



appea

the voice of australia's  
oil and gas industry

Submission

October 2013

**APPEA Submission: Environment and  
Public Affairs Committee  
'Inquiry into the Implications for  
Western Australia of Hydraulic  
Fracturing for Unconventional Gas'**



## CONTENTS

<b>TERMS OF REFERENCE .....</b>	<b>3</b>
<b>EXECUTIVE SUMMARY .....</b>	<b>3</b>
<b>RECOMMENDATIONS .....</b>	<b>5</b>
<b>ONSHORE NATURAL GAS IN WESTERN AUSTRALIA .....</b>	<b>6</b>
WHY WE NEED ENERGY .....	7
WHY ONSHORE NATURAL GAS.....	8
THE DEVELOPMENT OF ONSHORE GAS IN WESTERN AUSTRALIA .....	10
<b>SAFE AND RESPONSIBLE OPERATOR PRACTICES .....</b>	<b>14</b>
THE USE OF HYDRAULIC FRACTURING IN A SAFE AND SUSTAINABLE WAY .....	14
CONSTRUCTION OF WELLS TO EXACTING STANDARDS.....	16
MONITORING EVERY RELEVANT ASPECT OF THE ENVIRONMENT FOR CHANGE .....	17
MINIMISING IMPACTS ON THE LANDSCAPE .....	18
USING LOW IMPACT CHEMICALS AND DISCLOSING AS MUCH AS POSSIBLE.....	20
MINIMISING WATER USE AND RECYCLING WHERE POSSIBLE .....	21
REHABILITATION OF LAND IMPACTED BY PETROLEUM ACTIVITIES .....	22
EARLY, OPEN AND MEANINGFUL COMMUNICATION .....	23
THE IMPORTANCE OF A FACT-BASED DISCUSSION .....	25
CONTINUOUS IMPROVEMENT .....	27
<b>THE DELIVERY OF ROBUST AND EFFICIENT REGULATION .....</b>	<b>28</b>
REGULATING EXPLORATION-STAGED ACTIVITIES.....	28
REGULATING ACTIVITIES AS THEY ADVANCE.....	29
<b>ADVANCING THE INDUSTRY.....</b>	<b>31</b>

## TERMS OF REFERENCE

- a) How hydraulic fracturing may impact on current and future uses of land;
- b) The regulation of chemicals used in the hydraulic fracturing process;
- c) The use of ground water in the hydraulic fracturing process and the potential for recycling of ground water; and
- d) The reclamation (rehabilitation) of land that has been hydraulically fractured.

## EXECUTIVE SUMMARY

The technology, operational experience and regulation already exist to enable the safe and sustainable extraction of Western Australia's significant natural gas resources from shale and tight rocks. With growing demands for natural gas globally and in Western Australia, and the increasing cost and technical barriers to developing offshore resources, these resources will play a key role in delivering security of natural gas supplies for the State. Accessing these resources on a commercial basis has become possible through the combination of two well-tried technologies – multistage hydraulic fracturing and horizontal drilling.

The development of these previously uncommercial sources of natural gas will deliver significant economic and environmental benefits for Western Australia – through job creation, industry stimulation and lowering of greenhouse emissions. In the United States the uptake of shale gas has seen a fall in carbon emissions of between 200 and 400 million tonnes (as a result of natural gas replacing coal-fired electricity) and led to a 'manufacturing renaissance' from lower cost feed stocks. The development of onshore natural gas industries in Queensland has also led to the creation of thousands of jobs.

Realisation of these benefits will require a foundation of community confidence. This will be achieved through safe and responsible operator practices, robust regulation, and early and open communication.

Fortunately, companies are able to transfer decades of experience and operational practices in pursuing offshore natural gas developments to pursuing extraction of these previously uncommercial natural gas sources. In particular, the knowledge obtained from the use of hydraulic fracturing more than 700 times in Western Australia since 1965 provides a significant advantage with ensuring sustainable operations. Companies currently focus significant efforts on protecting the environment, including through extensive monitoring, construction of wells to exacting standards, and the use and disclosure of low impact chemicals.

Current early exploration efforts are overseen by a regulatory framework that has proven capable of managing the same techniques and technologies for nearly 50 years and adapting to new ones as they emerge. The effectiveness of this framework and the ability for risks to be managed effectively has been recognised through several reviews by independent experts which are referred to throughout this submission. The management of projects as they advance past early-stage exploration may require the regulatory framework to adapt, and industry is working closely with government to ensure robust and efficient regulation.

Industry and government has also been working to ensure that fact-based information reaches the community, including through independent third parties such as CSIRO, to enable informed discussion and decision making. This is an important means of countering the misinformation



that has been spread by groups ideologically opposed to natural gas, who ignore the extensive body of science proving it poses negligible environmental and health risks.

While there are challenges ahead, the considered pace and manner in which the industry is approaching exploration (and potentially development) provides time to face these challenges head on.

APPEA would be pleased to provide further information to the Inquiry at the Committee's convenience.



## RECOMMENDATIONS

- Planning for multiple land uses to ensure coexistence of potential shale gas activities with existing activities will be very important to industry and landowners. In this regard, implementation of the Standing Council on Energy and Resources Multiple Land Use Framework, discussed further at Attachment 2, should be pursued across government to deliver shared benefits to all stakeholders. This Framework should be integrated into planning documents such as the State Planning Strategy and any strategic frameworks relating to the development of an onshore gas industry in Western Australia.
- Development of a regulatory disclosure protocol to enable the use of leading practice and environmentally benign chemicals in hydraulic fracturing should be pursued. This would enable the newest technologies to be used in Western Australia without intellectual property concerns resulting from public disclosure.
- A better understanding of local environments, particularly in relation to water resources, is required in many areas and the commitment of the State Government to develop an environmental database will be very useful in consolidating and communicating this information.
- The Australian Council of Learned Academies (ACOLA) report, 'Engineering Energy: Unconventional Gas Production', is referred to throughout this submission and should play a larger role in the discussion in Australia. Released in May 2013, APPEA would commend the document to the Environment and Public Affairs Committee.



## ONSHORE NATURAL GAS IN WESTERN AUSTRALIA

### **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 240 associate member companies providing a wide range of goods and services to the industry.

### **The Inquiry**

APPEA welcomes the opportunity to input into the Environment and Public Affairs Committee's Inquiry into the Implications of Hydraulic Fracturing for Unconventional Gas. APPEA hopes that the Inquiry will provide the clarity required to properly inform the public on both the benefits and perceived risks of hydraulic fracturing and onshore natural gas in Western Australia. This submission should be read in conjunction with submissions from APPEA's members which will provide further technical detail in relation to shale and tight gas developments.

APPEA believes that the key technical issues at the centre of the Inquiry are being managed effectively by the petroleum industry in the way the exploration programs have been planned and developed. The critical issues identified by the terms of reference have been considered in detail by ACOLA.<sup>1</sup>

The science indicates that, with appropriate monitoring and robust and transparent regulation in place, shale and tight gas resources can be developed safely and effectively as an economically important additional energy source which could significantly reduce Australia's greenhouse gas emissions.<sup>2</sup> Other impacts in relation to health, cumulative impacts, seismicity, fugitive emissions, social impacts, groundwater contamination and best practice regulation for onshore natural gas have also been considered extensively by the existing literature.<sup>2</sup>

The industry has the technical capability to develop shale and tight gas resources but acceptable development of the industry will rely on community confidence.<sup>3</sup> This confidence will require robust regulation, responsible operator practices and early and effective communication with stakeholders. APPEA's submission seeks to demonstrate how the industry has worked across these three areas to build confidence.

---

<sup>1</sup> Cook, P, Beck, V, Brereton, D, Clark, R, Fisher, B, Kentish, S, Toomey, J and Williams, J (2013). 'Engineering Energy: Unconventional Gas Production.' Australian Council of Learned Academies (ACOLA), [www.acola.org.au](http://www.acola.org.au).

<sup>2</sup> These issues have been covered in detail in publications by ACOLA, the International Gas Union and International Energy Agency.

<sup>3</sup> 'Golden Rules for a Golden Age of Gas', International Energy Agency (2012), [www.iea.org](http://www.iea.org)



## WHY WE NEED ENERGY

Natural gas will continue to play a critical role in meeting the world's demand for energy. The US Energy Information Administration recently projected demand would increase by 52 per cent between 2010 and 2040.<sup>4</sup> While nuclear and renewable sources will provide increased contributions (2.5 per cent per annum), fossil fuels are expected to supply nearly 80 per cent of world energy needs through to 2040.<sup>5</sup>

Much of this demand will come from non-OECD (Organisation for Economic Cooperation and Development) countries, which are expected to increase their energy demand by 90 per cent during this period (compared to 17 per cent in OECD countries).

