



appea the voice of australia's  
oil and gas industry

Submission

July 2015

# APPEA Submission to the Inquiry into Unconventional Gas in Victoria

July 2015



## CONTENTS

<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
<b>ABOUT APPEA .....</b>	<b>6</b>
<b>GENERAL COMMENTS.....</b>	<b>6</b>
CONVENTIONAL VERSUS 'UNCONVENTIONAL' NATURAL GAS .....	6
LEADING PRACTICE REGULATION .....	6
COMMUNITY ENGAGEMENT .....	7
HYDRAULIC FRACTURING .....	8
<b>INQUIRY TERMS OF REFERENCE .....</b>	<b>9</b>
(1) THE PROSPECTIVITY OF VICTORIA'S GEOLOGY FOR COMMERCIAL SOURCES OF ONSHORE UNCONVENTIONAL GAS; .....	9
(2) THE ENVIRONMENTAL, LAND PRODUCTIVITY AND PUBLIC HEALTH RISKS, RISK MITIGATIONS AND RESIDUAL RISKS OF ONSHORE UNCONVENTIONAL GAS ACTIVITIES;.....	11
(3) THE COEXISTENCE OF ONSHORE UNCONVENTIONAL GAS ACTIVITIES WITH EXISTING LAND AND WATER USES, INCLUDING	14
(A) AGRICULTURAL PRODUCTION AND DOMESTIC AND EXPORT MARKET REQUIREMENTS; .....	14
(B) THE LEGAL RIGHTS OF PROPERTY OWNERS AND THE IMPACT ON PROPERTY VALUES; AND.....	14
(C) ANY IMPLICATIONS FOR LOCAL AND REGIONAL DEVELOPMENT, INVESTMENT AND JOBS; .....	14
(4) THE ABILITY OF POTENTIAL ONSHORE UNCONVENTIONAL GAS RESOURCES CONTRIBUTING TO THE STATE'S OVERALL ENERGY SOURCES INCLUDING — .....	17
(A) AN ABILITY TO PROVIDE A COMPETITIVE SOURCE OF ENERGY AND NON-ENERGY INPUTS FOR VICTORIAN INDUSTRIES;....	17
(B) AN AFFORDABLE ENERGY SOURCE FOR DOMESTIC CONSUMERS; AND.....	17
(C) CARBON DIOXIDE EMISSIONS FROM THESE SOURCES; .....	17
(5) THE RESOURCE KNOWLEDGE REQUIREMENTS AND POLICY AND REGULATORY SAFEGUARDS THAT WOULD BE NECESSARY TO ENABLE EXPLORATION AND DEVELOPMENT OF ONSHORE UNCONVENTIONAL GAS RESOURCES, INCLUDING — .....	19
(A) FURTHER SCIENTIFIC WORK TO INFORM THE EFFECTIVE REGULATION OF AN ONSHORE UNCONVENTIONAL GAS INDUSTRY, INCLUDING THE ROLE OF INDUSTRY AND GOVERNMENT, PARTICULARLY IN RELATION TO RIGOROUS MONITORING AND ENFORCEMENT, AND THE EFFECTIVENESS OF IMPACT MITIGATION RESPONSES; AND .....	19
(B) PERFORMANCE STANDARDS FOR MANAGING ENVIRONMENTAL AND HEALTH RISKS, INCLUDING WATER QUALITY, AIR QUALITY, CHEMICAL USE, WASTE DISPOSAL, LAND CONTAMINATION AND GEOTECHNICAL STABILITY;.....	20
(6) RELEVANT DOMESTIC AND INTERNATIONAL REVIEWS AND INQUIRIES COVERING THE MANAGEMENT OF RISKS FOR SIMILAR INDUSTRIES INCLUDING, BUT NOT LIMITED TO, THE VICTORIAN AUDITOR-GENERAL OFFICE'S REPORT UNCONVENTIONAL GAS: MANAGING RISKS AND IMPACTS (CONTINGENT UPON THIS REPORT BEING PRESENTED TO PARLIAMENT) AND OTHER REPORTS GENERATED BY THE VICTORIAN COMMUNITY AND STAKEHOLDER ENGAGEMENT PROGRAMS. ....	20
<b>HYDRAULIC FRACTURING.....</b>	<b>26</b>
THE USE OF HYDRAULIC FRACTURING IN A SAFE AND SUSTAINABLE WAY .....	28
CONSTRUCTION OF WELLS TO EXACTING STANDARDS .....	30
MONITORING EVERY RELEVANT ASPECT OF THE ENVIRONMENT FOR CHANGE .....	31
DISCLOSURE AND USE OF LOW IMPACT CHEMICALS .....	32
<b>FREQUENTLY ASKED QUESTIONS.....</b>	<b>33</b>



## EXECUTIVE SUMMARY

APPEA welcomes the opportunity to contribute to the Standing Committee on the Environment and Planning Inquiry into the exploration, extraction, production and rehabilitation for onshore unconventional gas in Victoria.

The Inquiry provides an important and appropriate opportunity for greater balance and perspective to be introduced into the discussion surrounding onshore gas exploration and development in Victoria - a discussion which regrettably has been the subject of short-sighted political agendas and anti-development activism and fear campaigns.

We submit that there is a pressing economic and social requirement for a genuine fact based examination into how onshore unconventional gas can provide increased gas supply and greater energy security to Victoria.

The 2013 Gas Market Taskforce highlighted that:

*Victoria has enjoyed cheap and reliable natural gas for many years but those days are fading fast. Prices are rising, known conventional gas resources in Bass Strait will not last forever and there are prospects of onshore gas.*

*Victorians should be under no illusions. Rising gas prices will have a negative impact on Victoria's manufacturing base. Jobs and investment are at risk. Costs of living will rise and could rise for longer if not addressed...the only sensible course of action is for the Victorian Government and other eastern states to promote production of additional gas supply.*

Onshore gas development in Victoria must be afforded priority and the Committee should recommend immediate action to progress onshore gas exploration.

There is a very strong case for the unconventional gas industry to proceed in Victoria. The findings of multiple Australian and international reviews and inquiries by eminent individuals and institutions are clear - the risks associated with unconventional gas can be managed effectively through the creation of a robust regulatory regime, underpinned by effective monitoring and compliance.

Victoria is fortunate that there a number of contemporary Australian examples of such regulatory regimes already in place. While each jurisdiction is unique, there is no need to 'reinvent the wheel' as the lessons have already been learnt.

A key reference in this regard is the COAG Standing Council on Energy and Resources (SCER) endorsed National Harmonised Regulatory Framework for Natural Gas from Coal Seams (the Framework)<sup>1</sup>. The Framework is supported by APPEA and though it was primarily developed for coal seam gas, it can be readily adapted to unconventional gas more broadly. Adoption of the

<sup>1</sup> <http://www.scer.gov.au/workstreams/land-access/coal-seam-gas/>



Framework does not necessarily require the development of new legislation, as many of its elements are already in place.

Bipartisan political support, regulation based on science, and effective communication of the regulatory system within the broader community has seen Queensland increase gas production and reserves tenfold in recent years. In addition to producing enough gas to supply the domestic market, Queensland is now home to a gas export industry after an investment phase that saw over \$70 billion of expenditure to construct three major projects. These projects will produce considerable direct benefits to the State in terms of employment, business opportunities, regional development, and significant income for government for decades to come.

The Federal Minister for Industry and Science, the Hon Ian Macfarlane MP recently said to a national newspaper<sup>2</sup> that the benefits are now flowing because Queensland politicians stood up to the fear and misinformation that threatened the industry's early development.

*There was no politicking – it was all fact, all science...local government, state government, and the federal government all stood shoulder to shoulder, and we brought about the biggest economic revolution to rural Queensland that has occurred in my lifetime.*

In a recent speech<sup>3</sup> delivered in Melbourne by The Hon Gary Gray AO MP, the Federal Shadow Minister for Resources said that:

*...properly executed and thoughtfully engaged, the onshore gas industry is a massive benefit....not just to our states, not just to our nation, but importantly as we've seen in Queensland to communities, to jobs, to build better communities and stronger communities.*

APPEA requests that the Inquiry develops recommendations that reflect both the urgency associated with the need to appraise and evaluate the State's major gas reserves and the compelling evidence that the risks associated with unconventional gas exploration and development can be safely managed. We submit that there is no sound basis for continuing to delay an industry that can provide substantial economic and community benefits to the State.

This Inquiry presents the Committee with an opportunity to exhibit multi-party consensus, leadership and stewardship – the stakes are substantial, further inaction or a continuation of policies that undermine the development of onshore gas projects, will only impose costs on the community, in jobs, economic growth and higher energy prices.

Listed below are the key recommendations APPEA seeks from the Inquiry:

### Recommendations

1. Victoria should establish an independent Gas Fields Commission or similar model to lead community engagement and education in relation to unconventional gas.

<sup>2</sup> <http://www.afr.com/news/special-reports/australia-energy-future/macfarlane-to-state-governments-sort-out-coal-seam-gas-20150702-gi3bvr>

<sup>3</sup> <http://garygray.com.au/Home/Post/4485/Shadow-Minister-s-Speech-APPEA-Conference-and-Exhibition-2015-Melbourne>



2. The Inquiry recommends that the current moratorium on hydraulic fracturing is immediately removed.
3. The Inquiry recommends that the current moratorium on onshore gas exploration is immediately removed.
4. Victoria adopts the risk-based approach to regulation set out in the COAG National Harmonised Regulatory Framework for Natural Gas from Coal Seams and adapts this Framework to underpin regulation of unconventional gas in Victoria.
5. Victoria incorporates the principles of the COAG Multiple Land Use Framework in its policies to manage coexistence.
4. The Inquiry should refer to the findings of Australian and international reports into unconventional gas and hydraulic fracturing in making its recommendations, in particular those by:
  - The Australian Council of Learned Academies
  - The NSW Chief Scientist and Engineer
  - Allan Hawke AC for the Northern Territory Government
  - The New Zealand Parliamentary Commissioner for the Environment
  - The Council of Canadian Academies
  - The UK Royal Society and the Royal Academy of Engineering
  - The United States Environmental Protection Agency



**ABOUT APPEA**

The Australian Petroleum Production and Exploration Association is the peak national body representing Australia's oil and gas exploration and production industry. APPEA has more than 85 full member companies exploring for and producing Australia's oil and gas resources. These companies currently account for around 98 per cent of Australia's total oil and gas production and the vast majority of exploration. APPEA also represents over 290 associate member companies providing a wide range of goods and services to the industry.

**GENERAL COMMENTS**

**CONVENTIONAL VERSUS 'UNCONVENTIONAL' NATURAL GAS**

It should be noted at the outset that there is no material difference between the composition of natural gas retrieved from conventional sources (e.g. the gas consumed in Victoria today) and natural gas from shale or tight rock sources.

