

# Report to the CoAG Energy Council

australian petroleum production & exploration association limited

## *Unconventional Gas in Australia*

*November 2017*

the voice of Australia's oil and gas industry



## About APPEA

The Australian Petroleum Production & Exploration Association Ltd (APPEA) is the peak national body representing the oil and gas exploration, development and production industry in Australia. The Association's members account for more than 95 per cent of Australia's petroleum production and the vast majority of exploration. APPEA's membership also includes many companies providing services to the industry.

APPEA works with Australian governments to promote the development of the nation's oil and gas resources in ways that maximise the return to the Australian industry and community. We aim to secure regulatory and commercial conditions that enable member companies to operate safely, sustainably and profitably. The Association also seeks to increase community and government understanding of the upstream petroleum industry by publishing information about the sector's activities and economic importance to the nation.

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## Executive Summary

Natural gas is essential to the Australian economy.

Almost half of Australian homes – five million households – are connected to the natural gas network. In NSW and Victoria alone, 2.3 million homes are connected. Gas accounts for 44 per cent of household energy use, with more than 11 million residential gas appliances in use.<sup>1</sup>

Natural gas is indispensable to many manufacturing processes. Gas is used to produce non-ferrous metals (such as aluminium, copper and zinc), chemicals and polymers (such as fertilisers and anti-freeze), plastics and non-metallic mineral products like glass, ceramics, cement and bricks, and is also used in food preparation, processing and packaging, fermentation and brewing.

APPEA estimates about 225,000 jobs in the manufacturing sector rely on natural gas. Manufacturing clusters dependent upon gas are found in all Australian states.

Until recently, the demand for natural gas has been met from ‘conventional’ gas reserves (for example, the Cooper, Gippsland and Carnarvon basins). However, in eastern Australia, production from these established conventional sources has peaked. New conventional gas projects, such as the \$5.5 billion Kipper-Turrum project, are underway but will only partly replace lost output.

Fortunately, the last decade has seen a new and growing source of supply created – the coal seam gas reserves of Queensland. The potential of coal seam gas was identified in the 1990s. However, technical challenges and production costs higher than established conventional sources prevented its large-scale development. The opportunity to use coal seam gas as the feedstock for liquefied natural gas (LNG) exports changed the equation, drawing in an unprecedented \$70 billion in investment to unlock the resource.

Today, Queensland’s unconventional gas reserves are the largest single source of natural gas in eastern Australia. More than half of the gas consumed on the east coast is coal seam gas from Queensland; almost 90 per cent of gas reserves on the east coast are unconventional gas.<sup>2</sup>

The LNG industry has not only created its own supply – it has created much of the new supply flowing into the domestic market.

Queensland’s oil and gas industry employs an estimated 27,000 people, generates more than \$9 billion in value added activities, including \$3.9 billion in annual associated salaries. Average earnings in the industry are over \$150,000 per annum, double the Queensland average.

Over the last two financial years, \$15 billion of industry investment has help sustain 3,100 Queensland businesses; most of these (more than 80 per cent) are based in regional areas such as Gladstone, Callide, and Maranoa.

The industry has a relatively small physical ‘footprint’ which limits its impact on traditional rural industries. Access to land is negotiated under a regulatory framework which seeks to minimise impacts and ensures fair compensation for landowners. There are 5,861 conduct and compensation

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<sup>1</sup> Deloitte Access Economics (2016) – Analysis for Gas Vision 2050

<sup>2</sup> EnergyQuest, Energy Quarterly, September 2017 Report. <http://www.energyquest.com.au>

agreements signed with Queensland landowners who have received \$387 million in co-existence payments from 2011 to 2017.

Regional communities and other local industries are sharing the benefits of the infrastructure funded by the gas industry. For example, renewable energy projects are connecting to new power infrastructure built to serve gas projects. Farmers now have access to new supplies of free, treated water for irrigation, lifting productivity and farm incomes.

Outside Queensland, unconventional gas production is in its infancy, largely because of regulatory restrictions. While most of New South Wales is effectively closed to development, one project underway, Santos's Narrabri project, could supply 50 per cent of the state's gas demand. The Northern Territory has major unconventional resources. Victoria has significant natural gas potential with up to 27 TCF (28,514 PJ) of unconventional gas in the onshore Gippsland and Otway basins. Western Australia and South Australia also have promising resources which could underwrite significant industrial development.

In eastern Australia, time is running out for the development of new, unconventional gas resources in time to replace declining output from existing fields. Independent analysis by McKinsey and partners indicates that \$50 billion may be required to fund new supply to 2030. McKinsey warns that a failure to make timely investment in new supplies will create tight supply and push up prices.

## Background to this Report

The communique from the 4 December 2015 Council of Australian Governments (COAG) Energy Council noted:

*“The Council has released a Gas Supply Strategy which includes four key streams:*

- *Increased sharing of geoscience and other information about potential resources to improve certainty around gas supply data;*
- *Strengthening scientific rigour and the sharing of information to improve baseline and monitoring data of unconventional gas resources across the community;*
- *Harmonising regulatory frameworks to manage risk and address issues; and*
- *Improving collaboration to promote industry best practice.*

*The Strategy will be complemented by a range of other measures.”*

The Australian Petroleum Production & Exploration Association (APPEA) was requested to prepare an “Unconventional Gas Activities Report” to collate nationally consistent information on unconventional gas developments in Australia.

APPEA provided the first report to the COAG Energy Council in July 2016. This report provides additional information around the unconventional gas industry’s economic contribution, direct and indirect employment, work with contractors, local communities and landholders. To incorporate this additional data, this report had to be adjusted to reporting on a financial year basis. As a result, 2015-16 and 2016-17 financial year data is presented.

## Section 1 – Unconventional Gas in Australia

### **What is Unconventional Gas?**

“Unconventional” gas is natural gas sourced from geological formations different to those traditionally tapped for gas developments. Both “conventional” gas and “unconventional” gas is predominantly methane. Coal seam gas (CSG) is almost pure methane whereas conventional gas may also contain ethane, propane, butane, and other hydrocarbons. In general, gas reserves are classified as “conventional” or “unconventional” according to the geology of the resource:

- “Conventional” gas reservoirs largely consist of porous sandstone formations capped by impermeable rock, with the gas stored at high pressure. Australia’s remaining conventional gas reserves are largely (but not exclusively) offshore. Conventional gas usually flows to the production well and to the surface under pressure, though some wells need compression to flow. This type of production has historically been the source of most natural gas, hence the term “conventional”. Onshore conventional gas has been produced in many jurisdictions in Australia for decades.
- “Unconventional” gas reservoirs include coal seams, shale, and tight sandstone formations. CSG is found in coal seams where methane is bonded to the surface of coal particles and held there by water pressure. The technical term for this is ‘adsorption’. To extract CSG, water already in the coal seam, known as formation water, must be pumped out to reduce the reservoir pressure and release the gas. Shale gas and tight gas occur within rock formations that have extremely low permeability, making it difficult for gas to flow to wells.

Different geologies can require different techniques to extract natural gas. While hydraulic fracturing is often associated with unconventional gas extraction, the frequency of fracturing varies considerably. Hydraulic fracturing is not frequently used in CSG and conventional gas production (around 6 per cent of wells to date have undertaken hydraulic fracturing).

However, hydraulic fracturing is necessary in shale gas and tight gas wells to increase the flow of gas from the reservoir. There is a long history of safe, successful fracturing in the South Australian part of the Cooper Basin; since 1969, more than 800 fracturing stimulations have been done in the basin.

Underground coal gasification (UCG) is often confused with coal seam gas production, but it is an entirely different process to natural gas extraction. UCG involves partially burning coal seams in situ and then extracting the “syngas” produced. Syngas is not methane, but a mixture of carbon monoxide and hydrogen. UCG is not part of the natural gas industry and APPEA does not represent UCG operators. This report does not provide data on UCG operations.



## Australia's Unconventional Gas Resources

By world standards, Australia has substantial unconventional gas resources.<sup>3</sup>

**Table 1: Coal Seam, Shale and Tight Gas Reserves and Resources**

TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP	COMMERCIAL	<b>PRODUCTION: 687 PJ in 2015</b>				
			RESERVES 1P: 35 PJ	<b>RESERVES 2P: 43,638PJ</b>	RESERVES 3P: 41 PJ		
	SUB-COMMERCIAL	CONTINGENT RESOURCES 1C: 3,762 PJ	<b>CONTINGENT RESOURCES 2C: 40,159 PJ</b>	CONTINGENT RESOURCES 3C: 32,865 PJ			
		UNRECOVERABLE					
	UNDISCOVERED PIIP		PROSPECTIVE RESOURCES Low Estimate: 93,487 PJ	<b>PROSPECTIVE RESOURCES Best Estimate: 652,678 PJ</b>	PROSPECTIVE RESOURCES High Estimate: 767,807 PJ		
			UNRECOVERABLE				

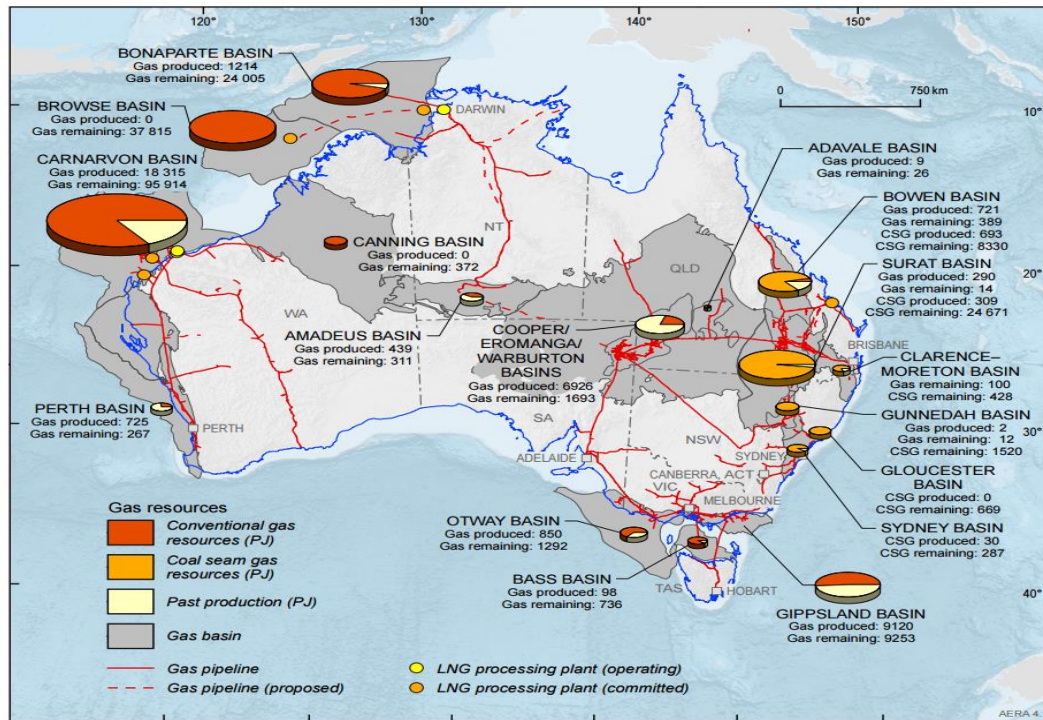
Source: Geoscience Australia (2017)

Estimates will change over time as more information is obtained from geoscience research and exploration or as changing market conditions make some deposits more or less commercial.<sup>4</sup> The location of Australia's gas resources is illustrated in Figure 1.

<sup>3</sup> Geoscience Australia (2016), [www.coagenergycouncil.gov.au/publications/report-coag-energy-council-unconventional-reserves-resources-production-forecasts-and](http://www.coagenergycouncil.gov.au/publications/report-coag-energy-council-unconventional-reserves-resources-production-forecasts-and).

<sup>4</sup> The full technical definition of resources and reserves is available through the Society of Petroleum Engineers (2007), [www.spe.org/industry/docs/Petroleum\\_Resources\\_Management\\_System\\_2007.pdf](http://www.spe.org/industry/docs/Petroleum_Resources_Management_System_2007.pdf).

**Figure 1: Location of Australia's Gas Resources and Infrastructure<sup>5</sup>**



Source: Geoscience Australia, Australian Energy Resource Assessment (2016)

In many cases, complete information on Australia’s unconventional gas reserves is unavailable due to a lack of exploration and data gaps. For many years, Geoscience Australia has been reporting estimated reserves, resources and production of Australia’s unconventional petroleum to COAG. The most recent report shows the following 2P reserves, resources and prospective resources:

**Table 2: Coal Seam, Shale and Tight Gas Reserves and Resources by Jurisdiction<sup>6</sup>**

State	2P Reserves (PJ)	2P Contingent Resources (PJ)	3P Prospective Resources (PJ)
Queensland	43,597	26,709	185,793
New South Wales	41 <sup>7</sup>	2,254	
Victoria		4,060	9,875
Tasmania			
South Australia		6,881	181,799
Western Australia			254
Northern Territory			275 211
<b>Total</b>	<b>43,638</b>	<b>39,904</b>	<b>652,932</b>

Source: Geoscience Australia (2017)

<sup>5</sup> Geoscience Australia – Note For remaining resources, conventional gas values represent total demonstrated resources; CSG values show 2P reserves.

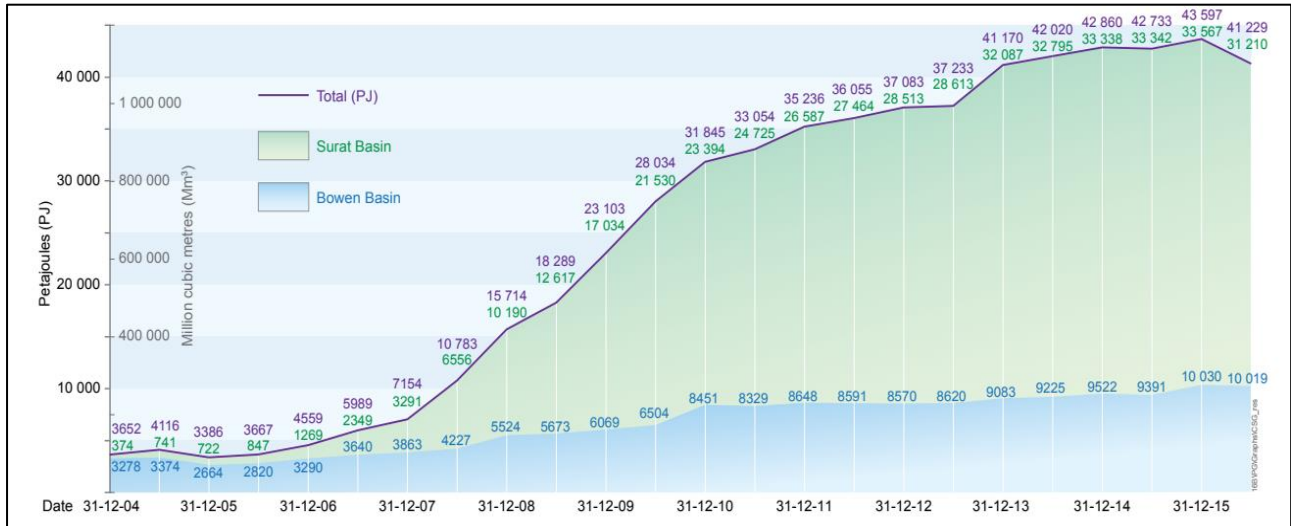
<sup>6</sup> Geoscience Australia, ‘Upstream Petroleum and Offshore Minerals Working Group Inaugural Report to the Standing Council on Energy and Resources on Unconventional Reserves, Resources, Production, Forecasts and Drilling Rates’, <http://www.coagenergycouncil.gov.au/publications/report-coag-energy-council-unconventional-reserves-resources-production-forecasts-and>.

<sup>7</sup> 2P reserves in NSW have reduced from 3,082 PJ in 2015 to 41 PJ in December 2016. 2P resources have also reduced from 10,656 to 2,254 PJ December 2016.

The level of reported 2P CSG reserves for the period 1996 to 2010 is outlined in Chart 1.

The rapid growth recorded from 2007 to 2010 was driven by exploration by project proponents testing whether sufficient resources could be developed to support a Queensland LNG industry. The levels of reserves (2P) outside of Queensland have reduced in recent years as policies have restricted gas exploration and development.

**Chart 1: Coal Seam Gas 2P Reserves: 1996 to 2010**



Source: Coal Seam Gas in Australia – QLD Government. Petroleum and Gas 2017. (2017)

While we have a detailed understanding of Queensland’s gas resources and reserves, more exploration is required in other Australian jurisdictions to achieve comparable knowledge.

In Victoria, the onshore portions of both the Gippsland and Otway Basins have been identified as regions where unconventional gas may be found. In 2016, Geoscience Australia estimated Victoria’s unconventional resource could be up to 4,060 PJ (2C) of contingent resources with prospective resources of 9,875 PJ.<sup>8</sup> New South Wales has 2P reserves of over 2,254 PJ.

Victorian government studies, released in 1995, confirmed strong resource potential in the state. Geoscience Australia studies show that the unconventional gas *potential* in Victoria could be higher than 26.9 TCF (**28,514 PJ**) in the onshore Gippsland and Otway basins.<sup>9</sup> The often-cited lack of “proven or probable”<sup>10</sup> reserves in Victoria is misleading; a reserve cannot be considered proven or probable unless there is government approval and commercial pathway for development. Government prohibitions on industry exploration prevent the work required to convert contingent resources into ‘bankable’ 2P reserves.

<sup>8</sup> Geoscience Australia (2016), *Coal Seam, Shale and Tight Gas in Australia: Resources Assessment and Operation Overview 2016*.

<sup>9</sup> Geoscience Australia (2016) - Interim Otway Basin resource assessment and Interim Gippsland Basin resource assessment.