Similarly, Australia's energy demand is expected to increase by 29 per cent between 2008 and 2035. Petroleum products, which represented 39 per cent of energy consumption in 2011-12, will meet most of this demand. Into the future natural gas will continue to supply energy to various industries (e.g. mining), households (e.g. hot water, stove tops) and sectors such as transport (e.g. Transperth's compressed natural gas bus fleet).

Driven by the economy and lifestyles, Western Australia is the most gas-dependent jurisdiction in Australia with natural gas supplying 55 per cent of energy consumed in the State.<sup>6</sup> This gas is primarily supplied by the North West Shelf Project and Apache's Varanus Island facility and consumed in large quantities by the mining, manufacturing and electricity generation sectors.<sup>7</sup> The recently released *WA Gas Statement of Opportunities* (GSOO) found that forecast average

<sup>4</sup> 'EIA projects world energy consumption will increase 56% by 2040', US Energy Information Administration, (2013) <http://www.eia.gov/todayinenergy/detail.cfm?id=12251> [Accessed 17/09/13].

<sup>5</sup> *Ibid.*

<sup>6</sup> 'Energy in Australia 2012', Bureau of Resources and Energy Economics (2012), <http://www.bree.gov.au/documents/publications/energy-in-aust/energy-in-australia-2012.pdf> [Accessed 17/09/13]; WA Office of Energy, 'Strategic Energy Initiative Directions Paper', [http://www.finance.wa.gov.au/cms/uploadedFiles/Public\\_Utility\\_Office/WAs\\_Energy\\_Future/Strategic+Energy+Initiative+Directions+Paper\\_web.pdf](http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/WAs_Energy_Future/Strategic+Energy+Initiative+Directions+Paper_web.pdf) (2011), [Accessed 17/09/13].

<sup>7</sup> 'Energy White Paper 2012', Department of Resources, Energy and Tourism (2012), [http://www.ret.gov.au/energy/Documents/ewp/2012/Energy\\_20White\\_Paper\\_2012.pdf](http://www.ret.gov.au/energy/Documents/ewp/2012/Energy_20White_Paper_2012.pdf), P. 160 [Accessed 17/09/13].



annual growth for domestic gas demand is expected to be 1.1 per cent per annum.<sup>8</sup> Under a constrained scenario this will lead to an increase in gas demand of about nine per cent in 2022, a rate similar to the average growth of the domestic gas market between 2003 and 2012.

Given the prominent role of natural gas in Western Australia, continued access to secure, reliable and competitively priced energy is critical.<sup>9</sup> With the increasing challenges and cost of offshore gas developments, it is likely that onshore gas fields will become more prominent sources of natural gas supply for Western Australia's domestic consumption. In addition to reinforcing the State's energy security, onshore natural gas has the potential to provide significant benefits to regional areas within the proximity of activities.

## WHY ONSHORE NATURAL GAS

There is no material difference between the composition of natural gas retrieved from conventional sources (e.g. from the North West Shelf project) and natural gas from shale or tight rock sources.

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 two and five kilometres.

Estimates from the US Energy Information Administration have suggested that Australia could possess recoverable resources of 17.5 billion barrels of shale oil and condensate and 437 trillion cubic feet of shale gas.<sup>10</sup> These equate respectively to the sixth and seventh largest global reserves of shale oil and gas.

Western Australia has been identified as one of the largest potential supplies of natural gas from shale rocks in the world. These resources are typically located at depths of between two and four kilometres below the ground and separated from near-surface freshwater aquifers by at least a kilometre of virtually impermeable rock.

---

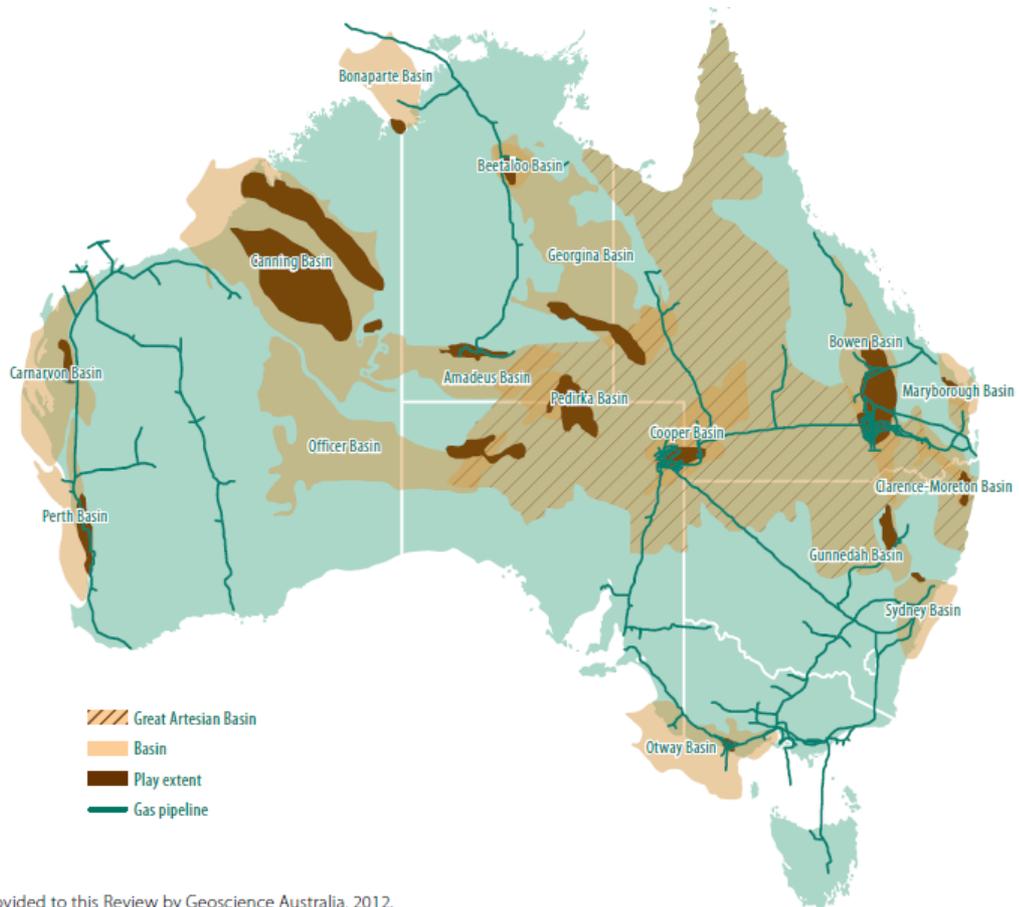
<sup>8</sup> 'Gas Statement of Opportunities', Independent Market Operator (2013), <http://www.imowa.com.au/GSOO> [Accessed 17/09/13].

<sup>9</sup> 'Strategic Energy Initiative: Energy 2031', Public Utilities Office (2012), [http://www.finance.wa.gov.au/cms/uploadedFiles/Public\\_Utility\\_Office/WAs\\_Energy\\_Future/Strategic\\_Energy\\_Initiative\\_Energy2031\\_Final\\_Paper.pdf](http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Utility_Office/WAs_Energy_Future/Strategic_Energy_Initiative_Energy2031_Final_Paper.pdf) [Accessed 17/09/13].

<sup>10</sup> Based on the risked recoverable levels of the Georgina, Beetaloo, Maryborough, Canning and Cooper Basins. See 'Technically recoverable shale oil and shale gas resources', US Energy Information Administration (2013), <http://www.eia.gov/analysis/studies/worldshalegas/> [Accessed 17/09/13].



Figure 1. Australia's Assessed Prospective Shale Gas and Shale Oil Basins



Provided to this Review by Geoscience Australia, 2012.

Source: ACOLA

Western Australia's share of these resources is significant, with recoverable gas resources estimated to be in the order of 32 trillion cubic feet from the Perth Basin (Mid West) and 235 trillion cubic feet from the Canning Basin. These Basins are also estimated to hold approximately 10 billion barrels of recoverable shale oil and condensate resources.<sup>11</sup> However, low levels of historic exploration means that these areas remain largely underdeveloped and are considered frontier or 'green field' exploration zones, which are typically recognised as more challenging to access. In addition, some areas are distant from markets and infrastructure which adds additional hurdles to development.