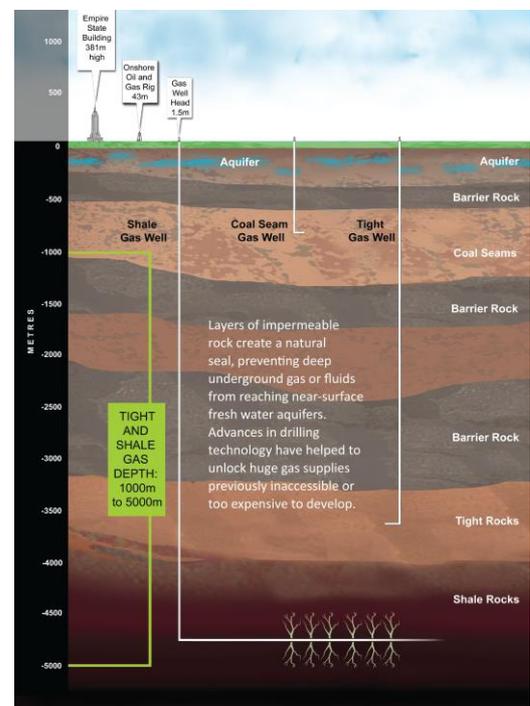
The key difference between 'conventional' and 'unconventional' natural gas is the manner, ease and cost associated with extracting the resource.

Conventional gas reservoirs are typically porous sandstone with high permeability (permeability is a characteristic that allows gas to flow through rock).

Shales are fine-grained sedimentary rocks formed from the compaction of silt and mud. 'Tight' rocks are typically limestone and sandstone. Both 'shale' and 'tight' rocks have very low levels of permeability and are found deep underground, typically at depths of between one and five kilometres.

The methods used and land use foot print for extracting petroleum from these sources vary according to technical and engineering requirements but are essentially the same across conventional and unconventional sources

**Figure 1: Underground Gas Resources**



**LEADING PRACTICE REGULATION**

Effective regulation is critical to building community confidence, as it ensures that activities are assessed and approved to standards that mitigate risk and minimise environmental impacts. If investment is to be encouraged and maximised, regulation must also be efficient in terms of avoiding duplication while delivering certainty and transparency.

The gas industry is committed to working with the Victorian Government in updating and adapting onshore regulatory regimes to changes in the industry. Government also needs to ensure that its reform processes and the outcomes it seeks to deliver are well understood by the



community, particularly those with an interest in the land accessed by petroleum explorers and producers.

The key reference for regulators in Australia should be Australian Government's 2015 Domestic Gas Strategy and the Standing Council on Energy and Resources (SCER) endorsed National Harmonised Regulatory Framework for Natural Gas from Coal Seams (the Framework).

The Framework is supported by APPEA and though it was primarily developed for coal seam gas it can be readily adapted to unconventional gas more broadly. Adoption of the Framework does not necessarily require the development of new legislation, as many of its elements are already in place, however in some areas existing legislation or regulation may require adaption in Victoria.

The Framework provides a suite of leading practice principles and provides guidance to regulators. The Framework covers the key areas of operation (and risk), including well integrity, water management and monitoring, hydraulic fracturing and chemical use.

The Framework itself is not in itself a risk assessment of the industry, but has developed a set of leading practices which are framed in a way that is compatible with a risk-based approach to regulation.

The strength of the industry's ongoing commitment to continuous improvement and the extensive regulatory oversight of the industry are often lost within the onshore gas debate. This debate has often seen fact and science-based evidence diluted by extremist claims from 'ideological crusaders'<sup>4</sup> seeking to spread misinformation rather than engage in a constructive dialogue. In this regard, **Attachment 1** provides details of 'Frequently Asked Questions' and responses that APPEA has used to clarify a number of inaccurate statements.

## COMMUNITY ENGAGEMENT

The unconventional gas industry is relatively new in Victoria and accordingly there is an increased requirement for industry and government to engage with the community about the industry's activities and how they are regulated.

In Queensland the establishment of a Gas Fields Commission has significantly improved the level of community engagement and the dialogue between government, industry, and landholders. The Commission also assists in de-politicising the regulation of the industry as it is independent of the Minister and relevant government departments.

The Commission has strong information gathering powers but does not set regulation or undertake compliance and enforcement in its own right. Instead, the Commission engages closely with the community and acts as an influential voice with industry and government should any action or reform be required.

The Gas Fields Commission model is proven. APPEA strongly recommends that a 'commission model' be adopted in Victoria. Given the earlier stage of development of the Victorian industry, we submit that a Commission could play a highly important role in the education of the community.

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<sup>4</sup> Potter, B, 'Demand to sort out 'ideological crusaders'', *Australian Financial Review*, 9 September 2013.



## RECOMMENDATION

1. Victoria should establish an independent Gas Fields Commission or similar model to lead community engagement and education in relation to unconventional gas.

## HYDRAULIC FRACTURING

The process of hydraulic fracturing has been used in Australia since the 1960s. Since that time around 1,500 wells in South Australia, Western Australia, Queensland, New South Wales, and the Northern Territory have been hydraulically fractured with no adverse effects on water aquifers<sup>5</sup>.

The technology that is used to fracture wells accessing conventional oil and gas resources is the same as that used to fracture wells drilled into deeper shale oil and gas resources (regardless of whether the wells are vertical only or also extend horizontally).

The use of multi-stage hydraulic fracturing represents best practice within the industry for accessing low permeability, conventional and unconventional oil and gas resources on a commercial basis. Hydraulic fracturing is also used outside the petroleum industry for purposes such as the production of geothermal energy and improving the flow of water bores. Further information on hydraulic fracturing is contained in **Attachment 1**.

The types of risks encountered in fracturing conventional oil and gas wells and the management practices used to minimise those risks are the same as those encountered and managed while drilling shale and tight oil and gas deposits. The sizes or level of risk are similar and in some cases lower due to the greater depths associated with shale deposits and hence greater vertical separation between fracture zones and water aquifers.

The critical issues around hydraulic fracturing and development of shale and tight resources have been considered in detail by multiple studies and reviews including those by:

- The Australian Council of Learned Academies<sup>6</sup>
- The NSW Chief Scientist and Engineer<sup>7</sup>
- Allan Hawke AC for the Northern Territory Government<sup>8</sup>
- The New Zealand Parliamentary Commissioner for the Environment<sup>9</sup>
- The Council of Canadian Academies<sup>10</sup>
- The UK Royal Society and the Royal Academy of Engineering<sup>11</sup>
- The United States Environmental Protection Agency<sup>12</sup>

<sup>5</sup> See for example, 'DMP sets the record straight for shale and tight gas', [http://www.dmp.wa.gov.au/7105\\_17715.aspx](http://www.dmp.wa.gov.au/7105_17715.aspx)

<sup>6</sup> ACOLA

<sup>7</sup> <http://www.chiefscientist.nsw.gov.au/coal-seam-gas-review>

<sup>8</sup> <http://www.hydraulicfracturinginquiry.nt.gov.au/index.html>

<sup>9</sup> <http://www.pce.parliament.nz/publications/all-publications/evaluating-the-environmental-impacts-of-fracking-in-new-zealand-an-interim-report> and <http://www.pce.parliament.nz/assets/Uploads/PCE-OilGas-web.pdf>

<sup>10</sup>

[http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/shale%20gas/shalegas\\_fullreporten.pdf](http://www.scienceadvice.ca/uploads/eng/assessments%20and%20publications%20and%20news%20releases/shale%20gas/shalegas_fullreporten.pdf)

<sup>11</sup> <https://royalsociety.org/~media/policy/projects/shale-gas-extraction/2012-06-28-shale-gas.pdf>

<sup>12</sup> [http://www2.epa.gov/sites/production/files/2015-06/documents/hf\\_es\\_erd\\_jun2015.pdf](http://www2.epa.gov/sites/production/files/2015-06/documents/hf_es_erd_jun2015.pdf)



Each of these inquiries were carried out by eminent people in their fields and each inquiry came to essentially the same conclusion – the risks associated with hydraulic fracturing and unconventional gas can be managed, as long as leading operational practices are implemented and enforced by rigorous leading practice regulation.

#### RECOMMENDATION

2. The Inquiry recommends that the current moratorium on hydraulic fracturing is immediately removed.

#### INQUIRY TERMS OF REFERENCE

(1) The prospectivity of Victoria's geology for commercial sources of onshore unconventional gas;

The 2013 Gas Market Taskforce found that, presently, all forms of unconventional natural gas (in shale, tight and coal seam formations) in Victoria are at an early stage of exploration and there is a lack of key information to estimate potential resource sizes. There is no production, commercial reserves or identified reserves of unconventional gas in Victoria.

This is confirmed in a research paper completed by the Victorian Department of Parliament Services in 2013 titled 'Unconventional Gas: Coal Seam Gas, Shale Gas and Tight Gas'<sup>13</sup>. Below we have reproduced parts the report for the convenience of the Inquiry.

There may be significant onshore gas resources in Victoria, but in the absence of further exploration this will not be known with certainty. Exploration for petroleum is a low impact activity and should be allowed to proceed in Victoria.

#### RECOMMENDATION

3. The Inquiry recommends that the current moratorium on onshore gas exploration is immediately removed.

#### Unconventional Gas Resources in Victoria - extract from Parliamentary Services paper

*At present, Victoria has no coal seam gas or shale gas production or confirmed resources. The parts of Victoria with the highest potential for unconventional gas are the Gippsland and Otway basins. Since 2000, a number of exploration licences have been issued and exploratory drilling undertaken. If located, the feasibility of successful extraction of CSG or shale gas is uncertain. Notably, the exploration company Lakes Oil found tight gas in Gippsland in 2004, which is yet to be produced. There is the potential for more tight gas to*

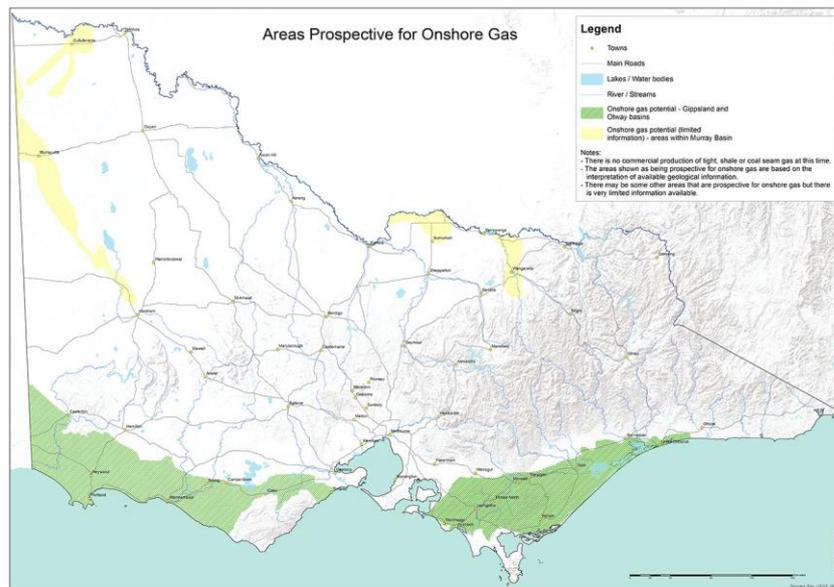
<sup>13</sup> <http://www.parliament.vic.gov.au/publications/research-papers/8927-unconventional-gas-coal-seam-gas-shale-gas-and-tight-gas>



*be found in the Gippsland and Otway basins for which the feasibility of extraction would need to be determined<sup>14</sup>.*

Figure 2 provides a map from the Victorian onshore gas website which outlines areas of prospective onshore gas in Victoria. Victoria has hosted onshore petroleum exploration for around 100 years and many wells have been drilled. As shown in Figure 3 below these have predominantly been in coastal regions.

