



# Select Committee on Unconventional Gas Mining

australian petroleum production & exploration association limited

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the voice of Australia's oil and gas industry

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# 1 Executive summary

APPEA regards the Select Committee on Unconventional Gas Mining as an opportunity to place on the public record a comprehensive response to the numerous claims—factual and otherwise—made about unconventional gas.

APPEA's views can be summarised as:

- Natural gas is an essential commodity for modern Australia. Natural gas is needed for power generation and is an indispensable feedstock for manufactured products such as fertilisers, plastics and chemicals.
- Gas demand in eastern Australia will continue to be strong and will increasingly need to be supplied from unconventional sources such as coal seam and shale gas.
- The technology used to extract unconventional gas has been widely used for decades.
- Experience in Australia and overseas, as well as independent assessments by leading expert bodies such as the CSIRO, the Australian Council of Learned Academies and the Royal Society, confirm that, properly regulated, unconventional gas developments do *not* threaten the environment or public health.
- The economic benefits to Australia and regional communities are significant and lasting. The industry generates highly skilled jobs, export dollars, and government revenue.
- Gas developments need not compete with other land uses. The industry's footprint is relatively small and the industry is successfully coexisting with a variety of other activities including intensive cropping, grazing, and organic farming.

APPEA members value community support. Our members respect the fact that their operations usually occur on land owned by others. Members typically exceed legislated requirements with the aim of fostering trusted, long-term relationships. The gas industry understands that its success depends on its reputation and its 'on-the-ground' performance.

While there are many people with concerns about the operation of the industry who wish to know the facts, there are also well-resourced activist campaigns promoting anti-development agendas. Unfortunately, these campaigns often show little regard for the truth and are rarely held accountable for their claims.

APPEA believes claims against the industry should be tested by genuine, independent experts.

APPEA urges the Committee to use the inquiry to place the public debate on a sound, factual basis. There is ample evidence from leading experts such as the CSIRO, the Australian Council of Learned Academies, the NSW Chief Scientist and Engineer, the head of the United States Environmental Protection Agency, and the Chair of the UK's Independent Advisory Committee on Climate Change—to name a few—which should be recognised in the work of the Committee.

APPEA looks forward to working with the Committee to this end.





## 2 Introduction

The Australian Petroleum Production & Exploration Association (APPEA) is the peak national body representing the upstream oil and gas exploration and production industry. APPEA has more than 80 full member companies comprising oil and gas explorers and producers in Australia. APPEA members produce an estimated 98 per cent of the nation's petroleum. APPEA also represents more than 250 associate member companies providing goods and services to the upstream oil and gas industry. Further information about APPEA can be found at [www.appea.com.au](http://www.appea.com.au).

This submission is intended to give the Committee an appreciation of the vast body of science, research, and regulation that underpins the modern Australian onshore natural gas industry.

To this end we have provided 48 primary references and fact sheets as attachments. These collectively run to over 2400 pages and are sourced from leading independent and respected institutions including:

- CSIRO
- Australian Government Bureau of Resources and Energy Economics
- Australian Council of Learned Academies
- Australian Government's Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development
- Queensland Valuer-General
- Queensland GasFields Commission
- Queensland Department of Health
- Western Australian Health Department

We have also provided details of some of the key pieces of regulation applying to the industry that are relevant to the terms of reference, such as the 'make good' regime in Queensland, and key government reports, such as the Queensland Office of Groundwater Impact Assessment's report on underground water impacts from the CSG-LNG industry.

It is important that the Committee takes account of this independent information, science, and data and ensures that fear campaigning and misinformation do not displace fact and credible evidence.



### 3. 'Conventional' vs 'unconventional' gas

The distinction between '**unconventional**' gas and '**conventional**' gas is simply based on the type of rock the gas is found in:

- 'Conventional' gas reservoirs largely consist of porous sandstone formations capped by impermeable rock, with the gas stored at high pressure. Australia's conventional gas reserves are mostly offshore. Conventional gas often 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'.
- 'Unconventional' gas reservoirs include coal seams, shale, and tight sandstone formations (where the sand is more compacted). CSG is found in coal seams where methane is bonded to the coal and is trapped underground by water pressure. To extract CSG, water already in the coal seam, known as formation water, needs to be pumped out to lower 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.
- Onshore conventional gas has been produced in SA, NSW and Queensland for many years. The Cooper Basin has been developed as a conventional onshore field.
- Hydraulic fracturing *may* be used in CSG and conventional gas production (to date only about 10 per cent of wells in Queensland have required hydraulic fracturing). Hydraulic fracturing is always used in shale gas and tight gas wells to increase the flow of gas from the reservoir.
- The main constituent of both 'conventional' and 'unconventional' natural gas is methane. CSG is almost pure methane whereas conventional gas may also contain ethane, propane, butane, and other hydrocarbons.
- As the peak body for the oil and gas industry, APPEA represents members exploring for, and producing, conventional and unconventional gas.
- **Underground Coal Gasification** or UCG is an entirely different process to natural gas extraction. UCG involves partially burning coal seams in situ and then extracting the resultant product of combustion—known as 'syngas'—which is a mixture of carbon monoxide and hydrogen.
- APPEA does not represent any companies involved in UCG production.

# 4 Natural gas—the facts

There are many misleading claims made by critics seeking to demonise natural gas exploration and production.

However, the verdict from leading institutions and experts is clear and consistent.

The considered judgment of the experts below—all independent of the industry—reflects a thorough evaluation of the evidence.

Who said it	What they said
<b>Allan Hawke AC</b> Page x: Executive Summary of the <i>Report the Independent Inquiry into Hydraulic Fracturing in the Northern Territory</i> , 2014	<p>“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.”</p> <p>“The substantive weight of agreed expert opinion, the Inquiry finds that there is no justification whatsoever for the imposition of a moratorium on hydraulic fracturing in the NT.”</p>
<b>The Australian Council of Learned Academies</b> Page 177: Conclusion of <i>Engineering Energy: Unconventional Gas Production—A study of shale gas in Australia</i> , 2013	<p>“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.”</p>
<b>Mary O’Kane</b> NSW Chief Scientist and Engineer Page 7: <i>Final Report of the Independent Review of Coal Seam Gas Activities in NSW</i> , 2014	<p>“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 <i>Gasland</i> 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.”</p>
<b>Gina McCarthy</b> US Environmental Protection Agency Administrator <i>National Journal</i> , 11 June 2013	<p>“There’s nothing inherently dangerous in fracking that sound engineering practices can’t accomplish.”</p>
<b>Australian Academy of Technological Services and Engineering</b> Media Release: <i>Best practice and community support are keys to unconventional gas</i> , 3 December 2015	<p>“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.”</p>



Who said it	What they said
<p><b>Public Health England</b> Cover note to final publication of the <i>Review of the potential public health impacts of exposures to chemical and radioactive pollutants as a result of the shale gas extraction process</i> (2013)</p>	<p>“Overall, however, we do not regard shale gas exploitation as posing a significant regulatory challenge for the protection of local people’s health as a result of releases of chemical and radioactive pollutants. The PHE position remains, therefore, that the shale gas extraction process poses a low risk to human health if properly run and regulated.”</p>
<p><b>Queensland Department of Health</b> Page 18: Conclusion of <i>Coal Seam Gas in the Tara region: Summary risk assessment of health complaints and environmental monitoring data</i></p>	<p>“Based on the clinical and environmental monitoring data available for this summary risk assessment, a clear link cannot be drawn between the health complaints by some residents in the Tara region and impacts of the local CSG industry on air, water or soil within the community. The available evidence does not support the concern among some residents that excessive exposure to emissions from the CSG activities is the cause of the symptoms they have reported.”</p>
<p><b>Lord Deben</b> Chair of the UK’s Independent Advisory Committee on Climate Change <i>The Guardian, Some green extremists ‘close to Trotskyites,’ says Lord Deben</i>, 21 January 2014</p>	<p>“The people, for example, who suggest if you frack at all this is devastatingly damaging. They’re wrong ... That is a nonsensical position. I do think that all of us who are sensible on this matter do have to distinguish ourselves from those who take that kind of almost theological view about all these things and those of us saying we’ve got to find a practical means of delivering what really matters, which is a world that stops destroying itself, whether it’s on climate change or this appalling thing we’re doing to the oceans.</p>
<p><b>Richard A Muller</b> Professor of Physics, University of California, Berkeley Centre for Policy Studies, <i>Why every serious environmentalist should favour fracking</i>, December 2013</p>	<p>“Environmentalists who oppose the development of shale gas and fracking are making a tragic mistake. “Some oppose shale gas because it is a fossil fuel, a source of carbon dioxide. Some are concerned by accounts of the fresh water it needs, by flaming faucets, by leaked ‘fugitive methane’, by pollution of the ground with fracking fluid and by damaging earthquakes. These concerns are either largely false or can be addressed by appropriate regulation.”</p>

In contrast to the above statements there are many myths and misrepresentations of the industry in the public domain that do not pass the common sense test. Many of these have or are likely to be brought to the Committee.

Below we have compared some of the myths to the facts to highlight the importance of the Committee ensuring that all evidence it hears is tested to ensure it is backed by solid evidence and accurately reflects the scientific consensus.

## Myth

Research from Cornell University now indicates that the emissions footprint for CSG is significantly higher than previously thought.

### **Lock the Gate—Submissions to State and Federal Parliamentary Inquiries**

## Fact

This completely false claim was made in a number of written submissions to parliamentary inquiries by Lock the Gate. When challenged, the group was forced to admit that it had misled both the NSW Legislative Council and the Australian Senate.

Though Lock the Gate purported to be quoting from Cornell University research, they had in fact replaced the words 'shale gas' with 'coal seam gas'.

The President of Lock the Gate claimed this was an 'honest mistake' and that he 'wasn't attempting to pretend' this US-based research on unconventional gas related to Australian CSG.

The research relied upon has also been comprehensively rebutted, including by further work from Cornell University.

In the Australian context, in 2014 the CSIRO<sup>1</sup> made direct measurements of 43 individual CSG wells in Australia. Its researchers measured a median methane emission for a well of 0.6 g/min, which is about the same as four cows. These measured emission rates are very much lower than those that have been reported for US unconventional gas production.

This example highlights the need for the Committee to ensure that the evidence it relies on is fact based, relevant to the industry in Australia rather than overseas examples, and reflects scientific consensus.

Many [hydraulic fracturing] chemicals have not been assessed for their long-term impacts on the environment and human health. In Australia, of the 23 identified as commonly used 'fracking' chemicals, only two have been assessed at all by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS) and neither for their use in CSG.

### **National Toxics Network (NTN)—Submission to the Select Committee on Unconventional Gas Mining**

This claim is misleading and does not accurately represent the Australian Government's knowledge and management of chemical risk.

A key detail omitted is that NICNAS has in fact *not* assessed about 85 per cent of the 40,000 industrial chemicals in use in Australia.

Given that the CSG industry is a minor user of chemicals within the broader Australian economy, the base claim made by NTN applies to almost every industry in Australia.

NTN is no doubt aware of this given they are represented on a NICNAS stakeholder advisory group.

Nevertheless, there have been several comprehensive hydraulic fracturing risk assessments completed by the petroleum industry that have been considered and accepted by governments as part of multiple state and federal ministerial project approval processes. These assessments consider real world chemical use and all aspects of risk and risk mitigation and collectively cover over 200 chemicals.

Some drilling chemicals, such as silica or crystalline quartz, bentonite clay and cristobalite are known to be carcinogenic.

### **National Toxics Network—Submission to the Select Committee on Unconventional Gas Mining**

This claim is disingenuous at best.

NTN is apparently unaware or unconcerned that:

- Bentonite clay is in common use as 'kitty litter' and in cosmetics as a facial mask.
- Silica, crystalline quartz, and cristobalite are also known as 'sand' (as found at the beach).

The chemicals and compounds used in fracking are mostly unknown. Gas companies do not disclose their toxic recipes

### **Senator Glenn Lazarus—Adjournment Speech, Senate Hansard 3 March 2015**

This claim is false.

The industry discloses chemicals to government and to landholders—this a legal requirement in Queensland.

Details of the chemicals used are also available on company and government websites. For example: <https://www.ehp.qld.gov.au/management/non-mining/fracking-chemicals.html>

<sup>1</sup> <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/publications/csg-fugitive-emissions>

## Myth

Produced [CSG] water, which is water that has been extracted and or injected and then extracted with the megatoxic cocktail of chemicals and compounds, is then dumped into ponds which sit on people's properties.

**Senator Glenn Lazarus—Adjournment Speech, Senate Hansard 3 March 2015**

Shale gas fracking in Western Australia could pollute our groundwater with toxic chemicals and threaten the health of the community.

**Conservation Council of WA**

There could soon be thousands of fracking wells across iconic areas of WA, like the Kimberley, Ningaloo and farmland and wildflower country in the Mid West. Fracking will change these landscapes forever—covering them in a spider's web of risky gas wells, wastewater [sic] ponds, pipelines and access roads.

**Conservation Council of WA**

The value of properties affected by CSG mining has plummeted. Farmers cannot sell their land and their land is now worthless because it no longer includes clean safe water.

**Senator Glenn Lazarus—Adjournment Speech, Senate Hansard 3 March 2015**

Experts are of the view that underground water will never return to many areas across the country and if it ever does, it will be recontaminated because the chemicals used in the CSG extraction process take many years to break down, if ever.

**Senator Glenn Lazarus—Adjournment Speech, Senate Hansard 3 March 2015**

## Fact

CSG water is not 'megatoxic'.

This water is a resource to the community and has been used for many decades—untreated—for agricultural, industrial, urban, stock and domestic purposes.

According to the Queensland Government there are in fact over 2000 landholder bores taking almost 17 billion litres of water from the Walloons Coal Seams in the Surat Basin—the same coal seams underpin the Queensland CSG industry.

This statement is at odds with the findings of the Western Australian Department of Health's risk assessment which states:

"The health risk assessment (HRA) has focussed on the potential for hydraulic fracturing to affect drinking water sources. The HRA has found that, under the right conditions, hydraulic fracturing of shale gas reserves in WA can be successfully undertaken without compromising drinking water sources."

This claim was rejected outright by the Western Australian Parliamentary Standing Committee on Environment and Public Affairs.

The Committee's report on the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas states:

"The Committee finds that the statement that the development of the unconventional gas industry in Western Australia will result in thousands of wells in the Kimberley and the Mid West has been over-stated and is not based on evidence."

This statement is at odds with the view of professional land valuers in Queensland.

The 'overwhelming view' of the Queensland Valuer-General and representatives from major Queensland rural valuation firms is:

"...given the prolonged drought and lack of property sales with gas infrastructure, there [is] still insufficient evidence of a trend in rural property values as a result of the onshore gas industry."

There are also a number of properties that have been advertised and sold with gas wells listed as a positive feature.

We are not aware of any qualified professionals who have expressed the view that water 'will never return to many areas' or that recharge water will be 'recontaminated'.

Aquifers are continually recharged with water via natural processes. This does not change because groundwater is being extracted, whether by the natural gas industry or anyone else.

In any case CSG production does not involve the removal of all underground water, or even all water within a coal seam.

In the Surat Basin, for example, there remains a vast underground water resource consisting of several distinct aquifers that continues to be used by landholders and other water users.

## Myth

Communities affected by CSG mining are experiencing a range of chronic health problems directly traceable to contamination of their air, of their water wells/bores or of surface water

**Senator Glenn Lazarus—Adjournment Speech, Senate Hansard 3 March 2015**

Research into the economic and social impacts of the unconventional gas industry in Queensland has shown that the industry has led to a reduction in community well-being and social cohesion; a deterioration in local skills and infrastructure; few additional local job opportunities; and limited economic benefit to the wider economy.

**Lock the Gate—Unconventional Gas Senate Inquiry Submission Guide**

The process of hydraulic fracturing can release naturally occurring BTEX so it remains a risk factor during coal seam gas operations even when regulation is in place to ban gas companies using it as an additive during drilling.

**Lock the Gate—About Coal Seam Gas**

## Fact

This statement is at odds with the findings of an investigation into these claims by the authorities.