Despite the potential of shale and tight gas, there is no significant production in Western Australia at present. A small number of APPEA members are in the early stages of exploration for these resources in Western Australia, as outlined in Figure 3 below.

<sup>11</sup> 'EIA/ARI World Shale Gas and Shale Oil Resource Assessment', US Energy Information Administration (2013), [http://www.eia.gov/analysis/studies/worldshalegas/pdf/chapters\\_i\\_iii.pdf?zscb=395186](http://www.eia.gov/analysis/studies/worldshalegas/pdf/chapters_i_iii.pdf?zscb=395186), [Accessed 17/09/13], P. III-4.



Figure 2. Onshore Operators and Regions of Exploration in Western Australia

OPERATOR	PRIMARY EXPLORATION FOCUS
Buru Energy	Canning Basin
Hess	Canning Basin
New Standard Energy	Carnarvon Basin, Canning Basin
Latent Petroleum	Mid West
Norwest Energy	Mid West
AWE	Mid West

These companies and APPEA are working closely with stakeholders to ensure sustainable coexistence that can enable benefits to flow from the industry to communities. It should be noted that onshore gas exploration and production is also occurring in South Australia, the Northern Territory and Queensland.

## THE DEVELOPMENT OF ONSHORE GAS IN WESTERN AUSTRALIA

Western Australia currently consumes 0.5 trillion cubic feet of natural gas per year, which puts in context the scale of the State's potential shale and tight gas recoverable resources of 267 trillion cubic feet.<sup>12</sup> The development and availability of this energy resource will have broad benefits, as demonstrated by the recent and rapid transformation of the North American energy sector which has significantly bolstered the US economy.

### **Economic Benefits**

The global forecaster IHS recently found that the resurgence in onshore gas and oil in the US had created at least 1.7 million jobs across the US in 2012 with estimated growth to 2.5 million jobs by 2015.<sup>13</sup> In the US the shale gas industry has generated \$63 billion in government revenues and this is expected to increase to \$113 billion by 2020.

Notably, the US experience has demonstrated that benefits can flow to adjacent states that have little or no production in addition to those that host the industries. Large economic contributions have been seen through the delivery of critical goods and services that are vital to the oil and gas supply chain.<sup>14</sup> This has created a 'manufacturing renaissance' which is expected to support 460,000 jobs by 2020.<sup>15</sup> In addition, lower energy costs and feedstock prices directly resulting from unconventional gas production are expected to increase industrial production by \$258 billion in 2020. Taking into account these broader benefits, estimated jobs created by unconventional gas development would total 2.1 million in 2013 increasing to 3.3 million in 2020.<sup>16</sup>

<sup>12</sup> 'Natural Gas from Shale and Tight Rocks Fact Sheet', Department of Mines and Petroleum (2013), [http://www.dmp.wa.gov.au/documents/Shale\\_and\\_tight\\_gas\\_and\\_WA\\_future\\_energy\\_security.pdf](http://www.dmp.wa.gov.au/documents/Shale_and_tight_gas_and_WA_future_energy_security.pdf) [Accessed 17/09/13].

<sup>13</sup> 'America's New Energy Future – The Unconventional Oil and Gas Revolution and the US Economy', IHS Global Insight (2013), <http://www.ihs.com/info/ecc/a/americas-new-energy-future-report-vol-2.aspx>, [Accessed 17/09/13]

<sup>14</sup> *Ibid.*

<sup>15</sup> 'U.S. Unconventional Oil and Gas Revolution to Increase Disposable Income by more than \$2,700 per Household and Boost U.S. Trade Position by More than \$164 billion in 2020', IHS (2013), <http://press.ihs.com/press-release/economics/us-unconventional-oil-and-gas-revolution-increase-disposable-income-more-270>, [Accessed 17/09/13].

<sup>16</sup> *Ibid.*



A similar success story has been seen in Australia. In Queensland the coal seam gas industry has been identified as a significant contributor to the Queensland economy through job creation. Data obtained from APPEA members indicates that more than 27,000 people were employed in Queensland's CSG industry in Q4 2012.

Between January 2011 and Q4 2012 economic flows from the CSG industry to Queensland communities was valued at over \$97 million. While offshore LNG projects are generally an order of magnitude beyond a shale or tight gas project in terms of scale, they do provide an indication of the community benefits likely to flow from energy developments.

The offshore oil and gas sector has been operating and supporting local communities in Western Australia's north-west for over 25 years, including significant investment in community infrastructure and social initiatives across the region.<sup>17</sup> For example, the North West Shelf project currently spends approximately \$600 million per annum with Australian-based businesses for operational activities. Similarly, the Apache-operated Devil Creek domestic gas project has reported annual payments to Australian-based businesses of \$1.4 billion.<sup>18</sup>

In New Zealand, Todd Energy's Mangahewa shale gas project has added \$400 million to national GDP and provided 1,360 jobs over seven years.

In addition to the economic activity generated from these projects, the energy sector also has a history of supporting projects within the communities in which they operate, including investment in infrastructure, education and research (e.g. health and environmental).

The development of a shale and tight gas industry in Western Australia would have significant social and economic benefits. The magnitude of social and economic impacts of a development will vary depending on the activities, location, speed, scale, duration and configuration.<sup>19</sup> The ACOLA Report notes that economic diversification that leverages energy projects is the best way of contributing to the long-term wellbeing of a region, though a planned approach to regional development is important. The Western Australian onshore gas industry is currently discussing how to maximise the local benefits of shale and tight gas production through incentives for regional contractors, farm-friendly working conditions, community development programs and fair compensation payments.

### ***Environmental Benefits***

The development of a shale and tight gas sector holds potential to provide a number of positive environmental benefits. In June 2013, the International Energy Agency (IEA) released a report noting that emissions from the United States had fallen by 3.8 per cent (200 million tonnes) over the previous year. In total, US emissions have fallen between 400 and 500 million tonnes – twice the reduction achieved in the rest of the world as a result of the Kyoto Protocol.

---

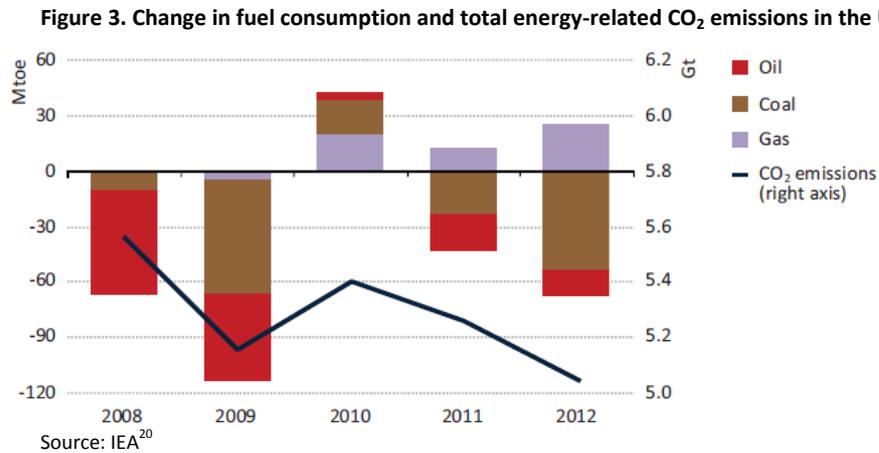
<sup>17</sup> 'The wider contribution to Australia of the Oil and Gas Industry', Australian Venture Consultants (2012), P. 15.

<sup>18</sup> *Ibid.*, P. 19

<sup>19</sup> ACOLA. P. 153



The IEA attributed this fall to the increased uptake of natural gas, in particular from shale sources, which replaced coal in power generation, as indicated in Figure 4 below.



Natural gas currently offers the cleanest viable source of baseload and peaking power in Australia. This is supported by the evidence out of the US, discussed in the case study above, which highlights the US experience with falling carbon emissions as a result of the uptake of shale gas. Within Australia it is expected that increased access to shale and tight gas would likely decrease the contribution of coal-fired generation (as happened in the US) to the electricity mix.<sup>21</sup> This conclusion has also been supported by a recent study from the UK Department of Energy and Climate Change and the ACOLA report in Australia, as illustrated in Figure 5 below.<sup>22</sup> Natural gas is therefore the cleanest source of energy available at this time after renewables.