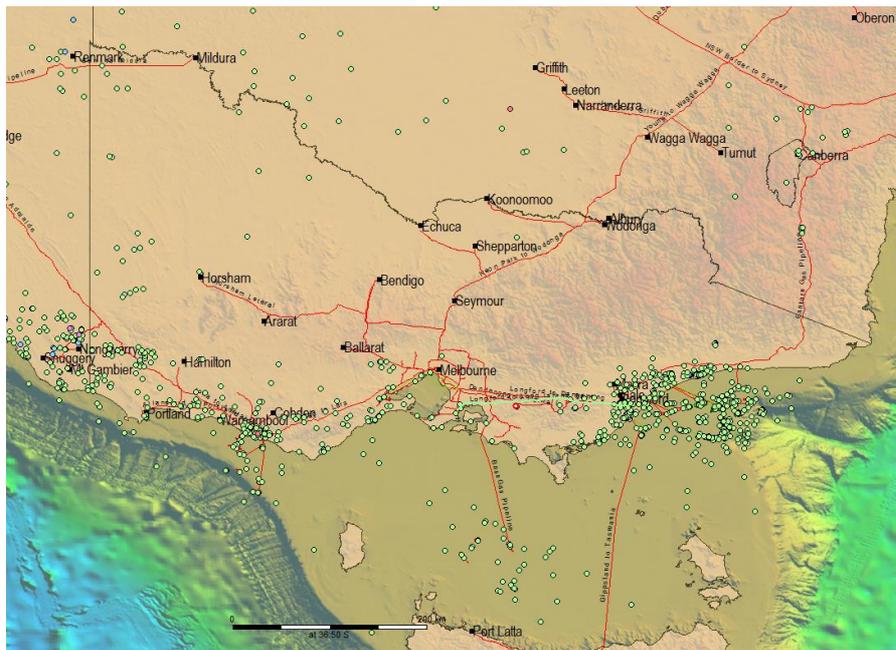
**Figure 2**



Source: [http://onshoregas.vic.gov.au/\\_data/assets/image/0009/1027386/Area-prospective-for-natural-gas-large.jpg](http://onshoregas.vic.gov.au/_data/assets/image/0009/1027386/Area-prospective-for-natural-gas-large.jpg)

**Figure 3**

<sup>14</sup> Department of State Development, Business and Innovation (2013) 'What is Coal Seam Gas, How is it Found and Produced?', DSDBI website, viewed 4 December 2013, <http://www.energyandresources.vic.gov.au/earth-resources/community-information/landholders-info/coal-seam-gas-guidelines/what-is-coal-seam-gas>



Source: Encom GPlInfo / APPEA (2015)

## (2) The environmental, land productivity and public health risks, risk mitigations and residual risks of onshore unconventional gas activities;

Gas production is an industrial process and like any industrial process, or any human activity more broadly, there are associated risks. Risk cannot be completely eliminated from any system or activity but risk can be managed.

Many of the activities – and associated risks – found in unconventional gas exploration and production are common in other industries. For example, drilling is undertaken in mining and agriculture. Hydraulic fracturing is used in geothermal energy production and to improve the flow of water bores. Pipelines are used to transport water and deliver gas to hundreds of thousands of households.

The fact that these risks are manageable is clearly demonstrated by the Queensland coal seam gas industry, which coexists successfully with high-value agriculture and farming practices that are required to meet high standards, such as organic farming.

It should come as no surprise that the risks associated with unconventional gas have been extensively considered and the findings of the numerous domestic and international reviews of unconventional gas and fracking referenced throughout this submission have all reached essentially the same conclusion - the risks associated with unconventional gas and hydraulic fracturing can be managed effectively through the creation of a robust regulatory regime.

Victoria is fortunate that there a number of contemporary Australian examples of robust regulatory regimes for unconventional gas that provide a model for how to manage risk and can be readily adapted to Victoria.

All mainland states other than Victoria host active unconventional gas exploration and Queensland, NSW, and South Australia have all been producing unconventional gas for many



years, with Queensland home to over \$70 billion of investment in three coal seam gas export projects.

Like Victoria, each of these jurisdictions primarily manages risk as projects progress through approvals to on-ground activity. In order to effectively manage risk, the context in which it occurs needs to be understood. Once risk is identified within these various contexts, an assessment and prioritisation of risks can be made on the basis of potential impacts the likelihood of a particular event occurring.

Comprehensive environmental impact assessments are undertaken by project proponents which set identify, evaluate, and set out plans to mitigate all risk and impacts associated with a project proposal. These are then assessed by governments within each regulatory system and conditions applied so that risk is reduced to as low as reasonably practicable.

The industry is also focussed on carrying out all aspects of its activities safely and in a sustainable manner and this section outlines current practices to achieve this. In particular, the industry understands and agrees that conservation and protection of ground water is a priority.

Key factors which protect the environment during natural gas production include:

- Rigorous well construction standards to protect aquifers;
- Isolation of all fluids that might have a detrimental impact;
- Well designs that ensure numerous failsafe levels of protection; and
- Full disclosure and consultation with communities and Government agencies before, during and after all activities.

Many of these practices are detailed in the industry's voluntary Code of Practice for Hydraulic Fracturing<sup>15</sup>.

### **Standing Committee on Energy and Resources National Harmonised Regulatory Framework for Natural Gas from Coal Seams 2013**

As noted above, a key reference for regulators in Australia should be the Standing Council on Energy and Resources (SCER) has endorsed a National Harmonised Regulatory Framework for Natural Gas from Coal Seams (the Framework)<sup>16</sup>.

The Framework covers the key areas of operation (and risk) – well integrity, water management and monitoring, hydraulic fracturing and chemical use. The Framework itself is not in itself a risk assessment of the industry but has developed a set of leading practices which are framed in a way that is compatible with a risk-based approach to regulation.

The Framework recommends that regulatory and legislative settings should be underpinned by the principle of co-existence. This is where a shared commitment exists between the resources industry, other land users, local communities and governments to multiple, merit-based and

<sup>15</sup> 'Code of Practice for Hydraulic Fracturing', Australian Petroleum Production and Exploration Association (2011), [http://wa-onshoregas.info/sites/wa-onshoregas.info/files/APPEA\\_Code\\_of\\_Practice.pdf](http://wa-onshoregas.info/sites/wa-onshoregas.info/files/APPEA_Code_of_Practice.pdf), [Accessed 17/09/13].

<sup>16</sup> <http://www.scer.gov.au/workstreams/land-access/coal-seam-gas/>



sequential land use that provides certainty for industry and improved community confidence in land use decision-making.

The Framework identifies 18 leading practices to mitigate the potential impacts associated with the development of natural gas from coal seams and build a robust national regulatory regime for the industry. These are summarised in Table ES.1 in the Framework which is copied below.

Table ES.1: Summary of leading practices

Leading practice	Well integrity	Water management	Hydraulic fracturing	Chemical use
1 Undertake a comprehensive environmental impact assessment, including rigorous chemical, health and safety and water risk assessments	✓	✓	✓	✓
2 Develop and implement comprehensive environmental management plans or strategies which demonstrate that environmental impacts and risks will be as low as reasonably practicable	✓	✓	✓	✓
3 Apply a hierarchy of risk control measures to all aspects of the project	✓	✓	✓	✓
4 Verify key system elements, including well design, water management and hydraulic fracturing processes, by a suitably qualified person	✓	✓	✓	✓
5 Apply strong governance, robust safety practices and high design, construction, operation, maintenance and decommissioning standards for well development	✓	✓	✓	✓
6 Require independent supervision of well construction	✓			
7 Ensure the provision and installation of blowout preventers informed by a risk assessment	✓			
8 Use baseline and on-going monitoring for all vulnerable water resources		✓		
9 Manage cumulative impacts on water through regional-scale assessments		✓		
10 Ensure co-produced water volumes are accounted for and managed		✓		
11 Maximise the recycling of produced water for beneficial use, including managed aquifer recharge and virtual reinjection		✓		
12 Require a geological assessment as part of well development and hydraulic fracturing planning processes	✓	✓	✓	
13 Require process monitoring and quality control during hydraulic fracturing activity			✓	✓
14 Handle, manage, store and transport chemicals in accordance with Australian legislation, codes and standards			✓	✓
15 Minimise chemical use and use environmentally benign alternatives			✓	✓
16 Minimise the time between cessation of hydraulic fracturing and flow back, and maximise the rate of recovery of fracturing fluids			✓	✓
17 Increase transparency in chemical assessment processes and require full disclosure of chemicals by the operator in the production of natural gas from coals seams			✓	✓
18 Undertake assessments of the combined effects of chemical mixtures, in line with Australian legislation and internationally accepted testing methodologies			✓	✓

Key: ✓ Leading practice primarily applies to this core area and is discussed within its respective chapter  
 ✓ Leading practice is also relevant to this core area



#### RECOMMENDATION

4. Victoria should adopt the risk-based approach to regulation set out in the COAG National Harmonised Regulatory Framework for Natural Gas from Coal Seams and adapts this Framework to underpin regulation of unconventional gas in Victoria.

(3) The coexistence of onshore unconventional gas activities with existing land and water uses, including —

- (a) agricultural production and domestic and export market requirements;
- (b) the legal rights of property owners and the impact on property values; and
- (c) any implications for local and regional development, investment and jobs;

#### Coexistence and regional benefits

In Australia, the Crown 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.

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. The MLUF states that:

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

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.

Experience shows that petroleum companies have been able to successfully negotiate thousands of land access agreements and compensation arrangements with farmers. Over 4,700 landholder access agreements have been successfully negotiated in Queensland alone. Demonstrating that land access can be, and is being successfully managed.

In many cases, the extra water and income provided to landholders has increased agricultural productivity. In Queensland the gas industry is also delivering infrastructure and investment to several rural and regional districts, providing new jobs and strengthening and diversifying regional economies.



A 2013 study by KPMG<sup>17</sup> establishes that resources developments are not only making regions more prosperous, but also making their communities more stable and socially sustainable. The study compiles key standard-of-living measures and basic demographic profiles of Australia's nine main resources regions.

It is clear that resources developments are driving these regions' economies. 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%. The number employed in all industries – including resources – grew by just 14%.

In that same period, the population of Australia's resources regions had grown at 1.5% per year. This was the same as the national average but greater than the 0.8% for regional Australia more generally.

Queensland's Surat Basin – the region with the most coal seam gas industry activity – is an interesting example. In the Surat between 2006 and 2011:

- the population increased by 3.2%
- the total number of dwellings increased by 8%
- students finishing Year 12 increased by 4.3%
- residents with tertiary degrees increased by 2%.

Despite the rise in population, the unemployment rate remained stable at about 4% – 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%.

