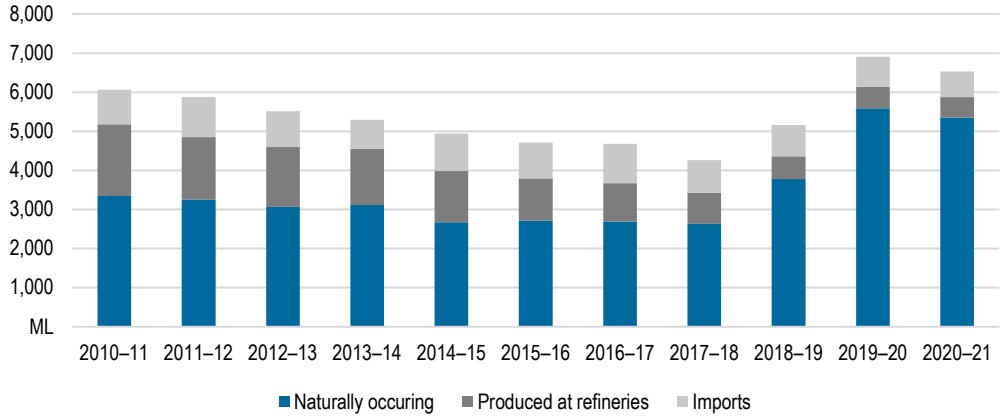
Australia produced 5,349 ML of naturally occurring LPG and 528 ML of refinery produced LPG in 2020-21. In the same year, Australia exported 4,249 ML and imported 656 ML of LPG.

LPG supply in Australia is summarised in **Figure 3.5**.

LPG production increased by over 100 per cent between 2017-18 and 2020-21. This mainly due to the naturally occurring LPG which is typically linked to gas production.

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

Figure 3.5 LPG supply in Australia, 2010-11 to 2020-21

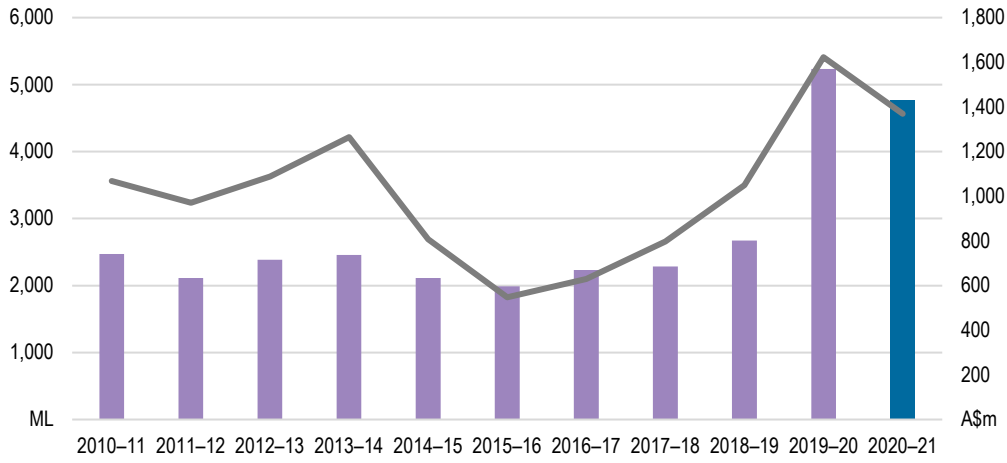


Source: DISR 2022 Resources and Energy Quarterly, March 2022, Table 5, Australian Petroleum Statistics, March 2022.

Australian sales of LPG in 2020-21, amounted to 1,660 ML of which 354 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.

Exports of LPG are summarised in **Figure 3.6**. LPG exports generated revenue of A$1.4bn (fob) in 2020-21.

Figure 3.6 Australia's LPG exports, 2010-11 to 2020-21



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

The value of Australian LPG production, imports, industry and household use and exports are summarised in **Table 3.4**. It is estimated that LPG production value was nearly $2 billion in 2020-21. Imports constituted around $198 million. At basic prices before tax and various margins, LPG supply in Australia is around $2.1 billion. Total production taxes paid was around $178 million and all margin activities employed constitute around $1.9 billion in supplying LPG to various users in the Australian economy.

Nearly one-third of LPG produced in value was exported in 2020-21.

Household demand for LPG was 45 per cent in 2020-21.

Table 3.4 Supply and use of LPG in Australia, 2014-15-2020-21

	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**

Note: BP is basic prices, PP is purchaser prices which is inclusive of taxes and margins. Taxes paid by the producers on using various inputs in their production process. They include import duties, excise duties, non-deductible GST, levies, various govt fees, insurance taxes etc. The taxes reported in this table don't include corporate taxes, production royalties or PRRT which are part of production costs and production 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 and can be transported using various carriers.

A primary demand for hydrogen currently in Australia is for petroleum refining[8] and ammonia production. This demand has been met from fossil fuels.

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

A small pilot project exported hydrogen to Japan in February 2022,[9] the economic contribution from this will be included in next year's 2021-22 economic contribution analysis report.

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

[8] 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.

[9] 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

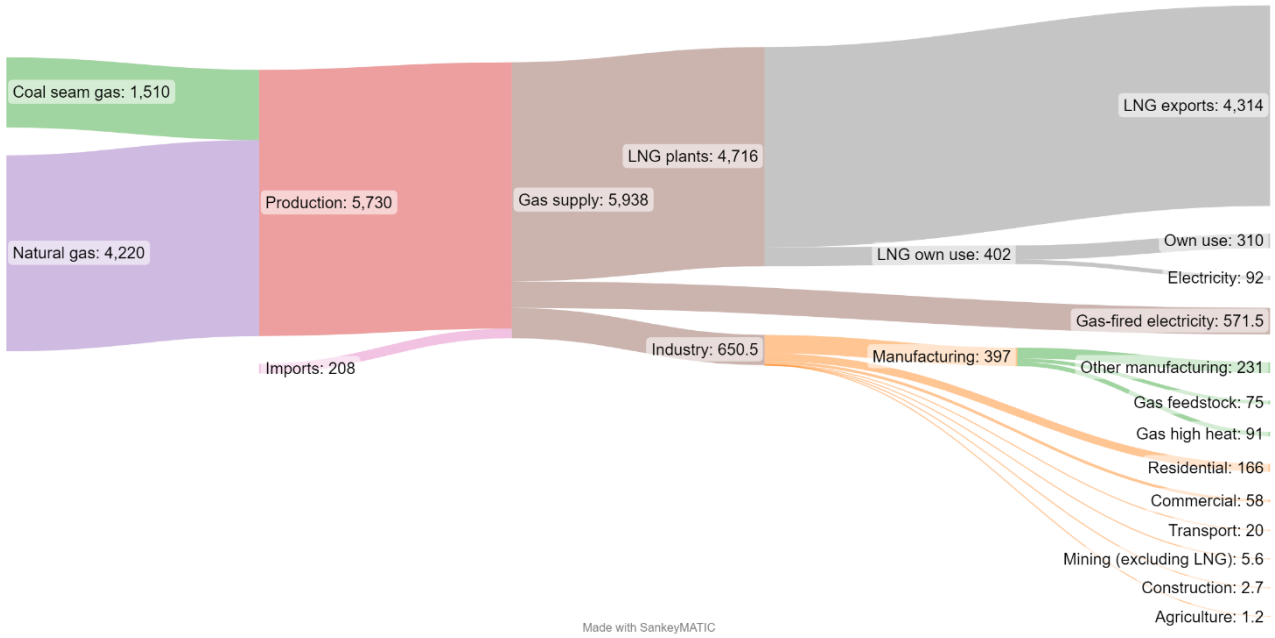
Hydrogen is gaining increasing attention as a clean fuel to help decarbonise economies. Australia's proven track record as an energy exporter — especially our expertise in exporting LNG — combined with our abundant renewable energy and suitable geological storage resources, means that the nation has 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. June 2022 Resources and Energy Major Projects (REMP) report includes hydrogen projects list focuses on large-scale projects that are targeting the production of hydrogen for sale, either in domestic or export markets.21 major hydrogen projects have been included in the REMP 2021 report, and over $133 billion worth of potential investment in hydrogen projects has been identified. This is 15% larger than oil and gas investment and twice the size of investment in coal. The majority of the proposed projects are for renewable hydrogen, reflecting Australia's abundant renewable energy sources available for hydrogen production rather than gas based hydrogen production. The majority of projects will not commence commercial operations until after 2025, with a significant amount commencing after 2027.

Source: DISR (2022), Resources and Energy Major Projects, June 2022.

3.2 Natural gas use in Australia

Natural gas is the third largest energy source in Australia (after oil and coal). It's used by power stations for electricity generation, factories for manufacturing, and homes for heating and cooking. It is a non-renewable source that emits around half the emissions of coal when used to generate electricity. Australia's gas flows (PJ) in 2020-21 are shown in **Figure 3.7**. Around, 5,730 PJ of natural gas (methane, ethane and coal seam gas) was produced in Australia in 2020-21. Of which 77 MT (or 4,314 PJ) was exported and 208 PJ was imported from the JDPA.

Figure 3.7 Australia's gas supply and use (PJ) in 2020-21

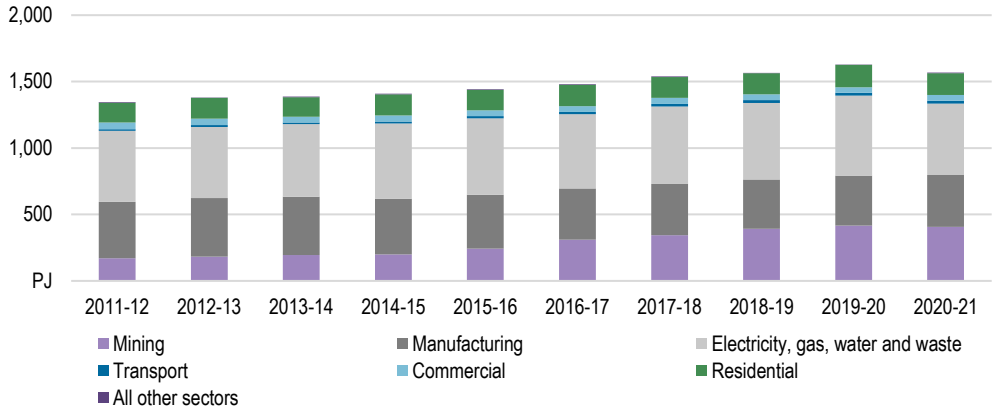


Source: ACIL Allen estimates based on Department of Industry, Science, and Resources (2022), Australian Energy Statistics 2020-21 and Resources and Energy Quarterly, June 2022.

It is assumed that the remining natural gas (after accounting for losses and discrepancies) demanded in the domestic economy was 1,568 PJ (see **Figure 3.8**). Its main uses were:

- electricity generation (571.5 PJ)
- LNG own use (402 PJ)
- manufacturing (397 PJ)
  - gas feedstock (75 PJ)
  - high heating gas (91 PJ)
- residential applications, like gas heating and cooking (166 PJ)
- all other sectors in the economy (75 PJ).

Figure 3.8 Natural gas demand by sector in Australia, 2011-12 to 2020-21

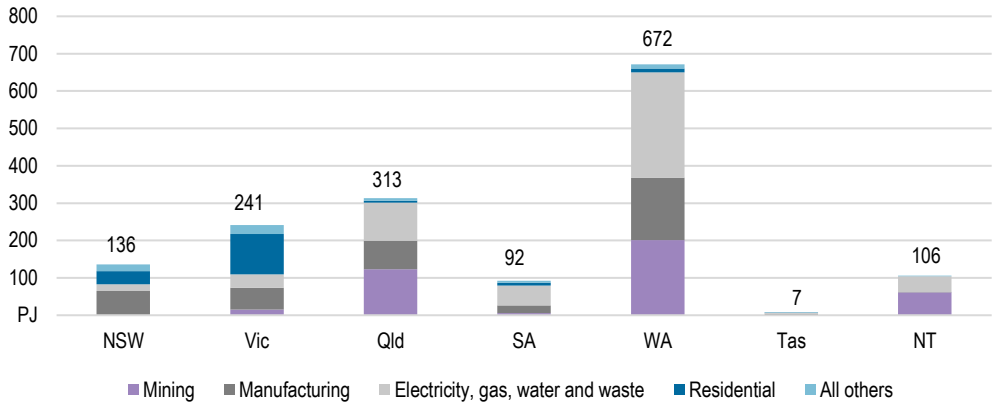


Source: Department of Industry, Science, and Resources (2022), Australian Energy Statistics 2020-21.

Over the past decade natural gas demand in Australia increased at an annual average growth rate of 2 per cent. The main contributor of this increase was own use by the LNG sector. Demand for gas in the mining sector increased at an average annual growth rate of 9.33 per cent.

The estimated natural gas demand by sector in each state in 2020-21 is summarised in **Figure 3.9**. The residential sector was the main consumer of natural gas in Victoria while electricity generation was the main user in WA. In Western Australia, Queensland and the Northern Territory, the mining sector is a significant consumer of gas.

Figure 3.9 Natural gas demand by sector by states, 2020-21



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

3.3 LPG uses in Australia

Australia's LPG flows (PJ) in 2020-21 are shown in **Figure 3.7**. The data is estimated based on Australian Energy Statistics and Resources and Energy Quarterly published by DISR.

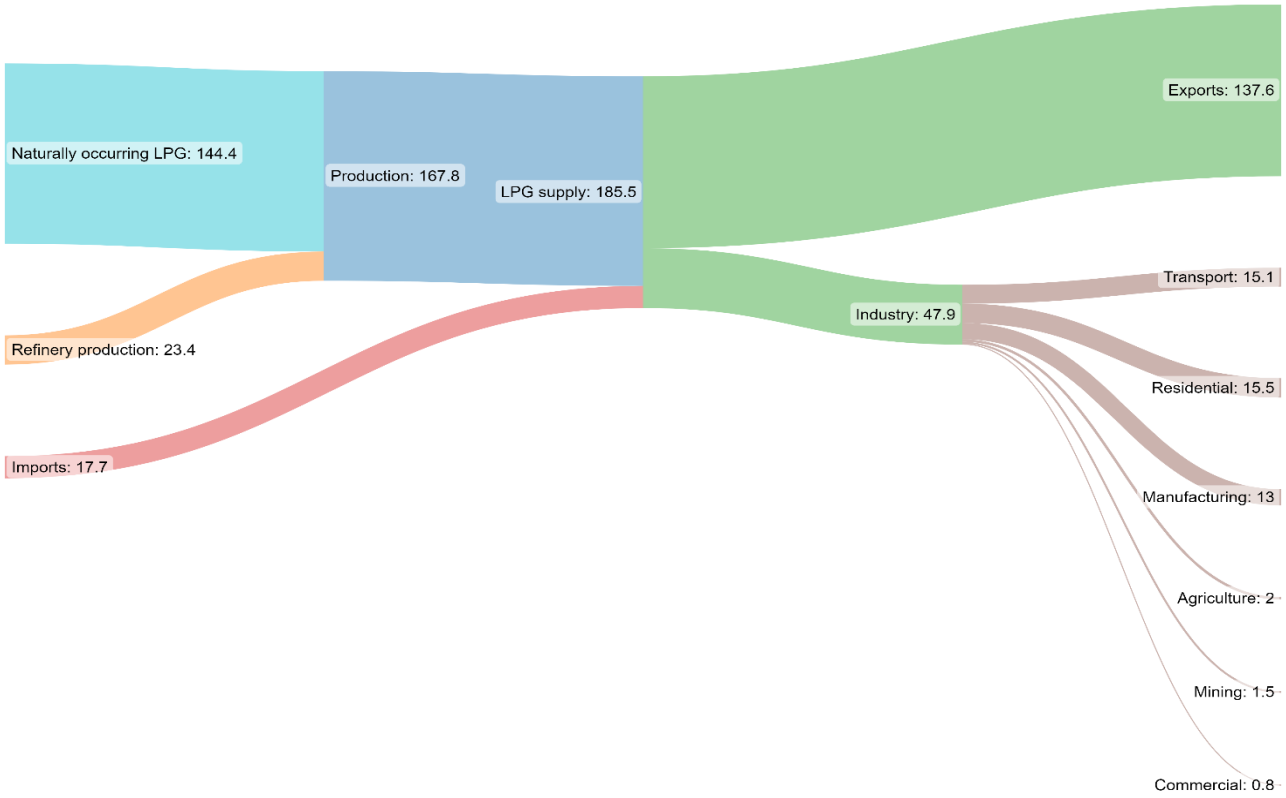
In terms of production from oil fields, crude oils with low gas levels are suitable for LPG production. Natural gas seams containing more of the heavier hydrocarbon fraction can also produce LPG in Australia. It is estimated that 144 PJ of LPG was produced from oil fields in 2020-21. Refineries produce LPG in the process of refining crude oil into many different petroleum products. It is estimated that 23.4 PJ of LPG was produced at refineries in 2020-21.