<sup>10</sup> For instance, see Daniel Andrews interview on ABC Insiders 09 October 2017.

## Section 2 – Australian Gas Markets

### **Australian Natural Gas Production and Consumption**

Australia's natural gas production increased by 21 per cent year-on-year in 2016-17 and doubled over the last decade. The increased production has been underpinned by increased coal seam gas (CSG) production in Queensland. CSG accounted for almost 59 per cent of national gas production and over 70 per cent of eastern market gas production in 2016-17.<sup>11</sup>

Natural gas is used in Australia for electricity generation, manufacturing, household heating and cooking, in the mining industry and for LNG exports.

In 2015-16, electricity generation accounted for 43 per cent of Australia's domestic gas use. Natural gas was the largest fuel source for electricity generation in the Northern Territory, Western Australia and South Australia accounting for 81 per cent, 57 per cent and 38 per cent of total electricity generation respectively.<sup>12</sup>

In the same period, manufacturing accounted for around 31 per cent of total domestic gas use in Australia. Gas is used as a source of energy and as an essential raw material (feedstock). The main industrial uses of natural gas are in the production of non-ferrous metals (such as aluminum, copper and zinc), in chemicals and polymers (such as fertilisers and anti-freeze), plastics and non-metallic mineral products like glass, ceramics, cement and bricks. Gas is also used in food preparation, processing and packaging, fermentation and brewing.

APPEA estimates that there are about 225,000 jobs in the manufacturing sector that rely heavily upon natural gas. Manufacturing clusters dependent upon gas are found in all Australian states. For more details on gas use in the manufacturing sector please see the APPEA fact sheet *Natural gas – essential for Australian manufacturing* ([Appendix 1](#)).

Households' use of natural gas in 2015-16 accounted for around 13 per cent of domestic use and mining accounted for about 9 per cent.

In 2016-17, Australian LNG exports increased by 42 per cent to total 52 million tonnes, valued at \$23 billion.

### **Natural gas: the fastest growing fossil fuel to 2040**

The International Energy Agency (IEA), in its World Energy Outlook 2017 (WEO), has forecast that natural gas will be the fastest growing fossil fuel to 2040. In the main IEA scenario (the 'New Policies' Scenario), natural gas demand is expected to increase by 45 per cent by 2040, accounting for a quarter of global energy demand.

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<sup>11</sup> EnergyQuest, Energy Quarterly, September 2017 Report. <http://www.energyquest.com.au>

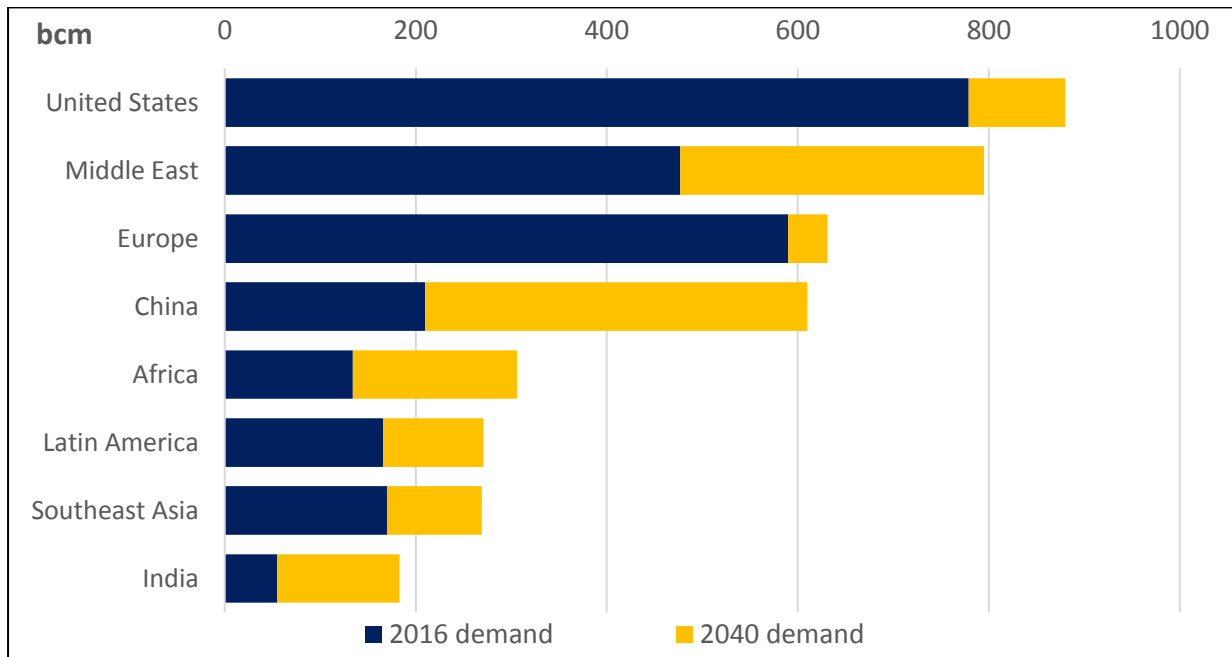
<sup>12</sup> Department of the Environment and Energy (2017), [Australian Energy Update 2017](#), August, Table O.

Australia’s proximity to gas-hungry Asia is a major advantage as Australia competes in the global gas market. In its WEO report, the IEA states:

*Natural gas demand grows in the New Policies Scenario, supporting a number of environmental goals, especially in the fast-growing conurbations of Asia. Strong growth in industrial gas consumption helps tackle local air pollution, while the ability of gas-fired power plants to operate flexibly makes them a valuable complement to the rising deployment of wind and solar PV generation.<sup>13</sup>*

The IEA forecasts that around \$8.6 trillion in investment is needed in the global gas supply chain to 2040.<sup>14</sup>

**Chart 2: Natural gas demand by selected regions in the New Policies Scenario**



Source: IEA (2017)

According to the IEA, the power generation sector and the industrial use of gas each account for 35 per cent of the increasing gas consumption to 2040. The WEO states that:

*The emissions that arise from the combustion of natural gas are well-known and show clear advantages for gas relative to other fossil fuels and, for particulate emissions, a favourable comparison with bioenergy....it is undeniable that gas has played an important part in recent positive CO2 emissions trends in many countries and in the overall flattening of global energy-related emissions since 2014.<sup>15</sup>*

<sup>13</sup>International Energy Agency (2017), [World Energy Outlook 2017](#), November, p. 437.

<sup>14</sup> International Energy Agency (2017), [World Energy Outlook 2017](#), November, p. 364.

<sup>15</sup> International Energy Agency (2017), [World Energy Outlook 2017](#), November, p. 400.

The IEA forecasts Australia's gas production to more than double to 195 bcm in 2040, up from 88 bcm in 2016, growing at an average annual rate of 3.4 per cent, the fastest among all OECD nations. Yet Australia only accounts for 6.4 per cent of the growth in global production.

The IEA forecasts the United States, Canada and Australia will lead global unconventional gas development in the medium-term. Increased natural gas production is expected to be dominated by unconventional gas, which increases by 3.2 per cent per year, reaching 1,654 bcm by 2040.<sup>16</sup> Inter-regional gas trade is forecast to increase by more than 70 per cent to total 1,230 bcm by 2040. IEA forecasts Australia's gas exports to more than triple to 137 bcm, from 45 bcm in 2016 by 2040. The bulk of the gas trade expansion comes from LNG, which increases its share from 39% in 2016 to about 60% by 2040.<sup>17</sup>

### Recent developments in Australia's East Coast Gas Market

In September this year, AEMO and the ACCC released forecasts for the east coast market for 2018 and 2019.<sup>18 19</sup>

Both reports estimated a shortfall of around 54 PJ in 2018, and about 48 PJ in 2019. These estimates assume a significant increase in demand from gas-fired generation and the first increase in demand from commercial and industrial customers for many years.

AEMO produced a further 'uncertainty scenario', with estimated additional shortfalls of 53 PJ in 2018 and 54 PJ in 2019. This contingent forecast is based on a scenario of high electricity demand exacerbated by sharp falls in output from renewable energy sources.<sup>20</sup>

These forecasts were much more pessimistic than the Gas Statement of Opportunities released by AEMO only six months earlier. In response, the Queensland LNG producers have guaranteed the Commonwealth that their projects will offer all their uncontracted gas to the domestic market first in 2018 and 2019. The terms and conditions of offers made to the market will be provided to the ACCC to improve transparency.

This agreement with the Commonwealth was over and above the *Gas Peak Demand Guarantee* given by east coast gas producers in March 2017 which guaranteed that gas will be available to meet peak demand in the National Electricity Market (such as during heat waves).

The gas industry has already taken significant steps to ensure additional supply. Since March 2017, more than a dozen announcements of additional supplies into the market have been made. Together these contracts represent an estimated additional 105 PJ of supply into the market – equivalent to more than 15 per cent of total demand.<sup>21 22</sup>

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<sup>16</sup> International Energy Agency (2017), [World Energy Outlook 2017](#), p. 346 Table 8.3.

<sup>17</sup> International Energy Agency (2017), [World Energy Outlook 2017](#), p. 360, 361.

<sup>18</sup> AEMO (2017), [Update to Gas Statement of Opportunities](#), September.

<sup>19</sup> ACCC (2017), [Gas Inquiry 2017–2020 Interim report](#), September.

<sup>20</sup> AEMO (2017), [Update to Gas Statement of Opportunities](#), September, p. 4.

<sup>21</sup> APPEA (2017), ['Gas industry is responding to supply concerns'](#), Media Release, 14 September.

<sup>22</sup> APPEA (2017), ['APPEA welcomes APLNG's latest domestic gas sales'](#), Media Release, 26 October.

## Price

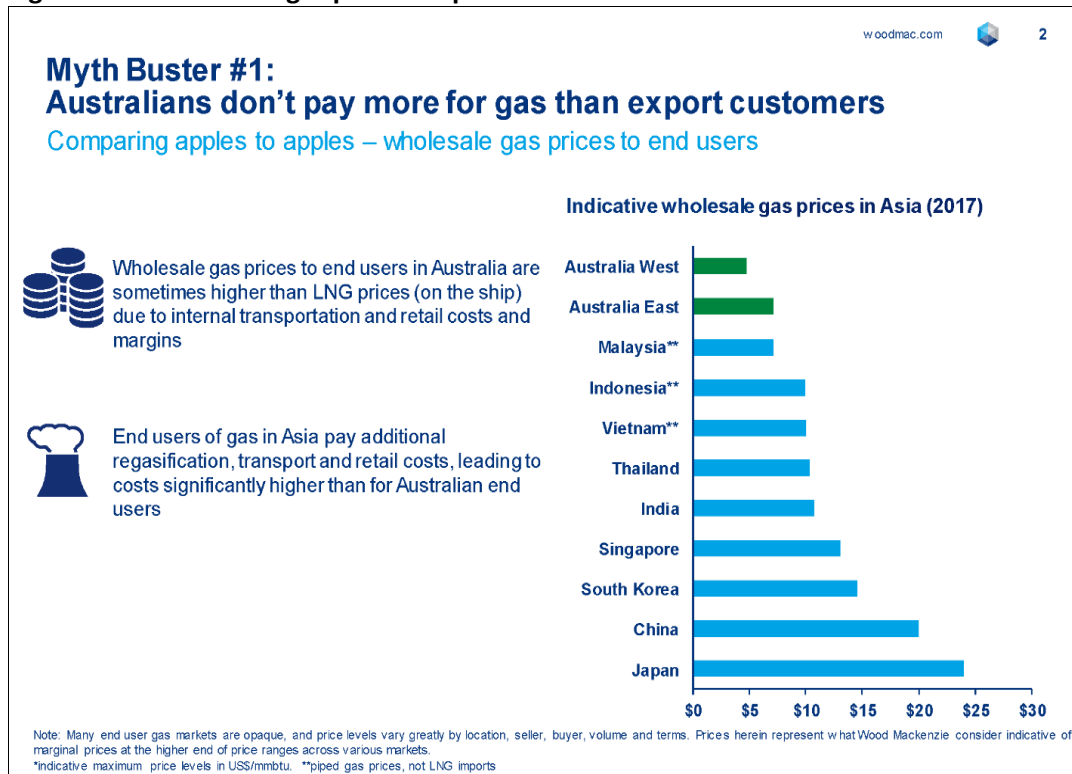
It is not unusual to read claims that Australians are paying more for natural gas than our export customers. However, these claims are not an ‘apples for apples’ comparison. In particular, critics typically compare *landed spot* LNG prices in Japan with *delivered contract* gas prices in eastern Australia to produce a striking but misleading headline.

It is misleading to equate a spot price for a product (LNG) in one country with a long-term contract price for a different product (gas) in another country. A spot price is a ‘point-in-time’ price reflecting the demand-supply balance for gas on a given day. Prices will fluctuate according to supply, exchange rates, movements in key market indices, market demand and a host of other factors. Customers seeking gas may be able to obtain all, some or none of the gas they need at the spot price available at any given time. This lack of certainty about supply means large users prefer long-term contracts to cover most if not all of their needs. A long-term contract *guarantees* the supply of set volumes of gas over a period of months or years, not days, and provides some certainty about future prices.

Comparing landed prices in Japan with delivered prices in Australia is also misleading. The cost of delivering gas can be significant in Australia – for example, transporting gas from a Queensland wellhead to Melbourne can add more than \$3 a gigajoule to delivered prices. The cost of transporting gas over the east coast pipeline network is considerably higher than shipping gas from Gladstone to Tokyo.

A useful comparison for the east coast gas prices is the wholesale delivered prices gas under long-term contracts in Asian markets. Wood Mackenzie in their analysis (below) has tried to dispel the myth ‘Australians are paying more for gas than export customers’. The analysis shows Australian domestic prices are well below what the customers are paying in Asia.

**Figure 2: International gas price comparisons**



Source: Wood Mackenzie South East Asia Gas & Power Service

## Section 3 – Unconventional Gas Activity

### Unconventional Gas Activity

Queensland’s gas industry continues to do the heavy lifting in the onshore gas industry.

Outside Queensland, there are only three wells producing unconventional gas. As the table below shows, exploration is modest across the east coast – only 55 new wells were added over the last two years, almost all located in Queensland. South Australia and Western Australia, despite other activity, have seen only one unconventional well drilled each in 2015-16 and 2016-17. Since the Santos’ drilling program in 2014 there have been no new wells drilled in New South Wales.

Table 3 below captures the available data on key industry indicators across Australia.

**Table 3: Unconventional Gas Activity**

	Queensland		Northern Territory		South Australia		Western Australia		New South Wales	
	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17	2015-16	2016-17
New Unconventional Exploration / pilot / Appraisal wells	22	23	5	4	5	1	1	0	0	0
New Unconventional gas Production Wells	661	553	0	0	0	0	0	0	0	0
Number of Fracture Stimulations for unconventional gas	130	122	2	0	3	0	0	0	0	0

Source: APPEA and State Governments. \*note table only counts activity in unconventional shale, CSG or tight fields.

### Queensland

A history of strong leadership and support from both major parties has underpinned the growth of Queensland’s gas industry. A bipartisan approach and a focus on coexistence has fostered more than \$70 billion worth of investment since 2010.

Activity in Queensland continues to be strong with 23 exploration wells and more than 550 production wells drilled in 2016-17. Only 6 per cent of the wells drilled in Queensland have required hydraulic fracturing. Like other states, Queensland has significant prospective resources, estimated to be 185,793 PJ.



**Table 4: 2015-16 and 2016-17 Unconventional Gas Activity in Queensland**

	Queensland		
	2015-16	2016-17	Total at end of 2016-17
<b>Well activities</b>			
Exploration / pilot / Appraisal wells	22	23	3,087
Production Wells	661	553	6,830
% fractured	19%	21%	6%
Number of Fracture Stimulations in unconventional gas wells	130	122	595
<b>Water management</b>			
Beneficial Use Water	49,760 ML	41,810 ML	163,500 ML
Monitoring Bores (cumulative)	1,108	1,496	1,496
<b>Land access</b>			
Signed Access Agreements	5,861	5,711a	5,711a
Active Access Agreements (hosting activity or infrastructure)	3,154	3,948	3,948
Formal Disputes of Access			1 (a)
Total Compensation Paid	\$78.5 Million	\$82.46 Million	\$387.2 Million (from 2011/12)

Source: Geoscience Queensland, APPEA

**Table 5: Queensland Reserves and Resources**

Queensland	TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP	PRODUCTION: 683 PJ in 2015*		
			RESERVES 1P	RESERVES 2P: 43,597 PJ*	RESERVES 3P
		COMMERCIAL	CONTINGENT RESOURCES 1C: 1 103 PJ	CONTINGENT RESOURCES 2C: 26,709 PJ**	CONTINGENT RESOURCES 3C: 18,554 PJ
		SUB-COMMERCIAL	UNRECOVERABLE		
		UNDISCOVERED PIIP	PROSPECTIVE RESOURCES Low Estimate: 12,608 PJ	PROSPECTIVE RESOURCES Best Estimate: 185 793 PJ***	PROSPECTIVE RESOURCES High Estimate: 84,843 PJ
			UNRECOVERABLE		

Source: Geoscience Australia

## New South Wales

No additional wells have been drilled in New South Wales in 2015-16 or 2016-17 since Santos' Dewhurst wells for the Narrabri project in 2014. Santos has no plans to use hydraulic fracture stimulation as part of the Narrabri Gas Project.

**Table 6: 2015-16 and 2016-17 Unconventional Gas Activity in New South Wales**

	New South Wales		
	2015-16	2016-17	Total at end of 2016-17
<b>Well activities</b>			
Exploration / pilot / Appraisal wells			494
Production Wells			145
Number of Fracture Stimulations in unconventional gas wells			168

## Northern Territory

The Northern Territory has the potential to become a new, major Australian gas province, but activity has been stalled by the moratorium introduced in September 2016.