Increases in residential property values across the Western Downs Region of Queensland increased by 8.8% in 2014, driven by towns such as in Miles (25%) and Wandoan (10%). For the remaining key towns within the Western Downs Region there has been little to no change. Increases have also occurred in commercial property (5%) and industrial property (2.9%) over the 2013/14 period<sup>18</sup>.

The value of primary production land in South West Queensland has generally fallen in the 2013/14 period, although sales have been limited in number. This can be attributed to drought and commodity market uncertainties. By contrast, Western Downs, where the CSG industry is active, has experienced one of the lowest decreases of -1.8% in Queensland.

These figures indicate that the resources sector – which in this case is mostly the CSG industry – is making the Surat region more prosperous, stable and sustainable.

### Land Use

Implementation of the Standing Council on Energy and Resources Multiple Land Use Framework should be pursued across government to deliver shared benefits to all stakeholders. This Framework should be integrated into planning documents and strategic frameworks relating to the further development of the onshore gas industry in Victoria.

<sup>17</sup> Sal B. and Verwoert L 2013 *Analysis of the Changing Resident Demographic Profile of Australia's Mining Communities* from [http://www.appea.com.au/wp-content/uploads/2013/04/130204\\_APPEA-MCA-demographics-report.pdf](http://www.appea.com.au/wp-content/uploads/2013/04/130204_APPEA-MCA-demographics-report.pdf)

<sup>18</sup> Department of Natural Resources and Mines (DNRM) Valuer-Generals 2014 Property Market Movement Report <https://publications.qld.gov.au/storage/f/2014-06-15T23%3A13%3A58.384Z/2014-property-market-movement-report-lores.pdf>



### *Rehabilitation of land impacted by petroleum activities*

All sites impacted by operations are rehabilitated to pre-disturbance standards, unless otherwise agreed with the landholder.

Once production is exhausted the operator will permanently seal the well with cement plugs – a process called abandonment. All cements used in operations are specially formulated to withstand high pressures and last for decades.<sup>19</sup>

### *Noise and localised impacts*

Gas companies consult with landholders about the location of wells and management of drilling and associated activities so as to minimise noise and other localised impacts. Companies will design their activities to minimise the impact of their operations on landholders in areas such as biosecurity, use of roads, speed limits, impacts on stock, fencing, fire management, rubbish disposal, abandonment of water bores, gates, protection of trees and location of accommodation camps.

Many of the impacts such as noise are of short term duration while specific types of activities are being undertaken (such as drilling or hydraulic fracturing). Once a well enters production and is connected to an underground pipeline gas gathering network, many of the localised impacts such as noise and vehicular traffic are greatly reduced or eliminated entirely.

### **Minimising water use**

Most of the water used in tight and shale gas production is used in the hydraulic fracturing process and quantities vary depending on local geological conditions, such as depths, porosity and the length and number of horizontal wells.<sup>20</sup> Water is generally obtained within the vicinity of operations and is typically brackish (i.e. not potable).

Companies are committed to minimising their footprint and all water used in hydraulic fracturing operations will be captured and reused where possible. As part of the approvals process, a company must also demonstrate that the taking of water will not have unacceptable impacts on aquifers.

The IGU estimates that between 11 and 19 million litres (ML) of water – equivalent to four Olympic swimming pools – is required to fracture a well.<sup>21</sup> The ACOLA Report notes that while water requirements might be large when considered independently, they are 'modest when set against consumption in irrigated agriculture.'<sup>22</sup>

After hydraulic fracturing has been completed and the pressure from pumping is reduced, water begins to flow back to the wellhead. This 'flow back' is a mixture of the original hydraulic fracturing fluid – containing less than one per cent of chemical additives – and any natural formation water – containing dissolved constituents from the shale or tight formation itself.<sup>23</sup>

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<sup>19</sup> ACOLA, P. 128.

<sup>20</sup> ACOLA P. 113

<sup>21</sup> IGU P. 28

<sup>22</sup> ACOLA P. 113

<sup>23</sup> IGU P. 28



Between 20 and 70 per cent of this water will flow back to the surface with the initial gas production, with the rest remaining in the formation. This can be recycled and used to hydraulically fracture other wells. The quantity of water being recycled is increasing as companies become more familiar at handling waste onsite, water treatment technologies become more readily available and as chemical additives are improved.

Proponents manage the supply of water, storage, containment and disposal of recovered stimulation fluid appropriate to their environmental setting. In many locations, water that cannot be recycled is placed in specially designed ponds for evaporation. The residue from this process is tested and, if required, safely removed to a licensed disposal facility. At no point does this water contact groundwater sources.

With appropriate well design and protection in place, risks and mitigation in relation to impacts on water from shale gas should primarily focus on reinjection and impacts at the surface.<sup>24</sup>

#### RECOMMENDATION

5. Victoria should incorporate the principles of the COAG Multiple Land Use Framework in its policies to manage coexistence.

(4) The ability of potential onshore unconventional gas resources contributing to the State's overall energy sources including —

- (a) an ability to provide a competitive source of energy and non-energy inputs for Victorian industries;
- (b) an affordable energy source for domestic consumers; and
- (c) carbon dioxide emissions from these sources;

Gas is an important energy source and underpins Victoria's economy. Onshore gas development could ensure this key role continues well into the future.

Victoria's access to competitive energy has helped underpin its economic growth and diversity. Natural gas currently for 19 per cent of all energy used in Victoria and in 2012-13, Victoria consumed 220PJ of natural gas, making it the largest consumer in the eastern Australian gas market<sup>25</sup>.

Historically, gas production from the Gippsland Joint Venture has supplied the State and seen Victoria as a net gas exporter to other states in eastern Australia.

In the future, onshore gas developments can help complement offshore gas developments, continuing to supply competitive gas to Victoria and to the eastern Australian gas market.

Onshore supply can also play a role in ensuring gas at competitive prices can help underpin Victoria's energy mix and Victorian industry into the future. Further supply, including from

<sup>24</sup> ACOLA, P. 129.

<sup>25</sup> 'Electricity Gas Australia, 2014', Energy Supply Association of Australia (2014), P. 62.



onshore gas developments, can place downward pressure on prices for both industry and residential consumers and improve Victoria's energy security.

Onshore gas developments can also provide a new economic development opportunity for the State. While comprehensive modelling of the economic benefits of developing an onshore gas industry is difficult without an improved understanding of the State's onshore gas resources, economic modelling exercises in other jurisdictions have demonstrated the benefit that could flow from developing a vibrant onshore gas industry.

The Gas Market Taskforce established that there is compelling evidence that the manufacturing sector considered that rising gas prices constituted a significant threat to their competitive position. These concerns will only intensify the longer that gas exploration and production is restrained.

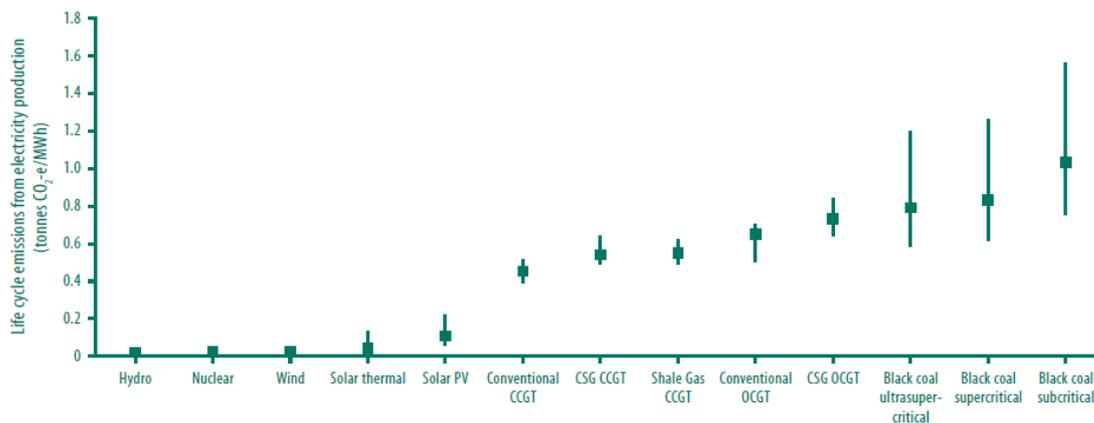
Simple economics dictates that the best way to address these pressures is to bring more gas to market. Onshore gas development in Victoria must be afforded priority and government should take immediate action to enable exploration to proceed.

Using more natural gas in Australia's (including Victoria's) power generation and resource processing would also assist in reducing greenhouse gas emissions.

These outcomes are possible because currently available natural gas technologies produce only 30 per cent of the emissions produced by current brown coal technologies in generating electricity.

This is illustrated in Figure 4, which shows the significantly lower greenhouse gas emission associated with the gas-fired electrical power generation compared to the use of other conventional fuels.

**Figure 4: Emissions intensity of various fuel types for electricity generation (tonnes CO<sub>2</sub>-e/MWh)**



Source: ACOLA (2013).

The increased use of natural gas also has several additional environmental benefits, such as:

- Reduced emissions of particulates.
- Reduced emissions of sulphur dioxide (an important contributor to smog and acid rain).
- Significantly lower demand for water for power station cooling.



Much greater use of Australia's extensive gas resources will be crucial in meeting the challenge of significantly reducing global greenhouse gas emissions at lowest possible cost whilst enhancing Australia's economic performance.

In relation to fugitive emissions<sup>26</sup> associated with onshore gas production, the industry reports emissions from all stages of production, supply and use to the Department of Environment<sup>27</sup> and the Clean Energy Regulator under the *National Greenhouse and Energy Reporting Act 2007* and reported publicly in Australia's *National Greenhouse Accounts*.

The most recent *National Inventory by Economic Sector*<sup>28</sup> showed that Australia's total estimated fugitive emissions for 2013 were 38.2 Mt CO<sub>2</sub>-e – about 7 per cent of net national emissions. National oil and natural gas production, processing and distribution account for 31.4 per cent of fugitive emissions. The remaining 68.6 per cent was produced by the coal industry.

In addition, fugitive emissions from Australian oil and gas operations 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<sup>29</sup> to the United Nations Framework Convention on Climate Change.

The gas industry has also supported and continues to support research being undertaken by the CSIRO to investigate fugitive emissions from onshore natural gas production in Australia. The CSIRO report, *Field Measurements of Fugitive Emissions from Equipment and Well Casings in Australian Coal Seam Gas Production Facilities*<sup>30</sup>, prepared for the Department of the Environment and released in August 2014, involved CSIRO scientists measuring fugitive methane emissions from a number of production wells in Queensland and NSW.

The report finds greenhouse gas emissions from Australian coal seam gas production wells to be very low, especially when compared to the volume of gas produced from the wells. The median methane emission rate from all sources for the 43 wells examined was approximately 0.6 grams per minute, while the mean emission rate was about 3.2 grams per minute. This compares to a mean production rate of the wells examined of 29,600 m<sup>3</sup> per day and represents about 0.02 per cent of total production. This is much lower than recent estimates of methane emissions from gas production in the United States. Put another way, the median emission rate is about the same as daily methane emissions from four cows. Further CSIRO research<sup>31</sup> is underway.