According to Queensland Health, no link has been found between coal seam gas operations and health concerns.

Queensland Health did however find that the nature of complaints meant there were multiple potential causes and explanations that are not related to CSG activities including faecal contamination in the water supply, the use of wood-fired heaters or open fires, and rainwater contaminated with bacteria, viruses or other organisms.

A further reference is the ongoing Monash University Health Watch Study which has been studying the health of around 19,000 past and present Australian petroleum industry workers since 1980.

The Monash research clearly shows that petroleum industry employees have better health than the general Australian community and are less likely to die of the diseases commonly causing death—including cancer, heart and respiratory conditions.

The source of the 'research' quoted by Lock the Gate is the Australia Institute, which is a Green Party think tank led by the former Chief of Staff to Bob Brown and Christine Milne.

Politically motivated research should not be relied on where it is in conflict with research by reputable Australian Government institutions, such as the CSIRO and the Bureau of Resource and Energy Economics research attached to this submission.

For example, the CSIRO reported in 2013 that the CSG industry is contributing to poverty reduction, increasing employment and family income, and that there is a growing youth population in regions with CSG development. And in 2015 the Australian Government's Bureau of Resource and Energy Economics (BREE) reported there are long term net economic benefits from CSG.

This statement is disingenuous at best and falsely represents the risk posed by BTEX.

BTEX is an acronym that stands for benzene, toluene, ethylbenzene, and xylenes. BTEX are natural compounds found in crude oil, coal, and gas deposits and as such may be naturally present at low concentrations in groundwater extracted in the vicinity of these deposits.

Benzene has also previously been detected in flavoured beverages by Food Standards Australia New Zealand (FSANZ) at similar or higher levels to those detected in water from coal seams.

However, in the context of beverages intended for human consumption (as opposed to untreated groundwater extracted from a coal seam) FSANZ was not overly concerned and said that the results:

"...do not raise any public health concerns in relation to benzene levels in flavoured non-alcoholic beverages available in Australia, as the trace amounts found make a very small impact on overall benzene exposure."

## Myth

The large amount of water used in fracking would put severe pressure on the Territory's underground water resources, which are relied upon by communities and industries across the NT.

### **Frack Free NT Alliance**

There is no possible satisfactory coexistence of an open-cut coalmine or a coal seam gas field with any sort of intensive agriculture. It is just a laughable idea that that is the case.

### **Drew Hutton, President of Lock the Gate—evidence to the Senate Environment and Communications Legislative Committee**

The nature of the unconventional gas process is such that it cannot be safely managed or regulated.

### **Dr GERALYN MCCARRON, GP—Submission to the Select Committee on Unconventional Gas Mining**

The EPA in the State of Pennsylvania in the United States has on record 243 proven cases of ground water or bore water contamination due to fracking chemicals.

### **Variations of this claim have been made in a number of submissions to previous Australian parliamentary inquiries, and the claim features in 'submission guides' published by activist groups for this current inquiry**

## Fact

This statement is false and is thoroughly debunked in the report on hydraulic fracturing in the Northern Territory by Allan Hawke AC.

As noted in that report:

- The projected water requirements for fracturing are small relative to total water availability at NT or regional scales.
- Moore (2012) estimated that the water requirement of a shale gas well over a decade was equivalent to that needed to water a single golf course for one month, or to run a 1000 MW coal-fired power plant for 12 hours.
- The [report's] projection of 1.5–2.4 GL/year of total ground water extraction for fracturing activity for the entire NT falls within the range of maximum water entitlements recently granted to individual properties or enterprises in the Daly/Roper water Control District.

Case studies proving this statement to be false are provided in this submission. CSG is coexisting right now with intensive farming operations in Queensland. There are CSG operations coexisting with cropping, grazing, mixed use and organic farming.

Petroleum production has worked side by side with agriculture for many decades in Australia and in other parts of the world.

Texas for example has 218,000 oil and gas wells yet it also produces more agricultural produce than Queensland—which is bigger than Texas but has 7100 CSG wells.

This claim is at odds with the view of leading experts around the world.

Those that disagree with this view include:

- The Australian Council of Learned Academies.
- The NSW Chief Scientist and Engineer.
- Allan Hawke, AC.
- The Australian Academy of Technological Services and Engineering.
- Public Health England.
- Lord Deben, Chair of the UK's Independent Advisory Committee.
- The head of the US EPA.

This claim is incorrect and the background reveals many flaws.

These are discussed in detail by Energy In Depth<sup>2</sup> and include:

- The fracking process did not cause water contamination.
- Only one well showed the presence of drilling mud—the large majority of cases described naturally occurring minerals.
- Pennsylvania presumes operators to be responsible for *any* water well problems within 2500 feet of a drilling operation—even if a private water well is found to have minerals that could be naturally occurring, the operator must assume responsibility regardless and repair the water to 'pre-drill' quality.
- Several cases showed temporary contamination before returning to pre-drill water quality.
- The incidents make up a fraction of one percent of all wells drilled (243 incidents from over 30,000 wells drilled since 2006).

We urge the Committee to rely on the many reputable scientific assessments of the fracking process that have been carried out by leading individuals and institutions, such as those by the CSIRO or the NSW Chief Scientist and Engineer, which find that fracking can be conducted without threatening water resources.

2 <http://energyindepth.org/marcellus/digging-deeper-into-those-243-dep-determination-letters>

## CASE STUDY: The extreme response of activists to a farmer that said 'yes' to gas

The anti-gas movement portrays itself as representing landholders in the land access debate but the reality can be very different.

Father and son dairy farmers Robert and Peter Graham, the latter a former Lismore councillor, run cattle on their property near Bentley in northern NSW.

In 2014 the Graham's agreed to a gas company, Metgasco, undertaking exploration activities on their property.

Metgasco were exploring to see whether there were commercially viable conventional or tight gas resources in the region. The exploration activities amounted to the drilling of a single vertical well on an unused gravel quarry on the Graham's property. The Graham's were to be compensated for the use of their land and the activities were to be fully rehabilitated.

The response from the activist movement was extreme and directly targeted the Graham's and their ability to operate their farm.



The 'war barrier' blocking access to the Graham's farm driveway—road spikes, rubbish and a car cemented in place by activists.

## CASE STUDY: The extreme response of activists to a farmer that said “yes” to gas

A ‘war barrier’ was erected by activists to block one of the main entrances to the property, metal spikes were cemented into the road surface, gates were welded and padlocked shut, rubbish was left on the property, fences were knocked down, sheds were graffitied, and a car was concreted in a gateway. A security fence had to be erected around the house on the property to protect it from thieves and vandals.

Mr Graham said to the media at the time:

“They’re right in the driveway of our entry into our property.

“Look there’s no doubt that there is another entrance, but this is one of the main entrances that we use when we’re moving livestock or moving machinery.

“Lock the Gate tell us that they’re not interfering with the farmer, but what they don’t understand is how an operating farm works.”

“Horses from tick-infested properties were also brought in for a protest ride, with no thought to the consequences of spreading serious livestock diseases. Many times we called police or the council to move people off our property”

The Graham’s were also subjected to continual bullying and threats by activists, which included protestors saying they ‘know where your grandchildren go to school’. The Graham’s day-to-day farming activities were severely constrained.

This protest action was celebrated and promoted by the anti-gas activist movement. The President of Lock the Gate, Drew Hutton said at the protest: “This is what I live for, you know. This is where I come alive.”

For the Grahams and many others the anti-gas activists are simply anti-development at all and any cost. Legitimate and legal enterprises, including farms, are collateral damage in achieving that goal.



# 5 Benefits to the Australian economy

## Key points

- Natural gas is an essential commodity for modern Australia. Natural gas is needed for power generation and is an indispensable feedstock for manufactured products such as fertilisers, plastics and chemicals.
- Gas demand in eastern Australia will continue to be strong and will increasingly need to be supplied from unconventional sources such as coal seam and shale gas.
- Australia has abundant gas resources to meet domestic and export requirements, however the traditional supplies of natural gas from Bass Strait and the Cooper Basin are in decline and Australia needs to take steps now to unlock new reserves.
- The Australian Energy Market Operator (AEMO—a body established by COAG) forecasts that residential, commercial, industrial demand for gas in Eastern Australia will remain strong over the next 20 years and total gas demand will rise significantly as Australian exports of gas ramp up.
  - in the five years 2016–20, the total annual gas consumption in Australia is forecast to rise rapidly as Queensland’s liquefied natural gas (LNG) export facilities ramp up production
  - annual gas consumption is then projected to remain relatively steady over the rest of the 20-year outlook period to 2035.
- The IEA forecasts gas to be the fastest-growing fossil fuel, increasing by nearly 50 per cent to account for 24 per cent of total energy by 2040. This is driven by demand from China, the Middle East and North America. (International Energy Agency, World Energy Outlook 2015, November 2015).
- The LNG sector has projects valued at around \$200 billion either recently completed or under construction. (Department of Industry, Innovation and Science, Office of the Chief Economist, Resources and Energy Major Projects, October 2015).



- The successful natural gas development story unfolding in some parts of Australia, is underscored by sufficient gas reserves and resources to meet both domestic and export markets.
- The ability to access international markets has allowed the development of this new Australian industry. The investment underway in Queensland has helped power recent economic growth and, if not impeded, will continue for decades to come.
- But development on this scale has occurred only because of LNG. Access to overseas demand has provided the industry with the scale required to underpin the development of onshore gas reserves and to attract the investment and expertise required to develop these world-leading projects.
- Not only is it part of our export trade, strengthening and diversifying our engagement with the region, it is a vital contributor to federal and state government coffers through taxes and royalties that can be used to fund schools and hospitals.

## References

### **1 Australian Energy Market Operator: National Gas Forecasting Report (NGFR) for Eastern and South-Eastern Australia**

- The NGFR is an annual publication prepared by AEMO that provides forecasts of annual gas consumption and maximum gas demand across eastern and south-eastern Australia's interconnected gas markets over a 20-year outlook period.
- The 2015 NGFR forecasts rising demand for natural gas over the next 20 years.
- Also provided are two infographic as references illustrating the key findings of the NGFR.

## CASE STUDY: The role of unconventional gas in the east coast gas market

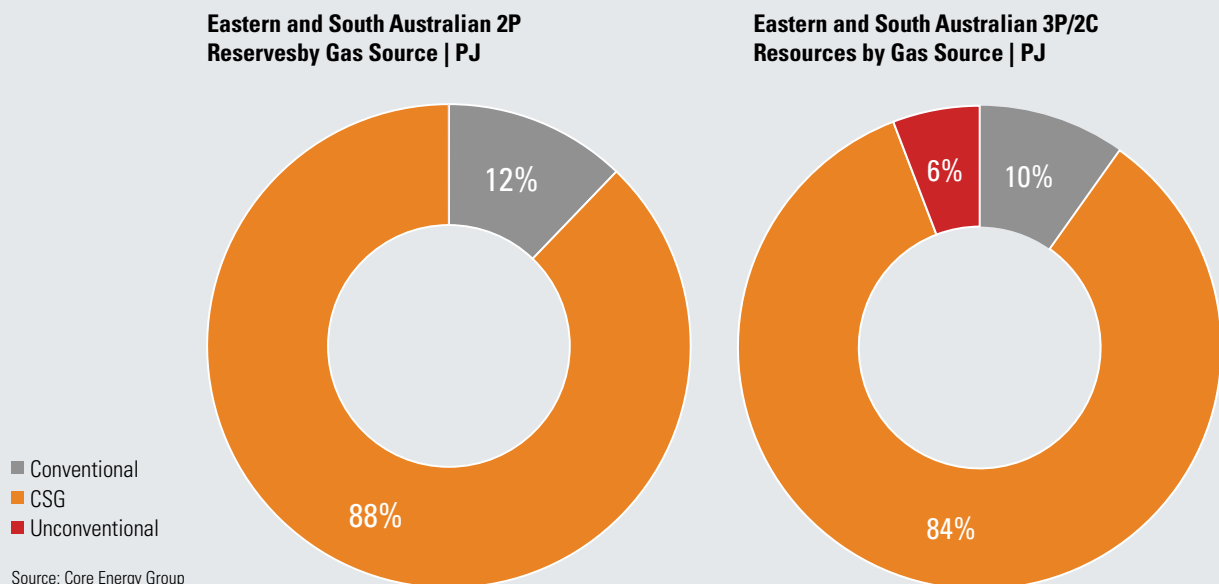
AEMO's five-year outlook for natural gas in Eastern Australia points to ongoing demand for gas into the east coast market and the need for ongoing exploration and development across the market.

This means onshore gas will have a key role to play.

The reason for this is a relatively straightforward one—at present, unconventional gas accounts for 88 per cent of east coast gas reserves (essentially, the amount of gas that can be commercially extracted, known as 2P reserves) and 90 per cent of east coast gas resources (the amount of gas that has been discovered but for various reasons is not yet considered commercial to extract, known as 3P or 2C resources).

The clear implication is that, in the absence of a major commercial discovery of conventional gas, the future of the industry will be in the unconventional space.

This is illustrated in the figure below<sup>3</sup>:



A further reference is the Australian Government Department of Industry, Innovation and Science's Office of the Chief Economist in its analysis of gas market. This was presented in December 2015, broke the east coast market into Northern and Southern regions, and found:

- North—production capacity (after LNG demand is served) is very tight and the market needs more production capacity.
- South—production capacity in the south is adequate, but reserve depletion soon becomes a problem. The south needs new gas reserves (NSW CSG, Victorian onshore gas, more exploration, NT supply) to maintain production.

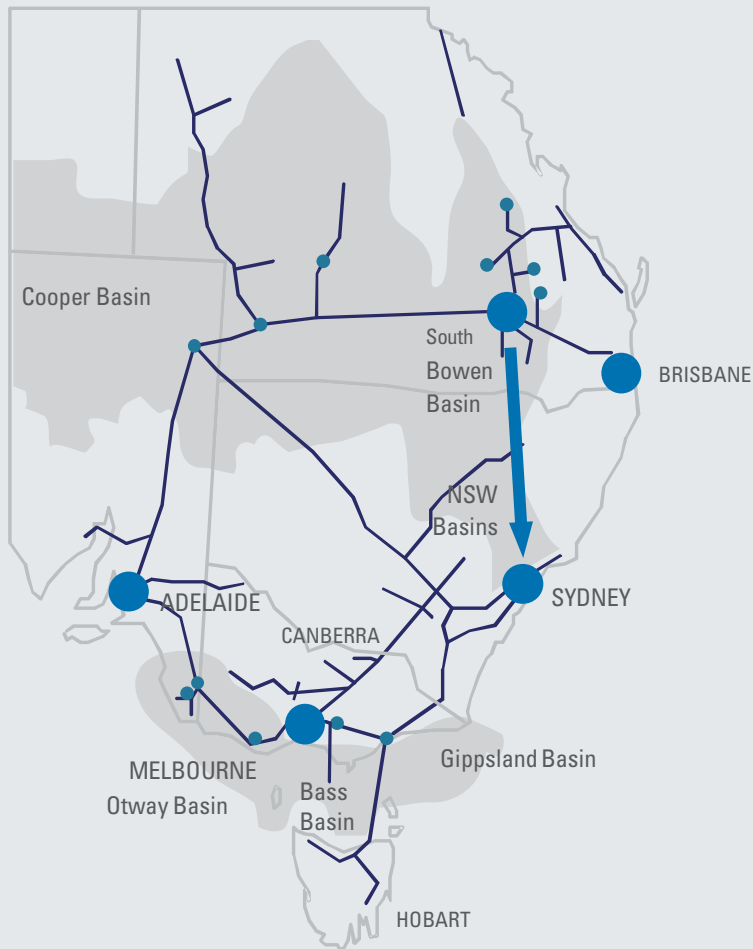
This is illustrated in the following figures<sup>4</sup>:

<sup>3</sup> <http://www.aemo.com.au/Gas/Planning/Gas-Statement-of-Opportunities/2015-GS00-Supporting-Information>