The most advanced unconventional play in the Northern Territory is shale gas in the Beetaloo Sub-basin of the McArthur Basin. Exploration and geological investigations of the Velkerri Formation in the Beetaloo Sub-basin indicate that the formation has huge potential resources of shale gas and liquids in-place.

**Table 7: 2015-16 and 2016-17 Unconventional Gas Activity in Northern Territory**

	Northern Territory		
	2015-16	2016-17	Total at end of 2016-17
<b>Well activities</b>			
Exploration / Pilot / Appraisal wells	5	4	9
Production Wells			
Number of Fracture Stimulations in unconventional gas wells	2		2
<b>Land access</b>			
Signed Access Agreements			~50

Source: NT Government, APPEA

**Table 8: Northern Territory Reserves and Resources**

TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP	COMMERCIAL	PRODUCTION			
			RESERVES 1P	RESERVES 2P	RESERVES 3P	
		SUB-COMMER	CONTINGENT RESOURCES 1C	CONTINGENT RESOURCES 2C	CONTINGENT RESOURCES 3C	
			UNRECOVERABLE			
	UNDISCOVERED PIIP		PROSPECTIVE RESOURCES Low Estimate: 8,626 PJ	PROSPECTIVE RESOURCES Best Estimate: 275,211 PJ	PROSPECTIVE RESOURCES High Estimate: 351,054 PJ	
		UNRECOVERABLE				

Source: Geoscience Australia.

### South Australia

Exploration drilling activity in the Cooper Basin has been steady over the last two years. Over 800 fracture stimulations have been undertaken in the South Australian part of the Cooper Basin since production commenced in 1969. While only one well was hydraulically fractured for unconventional gas operations in 2015-16 (Silver Star 1 exploration well), an additional 40 hydraulic fracturing operations were performed on conventional fields over the period (22 in 2015-16 and 18 in 2016-17).

Exploration has focused on low permeability (tight) sandstones in the REM and Patchawarra Formation sequence that contain the shale gas and coal seam gas resources. Better than expected well performance suggests that these wells have been producing from the unconventional reservoirs adjacent to the tight sands. Unconventional activity targeted the deep coals, shale and tight sand in the Cooper Basin.

**Table 9: 2015-16 and 2016-17 Unconventional Gas Activity in South Australia**

	South Australia		
	2015-16	2016-17	Total at end of 2016-17
<b>Well activities</b>			
Exploration / pilot / Appraisal wells	5	1	N/A
Production Wells			
Number of Fracture Stimulations in unconventional gas wells	3		

Source: APPEA and the South Australian Government

**Table 10: South Australia Territory Reserves and Resources**

TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP	COMMERCIAL	PRODUCTION			
			RESERVES 1P	RESERVES 2P	RESERVES 3P	
		SUB-COMMERCIAL	CONTINGENT RESOURCES 1C: 2,482 PJ*	CONTINGENT RESOURCES 2C: 6,881 PJ*	CONTINGENT RESOURCES 3C: 13,930 PJ*	
	UNDISCOVERED PIIP	UNRECOVERABLE				
		PROSPECTIVE RESOURCES Low Estimate: 72,253 PJ**	PROSPECTIVE RESOURCES Best Estimate: 181,799 PJ**	PROSPECTIVE RESOURCES High Estimate: 331,909**		
		UNRECOVERABLE				

Source: Geoscience Australia

### Western Australia

Western Australia is considered to hold significant shale and tight gas resources in the Kimberley, East Pilbara and Midwest regions.

WA is estimated to contain 30,800 PJ (280 trillion cubic feet) of potential natural gas from shale and tight rocks. These resources are in the Kimberley, east Pilbara and Midwest regions (in the Canning and Perth basins). Potential resources in the Gascoyne and Goldfield regions (Carnarvon and Officer basins) are still underexplored.

The Canning Basin is recognised as having significant potential. Prospective formations have great areal extent although the extent of unconventional resources within them is unknown. Resource estimates assessing the whole of a formation across the basin should, therefore, be suitably discounted for this uncertainty. Due to the remoteness of the basin, transport and infrastructure will also be a significant issue in any unconventional resource development.

In 2015-16, Buru Energy advised that further testing at Ungani Far West-1 was encouraging, while an independent assessment of the gas and liquids resources of its Valhalla North 1 program supported the view that it contains a nationally significant wet gas accumulation.<sup>23</sup>

In 2016-17 and in 2015-16, there was a single unconventional gas exploration well in Western Australia.

<sup>23</sup> [http://www.dmp.wa.gov.au/Documents/Petroleum/Petroleum-PWA\\_Sept2016.pdf](http://www.dmp.wa.gov.au/Documents/Petroleum/Petroleum-PWA_Sept2016.pdf)  
[http://www.dmp.wa.gov.au/Documents/Petroleum/Petroleum-PWA\\_Sept2017.pdf](http://www.dmp.wa.gov.au/Documents/Petroleum/Petroleum-PWA_Sept2017.pdf)

**Table 11: 2015-16 and 2016-17 Unconventional Gas Activity in Western Australia**

	Western Australia		
	2015-16	2016-17	Total at end of 2016-17
Well activities			
Exploration / pilot / Appraisal wells	1		N/A
Production Wells			
Number of Fracture Stimulations in unconventional gas wells	-		

Source: APPEA

**Table 12: Western Australia Reserves and Resources**

TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP	COMMERCIAL	PRODUCTION: 0* PJ in 2015		
			RESERVES 1P	RESERVES 2P	RESERVES 3P
		SUB-COMMERCIAL	CONTINGENT RESOURCES 1C: 177 PJ	CONTINGENT RESOURCES 2C: 254 PJ	CONTINGENT RESOURCES 3C: 382 PJ
	UNRECOVERABLE				
	UNDISCOVERED PIIP	PROSPECTIVE RESOURCES Low Estimate	PROSPECTIVE RESOURCES Best Estimate	PROSPECTIVE RESOURCES High Estimate	
		UNRECOVERABLE			

Source: Geoscience Australia WA Department of Mines and Petroleum, and Geoscience Australia from company annual reporting (2017).

## Victoria

On 30 August 2016, the Victorian Government announced a permanent ban on the exploration and development of all onshore unconventional gas in Victoria, and an extension of the moratorium on the exploration and development of conventional onshore gas until 30 June 2020. As a result, there has been no unconventional activity in Victoria.

In 2017 Lakes Oil undertook independent modelling that indicated the Wombat conventional gas field will flow commercial quantities of gas. Given the onshore location of the Wombat field, close to existing gas pipeline infrastructure, the gas could be brought on line quickly.<sup>24</sup>

<sup>24</sup> Lakes Oil 2017 Annual Report <http://www.lakesoil.com.au/index.php/reports-and-announcements/category/annual-reports>

There are Prospective or *Potential* resources that can give an indication of the potential for gas in Victoria. Potential gas resources may be located in the onshore Gippsland and Otway which are likely to contain conventional and unconventional gas.

Two report by Geoscience Australia, released in 2016, demonstrate the gas *potential* held in Victoria. The report indicated that 26.9 TCF (**28,514 PJ**) of unconventional gas could be found in the onshore Gippsland and Otway basins.<sup>25</sup>

**Table 13: Victoria Reserves and Resources**

TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP	COMMERCIAL	PRODUCTION			
			RESERVES 1P	RESERVES 2P	RESERVES 3P	
		SUB-COMMERCIAL	CONTINGENT RESOURCES 1C	CONTINGENT RESOURCES 2C: 4,060 PJ	CONTINGENT RESOURCES 3C	UNRECOVERABLE
	UNRECOVERABLE					
	UNDISCOVERED PIIP	PROSPECTIVE RESOURCES Low Estimate		PROSPECTIVE RESOURCES Best Estimate: 9,875 PJ		PROSPECTIVE RESOURCES High Estimate
		UNRECOVERABLE				

Source: Geoscience Australia

### Hydraulic fracturing

Hydraulic fracturing injects water-based fluids at high pressure into rock formations deep underground to create tiny fractures that enhance the flow of oil and gas. The process has been developed over more than 65 years and has been applied to millions of wells around the world, including more than 1,500 wells in Australia since the 1960s. Hydraulic fracturing is also used in renewable (geothermal) energy production and to enhance the productivity of water bores.

Numerous Australian and international reviews have found that the risks associated with hydraulic fracturing can be managed effectively with a robust regulatory regime.

In Queensland, around 6 per cent of all wells are hydraulically fractured and 20 per cent of the most recently drilled coal seam gas wells have been hydraulically fractured without incident. In the Cooper Basin in South Australia, about 40 wells have been hydraulically fractured over the last 2 years. Hydraulic fracturing in the Cooper Basin has occurred for many decades without incident.

In Western Australia, hydraulic fracturing has been used extensively to assist with the recovery of oil and gas from conventional resources – an estimated 800 wells hydraulically fractured since 1958, without incident.<sup>26</sup>

<sup>25</sup> Geoscience Australia, Unconventional - Interim Otway Basin resource assessment.

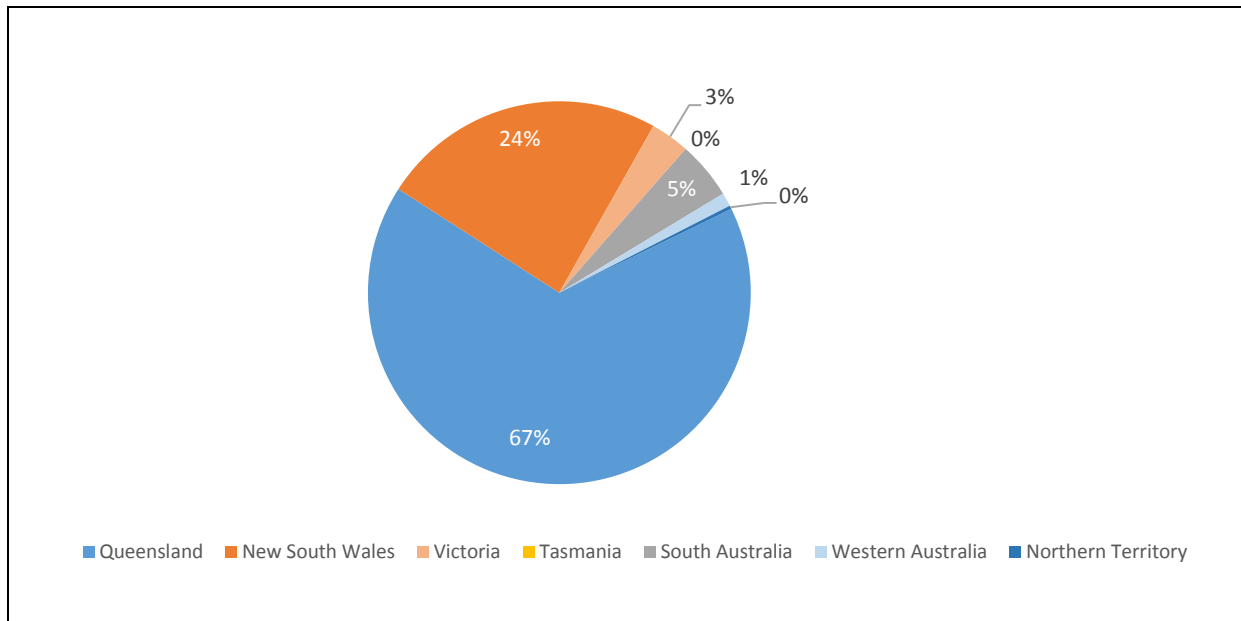
[https://d28rz98at9flks.cloudfront.net/104440/Rec\\_104440.pdf](https://d28rz98at9flks.cloudfront.net/104440/Rec_104440.pdf).

Unconventional - Interim Gippsland Basin resource assessment. [https://d28rz98at9flks.cloudfront.net/104422/Rec\\_104422\\_v3.pdf](https://d28rz98at9flks.cloudfront.net/104422/Rec_104422_v3.pdf)

<sup>26</sup> Department of Mines and Petroleum (2017), *Gas Fact Sheet: Hydraulic Fracture Simulation*, Government of Western Australia, <http://dmp.wa.gov.au/Petroleum/Hydraulic-fracture-stimulation-20018.aspx>.

Since the 1970s, fracking has been used to produce oil from the Class 'A' Nature Reserve of Barrow Island.

**Chart 3: Total Unconventional Fracture Stimulations in Australia**



Source: APPEA (2017)

### Petroleum Exploration in Australia

Exploration is the first step in developing gas reserves. It is a costly activity with no guarantee of commercial success.

Whether the search is for unconventional or conventional resources, exploration typically involves four stages:

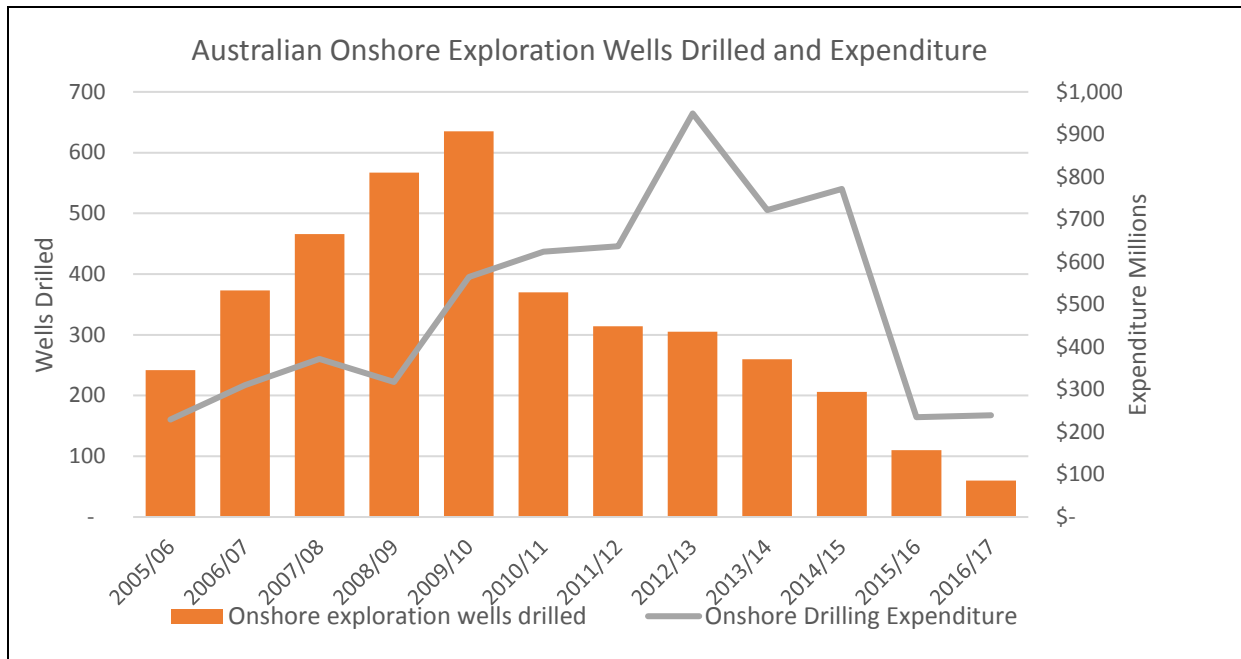
- A regional geological assessment by government to determine the resources' potential and which exploration permits should be acquired.
- Competitive bidding on areas. Generally, the government will release exploration blocks and companies will bid an indicative work program to secure a particular block, although some areas are subject to cash bidding arrangements.
- If a company is awarded an exploration permit over an area, it will then conduct activities (for example, seismic surveys and coreholes) to determine the likely location of hydrocarbon resources.
- Drilling only occurs once a suitable target has been identified. More often than not, exploration wells are not successful.

Following discovery of an oil or gas deposit, the field will be assessed for its potential for commercial development.

Petroleum exploration in Australia has been declining for many years. Chart 4 outlines the number of exploration wells drilled and exploration expenditure over the last decade.

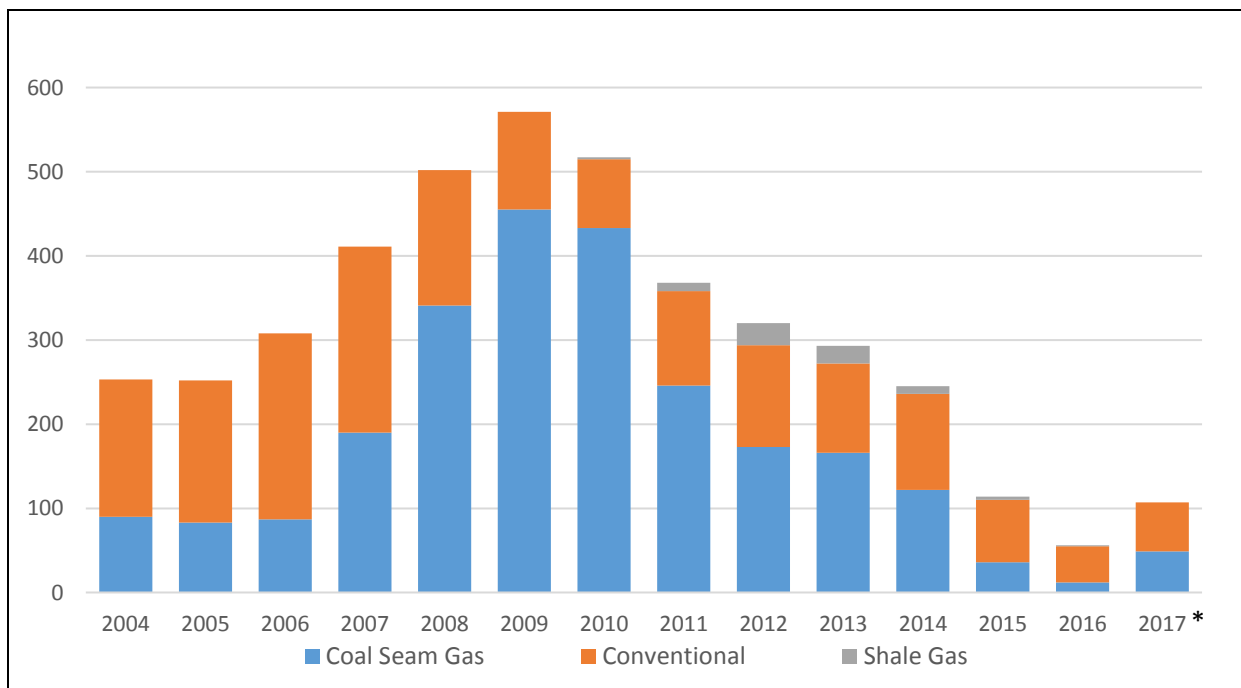
It should be noted that higher exploration costs lead to higher overall expenditure – and this can create the false impression of increased exploration activity when it is actually in decline. Recent bidding for acreage and commitments made by companies as part of their respective work programs indicate further falls in exploration activity.