(5) The resource knowledge requirements and policy and regulatory safeguards that would be necessary to enable exploration and development of onshore unconventional gas resources, including –

(a) Further scientific work to inform the effective regulation of an onshore unconventional gas industry, including the role of industry and government,

<sup>26</sup> Fugitive emissions refer to unintended releases of gas from industry operations.

<sup>27</sup> See <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement>.

<sup>28</sup> 'National Inventory by Economic Sector 2013', Department of the Environment (2015), <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/publications/national-inventory-economic-sector-2013>.

<sup>29</sup> 'National Inventory Report 2013, The Australian Government Submission to the United Nations Framework Convention on Climate Change' Department of the Environment (2015), <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/publications/national-inventory-report-2013>.

<sup>30</sup> 'Field Measurements of Fugitive Emissions from Equipment and Well Casings in Australian Coal Seam Gas Production Facilities', CSIRO (2014), <http://www.environment.gov.au/climate-change/greenhouse-gas-measurement/publications/csg-fugitive-emissions>.

<sup>31</sup> <http://www.csiro.au/en/Research/EF/Areas/Oil-gas-and-fuels/Onshore-gas/Coal-seam-gas-fugitives>.



particularly in relation to rigorous monitoring and enforcement, and the effectiveness of impact mitigation responses; and

(b) Performance standards for managing environmental and health risks, including water quality, air quality, chemical use, waste disposal, land contamination and geotechnical stability;

As noted in section 2 above and section 6 below, there are numerous Australian and international reviews and studies into unconventional gas which have all reached essentially the same conclusion - the risks associated with unconventional gas and hydraulic fracturing can be managed effectively subject to the creation of a robust regulatory regime.

The COAG National Harmonised Regulatory Framework for Natural Gas from Coal Seams (the Framework) sets out leading practices that can be applied in Victorian regulation (if not already) to manage environmental and health risks, and methodologies to produce the information needed to inform effective regulation on an ongoing basis.

APPEA submits that, taken together, the COAG Framework and the findings of the Australian and international reviews referenced in this submission provide the Inquiry with the information it needs to find that the risks associated with unconventional gas and hydraulic fracturing are manageable in Victoria.

In implementing the COAG Framework and any other reforms deemed necessary, APPEA recommends that government consult closely with industry and other stakeholders and clearly communicates to the community how the industry is regulated and the science underpinning this regulation.

(6) Relevant domestic and international reviews and inquiries covering the management of risks for similar industries including, but not limited to, the Victorian Auditor-General Office's report Unconventional Gas: Managing Risks and Impacts (contingent upon this report being presented to Parliament) and other reports generated by the Victorian community and stakeholder engagement programs.

A useful summary of national and international reviews into unconventional gas and hydraulic fracturing can be found in the final report of the Independent Inquiry into Hydraulic Fracturing in the Northern Territory led by Allan Hawke AC. The Hawke Inquiry itself found that the environmental risks associated with hydraulic fracturing can be managed effectively, subject to the creation of a robust regulatory regime and that there was 'no justification whatsoever for the imposition of a moratorium on hydraulic fracturing in the NT'.

We encourage the Inquiry to refer to the reports emanating from these inquiries. For convenience we have provided and extract from the Hawke Inquiry final report below.

#### **Extract from the Executive Summary of the Hawke Inquiry Final Report**

The Inquiry was informed by recent reports from overseas and Australian jurisdictions touched on below and dealt with in more detail in the Report.

#### *International reports*



International Reports Four International Reports of particular relevance to this Inquiry were considered:

- the New Zealand Parliamentary Commissioner for the Environment (Dr Jan Wright), Interim Report of November 2012, 'Evaluating the Environmental Impacts of Fracking in New Zealand';
- Dr Wright's Final Report in June 2014, 'Drilling for Oil and Gas in New Zealand: Environmental Oversight and Regulation';
- the Council of Canadian Academies' 2014 Report, 'Environmental Impacts of Shale Gas Extraction in Canada' following an investigation by The Expert Panel on Harnessing Science and Technology to Understand the Environmental Impacts of Shale Gas Extraction; and
- the Royal Society and the Royal Academy of Engineering, June 2012 Report, 'Shale Gas Extraction in the UK: a Review of Hydraulic Fracturing' following the UK Government Chief Scientific Adviser's request to carry out an independent review of the scientific and engineering evidence relating to the technical aspects of the risks associated with hydraulic fracturing to inform government policy making about shale gas extraction in the UK.

Major conclusions from these enquiries are reported below, and relevant evidence and conclusions are referenced throughout this Inquiry Report. These enquiries were carried out by eminent people in their fields and their range of expertise as well as those of the independent peer review panels can be viewed when accessing their reports.

The New Zealand Parliamentary Commissioner for the Environment's Interim 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.'

Dr Wright concluded that fracking can be managed effectively provided that operational practices are implemented and enforced through regulation. Her Final Report evaluated Government oversight and regulation for managing the environmental risks of the industry, finding them not to be adequate and leading to six recommendations about necessary improvements.

The Council of Canadian Academies (CCA) Panel comprised 14 experts, whose work and draft report was peer reviewed for its objectivity and quality by a group of ten eminent people selected by the Council for their diverse perspectives, areas of expertise, and broad representation of academic, industrial, policy and nongovernmental organisations. The CCA Report proposed a framework of five distinct elements to manage effectively the risks associated with shale gas development.

The Royal Society and the Royal Academy of Engineering Panel comprised eight experts; its Report was similarly peer reviewed by an independent panel of eight experts, while four others commented on sections of the draft.

The UK 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.

#### *Australian Reports*

The Inquiry also had regard to the approaches in other Australian jurisdictions, which are touched on below and dealt with in more detail in the Report.

Of particular interest, is the detailed review by the Australian Council of Learned Academies (ACOLA).

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 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; and
- Australian Academy of Technological Sciences and Engineering.

PMSEIC identified a series of six research topics under the 'Securing Australia's Future' heading to deliver research-based evidence and findings to support policy development in areas of importance for Australia's future.

The relevant ACOLA review is 'Engineering Energy: Unconventional Gas Production', which focused on shale gas in Australia, with a Final Report in May 2013. The Expert Working Group for the review comprised:

- Professor Peter Cook CBE, FTSE;
- Dr Vaughan Beck FTSE;
- Professor David Brereton;
- Professor Robert Clark AO, PSM, FRSN;
- Dr Brian Fisher AO, PSM, FASSA;
- Professor Sandra Kentish;
- Mr John Toomey FTSE; and
- Dr John Williams FTSE.

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; and
- Professor John Loughhead FEng, FTSE, OBE.



The ACOLA Report Summary said that:

*'A number of environmental issues related to the shale gas industry have arisen in the United States and similar questions have been raised about potential impacts in Australia. A large number of impacts are possible, but the likelihood of many of them occurring is low and where they do occur, other than in the case of some biodiversity impacts, there are generally remedial steps that can be taken. Nonetheless it is important that the shale gas industry takes full account of possible adverse impacts on the landscape, soils, flora and fauna, ground water and surface water, the atmosphere and on human health in order to address people's concerns. This will require improved baseline studies against which to measure future change and to compare natural change and change resulting from industry activities. The footprint and regional scale over which shale gas operations may occur can be minimised by measures such as drilling multiple wells from one drill pad, but nonetheless there will be some cumulative regional, ecological and hydrological impacts, including fragmentation of habitats and overall landscape function. These will need to be carefully assessed and managed using best practice.'*

The ACOLA Report includes important findings in relation to landscape and biodiversity, water, induced seismicity, greenhouse gas emissions, community issues, and monitoring, governance and regulation.

On chemical and water management, the Report says:

*'Contamination of aquifers and surface water can result from chemical spillage. The industry already has rigorous systems for dealing with spillage, or from the incorrect disposal of the hydraulic fracturing fluid (already controlled by regulators under most jurisdictions), or from produced water. Contamination can also potentially occur via leakage from a borehole into a freshwater aquifer, due to borehole failure, particularly from abandoned bores, or (though less likely) from an incorrect hydraulic fracturing operation. These are unlikely to occur if best practice is followed, but regulations need to be in place and enforced, to help to ensure this.'*

In relation to monitoring and regulation, the Report concludes:

*'Monitoring of shale gas production and impacts is likely to be undertaken by petroleum companies as part of their normal operations, but in order to win community confidence, truly independent monitoring will need to be undertaken by government or other agencies and/or credible research bodies. Induced seismicity, aquifer contamination, landscape and ecosystem fragmentation, greenhouse and other emissions to the atmosphere, together with potentially adverse social impacts, are all likely to be areas of community concern that will need to be monitored and for which baseline surveys will be required. It will not be feasible to monitor large areas for extended periods of time and therefore monitoring will need to be carefully and cost effectively targeted to answer specific questions and transparently address particular concerns. This will require a robust regulatory regime, which will build on existing regulations and which will also fully take account of the need for sensible and multiple land use, based around well-resourced regional planning and cumulative risk assessment.'*

Issues around 'social licence' for gas extraction operations were raised in many submissions and have been addressed in other enquiries. The ACOLA Report notes:



*'Gaining and retaining a 'social licence to operate' will be important to all shale gas operations and will need to be approached not just as a local community issue, but also at regional, state and national levels. In order to develop effective relationships with communities potentially impacted by shale gas developments, it will be necessary to have open dialogue, respect and transparency. It will also be important there is confidence in the community that not only are shale gas operations and impacts being effectively monitored, but also that concerns will be identified and remediated, or operations stopped before a serious problem arises. Many of the most prospective areas for shale gas are subject to Native Title or are designated Aboriginal Lands and it will be important to ensure that traditional owners are aware of the nature and scale and the possible impact of shale gas developments from the start. The industry also has the potential to help address the aspirations of Aboriginal people to build greater economic self-sufficiency.'*

...

### **New South Wales**

The Chief Scientist and Engineer (CSE), Professor Mary O'Kane, delivered her Independent Review of Coal Seam Gas Activities in NSW - Study of Regulator Compliance Systems and Processes for Coal Seam Gas to the NSW Premier on 30 September 2014 (the final of three volumes). The CSE found that CSG mining in NSW was manageable subject to appropriate safeguards.

### **Queensland**

CSG production is under way in various areas, with hydraulic fracturing as part of the extraction process. To support commercialisation of the resources, significant investments are being made in constructing liquefied natural gas (LNG) facilities at Gladstone and the associated pipelines to connect gas fields to the new facilities.

To manage compliance and enforcement, the Queensland Government established the CSG Compliance Unit (formerly the LNG Enforcement Unit) which includes

*'multi-disciplinary industry and environmental staff from across government, including environmental and ground water experts, petroleum and gas safety specialists and staff specialising in land access issues'.<sup>32</sup>*

The Inquiry observed that levels of community acceptance vary in different parts of the State and there has been significant public commentary and activity against the industry in some areas. As part of their commitment to give the community a stronger voice in the industry's development, the Government set up the Gas Fields Commission - a statutory body to manage the coexistence of rural land holders, communities and the CSG industry.