LPG trade into and out of Australia is supported by import and export terminals around the Australian coast. Australia exported 137.6 PJ of LPG in 2020-21. The major export facilities are located at Westernport Victoria, Port Bonython South Australia, and Kwinana and Dampier in Western Australia. These facilities are capable of handling Very Large Gas Carriers typically used for international shipping of LPG.

Around 17.7 PJ of LPG was imported into Australia in 2020-21, mainly through an import facility located at Port Botany in New South Wales.

LPG use by industry was 47.9 PJ in 2020-21. 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 specifications for domestic and industrial heating. 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 2020-21



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

The economic contribution estimates of four gaseous fuels – natural gas in gaseous form, LNG, LPG and CNG – by state and Australia are provided below. These estimates are based on various data sources using input-output multiplier analysis.

3.4.1 Value-added

The estimated revenue associated with the production of gaseous fuels in Australia are summarised in **Table 3.5**. The total estimated revenue of associated with the production of gaseous fuels in Australia in 2020-21 was $45,863 million.

Table 3.5 Revenue from gaseous fuels production, 2020-21

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	A$m	A$m	A$m	A$m	A$m
NSW	7	0	1	5	**14**
Vic.	1,009	0	159	7	**1,175**
Qld	3,090	11,494	487	3	**15,075**
SA	257	0	41	2	**300**
WA	7,552	16,625	1,191	11	**25,379**
Tas.	0	0	0	0	**0**
NT	160	3,734	25	0	**3,919**
ACT	0	0	0	1	**1**
Australia	**12,077**	**31,853**	**1,904**	**30**	**45,863**

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 **$20,724 million** (see **Table 3.6**), mostly comprising pre-tax returns to owners of the industry and compensation of employees.

In 2020-21, Australian GDP was $2,067 billion, implying that the direct economic contribution of all gaseous fuels production accounted for 1 per cent of Australia's 2020-21 GDP.

The Northern Territory reported the highest direct GTP contribution from the production of gaseous fuels in 2020-21.It is followed by Western Australia where gaseous fuel production directly contributed 3.28 per cent of state's GSP, and Queensland (1.75 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, 2020-21

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	6	0	1	2	**8**	**0.00%**
Vic.	723	0	114	2	**839**	**0.18%**
Qld	2,275	3,786	359	1	**6,420**	**1.75%**
SA	175	0	28	1	**203**	**0.17%**
WA	5,523	5,476	871	3	**11,874**	**3.28%**

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total	Per cent of GSP/GTP/ GDP
Tas.	0	0	0	0	**0**	**0.00%**
NT	129	1,230	20	0	**1,379**	**5.50%**
ACT	0	0	0	0	**0**	**0.00%**
Australia	**8,830**	**10,492**	**1,392**	**9**	**20,724**	**1.00%**

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 2020-21 was 16,656 (see **Table 3.7**). Employment patterns follow the production pattern of states.

Table 3.7 Direct employment from gaseous fuels production, 2020-21

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	2	0	0	7	**10**
Vic.	708	0	112	10	**829**
Qld	690	4,383	109	5	**5,186**
SA	85	0	13	3	**102**
WA	2,318	6,340	366	15	**9,039**
Tas.	0	0	0	0	**0**
NT	57	1,424	9	0	**1,490**
ACT	0	0	0	1	**1**
Australia	**3,860**	**12,146**	**609**	**41**	**16,656**

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

3.5 Production: Indirect economic contribution

The direct contribution of an activity in terms of value added is confined to the initial impacts of the activity. However, purchases of intermediate inputs or spending of incomes made because of an activity will lead to further economic impacts. These are estimated as the indirect contribution.

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

— Purchases of intermediate inputs by industry: The sector or industry purchase goods and services from various businesses in the region to produce its output e.g., diesel, additional electricity use, other related chemicals within the sector, or services from other sectors. This creates demand for those services and further stimulates the economic activity in the region.

— Employees spend: The income received by the employees in the industry is spent on purchasing various goods and services in the region. This additional spend generates additional economic activity.

As discussed in Appendix A, the above two effects are captured by the supply chain information embodied in input-output tables (and the associated 'input-output multipliers') of the Australian and state economies. 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). From these tables, ACIL Allen has calculated a range of multipliers 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

It is estimated that the Australian production of gaseous fuels spent $25,139 million on intermediate goods and services in producing its outputs in 2020-21 (see Table 3.8). Of this, it is estimated that $23,287 million was spent on domestically produced goods and services comprising various intermediate inputs.

Table 3.8 Intermediate input use in gaseous fuel production, 2020-21

	Natural gas (excl. LNG)	LNG	LPG	CNG	Total
	A$m	A$m	A$m	A$m	A$m
Gas	193.6	2,061.8	30.5	12.7	**2,298.7**
Transport	135.5	1,172.9	21.4	0.0	**1,329.7**
Construction	411.7	1,588.6	64.9	0.0	**2,065.3**
Trade	107.6	953.3	17.0	3.6	**1,081.4**
Finance and hiring	1,127.0	2,647.7	177.7	0.0	**3,952.4**
Business services	191.2	3,677.5	30.1	0.0	**3,898.8**
Electricity	247.3	1,979.6	39.0	0.0	**2,266.0**
Others	607.3	5,689.9	95.8	1.9	**6,394.8**
TOTAL	**3,021.3**	**19,771.4**	**476.4**	**18.1**	**23,287.2**

Source: ACIL Allen estimates based on input-output tables.

It is estimated that the domestic spend of $29,068 million associated with the production of gaseous fuels indirectly contributed $19,304 million (see **Table 3.9**) to the Australian economy, which is between 0.93 per cent of GDP in 2020-21. This is in addition to the direct economic contribution of gaseous fuel production contribution of 1 per cent reported in **Table 3.6**.

Table 3.9 Indirect value-added from gaseous fuels production, 2020-21

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	4	0.00%
Vic.	341	0	54	3	397	0.08%
Qld	840	6,640	133	3	7,615	2.08%
SA	88	0	14	1	103	0.09%
WA	1,451	7,985	229	9	9,673	2.67%
Tas.	0	0	0	0	0	0.00%
NT	14	1,496	2	0	1,512	6.03%

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total	Per cent of GSP/GTP/ GDP
ACT	0	0	0	0	0	0.00%
Australia	**2,736**	**16,121**	**431**	**17**	**19,304**	**0.93%**

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

3.5.2 Employment

It is estimated that 92,628 (**Table 3.10**) FTE jobs were indirectly supported by gaseous fuel production activities in the Australian economy.

Table 3.10 Indirect employment from gaseous fuels production, 2020-21

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	8	0	1	9	18
Vic.	1,491	0	235	13	1,739
Qld	3,553	33,994	560	8	38,115
SA	381	0	60	4	445
WA	5,823	39,086	918	21	45,848
Tas.	0	0	0	0	0
NT	43	6,413	7	0	6,463
ACT	0	0	0	1	1
Australia	**11,298**	**79,493**	**1,782**	**55**	**92,628**

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 4.3 and 4.4 provides the total economic footprint of the gaseous fuels production in 2020-21. The estimated total (direct and indirect) value-added contribution from gaseous fuel production by state is provided in **Table 3.11**.

Table 3.11 Total value-added contribution from gaseous fuel production by state, 2020-21

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	8	4	12	0.00%
Vic.	839	397	1,236	0.26%
Qld	6,420	7,615	14,036	3.83%
SA	203	103	306	0.26%
WA	11,874	9,673	21,547	5.96%
Tas.	0	0	0	0.00%
NT	1,379	1,512	2,891	11.53%

	Direct	Indirect	Total	Total (%GSP)
ACT	0	0	0	0.00%
Australia	**20,724**	**19,304**	**40,028**	**1.94%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates 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 3.12**.

Table 3.12 Total value-added contribution from gaseous fuel production by gas, 2020-21

	Direct	Indirect	Total	Total (%GDP)
	A$m	A$m	A$m	%
Natural gas	8,830	2,736	11,566	0.56%
LNG	10,492	16,121	26,613	1.29%
LPG	1,392	431	1,824	0.09%
CNG	9	17	26	0.00%
Australia	**20,724**	**19,304**	**40,028**	**1.94%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

3.6.2 Employment

The estimated total (direct and indirect) employment contribution from gaseous fuel production is provided by state in **Table 3.13**.

Table 3.13 Total employment contribution from gaseous fuel production by state, 2020-21

	Direct	Indirect	Total	% Total employment
	FTE jobs	FTE jobs	FTE jobs	%
NSW	10	18	28	0.001%
Vic.	829	1,739	2,568	0.091%
Qld	5,186	38,115	43,301	2.051%
SA	102	445	547	0.078%
WA	9,039	45,848	54,887	4.842%
Tas.	0	0	1	0.000%
NT	1,490	6,463	7,953	6.755%
ACT	1	1	2	0.001%
Australia	**16,656**	**92,628**	**109,284**	**1.019%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

The estimated total (direct and indirect) employment contribution from gaseous fuel production is provided by fuel in **Table 3.14**.

Table 3.14 Total employment contribution from gaseous fuel production by gas, 2020-21

	Direct	Indirect	Total
	FTE jobs	FTE jobs	FTE jobs
Natural gas in gaseous form	3,860	11,298	15,158
LNG	12,146	79,493	91,639
LPG	609	1,782	2,390
CNG	41	55	97
Australia	**16,656**	**92,628**	**109,284**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

3.6.3 Australian economy

The total (direct and indirect) Australian economic contribution of gaseous fuel production in 2020-21 is summarised in **Figure 3.11**.

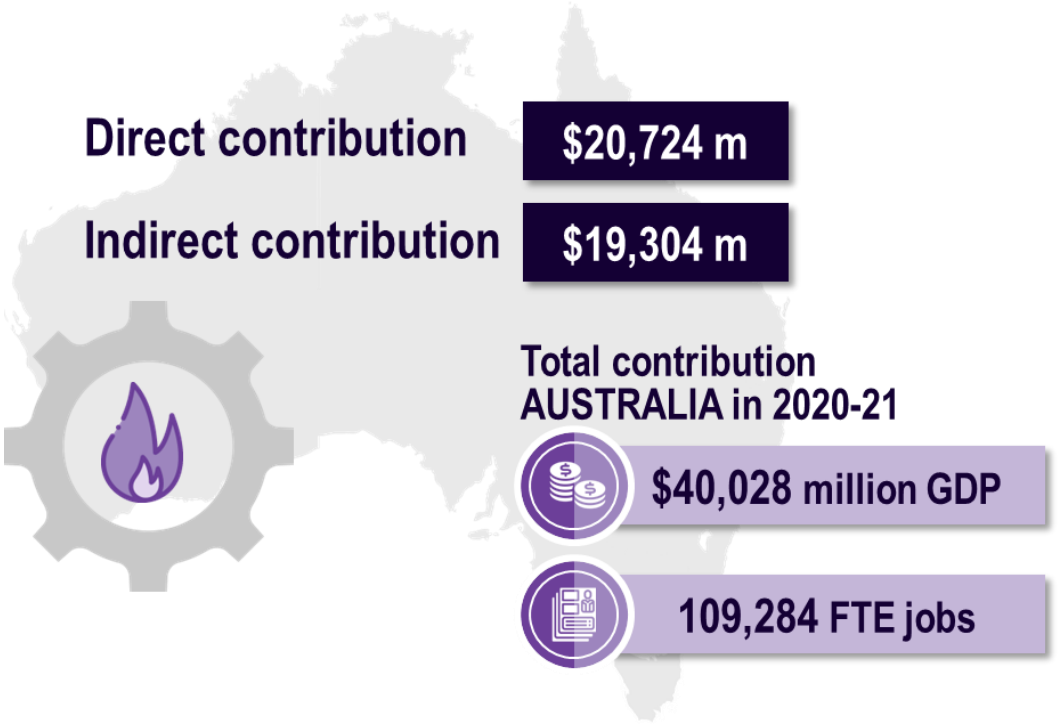
In 2020-21, it is estimated that gaseous fuel production in Australia had:

— a *total* contribution of $40,028 million to Australian GDP, comprising $20,724 million directly from the gaseous fuel production activities (direct value-added contribution) and $19,304 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 1.94 per cent to Australian GDP in 2020-21.

— a *total* employment contribution of 109,284 FTE jobs throughout Australia. To put this another way, for every one million dollars of revenue received by the Australian gaseous fuel production activities, there are up to 2.4 FTE jobs that are supported elsewhere in the Australian economy.

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

Figure 3.11 Estimated contribution of gaseous fuel production to Australian economy, 2020-21



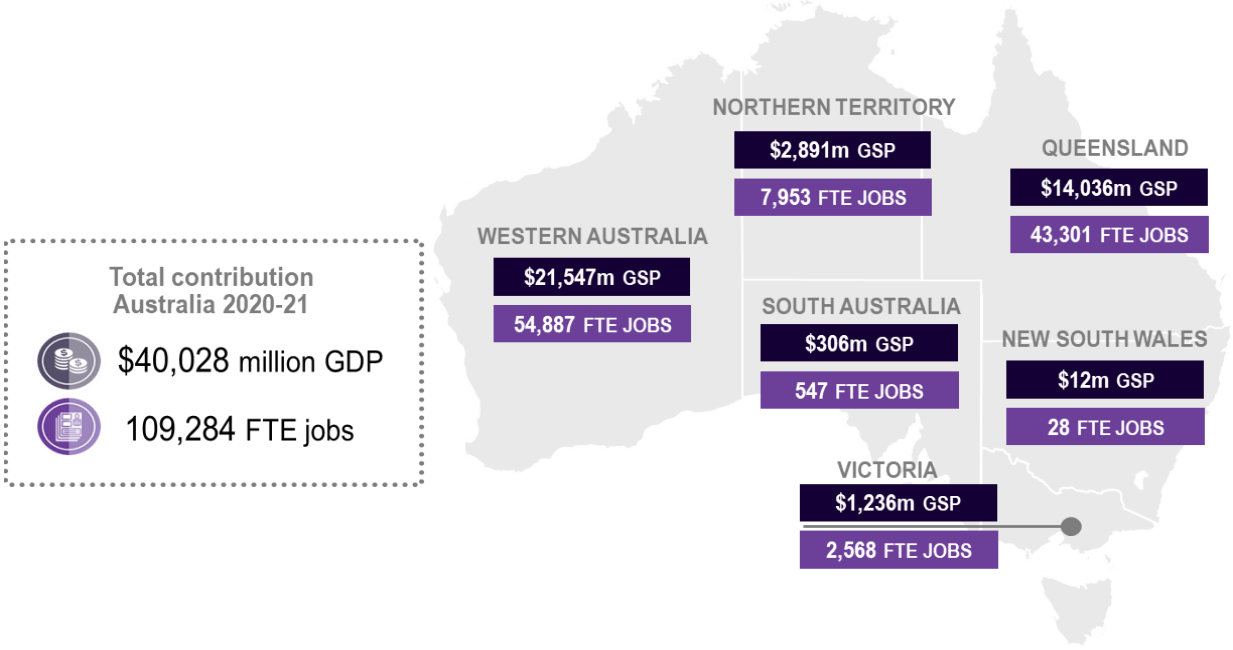
Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

3.6.4 State economies

The total (direct and indirect) economic contribution of gaseous fuel production to state economies in 2020-21 is summarised in **Figure 3.12**.

Figure 3.12 Estimated contribution of gaseous fuel production to state economies, 2020-21



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

New South Wales

In 2020-21, it is estimated that gaseous fuel production in New South Wales had:

— a *total* contribution of $12 million to New South Wales GSP, comprising $8 million directly from the gaseous fuel production activities (direct value-added contribution) and $4 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.0019 per cent to New South Wales GSP in 2020-21.

— a *total* employment contribution of 28 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, there are up to 2 FTE jobs that are supported elsewhere in the New South Wales economy.