**Chart 4: Exploration Wells Drilled: Onshore**



Source: APPEA and the Australian Bureau of Statistics

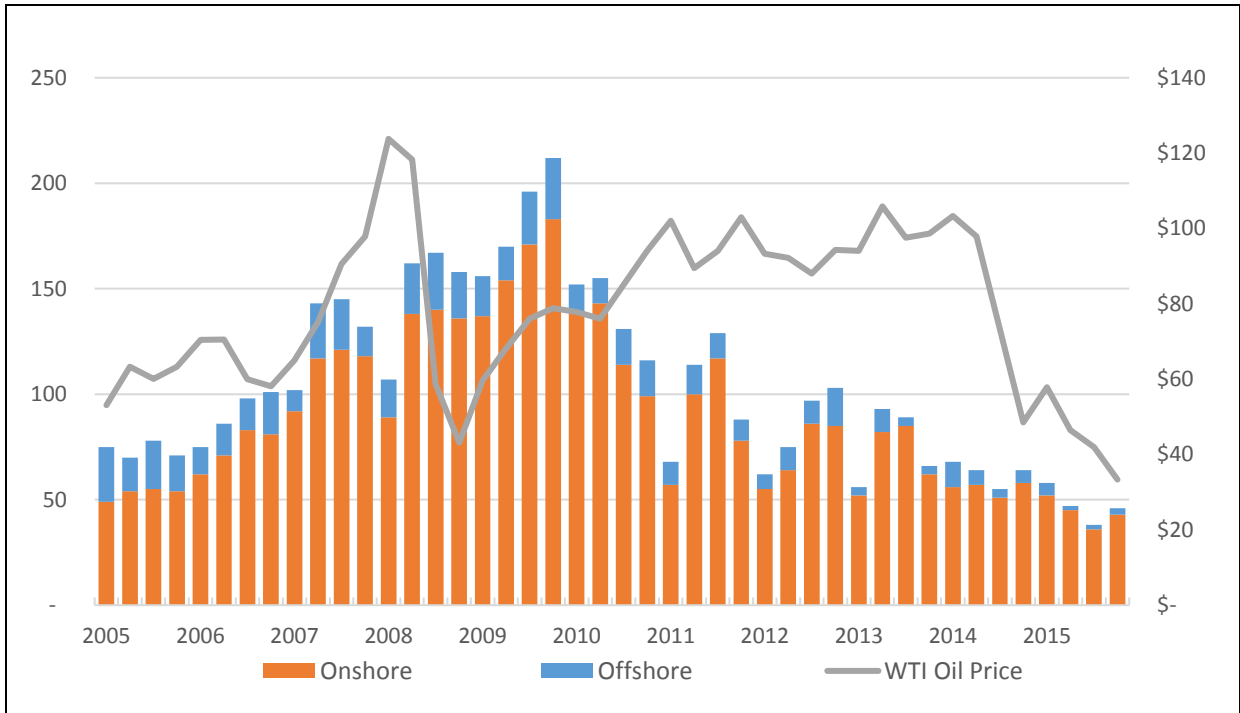
**Chart 5: Exploration and Appraisal Wells (Onshore)**



Source: APPEA (2017) \*Calendar year to October 2017.



**Chart 6: Australian Exploration Wells Drilled and WTI Crude Oil Price**



Source: APPEA, Reserve Bank of St. Louis (2017)

## Section 4 – Economic Contribution

The economic contribution of the unconventional gas industry to Australia, and particularly Queensland, is significant and growing. Data collected and analysed by the Queensland Resources Council (QRC) and APPEA shows:

- \$22.6 billion in output/turnover (\$13.5 billion in 2015-16 and \$9.3 billion in 2016-17) (a measure of direct and supply chain purchases from businesses);
- \$21.8 billion (\$12.8 billion in 2015-16 and \$9.08 billion in 2016-17) in value added or contribution to Gross State Product (GSP), amounting to 4.1 per cent of GSP for Queensland in 2015-16 and 2.9 per cent of GSP in 2016-17. This was through combined direct effects and supply chain and consumption effects;
- \$8.2 billion in income (wages and salaries) paid to workers (\$4.36 billion in 2015-16 and \$3.87 billion in 2016-17); and
- 44,307 full time equivalent jobs supported in 2016-17.

**Table 13: Economic Impact of Queensland Oil and Gas Sector**

<b>Value Added (\$m)</b>	<b>2015-16</b>	<b>2016-17</b>
Direct	6,170	4,157
% of GSP/GDP	2.0%	1%
Indirect	4,354	3,133
Total value added (Type I)	10,524	7,290
% of GSP/GDP	3.3%	2.3%
Consumption-induced	2,303	1,798
Total value added (Type II)	12,827	9,089
% of GSP/GDP	4.1%	2.9%
Queensland Royalties	36	97
<b>Employment (FTEs)</b>		
Direct	4,727 (+685 contractors)	4,156
Indirect	34,832	23,042
Total employment (Type I)	39,559	27,198
% of total state/national employment	1.7%	1.2%
Consumption-induced	25,750	17,109
Total employment (Type II)	65,309	44,307
% of total state/national employment	2.8%	1.9%
<b>Business spend (incl. community contributions and govt payments) (\$M)</b>		
Direct	5,425	3,523
Indirect	3,420	2,262
Total business spend (Type I)	8,845	5,785
Consumption-induced	4,623	3,509
Total business spend (Type II)	13,468	9,292
<b>Wages &amp; salaries (\$M)</b>		
Direct	745	635
Indirect	2,251	1,957
Total wages & salaries (Type I)	2,996	2,651
Consumption-induced	1,366	1,226
Total wages & salaries (Type II)	4,362	3,877

<b>Other</b>		
Investment in Roads	88.2	25.8

Source: QRC/APPEA (2017)

Note: Consumption-induced impacts, that is, the increase in economic activity generated to service the additional employment generated or sustained through the direct and indirect effects, are included in Type II impacts, but are excluded from Type I impacts.

In terms of total economic benefit, the oil and gas sector has the highest overall impact in the Brisbane region, with total value added of \$6 billion, followed by Darling Downs (\$1.44 billion) and Fitzroy (\$548 million)<sup>27</sup> in 2016-17.

## Workforce

Direct employment is a key measure of the economic contribution of the natural gas industry (including the unconventional gas sector).

The Australian Bureau of Statistics (ABS) reports industries according to the *Australian and New Zealand Standard Industrial Classification 2006* and as a result records direct employment in the gas industry under a variety of divisions. Various gas industry employment categories are grouped together with mining, manufacturing or electricity and waste categories.

The industry classification of oil and gas extraction is only one component of the industry. ABS data does not directly count service and support activities, petroleum refining, LNG manufacturing, construction, gas services or distribution and gas supply. Nor does it count the many manufacturing plants that rely on petroleum products as a feedstock. For example, the gas supply industry in Australia employs 20,700 people in Australia, but industry critics generally do not include this in the industry's employment numbers.

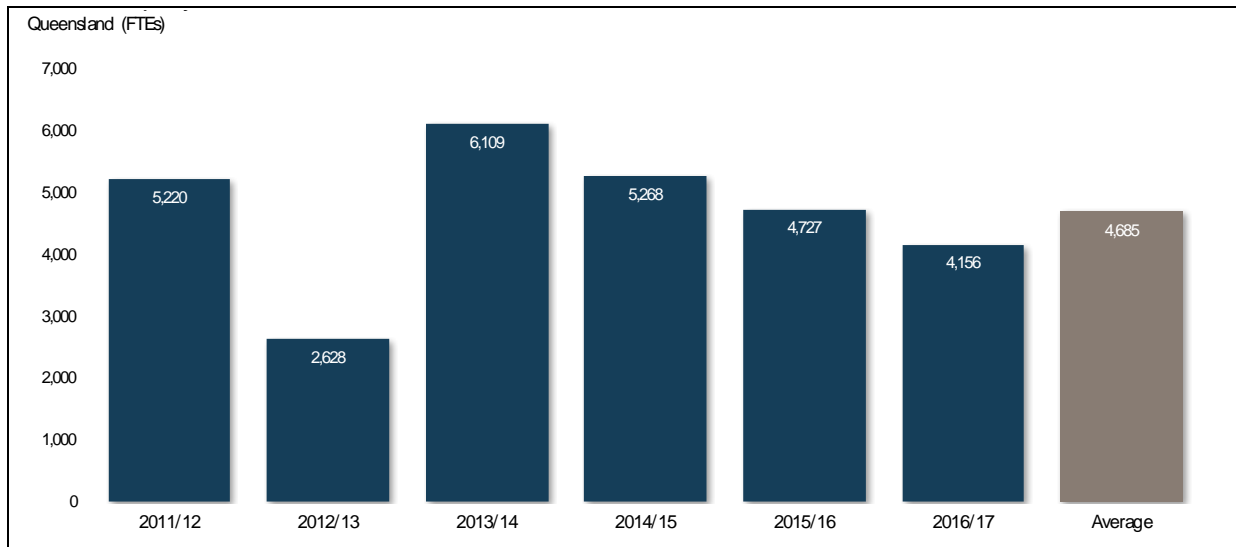
APPEA recommends caution in quoting ABS data associated with gas industry employment as there is a strong likelihood that reported information will significantly underestimate the industry's employment contribution.<sup>28</sup>

## Detailed workforce information – Queensland

The total workforce of participating oil and gas companies in Queensland in 2015-16, as determined by full-time equivalent workers by place of work was 4,727 fulltime resident employees. The direct workforce has reduced as projects have transitioned from construction to operation.

<sup>27</sup> Economic Contribution Report – QLD LNG industry (2016-17). Direct + type I and type II impacts.

<sup>28</sup> Australian Bureau of Statistics (2011), *Census data, working population profile*.

**Chart 7: Direct Employment Workforce of Qld Petroleum & Gas Sector**

**Table 14: Total Direct Workforce of Queensland Oil and Gas Sector, 2015-16<sup>29</sup>**

Region	Residing employees	Workforce by place of operation						Total workforce	
	(FTEs)	Direct		Female	Indigenous		Contractors		
		No.	% of direct	No.	% of direct	No.	% of direct	No.	
Brisbane	2,904	3,128	22.20%	695	2.20%	70	2.20%	424	3,552
Central West	1	0	n.a.	0	n.a.	0	n.a.	0	0
Darling Downs	478	968	11.40%	110	1.40%	14	1.40%	156	1,124
Far North	21	0	n.a.	0	n.a.	0	n.a.	0	0
Fitzroy	523	612	6.70%	41	0.00%	0	0.00%	61	673
Gold Coast	159	97	12.40%	12	2.10%	2	2.10%	5	102
Mackay	78	92	8.70%	8	0.00%	0	0.00%	4	96
North West	1	0	n.a.	0	n.a.	0	n.a.	0	0
Northern	24	0	n.a.	0	n.a.	0	n.a.	0	0
South West	163	322	13.00%	42	17.10%	55	17.10%	35	357
Sunshine Coast	233	0	n.a.	0	n.a.	0	n.a.	0	0
West Moreton	41	5	0.00%	0	0.00%	0	0.00%	0	5
Wide Bay-Burnett	101	0	11.10%	0	4.00%	0	4.00%	0	0
<b>Total</b>	<b>4,727</b>	<b>5,225</b>	<b>17.40%</b>	<b>908</b>	<b>2.70%</b>	<b>141</b>	<b>2.70%</b>	<b>685</b>	<b>5,910</b>

Source: Lawrence Consulting, QRC and APPEA

<sup>29</sup> 2016/17 detailed workforce data not yet available

Modelling undertaken for APPEA indicates that the industry supports, indirectly, a further 23,042 employees. Consumption induced impacts further increases this to 44,307.

Women are an important part of the industry's workforce, accounting for 17.4 per cent of all workers, higher than the mining industry average of 13.7 per cent.<sup>30</sup>

Women work primarily in the Administration/clerical (83.6 per cent), followed by Other (36.2 per cent), Financial professional (49.1 per cent), Project management (31.7 per cent) and Geologists (31.5 per cent). (APPEA QRC 2015-16)

The oil and gas industry is committed to ensuring opportunities for Aboriginal training and employment are maximised as the industry grows from short-term exploration work through to multi decade operations.

The resources sector is the largest private sector employer of Indigenous people in Australia, and where an Indigenous business is embedded in a resources project the percentage of Indigenous employment increases dramatically. The Queensland gas industry employs 141 indigenous persons, with significant opportunities provided in training and upskilling across the nation. See Case Study: Pangaea Northern Territory Indigenous Employment Training Pilot Program

The broader mining and energy resources industry has a higher proportion of indigenous employees than any other Australian industry.

### **High paying and highly skilled**

The people employed by the oil and gas extraction industry are highly qualified and in high paying, value adding jobs. The average industry salary in Queensland was \$152,000, double the Queensland average of \$77,433 in 2016-17.<sup>31</sup>

According to the 2016 Census, the oil and gas industry is the highest paying sector in the Australian economy. Close to half of the workforce (47.5%) earn more than \$3,000 per week (>\$156,000 per annum). This is significantly higher than the average weekly earnings for all workers across the economy of \$1,146 per week.<sup>32</sup>

According to the ABS 2016 census, most (64 per cent) people employed by the oil and gas extraction industry earn more than \$100,000 per year.

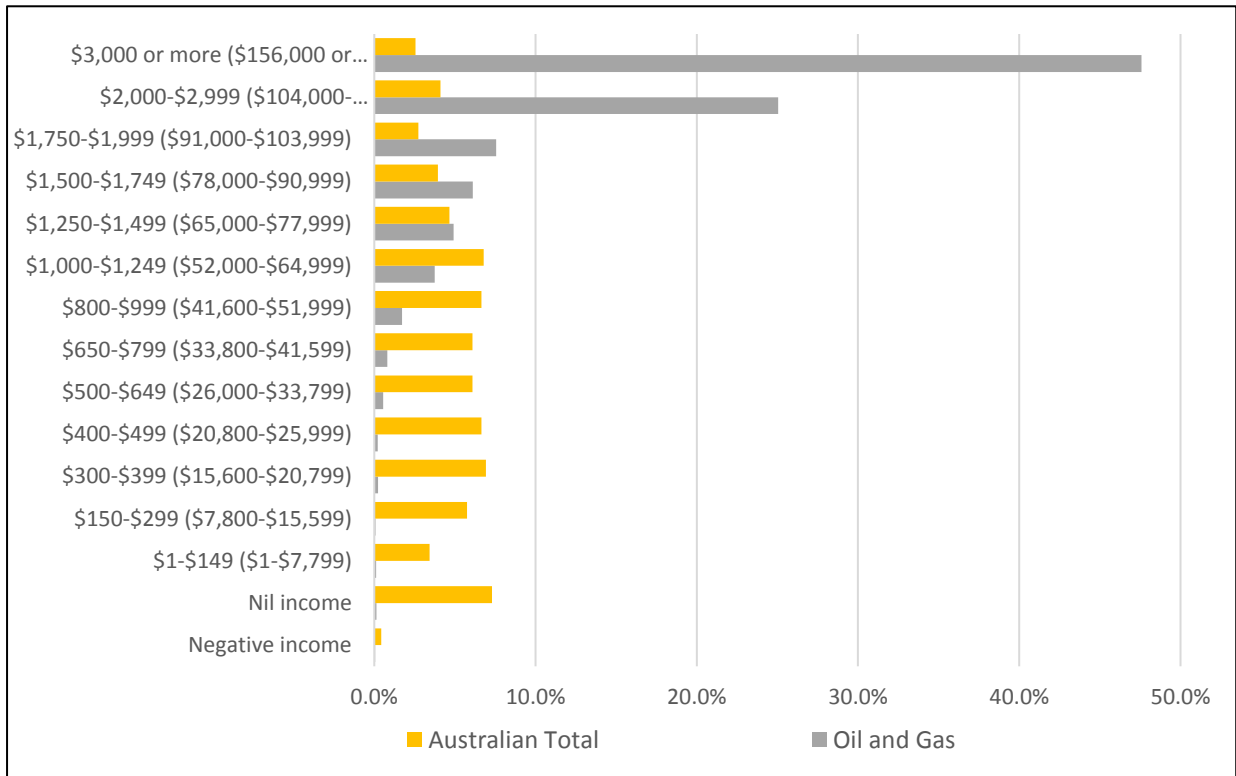
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<sup>30</sup> ABS (2016), *Labour Force, Australia, Detailed, Quarterly, Feb 2016*, cat. no. 6291.0.55.003, <http://www.abs.gov.au/ausstats/abs@.nsf/mf/6291.0.55.003>.

<sup>31</sup> Queensland Government Statistician's Office (2017), *Average weekly earnings, Queensland and Australia*, <http://www.qgso.qld.gov.au/products/tables/average-weekly-earnings-qld-aus/index.php>.