<sup>3232</sup> <https://www.business.qld.gov.au/industry/csg-lng-industry/regulatory-framework-csg-lng/enforcement-compliance>



#### RECOMMENDATION

6. The Inquiry should refer to the findings of Australian and international reports into unconventional gas and hydraulic fracturing in making its recommendations, including in particular those by:
  - The Australian Council of Learned Academies
  - The NSW Chief Scientist and Engineer
  - Allan Hawke AC for the Northern Territory Government
  - The New Zealand Parliamentary Commissioner for the Environment
  - The Council of Canadian Academies
  - The UK Royal Society and the Royal Academy of Engineering
  - The United States Environmental Protection Agency

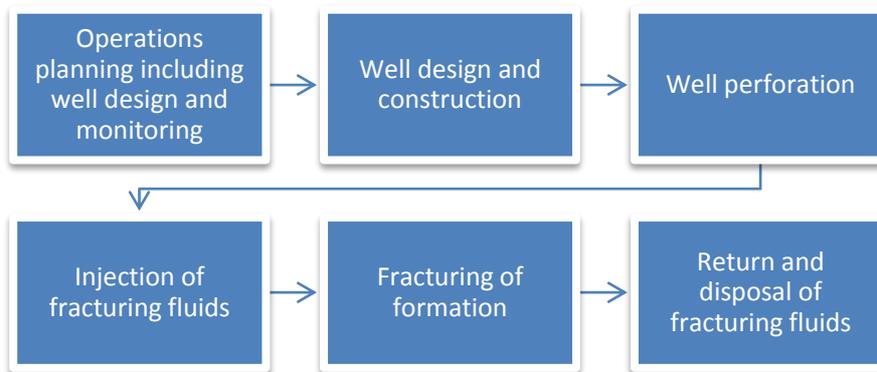


## ATTACHMENT 1

### HYDRAULIC FRACTURING

Like the natural movement of the Earth's crust, hydraulic fracturing of rocks releases trapped fluids or gasses. In the context of petroleum operations, hydraulic fracturing is used to increase the flow of oil and gas to a well, therefore increasing production and reducing the total number of wells needed to develop a resource. It allows commercialisation of low permeability (shale or tight gas) reservoirs in which oil and gas do not easily flow. It can also be used with other natural resources such as to access geothermal energy and to increase water production.

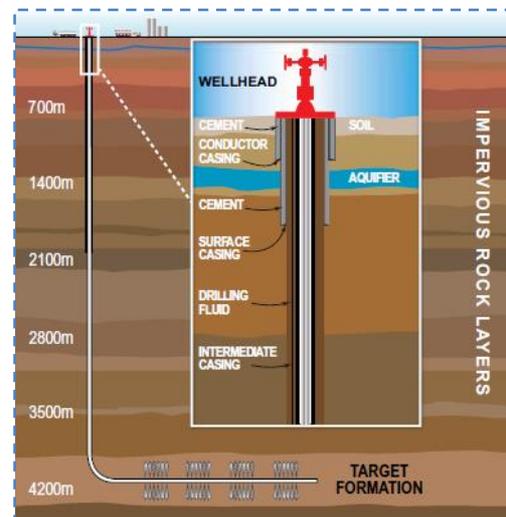
Key steps in well design and construction and hydraulic fracturing are outlined below:



1. After a well has been drilled, including any horizontal pathways, it is cased in multiple layers of steel (casing) and concrete.
2. A perforating tool is then used to create small holes in the lowermost well casing within the target zone (i.e. the depth at which gas is expected to be located) so that fluid can only enter within a certain section of the well.
3. Hydraulic fracturing is then used, which involves pumping a fluid down the well at high pressure to open tiny cracks in the target rock reservoir. This fluid contains 'proppants', such as sand or tiny ceramic beads, which are used to hold the fissures open and improve the flow of gas or oil. Most fluid contains a small percentage – less than one per cent – of chemical additives to make the technique more efficient.

All recovered fluids are isolated in sealed storage areas designed to prevent leakage, including specially designed and constructed dams or above-ground holding tanks. Depending on regulatory conditions, these fluids are then reused in subsequent well stimulation activities, treated for other uses or disposed of through an approved facility.

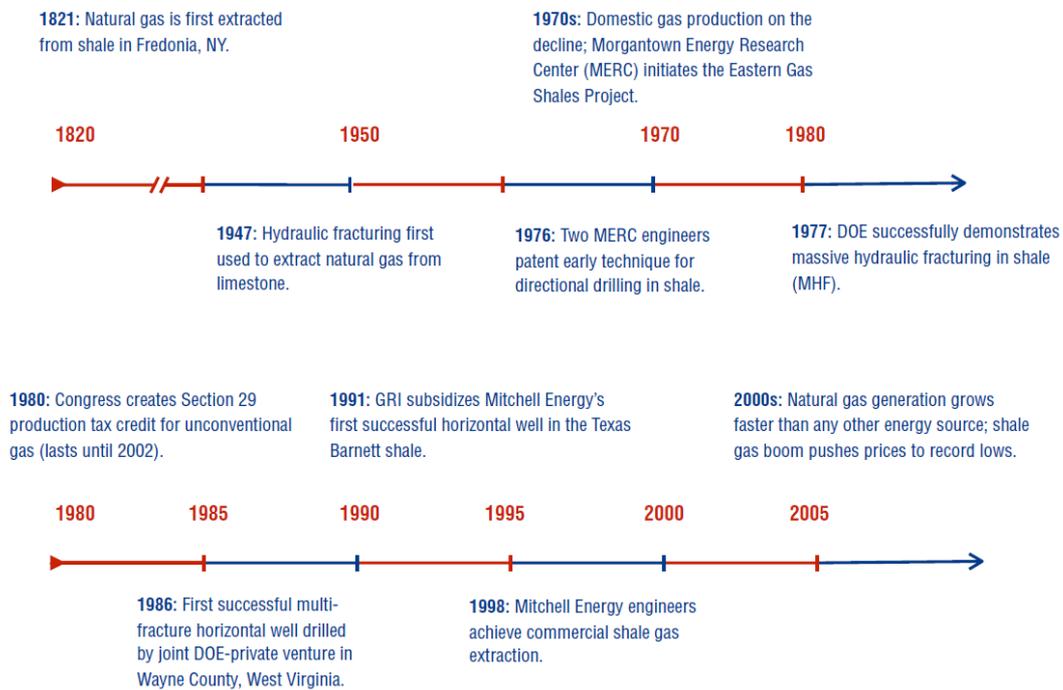
Figure 1.– The Hydraulic Fracturing Process





Reviews of the emergence of shale gas development in the US have found that a number of factors converged in the early 2000's to make it profitable for firms to produce large quantities of gas. As outlined below in Figure 2, this includes public-private partnerships into research and commercialisation and federal government support for commercialisation. Hydraulic fracturing technology took time to develop but ultimately resulted in cost-effective production of natural gas from shale rocks.<sup>33</sup> Ultimately, government support and the development and implementation of multistage hydraulic fracturing and horizontal drilling techniques enabled shale resources to be accessed on a commercial basis.

**Figure 2. Shale Gas Development in the US: A Timeline**



DOE = US Department of Energy; GRI = Gas Research Institute

Source: Breakthrough Institute<sup>34</sup>

### The development of hydraulic fracturing

Hydraulic fracturing was first used commercially 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. Within the first year of its implementation, 332 wells were treated with an average production increase of 75 per cent. It is now reportedly used in approximately 60 per cent of all petroleum wells drilled and, as at 2010, was credited with adding more than nine billion barrels of oil and 700 trillion cubic feet of gas to US reserves alone.<sup>35</sup> In

<sup>33</sup> Wang, Z, Krupnick, A, 'A Retrospective Review of Shale Gas Development in the United States: What Led to the Boom?', Resources for the Future (2013), <http://www.rff.org/RFF/documents/RFF-DP-13-12.pdf>, [Accessed 17/09/13].

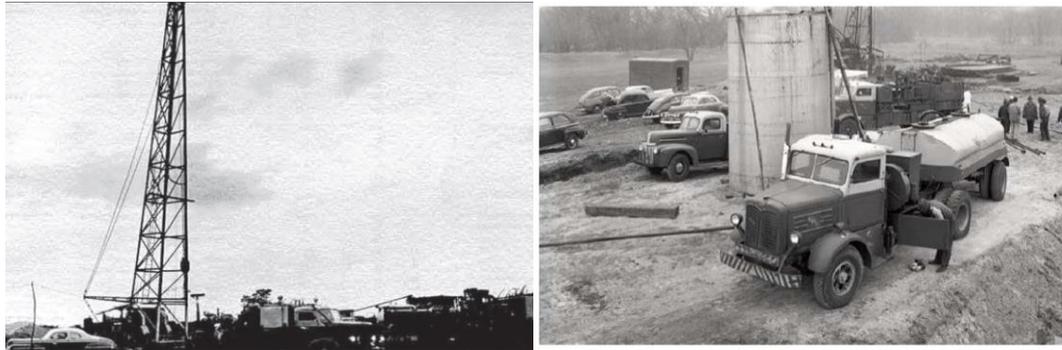
<sup>34</sup> Trembath, A, Jenkins, J, Nordhaus, T, Shellenberger, M, 'Where the Shale Gas Revolution Came From', Breakthrough Institute (2012), [http://thebreakthrough.org/blog/Where\\_the\\_Shale\\_Gas\\_Revolution\\_Came\\_From.pdf](http://thebreakthrough.org/blog/Where_the_Shale_Gas_Revolution_Came_From.pdf), [Accessed 17/09/13].

<sup>35</sup> Montgomery, C, Smith, M, 'Hydraulic Fracturing: History of An Enduring Technology', Society of Petroleum Engineers (2010), <http://www.spe.org/jpt/print/archives/2010/12/10Hydraulic.pdf>, [Accessed 17/09/13].



general, fracturing is considered to have increased US oil and gas reserves by at least 30 per cent and 90 per cent respectively and is expected to move the country towards levels of energy security it hasn't experienced in decades.

**Figure 3. The first commercial fracture treatments by Halliburton**



Source: Society of Petroleum Engineers<sup>36</sup>

#### THE USE OF HYDRAULIC FRACTURING IN A SAFE AND SUSTAINABLE WAY

The use of multi-stage hydraulic fracturing represents best practice within the 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 has also been used extensively within Australia. Since the early 1980s, Santos has hydraulically fractured 30 wells in the Amadeus Basin. In South Australia, the technique has been used for conventional petroleum extraction more than 685 times over the last 40 years and in Western Australia it has been used more than 780 times (including 734 times on Barrow Island). Located off the coast of Western Australia, Barrow Island has been identified as an 'A' Class nature reserve – the highest level of environmental protection afforded in the State. Hydraulic fracturing is also commonly used by oil and gas operators in Australia's offshore waters.

*Since the 1960s, around 1500 wells in South Australia, Western Australia, Queensland, and the Northern Territory have been hydraulically fractured without adverse impacts on groundwater.*

Hydraulic fracturing can also be used in geothermal energy production and to stimulate water flows. Its use in oil and gas wells has generated concerns that:

<sup>36</sup> *Ibid.*



- a fracture may extend up through the formations and enter a water aquifer thereby contaminating the water; and
- the risks of environmental damage are much higher for horizontal well fracturing compared to vertical well fracturing.