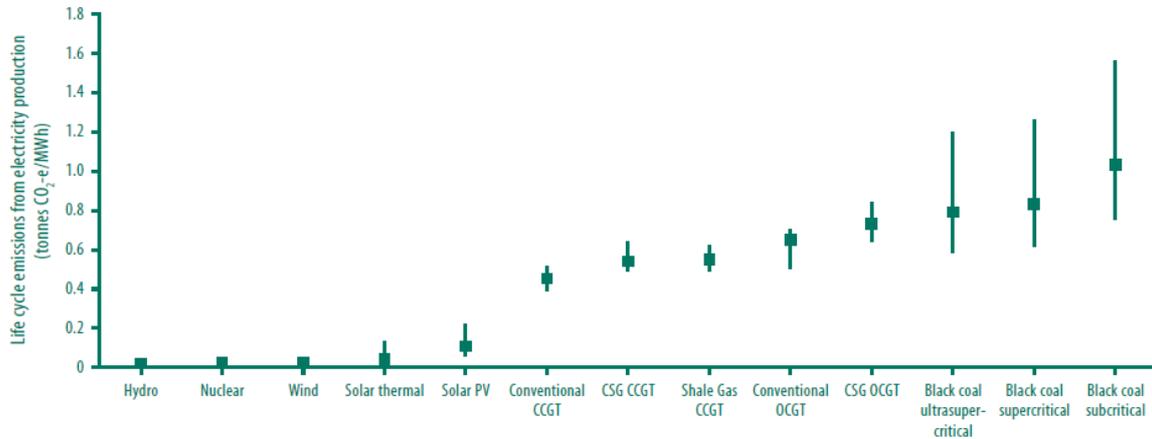
<sup>20</sup> 'Redrawing the energy-climate map', International Energy Agency (2013), <http://www.worldenergyoutlook.org/media/weowebiste/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf>, [Accessed 17/09/13].

<sup>21</sup> ACOLA. P. 17

<sup>22</sup> MacKay, D, Stone, T, 'Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use', Department of Energy and Climate Change (2013), [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237330/MacKay\\_Stone\\_shale\\_study\\_report\\_09092013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf), [Accessed 17/09/13].



Figure 4.– The range of life cycle emissions for electricity generation (tonne CO<sub>2</sub>e/MWh)



Source: ACOLA

Many critics of natural gas, in particular the increased use of shale and tight gas, have made clear their opposition to the industry because it delays the transition to renewable energy.<sup>23</sup> This argument is grounded in ideology and does not account for the evidence, which shows that natural gas provides the quickest, most economically efficient and most reliable opportunity to reduce Australia's carbon emissions.

### ***Distribution of Benefits***

The scale and benefits of shale and tight gas developments will vary from region to region but will need to be supported by effective strategic planning (through tools such as the State Planning Strategy) to ensure impacts benefits are maximised and coexistence is maintained.

APPEA has been involved in a similar strategic approach to the development of the shale and tight gas industry in South Australia, through the Roundtable for Unconventional Gas hosted by the Department of Manufacturing, Industry, Trade, Resources and Energy. Such planning, when supported by communication, information sharing and transparency, ensures that the benefits to the community from a potential industry are maximised (including in relation to components of projects such as surface infrastructure).<sup>24</sup>

<sup>23</sup> "There's no contest: we shouldn't be burning either gas or coal. Instead, we should leave them in the ground, and move towards renewable sources of energy." 'Climate Change and Fracking', Clean Water Health Land (2013), <http://cleanwaterhealthyland.org.au/content/climate-change>, [Accessed 17/09/13].

<sup>24</sup> ACOLA. P. 154

## SAFE AND RESPONSIBLE OPERATOR PRACTICES

The industry is 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 top priority. Key factors which protect the environment during natural gas production include:

- Exacting construction standards and well planning 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 in Western Australia.<sup>25</sup> It should be noted that these are broader than the Inquiry's Terms of Reference but are important chapters in how the industry is able to protect the environment.

The industry supports the findings of ACOLA that resources can be extracted in a manner and in locations that do not compromise agriculture, water resources, alternative land uses and landscape function.<sup>26</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 shale and tight reservoirs on a commercial basis. Provided in Attachment 1 is an outline of how the process works and detailed below are the ways in which the industry uses it safely and sustainably.

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. In South Australia, the technique has been used for conventional petroleum extraction more than 685 times over the last 40 years. This is the same technique that, according to the former WA Minister for Mines and Petroleum Hon. Norman Moore, has been used more than 734 times on Barrow Island since

---

<sup>25</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>26</sup> ACOLA P. 98



1965.<sup>27</sup> 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.

On mainland Western Australia, hydraulic fracturing has been used 21 times at the Dongara gas field in the Perth Basin (Mid West) since 1974. Other examples of hydraulic fracturing for tight and shale gas in Western Australia include:

**Figure 5. Historic Hydraulic Fracturing for Tight and Shale Gas in WA**

FIELD	LOCATION	YEAR
Gingin Field	Gingin	1971
Whicher Range	Mid West	1982 (WR-3), 1997 (WR-1 & WR-4), 2003 (WR-5)
Warro	Mid West	2009 (W-3), 2011 (W-4)
Yulleroo	Canning Basin	2011
Arrowsmith	Mid West	2012
Senecio	Mid West	2012
Woodada	Mid West	2012

It is noted that hydraulic fracturing can also be used in geothermal energy production and to stimulate water flows.

One of the key concerns relating to the use of hydraulic fracturing is that it will penetrate aquifers, however this is highly unlikely. The process of hydraulic fracturing is monitored to confirm the extent of the rock fractures is tightly controlled during fracturing events. In all but one per cent of cases, the maximum penetration of fractures into the surrounding rocks is 350 metres, with a separation from ground water (typically within 1500 metres of the surface) by one or two kilometres in Western Australia.<sup>28</sup>

Extensive research on hundreds of wells in the US has 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.

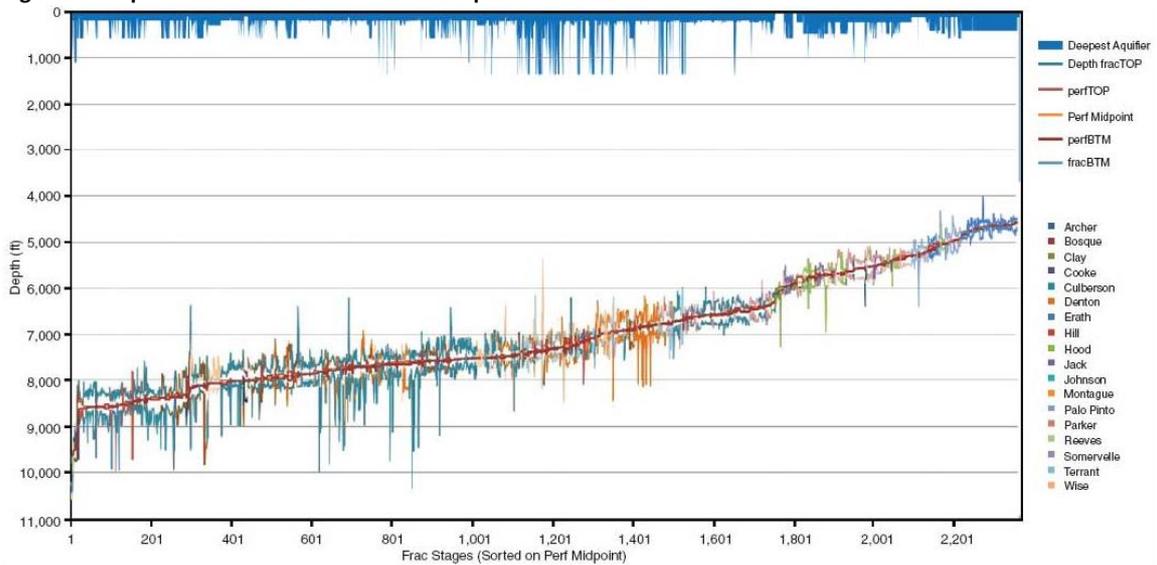
---

<sup>27</sup> Xamon, A, 'Question on Notice No. 4510', Western Australian Parliament (2011), <http://www.parliament.wa.gov.au/parliament/pquest.nsf/a02db76382427ad84825718e0018e9c9/168b5dba6804dbd3482578ee002c46d9?OpenDocument>, [Accessed 17/09/13].