Victoria

In 2020-21, it is estimated that gaseous fuel production in Victoria had:

— a *total* contribution of $1,236 million to Victorian GSP, comprising $839 million directly from the gaseous fuel production activities (direct value-added contribution) and $397 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.26 per cent to Victorian GSP in 2020-21.

— a *total* employment contribution of 2,568 FTE jobs throughout Victoria. To put this another way, for every one million dollars of revenue received by the Victorian gaseous fuel production activities, there are up to 2.2 FTE jobs that are supported elsewhere in the Victorian economy.

Queensland

In 2020-21, it is estimated that gaseous fuel production in Queensland had:

— a *total* contribution of $14,036 million to Queensland GSP, comprising $6,420 million directly from the gaseous fuel production activities (direct value-added contribution) and $7,615 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 3.83 per cent to Queensland GSP in 2020-21.

— a *total* employment contribution of 43,301 FTE jobs throughout Queensland. To put this another way, for every one million dollars of revenue received by the Queensland gaseous fuel production activities, there are up to 2.9 FTE jobs that are supported elsewhere in the Queensland economy.

South Australia

In 2020-21, it is estimated that gaseous fuel production in South Australia had:

— a *total* contribution of $306 million to South Australia GSP, comprising $203 million directly from the gaseous fuel production activities (direct value-added contribution) and $103 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.26 per cent to South Australia GSP in 2020-21.

— a *total* employment contribution of 547 FTE jobs throughout South Australia. To put this another way, for every one million dollars of revenue received by the South Australia gaseous fuel production activities, there are up to 1.8 FTE jobs that are supported elsewhere in the South Australia economy.

Western Australia

In 2020-21, it is estimated that gaseous fuel production in Western Australia had:

— a *total* contribution of $21,547 million to Western Australia's GSP, comprising $11,874 million directly from the gaseous fuel production activities (direct value-added contribution) and $9,673 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 5.96 per cent to Western Australia's GSP in 2020-21.

— a *total* employment contribution of 54,887 FTE jobs throughout Western Australia. To put this another way, for every one million dollars of revenue received by the Western Australia gaseous fuel production activities, there are up to 2.2 FTE jobs that are supported elsewhere in the Western Australia economy.

Northern Territory

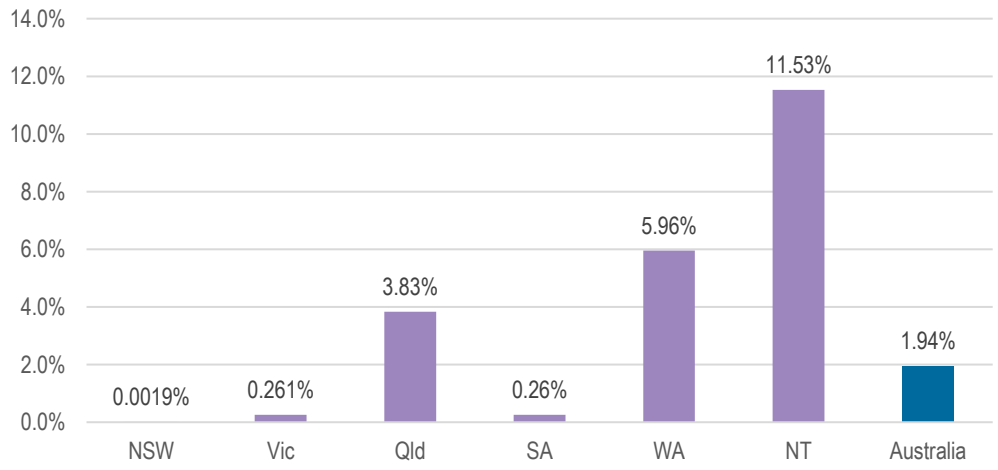
In 2020-21, it is estimated that gaseous fuel production in the Northern Territory had:

— a *total* contribution of $2,891 million to the Northern Territory's GTP, comprising $1,379 million directly from the gaseous fuel production activities (direct value-added contribution) and $1,512 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 11.53 per cent to the Northern Territory's GTP in 2020-21.

— a *total* employment contribution of 7,953 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, there are up to 2 FTE jobs that are supported elsewhere in the Northern Territory economy.

A summary of gaseous fuel production activities to state GSPs are provided in **Figure 3.13**.

Figure 3.13 Gaseous fuel production activities to State GSPs, 2020-21



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

Contribution of transport and distribution of gaseous fuels

4

The economic contribution estimates of gaseous fuels transportation and distribution by state and fuel are provided in this chapter. 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

The estimated revenue from transportation and distribution of gaseous fuels in Australia are summarised in **Table 4.1**. This includes transportation and distribution of imported LPG.

The total estimated revenue (margins and taxes) of the Australian gaseous fuels transport and distribution in 2020-21 was $8,973 million.

Table 4.1 Revenue from gaseous fuels transport and distribution, 2020-21

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	A$m	A$m	A$m	A$m	A$m
NSW	530	0	520	0	**1,049**
Vic.	1,189	0	566	0	**1,755**
Qld	1,309	6	453	0	**1,767**
SA	457	0	160	0	**617**
WA	2,910	8	253	0	**3,171**
Tas.	28	0	56	0	**85**
NT	462	2	23	0	**487**
ACT	28	0	13	0	**41**
Australia	**6,913**	**16**	**2,044**	**0**	**8,973**

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 **$4,603 million** (see **Table 4.2**), mostly comprising wages, taxes and subsidies.

In 2020-21, Australian GDP was $2,067 billion, implying that the direct economic contribution of all gaseous fuels transport and distribution accounted for 0.223 per cent of Australia's 2020-21 GDP.

Table 4.2 Direct value-added from gaseous fuels transport and distribution, 2020-21

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	245.8	0.0	287.1		**532.9**	0.083%
Vic.	522.8	0.0	322.6		**845.4**	0.178%
Qld	630.3	3.9	258.0		**892.2**	0.244%
SA	223.4	0.0	95.0		**318.3**	0.270%
WA	1,539.6	6.1	149.2		**1,694.9**	0.469%
Tas.	14.9	0.0	34.5		**49.4**	0.142%
NT	232.0	1.4	13.8		**247.2**	0.986%
ACT	14.8	0.0	7.9		**22.7**	0.052%
Australia	**3,423.6**	**11.4**	**1,168.1**		**4,603.1**	**0.223%**

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 19,577 FTE jobs in 2020-21.

Table 4.3 Direct employment from gaseous fuels transport and distribution, 2020-21

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	707	0	2,721		**3,428**
Vic.	1,705	0	2,956		**4,661**
Qld	1,568	8	2,252		**3,828**
SA	605	0	810		**1,415**
WA	3,849	8	1,170		**5,027**
Tas.	32	0	262		**294**
NT	734	2	108		**844**
ACT	31	0	50		**80**
Australia	**9,230**	**19**	**10,328**		**19,577**

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

4.2 Transport and distribution: Indirect contribution

4.2.1 Value-added

It is estimated that the Australian all gaseous fuels transportation and distribution spent $7,687 million on domestic margins in transporting and distributing gaseous fuels in 2020-21 comprising:

- $3,361 million on gas distribution margins
- $3,073 million on transport margins
- $1,252 million on wholesale and retail trade margins

It is estimated that the domestic spend of $7,687 million by all gaseous fuels transport and distribution indirectly contributed $3,514 million (see **Table 4.4**) to the Australian economy, which is 0.17 per cent of GDP in 2020-21.

This is in addition to the direct gaseous fuels' transportation and distribution contribution of 0.223 per cent reported in **Table 4.2**.

Table 4.4 Indirect value-added from gaseous fuels transport and distribution, 2020-21

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	225	0	197		**421**	0.066%
Vic.	611	0	203		**813**	0.172%
Qld	550	2	149		**701**	0.191%
SA	193	0	48		**240**	0.204%
WA	1,082	2	69		**1,153**	0.319%
Tas.	8	0	13		**21**	0.060%
NT	149	0	5		**154**	0.614%
ACT	8	0	3		**10**	0.023%
Australia	**2,825**	**4**	**684**		**3,514**	**0.170%**

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

4.2.2 Employment

It is estimated that 16,931 (**Table 4.5**) FTE jobs were indirectly supported by gaseous fuel transport and distribution activities in the Australian economy.

Table 4.5 Indirect employment from gaseous fuels transport and distribution, a lower bound 2020-21

State	Natural gas (excluding LNG)	LNG	LPG	CNG	Total
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs
NSW	1,115	0	976		**2,091**
Vic.	3,345	0	1,083		**4,429**
Qld	2,666	10	743		**3,419**
SA	958	0	240		**1,198**
WA	4,688	8	303		**4,999**
Tas.	40	0	64		**104**
NT	634	1	16		**651**
ACT	30	0	10		**40**
Australia	**13,476**	**20**	**3,435**		**16,931**

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 5.1 and 5.2 provides total economic footprint of the gaseous fuels transport and distribution in 2020-21. The estimated total (direct and indirect) value-added contribution from gaseous fuel transport and distribution by state is provided in **Table 4.6**.

Table 4.6 Total value-added contribution from gaseous fuel transport and distribution by state, 2020-21

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	533	421	954	0.15%
Vic.	845	813	1,659	0.35%
Qld	892	701	1,593	0.43%
SA	318	240	559	0.47%
WA	1,695	1,153	2,848	0.79%
Tas.	49	21	70	0.20%
NT	247.2	154.1	401	1.60%
ACT	23	10	33	0.07%
Australia	**4,603**	**3,514**	**8,117**	**0.39%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates 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 4.7**.

Table 4.7 Total value-added contribution from gaseous fuel transport and distribution by gas, 2020-21

	Direct	Indirect	Total	Total (%GDP)
	A$m	A$m	A$m	%
Natural gas	3,424	2,825	6,249	0.30%
LNG	11	4	15	0.00%
LPG	1,168	684	1,853	0.09%
CNG	0	0	0	0.00%
Australia	**4,603**	**3,514**	**8,117**	**0.39%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

4.3.2 Employment

The estimated total (direct and indirect) employment contribution from gaseous fuel transport and distribution is provided by state in **Table 4.8**.

Table 4.8 Total employment contribution from gaseous fuel transport and distribution by state, 2020-21

	Direct	Indirect	Total	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	%
NSW	3,428	2,091	5,519	0.160%
Vic.	4,661	4,429	9,090	0.323%
Qld	3,828	3,419	7,247	0.343%
SA	1,415	1,198	2,613	0.374%
WA	5,027	4,999	10,027	0.885%
Tas.	294	104	398	0.197%
NT	844	651	1,494	1.269%
ACT	80	40	120	0.062%
Australia	**19,577**	**16,931**	**36,508**	**0.340%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

4.3.3 Australian economy

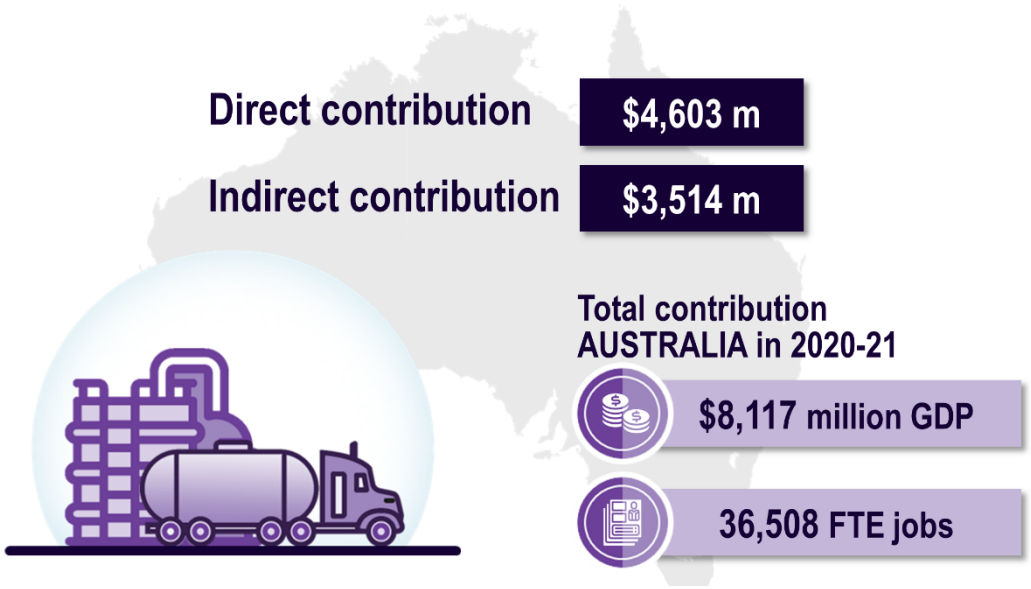
The Australian economic contribution of the gaseous fuel transport and distribution in 2020-21 is summarised in **Figure 4.1**.

In 2020-21, it is estimated that gaseous fuel transport and distribution in Australia had:

— a *total* contribution of $8,117 million to Australian GDP, comprising $4,603 million directly from the gaseous fuel production activities (direct value-added contribution) and $3,514 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.39 per cent to Australian GDP in 2020-21.

— a *total* employment contribution of 36,508 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, there are up to 4.1 FTE jobs that are supported elsewhere in the Australian economy.

Figure 4.1 Estimated total contribution of gaseous fuel transport and distribution to Australian economy, 2020-21

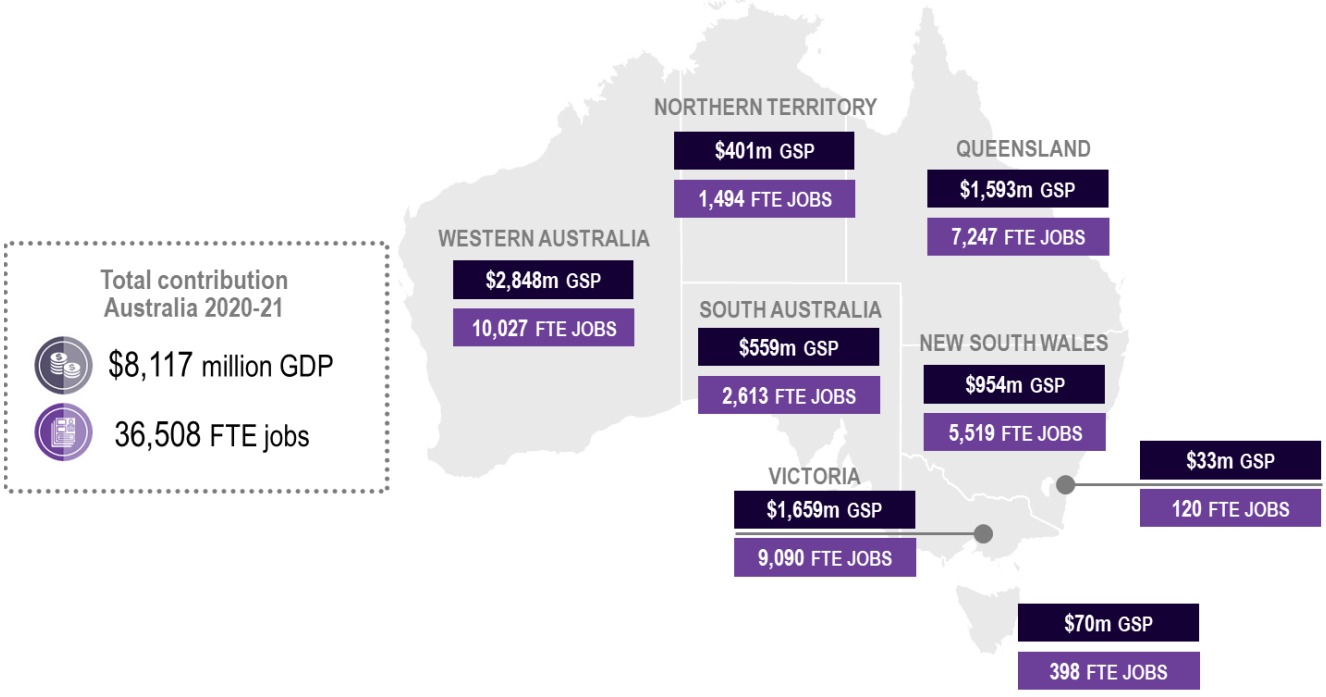


Source: ACIL Allen estimates based on ABS, DISR and IBISWorld data

4.3.4 State economies

The total economic contribution of the gaseous fuel transport and distribution to state economies in 2020-21 is summarised in **Figure 4.2**.