<sup>32</sup> 2016 Australian Census (2017) <http://www.abs.gov.au/census>

**Chart 8: Average Weekly Income for oil and gas and Australian Average**



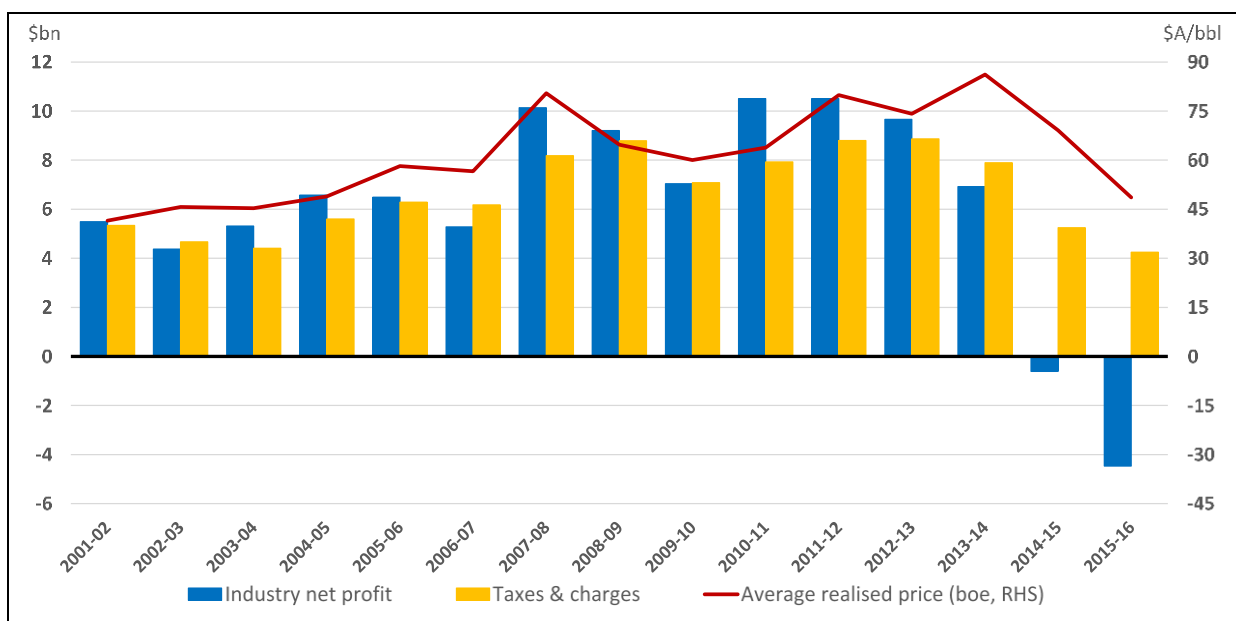
Source: Australian Bureau of Statistics – Australian Census (2016)

## Section 5 – Fiscal Contribution

Oil and gas production in Australia is subject to numerous layers of taxation, including income (company) tax, GST and numerous other fees and charges (at a federal, state/territory and local government level). The industry is also subject to a variety of resources taxes, including petroleum royalties and the petroleum resource rent tax (PRRT). No other competing fuels in the energy market are subject to an additional, profits-based tax like the PRRT.

Before 2014-15, taxes and resource charges on average accounted for about one half of the oil and gas industry's pre-tax profit. Reflecting the significant fall in commodity prices that began in late 2014 (together with the peak in spending associated with new gas projects) the industry recorded a net operating loss of \$0.6 billion in 2014-15 and \$4.5 billion for the year 2015-16. Despite these losses, the industry's total tax payments remained strong – estimated at \$4.3 billion for 2015-16 (compared with \$5.2 billion in 2014-15). The industry's overall return on assets was estimated at -1.3 per cent, based on a total asset value of \$345 billion.

**Chart 9: Oil and Gas Industry Net Profit, Tax Contribution and Average Prices Realised: 2000-01 to 2015-16.**



Source: APPEA Financial Survey (2017)

Company tax is levied at a corporate level, while resource taxes are generally applied at a project or production licence level. In terms of resource taxation:

- States and the Northern Territory Government levy royalties on onshore production (both from conventional and unconventional sources) and from offshore production in state/territory waters.
- Commonwealth crude oil and condensate production excise and Commonwealth petroleum royalty applies to production sourced from licences derived from Offshore Exploration Permits WA-1-P and WA-28-P (including the North West Project). Commonwealth crude oil and condensate production excise also applies to crude oil and condensate production from areas under state and territory jurisdiction.
- PRRT applies to production (conventional and unconventional) from all projects (offshore and onshore).

## **Petroleum Royalties**

Each state and territory applies royalties on the production of oil and gas (from conventional and unconventional sources). Royalties are generally assessed as a percentage of the wellhead value of production. The wellhead value is calculated by subtracting the cost of transportation and processing involved in bringing the raw products from the wellhead to a point at which marketable products are sold. Royalties are generally assessed on a licence area basis.

Allowable deductions when determining the wellhead value include a variety of post-wellhead production costs, including certain treatment, transportation and storage expenses and eligible depreciation and operating expenses. Most jurisdictions levy royalties at a rate of 10 per cent of the wellhead value.

The petroleum royalty payable depends on a range of factors, including costs and the level of production. As the sales price is critical to the wellhead value, movements in oil and gas prices will significantly affect the forecast level of royalty payments. The Queensland Government has forecast petroleum royalty collections of \$296m in the year 2020-21 (see below).

## **Petroleum Resource Rent Tax**

PRRT is a profits-based resource tax that applies to all oil and gas projects in Australia. It is levied by the Commonwealth Government under the provisions of the *Petroleum Resource Rent Tax Assessment Act 1987*. A liability to pay PRRT arises after a project has recovered all eligible outlays associated with the project (including after deducting eligible exploration expenditure transferred from other projects), plus a threshold (or risk-adjusted) rate of return.

PRRT was first introduced in the mid-1980s for new offshore projects. In the early 1990s the regime was expanded to cover the Bass Strait project. From 1 July 2012, the PRRT was further extended to apply to all onshore petroleum production, including unconventional gas. For onshore oil and gas projects (those captured by the 2012 extension of the PRRT regime), the then existing resource taxes and charges that applied at the time of the extension have been fully retained.

PRRT is a profits-based tax:

- It is assessed on an individual project basis - project may comprise one or more petroleum production licences.
- A tax rate of 40 per cent applies.
- A liability is incurred when all allowable expenditures have been deducted from assessable receipts.
- Assessable receipts include the amounts received from the sale of all petroleum.
- Deductions include capital and operating costs relating to the petroleum project. These are deductible in the year they are incurred. Deductible expenditures include those related to exploration (including eligible exploration costs incurred by a taxpayer in other areas), development, operating and closing down activities.
- Costs associated with the liquefaction of gas and storing and shipping LNG are outside the scope of the tax - a 'marketable petroleum commodity' exists before these processes occur.
- Undeducted expenditures are compounded forward at a variety of set rates depending on the nature of those expenditures and when they are incurred.



Other resource taxes and charges (including royalties) incurred in relation to a project are rebateable against a project's PRRT liability. This avoids imposing double taxation on projects. Like other resource charges, PRRT is deductible in determining a taxpayer's income tax liability.

The PRRT a project pays is determined by numerous factors, including:

- A tax liability under the PRRT regime is incurred only once a threshold return has been generated. As such, PRRT is unlikely to be paid from a project until a number of years of production.
- Other resource taxes and charges from a project (such as state and federal royalties and production excise) are rebateable against a PRRT liability from the same project.
- As PRRT is a profits-based tax, a tax liability depends on factors such as commodity prices, exchange rates and project costs. This is a design feature of the regime, and reflects the high rate of tax that is applicable when a tax liability is incurred.

### Unconventional Gas Taxation Estimated Contribution

As the unconventional gas industry is still in the early stages of production, the level of taxation paid is gradually building.

As company tax is calculated on an entity's overall business base (not a project level), it is not possible to estimate the amount of company tax that is directly attributable to unconventional gas production. At this stage of the development cycle, taxation directly attributable to unconventional gas production is likely to be relatively low. This reflects the high level of costs that have been quite recently incurred.

Most of Australia's unconventional gas production is sourced from Queensland. The petroleum royalty data presented below is derived from the 2017-18 Queensland Government Budget Papers. APPEA estimates that most of the State's petroleum royalty receipts are directly associated with CSG production. Small but unquantifiable amounts of royalty may be payable in other jurisdictions.

As indicated above, the PRRT regime was extended to cover onshore petroleum production with effect from 1 July 2012. The combination of relatively low levels of production, high levels of deductible expenditure in the early lives of projects, low prices and the payment of petroleum royalties means that PRRT liabilities are not expected to be incurred for a number of years. This was acknowledged when the regime was extended onshore in 2012.

**Table 15: Unconventional Gas Production – Estimated Taxation Payments**

	2018-19	2019-20	2020-21
Company Tax (1)	n/a	n/a	n/a
Petroleum Royalties (2)	194	248	296
PRRT (3)	n/a	n/a	n/a

Source: Queensland Budget Papers/APPEA (2017)

Notes:

n/a – not available

(1) Company tax is paid at a corporate level, data at a project or commodity level is not available. The amounts payable are expected to increase significantly over time.

(2) Petroleum royalties are sourced from 2017-18 Queensland Budget Papers, and includes minor amounts from conventional petroleum sources. Royalty payments from other states are not included – APPEA estimates that such amounts are likely to be relatively small based on the levels of unconventional gas production from outside Queensland.

(3) Estimated to be modest until projects recover investment costs.

## Section 6 – Regulation

### Regulatory Overview

The natural gas industry is regulated by many agencies – Commonwealth, State and Territory. Most Australian jurisdictions have significantly changed gas industry regulation to accommodate unconventional gas operations. In many cases, these reforms have been informed by reviews conducted by independent experts or parliamentary committees (examples are provided in Table 16 below). Many of these regulatory changes have built upon or been grafted onto existing provisions for conventional petroleum operations.

The main regulatory instruments are identified in Table 16 below. The industry complies with industry-specific requirements (for example, environmental, safety and public health, land use, planning) as well as generic resource or business regulation. The regulatory arrangements are complex and often involve considerable, costly duplication.

Governments have sometimes rejected reform recommendations on flimsy grounds. For example, while the Tasmanian review of hydraulic fracturing found that *“the risks associated with this technology [hydraulic fracturing] are seen as low and manageable by industry”*, the Tasmanian Government took the view that *“Fracking may not be compatible with the Tasmanian community’s aspirations for our rural communities and regional landscapes.”*

**Table 16: Regulation of Unconventional Gas in Australia**

Jurisdiction	Review(s)	Current status	Principal legislation/regulation
National	Australian Council of Learned Academies, ‘Securing Australia’s Future – Engineering Energy: Unconventional gas production’	The Commonwealth Government is working with States/Territories to negotiate assessment and approval bilateral agreements under the <i>Environment Protection and Biodiversity Conservation Act 1999</i> .	<ul style="list-style-type: none"> <li>• <i>Environment Protection and Biodiversity Conservation Act 1999</i></li> <li>• <i>Water Act 2007</i></li> <li>• <i>Native Title Act 1993</i></li> <li>• <i>Industrial Chemicals (Notification and Assessment) Act 1989</i></li> <li>• <i>Corporations Act 2001 and Australian Securities and Investments Commission Act 2001</i></li> <li>• <i>Fair Work Act 2009</i></li> <li>• <i>Petroleum Resource Rent Tax Assessment Act 1987</i></li> <li>• <i>Income Tax Assessment Act (various years)</i></li> <li>• <i>Excise Tariff Act 1921</i></li> </ul>

Jurisdiction	Review(s)	Current status	Principal legislation/regulation
Queensland		<p>Coal seam gas exploration and production is widely undertaken in Queensland. Significant environment and land access reforms have been implemented previously.</p> <p>An independent review of the GasFields Commission is underway, with a final report and recommendations due to the Minister for State Development in mid-2016.</p>	<ul style="list-style-type: none"> <li>• <i>State Development and Public Works Organisation Act 1973</i></li> <li>• <i>Environmental Protection Act 1994</i></li> <li>• <i>Environmental Protection Regulation 2008</i></li> <li>• <i>Fisheries Act 1994</i></li> <li>• <i>Forestry Act 1959</i></li> <li>• <i>Nature Conservation Act 1992</i></li> <li>• <i>Regional Planning Interests Act 2014</i></li> <li>• <i>Petroleum and Gas (Production and Safety) Act 2004</i></li> <li>• <i>Waste Reduction and Recycling Act 2011</i></li> <li>• <i>Water Act 2000</i></li> <li>• <i>Aboriginal Cultural Heritage Act 2003</i></li> <li>• <i>Queensland Heritage Act 1992</i></li> <li>• <i>Public Health Act 2005</i></li> <li>• <i>Transport Operations (Road Use Management) Act 1995</i></li> <li>• <i>Queensland Industrial Relations Act 1999</i></li> <li>• <i>Sustainable Planning Act 2009</i></li> <li>• <i>Petroleum and Gas (Production and Safety) Act 2004 (and Petroleum Act 1923)</i></li> </ul>
NSW	NSW Chief Scientist & Engineer, <i>Independent Review of Coal Seam Gas Activities in NSW</i> .	<p>Following an extensive independent review of the NSW regulatory framework and how it manages CSG activities, conducted by Professor Mary O’Kane AC, the NSW Government responded with the NSW Gas Plan.</p> <p>Under the Plan, the Government will:</p> <ul style="list-style-type: none"> <li>• Make better science and information available to decision-makers and the community;</li> <li>• Take a more strategic approach to issuing petroleum exploration titles;</li> <li>• Introduce strong and certain regulation with a lead regulator responsible for compliance and enforcing conditions of approval for gas activities in NSW;</li> <li>• Share the benefits of gas development with landholders and local communities; and</li> <li>• Secure gas supplies by exploring all supply options.</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Environmental and Planning Assessment Act 1979</i></li> <li>• <i>Heritage Act 1977</i></li> <li>• <i>National Parks and Wildlife Act 1974</i></li> <li>• <i>Petroleum (Onshore) Act 1991</i></li> <li>• <i>Protection of the Environment Operations Act 1997</i></li> <li>• <i>Water Management Act 2000</i></li> <li>• <i>Dangerous Goods (Road and Rail Transport) Act 2008</i></li> <li>• <i>Environmentally Hazardous Chemicals Act 1985</i></li> <li>• <i>NSW Work Health and Safety (Mines and Petroleum Sites) Act 2013</i></li> <li>• <i>Public Health Act 2010</i></li> <li>• <i>Industrial Relations Act 1996</i></li> </ul>
Victoria	Victorian Auditor-General’s Report, <i>Unconventional Gas: Managing Risks and Impacts</i> . Legislative Council Inquiry into Unconventional Gas in Victoria.	Following two reviews of unconventional gas in Victoria, a moratorium remains in place.	<ul style="list-style-type: none"> <li>• <i>Petroleum Act 1998</i></li> <li>• <i>Petroleum Regulations 2011</i></li> <li>• <i>Mineral Resources (Sustainable Development) Act (MRSDA) 1990</i>.</li> <li>• <i>Planning and Environment Act 1987</i>.</li> <li>• <i>Environment Effects Act 1978</i></li> <li>• <i>Water Act 1989</i></li> <li>• <i>Environment Protection Act 1970</i></li> <li>• <i>Mineral Resources (Sustainable Development) Act (MRSDA) 1990</i></li> <li>• <i>Occupational Health and Safety Act 2004 and the Dangerous Goods Act 1985</i></li> </ul>
SA	Parliament of South Australia, Natural Resources Committee, Inquiry into Unconventional Gas. [Ongoing].	<p>The Cooper Basin is the only area where unconventional gas exploration and development has been undertaken.</p> <p>The Roundtable for Unconventional Gas has provided a forum for consideration of improvements to the existing regulatory framework.</p>	<ul style="list-style-type: none"> <li>• <i>Petroleum and Geothermal Energy Act 2000</i></li> <li>• <i>Development Act 1993</i></li> <li>• <i>Environment Protection Act 1993</i></li> <li>• <i>Native Vegetation Act 1991</i></li> <li>• <i>Natural Resources Management Act 2004—Far North Water Allocation Plan</i></li> <li>• <i>Aboriginal Heritage Act 1988</i></li> <li>• <i>Heritage Places Act 1993</i></li> <li>• <i>Work Health and Safety Act 2012</i></li> </ul>