It is not possible for a fracture to rise vertically a thousand metres or more to reach shallow water aquifers. Each well and fracture operation is specifically engineered based on the geology, geomechanics and well parameters.<sup>37</sup> Fracture behaviour typically depends on a variety of site-specific factors, including:

- the physical properties, types and thicknesses of the objective formation and the surrounding formations;
- the presence of existing natural fracture systems and their orientation;
- the amount and distribution of stress through the target and surrounding formations
- the design of a particular stimulation, including the volume of fracturing fluid injected into the subsurface, the fluid injection rate and the fluid viscosity; and
- placement of casing perforations.

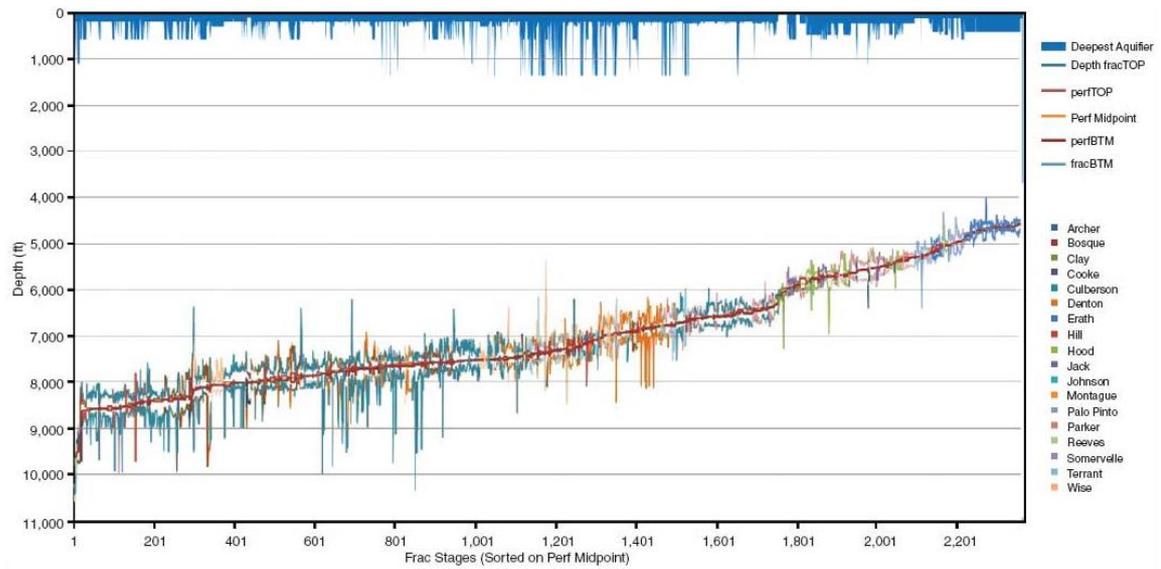
In light of these factors, the propagation of fractures is controlled through various techniques including careful selection of fluids, their volumes and pumping rates. Taking these factors into account, fracturing stages are designed and controlled in ways that limit fractures to only the formation of interest, thereby maximising the commercial extraction of hydrocarbons and minimising fracturing costs. Fracture growth can be monitored through a variety of means, including microseismic techniques that provide an image of the fractures by detecting microseisms that are triggered by shear slippage on bedding planes or natural fractures adjacent to the induced fracture.

Every vertical and horizontal well utilises high strength materials, including concentric layers of cement around multiple layers of steel casing that are selected to meet that well's engineering specifications and design parameters. Compared to conventional oil and gas fields, deeper shale wells have greater separation from water aquifers and generally have multiple natural barriers and formations with very low permeability above the fracturing zone. The fracturing of horizontal wells is therefore no riskier than fracturing vertical wells.

Microseismic studies undertaken in the Cooper Basin and eextensive research on hundreds of wells in the US have conclusively demonstrated that the fractures induced by the process are normally confined to the rocks close to the zone of interest. The following chart shows the relative separation of aquifers from fractures, with the maximum extent of the induced fractures and their relation to the aquifers.

#### Figure 4 – Separation between fractures and aquifers in the Barnett Shale

<sup>37</sup> For further information see "National Human Health Risk Evaluation for Hydraulic Fracturing Fluid Additives" prepared by Gradient Corporation for Halliburton Energy Services, May 2013. [http://www.energy.senate.gov/public/index.cfm/files/serve?File\\_id=53a41a78-c06c-4695-a7be-84225aa7230f](http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=53a41a78-c06c-4695-a7be-84225aa7230f)



Source: FracFocus<sup>38</sup>

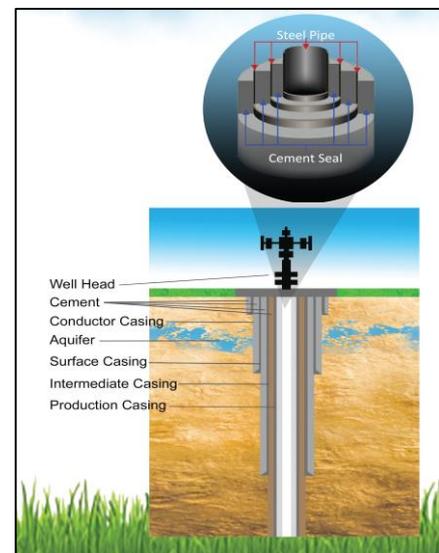
The industry believes there is clear evidence that the technology has been and will continue to be applied safely and sustainably in Australia.

#### CONSTRUCTION OF WELLS TO EXACTING STANDARDS

Petroleum producers construct wells to the highest standards to ensure that gas is kept within the well and water is kept out. Responsible companies will rely on established standards relating to well design, well construction, well integrity management and well abandonment that adhere to practices published by organisations such as the American Petroleum Institute. These meet or commonly exceed expectations of the regulator and are subject to review and audit. In addition to meeting regulatory requirements, companies have a significant financial incentive to ensure that there is no connectivity between a well and surrounding aquifers. Any loss of hydrocarbons from a well reduces the amount that is produced and sold.

In addition to complying with regulatory requirements and industry standards, the design of a particular well will take into account a variety of site-specific factors, including the depth of the target formation, the presence of intervening formations containing gas that must be isolated, the presence and depths of aquifers to be isolated and the anticipated pressures to which the well will be subject, among others. However, certain fundamentals are characteristic of all modern shale gas wells and other wells used for producing oil and gas from unconventional formations.

**Figure 5 – Separation from aquifers**



<sup>38</sup> 'Hydraulic Fracturing: The Process', FracFocus, <http://fracfocus.org/hydraulic-fracturing-how-it-works/hydraulic-fracturing-process> [Accessed 17/09/13].



As demonstrated in Figure 6, multiple layers of steel and cement, along with extensive surface safety equipment, are used to keep the gas and fluids inside the well and under control as they pass through shallow formations with drinking water aquifers. The design, construction and completion of a well to the highest standards is recognised as one of the most important ways of ensuring that the environment is protected throughout operations. When a well is properly constructed it provides a strong, long lasting seal that isolates the well and deep gas formations from aquifers.

A 2011 report from the US Ground Water Protection Council examined more than 34,000 wells drilled and completed in the state of Ohio between 1983 and 2007, of which a total of 12 had issues related to well construction.<sup>39</sup> Of 187,000 wells drilled in Texas the study found that there were two incidents relating to well construction. Most of those incidents (more than 80 percent) occurred in the 1980s and 1990s before improved cement formulas and regulations were in place. Similar to performing a service on a car, these wells required routine maintenance on the casing or cement.

Importantly, there have been no cases where hydraulic fracturing has been identified as the cause of groundwater contamination.<sup>40</sup>

Ensuring that well integrity is maintained throughout the life of operations is critical to safety and the protection of the environment. The risk of a well casing failure in Australia is low because the industry is committed to ensuring that wells are constructed and maintained to the highest standards.<sup>41</sup> APPEA is not aware of any problematic, abandoned oil and gas wells in Tasmania.

The industry will continue to construct wells to the highest standards to ensure that gas and fluids are kept in and water is kept out of wells. This includes taking advantage of innovation in cements to continue to improve the construction of new wells and the durability of casings. The industry is also committed to monitoring and performing maintenance on any wells that are not functioning as expected.

## MONITORING EVERY RELEVANT ASPECT OF THE ENVIRONMENT FOR CHANGE

Companies use extensive monitoring to detect any possible changes in the environment as a result of operations. Before, during and after activities commence, monitoring is put in place to measure the potential impact on the environment. Before drilling a well, it is standard practice that companies undertake extensive surveys to fully understand the environment.

Technicians and engineers use a range of monitoring techniques to show that the production process is working safely and effectively. Monitoring processes are designed for the specific environmental and geological conditions and risks associated with each project. Standard forms of monitoring include:

<sup>39</sup> Kell, S, 'State Oil and Gas Agency Groundwater Investigations And their Role in Advancing Regulatory Reforms', Ground Water Protection Council (2011), [http://www.gwpc.org/sites/default/files/event-sessions/05Kell\\_Scott\\_0.pdf](http://www.gwpc.org/sites/default/files/event-sessions/05Kell_Scott_0.pdf) [Accessed 27/09/13].

<sup>40</sup> Peterson, J, Hamilton, H, 'No contamination from Fayetteville Shale Exploration Found in Sampled Wells', United States Geological Society (2013), <http://www.usgs.gov/newsroom/article.asp?ID=3489#.UifgtEqQ-70> [Accessed 17/09/13] ; 'EPA's Lisa Jackson on Hydraulic Fracturing', EnergyInDepth YouTube, [http://www.youtube.com/watch?v=tBUTHB\\_7Cs](http://www.youtube.com/watch?v=tBUTHB_7Cs) [Accessed 17/09/13].

<sup>41</sup> ACOLA P. 120



- Water sampling (e.g. surface water, groundwater)
- Air quality (e.g. gas, dust and noise)
- Vegetation and flora (e.g. weed infestations)
- Fauna (e.g. for conservation species)
- Fracture monitoring (e.g. geophone arrays to assess stimulation extent)
- Well head (e.g. pressure changes within the well)
- Soils/topography (e.g. for erosion)
- Social (e.g. impact on communities)
- Cultural (e.g. disturbance of cultural sites)

This information could have wider applications and be accessible to landholders and others through the development of a government-sponsored environmental database. This would assist industry generally (not just oil and gas) and lead to a more informed discussion about the potential environmental impacts of industry activity.

#### DISCLOSURE AND USE OF LOW IMPACT CHEMICALS

During hydraulic fracturing a fluid is used to carry 'proppants' which hold the rock fissures open and allow the gas to flow more easily into the well. The fluid is mostly made up of water and sand (approximately 99.5 per cent). The remainder is a mixture of chemical additives, added at very low concentrations and which enhance the outcomes from the fracturing treatment. A typical fracture treatment will use three to 12 additive chemicals, depending on the characteristics of the water and the formation being fractured.

**Figure 7 – Typical proppant used in hydraulic fracturing**



Each chemical serves a specific engineering purpose<sup>42</sup> and ensures the operation is carried out safely and the long term integrity of the well is assured.<sup>43</sup> These chemicals are found in familiar household products including ice cream, vinegar, table salt, cosmetics and antiseptics.