Figure 4.2 Estimated total contribution of gaseous fuel transport and distribution to state economies, 2020-21



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

New South Wales

In 2020-21, it is estimated that gaseous fuel transport and distribution in New South Wales had:

— a *total* contribution of $954 million to New South Wales GSP, comprising $533 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $421 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.15 per cent to New South Wales GSP in 2020-21.

— a *total* employment contribution of 5,519 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, there are up to 5.3 FTE jobs that are supported elsewhere in the New South Wales economy.

Victoria

In 2020-21, it is estimated that gaseous fuel transport and distribution in Victoria had:

— a *total* contribution of $1,659 million to Victorian GSP, comprising $845 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $813 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.35 per cent to Victorian GSP in 2020-21.

— a *total* employment contribution of 9,090 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, there are up to 5.2 FTE jobs that are supported elsewhere in the Victorian economy.

Queensland

In 2020-21, it is estimated that gaseous fuel transport and distribution in Queensland had:

— a *total* contribution of $1,593 million to Queensland GSP, comprising $892 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $701 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.43 per cent to Queensland GSP in 2020-21.

— a *total* employment contribution of 7,247 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, there are up to 4.1 FTE jobs that are supported elsewhere in the Queensland economy.

South Australia

In 2020-21, it is estimated that gaseous fuel transport and distribution in South Australia had:

— a *total* contribution of $559 million to South Australia GSP, comprising $318 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $240 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.47 per cent to South Australia GSP in 2020-21.

— a *total* employment contribution of 2,613 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, there are up to 4.2 FTE jobs that are supported elsewhere in the South Australia economy.

Western Australia

In 2020-21, it is estimated that gaseous fuel transport and distribution in Western Australia had:

— a *total* contribution of $2,848 million to Western Australia's GSP, comprising $1,695 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $1,153 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.79 per cent to Western Australia's GSP in 2020-21.

— a *total* employment contribution of 10,027 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, there are up to 3.2 FTE jobs that are supported elsewhere in the Western Australia economy.

Tasmania

In 2020-21, it is estimated that gaseous fuel transport and distribution in Tasmania had:

— a *total* contribution of $70 million to Tasmania's GSP, comprising $49 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $21 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.20 per cent to Tasmania's GSP in 2020-21.

— a *total* employment contribution of 398 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, there are up to 4.7 FTE jobs that are supported elsewhere in the Tasmanian economy.

Northern Territory

In 2020-21, it is estimated that gaseous fuel transport and distribution in the Northern Territory had:

— a *total* contribution of $401 million to the Northern Territory's GTP, comprising $247 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $154 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 1.60 per cent to the Northern Territory's GTP in 2020-21.

— A *total* employment contribution of 1,494 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, there are up to 3.1 FTE jobs that are supported elsewhere in the Northern Territory economy.

Australian Capital Territory

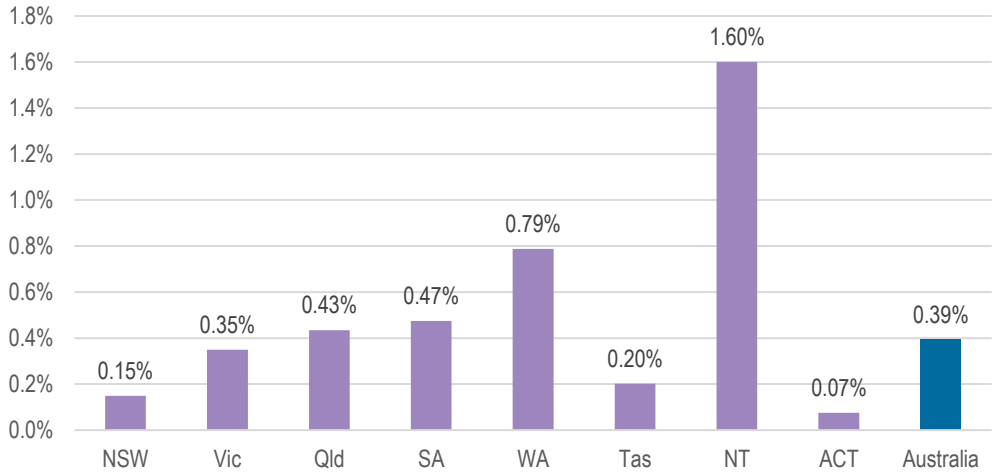
In 2020-21, it is estimated that gaseous fuel transport and distribution in the ACT had:

— a *total* contribution of $33 million to the ACT's GTP, comprising $23 million directly from the gaseous fuel transport and distribution activities (direct value-added contribution) and $10 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.7 per cent to the ACT's GTP in 2020-21.

— a *total* employment contribution of 120 FTE jobs throughout ACT. To put this another way, for every one million dollars of revenue received by ACT gaseous fuel transport and distribution activities, there are up to 2.9 FTE jobs that are supported elsewhere in the ACT economy.

A summary of gaseous fuel transport and distribution activities to state GSPs are provided in **Figure 4.3**.

Figure 4.3 Gaseous fuel transport and distribution activities to State GSPs, 2020-21



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

Contribution of gas fired electricity generation

5

5.1 Gas fired electricity generation

The quantity of gas used to generate electricity in Australia is shown in **Figure 5.1**.

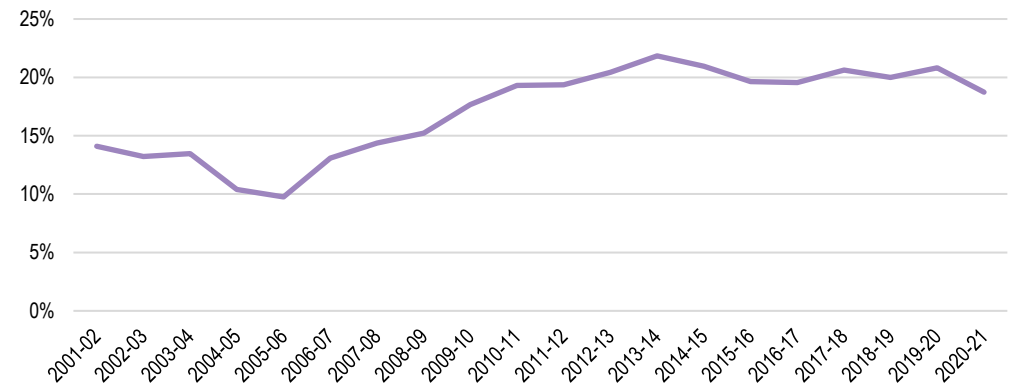
In 2020-21, nearly 523 PJ of natural gas was used to generate electricity in Australia. Nearly 34 per cent of natural gas (excluding LNG use) produced in Australia was consumed by the electricity generation sector in 2020-21.

Figure 5.1 Natural gas use in electricity generation, 2001-02 to 2020-21

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

The natural gas share in the electricity generation increased from 14 per cent in 2001-02 to 21 per cent in 2019-20 and 19 per cent in 2020-21 (**Figure 5.2**). On average around 20 per cent of electricity was generated from using natural gas over the past ten years in Australia. This would change as result of availability of more renewable energy in coming years.

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

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

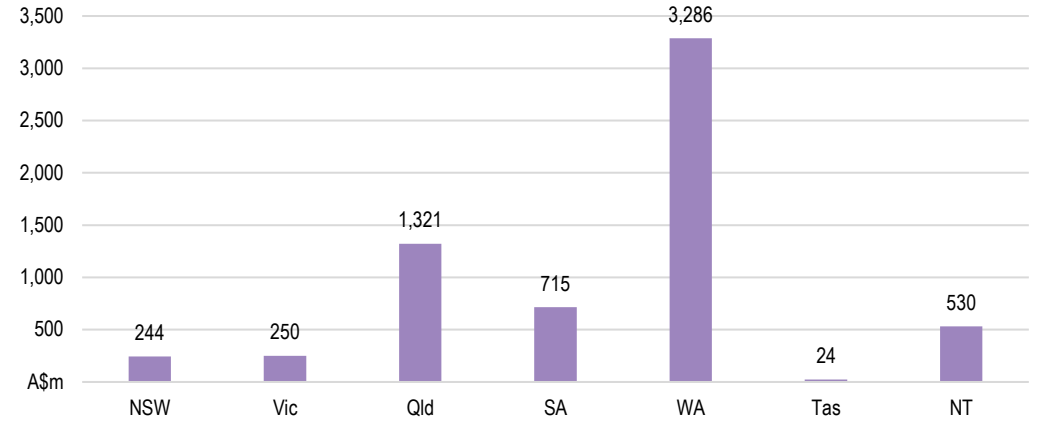
Figure 5.3 Australian electricity generation by natural gas, 2020-21

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 2020-21 was $6,371 million (**Figure 5.4**).

Figure 5.4 Revenue of gas fired electricity generation by state, 2020-21



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

The direct economic contribution or direct value-added of electricity generated from natural gas embodied within this revenue is estimated to have been **$1,871 million** (see **Figure 5.5**), mostly gross operating surplus and wages and salaries of employees.

Figure 5.5 Direct value-added of gas fired electricity generation by state, 2020-21

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

In 2020-21, Australian GDP was $2,067 billion, implying that the direct economic contribution of electricity generated from natural gas accounted for 0.09 per cent of Australia's 2020-21 GDP.

The estimated direct employment in the gas-fired electricity generation industry in 2020-21 was 3,321 FTE jobs.

5.3 Gas fired electricity generation: Indirect contribution

It is estimated that the Australian gas-fired electricity generation industry spent $4,500 million on gas, other goods and services in producing electricity in 2020-21. Of this it is estimated that $4,292 million was spent on domestically produced goods and services comprising:

- $1,948 million on gas
- $926 million on business, finance and insurance services
- $865 million on electricity transmission and distribution and marketing operations
- $596 million on other inputs and services.

It is estimated that the domestic spend of $4,292 million by the gas-fired electricity generation industry indirectly contributed $2,239 million to the Australian economy, which is 0.11 per cent of GDP in 2020-21. This is in addition to the direct contribution of 0.09 per cent.

It was estimated that 8,968 FTE jobs were indirectly supported by gas-fired electricity generation industry activities in the Australian economy.

5.4 Gas fired electricity generation: Total contribution

Adding the direct and indirect economic contributions from Sections 6.2 and 6.3 provides lower and upper bound estimates of the total economic footprint of the Australian gas-fired electricity generation industry in 2020-21.

5.4.1 Value- added

The estimated total (direct and indirect) value-added contribution from gas fired electricity generation by state is provided in **Table 5.1**.

Table 5.1 Total value-added contribution from gas fired electricity generation by state, 2020-21

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	128	115	243	0.04%
Vic.	49	240	289	0.06%
Qld	522	671	1,193	0.33%
SA	238	372	610	0.52%
WA	746	763	1,509	0.42%
Tas.	9	11	20	0.06%
NT	179	67	246	0.98%
ACT	0	0	0	0.00%
Australia	**1,871**	**2,239**	**4,110**	**0.20%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR.

5.4.2 Employment

The estimated total (direct and indirect) employment contribution from gas fired electricity generation by state is provided in **Table 5.2**.

Table 5.2 Total employment contribution from gas fired electricity generation by state, 2020-21

	Direct	Indirect	Total	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	
NSW	260	419	679	0.020%
Vic.	206	1,015	1,221	0.043%
Qld	627	2,515	3,142	0.149%
SA	598	1,384	1,982	0.284%
WA	1,384	3,338	4,721	0.417%
Tas.	23	38	61	0.030%

	Direct	Indirect	Total	Per cent of total employment
NT	224	259	483	0.411%
ACT	0	0	0	0.000%
Australia	**3,321**	**8,968**	**12,289**	**0.115%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR

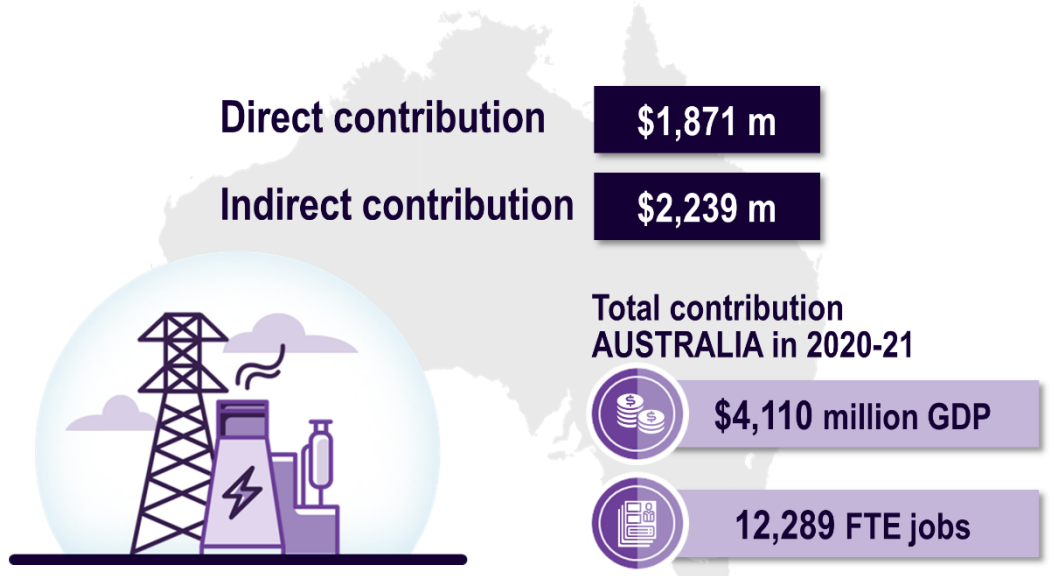
5.4.3 Australian economy

The total estimated economic contribution of the gas-fired electricity generation industry in 2020-21 is summarised in **Figure 5.6**. In 2020-21, it is estimated that gas-fired electricity generation in Australia resulted in:

— a *total* contribution of $4,110 million to Australian GDP, comprising $1,871 million directly from the industry (direct contribution) and $2,239 million indirectly from its input demand sources (indirect contribution). As a whole, the gas fired electricity generation industry contributed a minimum of 0.20 per cent to Australian GDP in 2020-21.

— a *total* employment contribution of 12,289 FTE jobs throughout Australia. To put this another way, for every one million dollars of revenue received by the Australian gas fired electricity generation industry, there are up to 1.9 FTE jobs that are supported elsewhere in the Australian economy.

Figure 5.6 Estimated contribution of gas fired electricity generation to Australian economy, 2020-21



Source: ACIL Allen estimates based on ABS and DISR

5.4.4 State economies

The total economic contribution of the gas fired electricity generation to state economies in 2020-21 is summarised in **Figure 5.7**.

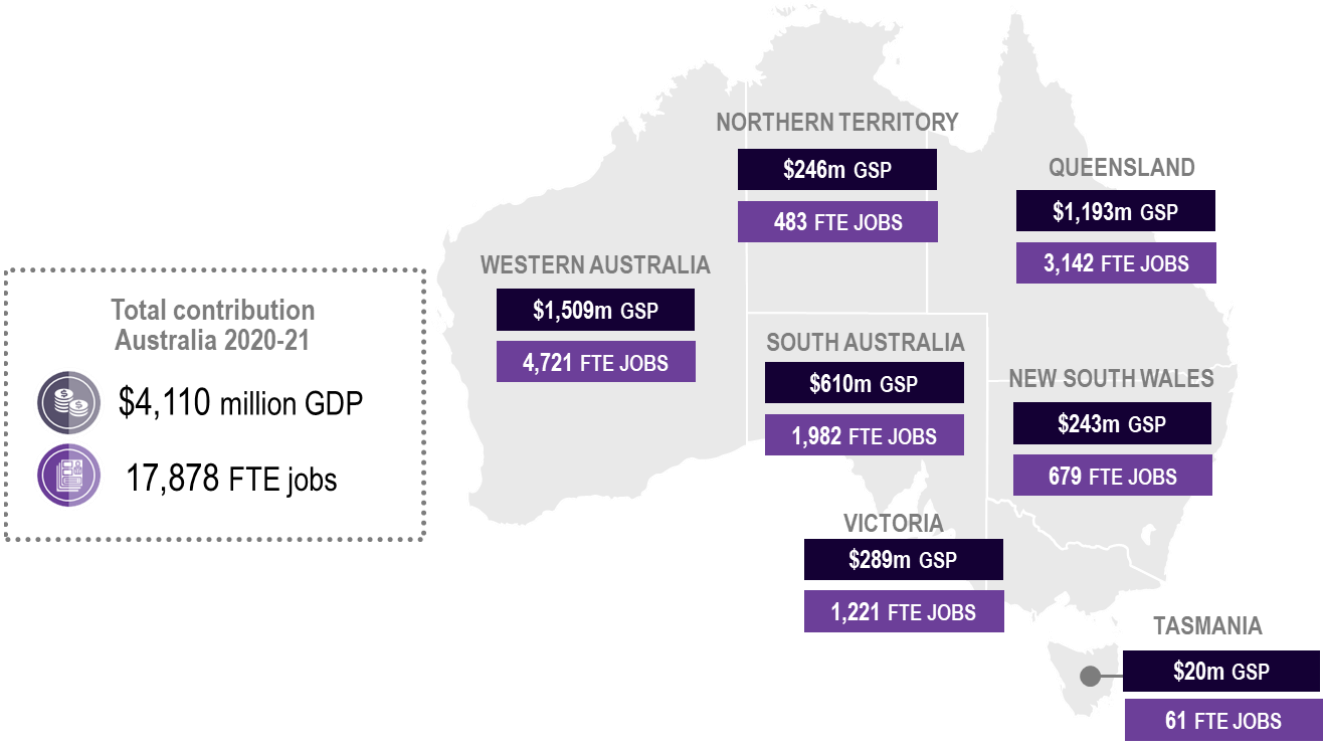
New South Wales

In 2020-21, it is estimated that gas fired electricity generation in New South Wales had:

— a *total* contribution of $243 million to New South Wales GSP, comprising $128 million directly from the gas fired electricity generation activities (direct value-added contribution) and $115 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.04 per cent to New South Wales GSP in 2020-21.