<sup>28</sup> 'Durham's Richard Davies speaks at Geological Society Briefing on fracking and hydraulic fractures', Durham University (2012), <https://www.dur.ac.uk/dei/news/?itemno=14865>, [Accessed 17/09/13].



Figure 6.– Separation between fractures and aquifers in the Barnett Shale



Source: FracFocus<sup>29</sup>

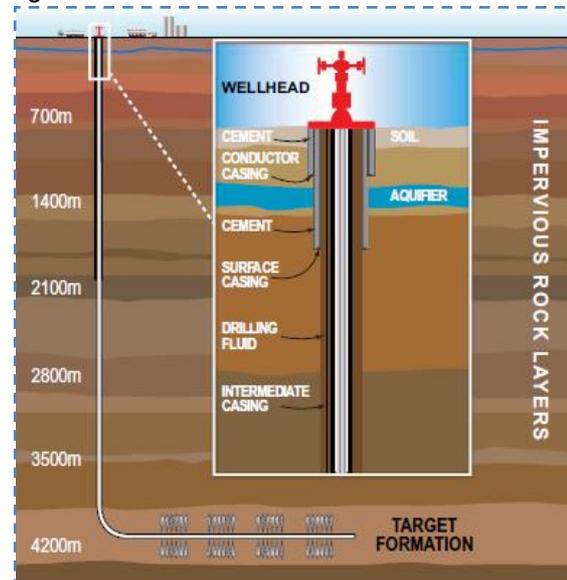
The industry believes there is clear evidence that the technology has been and will continue to be applied safely and sustainably in Western Australia.

### CONSTRUCTION OF WELLS TO EXACTING STANDARDS

Petroleum producers construct wells to the appropriate standards to ensure that gas is kept within the well and water is kept out. Responsible companies will have in place 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 commonly meet or exceed expectations of the regulator and are subject to review and audit.

As demonstrated in Figure 6, multiple layers of steel and cement, along with extensive surface safety equipment, are used to keep the gas inside the well and under control. 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

Figure 7. Well Construction



Source: International Gas Union

<sup>29</sup> 'Hydraulic Fracturing: The Process', FracFocus, <http://fracfocus.org/hydraulic-fracturing-how-it-works/hydraulic-fracturing-process> [Accessed 17/09/13].



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.

Research by the US Ground Water Protection Council has found that rates of well leakage can be between 0.01 and 0.03 per cent.<sup>30</sup> Most of these 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. More recent research published in the journal *Science* has estimated well leakage rates at between one and three per cent.<sup>31</sup>

Importantly, there have been no cases where hydraulic fracturing has been identified as the cause of groundwater contamination.<sup>32</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>33</sup>

The industry will continue to keep gas in and water out of wells by ensuring that they are constructed to the highest standards. 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 fixing any wells that are not functioning to the standards required.

#### 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 (including 3D seismic over time) to fully understand the environment.

Technicians and engineers 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. Standard forms of monitoring include:

- Water sampling (e.g. surface water, groundwater)
- Air quality (e.g. gas, dust and noise)

---

<sup>30</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>31</sup> Vidic, R, Brantley, S, Vandenbossche, J, Yoxtheimer, D, Abad, J, 'Impact of shale gas development on regional water quality', *Science* (2013), <https://n-1.cc/file/download/1708283> [Accessed 27/09/13].

<sup>32</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>33</sup> ACOLA P. 120



- Vegetation and flora (e.g. weed infestations)
- Fauna (e.g. for conservation species)
- Seismicity (e.g. potential seismic events)
- 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)

Where required, monitoring will be adapted to ensure that all changes to the environment as a result of activities are watched closely.

A more detailed understanding of the environment in areas prospective for natural gas, particularly in relation to water resources, is required in many areas and the commitment of the State Government to develop an environmental database will be very useful in consolidating and communicating this information.

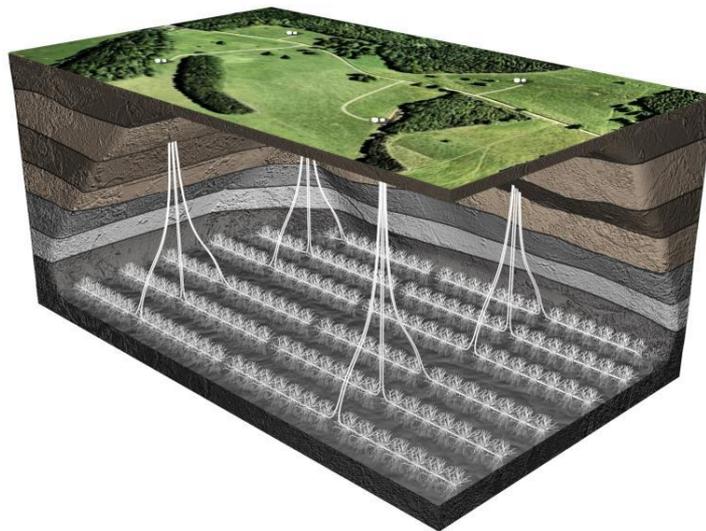
## MINIMISING IMPACTS ON THE LANDSCAPE

This section relates to Terms of Reference 1.1(a).

Companies are committed to working with landowners to identify where an activity can be located that causes the least amount of land use disturbance.

The cost of drilling a shale or tight gas well in Western Australia is very expensive, often around \$20 million, and operators are therefore very careful in how they plan and execute drilling. In the current early stage of exploration companies will primarily

Figure 8.– Multiple wells drilled from central pads



Source: Statoil<sup>34</sup>

rely on vertical wells. As the industry moves towards commercial production, producers will use some horizontal drilling. This will improve the efficiency of the operations and allow for the use of widely spaced drill pads limiting the potential for surface land disturbance.

<sup>34</sup> 'Statoil strengthens US shale gas position', Statoil (2010), <http://www.statoil.com/en/newsandmedia/news/2010/pages/26marmarcellus.aspx> [Accessed 27/09/13]



Horizontal drilling describes the process of drilling vertically to a target depth and then turning and drilling horizontally, usually to a distance of 1-3 kilometres. This increases the amount of rock in contact with the well and increases the gas production rate, thereby decreasing the number of wells required. Typically 6-12 horizontal wells can be drilled from a single surface location or 'pad', which concentrates all activities into an area of approximately a hectare, thereby minimising surface disturbance.

As noted by the International Gas Union (IGU), shale gas production requires a much smaller land use footprint than conventional natural gas drilling and other forms of energy production.<sup>35</sup> While pads containing multiple wells are likely to require more land than a pad for a single well, it has been found that this extra land use would more than offset the fewer well pads required overall. A pad containing between four and eight wells is expected to cover less than the size of a standard house block after land rehabilitation. In a development where multiple pads were required to commercialise a field, these pads would be placed between one and four kilometres apart.

As noted by ACOLA, "overall, there clearly is a smaller total area of land disturbance associated with horizontal wells for shale gas development than that for vertical wells."<sup>36</sup> These levels of land disturbance are also expected to be lower than those associated with agriculture or urban development.<sup>37</sup> Strategic planning for coexistence of industries should seek to take into account the impact of all activities and how they can minimise their total land disturbance.

After a well is established and a project moves from exploration to production, most of the land is rehabilitated around each well pad 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 typically be spaced between one and three kilometres apart across a production area. The number of wells and well pads will depend on the nature of the reservoir rocks identified by exploration programs and production history of the wells.

Planning for multiple land uses to ensure coexistence of potential shale gas activities with existing activities will be very important to industry and landowners. It will also be an important way of ensuring that the maximum benefit is obtained from potential developments, with surface infrastructure in remote locations such as the Canning Basin potentially also serving to assist with unlocking these regions.

In this regard, implementation of the Standing Council on Energy and Resources Multiple Land Use Framework, discussed further at Attachment 2, should be pursued across government to deliver shared benefits to all stakeholders. This Framework should be integrated into planning documents such as the State Planning Strategy and any strategic frameworks relating to the development of an onshore gas industry in Western Australia.

---

<sup>35</sup> 'Shale Gas: The Facts About Environmental Concerns', International Gas Union (IGU) (2012), [http://www.igu.org/gas-knowhow/publications/igu-publications/UG20120064\\_IGU\\_ShaleBooklet\\_Final\\_forWeb1.pdf](http://www.igu.org/gas-knowhow/publications/igu-publications/UG20120064_IGU_ShaleBooklet_Final_forWeb1.pdf), [Accessed 17/09/13].