<sup>4</sup> <http://www.industry.gov.au/Office-of-the-Chief-Economist/Events/Pages/Resources-and-Energy-Workshop.aspx> and <http://www.industry.gov.au/Office-of-the-Chief-Economist/Events/Documents/Outlook-for-the-East-Australian-Gas-Market.pdf>

# State of the market

Not yet fully inter-connected



- Hub
- Processing plant

### North

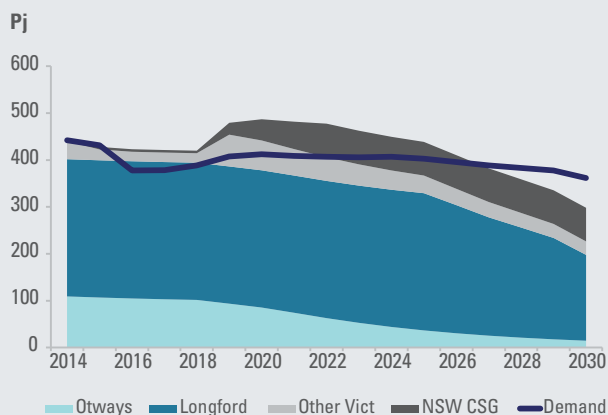
- Queensland (Brisbane, Gladstone and Mt. Isa)
- Cooper Basin
- Surat/Bowen basins

### South

- Victoria, NSW, South Australia and Tasmania
- Gippsland, Bass and Otway basins
- NSW CSG basins

## In the South

Adequacy of gas production capacity  
Maximum production capacity and forecast demand

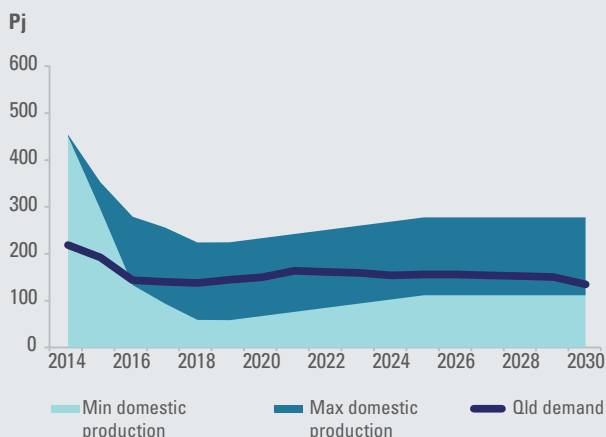


Production capacity in the South is adequate  
Reserve depletion soon becomes a problem  
The South needs new gas reserves to maintain production:

- NSW CSG
- More exploration
- NT supply

## In the North

Adequacy of gas production capacity  
Maximum production capacity and forecast demand



- Production capacity (after LNG demand is served) is very tight
- LNG production can vary between nameplate and Take-or-Pay
- The market needs more production capacity

Source: Industry, Innovation and Science (2015)



# 6

# Government regulation

## Key points

- The onshore natural gas industry is comprehensively regulated at both the Commonwealth and state level.
- A national framework exists in the form of the COAG-endorsed National Harmonised Regulatory Framework for Natural Gas from Coal Seams which provides a leading practice regulatory approach that can be adopted by state regulators. The COAG Framework is also supported by APPEA and provides a suite of leading practice principles covering the key areas of operation—well integrity, water management and monitoring, hydraulic fracturing and chemical use.
- The requirements for Western Australian and Queensland are summarised in the infographics below.
- An onshore gas company operating nationally needs to comply with over 70 pieces of state and federal legislation, numerous additional regulations, associated operational policies (for example the Queensland CSG Water Management Policy), and local council regulations.
- In addition to the requirements in place throughout the exploration and operational phases the industry is required to reinstate and rehabilitate disturbed areas under federal and state government regulation. Companies are also required to provide a comprehensive financial assurance as a security deposit to ensure compliance with rehabilitation.
- Key federal and state legislation—not including associated regulations and operational policies—includes the following:

Image supplied by  
Qld Parliament

## **Federal**

- *Environment Protection and Biodiversity Conservation Act 1999*
- *Water Act 2007*
- *Native Title Act 1993*
- *Industrial Chemicals (Notification and Assessment) Act 1989*
- *Corporations Act 2001 and Australian Securities and Investments Commission Act 2001*
- *Fair Work Act 2009*
- Taxation legislation (various)

## **Queensland**

- *State Development and Public Works Organisation Act 1973*
- *Environmental Protection Act 1994*
- Environmental Protection Regulation 2008
- *Fisheries Act 1994*
- *Forestry Act 1959*
- *Nature Conservation Act 1992*
- *Regional Planning Interests Act 2014*
- *Petroleum and Gas (Production and Safety) Act 2004*
- *Waste Reduction and Recycling Act 2011*
- *Water Act 2000*
- *Aboriginal Cultural Heritage Act 2003*
- *Queensland Heritage Act 1992*
- *Public Health Act 2005*
- *Transport Operations (Road Use Management) Act 1995*
- *Queensland Industrial Relations Act 1999*
- *Sustainable Planning Act 2009*

## **New South Wales**

- *Environmental and Planning Assessment Act 1979*
- *Heritage Act 1977*
- *National Parks and Wildlife Act 1974*
- *Petroleum (Onshore) Act 1991*
- *Protection of the Environment Operations Act 1997*
- *Water Management Act 2000*
- *Dangerous Goods (Road and Rail Transport) Act 2008*
- *Environmentally Hazardous Chemicals Act 1985*
- *NSW Work Health and Safety (Mines and Petroleum Sites) Act 2013*
- *Public Health Act 2010*
- *Industrial Relations Act 1996*

## **Northern Territory**

- *Environmental Assessment Act 1982*
- *Territory Parks and Wildlife Act 2006*
- *Waste Management and Pollution Control Act 1997*
- *Water Act 1992*
- *Petroleum Act 1984*
- *Northern Territory Aboriginal Sacred Sites Act 1989*

- *Dangerous Goods Act 1998*
- *Petroleum Act 1984—Schedule of Onshore Petroleum Exploration and Production Requirements*
- *Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Act 2010*
- *Work Health and Safety (National Uniform Legislation) Act 2011*  
*Work Health and Safety (National Uniform Legislation) Act 2011*

### **Western Australia**

- *Conservation and Land Management Act 1984*
- *Environmental Protection Act 1986*
- *Wildlife Conservation Act 1950*
- *Environment Protection Act 1986*
- *Rights in Water and Irrigation Act 1914*
- *Planning Authority Act 1972*
- *Aboriginal Heritage Act 1972*
- *Petroleum and Geothermal Energy Resources Act 1967*
- *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012*
- *Contaminated Sites Act 2003*
- *Health Act 1911*
- *Occupational Safety and Health Act 1984*
- *Petroleum and Geothermal Energy Resources (Occupational Safety and Health) Regulations 2010*
- *Petroleum and Geothermal Energy Resources (Management of Safety) Regulations 2010*

### **Victoria**

- *Petroleum Act 1998*
- *Petroleum Regulations 2011*
- *Mineral Resources (Sustainable Development) Act (MRSDA) 1990.*
- *Planning and Environment Act 1987.*
- *Environment Effects Act 1978*
- *Water Act 1989*
- *Environment Protection Act 1970*
- *Mineral Resources (Sustainable Development) Act (MRSDA) 1990*
- *Occupational Health and Safety Act 2004 and the Dangerous Goods Act 1985*

### **South Australia**

- *Petroleum and Geothermal Energy Act 2000*
- *Development Act 1993*
- *Environment Protection Act 1993*
- *Native Vegetation Act 1991*
- *Natural Resources Management Act 2004—Far North Water Allocation Plan*
- *Aboriginal Heritage Act 1988*
- *Heritage Places Act 1993*
- *Work Health and Safety Act 2012*

# References

## **1 Onshore gas—key legislation and regulation**

- This 51 page document was prepared by APPEA to assist the Committee in its consideration of the adequacy of the legislative, regulatory, and policy framework for onshore gas.
- The document provides a high level summary of the numerous policies and legislation in place, the issues they address, and the requirements placed on onshore gas operators.

## **2 COAG: Standing Committee on Energy and Resources National Harmonised Regulatory Framework for Natural Gas from Coal Seams**

- This framework delivers on a commitment by Australian governments to put in place a suite of leading practice principles, providing guidance to regulators in the management of natural gas from coal seams and ensuring regulatory regimes are robust, consistent and transparent across all Australian jurisdictions.
- The framework focuses on four key areas of operations which cover the lifecycle of development: well integrity, water management and monitoring, hydraulic fracturing and chemical use.
- Through this focus, the framework provides assurance for communities and farmers that concerns in relation to protecting and managing both underground and surface water resources in particular are taken seriously by government and are being effectively regulated.

**Conservation and Land Management Act 1984**

- Establishes a comprehensive set of legislative provisions dealing with state conservation and land management matters.
- Established a number of statutory bodies:
  - Conservation Commission of Western Australia
  - Marine Parks and Reserves Authority
    - Marine Parks and Reserves Scientific Advisory Committee.
  - Responsible for conservation of threatened species and ecological communities.

**Native Title Act 1993 (Commonwealth)**

- An indigenous land use agreement or future acts agreement must be reached with native title claimants.
- Requirements for notification/advertising, negotiation and reimbursement of expenses are all stipulated.

**Environment Protection and Biodiversity Conservation Act 1999 (Cwth)\***

- EIS is required addressing relevant Matters of National Environmental Significance e.g: wetlands of international importance; listed threatened species and ecological communities; listed migratory species; impact of CSG development on water resources.
- Considers findings of Independent Expert Scientific Committee.
- Strict approval conditions requiring:
  - offsets for matters of national environmental significance
  - requirements for further detailed studies
  - detailed management plans for subordinate approval
    - regular third party auditing.

\* Note: no 'approvals bilateral' in place for CSG activities meaning project must be approved at both state and federal levels.

**Environmental Protection Act 1986 (WA)**

- Environmental Impact Assessment required for resource activities likely to have significant environmental impacts. EIA includes: human and health issues; social networks; community engagement; visual and landscape issues; heritage and archaeology; flora and fauna; air and water quality; noise and vibration; geology and soils; energy resources; waste management; transportation; project management.
- General environmental duty to prevent and minimise harm.
- Requirements for notifiable activities.
- Duty to notify environmental harm.
- Provides for the prevention, control and abatement of pollution and environmental harm and for the conservation, preservation, protection, enhancement and management of the environment.
- Legislation for the formation of the WA Environmental Protection Agency (EPA).
- Requires proponents to prepare Environmental Management Plans (EMPs) to manage the environmental aspects of their proposals, which are required as part of their Environmental Management Systems.

**Petroleum and Geothermal Energy Resources (Environment) Regulations 2012**

- Regulations is to ensure that any petroleum activity or geothermal activity carried out in the state is:
  - carried out in a manner consistent with the principles of ecologically sustainable development
  - carried out in accordance with an environment plan.

**Petroleum Pipelines (Environment) Regulations 2012**

- Regulation for protecting the environment regarding pipelines.
- Ensure projects are carried out in accordance with an environment plan.

**Petroleum (Submerged Lands) (Environment) Regulations 2012**

- Regulation for protecting the environment in state waters.
- Ensure projects are carried out in accordance with an environment plan.

**Petroleum and Geothermal Energy Resources Act 1967**

**Land access**

- Petroleum operators proposing to conduct exploration or production activities on private land must negotiate a land access agreement with the land owner before approval is granted by DMP for any activity to take place.
- A petroleum or geothermal energy title holder shall not commence operations on private land until compensation, if any, is paid to the owner and occupier of the land or agreement has been reached as to payment of compensation.
- Compensation is for the land owner and occupier being deprived of possession of the land and for damage to the land. Further compensation for damage also extends to any improvements on the property and for severance of the land to be occupied from other land of the owner or occupier. It also extends to rights of way and all consequential damage.
- If compensation cannot be agreed between the PGER Act title holder and the owner and occupier of the private land, then either party may apply to the Magistrates Court.

**Royalties**

- Petroleum royalties are administered and collected under state and Commonwealth legislation.
- Royalties collected for onshore projects are retained by the state government, while offshore royalties are shared between the state and Commonwealth in accordance with the relevant legislation.



**Aboriginal Affairs Planning Authority Act 1972**

- Established the statutory body The Aboriginal Lands Trust (ALT)
- The ALT administers the issue of permits for entry onto reserves that are subject to Part III of the AAPA Act. Mining Access Permits are required whenever you enter a Part III Aboriginal reserve under the AAPA Act to conduct any petroleum operation and on every occasion that you travel through such reserves to access petroleum titles outside the reserve for the purpose of petroleum operations.

**Occupational Safety and Health Act 1984**

- The OSH Act places certain duties of care for safety and health at the workplace on employers, principal/main contractors, sub-contractors, people involved in labour hire, employees, self-employed people, manufacturers, designers, importers and suppliers. It also places emphasis in the duties of care on the prevention of accidents and injury or harm.

**Petroleum Pipelines Act 1969**

- Pipelines can be licensed to cross any type of land, including private land. The licence provides the licensee with the right to construct and operate a pipeline but pursuant to Section 12(3) it is a mandatory condition of the licence that before construction of the pipeline commences over a parcel of land, the licensee first acquire all the lands in that part of the licence area, or a lease, licence or other authority over the lands and acquired and registered all easements over those lands as are necessary for him to lawfully construct and have the right of access to the pipeline once constructed.

**Environmental Protection Act 1986**

- Standards and offences for causing environmental nuisance such as through: noise, dust, odour, light.

**Environmental Protection Act 1986**

- Offences and statutory rectification tools regarding environmental harm (including human health impacts) caused by CSG:
  - air quality standards set out in the Environmental Protection (Air) Policy
  - the National Environment Protection Measure for Ambient Air and Air Toxics.
- Releases of associated water to areas where drinking water supplies may be impacted must demonstrate that no human health impacts will arise and appropriate monitoring will be in place.

**Contaminated Sites Act 2003**

- Management of contaminated sites to protect human health.

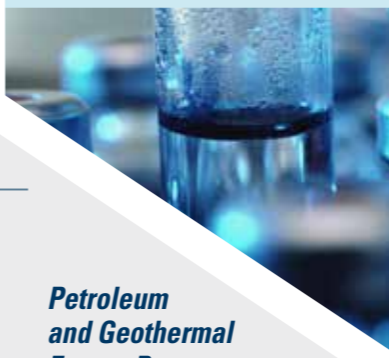


**Petroleum Pipelines Act 1969**

- Petroleum Pipeline (Management of Safety) Regulations 2010.
- Petroleum Pipelines (Occupational Safety and Health) Regulations 2010.
- Formal safety assessment—a detailed description of the risk assessment for the operation that provides evidence of the assessments and relevant studies undertaken. All hazards (both hydrocarbon and non-hydrocarbon) should be identified and their associated level of risks determined. The assessment should focus on identifying those hazards associated with major accident events (i.e. those accidents with the potential to cause multiple fatalities) and how the risks are being managed.
- An acknowledgement of the OSH duties that various persons have under the Act and a detailed explanation of how an licensee not only meets those obligations but also how it ensures that all other involved persons meet their obligations.
- A detailed explanation of how compliance with the safety case is to be measured and managed and how the system will be reviewed.

**WA Environmental Protection Agency**

- Any proposed petroleum activity likely to have a significant impact on water resources and the environment is referred to the Environmental Protection Authority for an independent assessment.



**Petroleum and Geothermal Energy Resources Act 1967**

- Petroleum and Geothermal Energy Resources (Occupational Safety and Health) Regulations 2010.
- Petroleum and Geothermal Energy Resources (Management of Safety) Regulations 2010.
- Implementation of safety management systems.
- A safety management system is assessed in accordance with listed OSH laws by Petroleum Safety, and formally accepted by the minister (or their delegate), or rejected.

**Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)\***

- EIS is required addressing relevant Matters of National Environmental Significance e.g:
  - wetlands of international importance
  - impact of CSG development on water resources.
- Strict approval conditions requiring:
  - detailed management plans for subordinate approval (e.g. water monitoring and management plans)
  - extensive monitoring and modelling of water resources
  - regular third party auditing.