— a *total* employment contribution of 1,221 FTE jobs throughout Victoria. it is estimated that the total gas fired electricity generation activities in New South Wales supported up to 679 FTE jobs. To put this another way, for every one million dollars of revenue received by the New South Wales gas fired electricity generation, there are up to 2.8 FTE jobs that are supported elsewhere in the New South Wales economy.

Figure 5.7 Estimated contribution of gas fired electricity generation to state economies, 2020-21



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

Victoria

In 2020-21, it is estimated that gas fired electricity generation in Victoria had:

— a *total* contribution of $289 million to Victorian GSP, comprising $49 million directly from the gas fired electricity generation activities (direct value-added contribution) and $240 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.06 per cent to Victorian GSP in 2020-21.

— a *total* employment contribution of 1,221 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, there are up to 4.9 FTE jobs that are supported elsewhere in the Victorian economy.

Queensland

In 2020-21, it is estimated that gas fired electricity generation in Queensland had:

— a *total* contribution of $1,193 million to Queensland GSP, comprising $522 million directly from the gas fired electricity generation activities (direct value-added contribution) and $671 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.33 per cent to Queensland GSP in 2020-21.

— a *total* employment contribution of 3,142 FTE jobs throughout Queensland. To put this another way, for every one million dollars of revenue received by the Queensland gas fired electricity generation activities, there are up to 2.4 FTE jobs that are supported elsewhere in the Queensland economy.

South Australia

In 2020-21, it is estimated that gas fired electricity generation in South Australia had:

— a *total* contribution of $610 million to South Australia GSP, comprising $238 million directly from the gas fired electricity generation activities (direct value-added contribution) and $372 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.52 per cent to South Australia GSP in 2020-21.

— a *total* employment contribution of 1,982 FTE jobs throughout South Australia. To put this another way, for every one million dollars of revenue received by the South Australia gas fired electricity generation activities, there are up to 2.8 FTE jobs that are supported elsewhere in the South Australia economy.

Western Australia

In 2020-21, it is estimated that gas fired electricity generation in Western Australia had:

— a *total* contribution of $1,509 million to Western Australia's GSP, comprising $746 million directly from the gas fired electricity generation activities (direct value-added contribution) and $763 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.42 per cent to Western Australia's GSP in 2020-21.

— a *total* employment contribution of 4,721 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, there are up to 1.4 FTE jobs that are supported elsewhere in the Western Australia economy.

Tasmania

In 2020-21, it is estimated that gas fired electricity generation in Tasmania had:

— a *total* contribution of $20 million to Tasmanian GSP, comprising $9 million directly from the gas fired electricity generation activities (direct value-added contribution) and $11 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.06 per cent to Tasmanian GSP in 2020-21.

— 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, there are up to 2.6 FTE jobs that are supported elsewhere in the Tasmanian economy.

Northern Territory

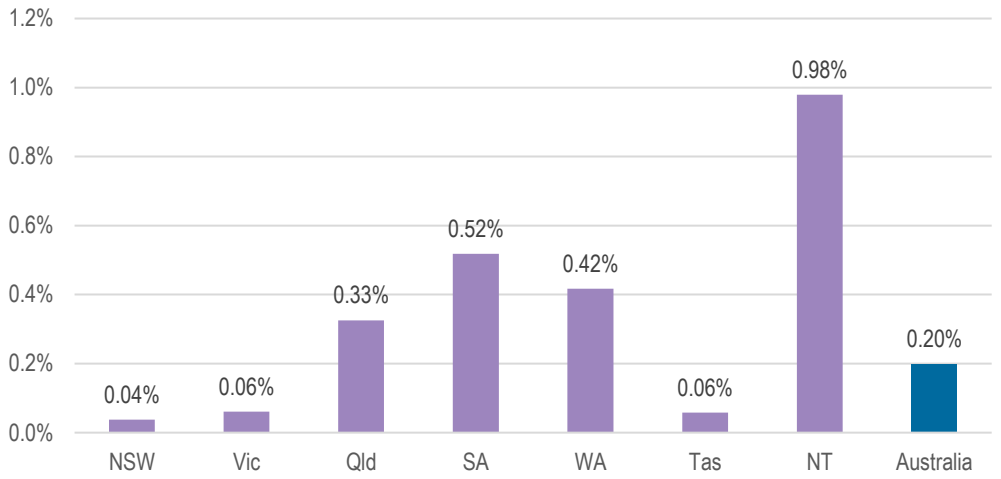
In 2020-21, it is estimated that gas fired electricity generation in the Northern Territory had:

— a *total* contribution of $246 million to the Northern Territory's GTP, comprising $179 million directly from the gas fired electricity generation activities (direct value-added contribution) and $67 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.98 per cent to Northern Territory's GTP in 2020-21.

— a *total* employment contribution of 483 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, there are up to 0.9 FTE jobs that are supported elsewhere in the Northern Territory economy.

A summary of gas fired electricity generation activities to state GSPs are provided in **Figure 4.3**.

Figure 5.8 Contribution of gas fired electricity generation to State GSPs, 2020-21



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.

Natural gas is consumed in two ways in the chemical industry — 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 describes the use of 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, 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 undergoes transformation in 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.

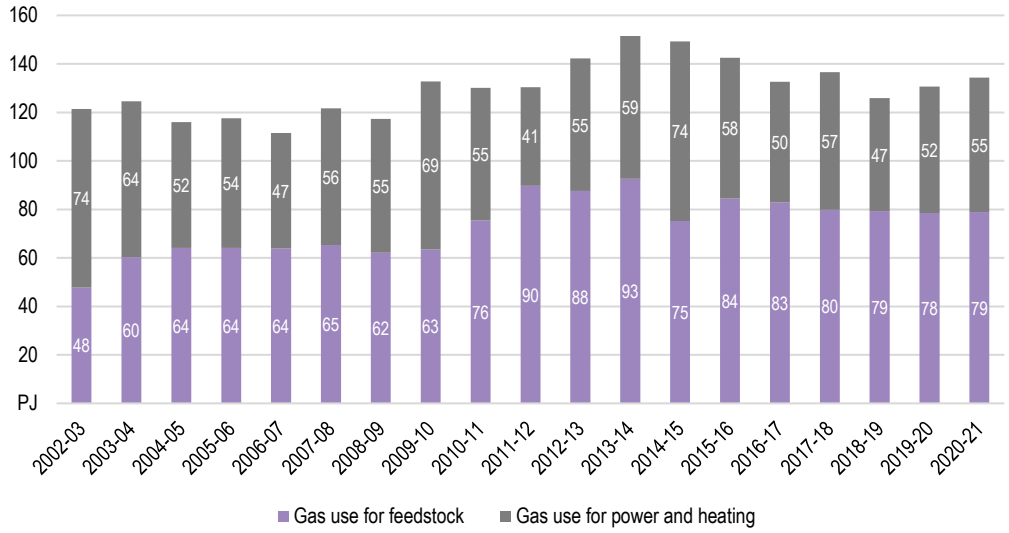
6.1 Gas use as feedstock

The chemical industry transforms hundreds of millions of tons of natural raw materials from earth, water and air into valuable products. It is an energy intensive sector, being the second largest user of energy in the manufacturing sector after petroleum and coal products in Australia. The chemical industry relies upon natural gas inputs not only as fuel and power for its operations, but also as raw materials in the manufacture of its many products.

Approximately 134 PJ of gas was used in the chemical industry in 2020-21, of which 55 PJ was used for fuel and power and 79 PJ for feedstock (**Figure 6.1**). Feedstock gas use in the total chemical industry constitutes just over 59 per cent of 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 chemical sector, 2002-03 to 2020-21



Note: 2020-21 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 DISER and have been sourced from the National Greenhouse Gas Inventory (NGGI).

Source: DISR (2021), Australian Energy Statistics 2019-20 and DISR 2022 Resources and Energy Quarterly, March 2022, and Australia's National Inventory submission 2020 CRF reporting tables. https://unfccc.int/documents/478998

In theory, there are a wide range of alternative energy sources for the purpose of generating power or heat. Consequently, it is possible that gas used for the purposes of power or heat could be substitutable with non-gas energy sources (such as electricity, for example), depending on the economics. An exception may be specific uses by certain manufacturing sectors (or indeed, any other sector of the economy) which require certain heat properties (particularly high temperature heat) that aren't easily obtained from non-gaseous fuels. Chapter 7 analyses the economic contribution of selected activities, but in the absence of information regarding the technical feasibility of substituting gas used for power or heat for non-gaseous fuels, this study has been conservative and assumed that usage of gas for power or heat by any other consumer is not essential and is not included in the estimates of the gas economy.

In contrast to gas used for heat, 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 chemistry of plastics, fertilisers and thousands of other products, with these activities deemed to be 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 purposes.

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 2020-21 was $11,426 million (**Figure 6.2**).

Figure 6.2 Revenue of gas-feedstock chemical sector by state, 2020-21

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

The direct economic contribution or direct value-added of chemicals from natural gas embodied within this revenue is estimated to have been $3,409 million (see **Figure 6.3**), mostly gross operating surplus and wages and salaries of employees.

In 2020-21, Australian GDP was $2,067 billion, implying that the direct economic contribution of gas-feedstock chemical sector accounted for 0.165 per cent of Australia's 2020-21 GDP.

The estimated direct employment in the gas-feedstock chemical sector in 2020-21 was 10,046 FTE jobs.

Figure 6.3 Direct value-added of gas-feedstock chemical sector by state, 2020-21

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

6.3 Gas feedstock chemicals: Indirect contribution

It is estimated that the Australian gas-feedstock chemical sector spent $8,017 million on goods and services in producing various chemicals in 2020-21. Of this it is estimated that $6,421 million was spent on domestically produced goods and services comprising:

— $1,697 million on gas

— $756 million transport

— $751 million on business, finance and insurance services

— $589 million wholesale and retail trade

— $206 million on electricity transmission and distribution and marketing operations

— $53 million on other inputs and services.

It is estimated that the domestic spend of $6,421 million by the gas-feedstock chemical sector indirectly contributed $4,342 million to the Australian economy, which is 0.21 per cent of GDP in 2020-21. This is in addition to the direct contribution of 0.165 per cent.

It was estimated that between 23,028 FTE jobs were indirectly supported by gas-feedstock chemical sector activities in the Australian economy.

6.4 Gas feedstock chemicals: Total contribution

Adding the direct and indirect economic contributions from Sections 6.2 and 6.3 provides total economic footprint of the Australian gas-feedstock chemical sector in 2020-21.

6.4.1 Value- added

The estimated total (direct and indirect) value-added contribution from gas-feedstock chemical sector by state is provided in **Table 6.1**.

Table 6.1 Total value-added contribution of gas-feedstock chemical sector by state, 2020-21

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	781	895	1,676	0.26%
Vic.	608	784	1,392	0.29%
Qld	1,088	1,435	2,523	0.69%
SA	138	164	302	0.26%
WA	707	989	1,696	0.47%
Tas.	54	55	109	0.31%
NT	30	19	49	0.20%
ACT	2	1	3	0.01%
Australia	**3,409**	**4,342**	**7,751**	**0.37%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR.

6.4.2 Employment

The estimated total (direct and indirect) employment contribution from gas-feedstock chemical sector by state is provided in **Table 6.2**.

Table 6.2 Total employment contribution from gas-feedstock chemical sector by state, 2020-21

	Direct	Indirect	Total	Per cent of total employment
	FTE jobs	FTE jobs	FTE jobs	
NSW	2,300	4,835	7,135	0.207%
Vic.	1,823	4,566	6,389	0.227%

	Direct	Indirect	Total	Per cent of total employment
Qld	3,382	7,610	10,991	0.521%
SA	339	913	1,252	0.179%
WA	2,002	4,730	6,732	0.594%
Tas.	134	297	430	0.213%
NT	62	73	135	0.114%
ACT	5	5	10	0.005%
Australia	**10,046**	**23,028**	**33,074**	**0.308%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

Source: ACIL Allen estimates based on ABS and DISR.

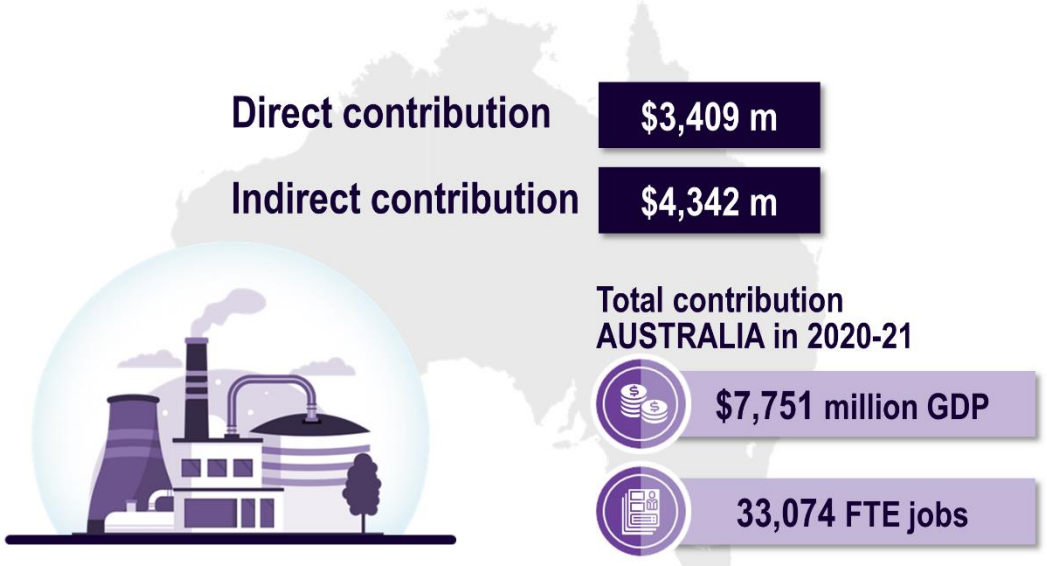
6.4.3 Australian economy

The total estimated economic contribution of the gas-feedstock chemical sector in 2020-21 is summarised in **Figure 6.4**. In 2020-21, it is estimated that the gas-feedstock chemical sector in Australia resulted in:

— a *total* contribution of $7,751 million to Australian GDP, comprising $3,409 million directly from the industry (direct contribution) and $4,342 million indirectly from its input demand sources (indirect contribution). As a whole, the gas-feedstock chemical sector contributed a minimum of 0.37 per cent to Australian GDP in 2020-21.

— it is estimated that the gas-feedstock chemical sector in Australia supported up to 33,074 FTE jobs in 2020-21. To put this another way, for every one million dollars of revenue received by the Australian gas-feedstock chemical sector, there are up to 2.9 FTE jobs that are supported elsewhere in the Australian economy.