Jurisdiction	Review(s)	Current status	Principal legislation/regulation
WA	<p>Dr Tina Hunter, <i>Regulation of Shale, Coal Seam and Tight Gas Activities in Western Australia</i>.</p> <p>Parliament of Western Australia, Legislative Council, Inquiry into Hydraulic Fracturing for Unconventional Gas.</p>	<p>There have been two tranches of regulatory reforms in Western Australia. In response to the 2011 review by Dr Tina Hunter, the WA Government developed and introduced new environment and resource management regulations which captured issues associated with unconventional gas.</p> <p>Following the WA Parliament Legislative Council Environment and Public Affairs Committee's Inquiry into Hydraulic Fracturing, a further round of reforms has been agreed to by the WA Government and is expected to be progressed through 2016.</p>	<ul style="list-style-type: none"> <li>• <i>Conservation and Land Management Act 1984</i></li> <li>• <i>Environmental Protection Act 1986</i></li> <li>• <i>Wildlife Conservation Act 1950</i></li> <li>• <i>Environment Protection Act 1986</i></li> <li>• <i>Rights in Water and Irrigation Act 1914</i></li> <li>• <i>Planning Authority Act 1972</i></li> <li>• <i>Aboriginal Heritage Act 1972</i></li> <li>• <i>Petroleum and Geothermal Energy Resources Act 1967</i></li> <li>• <i>Petroleum and Geothermal Energy Resources (Environment) Regulations 2012</i></li> <li>• <i>Contaminated Sites Act 2003</i></li> <li>• <i>Health Act 1911</i></li> <li>• <i>Occupational Safety and Health Act 1984</i></li> <li>• <i>Petroleum and Geothermal Energy Resources (Occupational Safety and Health) Regulations 2010</i></li> <li>• <i>Petroleum and Geothermal Energy Resources (Management of Safety) Regulations 2010</i></li> </ul>
NT	<p>Dr Allan Hawke AC, <i>Report of the Inquiry into Hydraulic Fracturing in the Northern Territory</i>.</p>	<p>An independent review of the regulatory framework for unconventional gas in the Northern Territory has identified improvements to the existing regulatory framework which would further refine the Territory's ability to manage unconventional gas.</p> <p>In August 2015, the Territory introduced 'Onshore Oil and Gas Guiding Principles' as an interim measure while key recommendations from the Hawke Review are being progressed.</p>	<ul style="list-style-type: none"> <li>• <i>Environmental Assessment Act 1982</i></li> <li>• <i>Territory Parks and Wildlife Act 2006</i></li> <li>• <i>Waste Management and Pollution Control Act 1997</i></li> <li>• <i>Water Act 1992</i></li> <li>• <i>Petroleum Act 1984</i></li> <li>• <i>Northern Territory Aboriginal Sacred Sites Act 1989</i></li> <li>• <i>Dangerous Goods Act 1998</i></li> <li>• <i>Petroleum Act 1984—Schedule of Onshore Petroleum Exploration and Production Requirements</i></li> <li>• <i>Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act 2010</i></li> <li>• <i>Work Health and Safety (National Uniform Legislation) Act 2011</i></li> </ul>
Tasmania	<p>Department of Primary Industries, Parks, Water and Environment, <i>Review of Hydraulic Fracturing in Tasmania</i>.</p>	<p>Following a review of hydraulic fracturing by the Tasmanian Government, a moratorium remains in place until March 2020. Exploration, including for unconventional gas, is still permitted. However hydraulic fracturing is forbidden.</p>	<ul style="list-style-type: none"> <li>• <i>Mineral Resources Development Act 1995;</i></li> <li>• <i>Environmental Management and Pollution Control Act 1994;</i></li> <li>• <i>Land Use Planning and Approvals Act 1993</i></li> </ul>

Source: APPEA and State Governments

## Fraser Institute Report

The Fraser Institute's Global Petroleum Survey of 'barriers to investment' assesses regulatory performance across local and international jurisdictions.<sup>33</sup> The survey includes an annual 'Policy Perception Index' measuring investor sentiment based on regulatory climate, political risk, production taxes, quality of infrastructure and other factors.

In the 2016 survey, Queensland ranked 47 out of 96 global jurisdictions for investment attractiveness. For the past two years, Queensland has improved on all rankings. The survey shows

<sup>33</sup> Fraser Institute (2016), *Global Petroleum Survey 2016*, December, <https://www.fraserinstitute.org/studies/global-petroleum-survey-2016>.

NSW as amongst the bottom 10 of least attractive investment destinations in the world, in company with Venezuela, Libya and Russia.

For Victoria over 40 per cent of investors are strongly deterred by a lack of political stability and over 40 per cent are concerned with the lack of fair and transparent legal processes. With bans on conventional and unconventional onshore gas, Victoria has fallen from being one of Australia's most attractive jurisdictions in 2011 to the second worst in 2016.

**Table 17: Ranking of Jurisdiction Performance – Fraser Institute Report**

	NSW		NT		Qld		SA		Tas		Vic		WA		Cwth	
	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015	2016	2015
Fiscal Terms	80	60	-	12	39	18	-	1	-	31	52	40	19	14	15	38
Environmental Regulations	95	121	-	51	79	105	-	20	-	107	83	120	80	68	78	94
Regulation Uncertainty	92	64	-	16	32	33	-	11	-	51	75	55	37	33	29	28
Cost of Regulatory Compliance	91	112	-	59	77	63	-	20	-	103	74	103	70	76	63	61
Regulatory Duplication	68	111	-	79	44	56	-	43	-	100	38	90	35	61	39	39
Disputed Land Claims	88	110	-	109	73	102	-	25	-	118	89	88	86	108	30	30
Labour Regulations	88	104	-	49	79	103	-	55	-	90	81	102	80	87	83	97

Source: Fraser Institute (2016)

## Regulatory developments

### Commonwealth Government

#### Gas Acceleration Program (GAP)

In July 2017, the \$26 million Gas Acceleration Program (GAP) was established to accelerate the exploration and development of gas resources. GAP will support projects with the greatest likelihood of securing new and significant gas supplies for the eastern gas market from onshore gas fields.

#### East Coast gas development program

The 2017-18 Budget provided \$28.7 million to accelerate the development of new onshore gas supply in the Northern Territory and along the east coast of Australia. The program will help pull forward new gas supply projects. The program is similar to the South Australian government PACE program that has accelerated the development of five projects supplying the local market, with a second round of projects to be announced later this year.

APPEA welcomes this initiative. The only genuine, lasting solution to the tight east coast gas market is more supply. More supply will boost liquidity and competition in the market, putting downward pressure on prices.

APPEA also welcomes the \$19.6 million allocated to the Gas Market Reform Group to accelerate reforms agreed by the COAG Energy Council to improve gas market efficiency and transparency and the funding to the Australian Competition and Consumer Commission for regular market monitoring and reporting on the east coast gas market.

### Geological and Bioregional Assessments Program

The 2017-18 Budget also provided \$30.4 million for a Geological and Bioregional Assessments program to examine new gas reserves and support increased domestic supply by assessing the environmental safety of unconventional gas projects.

## **South Australia**

### Roadmap for Unconventional Gas Projects

The *Roadmap for Unconventional Gas Projects* in SA was implemented in 2012 and has established strong leadership to ensure South Australia develops their state's unconventional gas resources.<sup>34</sup> The roadmap encourages safe exploration and production of unconventional gas under this State's robust and effective regulatory framework, the *Petroleum and Geothermal Energy Act 2000*. Collectively, the Roadmap's 125 recommendations cover the full life cycle of unconventional gas projects - from exploration to production and possible liquefied natural gas exports.

The Roadmap's key focus is collaborating with community and business to secure the benefits of unconventional gas to South Australia.

### PACE South Australia

The Plan for Accelerating Exploration (PACE) gas grant program aims to increase the supply of gas and increase competition between gas suppliers in South Australia's energy market.

The second round of PACE Gas grants, announced by the South Australian Government on 17 March 2017, provides an additional \$24 million to accelerate investments in gas projects in South Australia.

## **Queensland**

### Queensland Gas Supply and Demand Action Plan

The terms of reference for the *Gas Supply and Demand Action Plan* were released in July 2015.<sup>35</sup>

Through the gas action plan, the Queensland Government aims to reinforce Queensland's status as a leading jurisdiction for the responsible supply of onshore gas and achieve the following benefits for Queenslanders:

- improved accountability for environmental and social performance
- better information for communities and gas companies
- enhanced ability for the government to manage gas resources
- delivery of a more cohesive regulatory system
- economic benefits, including increased availability of gas to the domestic market.

### Queensland Annual Exploration Program

Queensland has introduced a new approach to the release of acreage for energy and minerals. The annual exploration program provides the strategic direction for exploration in Queensland. It identifies the exploration areas to be released over the next financial year and government priorities for the responsible development of our petroleum and gas, minerals and coal resources. The annual exploration program provides certainty to both industry and investors and the early engagement

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<sup>34</sup> <https://statedevelopment.sa.gov.au/resources/unconventional-gas-projects>

<sup>35</sup> Queensland Government (2017), *Queensland Gas Supply and Demand Action Plan*, <https://www.dnrm.qld.gov.au/our-department/corporate-information/policies-initiatives/mining-resources/gas-supply-demand-action-plan>.

with stakeholders can build productive relationships between the sector and the broader community.

## **Western Australia**

### Moratorium and Inquiry

While the regulatory environment in WA is generally favourable for oil and gas activities, a second State inquiry into the use of hydraulic fracturing in Western Australia announced in September 2017 together with a ban on hydraulic fracturing in Perth, Peel and the South West has introduced significant uncertainty for unconventional activities.<sup>36</sup>

A scientific inquiry is underway to assess and report on the potential impacts of hydraulic fracturing on the onshore environment of WA outside areas covered by a ban. It will identify environmental, health, agricultural, heritage and community impacts relevant to locations, use credible scientific and historical evidence to assess the level of risk, and the potential mitigation through a scientific approach to regulation. It will also hold community meetings. The inquiry is expected to build on the work of other recent formal inquiries including a two year parliamentary inquiry in WA that found it poses negligible risk if properly regulated.

The uncertainty resulting from this further inquiry may further weaken onshore exploration activity in the State. Recent approvals reports from the WA Department of Mines, Industry Regulation and Safety indicate that only four applications for new petroleum exploration permits were received by the Government for financial year 2016-17.

### Exploration Incentive

The West Australian State Government has some initiatives underway to stimulate investor interest – refunding a \$130 million Exploration Incentive Scheme and amalgamating and modernising legislation as a way to reduce regulatory burden. Reduction in regulatory burden is difficult to measure but anecdotal feedback from industry participants suggests this remains a competitive disadvantage for the State compared to other mature jurisdictions such as Canada.

## **Northern Territory**

### Moratorium

On 14 September 2016, the Northern Territory Government announced a moratorium on hydraulic fracturing of onshore unconventional reservoirs including the use of hydraulic fracturing for exploration, extraction, production and including Diagnostic Fracture Injection Testing (DFITs). The moratorium will remain in place until the government has considered the findings of the Hydraulic Fracturing Inquiry.<sup>37</sup>

### Hydraulic Fracturing Inquiry

On 3 December 2016 the Northern Territory Government announced an independent Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs in the Northern Territory.

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<sup>36</sup> <https://www.mediastatements.wa.gov.au/Pages/McGowan/2017/09/McGowan-Government-implements-fracking-commitment.aspx>

<sup>37</sup> Fact Sheet: Moratorium on Hydraulic Fracturing, Management of Tenure  
[https://nt.gov.au/\\_data/assets/pdf\\_file/0005/382658/factsheet-moratorium-on-hydraulic-fracturing-management-of-tenure.pdf](https://nt.gov.au/_data/assets/pdf_file/0005/382658/factsheet-moratorium-on-hydraulic-fracturing-management-of-tenure.pdf)

The Inquiry is investigating the environmental, social and economic risks and impacts of hydraulic fracturing of onshore unconventional gas reservoirs and associated activities in the Northern Territory. The inquiry has extended its reporting period and is due to report in March 2018.

#### CORE

Announced in the 2014 budget, the NT Government is investing \$23.8 million over four years through the Department's NT Geological Survey (NTGS) Division to stimulate the exploration, discovery and development of new mineral and petroleum resources under its Creating Opportunities for Resource Exploration (CORE) initiative. The initiative is being undertaken by the Northern Territory Geological Survey (NTGS) and focusses on acquiring new precompetitive geoscience information to stimulate exploration and collaborative regional assessments of shale gas potential.

#### **Victoria**

A moratorium on hydraulic fracturing has been in place in Victoria since August 2012. On 30 August 2016, the Victorian Government announced a permanent ban on the exploration and development of all onshore unconventional gas in Victoria, and an extension of the current moratorium on the exploration and development of conventional onshore gas until 30 June 2020.

#### Victoria Gas Program

The Victorian Government has allocated \$42.5 million over four years in the State Budget 2017-18 to deliver the "Victorian Gas Program". The Program, which will run from 2017 to 2020, is proposed to deliver a program of geoscience and environmental research and related activities - including community engagement - for onshore conventional gas, offshore gas and underground gas storage.

The program will look closely at Victoria's gas prospectivity and the issues associated with onshore conventional gas to inform future decisions by the Victorian Government. The studies will be undertaken by scientists from the Geological Survey of Victoria and will focus on the Otway Basin in south west Victoria and the Gippsland Basin in south east Victoria.<sup>38</sup>

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<sup>38</sup> <http://earthresources.vic.gov.au/earth-resources/victorian-gas-program>



## Section 7 – Community Engagement

### Land Access

Land access for unconventional gas exploration and development is primarily regulated by state and territory governments. State and Territory governments own mineral resources. They determine which resources are made available for exploration and production, and they set the conditions for development. Companies bid for development rights and, when producing, they pay royalties and other taxes to governments.

Access to land for petroleum exploration and development is comparable to other public purposes such as construction of roads, rail, power lines, pipelines and irrigation infrastructure. There is obvious potential for conflict between the community's interest in seeing resources developed and private landowners' concerns about developments occurring on their land.

The Commonwealth's Multiple Land Use Framework (MLUF), endorsed by the COAG Energy Council, recognises this potential for conflict:

*"... rights of all land users and the potential of all regulated land uses should be acknowledged and respected, while ensuring that regulated land is not restricted to a sole use without considering the implications or consequences for other potential land uses, and the broader benefits to all Australians."<sup>39</sup>*

The Australian oil and gas industry strongly supports policies that balance these competing interests and promote co-operation and co-existence. Gas developments have a relatively modest 'footprint' and can be readily conducted alongside traditional rural industries. There are significant benefits for regional communities from industry investment in infrastructure. CSG operations also offer the production of new, reliable supplies of water for agriculture.

Land access regulation varies between jurisdictions. However, there are some common requirements:

- notifying the landholder before starting operations;
- negotiating an access agreement with the landholder which determines the terms and conditions of access before any significant activities are undertaken;
- compensating the landholder for any loss arising from industry activities; and
- arbitration where landholders and companies cannot agree on land access and, failing that, recourse through the relevant court or tribunal.<sup>40</sup>

Companies have successfully negotiated thousands of land access agreements and compensation arrangements with farmers. Over 5,700 landholder access agreements have been negotiated in Queensland. Queensland landowners received \$387 million in compensation in the six years to July 2017.

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<sup>39</sup> [www.scer.gov.au/publications/multiple-land-use-framework-december-2013](http://www.scer.gov.au/publications/multiple-land-use-framework-december-2013).

<sup>40</sup> Productivity Commission (2013), *Mineral and Energy Resource Exploration Inquiry Report*, <http://www.pc.gov.au/inquiries/completed/resource-exploration/report/resource-exploration.pdf>.

**Table 18: Queensland Land Access Agreements, 2015-16 and 2016-17**

	Added in 2015-16	Added in 2016-17	Cumulative Total (2011-12 to 2016-17)
Land Access Agreements (total)	288	1099	5711
Land Access Agreements (Active)	N/A	272	3948
QLD Land Access Agreements Value	\$78 million	\$82 million	\$387 million

Source: APPEA (2017)

### Gasfields Commission of Queensland – “On New Ground”

The GasFields Commission of Queensland is an independent statutory body formed to manage and improve co-existence between rural and regional communities and the State’s onshore gas industry.

The Commission recently released a report on the CSG industry’s impact from 2010 to 2016<sup>41</sup>. As well as containing a broad range of operational data, the report presented significant economic and regional impacts, including:

- More than \$238 million paid in compensation to landowners up to June 2015.
- Significant ‘in-kind’ benefits for landowners, including new fencing, roads, gravel and the supply of water.
- \$10.6 billion in direct spending in Queensland in 2014-15 alone, benefiting more than 3,500 businesses state wide.
- Major contributions (exceeding 10 per cent contribution to Gross Regional Product in 2014-15) in the Brisbane, Darling Downs and South West regions.
- Employment (direct and contractors) of more than 22,000 as at June 2015.
- Provision of \$360 million to road infrastructure in the State, including \$275 million on local roads.

### Landholder payments

Landholders are fairly compensated for their time working with the natural gas industry. The industry’s obligation to compensate landowners creates a strong, mutual incentive to negotiate access in ways which minimise impacts on the landowner’s business

Landholder payments in Queensland are calculated based on the disturbance experienced by the landholder. This approach ensures a tailored, equitable payments that consider the specific disturbance (e.g. wells, tracks) and the value and use of the affected land (e.g. vacant scrub land or irrigated cropping).

<sup>41</sup> Gasfields Commission, On New Ground  
[http://www.gasfieldscommissionqld.org.au/resources/documents/Report%20Learnings\\_%20FINAL.PDF](http://www.gasfieldscommissionqld.org.au/resources/documents/Report%20Learnings_%20FINAL.PDF)

The payment model provides a consistent model that is exempt from commodity price changes. It ensures landholder carry no risk and receive a guaranteed payment. Landholders receive an equitable payment based on the activity on their land. Importantly this activity may occur in the exploration phase that is potentially years before production commences (if at all) and royalties are paid.

The existing model is delivering for landholders.

Between 2011 and 2015, over \$300 million was paid to landholders in Queensland in compensation payments. In 2015, Santos paid approximately \$11.1 million in landholder compensation across its Australian operations. Santos estimated that a farmer in NSW with 4 wells on his or her property would receive \$100,000 per annum (or over \$1 million over ten years).<sup>42</sup>

Origin has committed approximately \$400 million in compensation payments to their first 100 landholders over the life of the Australia Pacific LNG project.

In 2015 Origin Energy calculated the average contract value across 87 properties. For a grazing and cultivation property the average contract payment is \$8 million over the life of the 30-year project (\$266,000 per annum).<sup>43</sup>

**Table 19: Origin Energy - Compensation to landholders with development CCA's up until 31 December 2015**

Type of Property	Number of Properties	Range of total contract values <sup>(a)</sup>	Average Contract Value <sup>(b)</sup>
Grazing and Cultivation (Combination)	16	\$600,000 - \$28 million	\$8 million
Lifestyle and Grazing (Combination)	13	\$300,000 - \$3 million	\$1 million
Lifestyle	27	\$70,000 - \$1 million	\$400,000
Grazing and Cultivation (Combination)	31	\$65,000 - \$50 million	\$7 Million

Source: Origin Energy (a) Per property over 30 year contract life (assuming 2.5% CPI), (b) Average per property)

### Case Study – Engagement with Regional Communities and community organisations in Queensland

During 2015-16 and 2016-17 financial year the Queensland oil and gas industry directly contributed to 169 separate community groups in a wide range of areas including health, education, environment and the arts.