**Rights in Water and Irrigation Act 1914**

- Provides the statutory basis for planning and allocation of water, as well as assessment of proposed water wells and taking of water license applications.
- The Department of Water issues licenses and permits under the *Rights in Water and Irrigation Act 1914* to:
  - take water
  - construct wells
  - interfere with the beds and banks of a watercourse.

**Health Act 1911**

- Assessment of water quality in water supplies to safeguard human health.

**The WA Department of Mines and Petroleum**

- All chemicals to be used in hydraulic fracturing to be disclosed in a drilling application and environment management plan. There is now full public disclosure required for products, additives, chemicals and other substances that may be used in drilling, hydraulic fracturing or other 'down-well' petroleum related activities.

**Petroleum and Geothermal Energy Resources (Environment) Regulations 2012**

- Where approval is sought to construct a new bore on private land for the dual purposes of providing a water supply and for monitoring groundwater (associated with a petroleum activity), it will require approval under an environmental plan.
- Limits the concentration of petroleum in any produced formation water that may be discharged into the sea or injected or re-injected into wells as a result of a petroleum activity. Contains detailed monitoring and reporting requirements for emissions and discharges.

**Environment Protection Act 1986**

- Protection and management of the state's natural water sources.
- License and register all water and wastewater related to activities.
- Environmental protection policies and state environment policies regarding water.
- Water quality management and monitoring and advising the government on policy recommendations.



**Regional Planning Interests Act 2014**

- Sets out 'Strategic Environmental Areas' in which approvals must be sought to undertake petroleum activities.
- Approval will only be given where it can be demonstrated that the activities will not impact directly or indirectly

**Waste Reduction and Recycling Act**

- Beneficial use approvals
  - General BUA for irrigation
  - General BUA for other uses

**Environmental Protection Act 1986**

- Standards and offences for causing environmental nuisance such as through: noise, dust, odour, light.

**Aboriginal Cultural Heritage Act 2003 (Qld)**

- Requires preparation of a cultural heritage management plan which protects Indigenous cultural heritage values.
- Once approved the CHMP is legally binding.

**Native Title Act 1993 (Cwlth)**

- An indigenous land use agreement or future acts agreement must be reached with native title claimants.
- Requirements for notification/advertising, negotiation and reimbursement of expenses are all stipulated..

**Queensland Heritage Act 1992**

- Prohibits interference with the cultural heritage significance of protected areas.
- Where disturbance is unavoidable permits may be obtained based on a CHMP detailing avoidance and mitigation strategies.

**Petroleum and Gas (Production and Safety) Act 2004**

**Land access**

- Petroleum and gas companies must use best endeavours to consult with landholders about access, how authorised activities are carried out and compensation.
- Unreasonable interference with landholders lawful activities must not occur.
- Giving detailed notice at least two weeks before entry.
- Before undertaking any activities which may have a significant impact on the landholder's business or land use, formal arrangements for how activities are to be undertaken and what compensation is to be paid must be determined.
- Accounting, legal or valuation costs to negotiate a Conduct and Compensation Agreement must be met by the oil and gas company.
- Facilitated conferences or alternative dispute resolution processes are facilitated in the event negotiations fail.
- Should agreement still not be reached, the matter can be referred to the Land Court for resolution.
- Compensation is required to cover:
  - deprivation of land use
  - reduction in land value
  - reduction in land use including reduced use that could be made through any improvements to it
  - severance of any land from other parts of the land owned by the landholders
  - any cost, damage or loss arising from activities carried out under the land surface
  - accounting, legal or valuation costs to negotiate a Conduct and Compensation Agreement
  - damages incurred by the landholder from any of the above.

**Compliance with the Queensland Land Access Code is mandatory and key elements include:**

- liaising closely and in good faith with the landholder
- giving notice regarding proposed activities
- ensuring all company staff and contractors are appropriately trained regarding conduct of activities on a landholder's property
- ensuring use of existing tracks where possible and ensuring they are kept in good order
- driving at appropriate speeds
- minimising disturbance to people, livestock and property
- avoiding spread of declared pests
- returning gates to original positions.
- Prohibition of cutting of fences.

**Royalties**

- Significant royalties are collected from onshore oil and gas projects and a large percentage is provided back to resource producing regions through the Royalties to the Regions program funding upgrades to roads, landfills, sewage treatment, medical and other infrastructure facilities.

**Use of public roads**

- Notifiable road uses such as for seismic and drilling related transport on state or local roads trigger requirements to negotiate with Council and Qld Transport and Main Roads regarding how activities on roads will be conducted in relation to safety as well as required road upgrades and compensation.

**Environmental Protection Act 1994 (Qld)**

- Environmental authority for resource activities requires compliance with numerous (commonly up to 300) conditions: contingency planning; flora/fauna surveys; avoidance of environmentally sensitive areas (e.g. endangered and of concern regional ecosystems, sensitive wetlands, nature refuges); offsets for matters of state environmental significance; restrictions on activities within or near watercourses; detailed hydraulic fracturing risk assessments and mitigation strategies; produced water management plans; soils management; erosion and sediment control; third party compliance auditing; noise modelling, monitoring and upper limits; strict waste disposal requirements; strict land and vegetation rehabilitation requirements; financial assurance held in trust by government to cover all rehabilitation liabilities

**Nature Conservation Act 1992**

- Protected plants clearing permit
- Protected animals movement permit
- Wildlife movement permit
- Species management plan
- Offset requirements

**Environmental Protection Regulation 2008**

- Waste tracking requirements
- National Pollutant Inventory requirements

**Regional Planning Interests Act 2014**

- Key aim is to ensure coexistence of resource activities and other land uses such as agriculture and townships
- Sets out 'Priority Agricultural Areas (PAA)', 'Priority Living Areas (PLA)' and 'Strategic Cropping Areas (SCA)' in which undertaking petroleum activities are regulated.
- Obtaining voluntary landholder agreement regarding how the activities will be carried out is the most efficient method of satisfying requirements for PAA and SCA
- Where no voluntary landholder agreement has been reached an application is required to demonstrate that key features of the area (such as priority agricultural land uses) will not be materially impacted
- Landowner and broader public consultation are required in order to gain an approval, the results of which will be considered in making the final decision

**Environmental Protection Act 1994**

- Offences and statutory rectification tools regarding environmental harm (including human health impacts) caused by CSG:
  - air quality standards set out in the Environmental Protection (Air) Policy
  - the National Environment Protection Measure for Ambient Air and Air Toxics
  - releases of associated water to areas where drinking water supplies may be impacted must demonstrate that no human health impacts will arise and appropriate monitoring will be in place.



**Petroleum and Gas (Production and Safety) Act 2004**

**Gas safety**

- A mandatory safety management plan with numerous detailed content requirements such as: safety assessments; skills and training assessments and program; standard operating procedures; control systems; emergency procedures; review and audit procedures; key performance indicators; record keeping requirements.
- Powers for government safety inspectors to require improvements to safety management plans, issue specific safety requirements and instructions as well as responding to incidents.
- Specific responsibilities for the 'executive safety manager' to ensure safety within the organisation with severe penalties for non compliance.
- Specific responsibilities for the 'site safety manager' to ensure safety on site and compliance by all staff and contractors with severe penalties for non-compliance.
- Proactive compliance programmes such as the CSG well head safety program.

**Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)\***

- EIS is required addressing relevant Matters of National Environmental Significance e.g: wetlands of international importance; listed threatened species and ecological communities; listed migratory species; impact of CSG development on water resources
- Considers findings of Independent Expert Scientific Committee
- Strict approval conditions requiring: offsets for matters of national environmental significance; requirements for further detailed studies; detailed management plans for subordinate approval; regular third party auditing

**Forestry Act 1959**

- Permits for taking of forest products
- Extraction of quarry material on state land

**Fisheries Act 1994**

- Waterway barrier works approvals

**Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)\***

- EIS is required addressing relevant Matters of National Environmental Significance e.g:
  - Wetlands of international importance
  - Impact of CSG development on water resources
  - Strict approval conditions requiring:
    - Detailed management plans for subordinate approval (e.g. water monitoring and management plans)
    - Extensive monitoring and modelling of water resources
    - Regular third party auditing

**Public Health Act 2005**

- Provides powers for mandatory public health orders to be issued to remove or reduce public health risks.
- Requires a register of environmental health events to be kept to enable investigation and management of public health risks.
- Queensland Health may undertake investigations under the Public Health Act as well as to support actions under the Environmental Protection Act such as the risk assessment of health complaints and monitoring data regarding CSG in the Tara region.

**Transport Operations (Road Use Management) Act**

- Driver licensing
- Sets requirements for training, routes and excluded goods for transport
- Vehicle operation specifications

**State Development and Public Works Organisation Act 1973 (Qld)\***

- Environmental Impact Statement: consultation on terms of reference; consultation on main EIS; supplementary EIS (if required)
- Coordinator-General's report mandatory requirements:
  - requirements for further detailed studies
  - Coordinator-General required offsets
  - detailed management plans for subordinate approval
  - regular third party auditing

\* Note: no 'approvals bilateral' in place for CSG activities meaning project must be approved at both state and federal levels.

**State Development and Public Works Organisation Act 1973\***

- Environmental Impact Statement—water related aspects must be addressed including:
  - sourcing water for operations
  - co-produced (associated water) forecasts and management
- Coordinator-General's report—mandatory requirements:
  - Coordinator-General required offsets
  - requirements for further detailed studies
  - detailed management plans for subordinate approval.
  - extensive monitoring and modelling
  - regular third party auditing.

**Water Act 2000 (Qld)**

**Underground water**

- Requires baseline assessment of landholders' water bores prior to production testing activities beginning
- Requires an Underground Water Impact Report to be submitted for regulator approval which:
  - Provides detailed hydrogeological information for the project area
  - Predict the volume of water likely to be required to be extracted from relevant aquifers
  - Undertake modelling to predict any impacts to aquifers (both where water will be extracted as well as indirect impacts to other aquifers)
  - Identify any water bores that will be affected both in the short term and long term
  - Propose a mandatory monitoring strategy to ensure that aquifers are responding as predicted
  - Propose a mandatory strategy to mitigate any impacts to springs
  - Requires any bores identified to be impacted in the short term to be re-assessed. Where this assessment identifies an impact on the bore, the impact must be made go to the bore's owner by methods such as deepening or refurbishing existing bores, providing an alternative supply, or financial compensation
- Requires modelling used in UWIRs to be revised every year and updates provided to the regulators
- Requires the revision and resubmission for approval of all UWIRs every three years to ensure adaptive management of impacts should it become clear that they be higher or lower than originally predicted
- In circumstances where the impacts of individual oil and gas companies may overlap, the UWIR will be prepared by the Queensland Government and mandatory requirements for make good agreements, further monitoring and spring impact mitigation measures will be imposed on specified companies
- Changes to the Water Act were passed in 2014 to require a water licence to be obtained to extract water other than associated water, however these provisions have not yet commenced. To obtain a water licence, it must be demonstrated that the proposed take will be sustainable and in accordance with any relevant Water Resource Plans and subordinate material.

**Surface water**

- Water licences are required to extract water from rivers, lakes and streams or harvest overland flow. To obtain a water licence
- Riverine Protection Permits are required to excavate in a watercourse, lake or spring or place fill in a watercourse lake or spring.

**Codes**

- Mandatory codes of practice have been developed to stipulate detailed mandatory requirements to ensure wells are constructed and decommissioned in a manner that will protect safety and the environment.
- Codes have been developed for CSG wells and will shortly be released for deep wells such as for gas sourced from shale and tight formations.
- The codes cover issues which control safety and health such as current and future fugitive emissions including: well design; casing; cementing; well heads; control equipment; drilling fluids; testing and logging; ongoing monitoring and maintenance; decommissioning; record keeping.

## CASE STUDY: The higher standard for CSG dams

In Queensland, the regulatory standard for CSG industry dams is far higher than that applied to other water users that produce and store the same water.

Landholders are able to extract water from coal seams and store the water in dams with no engineering standard. According to the Queensland Government, nearly 17 billion litres of water is extracted from the Walloons Coal Measures (the same coal seams targeted by the CSG industry) by over 2000 landholder bores each year.

Farm dams that have a storage capacity of more than 250 megalitres may be subject to some regulatory requirements, but even in this case there will likely fewer design and reporting requirements to be imposed than oil and gas industry dams holding 100 times less water (2.5 megalitres) even if it is of exactly the same quality.

The regulatory requirements specific to CSG industry water storage are extensive and include engineering design, construction, maintenance requirements.

Requirements for CSG industry regulated dams include:

- Requirements for assessment (and reassessment) of the consequence category of the dam including an assessment report and certification.
- Construction must be under the supervision of a suitably qualified Registered Professional Engineer of Queensland (RPEQ).
- Designed to comply with a range of specific requirements such as:
  - having a floor and sides which contain the wetting front for the operational life
  - having a system to detect leakage through the floor or sides
  - be capable of repair or rectification if issues do arise
  - specific allowances for how much water may be stored and specific buffers for rainfall events
  - specific spillway capacities.
- Certification of the construction by a suitably qualified RPEQ.
- Have a mandatory reporting level, which when water levels rise above triggers requirements to notify DEHP.



CSG industry dam showing engineered layers.

## CASE STUDY: *continued*

- Be subject to annual inspection and certification requirements by a suitably qualified RPEQ and the report provided to DEHP.
- Specific rehabilitation requirements including the following acceptance criteria:
  - the landform is safe for humans and fauna
  - the landform is stable with no subsidence or erosion gullies for at least three (3) years
  - any contaminated land (e.g. contaminated soils) is remediated and rehabilitated
  - not allowing for acid mine drainage
  - there is no ongoing contamination to waters (including groundwater)
  - rehabilitation is undertaken in a manner such that any actual or potential acid sulfate soils on the area of significant disturbance are treated to prevent or minimise environmental harm in accordance with the Instructions for the treatment and management of acid sulfate soils (2001)
  - all significantly disturbed land is reinstated to the pre-disturbed soil suitability class
  - for land that is not being cultivated by the landholder:
    - groundcover, that is not a declared pest species is established and self-sustaining
    - vegetation of similar species richness and species diversity to pre-selected analogue sites is established and self-sustaining
    - the maintenance requirements for rehabilitated land is no greater than that required for the land prior to its disturbance caused by carrying out the petroleum activity(ies)
  - for land that is to be cultivated by the landholder, cover crop is revegetated, unless the landholder will be preparing the site for cropping within three months of petroleum activities being completed.
- Maintenance of a register of all the dams which must be approved by DEHP whenever entries are made.

A photograph of two men crouching in a grassy field under a blue sky with scattered clouds. The man on the left is wearing a white long-sleeved shirt, light-colored trousers, and a light-colored cap. The man on the right is wearing a grey long-sleeved shirt, blue jeans, and a wide-brimmed hat. They appear to be engaged in a conversation or a field inspection.

# 7 Land access and coexistence

## Key points

- APPEA strongly supports policies that foster coexistence. The approach of working together to establish a framework that supports ongoing development in both the agriculture and resources sectors, and of education and mutual understanding of the needs of all parties, has proven successful and will continue to be the most effective way to manage land access in Australia.
- Australia's system of access to resources is not unique. Canada, for example, uses the same approach. Canada has produced onshore gas since 1859 and in 2014 produced 15 times as much onshore gas as Australia. In general, there are no examples in the USA, Canada or the UK where the landholder has a veto right on resource development.
- The Australian Government's Multiple Land Use Framework (MLUF) is an established position between the Australian and state/territory governments on co-existence and is supported by APPEA. Queensland's CSG industry, for example, successfully coexists with a wide variety of land uses, including grazing, intensive cropping, and organic farming.
- Australia is fortunate to have a well-established and orderly system of access for all resources and we should be cautious in considering radical alterations to this system.
- In Australia, the Crown (i.e. state governments) owns the mineral resources and the State is responsible for allocating permits to explore and licences to produce. Before petroleum companies seek access to properties to explore for Crown resources in onshore areas, they carry out extensive consultation with landholders and farmers. Companies bid for development rights and when producing, pay royalties and other taxes to governments which are used to improve the wealth of the local communities, the state and the nation.