Figure 6.4 Estimated contribution of gas-feedstock chemical sector to Australian economy, 2020-21

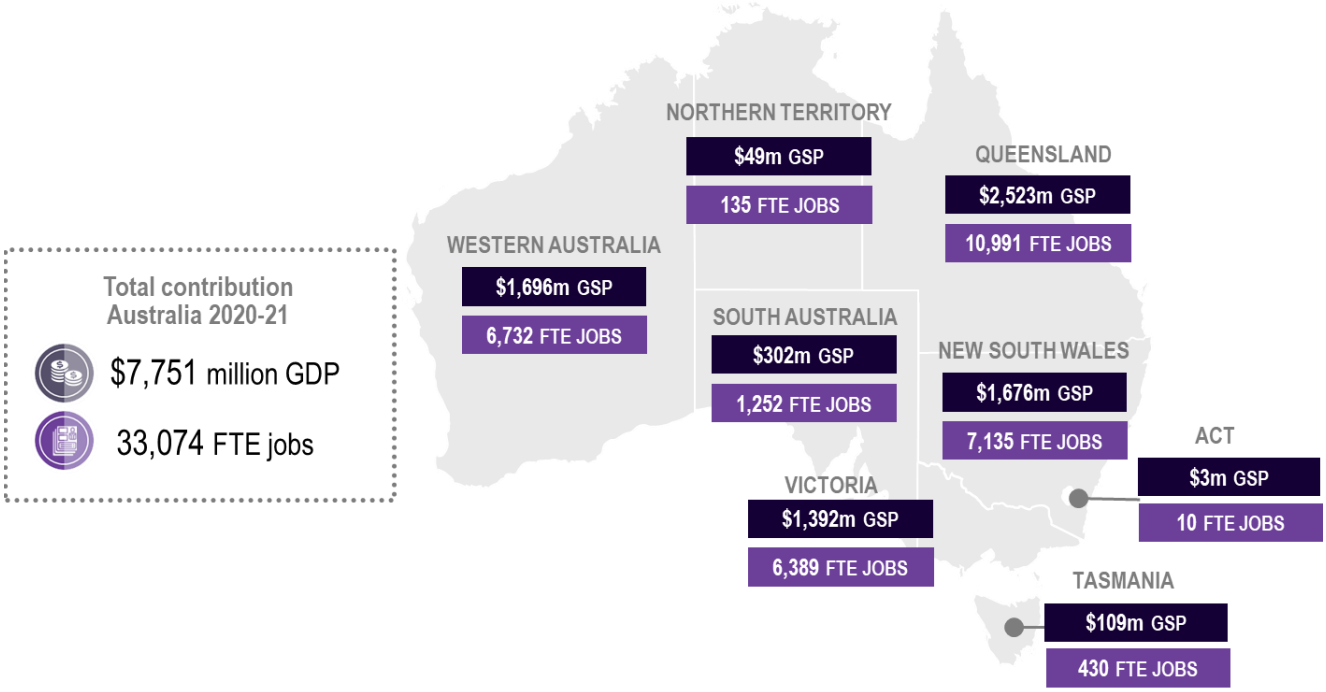


Source: ACIL Allen estimates based on ABS and DISR

6.4.4 State economies

The economic contribution of the total gas-feedstock chemical sector to state economies in 2020-21 is summarised in **Figure 6.5**.

Figure 6.5 Estimated contribution of gas-feedstock chemical sector to state economies, 2020-21



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

New South Wales

In 2020-21, it is estimated that the total gas-feedstock chemical sector in New South Wales had:

- a *total* contribution of $1,676 million to New South Wales GSP, comprising $781 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $895 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.26 per cent to New South Wales GSP in 2020-21.
- it is estimated that the total gas-feedstock chemical sector activities in New South Wales supported up to 7,135 FTE jobs. To put this another way, for every one million dollars of revenue received by the New South Wales gas-feedstock chemical sector, there are up to 2.9 FTE jobs that are supported elsewhere in the New South Wales economy.

Victoria

In 2020-21, it is estimated that the total gas-feedstock chemical sector in Victoria had:

- a *total* contribution of $1,392 million to Victorian GSP, comprising $608 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $784 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.29 per cent to Victorian GSP in 2020-21.
- it is estimated that the total gas-feedstock chemical sector in Victoria supported up to 6,389 FTE jobs. To put this another way, for every one million dollars of revenue received by the Victorian gas-feedstock chemical sector activities, there are up to 3.2 FTE jobs that are supported elsewhere in the Victorian economy.

Queensland

In 2020-21, it is estimated that the total gas-feedstock chemical sector in Queensland had:

— a *total* contribution of $2,523 million to Queensland GSP, comprising $1,088 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $1,435 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.69 per cent to Queensland GSP in 2020-21.

— it is estimated that the total gas-feedstock chemical sector in Queensland supported up to 10,991 FTE jobs. To put this another way, for every one million dollars of revenue received by the Queensland gas-feedstock chemical sector, there are up to 3 FTE jobs that are supported elsewhere in the Queensland economy.

South Australia

In 2020-21, it is estimated that the total gas-feedstock chemical sector in South Australia had:

— a *total* contribution of $302 million to South Australia GSP, comprising $138 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $164 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.26 per cent to South Australia GSP in 2020-21.

— it is estimated that the total gas-feedstock chemical sector in South Australia supported up to 1,252 FTE jobs. To put this another way, for every one million dollars of revenue received by the South Australia gas-feedstock chemical sector activities, there are up to 2.7 FTE jobs that are supported elsewhere in the South Australia economy.

Western Australia

In 2020-21, it is estimated that the total gas gas-feedstock chemical sector in Western Australia had:

— a *total* contribution of $1,696 million to Western Australia's GSP, comprising $707 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $989 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.47 per cent to Western Australia's GSP in 2020-21.

— it is estimated that the total gas-feedstock chemical sector in Western Australia supported up to 6,732 FTE jobs. To put this another way, for every one million dollars of revenue received by the Western Australia gas-feedstock chemical sector activities, there are up to 2.7 FTE jobs that are supported elsewhere in the Western Australia economy.

Tasmania

In 2020-21, it is estimated that the total gas-feedstock chemical sector in Tasmania had:

— a *total* contribution of $109 million to Tasmanian GSP, comprising $54 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $55 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.31 per cent to Tasmanian GSP in 2020-21.

— it is estimated that the total gas-feedstock chemical sector in Tasmania supported up to 430 FTE jobs. To put this another way, for every one million dollars of revenue received by the Tasmanian gas-feedstock chemical sector activities, there are up to 2.3 FTE jobs that are supported elsewhere in the Tasmanian economy.

Northern Territory

In 2020-21, it is estimated that the total gas-feedstock chemical sector in the Northern Territory had:

— a *total* contribution of $49 million to Northern Territory's GTP, comprising $30 million directly from the gas-feedstock chemical sector activities (direct value-added contribution) and $19 million indirectly from its input demand sources (indirect contribution). As a whole, it contributed a minimum of 0.20 per cent to Northern Territory's GTP in 2020-21.

— it is estimated that the total gas-feedstock chemical sector in the Northern Territory supported up to 135 FTE jobs. To put this another way, for every one million dollars of revenue received by the Northern Territory gas-feedstock chemical sector activities, there are up to 1.6 FTE jobs that are supported elsewhere in the Northern Territory economy.

Australian Capital Territory

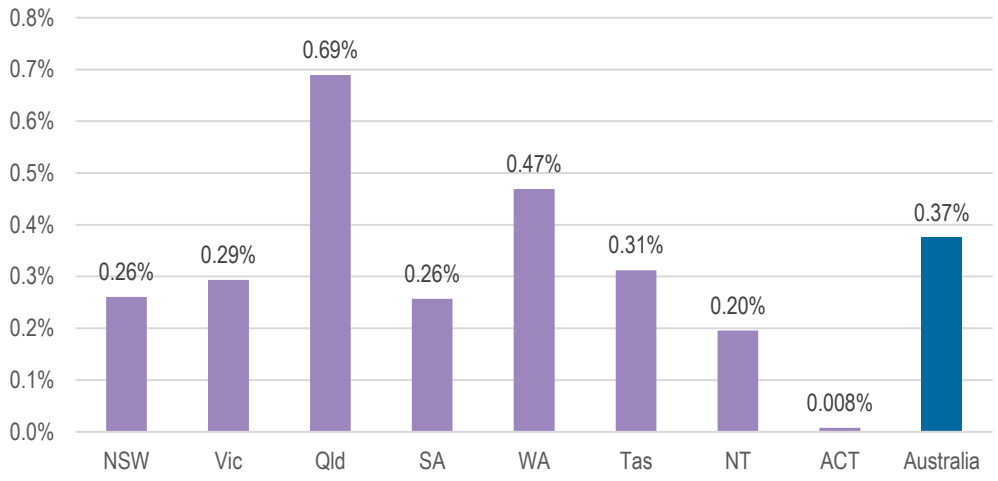
In 2020-21, it is estimated that the total gas-feedstock chemical sector in the ACT had:

— 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). As a whole, it contributed a minimum of 0.008 per cent to ACT GTP in 2020-21.

— it is estimated that the total gas-feedstock chemical sector in the ACT supported up to 10 FTE jobs. To put this another way, for every one million dollars of revenue received by the ACT gas-feedstock chemical sector activities, there are up to 1.5 FTE jobs that are supported elsewhere in the ACT economy.

A summary of gas-feedstock chemical sector to state GSPs are provided in **Figure 6.6**.

Figure 6.6 Contribution of gas-feedstock chemical sector to State GSPs, 2020-21



Source: ACIL Allen estimates based on ABS and DISR

Contribution of high temperature gas-based manufacturing 7

There are a range of manufacturing processes that require gaseous fuels for the purpose of obtaining high temperatures (>800°C). For the purpose of this analysis, the economic contributions of three key sub-sectors within the manufacturing sector have been analysed:

— 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 made 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 to smelt 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 main aluminium-containing ore, using the Bayer process involves two major energy-intensive process steps. The first process step involves the digestion of bauxite in a sodium hydroxide solution to produce aluminium hydroxide. This process step 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 required 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 the combustion of natural gas or coal. 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 energy efficiency of the refinery. The theoretical minimum is approximately 1.3 GJ/t.[10] This equates to around 27 PJ of gas use for heating in Alumina refining in 2020-21.

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 estimates of the gas economy in Chapters 3 and 4. Similarly, to prevent double counting of the economic contribution of gas-fired electricity (see Chapter 5), it has been assumed that all electricity used for alumina production is essentially sourced from gas-fired electricity.

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

The total estimated production of alumina in 2020-21 was 20.8MT valued at around $9.3 billion. Two states produce alumina — Western Australia and Queensland. The direct economic

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

contribution or direct value-added of alumina from natural gas embodied within this revenue is estimated to have been $1,870 million ($1,332 million in Western Australia and $538 million in Queensland).

The sector directly employed 8,660 FTEs in 2020-21.

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

It is estimated that the Australian alumina sector spent $558 million on goods and services (excluding natural gas and electricity) from Australia in producing alumina in 2020-21. It is estimated that the domestic spend of $558 million indirectly contributed $435 million to the Australian economy.

It was estimated that 1,954 FTE jobs were indirectly supported by the alumina production sector in the Australian economy.

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 2020-21, and are provided in **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, 2020-21

	Direct	Indirect	Total	Total (%GSP)
Value-added	A$m	A$m	A$m	%
Qld	538	365	903	0.25%
WA	1,332	70	1,402	0.39%
Australia	1,870	435	2,306	0.11%
Employment	FTE	FTE	FTE	%
Qld	2,862	1,667	4,529	0.21%
WA	5,798	287	6,085	0.54%
Australia	**8,660**	**1,954**	**10,613**	**0.10%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates 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.[11] Brick firing often occurs in long tunnel kilns through which bricks are moved steadily over 40 to 70 hours. The bricks are heated to a maximum temperature of 1040°C but both heating and cooling must occur slowly to avoid damaging the bricks. There may some alternative fuels available for bricks and ceramics manufacturing. Bricks and ceramics used around 15 PJ of gas in 2020-21.

[11] 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

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

The total estimated production of bricks and ceramics was valued at around $1,574 million in 2020-21. The direct economic contribution or direct value-added of bricks and ceramics from natural gas embodied within this revenue is estimated to have been $892 million.

The sector directly employed 3,275 FTEs in 2020-21.

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

It is estimated that the Australian bricks and ceramics sector spent $521 million on goods and services (excluding gas and electricity) from Australia in producing bricks and ceramics in 2020-21. It is estimated that the domestic spend of $521 million indirectly contributed $447 million to the Australian economy.

It was estimated that 2,648 FTE jobs were indirectly supported by the bricks and ceramics production sector in the Australian economy.

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 2020-21 (see **Table 7.2**).

Table 7.2 Total value-added contribution of gas-based high heat bricks and ceramics sector by state, 2020-21

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	284	114	399	0.062%
Vic.	189	73	262	0.055%
Qld	97	53	150	0.041%
SA	45	16	62	0.052%
WA	262	185	446	0.123%
Tas.	13	5	18	0.053%
NT	0	0	0	0.000%
ACT	1	0	2	0.004%
Australia	**892**	**447**	**1,339**	**0.065%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates 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 bricks and ceramics sector's high heat gas use contribution in 2020-21 (see **Table 7.3**).

Table 7.3 Total value-added contribution of gas-based high heat bricks and ceramics sector by state, 2020-21

	Direct	Indirect	Total	Total (%employment)
	FTE	FTE	FTE	%

	Direct	Indirect	Total	Total (%employment)
NSW	1,176	690	1,866	0.054%
Vic.	578	502	1,081	0.038%
Qld	361	321	682	0.032%
SA	146	115	261	0.037%
WA	951	985	1,936	0.171%
Tas.	55	35	90	0.045%
NT	0	0	0	0.000%
ACT	7	1	9	0.004%
Australia	**3,275**	**2,648**	**5,923**	**0.055%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

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

7.3 Glass and glass products

Glass and glass products used around 9 PJ of gas in 2020-21. 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, which contributes 5-20 per cent of the heat.[12]

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

The total estimated production of glass and glass products was valued at around $1,903 million in 2020-21. The direct economic contribution or direct value-added of glass and glass products from natural gas embodied within this revenue is estimated to have been $876 million.

The sector directly employed 4,299 FTEs in 2020-21.

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

It is estimated that the Australian glass and glass products sector spent $706 million on goods and services (excluding gas and electricity) from Australia in producing glass and glass products in 2020-21. It is estimated that the domestic spend of $706 million indirectly contributed $619 million to the Australian economy.

It was estimated that 3.370 FTE jobs were indirectly supported by the glass and glass products production sector in the Australian economy.

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 2020-21 (see **Table 7.4**).

[12] 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 7.4 Total value-added contribution of gas-based high heat glass and glass products sector by state, 2020-21

	Direct	Indirect	Total	Total (%GSP)
	A$m	A$m	A$m	%
NSW	286	180	466	0.072%
Vic.	232	167	399	0.084%
Qld	184	147	331	0.090%
SA	67	43	111	0.094%
WA	69	67	136	0.038%
Tas.	9	5	15	0.042%
NT	21	8	29	0.114%
ACT	8	2	10	0.022%
Australia	876	619	1,495	0.072%

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates 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 2020-21 (see **Table 7.5**).

Table 7.5 Total value-added contribution of gas-based high heat glass and glass products sector by state, 2020-21

	Direct	Indirect	Total	Total (%employment)
	FTE	FTE	FTE	%
NSW	1,538	946	2,484	0.072%
Vic.	993	998	1,991	0.071%
Qld	917	774	1,691	0.080%
SA	300	269	569	0.082%
WA	338	310	647	0.057%
Tas.	51	32	83	0.041%
NT	110	31	140	0.119%
ACT	52	11	63	0.032%
Australia	4,299	3,370	7,669	0.071%

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity.