<sup>42</sup> [https://www.ipart.nsw.gov.au/files/sharedassets/website/trimholdingbay/online\\_submission\\_-\\_santos\\_limited\\_-\\_a.\\_hicks\\_-\\_15\\_jun\\_2015\\_000000000.pdf](https://www.ipart.nsw.gov.au/files/sharedassets/website/trimholdingbay/online_submission_-_santos_limited_-_a._hicks_-_15_jun_2015_000000000.pdf)

<sup>43</sup> <http://www.aph.gov.au/DocumentStore.ashx?id=77e25ef3-cac4-40e5-9c07-3ebbb388fb02&subId=411918>

**Table 20: Number of Community Organisations Supported by Region, 2015-16**

Region	Total	% of total
Brisbane	37	22.0%
Central West	<10	n.p.
Darling Downs	66	39.1%
Far North	<10	n.p.
Fitzroy	30	18.0%
Gold Coast	<10	n.p.
Mackay	17	10.1%
North West	<10	n.p.
Northern	<10	n.p.
South West	12	7.1%
Sunshine Coast	<10	n.p.
West Moreton	<10	n.p.
Wide Bay-Burnett	<10	n.p.
<b>Total Queensland</b>	<b>168</b>	<b>100.0%</b>

Source: APPEA and QRC

Note: Only for those companies that provided supplier details. n.p. not publishable data

## Case Studies – Community Engagement

### Case Study: Pangaea Northern Territory Indigenous Employment Training Pilot Program

In 2015, Pangaea developed a close partnership between local contractors and the Northern Land Council (NLC) to develop a program to identify and train a group of cadets with the special cultural knowledge and support of the traditional owners of the land. The Program has been designed to ensure that young people have the opportunity to work ‘on their country’ while having the support network of family during placement.

The NLC helped Pangaea consult with senior Elders and spokespersons from each of the three family groups (Liwaja, Wubalawun and Jalalabayin people) on whose country Pangaea’s 2015 exploration campaign was being conducted. The meetings introduced the Program opportunity, but most importantly, engaged with ‘Mentors’ from each family group who could assist in selecting the most appropriate candidates from their extended families to take advantage of the training and employment opportunity.

The model of linking ‘country to candidates’ is essential for success. The over-riding sense of responsibility for country – and each other – in a family group was critical to ensuring completion rates and enthusiasm. In the future it also means that the land has been respected and its value preserved for future traditional owners.

The Pangaea drilling project created jobs which are needed to ensure that training opportunities lead to the social, cultural and economic benefits that communities need.

The NLC believes that the Pangaea Project has been a great boost and potentially holds great opportunity for traditional Aboriginal owners to employ their knowledge in managing their own country in the future.



### Case Study: QGC/Shell

QGC/Shell is a leading domestic producer of natural gas and operator of the QCLNG export project. Like all major project proponents QGC proactively invests in social and community infrastructure in order to provide a lasting legacy for the community and offset any impact it may have on existing infrastructure.

An example is QGC's investment in health services. QGC has implemented several initiatives aimed at improving health service delivery as detailed below.

#### Virtual services—Health-e-Regions

Telehealth is the umbrella term for the electronic and telecommunication-based expansion of health care services. Telehealth adds a new paradigm in healthcare, where the patient is monitored between clinic visits.

Telehealth has been shown to significantly reduce hospitalisations and visits to the emergency departments, while improving patients' quality of life. Telehealth also benefits patients where traditional delivery of health services is affected by distance and lack of local specialist clinicians. Time and cost to access health facilities often constitute a major obstacle to seeking care and can be a burden on the financial stability of a household.

In partnership with the University of Queensland's Centre for Online Health, QGC established the Health-e-Regions program, a comprehensive network of telehealth services in Dalby, Chinchilla and Miles that provides online and video links between patients and specialists in Toowoomba and Brisbane. In 2015, the program was extended to include Tara and Wandoan.

Between 2013 and 2014, 5,935 telehealth consultations were reported through the Darling Downs region, compared with 2,912 in the year before the project began. According to the University of Queensland Centre for Online Health's Deputy Director, Associate Professor Anthony Smith: "*We've had an overwhelmingly positive response from patients who have started using the Health-e-Regions telehealth service.*" The project has reduced the travel cost for families who previously had to travel significant distances to see a specialist in a major city.

#### Mobile services

Mobile outreach services enable greater utilisation of specialist competencies to serve remote communities. These services increase the effectiveness of frontline health workers and counsellors and respond directly to patient concerns. Often, outreach services trigger specialist follow-up visits, ultimately reducing inequity in access to care.

QGC funded Lifeline Darling Downs South West Queensland to support three mobile counsellors in the Western Downs Counselling Project, including a financial counsellor, to provide face-to-face counselling and outreach services to people in and around Dalby, Chinchilla, Wandoan, Miles and Tara. From February 2012 to December 2014, Lifeline Darling Downs South West Queensland counsellors supported 813 clients during 5,199 sessions. They have also delivered 23 group sessions in these regions. Counsellors were extensively accessed during the floods of 2012 in the Chinchilla community. The mobile counsellors reached many who may not otherwise have had access to counselling.

QGC provided \$1.2 million for the Tara Community Outreach Medical Service to provide mobile medical and dental service for families in the Tara Rural Residential Estates and broader region. Delivered by Murri Health Group, a not-for-profit Indigenous owned entity, the aim of the program was to increase the availability of preventative and primary health care. Since September 2013, the service has delivered 593 dental appointments and 563 general medical assessments and

treatments. Murri Health Group will be able to continue to provide health services on a sustainable basis, as they are funded through Medicare.

The QCLNG project area covers many remote locations where access by road is difficult and which require aerial transport in medical emergencies and during natural disasters. QGC works in partnership with other Queensland LNG proponents (Arrow Energy, APLNG, and Santos GLNG) to fund the Surat Gas Aero- Medical Service. Launched in 2011, this service has undertaken retrieval missions of community members and CSG workers, provided flood assistance and responded to emergency distress beacons. In addition to our Surat Basin medical evacuation helicopter, Curtis Island Rotary Wing Aeromedical Evacuation Service was launched in 2013 for the Gladstone region. Both services are managed by CareFlight Group Queensland. The joint \$35 million funding commitment has provided a dedicated response to medical emergencies and natural disasters across Central and Southern Queensland.

Combined, the aeromedical services conducted 496 retrievals over July 2012 to February 2014 of which 160 were for members of the public who needed urgent medical attention and would not have otherwise had a rotary service available to rapidly respond.



### Physical health infrastructure

QGC invested \$3.5 million in Gladstone Hospital to establish a renal dialysis unit and refurbish the peri-operative suite. As an outcome of the investment, patients can receive improved treatment in Gladstone, thus reducing the need to travel to Rockhampton or Brisbane for dialysis.

The investment included \$2 million for a renal dialysis centre, which included three renal dialysis units, patient chairs and a supporting reverse osmosis facility, refurbishment of the facility, staff training, and the cost of operating the centre for two years. Since the start of operations, the renal dialysis centre delivered 3508 treatments.

The remaining \$1.5 million was invested in the refurbishment of the hospital's 35-year-old peri-operative suite. Refurbishment commenced in April 2015 and, once complete, the suite will provide an improved environment for patients, relatives and staff and help in attracting priority services and specialist staff to Gladstone.

It will also complement the planned upgrade of the hospital's high dependency unit by allowing more patients to have operations at the hospital and then be cared for in the unit. Gladstone Hospital Executive Director Dr Nicki Murdock said; *"We are extremely grateful to our industry partners for these generous contributions that will improve the hospital for both patients and staff ... Up to 3000 patients are expected to use the new facilities each year and it will be wonderful for our dedicated and professional staff to have a modern, purpose-built workplace which will help them provide even better care to our patients."*

#### Support and infrastructure for health professionals

QGC identified the need to sustain or increase the capacity of staff in Indigenous community services to deliver rural health solutions. In partnership with Goondir Health Services, QGC invested \$166,350 into the Goondir Health Staff and Board Member Training Program.

The training package focused on increasing clinical and governance capacity to provide rural health services with training targeted to up-skill staff in the following six key areas:

- primary health care training for 11 staff
- service plan training for all staff and the Board
- health promotion training for 20 staff
- quality improvement training for 20 staff
- human resource management training for 1 staff member
- governance training for 10 staff and executive.

As a short-term support measure during peak construction period, QGC provided low cost housing to health workers in order to improve access to health services. QGC provided, at minimal rent, two, four-bedroom houses to the Darling Downs Hospital and Health Service to house a senior dentist and Director of Nursing in Miles.

QGC also supported the provision of 30 nursing bursaries through the University of Southern Queensland to encourage student nurses to undertake clinical placements in rural and regional hospitals away from family and support services.

#### **Case Study: Arrow Energy - regional specialist care**

Cardiovascular disease is the largest cause of death in Australians (2011 Census) and current research shows that cases of the disease are over 15 per cent higher in remote and regional areas.

The Heart of Australia program is a partnership between local Brisbane Cardiologist Dr Rolf Gomes and Arrow Energy to deliver Australia's first mobile specialist cardiac service to patients living in rural and remote Queensland.

The state of the art clinic, towed by a Kenworth prime mover, has two consulting rooms, new ultrasound, electrocardiogram and cardiac stress testing equipment.

It can instantly share test results with other GPs and hospitals and allow other specialists to dial-in through state-of-the-art telemedicine capabilities.

Since the program's launch in October 2014, the service has delivered:

- 355 specialist clinics in 11 towns across regional Queensland



- Provided care to more than 1,600 patients
- Referred 573 urgent cases identified with eight being referred for open heart surgery
- An average of 841kms travel saved per patient
- 216 avoidable hospital admissions/reduced length of stay



### **Case Study: Queensland CSG Landholder Support Project**

For many years, the Queensland gas industry has co-funded a landholder support program delivered by AgForce – the peak body for Queensland’s beef, sheep, and grain producers.<sup>44</sup> The program is a practical example of the gas and agricultural industries working together. A range of free services are provided to landholders, including advice on negotiating access with the industry.

The CSG Information Sessions assist landholders who are not yet at the negotiation stage, covering:

- An explanation of groundwater impacts and landholder rights
- Development plans in a given region
- Regulatory changes and new or updated legislation
- What landholders can expect when they enter into negotiations, including initial stages right through to negotiating rehabilitation.
- 
- The Advanced CSG Negotiation Support workshops are designed for people who:
  - Are negotiating a land access agreement; or
  - Have negotiated and settled a land access agreement; or
  - Are renegotiating their existing land access agreement; or
  - Are negotiating a Make Good agreement.

The CSG Digital Mapping Workshops provide practical computer training to help landholders develop a computer map to plan for potential CSG impacts on their land. The workshops cover skills and technology to develop a computer property map and plan, with property infrastructure and points of interest recorded, to help demonstrate to a resource company where and when it can conduct activities

A given property’s latest digital data and a mapping software demonstration program.

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<sup>44</sup> <http://www.agforceprojects.org.au/index.php?tgtPage=news&id=view,107>



*AgForce CSG Project Leader Daniel Phipps*

### **Case Study: A Joint Farming-Petroleum Approach to Land Access in Western Australia**

Between 2013 and 2015, APPEA, the WA Farmers Federation, the WA Pastoralists and Graziers Association and Vegetables WA developed Australia's first voluntary standard land access agreement. This standard agreement makes it easier for landholders and petroleum companies to negotiate a mutually beneficial arrangement. The agreement ensures that companies pay the landowner's costs for negotiating an agreement; provides a practical way to resolve disputes; and sets clear expectations for open and up-front communication.



### **Case Study: Long-term Community Investments in Queensland**

Between 2011 and 2014, QGC delivered one of the most substantial private investment programs in Queensland's history through its Social Impact Management Plan (SIMP).



QGC has delivered on the 94 commitments made under the SIMP in six areas:

- Employment and economic development
- Community safety, health and social infrastructure
- Housing
- Road and marine traffic management
- Indigenous participation
- Land use management.



Implementing the programs involved investments totalling about \$1 billion. Most funding was committed to roads and workforce accommodation. QGC also invested \$150 million in community projects, helping about 500 community-based, not-for-profit organisations. These funds include:

- \$3.5 million for the Gladstone Hospital, enabling thousands of treatments annually in a new renal dialysis centre and improved operating theatre resources.
- \$1.3 million to the Chinchilla Connexions Centre for social service delivery.
- More than \$600,000 to Queensland Fire and Emergency Services for infrastructure, equipment and other resources for rural fire brigades in the Western Downs region.
- Upgrades to airport infrastructure and safety in Chinchilla (\$4.7 million) and Gladstone (\$3.5 million).
- \$150 million for upgrading, maintaining or repairing public roads in the Western Downs and Gladstone.

### **Case Study: Engagement with Indigenous Communities in WA's Kimberley Region**

Buru Energy is an ASX-listed oil and gas exploration and production company, focused on the Canning Basin in Western Australia's Kimberley region. In 2015, Buru Energy undertook a tight gas appraisal project on and near Noonkanbah Station (Yungngora community).

Buru work with Traditional Owners includes:

- Delivering cultural inductions to all Buru Energy staff and contractors who worked on site during the tight gas project.
- Supporting independent specialist reviews for hydraulic fracturing.
- Partnering with Kimberley Training Institute (KTI) to train environmental cadets to undertake groundwater monitoring at well sites.
- Partnering with KTI to train personnel in security and operating excavators, water carts, dump trucks, front-end loaders and bobcats.
- Employing more than 30 Traditional Owners.
- A stimulation program with more than 13,500 hours of paid employment undertaken by community members.

Provided below is a Yungngora Community Statement, released in September 2015, regarding Buru Energy's activities.

11 September 2015

**The following is a joint statement released today by Yungngora Chairwoman, Caroline Mulligan and Koolkarriya Committee Chairman, Ronnie Lormada.**

We the Yungngora People are the recognized Native Title holders for Noonkanbah Station. Our lands around Noonkanbah have been our traditional lands for many thousands of years.

Buru Energy has recently completed their fracking operation on our country. We allowed this to happen after speaking to many experts about the effect of this activity on our country and the environment. Our experts looked at Buru's plans and let us know this is a safe activity if it is done properly. We trust Buru to do this properly.

"My hope and dream for the community and for the people as well is mainly getting young people involved in the workforce, getting them involved in looking after their country and with Buru it has been a really strong start with us and for the future."

"It has been great to see our young people work closely with Buru and we have that connection."

**The following is a statement from Thomas Skinner, Chairman of the Yungngora native title corporation.**

We are the new generation of Aboriginal owners that speak for our country and have the support of our old people. We have set up Koolkarriya as a business council that represents the seven clan groups of our Traditional Lands. The council really connects with Buru Energy so that we can have future work and opportunity for our young people.

The reason we selected the people on the business council is so that they can feed back to their own people that they can have their own business going as well. If Buru Energy get cranked up, that is really good for us.

We really want to keep this place going. We want to keep our young people safe from alcohol and the new drugs coming into the Kimberley. This is what is killing our people. Mining is giving us job opportunities to work on our own land. We need training and job opportunities for our kids future.

A mining company like Buru Energy come in here, they give opportunity and work. We want this.

**Alcohol and drugs is killing our people – not mining or oil and gas.**

**WE NEED THESE NEW OPPORTUNITIES.**

We welcome Buru.



**Yungngora**  
ASSOCIATION INC

Noonkanbah Station Rd  
PMB 400  
Via Fitzroy Crossing  
Western Australia 6765

Tel: (08) 9191 4691

Fax: (08) 9191 4689

Email: [yungngora@bigpond.com](mailto:yungngora@bigpond.com)

## Appendix

### Appendix 1

#### Natural gas – essential for Australian manufacturing

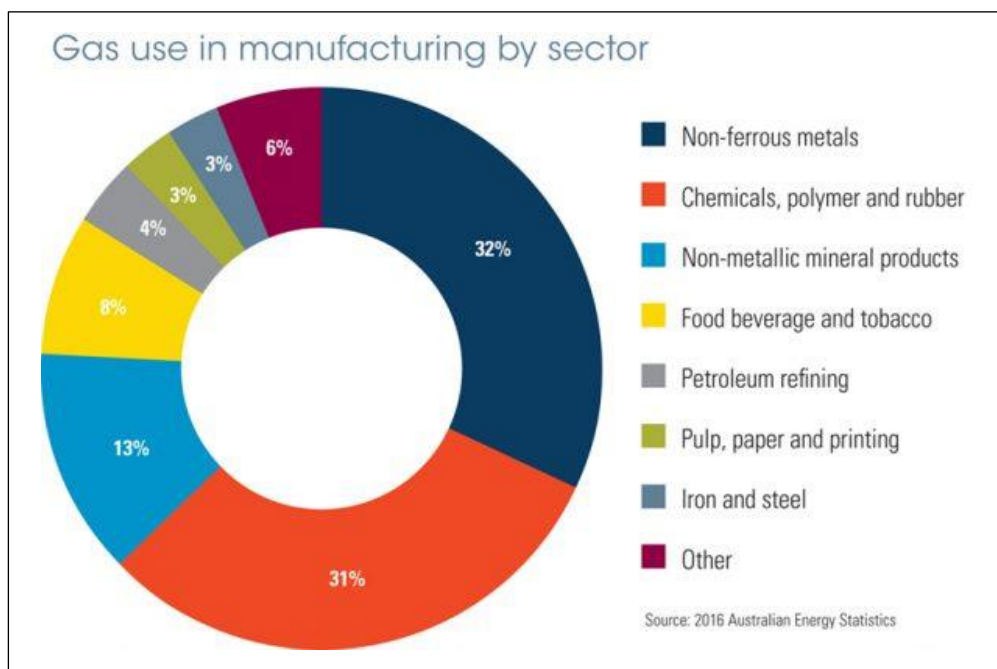
Natural gas is both a source of energy and an essential raw material for manufacturing. Almost one-third of the gas consumed in Australia is used by manufacturers.