- Most people identify public purposes as roads, power lines, water pipelines, and telecommunications cables, but resource extraction is also a public purpose as the resources are owned by the Crown. Access to land to explore for and produce resources is akin to other public purposes such as the construction of roads, rail, power lines, pipelines and irrigation infrastructure.
- It is also important to recognise the impact that the introduction of a retrospective landholder veto would have on the Australian resources industry, the reputation Australia currently enjoys as a stable investment destination, on royalty and taxation revenue for government, and on broader economic activity. These costs would be considerable.
- The Queensland CSG industry has negotiated more than 5000 agreements to build infrastructure on private land without overriding landholders through legal action. Clearly, this would not have been possible without constructive engagement between industry, landowners, agricultural representatives and communities.
- Land access in Queensland is governed by a well-established framework that has been developed and refined over time with input from the agriculture and resource industries.
- Compensation is paid to landholders under law and provides a significant source of income. In Queensland, landholders coexisting with the onshore gas industry have collectively been compensated in excess of \$200m in the five years to 2015 (GasFields Commission Queensland).

## References

### **1 COAG: Multiple Land Use Framework**

- The Multiple Land Use Framework (MLUF) has been developed to address challenges arising from competing land use, land access and land use change.
- The aim of the MLUF is to enable government, community and industry to effectively and efficiently meet land access and use challenges, expectations and opportunities.
- The MLUF is supported by APPEA.

## CASE STUDY: Agforce CSG landholder support workshops

In Queensland, APPEA has for several years co-funded a landholder education program delivered by Agforce—the peak body for Queensland’s beef, sheep, and grain producers.

The program is another practical example of the gas and agricultural industries working together and is free to landholders. A range of services are provided to landholders including advice on negotiating access with the industry and ensuring they understand key issues and government regulation.

The *Advanced CSG Negotiation Support* workshops are designed for people who:

- are negotiating a land access agreement
- have negotiated and settled a land access agreement
- are renegotiating their existing land access agreement
- are negotiating a Make Good agreement.

The *CSG Information Sessions* are for landholders who are not yet at the negotiation stage and cover:

- an explanation of groundwater impacts and landholder rights
- development plans in a given region
- government changes along with new or updated legislation
- what landholders can expect when they enter into negotiations including initial stages right through to negotiating rehabilitation.

The *CSG Digital Mapping Workshops* provide hands on, practical computer training to help landholders develop a property computer map to plan for potential CSG impacts at a property level. 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 mining activities
- a given property’s latest digital data and a mapping software demonstration program.

Agforce also runs field days under the program at which topics such as water and biosecurity are covered in detail.



# 8 Land value

## Key points

- There is no clear quantitative evidence that the onshore gas industry is having an impact, whether negative or positive, on rural property values. However, as noted by the GasFields Commission Queensland, some rural property listings underline the benefits of the value of compensation payable by the CSG industry to specific properties or the economic opportunity that comes from being located in proximity to the gas industry.
- In 2014 the Queensland GasFields Commission met with representatives of the rural valuation industry to discuss current property value trends and how to get more consistency in valuing the impacts of CSG activity on rural properties for compensation purposes. The meeting included the Queensland Valuer-General and representatives from major Queensland rural valuation firms and the 'overwhelming view' was that:

"...given the prolonged drought and lack of property sales with gas infrastructure, there was still insufficient evidence of a trend in rural property values as a result of the onshore gas industry."
- The Queensland Valuer-General's Property Market Movement Reports over 2014, 2015 and 2016 note that in rural areas there is limited sales activity and land values are linked to agricultural market factors, including for example:
  - the effects of a long-term and widespread drought
  - restrictive financial policies
  - the weakening Australian dollar
  - the strengthening beef market
  - agricultural commodity values.
- In some regional urban centres the mining and gas sector does influence property values, with the impact being generally positive when the sector is expanding and generally negative during slowdown periods (as is the case for any economic activity).
- APPEA is not aware of any reports of banks negatively reviewing farms due to the presence of CSG.

# References

## **1 Queensland GasFields Commission: Rural valuers share insights on gas impacts**

- This media release discusses the feedback received by the Commission from rural land valuers on the impact of the gas industry on land values.
- The overwhelming view was that there was still insufficient evidence of a trend in rural property values as a result of the onshore gas industry.

## **2 Queensland Valuer-General: Property Market Movement Report 2016**

- This report summarises the comprehensive analysis of all property markets within the 2016 annual valuation program for Queensland by a team of regionally based registered valuers in the State Valuation Service of the Department of Natural Resources and Mines.
- Key findings include:
  - As the gas industry in the Surat Basin moves from exploration and development into the production phase, property markets in that area have slowed. Workforce numbers dropped from their construction-phase peak in most communities affected by the slowing of the resource industry sector.
  - Across Queensland, limited sales activity in many rural markets—including grazing, broadacre farming, sugar cane and horticulture— resulted in continued static land values. The exception to this was increased land values in the grazing and broadacre farming markets of Central Queensland and the Darling Downs.
  - Any increase in land values was influenced by the strengthening of beef commodity prices. The grazing and broadscale farming markets are starting to rise from the bottom of the market cycle. The Eastern Young Cattle Index reached a record high at \$600.75c/kg in January 2016, compared with \$439.25c/kg at the same time in 2015.
  - Sales of rural land purchased by resource companies for the purpose of mining or other extractive industry are not used to determine statutory land values of rural land. This market activity has now slowed due to the state of resource sector, and respective markets are now being influenced by rural landowners.

## **3 Queensland Valuer-General: Property Market Movement Report 2015**

- This report summarises the comprehensive analysis of all property markets within the 2015 annual valuation program for Queensland by a team of regionally based registered valuers in the State Valuation Service of the Department of Natural Resources and Mines.
- Key findings include:
  - The mining and gas industries continue to influence the property market as the resources sector moves from an exploration and construction phase towards a production and export phase. This slowdown in activity is impacting on centres such as Gladstone, Wandoan, Mackay, and townships within the Bowen Basin and Central Highlands. Limited sales activity in rural markets across Queensland resulted in a continued static-to-softening of land values in grazing, horticulture, small cropping and dryland farming. Rural industries are dealing with the effects of a long-term and widespread drought, restrictive financial policies and rising costs.



- Across Queensland there is limited sales activity in rural markets, resulting in a continued static to softening of land values within the grazing, horticultural, small crop and dryland farming industries. All industries are dealing with the effects of a long-term and widespread drought, restrictive financial policies and rising costs. In contrast, the effects of the recent weakening of the Australian dollar and the strengthening of beef commodity prices may not be reflected in the marketplace for some time. The grazing market is at the bottom of its market cycle and has probably stabilised. These trends, where potential purchasers still remain cautious, will continue for some time until there is an improvement in the weather and more confidence in the economy.

#### **4 Queensland Valuer-General: Property Market Movement Report 2014**

- This report summarises the comprehensive analysis of all property markets within the 2014 annual valuation program for Queensland by a team of regionally based registered valuers in the State Valuation Service of the Department of Natural Resources and Mines.
- Key findings include:
  - The mining and gas industries continue to influence the property market as the resources sector is moving from an investment phase towards an export phase. This slowdown in activity in infrastructure construction is impacting on Gladstone which is showing evidence of a subdued residential market after years of high growth. Continuing activity in the Surat Basin is still driving development activity and land values in a number of centres including Miles.
  - Generally, across Queensland there has been limited sales activity in rural markets resulting in a continued softening of land values within the grazing, horticultural, small crop and dry land farming industries. The combined and ongoing effects of the continuing drought, global financial crisis, changes in bank lending policies, the persistent high Australian dollar, the overseas livestock trade ban, lower commodity prices and rising costs have made potential purchasers cautious.

## CASE STUDY: Rural property advertisements listing gas among property features

There is anecdotal evidence that the compensation provided by gas companies to landholders is viewed by some as a positive feature in property sales.

Such evidence was noted by the Queensland GasFields Commission in 2013.

### Property ads start to list gas among property features



Rural property advertisements listing features like “four gas wells and one monitoring well—\$10,000 a year paid to landowner” have appeared this year.

When asked about the impact that the presence of gas development had on rural property values, Wandoan Realty principal Ray Mortimer said it was “overall probably neutral at the moment”.

“It’s not adding to the property but it’s not taking away from it. In most of the places that have got gas it’s not detrimental to the property.”

Queensland Valuer-General Neil Bray said there are still very limited sales of any substance to demonstrate a market for the effect of gas wells on property values. He said this has also been confirmed by private sector valuers.

Mr Bray said the State Valuation Service was aware of rural property advertisements listing income from gas wells had appeared and that he was monitoring them.

“These advertisements could signify the possible maturity of the market in the acceptance of gas wells incorporated into a rural business and/or the market has identified the surety of income versus commodity fluctuations,” he said.

“However, there is no clarity in the market place at this time. The State Valuation Service can only interpret the market when preparing statutory valuations.”

Mr Mortimer agreed that surety of income provided from gas wells was attracting interest from potential property buyers.

“Some callers have expressed interest in the cashflow,” he said.

Other realtors however said they preferred not to list gas wells on advertisements, preferring to discuss any CSG activities occurring on a property with potential buyers over the phone.



# 8 Hydraulic fracturing

## Key points

- Hydraulic fracturing practices have been developed over more than 65 years and have been applied to millions of wells around the world. The process has been safely used in over 1500 wells in Australia since the 1960s.
- Fracking is also used in the renewable energy industry and to increase the flow rate of groundwater bores.
- Numerous Australian and international reviews have found that the risks associated with hydraulic fracturing can be managed effectively with a robust regulatory regime.
- For example, the Australian Government's Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC) commissioned a review by the Department of the Environment hydraulic fracturing issues associated with coal seam gas extraction, including the techniques involved, the risks and how they are managed, and the regulatory environment. The review found that:
  - Hydraulic fracturing is a long established process with significant international and Australian development in relation to regulation, including the restriction and management of chemicals, drilling and well construction processes.
  - From an International perspective, there have been significant developments in the management and regulation of fracturing and this has influenced operators and procedures in Australia, as most of the contractors are large international organisations.
  - International experience has shaped the regulatory framework.
  - Risk assessments completed by industry for coal seam gas extraction projects suggest that hydraulic fracturing does not pose a significant risk to the environment, subject to implementation of controls and standards.
  - The Queensland Environmental Authority conditions and the *NSW Code of practice on fracture stimulation activities* (NSW Trade & Investment 2012b) provide a good framework for the planning, execution and monitoring of hydraulic fracturing through a risk assessment process, specifically in relation to reporting of site-specific fracture analyses.

# References

## **1 Allan Hawke AC: Report of the Independent Inquiry into Hydraulic Fracturing in the Northern Territory 2014**

- This report presents the findings of a review of fracking for the Northern Territory Government by Allan Hawke AC.
- The Hawke Report contains two key recommendations:
  - 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.
  - The substantive weight of agreed expert opinion leads the Inquiry to find that there is no justification whatsoever for the imposition of a moratorium of hydraulic fracturing in the NT.
- The Hawke Report also contains a useful summary of other national and international reviews into unconventional gas and hydraulic fracturing. We encourage the Committee to refer to the reports emanating from these inquiries and have included the key reports as attachments to this submission.

## **2 The Australian Council of Learned Academies—Engineering Energy: Unconventional Gas Production 2013**

- ACOLA is a forum that brings together great minds, broad perspectives and knowledge, providing the nexus for true interdisciplinary co-operation to develop integrated problem solving and cutting edge thinking on key issues for the benefit of Australia. This interface combines the strengths of the four Learned Academies, the:
  - Australian Academy of the Humanities
  - Australian Academy of Science
  - Academy of the Social Sciences in Australia
  - Australian Academy of Technological Sciences and Engineering.
- ACOLA undertook a three year research program funded by the Australian Research Council, conducted for the Prime Minister's Science, Engineering and Innovation Council (PMSEIC) through the Chief Scientist and his Office.
- ACOLA's Report (except for the conclusions and recommendations) was peer reviewed by an independent panel of experts comprising:
  - Professor Hugh Possingham, FAA
  - Professor Lesley Head FASSA, FAHA
  - Professor John Loughhead, FEng, FTSE, OBE.
- The report finds that: "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."

### **3 The New Zealand Parliamentary Commissioner for the Environment: Evaluating the Environmental Impacts of Fracking in New Zealand**

- This report “dealt with the whole process of drilling for oil and gas, from choosing a well site right through to the abandonment of the well”
- The Commissioner concluded that fracking can be managed effectively provided that operational practices are implemented and enforced through regulation.

### **4 The UK Royal Society and the Royal Academy of Engineering: Shale Gas Extraction in the UK: a Review of Hydraulic Fracturing**

- This report found that: “The health safety and environmental risks associated with hydraulic fracturing as a means to extract shale gas can be managed in the UK as long as operational best practices are implemented and enforced through regulation. Hydraulic fracturing is an established technology that has been used in the oil and gas industries for many decades.”
- The UK has 60 years’ experience of regulating onshore and offshore oil and gas.

### **5 Society of Petroleum Engineers: Hydraulic Fracturing 101**

- This comprehensive paper provides a technical introduction to how hydraulic fracturing is undertaken and the science and engineering practices that are employed.

### **6 CSIRO: Hydraulic Fracturing**

- This fact sheet contains a high level summary of hydraulic fracturing and how risks are mitigated.

### **7 CSIRO: Hydraulic Fracturing for Coal Seam Gas (CSG) Stimulation in NSW**

- This report provides a description of hydraulic fracturing and general information about the use of hydraulic fracturing in Australia and New South Wales.
- The report was written at the request of the Office of the Chief Scientist and Engineer of NSW.

### **8 Australian Government Independent Expert Scientific Committee: Hydraulic fracturing (‘fracking’) techniques, including reporting requirements and governance arrangements**

- This report provides an overview of Australian and international experiences with the use of hydraulic fracturing (‘fracking’) in coal seam gas development, including techniques, environmental concerns, reporting requirements and existing governance arrangements.

## **9 Australian Academy of Technological Sciences and Engineering (ATSE): Communique—Unconventional Gas: Opportunities and Challenges**

- ATSE is an independent body of more than 800 Australian scientists and engineers seeking to enhance Australia’s prosperity through technological innovation.
- The communique flowed from a conference that brought together 150 participants (researchers, NGOs, governments, regulators, industry, as well as academicians) from Australia and around the world to discuss unconventional gas.
- The communique states:
  - Unconventional gas can be produced in a manner that is environmentally responsible and that provides significant societal benefits, provided leading practice is followed.
  - Provided leading practice is followed and 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.

## **10 South Australian Government: Unconventional Gas in South Australia— Shale gas, tight gas, coal seam gas and regulation of activities**

- This information sheet provides background and information on the history of unconventional gas in South Australia and how the industry is regulated.
- The information sheet notes that over 700 wells have been safely fracture stimulated to increase flows from hydrocarbon (both oil and gas) reservoirs over decades in South Australia (since 1969).

## CASE STUDY: State and federal government approvals for hydraulic fracturing

There have been several comprehensive hydraulic fracturing risk assessments completed by the petroleum industry that were provided to state and federal governments as part of the normal project approval process.

These risk assessments were considered and accepted by successive state and federal ministers and agencies and are the basis upon which companies around Australia are currently undertaking hydraulic fracturing activities.

The risk assessments, many of which are public documents, are extensive and identify and consider environmental and human health risks, and account for likelihood, consequence, and the mitigation as provided for by government regulation and industry procedures and practice.

State and federal government approvals for hydraulic fracturing activities have been issued on the basis of the assessment findings, being that the risk to human health and the environment from hydraulic fracturing is generally considered to be low to negligible. The highest identified risk level is considered to be at a level that can be adequately managed through the implementation of regulatory and operational management measures.