<sup>36</sup> ACOLA P. 103

<sup>37</sup> ACOLA P. 104



## USING LOW IMPACT CHEMICALS AND DISCLOSING AS MUCH AS POSSIBLE

This section relates to Terms of Reference 1.1(b).

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, which are added at very low concentrations and controlled by the cement and steel well casing. A typical fracture treatment will use three to 12 additive chemicals, depending on the characteristics of the water and the formation being fractured.

Figure 9. Typical proppant used in hydraulic fracturing



Source: Todd Energy<sup>38</sup>

Each chemical serves a specific engineering purpose<sup>39</sup> and ensures the operation is carried out safely and the long term integrity of the well is assured.<sup>40</sup> These chemicals are found in familiar household products including ice cream, vinegar, table salt, cosmetics and antiseptics.

The industry strongly supports transparent practices and companies publish details of their activities and environmental protection methods. Since the introduction of the State's *Petroleum and Geothermal Energy Resources (Environment) Regulations 2011*, APPEA and its members have incorporated the new requirements into operations and demonstrated a shared commitment to transparency and best practice operating standards and regulation.

The outcome of this process has been a decision by the WA Department of Mines and Petroleum (DMP) to use a systems-based method for chemical disclosure and an environmental risk assessment approach to assess product and chemical use on a case-by-case basis using the chemicals disclosure information and guidelines. APPEA believes this approach, when combined with environmental risk assessments, will allow the safe use of the chemicals needed in Western Australia.

Development of a regulatory disclosure protocol to enable the use of leading practice and environmentally benign chemicals in hydraulic fracturing should be pursued. This would enable the newest technologies to be used in Western Australia without intellectual property concerns resulting from public disclosure.

---

<sup>38</sup> Todd Energy, P. 36

<sup>39</sup> Including to reduce friction, remove bacteria and algae and prevent the formation and build-up of scale

<sup>40</sup> IGU P. 30



## MINIMISING WATER USE AND RECYCLING WHERE POSSIBLE

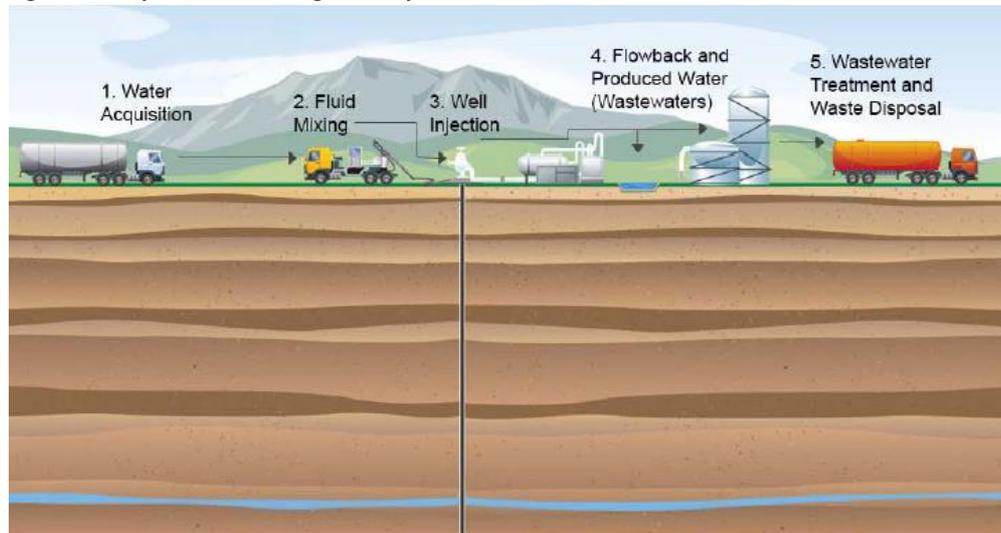
This section relates to Terms of Reference 1.1(c).

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>41</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 of water – equivalent to four Olympic swimming pools – is required to fracture a well.<sup>42</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>43</sup> In Western Australia, the annual expected water requirement of a typical tight gas development is equivalent to the annual irrigation needs of about seven hectares of carrots or 38 hectares of olive trees.

**Figure 10.– Hydraulic fracturing water cycle**



Source: Todd Energy<sup>44</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

<sup>41</sup> ACOLA P. 113

<sup>42</sup> IGU P. 28

<sup>43</sup> ACOLA P. 113

<sup>44</sup> Todd Energy P. 89



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>45</sup>

About a third 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 and water treatment technologies become more readily available.

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 or contaminate 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>46</sup> These activities are strictly regulated by DMP and companies are required to address the management of water at the surface and disposal in an Environment Plan.

In maximising the sustainability of operations, the industry constantly evaluates the ability for water used in operations to be recycled or reinjected into reservoirs. Reinjection involves pumping the water deep underground into approved aquifers, provided it does not degrade the quality of the groundwater.

A better understanding of the environment, particularly in relation to water resources, is required in many areas and the commitment of the State Government to develop an environmental database will be very useful in consolidating and communicating this information.

## REHABILITATION OF LAND IMPACTED BY PETROLEUM ACTIVITIES

This section relates to Terms of Reference 1.1(d).

All sites impacted by operations are rehabilitated as close to their original condition as possible. As per the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2011*, companies are required to identify in their approved Environment Plan how land will be rehabilitated after the conclusion of all relevant activities. Companies are also required to report the progress of rehabilitation efforts to DMP on a regular basis.

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>47</sup> The abandonment process is subject to strict conditions and a company's process is reviewed and approved by DMP.

---

<sup>45</sup> IGU P. 28

<sup>46</sup> ACOLA, P. 129.

<sup>47</sup> ACOLA, P. 128.



## EARLY, OPEN AND MEANINGFUL COMMUNICATION

Trust is central to building community confidence and the industry invests significant time and effort in engaging with communities and key stakeholders.<sup>48</sup> The industry also recognises that it is important for the public to be informed by credible third party sources and the industry has worked successfully with CSIRO (and DMP) to deliver a series of community workshops in the Mid West.<sup>49</sup>

APPEA and its members work closely with key stakeholders (affected landholders, Traditional Owners, shires, government representatives and other interest groups) in the area of operations to ensure they are provided with all relevant information in relation to activities. Companies are required to work with landowners prior to the commencement of activities to agree compensation for loss of income, disturbance and distraction. Further examples of how companies work with landholders is available in APPEA's Code of Practice for Hydraulic Fracturing.<sup>50</sup>

### ***Working with regional communities and the agriculture and pastoral sectors***

APPEA is working with peak farming and pastoral industry bodies and directly with regional communities to address some of the concerns about development of natural gas production on private land including concerns about water management and farmers' and pastoralists' rights.

The petroleum sector recognises that good communication and trust-building is necessary to underpin successful coexistence of the two industries in the future. On this basis, APPEA is working with WAFarmers and the WA Pastoralists and Graziers Association to establish a shared understanding of how science and cooperation can help in resolving technical issues and concerns about petroleum exploration activities.

These discussions have primarily focussed on the areas where activity is proposed or underway including the Canning Basin, the north Perth Basin and the Carnarvon Basin. The Mid West exploration areas include established farmland where some property owners have raised concerns about the implications of the industry's future development. The Carnarvon Basin includes some irrigated horticultural land about 30 kilometres from an exploration zone and the Canning and Carnarvon Basins include some pastoral stations.

The key concerns raised by farmers with APPEA include:

- Groundwater protection and competition for water use;
- Impact of petroleum exploration on pre-existing activities;
- Land access, compensation arrangements and farmers rights; and

---

<sup>48</sup> ACOLA, P. 26.

<sup>49</sup> For further information see the CSIRO report from this process. Taylor, B, Stone, P, 'Dongara Mid-West onshore gas community workshop – 24 October 2012', CSIRO Ecosystem Sciences (2012), [http://www.dmp.wa.gov.au/documents/Report\\_Onshore\\_gas\\_workshop.pdf](http://www.dmp.wa.gov.au/documents/Report_Onshore_gas_workshop.pdf) [Accessed 27/09/13].

<sup>50</sup> APPEA Code of Practice.



- Uncertainty about the scale, nature and timing of future industry and regulatory action.