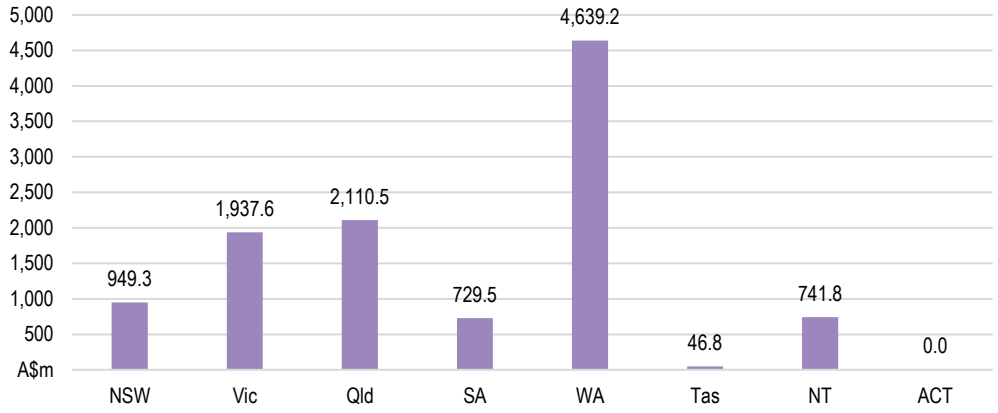
Source: ACIL Allen estimates based on ABS, ARENA 2019 and DISR.

8 Contribution of capital expenditure

8.1 Capital expenditure: Direct contribution

The total estimated gas appliances and gas related capital expenditures in 2020-21 was $11,155 million (**Figure 8.1**). This investment primarily occurred in Western Australia ($4.6 billion) and Queensland ($2.1 billion), two major gas producing states.

Figure 8.1 Capital expenditure by state, 2020-21



Source: AEAS 2022., Table 11, Page 15.

8.2 Capital expenditure: Indirect contribution

It is estimated that of $11,155 million of capital investment was spent on appliances, machinery and services in 2020-21. Of this it is estimated that $5,798 million was spent on domestically produced appliances, machinery and services comprising:

- $2,747 million on wholesale and retail trade
- $1,778 million appliances, machinery and equipment
- $1,192 million on mining exploration and geological services
- $81 million on other inputs and services.

It is estimated that the domestic capital expenditure of $5,798 million by the gas sector indirectly contributed $4,978 million to the Australian economy, which is 0.24 per cent of GDP in 2020-21.

It was estimated that 26,285 FTE jobs were indirectly supported in the Australian economy by capital expenditure by the gas sector.

8.3 Capital expenditure: Total contribution

The estimated total (indirect) value-added and employment contribution from capital expenditure by state is provided in **Table 8.1**. There is no direct value-added contribution of capital expenses.

Table 8.1 Total value-added contribution of capital expenditure by state, 2020-21

	Value-added		Employment	
	Total	Total (%GSP)	Total	Total (%)
	A$m	%	FTE jobs	%
NSW/ACT	364	0.06%	2,092	0.061%
Vic.	846	0.18%	5,214	0.185%
Qld	1,010	0.28%	5,289	0.251%
SA	341	0.29%	2,056	0.295%
WA	2,123	0.59%	10,627	0.938%
Tas.	15	0.04%	89	0.044%
NT	280	1.11%	918	0.779%
Australia	**4,978**	**0.24%**	**26,285**	**0.245%**

Note: Indirect economic activity due to interstate trade has been included in the regional contribution estimates based on their share of underlying activity. ACT capital expenditure not separately identified in the AEAS report.

Source: ACIL Allen estimates based on AEAS.

8.3.1 Australian economy

In 2020-21, it is estimated that gas-related capital expenditure in Australia resulted in:

- a *total* contribution of $4,978 million to Australian GDP. As a whole, the capital expenditure contributed a minimum of 0.24 per cent to Australian GDP in 2020-21.
- It is estimated that the capital expenditure supported up to 26,285 FTE jobs in 2020-21. To put this another way, for every one million dollars of capital expenditure spend, there are up to 2.4 FTE jobs that are supported elsewhere in the Australian economy.

8.3.2 State economies

The economic contribution of gas-related capital expenditure to state economies in 2020-21 is summarised below.

New South Wales

In 2020-21, it is estimated that gas-related capital expenditure in New South Wales had:

- a *total* contribution of $364 million indirectly from its input demand sources. As a whole, it contributed a minimum of 0.06 per cent to New South Wales GSP in 2020-21.
- it is estimated that the capital expenditure activities in New South Wales supported up to 2,092 FTE jobs. To put this another way, for every one million dollars of capital expenditure spend in New South Wales, there are up to 2.2 FTE jobs that are supported elsewhere in the New South Wales economy.

Victoria

In 2020-21, it is estimated that gas-related capital expenditure in Victoria had:

- a *total* contribution of $846 million indirectly from its input demand sources. As a whole, it contributed a minimum of 0.18 per cent to Vic GSP in 2020-21.

— it is estimated that the capital expenditure activities in Victoria supported up to 5,214 FTE jobs. To put this another way, for every one million dollars of capital expenditure spend in Victoria, there are up to 2.7 FTE jobs that are supported elsewhere in the Victorian economy.

Queensland

In 2020-21, it is estimated that gas-related capital expenditure in Queensland had:

— a *total* contribution of $1,010 million indirectly from its input demand sources. As a whole, it contributed a minimum of 0.28 per cent to Queensland GSP in 2020-21.

— it is estimated that the capital expenditure activities in Queensland supported up to 5,289 FTE jobs. To put this another way, for every one million dollars of capital expenditure spend in Queensland, there are up to 2.5 FTE jobs that are supported elsewhere in the Queensland economy.

South Australia

In 2020-21, it is estimated that gas-related capital expenditure in South Australia had:

— a *total* contribution of $341 million indirectly from its input demand sources. As a whole, it contributed a minimum of 0.29 per cent to South Australia GSP in 2020-21.

— it is estimated that the capital expenditure activities in South Australia supported up to 2,056 FTE jobs. To put this another way, for every one million dollars of capital expenditure spend in South Australia, there are up to 2.8 FTE jobs that are supported elsewhere in the South Australia economy.

Western Australia

In 2020-21, it is estimated that gas-related capital expenditure in Western Australia had:

— a *total* contribution of $2,123 million indirectly from its input demand sources. As a whole, it contributed a minimum of 0.59 per cent to Western Australia's GSP in 2020-21.

— it is estimated that the capital expenditure activities in Western Australia supported up to 10,627 FTE jobs. To put this another way, for every one million dollars of capital expenditure spend in Western Australia, there are up to 2.3 FTE jobs that are supported elsewhere in the Western Australia economy.

Tasmania

In 2020-21, it is estimated that gas-related capital expenditure in Tasmania had:

— a *total* contribution of $15 million indirectly from its input demand sources. As a whole, it contributed a minimum of 0.04 per cent to Tasmanian GSP in 2020-21.

— it is estimated that the capital expenditure activities in Western Australia supported up to 89 FTE jobs. To put this another way, for every one million dollars of capital expenditure spend in Tasmania, there are up to 1.9 FTE jobs that are supported elsewhere in the Tasmania economy.

Northern Territory

In 2020-21, it is estimated that gas-related capital expenditure in the Northern Territory had:

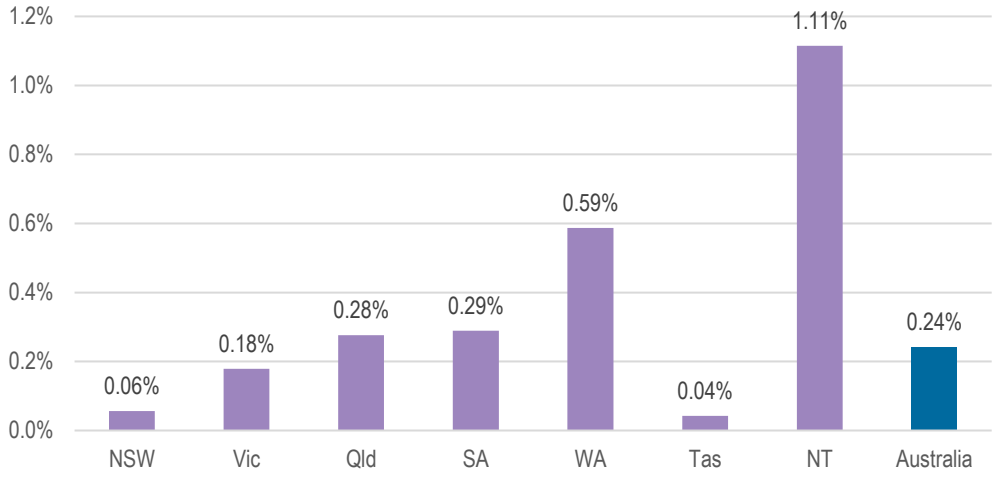
— a *total* contribution of $280 million indirectly from its input demand sources. As a whole, it contributed a minimum of 1.11 per cent to Northern Territory's GTP in 2020-21.

— it is estimated that the capital expenditure activities in the Northern Territory supported up to 918 FTE jobs. To put this another way, for every one million dollars of capital expenditure

spend in NT, there are up to 1.2 FTE jobs that are supported elsewhere in the Northern Territory economy.

A summary of capital expenditure to state GSPs are provided in **Figure 8.2**.

Figure 8.2 Contribution of capital expenditure to State GSPs, 2020-21



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

Source: ACIL Allen estimates based on ABS and DISR

Economic contribution of the Australian gas economy

9

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 2020-21, the Australian gas economy contributed at least $70 billion to Australian GDP and 241,646 FTE jobs (equivalent to 3.39% and 2.25%, respectively).

9.1 Gas production

A summary of the estimated total (direct and indirect) economic and employment contributions of gaseous fuel production is provided in **Table 9.1**. Over 57 per cent of the estimated gas economy was associated with the production of gaseous fuels in Australia in 2020-21. It is estimated that production of gaseous fuels contributed nearly 2 per cent of Australia's GDP and over 1 per cent of employment in 2020-21.

Table 9.1 Total contribution of production of gases, 2020-21

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	12	0.00%	28	0.00%
Vic.	1,236	0.26%	2,568	0.09%
Qld	14,036	3.83%	43,301	2.05%
SA	306	0.26%	547	0.08%
WA	21,547	5.96%	54,887	4.84%
Tas.	0	0.00%	1	0.00%
NT	2,891	11.53%	7,953	6.76%
ACT	0	0.00%	2	0.00%
Australia	**40,028**	**1.94%**	**109,284**	**1.02%**

Source: ACIL Allen estimates based on various sources.

9.2 Gas transport and distribution

A summary of the estimated total (direct and indirect) economic and employment contributions of transport and distribution of gaseous fuels is provided in **Table 9.2**. About 11.6 per cent of the estimated gas economy was from transport and distribution of gaseous fuels in the economy in 2020-21. It is estimated that the transport and distribution of gaseous fuels contributed nearly 0.39 per cent of Australia's GDP and about 0.34 per cent of employment in 2020-21.

Table 9.2 Total contribution of transport and distribution of gaseous fuels, 2020-21

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	954	0.15%	5,519	0.16%
Vic.	1,659	0.35%	9,090	0.32%
Qld	1,593	0.43%	7,247	0.34%
SA	559	0.47%	2,613	0.37%
WA	2,848	0.79%	10,027	0.88%
Tas.	70	0.20%	398	0.20%
NT	401	1.60%	1,494	1.27%
ACT	33	0.07%	120	0.06%
Australia	**8,117**	**0.39%**	**36,508**	**0.34%**

Source: ACIL Allen estimates based on various sources.

9.3 Gas fired electricity generation

A summary of the estimated total (direct and indirect) economic and employment contributions of gas fired electricity generation is provided in **Table 9.3**. About 5.9 per cent of the gas economy was contributed by gas fired electricity generation in 2020-21. Gas fired electricity generation contributed 0.20 per cent of Australia's GDP and 0.11 per cent of employment in 2020-21.

Table 9.3 Total contribution of gas fired electricity generation, 2020-21

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	243	0.04%	679	0.02%
Vic.	289	0.06%	1,221	0.04%
Qld	1,193	0.33%	3,142	0.15%
SA	610	0.52%	1,982	0.28%
WA	1,509	0.42%	4,721	0.42%
Tas.	20	0.06%	61	0.03%
NT	246	0.98%	483	0.41%
Australia	**4,110**	**0.20%**	**12,289**	**0.11%**

Source: ACIL Allen estimates based on various sources

9.4 Gas feedstock chemicals

A summary of the estimated total (direct and indirect) economic and employment contributions of gas feedstock chemical is provided in **Table 9.4**. About 11.1 per cent of the estimated gas economy was contributed by gas feedstock chemicals in 2020-21. Gas feedstock chemicals contributed 0.37 per cent of Australia's GDP and 0.31 per cent of employment in 2020-21.

Table 9.4 Total contribution of gas feedstock chemicals, 2020-21

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	1,676	0.26%	7,135	0.21%
Vic.	1,392	0.29%	6,389	0.23%
Qld	2,523	0.69%	10,991	0.52%
SA	302	0.26%	1,252	0.18%
WA	1,696	0.47%	6,732	0.59%
Tas.	109	0.31%	430	0.21%
NT	49	0.20%	135	0.11%
ACT	3	0.01%	10	0.01%
Australia	**7,751**	**0.37%**	**33,074**	**0.31%**

Source: ACIL Allen estimates based on various sources

9.5 High temperature gas-based manufacturing

This estimate includes the contribution of selected manufacturing activities that are dependent on gaseous fuels for high temperature (>800°C) processes. A summary of the estimated total (direct and indirect) economic and employment contributions of gas industrial process high heat is provided in **Table 9.5**. About 7.3 per cent of the gas economy was contributed by gaseous fuels for high temperature industrial processes. Gas-based industrial process heat contributed 0.25 per cent of Australia's GDP and 0.23 per cent of employment in 2020-21.

Table 9.5 Total contribution of high temperature gas-based manufacturing, 2020-21

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	864	0.13%	4,350	0.13%
Vic.	661	0.14%	3,072	0.11%
Qld	1,385	0.38%	6,901	0.33%
SA	172	0.15%	830	0.12%
WA	1,985	0.55%	8,668	0.76%
Tas.	33	0.09%	173	0.09%
NT	29	0.11%	140	0.12%
ACT	11	0.03%	71	0.04%
Australia	**5,140**	**0.25%**	**24,205**	**0.23%**

Source: ACIL Allen estimates based on various sources

9.6 Gas related capital expenditure

A summary of the estimated total (direct and indirect) economic and employment contributions of gas related capital expenditure is provided in **Table 9.6**. About 7.1 per cent of the estimated gas economy was contributed by gas related capital expenditure. Gas related capital expenditure contributed 0.24 per cent of Australia's GDP and 0.25 per cent of employment in 2020-21.

Table 9.6 Total contribution of gas related capital expenditure, 2020-21

State	Total value-added	% GSP/GDP	Total employment	% state/national employment
	A$m	%	FTE jobs	%
NSW	364	0.06%	2,092	0.06%
Vic.	846	0.18%	5,214	0.19%
Qld	1,010	0.28%	5,289	0.25%
SA	341	0.29%	2,056	0.29%
WA	2,123	0.59%	10,627	0.94%
Tas.	15	0.04%	89	0.04%
NT	280	1.11%	918	0.78%
ACT	0	0.00%	0	0.00%
Australia	**4,978**	**0.24%**	**26,285**	**0.25%**

Source: ACIL Allen estimates based on various sources

9.7 Total LPG economy

A summary of the estimated total (direct and indirect) economic and employment contributions of the LPG economy (production, and transport and distribution) is provided in **Table 9.7**. About 5.2 per cent of the total estimated Australian gas economy was contributed to by LPG. LPG contributed 0.18 per cent of Australia's GDP and 0.15 per cent of employment in 2020-21. This is a conservative estimate as it is limited to the contribution of LPG to the production, and transport and distribution of gaseous fuels and 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 9.7 Total economic contribution of the Australian LPG economy, by state, 2020-21

	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	288	197	485	0.08%	2,722	978	3,699	0.11%
Vic.	441	258	699	0.15%	3,072	1,326	4,398	0.16%
Qld	636	287	924	0.25%	2,366	1,329	3,696	0.18%
SA	125	62	187	0.16%	825	304	1,129	0.16%
WA	990	288	1,278	0.35%	1,523	1,183	2,705	0.24%
Tas.	35	13	47	0.14%	262	64	326	0.16%
NT	39	8	46	0.18%	119	24	143	0.12%
ACT	8	3	10	0.02%	50	10	59	0.03%
Australia	**2,561**	**1,116**	**3,677**	**0.18%**	**10,938**	**5,217**	**16,154**	**0.15%**

Source: ACIL Allen estimates based on various sources.

9.8 Total gas economy

9.8.1 Economic contribution

A summary of the total value-added contribution of the Australian gas economy by state is provided in **Table 9.8**.