CSG project risk assessments accepted by state and federal governments have been prepared and approved in accordance with:

- the *Environment Protection and Biodiversity Conservation Act 1999*
- the Queensland Government's Co-ordinator General Evaluation Report issued under Part 4 of the *State Development and Public Works Organisation Act 1971*
- Queensland Government Environmental Authorities granted and issued under the *Environmental Protection Act 1994*, and
- the NSW Government's *Code of Practice for Coal Seam Gas–Fracture Stimulation*.

The risk assessments account for all aspects of risk assessment and management and collectively:

- include over 200 individual chemicals or chemical constituents with the potential to be used in the hydraulic stimulation and drilling processes
- leverage internationally recognised data bases and industry best practices for toxicity assessments
- include chemical specific human and ecological toxicology profiles for all chemicals
- are based on empirical data from hydraulic fracturing
- cover the components of hydraulic fracturing and qualitatively and quantitatively assesses the risk to human health and environmental receptors in accordance with the Commonwealth Government's National Water Quality Management Strategy (NWQMS), National Environment Protection (Site Assessment) Measure (NEMP) and enHealth methodologies
- assess the toxicity of hydraulic fracturing chemicals for persistence, bioaccumulation and aquatic toxicity, terrestrial toxicity and human health toxicity
- reference extensive sets of key data sources with key references listed for each chemical on the toxicological profiles
- apply conservative (ie assume much greater risk than is likely) safety factors to toxicology in the calculation of risk
- demonstrate that the likelihood of exposure is generally low to negligible and that identified risks can be adequately managed through the implementation of regulatory and operational management measures.

## **CASE STUDY: History of hydraulic fracturing in petroleum, renewable energy, and water production**

Hydraulic fracturing is a process used to increase the flow of liquids and gas from underground formations. The process has application in any instance where increased flow is desirable and is therefore also used in renewable (geothermal) energy production and groundwater extraction.

The fracking process used in petroleum, geothermal energy, and water production is essentially the same and involves the controlled injection of fluid at high pressure into an underground formation to create or enhance small fractures in the rock which are then held open by a 'proppant' (which is often sand).

### **Petroleum**

The use of multi-stage hydraulic fracturing represents best practice within the petroleum industry for accessing low permeability, conventional and unconventional oil and gas resources on a commercial basis.

When combined with horizontal drilling, multistage hydraulic fracturing techniques are prime examples of the importance of innovation in the oil and gas industry to overcome technical challenges. These techniques and technologies have been developed over decades of research, trial and testing and are safe and sustainable ways of developing resources when best practice is followed by operators.

Hydraulic fracturing was first used commercially by the industry in 1949 in Stephens County, Oklahoma, and Archer County, Texas, to increase flow rates from tight hydrocarbon reservoirs and has since been used more than 2.5 million times worldwide. Fracking is considered to have increased US oil and gas reserves by at least 30 per cent and 90 per cent respectively and has moved the country towards levels of energy security it hasn't experienced in decades.

In Australia, fracking has been used for over 40 years, has been employed for 'conventional' petroleum extraction as well as 'unconventional' petroleum extraction, has been used offshore as well as onshore, including more than 700 times without incident on Barrow Island—an 'A' Class nature reserve in Western Australia.

### **Water bores**

Hydraulic fracturing is also used to increase the amount of water flow from existing dry and low yield water wells.

When used to enhance water bore productivity the process is often termed 'hydrofracturing' or 'hydrofracking'. The fluids used are predominantly water but often require the addition of biocides.

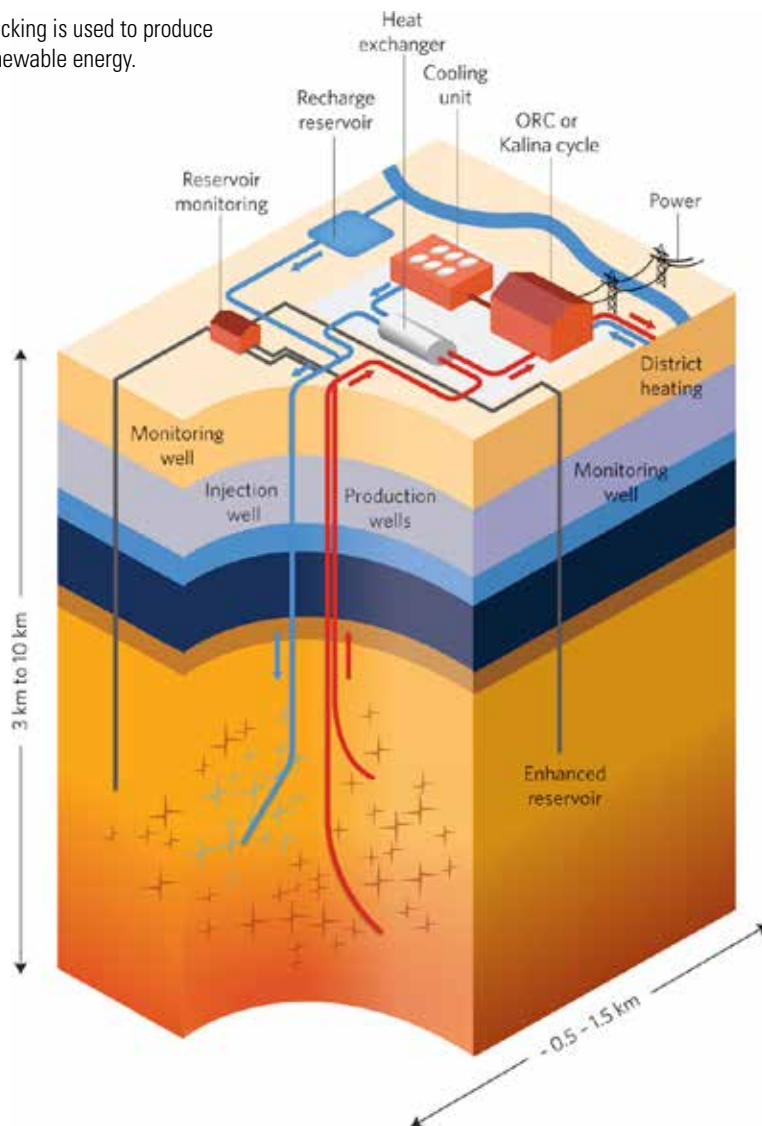
There are many firms that advertise and perform this service for landholders, and there are also many references that describe the process, for example the New Hampshire Department of Environmental Services Fact Sheet—Well Development by Hydro-fracturing<sup>5</sup>.

<sup>5</sup> <http://des.nh.gov/organization/commissioner/pip/factsheets/dwgb/documents/dwgb-1-3.pdf>



## CASE STUDY: *continued*

Fracking is used to produce renewable energy.



### Renewable energy

Hydraulic fracturing is used in geothermal energy production to increase the flow of water through hot rocks.

When used to produce geothermal energy the process is often termed 'enhanced geothermal systems' or EGS.

The process as used in geothermal energy production essentially involves the injection of millions of litres of water and chemicals into vertical wells at high pressure. This creates new fractures within the rock deep underground through which water can be pumped, heated and sent back to surface to generate power<sup>6</sup>.

Hydraulic fracturing is so important to renewable energy production that the Australian Government Australian Renewable Energy Agency (ARENA) provided \$32,750,000 in funding to support single project using the technology<sup>7</sup>.

6 <http://energy.gov/eere/geothermal/how-enhanced-geothermal-system-works> and <http://www.economist.com/news/business/21612193-why-geothermal-new-fracking-hot-rocks>

7 <http://arena.gov.au/project/cooper-basin-enhanced-geothermal-systems-heat-and-power-development>



# 10 Health

## Key points

- According to Queensland Health, no link has been found between coal seam gas operations and health concerns.
- According to Public Health England, the risks to public health from exposure to emissions from shale gas extraction are low if operations are properly run and regulated.
- A 33-year baseline health study of petroleum workers shows they have better health than the Australian community.
- The Queensland CSG industry has invested in partnerships to improve existing health service delivery and strengthen and introduce new programs to improve access to health services.

## References

### 1 **Monash University: Health Watch Study 14<sup>th</sup> report**

- This ongoing university-based research program has been studying the health of around 19,000 past and present Australian petroleum industry workers since 1980.
- The research clearly shows that petroleum industry employees have better health than the general Australian community and are less likely to die of the diseases commonly causing death - including cancer, heart and respiratory conditions.
- The 14<sup>th</sup> report of the study is attached and previous reports can be found at: <http://www.aip.com.au/health/ohs.htm>

## **2 Queensland Government Department of Health: Coal seam gas in the Tara region—Summary risk assessment of health complaints and environmental monitoring data**

- This report by the Queensland Government details the findings of their investigation following claims that gas development was harming residents in the Tara region.
- Queensland Health found no clear link could be drawn between the health complaints of some residents and the impacts of the local CSG industry on air, water or soil within the community.
- The Queensland Health report also found that the nature of complaints meant there were multiple potential causes and explanations that are unlikely to be caused by CSG activities including faecal contamination in the water supply, the use of wood-fired heaters or open fires, and rainwater contaminated with bacteria, viruses or other organisms.
- The report also noted:
  - The most prevalent reported symptoms are headache, transient (reversible) eye irritation, nosebleeds and skin rashes. All of these are common medical complaints generally, as reflected by the following data:
    - WHO (2012) reports an estimated 47 per cent of the adult population suffered a headache at least once within the last year and 1.7–4 per cent of the world’s adult population have headache on 15 or more days every month.
    - Various surveys of the prevalence of skin conditions in Australia have been reported (Marks, Plunkett, Merlin et al, 1999). These data show that the prevalence of self-reported skin disease, including eczema/dermatitis, is significant in the Australian community generally: The national health survey by the Australian Bureau of Statistics in 1989–90 found 12.7 per cent of the population reported a disease of the skin and subcutaneous tissue within the previous two weeks.
    - In regard to nosebleeds, lifetime incidence in the general population is estimated at 60 per cent, though fewer than 10 per cent seek medical attention. Peaks in incidence occur in children under 10 years of age and adults older than 45 years of age (Medscape Reference, 2011; NICE, 2011).

## **3 Government of Western Australia Department of Health: Hydraulic fracturing for shale and tight gas in Western Australian drinking water supply areas**

- In 2015, the WA Department of Health undertook a ‘human health risk assessment’ of hydraulic fracturing to inform the WA Legislative Council’s Environment and Public Affairs Committee’s Inquiry into Hydraulic Fracturing for Unconventional Gas.
- The document reviewed recent investigations into hydraulic fracturing and the potential impact on public health, including experiences in eastern Australia and internationally.
- The Health Risk Assessment found that “hydraulic fracturing of shale gas reserves in WA can be successfully undertaken without compromising drinking water sources.”
- This is primarily due to the depth of gas resources, the agreed industry/engineering standards, best practice regulation and appropriate site selection.

#### **4 Public Health England review of health impacts of shale gas extraction**

- This review of scientific literature focused on potential impacts from all stages of shale gas extraction, including hydraulic fracturing.
- It concluded risks to public health are low when operations are properly run and regulated.
- Other findings included:
  - potential risks and resulting problems reported in other countries were typically due to operational failure;
  - good on-site management and appropriate regulation was essential to minimise environmental and health risks;
  - proper well construction and maintenance was essential to reduce the risks of ground water contamination; and
  - hydraulic fracturing was unlikely to contaminate groundwater because of the depth at which it occurs.

## CASE STUDY: QGC—Major health initiatives

QGC is a leading producer of natural gas and operator of the QCLNG 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, we 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, 5935 telehealth consultations were reported through the Darling Downs region, compared with 2912 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 5199 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.

## CASE STUDY: *continued*

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 1600 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





# 11 Water production and use

## Key points

- Water production by the Queensland CSG industry accounts for a very small fraction of water in the Great Artesian Basin.
- The Underground Water Impact Report (UWIR) by the Office of Groundwater Impact Assessment indicates that water production by the CSG industry is expected to have a minimal impact on existing private water bores in Queensland.
- If petroleum activities impact on a landholder bore's capacity then the relevant company is required to enter an agreement with the landholder to make good the impact where the impact meets the regulatory threshold.
- 97 per cent of CSG water in Queensland is made available for beneficial use, with the majority going to agriculture.
- Landholders receiving treated water use the water to increase irrigated cropping and livestock watering—boosting agricultural production, economic flow-on opportunities and community benefits.

## References

### **1 Office of Groundwater Impact Assessment (OGIA): Underground Water Impact Report (UWIR)**

- The UWIR provides assessments on the impacts of water extraction by petroleum tenure holders on underground water resources in the Surat Cumulative Management Area (CMA), and specifies integrated management arrangements.

- The Surat CMA covers an area the size of Germany and the first UWIR is a baseline study that was in place two and half years before the commencement of LNG exports.
- In line with the UWIR's integrated management arrangements, gas companies have installed monitoring wells to detect any changes in aquifer pressure (using vibrating wireline piezometers) or changes in the chemistry in the aquifers underlying their permit areas. This information is delivered to the OGIA on a six-monthly basis.
- Of the 21,000 existing private water bores in the Surat CMA, OGIA found that just 85 (0.4%) would be immediately effected, and another 528 bores (2.51%) would be affected in the long-term. The majority of these bores are taking water from the same coal seams used for gas production. Further, given that the industry is not producing as much water as initially expected it is likely that the number of affected bores will also fall.
- Tenement holders are required to 'make good' on any bore level decline by providing landholders with alternative water supplies. This may include drilling new, deeper bores, or supplying treated water to the affected properties.

## **2 CSIRO: Water resource assessment for the Surat region**

- This document details CSIRO analysis and findings in relation to current and future water availability in the Surat and discusses modelling of the effect of CSG development.

## **3 Queensland Government: Quick Guide—Make Good**

- This guide sets out the regulatory framework for make good in Queensland.

## **4 Queensland Government GasFields Commission: CSG Water Treatment and Beneficial Use**

- This paper outlines the methods used to treat CSG water and the standards that companies are required to meet to ensure that this water is safe and fit for purpose. The paper also explores how treated CSG water is beneficially used in the agricultural industry and regional communities.

## **5 Queensland Government GasFields Commission: Groundwater Aquifer Connectivity in Queensland**

- This paper finds that the results of field and laboratory measurements and computer modelling show that low aquifer connectivity is a dominant geological characteristic of aquifers across the Surat, Bowen, and Galilee Basins in Queensland.
- The low degree of connectivity reflects a high resistance to cross formation flow due to the low vertical permeabilities of coal measures and aquitards and the often considerable vertical separation distances between aquifers and coal measures.
- CSG development is expected to induce aquifer leakage, but the low degree of aquifer connectivity means that widespread, negative impacts are not predicted.

**6 Queensland Government GasFields Commission: Collation of Water-Related Science and Research Activities in the Queensland Coal Seam Gas Sector**

- This paper provides summary details of 188 research projects pertaining to CSG water management.
- The projects were identified via a survey by the GasFields Commission of CSG companies, Queensland and Australian Government agencies, and universities.

**7 APPEA reference document: Coal seam gas and water volumes**

- This document discusses (with supporting references) CSG water production, the Great Artesian Basin, water use by CSG compared other industries, the interaction between CSG wells and aquifers, and the water monitoring strategy in place for Queensland's CSG industry.

## CASE STUDY: Australia Pacific LNG CSG water used to grow crops

The Fairy Meadow Irrigation Pipeline (FRIP) project was delivered by Origin on behalf of Australia Pacific LNG. The project involved construction of the 1870 megalitre irrigation storage dam located on the Monreagh property, the Monreagh pump station, the pipeline along Fairymeadow Road, and offtake points for participating landholders.

The FRIP project provides the opportunity for landholders to supplement their current cropping programs with new irrigation.

This irrigation scheme is an example of the CSG industry working with local farmers for mutual benefit. It opens the door for the Fairymeadow area to be farmed more intensively than it has in the past, which leads to increased local jobs in agriculture, and a financial boost for the local agricultural contractors and associated agricultural businesses. This supply of water is especially important in times of drought.

Water began flowing to participating landholders in April 2014, filling on-farm dams and allowing farmers to prepare fields for planting winter crops which have since been harvested.

Treated water is delivered via pipeline from reverse osmosis water treatment facilities at Talinga and Condabri and stored in Monreagh Dam, and transferred to landholders via the Fairymeadow Road Irrigation Pipeline.