APPEA is in talks with farmers' and graziers' representatives to develop a set of protocols and commitments which would:

- Protect the viability and amenity of farm and pastoral land;
- Ensure that rural property owners and leaseholders are well resourced and represented in negotiations with petroleum companies;
- Protect the environment – particularly water supplies; and
- Maximise the benefits of petroleum developments to local communities.

The process will include a joint workshop to identify the issues and ways to resolve them. The work will set objectives which are based, in part, on examples from other jurisdictions and reflect WA-specific requirements. The workshop is expected to establish a joint working group to prepare a draft agreement. The CSIRO will be involved as a technical advisor to identify the key scientific issues which would need to be addressed in any agreement.

The outcomes of the process are expected to complement recently updated regulations and guidelines for the control and management of the industry's development.

Products to come from this joint industry work could include a code of practice, an information website, a reference booklet and a set of guidelines for communication, negotiations and activities on private and pastoral lease land.

### ***Working with Traditional Owners***

Shale and tight gas exploration companies working with Traditional Owners in Western Australia have made it a priority to engage with Aboriginal communities. As the projects move from exploration to commercial development, Traditional Owners will emerge as key beneficiaries of the onshore petroleum industry.

Two companies with close links to Aboriginal communities are Buru Energy (operating in the Canning Basin) and New Standard Energy (exploring in the Canning and Carnarvon Basins). Both companies are working closely with Traditional Owners to build relationships based on mutual respect and confidence.

One of Buru's first major initiatives was to hand back exploration tenements in the Roebuck Bay area near Broome to the Yawuru Traditional Owners in 2011. The commitment has ensured that the Yawuru People are able to exercise their traditional roles as the custodians of Roebuck Bay without intrusion from oil and gas exploration. In relinquishing the tenements, Executive Director Eric Streitberg said the company's relationship with the community was founded on a respect for traditional country, culture and values.

Since then, Buru has developed a comprehensive program involving:

- Potential Indigenous training;
- Commitments to operations training and employment - if the projects go ahead on a commercial basis;
- Cross cultural training;
- Heritage protection;



- Support for independent expert advice; and

New Standard Energy has adopted an inclusive approach to its program from the start of its exploration programs. Traditional Owners have been extensively consulted prior to any operational activities (from seismic to civil works to drilling) and the company values their input.

The input isn't confined to mandated consultation periods, but is part of an ongoing two-way flow of information.

All of New Standard's exploration permits are covered by native title and the company is committed to protecting sites of cultural significance, while providing opportunities for Traditional Owners in return for access to their traditional lands. From the cultural awareness programs the company has implemented to its ethos of fairness and respect, New Standard is working to achieve mutually beneficial relationships with Traditional Owners.

## THE IMPORTANCE OF A FACT-BASED DISCUSSION

It is APPEA's view that the strength of regulatory approaches and the industry's ongoing commitment to continuous improvement 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>51</sup> seeking to spread misinformation rather than engage in a constructive dialogue. In this regard, Attachment 4 provides details of 'Frequently Asked Questions' and responses that APPEA previously distributed to State Members of Parliament to clarify a number of inaccurate statements made by the Conservation Council of Western Australia.

However, it is noted that APPEA has also had positive engagement with conservation groups in other jurisdictions where there is an appetite to discuss the issues and how activities can be better managed.

APPEA strongly believes that trust is critical to building community confidence and where there are legitimate landowner concerns they must be addressed by the industry. Industry should at all times be transparent, open and undertake early engagement with stakeholders.

Where possible within the broader debate, the industry continues to rely on peer-review science-based information.

### ***Case Study: Informing the Discussion with Independent Third Parties***

APPEA, DMP and CSIRO have jointly developed an initiative to provide information and advice on shale and tight gas production to community groups in Western Australia. The initiative is helping to provide an objective and effective basis for consultation during the planning and development of a natural gas industry based on shale and tight rock formations in Western Australia. The key objectives of the initiative are to

---

<sup>51</sup> Potter, B, "Demand to sort out 'ideological crusaders'", *Australian Financial Review*, 9 September 2013.



- Provide a source of credible, objective and expert information to the community;
- Facilitate and inform engagement with stakeholders and the community; and
- Address some of the misinformation surrounding the onshore gas industry

APPEA has been working with the WA State Government, particularly the DMP, on some of the key aspects of the partnership development.

The need for quality independent advice became evident during a series of community meetings and information workshops during 2012. Local residents had trouble reconciling the conflicting information from industry and anti- gas campaigners. A number of community leaders asked the CSIRO to become involved to provide trusted information.

On this basis, CSIRO participated in community meetings and contributed to the design of a community workshop. CSIRO observers prepared a report on the proceedings. Some of the key recommendations were

- Introduction of engagement processes for a diverse range of stakeholders
- Provision of information from independent and trusted sources
- Appropriate engagement for different stages of development
- Better coordination of information flows, and engagement processes
- An enhanced role for local government as an engagement hub.
- Provision of additional information to reflect:
  - local as well as national and international experiences and cases
  - existing and best-practice circumstances
  - the range of future development options, risks and scenarios e.g. identifying the low, mid and high development scenarios for the region as “possible futures”

Some of these initiatives are being implemented, and others will be put in place after further consultation with local community leaders and government agencies. As part of this process, APPEA has started discussions with peak farm bodies to develop protocols for exploration on private land (building on experience in other jurisdictions).

In the Canning Basin, the key players are reviewing the options for engagement with Traditional Owners and community groups. State Government and APPEA participated in some meetings with TOs involving a world expert on shale gas, Professor Peter Styles earlier this year to inform development of a suitable engagement model. The exploration companies are liaising with indigenous leaders on the most appropriate consultation strategies.

In the Northern Territory, CSIRO participated in June in an initial stakeholder meeting involving the NT Cattlemen’s Association. APPEA is working with the NT Government and CSIRO in relation to further public meetings. .

The purpose of these meetings is to discuss:

- Provision of expert advice to community groups on initiatives such as planned round table discussions with farmers
- Design of effective community engagement processes in the Kimberley communities
- A technical information audit and gap analysis – looking at scientific data applicable to



shale and tight gas development in WA, NT and South Australia

- Access to independent on-line information
- Participation in community reference groups

The costs of the present activities are shared equally between APPEA, DMP and CSIRO. APPEA is currently preparing a funding plan for member companies, government agencies and CSIRO.

## CONTINUOUS IMPROVEMENT

The industry is constantly seeking ways to improve its performance, including through innovation in technology and adapting techniques that further improve the sustainability of activities. Codes of practice are used to unite and demonstrate the industry's commitment to environmental and social sustainability. Australian and international studies inform and improve the way the industry does business and protects the environment.

The industry recognises that setting and adhering to high operating standards in relation to onshore natural gas operations is essential in maintaining and building a reputation which ensures that the industry is a welcome part of the Australian economy and communities.

This is particularly challenging with the wide variety of regulatory regimes and industry participants across Australia. Community and media attention has also made the challenges quite public and widely debated across a broad range of stakeholders.

Industry has therefore agreed to develop and promote leading Operating Principles and Practices. These will be used to:

- Set an appropriate expectation of leading practices;
- Encourage a consistency in approach across the industry;
- Provide a basis for harmonised, or at least consistent, laws and regulations across the jurisdictions; and
- Promote the responsible and sustainable practices of the industry with stakeholders.

The Australian Council of Learned Academies Report, 'Engineering Energy: Unconventional Gas Production', is referred to throughout this submission and should play a larger role in the discussion in Australia. Released in May 2013, APPEA views this document as the most comprehensive study of the industry and its potential impacts in Australia and would commend the document to the Environment and Public Affairs Committee.



## THE DELIVERY OF ROBUST AND EFFICIENT REGULATION

Effective regulation is an important means of providing the public with confidence that activities are assessed and approved to standards of sufficient rigour that they mitigate risk. Industry is confident that robust regulation already exists in Western Australia and will continue to work with government to evolve the regulatory framework as required.

Continuous improvement and the maintenance of an objective-based regulatory framework will be important to address environmental impacts – a key requirement that government and industry must continue to meet in order for the benefits of shale and tight gas to be accessed.

## REGULATING EXPLORATION-STAGED ACTIVITIES

All petroleum activities in Western Australia, and waters and islands within three nautical miles, are specifically regulated through the *Petroleum and Geothermal Energy Resources Act 1967 (PGERA)*, overseen by DMP. This legislation has been tried and tested in Western Australia and has successfully managed petroleum activities for decades, including the use of hydraulic fracturing.