Table 9.8 Total economic contribution of the Australian gas economy, by state, 2020-21

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	12	954	243	1,676	864	364	**4,113**	**0.64%**
Vic.	1,236	1,659	289	1,392	661	846	**6,083**	**1.28%**
Qld	14,036	1,593	1,193	2,523	1,385	1,010	**21,740**	**5.94%**
SA	306	559	610	302	172	341	**2,290**	**1.95%**
WA	21,547	2,848	1,509	1,696	1,985	2,123	**31,707**	**8.76%**
Tas.	0	70	20	109	33	15	**247**	**0.71%**
NT	2,891	401	246	49	29	280	**3,896**	**15.53%**
ACT	0	33	0	3	11	0	**48**	**0.11%**
Australia	**40,028**	**8,117**	**4,110**	**7,751**	**5,140**	**4,978**	**70,124**	**3.39%**

Note: Totals may not add due to rounding.

Source: ACIL Allen estimates based on various sources.

In total, it is estimated that the gas economy in Australia contributed at least $70 billion to the Australian economy, which is 3.39 per cent of GDP in 2020-21. Further, this year's estimate of economic contribution was impacted by the global pandemic and low gas prices which resulted in the estimated economic contribution being around 20-30 per cent lower than if the sector had not been affected by the pandemic. Nearly 76 per cent of the total value-added contribution comes from two major 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 (15.53 per cent), followed by Western Australia (8.76 per cent of GSP) and Queensland (5.94 per cent of GSP).

Table 9.9 Total economic contribution of the Australian gas economy, direct and indirect, 2020-21

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	%
Direct	20,724	4,603	1,871	3,409	3,638	–	34,246	1.66%
Indirect	19,304	3,514	2,239	4,342	1,502	4,978	35,879	1.74%
Australia	**40,028**	**8,117**	**4,110**	**7,751**	**5,140**	**4,978**	**70,124**	**3.39%**

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, 2020-21

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	26,613	15				ne	ne	ne
Natural gas	11,566	6,249	4,110	7,751*	5,140	ne	ne	ne
LPG	1,824	1,853				ne	ne	ne
CNG	26	0				ne	ne	ne
Hydrogen						ne	ne	ne
Australia	**40,028**	**8,117**	**4,110**	**7,751**	**5,140**	**4,978**	**70,124**	**3.39%**

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

A summary of employment within the gas economy by state is provided in **Table 9.11**.

It is estimated that, in 2020-21, the Australian gas economy contributed nearly 241,646 FTE jobs throughout the Australian economy, which was 2.25 per cent of total FTE jobs.

To put this another way, for every one million dollars of gas related activities in the Australian economy, there are up to 2.9 FTE jobs that are supported elsewhere in the Australian economy.

Table 9.11 Total employment contribution of the Australian gas economy, by state, 2020-21

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	28	5,519	679	7,135	4,350	2,092	**19,803**	**0.57%**
Vic.	2,568	9,090	1,221	6,389	3,072	5,214	**27,553**	**0.98%**
Qld	43,301	7,247	3,142	10,991	6,901	5,289	**76,871**	**3.64%**
SA	547	2,613	1,982	1,252	830	2,056	**9,280**	**1.33%**
WA	54,887	10,027	4,721	6,732	8,668	10,627	**95,662**	**8.44%**
Tas.	1	398	61	430	173	89	**1,152**	**0.57%**
NT	7,953	1,494	483	135	140	918	**11,123**	**9.45%**
ACT	2	120	0	10	71	0	**203**	**0.10%**
Australia	**109,284**	**36,508**	**12,289**	**33,074**	**24,205**	**26,285**	**241,646**	**2.25%**

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, 2020-21

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	16,656	19,577	3,321	10,046	16,233		**65,835**	**0.61%**
Indirect	92,628	16,931	8,968	23,028	7,972	26,285	**175,812**	**1.64%**
Australia	**109,284**	**36,508**	**12,289**	**33,074**	**24,205**	**26,285**	**241,646**	**2.25%**

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, 2020-21

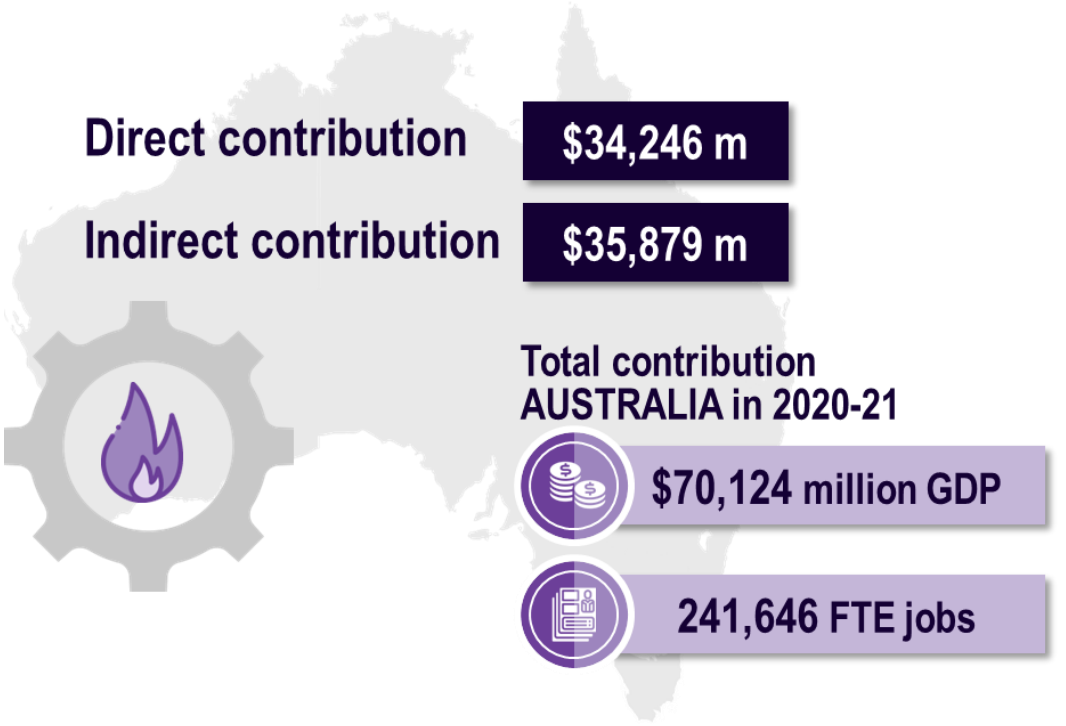
State	Production of gaseous fuels	Transport and distribution of gaseous fuels	Gas fired electricity generation	Gas feedstock chemical industry	High temp. gas-based manufacturing	Gas related capital expenditure	TOTAL	Per cent of GSP/GDP
	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	FTE jobs	%
LNG	91,639	38				ne	ne	ne
Natural gas	15,158	22,706	12,289	33,074*	24,205	ne	ne	ne
LPG	2,390	13,764				ne	ne	ne
CNG	97	0				ne	ne	ne
Hydrogen						ne	ne	ne
Australia	**109,284**	**36,508**	**12,289**	**33,074**	**24,205**	**26,285**	**241,646**	**2.25%**

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.

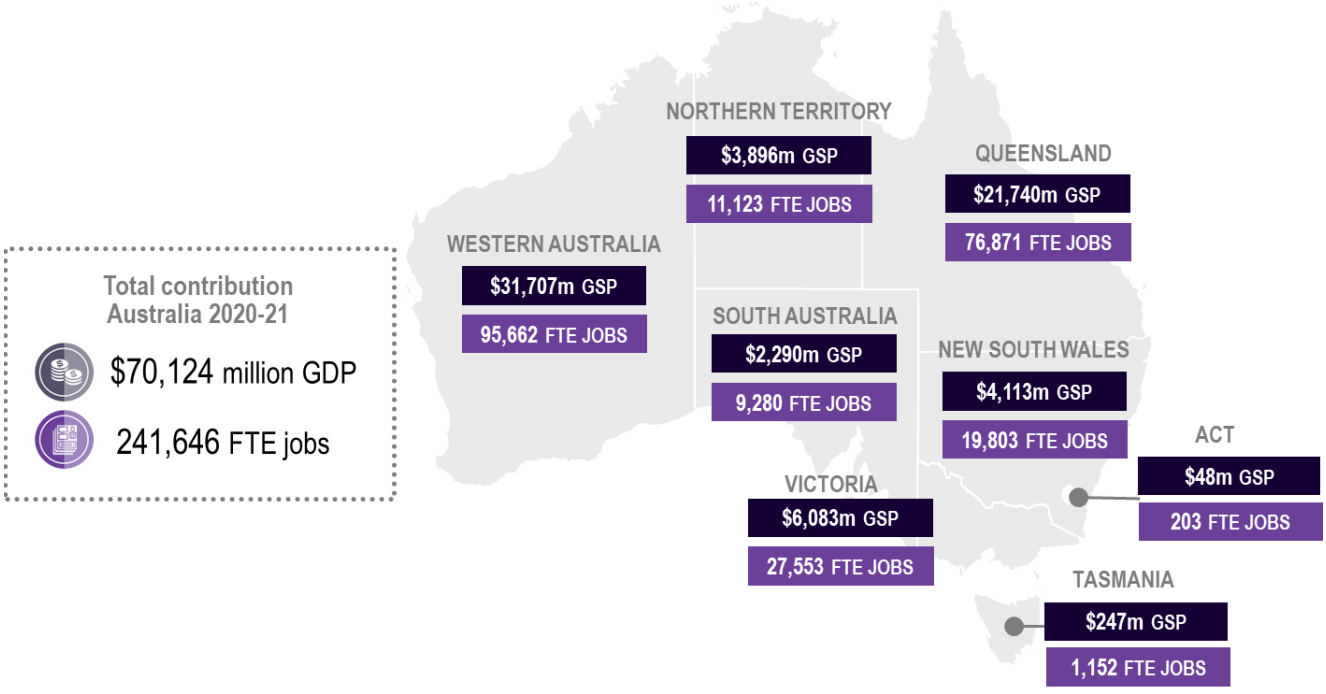
A summary of the estimated Australian gas economy is provided in **Figure 9.1**, **Figure 9.2** and **Figure 9.3**.

Figure 9.1 Estimated total contribution of the gas economy to the Australian economy, 2020-21



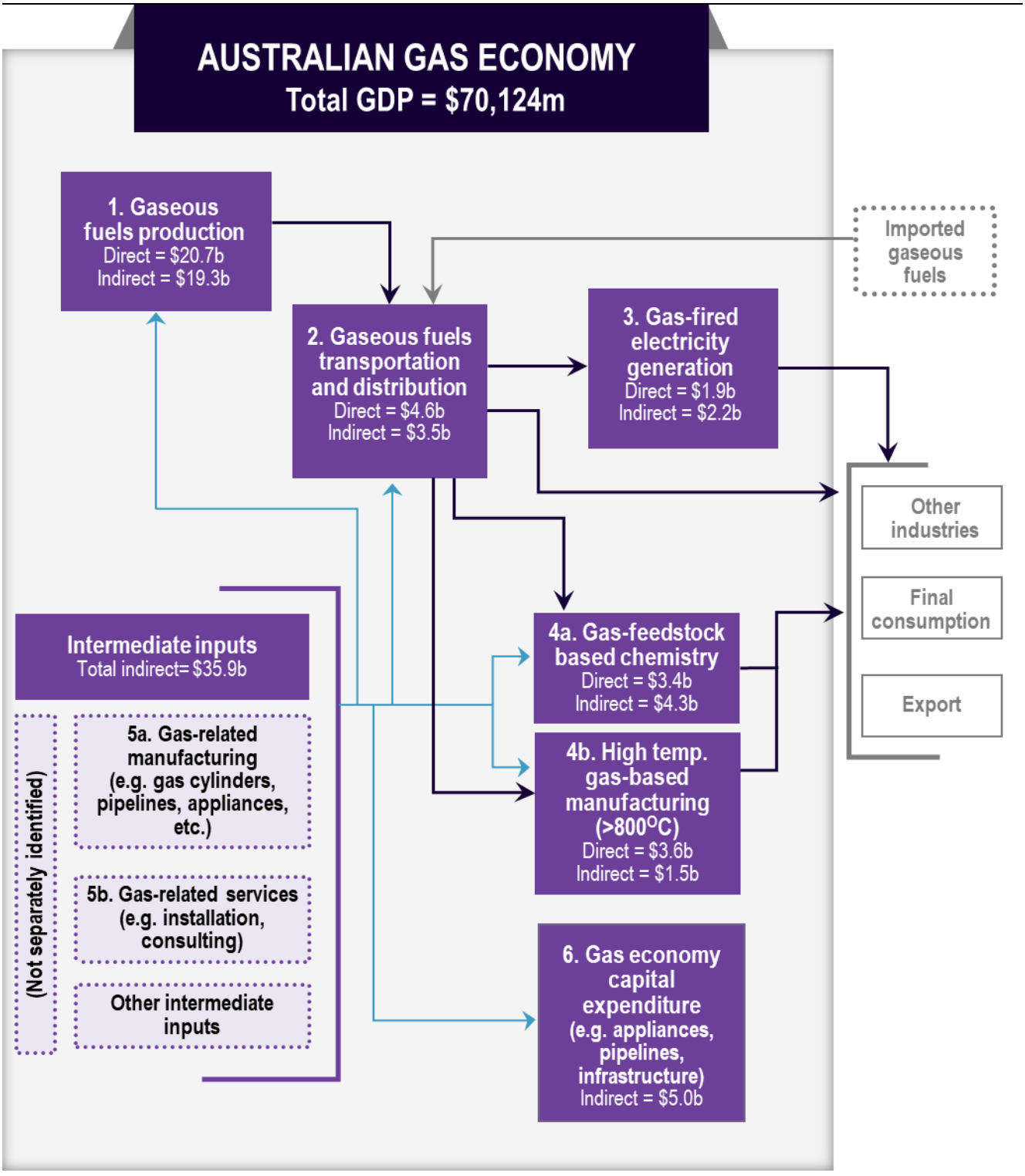
Source: ACIL Allen estimates based on various sources.

Figure 9.2 A summary of the estimated gas economy by state, 2020-21



Source: ACIL Allen estimates based on various sources.

Figure 9.3 Summary of the Australian gas economy, 2020-21



Source: ACIL Allen estimates based on various sources.

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Appendices

Input-output multiplier analysis

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.

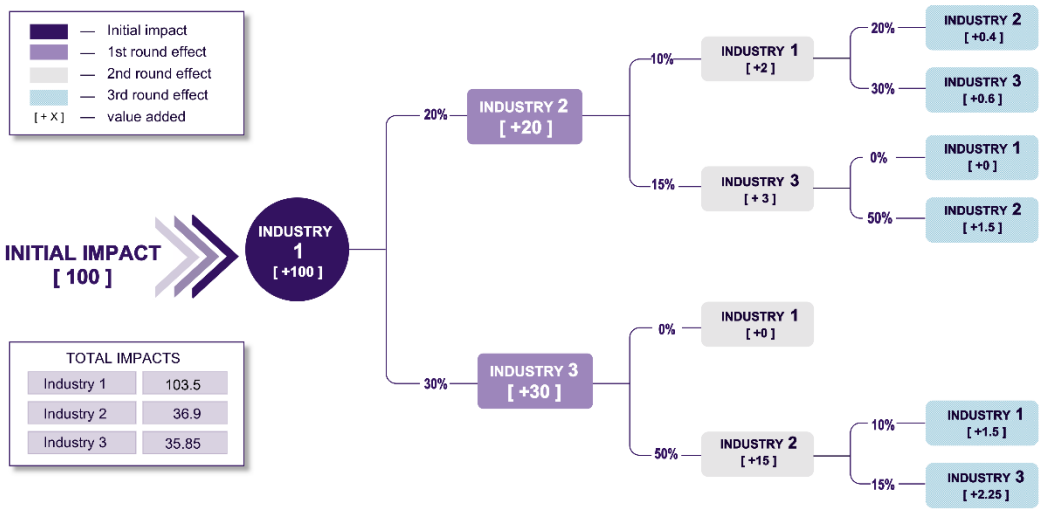
Input output models capture the direct and indirect effects of expenditure by capturing, for each industry, the industries it purchases inputs from and also the industries it sells its outputs to. For example, the Input-Output model for Western Australia captures purchases from and sales to industries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

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