The FRIP project forms part of Australia Pacific LNG's broader CSG water management strategy, which uses a variety of solutions to find the best outcome for water resources according to local conditions.

The FRIP project is a practical application of the Queensland Government's Coal Seam Gas Water Management Policy (2012) which requires CSG companies to find beneficial uses for treated CSG water, and demonstrates how the agricultural and resources industries can work together to develop shared benefits.

### **About the Fairymeadow Road Irrigation Pipeline Project:**

- Seven participating landholders
- Covering an estimated 3500 hectares
- 15 gigalitres of treated water per year during peak production
- A 22 km water distribution pipeline along Fairymeadow Road
- A 1870 megalitre irrigation dam, located on the Monreagh property (Monreagh Dam) which provides buffer storage
- A pump station at Monreagh Dam
- Irrigation off-takes for each participating landholder property along the water pipeline
- Water delivery gates to measure flow at each participating landholder property
- Talinga Water Treatment Facility
- Condabri Water Treatment Facility and booster pump station.

## CASE STUDY: Advanced scientific research on aquifers



In the last two years, Arrow has completed some of the most advanced scientific research to date on the impact of coal seam gas extraction on aquifers (from which farmers also draw water for irrigation).

In partnership with Queensland Government's Office of Groundwater Impact Assessment (OGIA), Arrow conducted two aquifer interconnectivity trials (including drilling four groundwater monitoring bores) on intensively farmed land in the Condamine Alluvium area—the first at Daleglade in 2013 and the second was at Lone Pine in 2014.

The two studies, on arguably some of the most intensively farmed land in Australia (over the Condamine Alluvium and Walloon Coal Measures) aimed to obtain accurate knowledge about the potential for groundwater flows between the Walloon Coal Measures (targeted for gas extraction) and the Condamine Alluvium aquifer, as this is vital to predicting CSG impacts on groundwater resources in the Surat Basin.

The results proved the potential for CSG impacts on groundwater resources in the Condamine Alluvium aquifer is extremely low. To date, there have been no impacts on the Condamine Alluvium aquifer.

Undertaken with the full support of landholders and government, the trials demonstrated coexistence between the CSG and farming industries can occur.



# 12 Water quality

## Key points

- Conservation and protection of groundwater is a top priority during all oil and gas activities.
- The use of chemicals during drilling, cementation and hydraulic fracture stimulation of wells is strictly regulated and carefully managed to minimise environmental risk.
- Studies and decades of practical experience show the risk of groundwater contamination is low.
- The quality of the water extracted from coal seams varies in its salt content depending on the geology of the area.
- The mineral composition of this water is no different to that of the bore water extracted from coal seams being used by farmers for irrigation. In some cases, the water drawn from coal seams cannot be used productively without further treatment. The treatment of this water by the CSG industry enables productive uses.

## References

### 1 Queensland Government CSG water policy framework

- The purpose of this policy is to:
  - clearly state the government's position on the management and use of CSG water
  - guide CSG operators in managing CSG water under their environmental authority
  - ensure community understanding about the government's preferred approach to managing CSG water.
- CSG operators must demonstrate how their water will be managed in accordance with the policy. CSG operators are also required to submit an annual evaluation of how effective and appropriate management of CSG water has been. This annual evaluation is carried out in consideration of measurable criteria.

## **2 Queensland Government: General Beneficial Use Approval - Irrigation of Associated Water (including coal seam gas water)**

- This reference specifies the standards that must be met to use CSG water for irrigation.
- There are two types of approvals of a resource for beneficial use—general and specific. A general BUA has clear standards which, if complied with, do not require individual assessment by the department. Anyone can operate under this type of BUA provided they comply with the conditions of the BUA.
- A specific BUA requires an individual assessment and is only available following approval by the department.

## **3 Queensland Government: General Beneficial Use Approval—Associated water (including coal seam gas water)**

- This reference specifies the standards that must be met to use CSG water for:
  - aquaculture
  - coal washing
  - dust suppression
  - construction
  - landscaping and revegetation
  - industrial and manufacturing operations
  - research and development
  - domestic, stock, stock intensive and incidental land management.

## **4 CSIRO: Coal seam gas developments - predicting impacts**

- This factsheet outlines reasons for using natural gas as an energy source, some of the potential impacts of CSG developments, and states the reasons why groundwater contamination from CSG operations is considered a low risk.

## **5 CSIRO: Coal seam gas—produced water and site management**

- This document discusses CSG water quality, treatment and uses.

## **6 CSIRO: CSG Water Injection Impacts: Modelling, Uncertainty and Risk Analysis**

- This report examines groundwater flow and transport modelling and uncertainty analysis to quantify the water quantity and quality impacts of a coal seam gas produced water injection scheme in the Surat Basin, Queensland.
- This study developed and applied an integrated multi-scale groundwater modelling methodology to assess the risks of water quantity and quality changes resulting from a large scale injection scheme proposed by Australia Pacific LNG (APLNG) in the Surat Basin, Queensland.

## **7 APPEA reference document: Coal seam gas and groundwater quality**

- This document discusses (with references to independent sources) chemical use, aquifer monitoring, and aquifer protection.

## CASE STUDY: Water from the Roma gas fields

Water from the gas fields in Roma typically contains between 1500–3000 parts per million (ppm) of total dissolved solids. The table below gives an idea of how this compares to other water sources. When beneficially used CSG water is treated to the mandated standard for the intended use.

A range of water management strategies are used, depending on a number of factors including the surrounding community and geology of the area, but the water is re-used for purposes such as irrigation, dust suppression and recharging depleted aquifers.

Water source	Water quality* (parts per million)
Rainwater	15–22 ppm
Desalinated water	180 ppm
Brisbane tap water	240 ppm
Average groundwater bore in Fairview, Queensland	300 ppm (average)
Roma tap water	800 ppm
Amended CSG water	1800 ppm
Average CSG water	1500–3000 ppm
Livestock and watering	5,000 ppm
Saltwater swimming pool	6,000 ppm
Seawater	35,000 ppm

\* Water quality is determined by measuring the total dissolved solids in the water

### How is the water purified?

Two main processes to treat water drawn from coal seams near Roma if required:

- 1 Desalination: Using the filtration process of reverse osmosis to separate salt from water.
- 2 Amendment: Altering the chemical balance of the water

### Desalination

Capital cities around Australia have adopted desalination to produce drinking water from the ocean. The industry is using the same proven technology to purify water it withdraws from coal seams.

### Amendment

Water that isn't as salty can be treated by using an amendment process. This involves changing the mineral make-up of the water to produce water that is suitable for the intended purpose. The suitability of amended water for any other uses is determined by the water quality and is regulated by the state government.

### What is done with the salt?

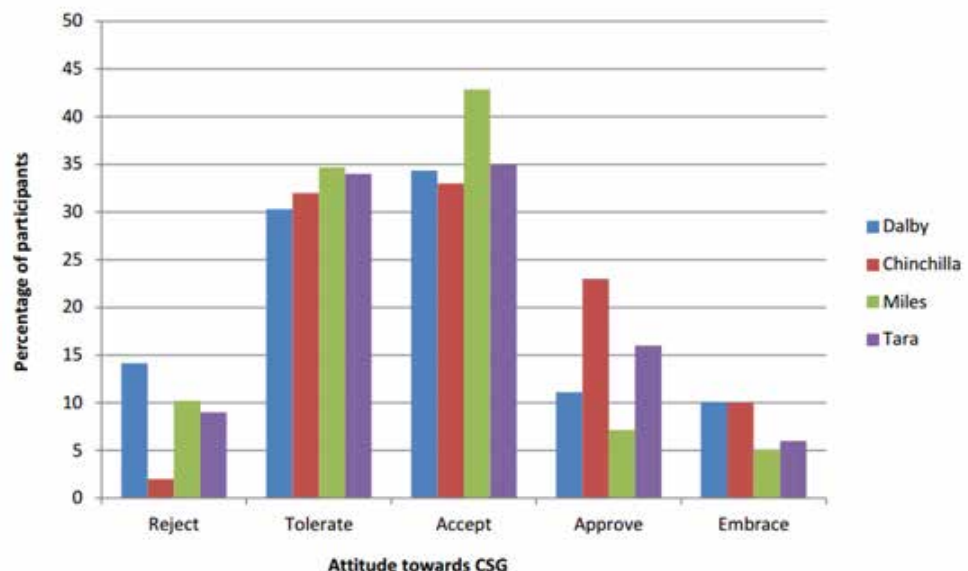
After desalination a brine (salty water) is produced. Industry works within strict government guidelines to ensure brine is always managed safely and responsibly. At Roma, the brine left over after desalination is currently reinjected into deep underground aquifers which are already high in salt. In any new areas of operation in future, this will be dependent on the geology of the areas.



# 13 Regional socio-economic benefits and community attitudes

## Key points

- A number of reputable and independent studies have been published in recent years that find significant positive regional socio-economic benefits of onshore gas and resources production. Community attitudes to the industry have also been found to be positive.
- The Australian Government's Bureau of Resource and Energy Economics (BREE) reported in 2015 that there are long term net economic benefits from CSG and negligible impacts of water and air quality to date.
- The CSIRO reported in 2013 that the CSG industry is contributing to poverty reduction, increasing employment and family income, and that there is a growing youth population in regions with CSG development.
- A 2013 study by KPMG showed that resources developments are not only making regions more prosperous, but also making their communities more stable and socially sustainable.
- A 2014 report by the CSIRO found that the majority of the community in Tara, Chinchilla, Miles, and Dalby accept, approve, or embraces the industry with only a small minority rejecting the industry:



Attitude towards CSG  
Source: CSIRO survey of community wellbeing and responding to change: Western Downs region in Queensland, September 2014

# References

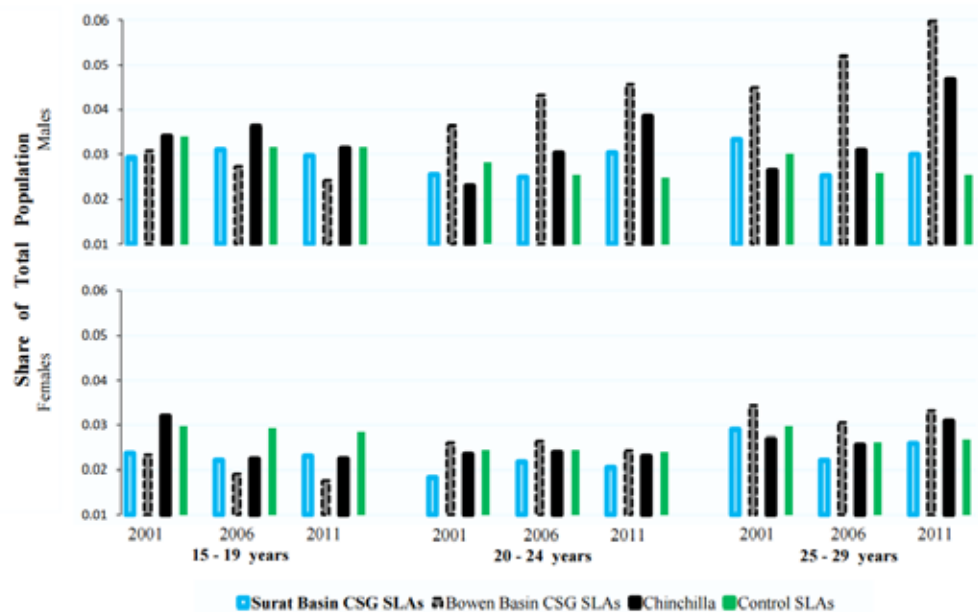
## 1 Australian Government Bureau of Resource and Energy Economics: Review of the socioeconomic impacts of coal seam gas in Queensland

- This report provides a synthesis of the nature and magnitude of various impacts of CSG development on communities in Queensland. It incorporates a literature review, which covers forecasts of impacts, statistical analyses of census and other data.
- The literature review was supported by a range of interviews and workshops with industry stakeholders. The analysis presents both economic and broader community impacts, as well as drawing a range of insights and conclusions about the experience of CSG development in the state.
- Headline economic impacts of CSG development in Queensland to date are found to be net positive, and are attributable to increases in employment, income, output, consumption and government revenue. These changes are broadly consistent with changes experienced as a result of a typical natural resource development.
- BREE also finds that the evidence to date shows that there have only been negligible impacts on water and air quality, and work is ongoing in order to continue to assess the potential impacts and reduce uncertainties about potential impacts going forward.

## 2 CSIRO: Impacts of unconventional gas development on rural community decline

- This working paper finds that:
  - Regions with CSG development have experienced a growing youth population share and, of particular note, a growing female youth population share, which is unlikely to be explained by non-resident workforces alone. This is shown in the chart below.

Male and female population share of total population for studied area based on Census data for 2001, 2006 and 2011 (ABS 2013)



- Poverty reduction was also observed in CSG regions, concentrated primarily in specific locations.
- The extensive spatial footprint of unconventional gas and increased female youth populations indicate a diversion from traditional boomtown effects in previous energy booms.
- Taken together, the results show signs of mitigating (and in some cases reversing) rural community decline.

### **3 KPMG: Analysis of the Changing Resident Demographic Profile of Australia's Mining Communities**

- KPMG found that in the five years to 2011, the number of people employed in the resources sector across the sampled regions grew by 13,810—or 50 per cent. The number employed in all industries—including resources—grew by just 14 per cent.
- In that same period, the population of Australia's resources regions had grown at 1.5 per cent per year. This was the same as the national average but greater than the 0.8 per cent for regional Australia more generally.
- In the Surat between 2006 and 2011:
  - The population increased by 3.2 per cent
  - The total number of dwellings increased by 8 per cent
  - Students finishing Year 12 increased by 4.3 per cent
  - Residents with tertiary degrees increased by 2 per cent.
  - Despite the rise in population, the unemployment rate remained stable at about 4 per cent—well below the Australian and Queensland averages.
  - The number of residents at the same address that they were living in five years previously increased by 3.3 per cent. So despite an influx of new workers, there are strong indications that locals no longer have to leave the region to find work.
  - In addition, in the last five years the retail trade sector has overtaken healthcare and social assistance as the region's largest industry of employment. This rebuts claims that money being made in the region is not being spent there.

### **4 CSIRO: Survey of community wellbeing and responding to change: Western Downs region in Queensland, September 2014**

- CSIRO finds that the majority of the community in Tara, Chinchilla, Miles, and Dalby accept, approve, or embrace the industry with only a small minority rejecting the industry.
- This CSIRO research also suggests that attitudes to the industry reflect personal circumstances (e.g. incomes, on-farm less positive than off-farm, whether recent or long established residents) and local community satisfaction (e.g. services, expectations of future etc).

## CASE STUDY: Buru Energy engagement with Indigenous communities

Buru Energy is an ASX listed oil and gas exploration and production company, focussed on the Canning Basin in the remote Kimberley region of Western Australia. In 2015, Buru Energy undertook a Tight Gas appraisal project on and near Noonkanbah Station (Yungngora community). Buru has partnered extensively with Traditional Owners, including through the following initiatives:

- Delivery of 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 in the field of Conservation and Land Management to undertake groundwater monitoring at well sites.
- Partnering with KTI to train personnel in security, the operation of excavators, water carts, dump trucks, front end loaders and bobcats.
- Employment of over 30 Traditional Owners during our recent Tight Gas Stimulation program with over 13,500 hours of paid employment undertaken by community members during the program.
- A joint statement was released by the Yungngora community in September 2015 regarding Buru Energy's activities and is copied below.

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

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## CASE STUDY: Santos CSG industry community investment

In addition to the broader socioeconomic benefits that come with increased economic activity and a more diverse regional economy, Queensland's natural gas and LNG industry has made significant public investments in the communities within which it operates.

The table below details the community investments made by one LNG operator, Santos GLNG, over the period 2011–2016. Other LNG operators have made similar investments in the Surat Basin.