Source: Todd Energy

The industry strongly supports transparent practices and companies operating in the Australia publish details of their activities and environmental protection methods. The Department of Mines and Energy (DME) publishes summaries of environment management plans and details of the chemicals used in hydraulic fracturing on its website. It is also developing chemicals disclosure

<sup>42</sup> Including to reduce friction, remove bacteria and algae and prevent the formation and build-up of scale

<sup>43</sup> IGU P. 30



guidelines. These should encourage the use of leading practice and innovative, environmentally benign chemicals in hydraulic fracturing.

To lift the visibility of the chemical disclosure regime, APPEA encourages consideration of a FracFocus.org style website for Australian jurisdictions, which could provide a one-stop-shop for information on areas being explored for shale and tight gas and the chemicals used in each well. The Queensland Department of Natural Resources and Mines (DNRM) has developed a similar model for providing information to the public on exploration activities, called the Coal Seam Gas Globe (further information is available at [www.dnrm.qld.gov.au](http://www.dnrm.qld.gov.au)). It is noted that the benefit of the DNRM model is that the data is government-sourced which enables a high level of consistency in the information.

APPEA notes that several companies are investing in 'green' or non-toxic additives to hydraulic fracturing fluids. APPEA would support further consideration of whether supplementary approaches beyond current regulatory requirements are required to continue to encourage innovation.

## FREQUENTLY ASKED QUESTIONS

### What is happening around the world?

Worldwide shale gas production is expected to be the biggest single source of new global energy over the next two decades. The US EIA has estimated that shale gas production will increase from 34 per cent in 2011 to 50 per cent in 2040.<sup>44</sup> The International Energy Agency estimates that natural gas will account for 20 per cent of world total primary energy supply by 2035.<sup>45</sup>

The USA is leading the world in development of the shale gas industry with significant economic and environmental benefits. The recent and rapid transformation of the North American energy sector based on natural gas from its shale resources highlights the potential for these benefits. One recent study illustrates the extent of the transformation. It found that the resurgence in onshore gas and oil in the US had created 1.7 million jobs in 2012.

The UK Government is encouraging petroleum companies to step up drilling programs for shale gas in Britain. Britain has significant potential for shale gas, with a number of groups looking at how these resources can replace ageing, coal-fired power stations.

China and Canada are expected to become major shale gas producers as global energy consumption increases by more than 50 per cent in the next two decades.<sup>46</sup>

### What are the facts about the environmental concerns?

*The process of hydraulic fracturing*

<sup>44</sup> US Energy Information Administration. 'Annual Energy Outlook 2013', [http://www.eia.gov/forecasts/aeo/MT\\_naturalgas.cfm](http://www.eia.gov/forecasts/aeo/MT_naturalgas.cfm)

<sup>45</sup> IEA, <http://www.iea.org/publications/freepublications/publication/kwes.pdf>

<sup>46</sup> US Energy Information Administration, 'International Energy Outlook 2011', <http://www.eia.gov/forecasts/ieo/>



The process of hydraulic fracturing – pumping fluid into deep geological zones to stimulate the flow of gas into production wells – is one feature of tight and shale gas production. Since the 1950s, some 780 petroleum wells have been drilled and fractured in Western Australia with no adverse effects on the environment, water sources or public health according to the WA Department of Mines & Petroleum. In the Northern Territory around 30 wells have been hydraulically fractured since the early 1980s with no adverse impacts on water aquifers. In Queensland, some 350 wells have been fractured since 2-11 with no adverse impacts on aquifers. It is a tightly controlled and highly regulated process.

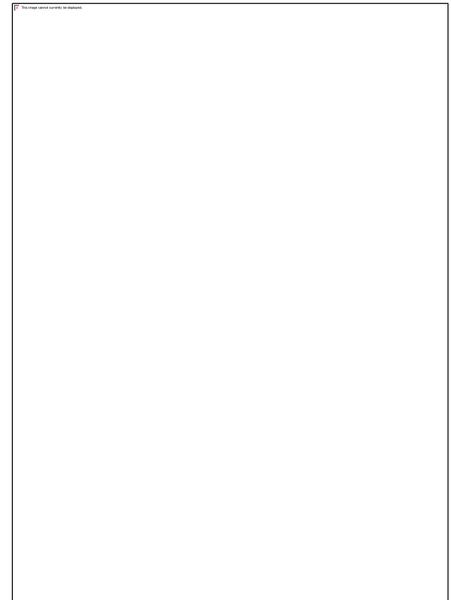
The regulations covering the industry are stringent and comprehensive. An explanation of the process can be found on the APPEA website.<sup>47</sup>

#### *Protection of groundwater*

The industry recognises the conservation and protection of ground water is a top priority. Key factors which protect groundwater during natural gas production are:

- The strength of the wells

Reinforced steel and concrete casings are designed to keep the gas inside the well. The diagram to the right is a cross section of a typical shale or tight gas well, reinforced to keep gas in and water out.



A 2011 report from the US Ground Water Protection Council examined more than 34,000 wells drilled and completed in the state of Ohio between 1983 and 2007, of which a total of 12 had issues related to well construction.<sup>48</sup> Of 187,000 wells drilled in Texas the study found that there were two incidents relating to well construction. Most of those incidents (more than 80 percent) occurred in the 1980s and 1990s before improved cement formulas and regulations were in place. Similar to performing a service on a car, these wells required routine maintenance on the casing or cement.

- The depth of the gas-bearing rock

Shale and tight gas resources are typically between one and five kilometres below the ground, separated from near-surface freshwater aquifers by hundreds of metres of very low permeability rock. The process of hydraulic fracturing is monitored to confirm that the extent of the rock fractures remain separated from ground water, typically by one to two kilometres of rock. Extensive research on hundreds of wells in the US has conclusively demonstrated that the fractures induced by the process are confined to the rocks close to the zone of interest. The chart

<sup>47</sup> APPEA: <http://wa-onshoregas.info>

More detail is available at [http://www.youtube.com/watch?feature=player\\_embedded&v=BEH4M7EulsU](http://www.youtube.com/watch?feature=player_embedded&v=BEH4M7EulsU)

<sup>48</sup> Kell, S, 'State Oil and Gas Agency Groundwater Investigations And their Role in Advancing Regulatory Reforms', Ground Water Protection Council (2011), [http://www.gwpc.org/sites/default/files/event-sessions/05Kell\\_Scott\\_0.pdf](http://www.gwpc.org/sites/default/files/event-sessions/05Kell_Scott_0.pdf) [Accessed 27/09/13].



in Figure 4, illustrates the depth of the process, the maximum extent of the induced fractures and the separation from aquifers.

- Effective monitoring programs

Highly trained technicians use a range of monitoring techniques based on seismic, pressure-testing and water sampling technology to show that the production process is working safely and effectively. Information from the monitoring is available to the public. These monitoring programs are closely regulated by various Government agencies.

- Limited water usage

For shale and tight gas, stage of hydraulic fracturing uses about 2.5 million litres of water – equivalent to the contents of an Olympic swimming pool. A well may undergo several stages of fracturing but water use is reduced by the re-use of water that flows back to the surface following previous fracturing stages.

- Surface water management

Up to 80 per cent of the fluids used during the fracturing process flow back to the surface. These fluids are stored in lined pits or in steel tanks until they can be reused in future fracturing jobs. When they are no longer needed, the fluids are placed in specially designed ponds for evaporation, leaving a small residue. This residue is tested and can then be safely removed and taken to a licensed disposal facility.

- Use of chemicals

The hydraulic fracturing fluid used to improve gas and oil production is typically comprised of more than 99.5 per cent water and sand and 0.5 per cent chemical additives. Many of the chemicals used are also found in common household and commercial applications. They include guar gum used in jelly sweets, salt, detergents and antiseptics - all of which are used in extremely low concentrations.

The chemical additives are assessed, fully disclosed and managed according to strict regulations. Monitoring ensures they remain in a closed process system – and don't contact fresh water.

### **Landscape impacts**

Opponents of natural gas production from shale and tight rocks have made wildly exaggerated claims about the number of wells which could be drilled in Australia. They have also used photographs of gas fields in the US which are very different in design and scale to the projects in Australia.

Shale and tight gas development in Australia is expected to be based on multiple horizontal wells from one well pad. This allows for higher natural gas production from one location and a smaller land use footprint.

After a well is established and a project moves from exploration to production, most of the land is rehabilitated, leaving a small area around the well head and the associated infrastructure. Each



well head will have a two metre tall “Christmas Tree” – or valve assembly – to control the gas production. These well pads would be spaced between one and four kilometres apart across a production area.

The number of wells and well pads will depend on the success of current exploration programs – and the development of gas markets, but will be far less than the unfounded claims being made.

### **The Gasland myth**

Gasland, a movie which has been used by groups opposing onshore natural gas development, was produced in the style of a documentary by filmmaker Josh Fox, who now makes a successful living from anti-gas campaigning.

A number of US authorities have followed up the allegations in his film and have found the majority to be untrue. For example, the signature scene is a “flammable faucet” segment in which a Colorado householder claims that gas producers have polluted his water supply with methane. He demonstrates this by lighting a match next to a kitchen tap which bursts into flames.

Tests by the State of Colorado Oil and Gas Conservation Commission on this location showed the gas was naturally occurring and not the result of commercial gas production activity.<sup>49</sup> The household bore had intersected a natural biogenic methane accumulation – a common local phenomenon reported long before the gas producers arrived on the scene. Mr Fox was provided with this information but chose not to use it in the film.

A more complete analysis of the film can be found at Energy in Depth.<sup>50</sup>

### **Calls for moratorium**

Some opponents of the industry have called for a moratorium on shale and tight gas exploration.

A halt to exploration would be counter-productive and unnecessary given the regulatory assessment and requirements imposed on operators by the Department of Mines and Energy and the Environmental Protection Agency. The information from exploration programs is being used to provide important data for the effective management and regulation of a future industry.

The moratorium would stop this flow of information and delay the introduction of shale and tight gas - without improving the level of local knowledge. This knowledge will be important in developing operational and regulatory approaches which can ensure that Australia’s shale and tight gas resources are developed in an environmentally responsible manner.

Exploration for shale oil and gas is also providing valuable new data about the size and location of the Australia’s underground water resources. New aquifers have been discovered including deeper saline aquifers unsuitable as drinking water but able to be used for drilling and hydraulic fracturing.

### **A partnership approach**

APPEA has worked with the Governments, CSIRO, farming groups and others to conduct public meetings and workshops in regional communities that provide access to information people can

<sup>49</sup> State of Colorado Oil & Gas Conservation Commission, <http://cogcc.state.co.us/library/GASLAND%20DOC.pdf>

<sup>50</sup> Energy in Depth, ‘GasLand Debunked’, <http://www.energyindepth.org/wp-content/uploads/2011/11/Debunking-Gasland.pdf>



trust and to create a dialogue with regulators and exploration companies. The industry believes that this partnership represents a proactive, innovative and responsible approach for delivering local background information to support national and international scientific studies.