Manufacturing in Australia is a \$100 billion industry directly employing 890,000 people.

About 225,000 people work in manufacturing sectors that rely heavily on gas; another 500,000 people work in related industries that do business with these manufacturers.

The main industrial uses of natural gas and gas-derived products are producing:

- non-ferrous metals (e.g. aluminium, copper, zinc, tin)
- chemicals and polymers (e.g. fertilisers, antifreeze)
- non-metallic mineral products (e.g. glass, ceramics, cement, bricks)
- plastic packaging for foods and beverages.
- Gas is also needed in food preparation and processing, fermentation and brewing.



#### Gas — powering industrial processes

Gas is second only to oil as an energy source for manufacturing.

Gas is essential for many industrial processes — without gas to fire kilns and furnaces, it would be impossible to make everyday products such as glass, bricks, paper, cement, steel and alumina. Many businesses meet their energy needs from their own gas-fired turbines.

Steel is galvanised with hot molten zinc to create a non-corrosive layer. Victoria-based GB Galvanising uses 50,000 gigajoules (GJ) of gas every year. No alternative fuel can maintain the necessary high temperatures.

Alumina refineries use gas for power generation and for refining bauxite to produce alumina, which is used to produce aluminium. Alumina refining requires temperatures greater than 1100°C. Gas is the only fuel that can achieve this temperature. Alcoa uses 95,000 terajoules (TJ) of gas each year in its three alumina refineries in Western Australia.

**Gas — the invisible ingredient of everyday products**

Natural gas is also a raw material (feedstock) for creating products such as fertilisers, explosives, paper, plastics and chemicals. In most cases, there is no substitute for gas. Gas is used to produce ammonia, which is an important feedstock for several industries.

The most commonly used fertiliser in the world is urea, which is produced from ammonia. Producing each tonne of urea requires 21GJ of natural gas — the same amount of gas that the average NSW household uses in a year. Australian industries use 1.6 million tonnes of urea each year.

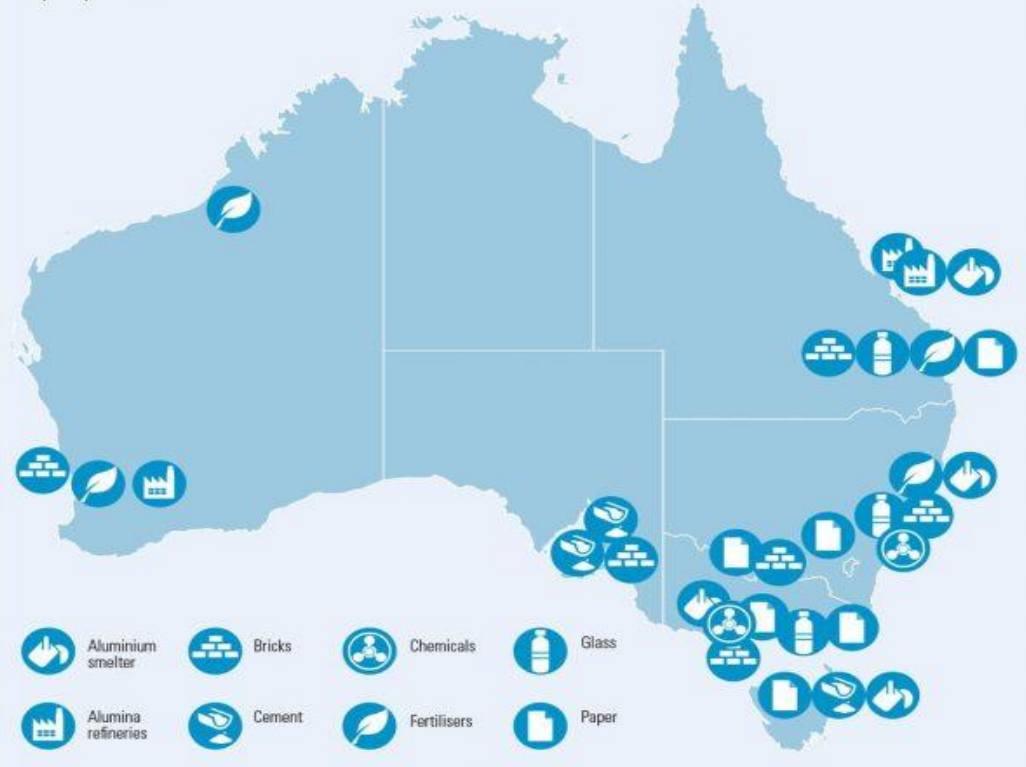
Ammonia is also used to make explosives and cleaning products, and in fermentation, brewing and winemaking.

Plastics are made from ethane, which is derived from natural gas. At 850°C, steam is added to ethane to break it into ethylene. This is then used to make plastics, which are used in food packaging and wrapping; plumbing and guttering; fibres and textiles; machine parts; and many other applications.

### Gas— fuelling manufacturing across industries and across Australia

Manufacturing clusters dependent on gas are found in all Australian states:

- **Fertilisers**—Brisbane (Qld); Kwinana and Pilbara (WA); and Kooragang (NSW).
- **Chemicals**—Altona (Vic) and Botany (NSW).
- **Paper**—Brisbane (Qld); Tumut and Albury (NSW); Maryvale, Coolaroo and Campbellfield (Vic); and Boyer (Tas).
- **Glass**—Melbourne (Vic); Eagle Farm (Qld); and Sydney (NSW).
- **Bricks**—Perth (WA); Albury, Cecil Park and Schofields (NSW); Thomastown and Scoresby (Vic); Darra and Oxley (Qld); and Golden Grove (SA).
- **Cement**—Angaston and Birkenhead (SA).
- **Alumina refineries**—Peel region and Kwinana (WA); and Gladstone and Yarwun (Qld).
- **Aluminium smelters**—Boyerne Island (Qld); Tomago (NSW); Portland (Vic); and Bell Bay (Tas).





**Appendix 2**  
**Table 21: Unconventional Gas Frameworks in Australia**

Primary Finding	Source
<b>“This Inquiry’s major recommendation, consistent with other Australian and International reviews, is that the environmental risks associated with hydraulic fracturing can be managed effectively subject to the creation of a robust regulatory regime.”</b>	Allan Hawke AC, <i>Report of the Independent Inquiry into Hydraulic Fracturing in the Northern Territory</i> , 2014, Executive Summary, page x.
<b>“The Committee finds that many of the concerns expressed by the community in relation to the impact of hydraulic fracturing for unconventional gas can be addressed through robust regulation and ongoing monitoring.”</b>	WA Legislative Council Environment and Public Affairs Committee, <i>Inquiry into Hydraulic Fracturing for Unconventional Gas</i> , 2015.
<b>“The evidence suggests that, provided appropriate monitoring programs are undertaken and a robust and transparent regulatory regime put in place (and enforced), there will be a low risk that shale gas production will result in contamination of aquifers, surface waters or the air, or that damaging induced seismicity will occur.”</b>	The Australian Council of Learned Academies, <i>Engineering Energy: Unconventional Gas Production – A study of shale gas in Australia</i> , 2013, p177.
<b>“There is a perception in some parts of the community that CSG extraction is potentially more damaging and dangerous than other extractive industries. This perception was heightened following the release of the American movie Gasland in 2010. The Review examined this issue in detail and concluded that, while the CSG industry has several aspects that need careful attention, as do almost all industries, it is not significantly more likely to be more damaging or dangerous than other extractive industries.”</b>	Mary O’Kane, NSW Chief Scientist and Engineer, <i>Final Report of the Independent Review of Coal Seam Gas Activities in NSW</i> , 2014, p7.
<b>“Provided best practice is followed, including ensuring that there is comprehensive knowledge of the sub-surface, hydraulic fracturing is most unlikely to cause damaging induced seismic events or result in widespread, systemic impacts on drinking water resources – of which there is no evidence from hydraulic fracturing of shales in the US.”</b>	Australian Academy of Technology and Engineering <i>Media Release – Best practice and community support are keys to unconventional gas</i> , 3 December 2015.

The US Energy Information Administration (EIA) estimates that Australia has the sixth largest shale oil resource (18 billion barrels) and the seventh largest shale gas resource (437 trillion cubic feet) in the world.<sup>45</sup> Australia’s CSG resources are estimated to be around 6 per cent of the world’s coal seam gas resources at 235 trillion cubic feet (4.6 million PJ) (Geoscience Australia 2012)<sup>46</sup>.

The EIA notes that “these shale oil and shale gas resource estimates are highly uncertain and will remain so until they are extensively tested with production wells.” The Australian Council of

<sup>45</sup> US Energy Information Administration, ‘Shale oil and shale gas resources are globally abundant’, <http://www.eia.gov/todayinenergy/detail.cfm?id=14431>.

<sup>46</sup> Australian Gas Resource Assessment 2012 [http://www.ga.gov.au/webtemp/image\\_cache/GA21116.pdf](http://www.ga.gov.au/webtemp/image_cache/GA21116.pdf)

Learned Academies' investigation into shale gas agrees:

*"... there is an urgent need to encourage shale gas exploration in Australia to provide a clearer picture of the extent of the resources and to safeguard Australia's position as a major world gas exporter and to improve resource and reserve estimates."<sup>47</sup>*

Australia's oil and gas supplies are categorised as either resources or reserves. Resources refer to the total estimated stock of oil and gas. Reserves is a narrower measure that estimates the quantities of the resource which can be extracted *on a commercial basis*.

The Society of Petroleum Engineers,<sup>48</sup> in conjunction with other global bodies, has established a framework for the reporting of reserves and resources (the Petroleum Resource Management System). The system has three broad categories:

- **Proved Reserves (1P)** are quantities of petroleum which, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially recoverable, from a given date forward, from known reservoirs and under defined economic conditions, operating methods, and government regulations. If deterministic methods are used, the term 'reasonable certainty' is intended to express a high degree of confidence that the quantities will be recovered. If probabilistic methods are used, there should be at least a 90 per cent probability that the quantities actually recovered will equal or exceed the estimate.
- **Probable Reserves** are those additional reserves that geoscience and engineering data indicate are less likely to be recovered than Proved Reserves but more likely to be recovered than Possible Reserves. It is equally likely that the quantities recovered will be greater than or less than the sum of the estimated Proved plus Probable Reserves (2P). If probabilistic methods are used, there should be at least a 50 per cent probability that the actual quantities recovered will equal or exceed the 2P estimate.
- **Possible Reserves** are additional reserves that geoscience and engineering data suggest are less likely to be recoverable than Probable Reserves. The total quantities recovered have a low probability to exceed the sum of Proved plus Probable plus Possible (3P) Reserves, which is equivalent to the high estimate scenario. If probabilistic methods are used, there should be at least a 10 per cent probability that the actual quantities recovered will equal or exceed the 3P estimate.

The best estimate of recovery from committed projects is generally considered to be the 2P sum of proved and probable reserves; 2P estimates are generally used in this report. **Contingent Resources** are less certain than reserves. Contingent resources are quantities considered recoverable but are not yet feasible due to technological or business hurdles, or environmental and/or governmental approval constraints. **Prospective Resources** are an estimate of the potential volumes associated with undiscovered accumulations.

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<sup>47</sup> Australian Council of Learned Academies, *Securing Australia's Future – Engineering energy: unconventional gas production*, [www.acola.org.au/index.php/projects/securing-australia-s-future/project-6](http://www.acola.org.au/index.php/projects/securing-australia-s-future/project-6), p.22.

<sup>48</sup> See: [www.spe.org/industry/reserves.php](http://www.spe.org/industry/reserves.php)

**Appendix 3**
**Table 22: Summary Table – Economic Contribution in Queensland**

	2015-16	2016-17
<b>Value Added (\$m)</b>		
Direct	6,170	4,157
% of GSP/GDP	2%	1%
Indirect	4,354	3,233
Total value added (Type I)	10,524	7,290
% of GSP/GDP	3.3%	2.3%
Consumption-induced	2,303	1,798
Total value added (Type II)	12,827	9,089
% of GSP/GDP	4.1%	2.9%
<b>Employment (FTEs)</b>		
Direct	4,727	4,156
% of total state/national employment	0.2%	
Indirect	34,832	23,042
Total employment (Type I)	39,559	27,198
% of total state/national employment	1.7%	1.2%
Consumption-induced	25,750	16,537
Total employment (Type II)	65,309	44,307
% of total state/national employment	2.8%	1.9%
<b>Business spend (incl. community contributions and government payments) (\$M)</b>		
Direct	5,425	3,523
Indirect	3,420	2,262
Total business spend (Type I)	8,845	5,785
Consumption-induced	4,623	3,509
Total business spend (Type II)	13,468	9,294
<b>Wages &amp; salaries (\$M)</b>		
Direct	745	635
Indirect	2,251	2,017
Total wages & salaries (Type I)	2,996	2,651
Consumption-induced	1,366	1,226
Total wages & salaries (Type II)	4,362	3,877
<b>Activity</b>		
Exploration Wells Queensland	22	23
Production Wells	661	553
Hydraulic Fracturing	130	122
% of Production Wells Fractured (as % of annual wells drilled)	20%	22%
Number of Monitoring Bores	1,108	1,250
Beneficial Use Water	49,760 ML	41,800 ML
Number of LNG Cargoes	187	301

**Appendix 4**  
**Selected Terms Used in this Report<sup>49</sup>**

<b>Term</b>	<b>Definition</b>
<b>1P</b>	Proved reserves.
<b>2P</b>	The sum of proved and probable reserves.
<b>3P</b>	The sum of proved, probable and possible reserves.
<b>2C</b>	Best estimate of contingent resources.
<b>3C</b>	High estimate of contingent resources.
<b>Abandoned/Decommissioned Wells</b>	Where the reservoir and high-pressure zones in a well are sealed with cement so that no fluids or gasses can escape after the drilling rig leaves the location.
<b>AEMO</b>	Australian Energy Market Operator.
<b>APPEA</b>	Australian Petroleum Production & Exploration Association.
<b>BCM</b>	Billion Cubic Metres (of gas).
<b>Co-produced water</b>	Produced water (also known as coal seam gas water or associated water) is the combination of hydraulic fracturing fluid (if hydraulic fracturing has occurred) and formation water, which is water that is already present in the coal seam. The gas and produced water are separated at the surface.
<b>Conventional gas</b>	Conventional gas reservoirs largely consist of porous sandstone formations capped by impermeable rock, with the gas stored at high pressure.
<b>CSG</b>	Coal seam gas is trapped in coal seams by water pressure. To extract CSG, water already in the coal seam must be pumped out to release the gas.
<b>Exploration well</b>	A well drilled to establish the existence of a possible petroleum deposit or to acquire information to delimit an established deposit. Exploration wells include wildcat and appraisal wells.
<b>Formal dispute of access</b>	An access dispute referred to a body (for example, a Magistrate's Court) for arbitration.
<b>Fracture stimulation/hydraulic fracturing.</b>	Hydraulic fracturing, also commonly referred to as fracking, is a method used by the oil and gas industry since the late 1940s to increase oil and gas extraction from reservoirs. It has been used in Western Australia and South Australia since the 1960s and in Queensland since the 1990s.
<b>GISERA</b>	Gas Industry Social and Environmental Research Alliance.
<b>LNG</b>	Liquefied natural gas.
<b>Land access agreement</b>	Agreement between a landholder and petroleum operator. Typically details the terms of access.

<sup>49</sup> Note: some of these definitions have been adopted from the CSIRO's "What is Unconventional Gas" Page: [www.csiro.au/en/Research/Energy/Hydraulic-fracturing/What-is-unconventional-gas](http://www.csiro.au/en/Research/Energy/Hydraulic-fracturing/What-is-unconventional-gas)

<b>Monitoring bores</b>	A well used for monitoring, typically for changes to water or atmospheric composition.
<b>MTPA</b>	Million tonnes per annum.
<b>Pilot and appraisal wells</b>	Exploration well drilled to establish the extent and size of a petroleum deposit that has already been discovered by a wildcat well.
<b>PJ</b>	Petajoule.
<b>Production wells</b>	A development well used for production of petroleum or of water for injection purposes.
<b>PRMS</b>	Petroleum resource management system.
<b>PRRT</b>	Petroleum Resource Rent Tax.
<b>Shale gas</b>	Shale gas occurs in rock formations under high pressure but having extremely low porosity making it difficult for gas to flow to wells.
<b>SIMP</b>	Social Impact Management Plan.
<b>Syngas</b>	Abbreviation for 'synthesis gas'. A fuel gas mixture consisting primarily of hydrogen, carbon monoxide and carbon dioxide. The result of UCG.
<b>TCf</b>	Trillion cubic feet (of gas). One TCF is enough gas to power a city the size of Perth for 10 years.
<b>Tight gas</b>	Tight gas is the term commonly used to refer to low permeability reservoirs that produce mainly dry natural gas. Many of the low permeability reservoirs that have been developed in the past are sandstone.
<b>Total (active) wells</b>	Total wells currently operating.
<b>UCG</b>	Underground coal gasification. This is not a form of unconventional gas production. It is a process of producing synthetic gas by partially burning coal seams in situ and then extracting the "syngas" produced.
<b>Unconventional gas</b>	Typically refers to gas found in coal seam, shale rocks or tight reservoirs (typically limestone and sandstone).