### Community Investments 2011–2016

LGA	Initiative	Project partner	Investment driver	Description	Duration	Status	Contribution
Maranoa, Banana and Central Highlands	Rural Fire Service slip on units	Queensland Fire Service	Social Impact Mitigation Community Safety	98 slip on units (500 Litre portable water tanks) donated to 45 rural fire services to support bush fire response in the region.	One off donations in 2011, 2012 and 2013	Complete	\$750k
Maranoa	Roma Airport Upgrade	Maranoa Regional Council	CG Condition Social Infrastructure	Funding contribution to upgrade the Roma airport and increase the terminals capacity to transit industry workforce.	Completed 2012	Complete	\$2.5m
Maranoa	Roma Allied Health	Queensland Health	Social Impact Mitigation Social Infrastructure	Funding contribution to the Nuriyn Wellness Centre to co-locate allied health service provision in Roma. The centre comprises of four dental surgeries, a dental laboratory, and facilities for slow-steam rehabilitation and injury prevention/management clinics.	Completed 2012	Complete	\$1m
Maranoa	Rent Assist Program	Horizon Housing	CG Condition— Integrated Project Housing Strategy / Social Infrastructure	Program established to provide rental or bond loan assistance to households on low to middle incomes experiencing short term rental increases.	2011–2014	Complete	\$560k
Maranoa	Roma Community Housing Project	Horizon Housing	CG Condition— Integrated Project Housing Strategy / Social Infrastructure	Construction and management of an affordable housing development in Roma. 16 studio apartments are designed to provide assistance primarily to key workers.	Construction completed 2013	Complete	\$1m
Maranoa	Aged Care Accommodation	Queensland Health	Social Impact Mitigation Social Infrastructure	Funding contribution to support the construction of the Mitchell Multipurpose Centre to boost regional capacity for aged care.	Construction completed 2013	Complete	\$100k
Maranoa	Affordable Housing Initiative	Maranoa Regional Council	CG Condition— Integrated Project Housing Strategy / Social Infrastructure	Facilitate the provision of affordable housing in the Maranoa Region.	2013–2015	Ongoing	\$4m
Maranoa	Infrastructure, Planning and Approvals Staff Resource	Maranoa Regional Council	Social Impact Mitigation Social Infrastructure	Funding contribution to Maranoa Regional Council to assist with staffing resources within the Infrastructure, Planning and Approvals Department.	2013	Complete	\$200k

## CASE STUDY: *continued*

LGA	Initiative	Project partner	Investment driver	Description	Duration	Status	Contribution
Maranoa and Gladstone	Aero Medical Evacuation Initiatives	CareFlight Group Queensland	Social Impact Mitigation Community Safety	Contribution to a joint industry aero medical evacuation (AME) helicopter service. The helicopter supports industry evacuation response as well as community retrievals in the Surat and Gladstone. The estimated contribution will be \$20m over the life of the project.	2011–2019	Ongoing	\$20m
Maranoa	Community Hub	Maranoa Regional Council	Social Impact Mitigation Social Infrastructure	Financial contribution to support the construction of a Community Hub in Roma, the Hub will provide a centralised location for community service delivery.	2013–2014	Complete	\$500k
Maranoa Roma Sewerage Upgrades		Maranoa Regional Council	Social Impact Mitigation Social Infrastructure	Financial contribution for support an upgrade to the Roma underground sewerage infrastructure.	2013–2015	Complete	\$1m
Maranoa	Roma Saleyards Wash Down Facility Upgrade	Maranoa Regional Council	Social Impact Mitigation Social Infrastructure / Water and the Environment	Financial contribution to upgrade a public wash down facility to reduce the spread of weeds.	2013–2015	Ongoing	\$500k
Maranoa	Weed and Pest Initiatives	Queensland Murray Darling Committee	Social Impact Mitigation Water and the Environment	Provision of funding for private wash downs to reduce the spread of weeds. Education program through signage.	2013–2015	Complete	\$216k
Maranoa	Regional School Upgrades	Injune State Schools P&C	Social Impact Mitigation Community Wellbeing and Liveability	Funding for the upgrade of the Injune State School air conditioning system.	2012–2013	Complete	\$25k
Maranoa	Arcadia Valley Community Precinct Upgrades	Arcadia Valley Recreation Association Inc.	Social Impact Mitigation Community Wellbeing and Liveability	Funding to improve facilities at the Arcadia Valley Community Precinct.	2013–2015	Complete	\$100k
Maranoa	Maranoa Regional Council Library Upgrades	Maranoa Regional Council	Social Impact Mitigation Community Wellbeing and Liveability	Funding to support the upgrade of technology in libraries in the Maranoa.	2014–2015	Complete	\$50k
Maranoa	CSG Schools Program	Department of Education Training and Employment	Social Impact Mitigation Local Industry Participation and Training	Funding for schools program, including F1, Power of Engineering, Try a Trade and Wonder of Science.	2013–2015	Complete	\$300k

## CASE STUDY: *continued*

LGA	Initiative	Project partner	Investment driver	Description	Duration	Status	Contribution
Maranoa	Shop Local Invest Local	Commerce Roma	Social Impact Mitigation Local Industry Participation and Training	Funding to support the Commerce Roma shop local invest local campaign. Campaign to deliver a suite of initiatives aim at building capacity and maturity of the local business community, helping to attract and retain staff and delivery of a local procurement assistance strategy.	2013–2015	Ongoing	\$150k
Maranoa	Maranoa PCYC Committee Bus	Maranoa PCYC	Social Impact Mitigation Community Wellbeing and Liveability	Funding for the purchase of a Community Bus, to increase school participation in PCYC facilities.	2013-2014	Complete	\$75k
Maranoa	Rapid Response to Emerging Threats	Maranoa Regional Council	Social Impact Mitigation Water and the Environment	Partnership with Maranoa Regional Council to ensure and early and coordinated response to weed and pest threats as they emerge.	2013-2015	Complete	\$20k
Maranoa	Community Water Initiative	Maranoa Regional Council	Social Impact Mitigation Social Infrastructure	Funding contribution to Maranoa Regional Council for the Wallumbilla Town Water bore.	2014-2015	Complete	\$250k
Maranoa	Deadly Choices Shirts	Charleville and Western Areas Aboriginal and Torres Strait Islander Community Health	Social Impact Mitigation Community Wellbeing and Liveability	Funding contribution to purchase deadly choices shirts to incentivise health checks.	2014	Complete	\$13.75k
Maranoa, Central Highlands, Banana and Western Downs	Stay on Track Outback	Queensland Police	Social Impact Mitigation Community Safety	Road safety awareness campaign. Promotional campervan and ute.	2014-2015	Complete	\$40k
Central Highlands	Rolleston Health Clinic	Rolleston Health Committee	Social Impact Mitigation Social Infrastructure	Funding for the purchase of a defibrillator to support the newly constructed Rolleston Health Clinic.	2014	Complete	\$41,588
Central Highlands	Arcadia Valley Road	Central Highlands Regional Council	CG Condition – Road Use Management Plan / Social Infrastructure	Funding to support the upgrade of a 23.5 kilometer section of the Arcadia Valley Road.	2014	Complete	\$3m
Banana	Palm Tree and Robinson Creek Wetlands Project	Fitzroy Basin Association	Social Impact Mitigation Water and the Environment	This project allowed FBA to research and record data regarding the Palm Tree and Robinson Creek wetlands areas. The research is publicly available, and a management plan has been developed to ensure the area is monitored and preserved.	2013-2014	Complete	\$90k



## CASE STUDY: *continued*

LGA	Initiative	Project partner	Investment driver	Description	Duration	Status	Contribution
Banana	Bauhinia Sports Ground	Bauhinia Sports Associations	Social Impact Mitigation Social Infrastructure	Contribution towards the major power supply and lighting upgrade of the Bauhinia Sports Association.	2012	Complete	\$20k
Banana	Biloela Art Gallery	Banana Shire Council	Social Impact Mitigation Social Infrastructure Community Wellbeing and Liveability	Contribution to the construction of the Banana Shire Regional Art Gallery.	2012-2013	Complete	\$500k
Banana	Banana Shire Council Weed Wash Down Facility	Banana Shire Council	Social Impact Mitigation Social Infrastructure	Funding for upgrades to the wash down facility in Moura to reduce the spread of weeds.	2012	Complete	\$200k
Banana	Bajool School of Arts Solar Panel Funding	Bajool School of Arts Committee	Social Impact Mitigation Social Infrastructure	Funding towards the supply and installation of solar panels.	2012	Complete	\$20k
Banana	Outdoor Cinema Equipment	Bauhinia, Moura, Banana and Jambin Communities	Social Impact Mitigation Social Infrastructure	Outdoor cinema equipment was provided to communities as part of the pipeline farewell tour.	2014	Complete	\$40k
Banana	Weed Awareness Signage	Dawson Catchment Coordinating Association Inc.	Social Impact Mitigation Water and the Environment	Partnership with DCCA to promote general awareness around weed spread. Continuation of awareness project with QMDC.	2015-2016	Ongoing	\$16k

# 14 Fugitive emissions and natural gas seeps

## Key points

- The industry reports emissions from natural gas production, supply and use to the Department of Environment and the Clean Energy Regulator under the *National Greenhouse and Energy Reporting Act 2007* and reported publicly in Australia's National Greenhouse Accounts.
- Fugitive emissions from oil and gas operations in Australia fell by 13.6 per cent between 1990 and 2013—despite a 55.6 per cent increase in production over that period—according to the Australian Government's submission to the United Nations Framework Convention on Climate Change.
- Natural gas seeps are instances of gas escaping to surface via natural pathways, and the presence of seeps was identified in Queensland as early as 1889.
- The gas industry supports baseline research being undertaken by the CSIRO to investigate fugitive emissions from Natural CSG production in Australia.
- In 2014 the CSIRO made direct measurements of 43 individual CSG wells in Australia. Its researchers measured a median methane emission for a well of 0.6 g/min, which is about the same as four cows. These measured emission rates are very much lower than those that have been reported for US unconventional gas production.

## References

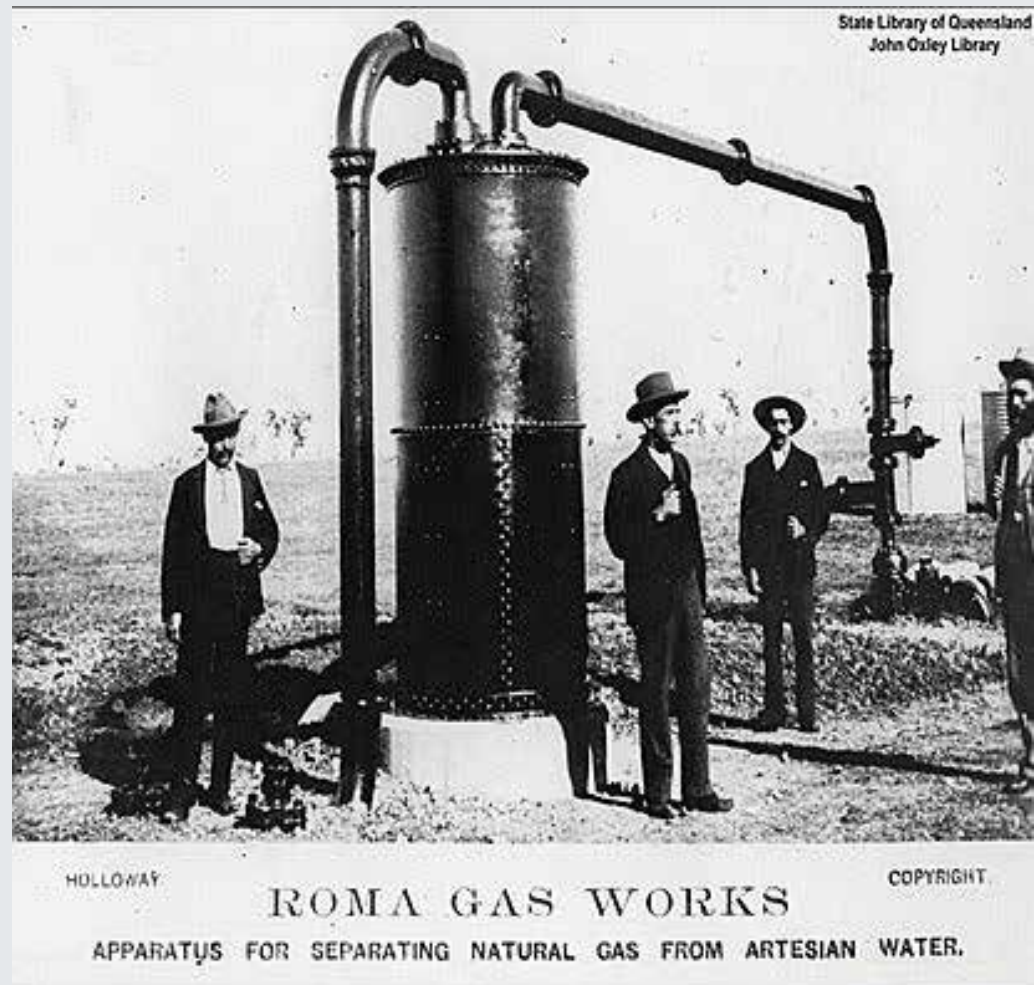
- 1 Australian Government: Federal Department of the Environment greenhouse gas measurement**
  - Details of the Australian Government's reporting requirements for greenhouse gas emissions are available at: <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement>
- 2 Australian Government: Submission to the United Nations Framework Convention on Climate Change**
  - The Submission and additional reporting on Australian greenhouse gas emissions is available at: <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/progress-inventory>
- 3 GasFields Commission Queensland: Historical evidence of landscape gas seeps in Qld coal basins**
  - This fact sheet summarises the results of a range of soil gas surveys undertaken in the 1980s and 1990s in Queensland which found a number of examples of naturally occurring landscape gas seeps.
  - This work is discussed further in the case study below.
- 4 CSIRO: Field Measurements of Fugitive Emissions from Equipment and Well Casings in Australian Coal Seam Gas Production Facilities**
  - This report to the Federal Department of the Environment reports the results of quantitative measurements of fugitive emissions from the Australian CSG industry.
  - The report found that emissions from Australian CSG are very much lower than emissions from unconventional gas production in the United States.

## CASE STUDY: The long history of natural gas seeps in Queensland

The GasFields Commission Queensland has undertaken a historical data search that identified the existence of natural gas seeps from the Surat, Eromanga, Cooper, Georgina, Bowen and Galilee basins.

These soil gas surveys demonstrate that landscape gas seeps existed naturally before the recent expansion of the onshore gas industry in Queensland.

In fact, water drilling as early as 1889 is recorded to have encountered naturally occurring gas accumulations and seeps, some of which were tapped early last century to light the streets of Roma.



## CASE STUDY: Using science to build community confidence

The CSIRO Perth Basin Research Program is assessing the potential impacts from oil and gas activities in the Perth Basin.

One of the industry's key environmental objectives is ensuring fugitive methane from the deep reservoirs does not contaminate local ground water and atmosphere.

Australian communities and regulators demand onshore proponents demonstrate comprehensive solutions in meeting this objective. CSIRO will investigate the development and application of new and proven technologies in the onshore Perth Basin to ensure these objectives are met and Australia remains a world leader in best environmental practice.

The initial objective of the project is to establish a baseline of environmental indicators that can be reliably and accurately monitored during the development of tight and shale gas resources.

CSIRO will coordinate the research effort which may involve other research providers such as UWA and Curtin University with the cooperative involvement of industry members.

Relevant WA Government agencies will also be invited to participate. The research program will look at monitoring aspects in four environmental domains: deep subsurface, shallow sub surface, surface and near-surface atmosphere

The goals of the initial research projects are to assess the existing level of knowledge about the onshore Perth Basin and identify:

- suitable methods and protocols for establishing environmental baselines associated with tight gas development
- vulnerable aspects of environmental domains to effectively target monitoring for potential impact.

The outcomes of the projects will be made public and will provide information to community, industry and government to address any environmental impacts potentially caused by development of onshore gas development. In turn this will assist industry and governmental bodies to assess current regulatory requirements, and establish best practice standards.