This legislative framework is supported by subsequent regulations which specifically address in detail issues such as the construction and maintenance of petroleum wells and the environmental impact of petroleum activities. The industry can also be subject to safety, health and water legislation.<sup>52</sup> This framework has recently been through a rigorous assessment by an independent expert which found that it is more than sufficient to manage shale and tight gas activities.

### ***Review of Shale and Tight Gas Regulation in Western Australia***

In July 2011, DMP released a review by Dr Tina Hunter (currently based at the University of Queensland) titled '*Regulation of Shale, Coal Seam and Tight Gas Activities in Western Australia*'. The Review considered the state of Western Australia's regulations and their ability to manage the development of tight and shale gas exploration.

While finding the existing regime robust, the Review led to the development and implementation of new environment regulations in 2012 with an increased focus on issues such as management of produced water. Further recommendations to strengthen the regulatory framework relating to management of well operations (including construction and maintenance of wells) are expected to be reflected in a new set of resource management regulations to be released in 2013.

---

<sup>52</sup> Including, amongst others, the Petroleum and Geothermal Energy Resources (Occupational Safety and Health) Regulations 2010, the Health Act 1911 and the Rights in Water and Irrigation Act 1914.



### **Environmental Protection Authority**

Where activities justify a higher level of assessment, they are elevated and assessed through the *Environmental Protection Act 1986 (EP Act)* which is overseen by the Environmental Protection Authority (EPA). In September 2011, the EPA released a Bulletin following the assessment of three hydraulic fracturing proposals and “emerging community interest”.<sup>53</sup> The EPA noted that:

- in deciding whether to assess a proposal the EPA will determine the significance of the environmental impact; and
- DMP is the lead agency for regulating the development of the gas industry.

The EPA identified areas of focus associated with these activities as:

- water use;
- storage and disposal of produced water;
- potential chemical contamination of groundwater and surface waters;
- disruption to aquifer connectivity;
- fugitive greenhouse gas emissions;
- changes to land use and associated infrastructure development; and
- clearing of native vegetation.

The EPA determined that there was no need to assess current small scale ‘proof of concept’ exploration proposals, as they were not likely to have a significant impact on the environment. Importantly, the EPA noted that any potential impacts could be managed through the DMP’s existing processes.

The EPA noted that it will assess future projects on a case-by-case basis and formal assessment will only occur if projects are likely to have a significant effect on the environment (as per the significance test outlined in the EPA’s *Environmental Impact Assessment (EIA) Administrative Procedures 2010*). APPEA has worked with DMP to consider the stage at which a project might be referred to the EPA and the characteristics of a project that will require formal assessment under the *EP Act*.

The history of the industry and the reviews of the regulatory framework’s ability to manage shale and tight gas activities clearly indicates that risks are effectively managed and mitigated.

### REGULATING ACTIVITIES AS THEY ADVANCE

APPEA has been working with DMP to clarify the stage at which projects might progress past a ‘proof of concept’ stage and require further consideration by the EPA. This work supplements the independent expert reviews of regulation referenced throughout this submission that have been conducted within Western Australia and Australia.

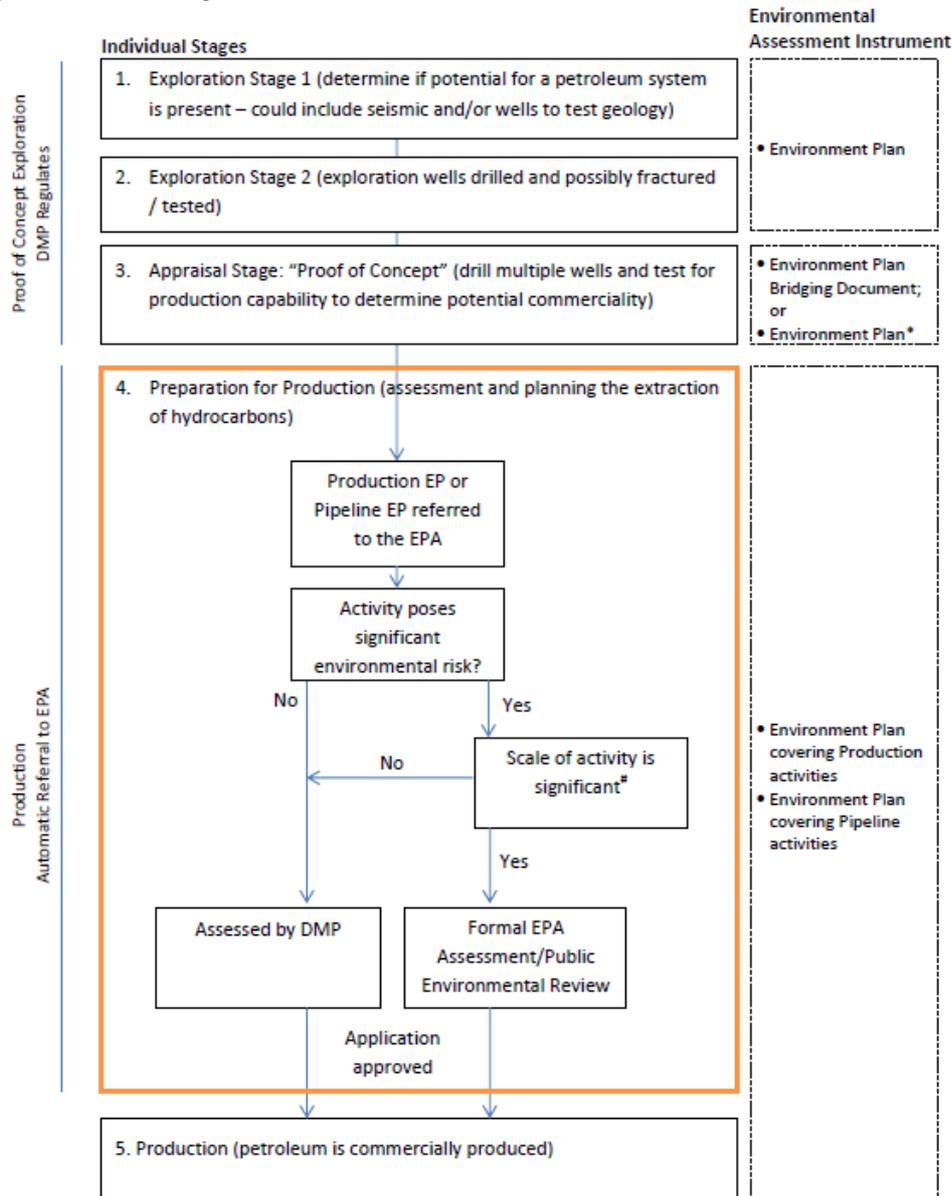
---

<sup>53</sup> ‘Environmental Protection Bulletin No. 15: Hydraulic fracturing of gas reserves’, Environmental Protection Authority (2011), <http://www.epa.wa.gov.au/EPADocLib/EPB%2015%20Fracking%20050911.pdf>, [Accessed 17/09/13]



As per the diagram below, industry believes that commercial production is an appropriate trigger for these higher level assessments.

Figure 11. Shale and Tight Gas Assessment and Referral Process



**Notes:**

# Advice from DMP is that the scale of projects, including whether they are significant, can only be determined by the EPA after it has become familiar with assessing onshore projects.

\* A new Environment Plan may be required if activities, such as extended well testing, have not been described sufficiently in the original EP

Source: APPEA

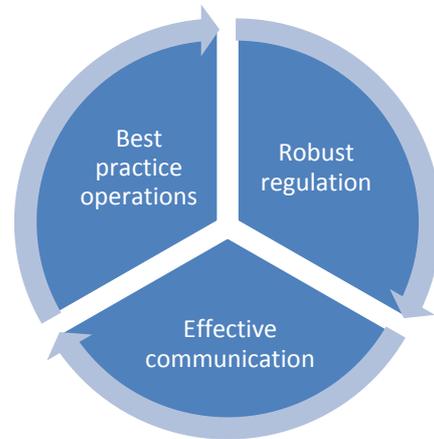


## ADVANCING THE INDUSTRY

This submission has discussed the three ingredients that industry believes are required for community confidence in the industry to be achieved – best practice from operators, robust regulation and effective communication.

The industry has enormous potential to be an economically important additional energy source which significantly reduces Australia's greenhouse gas emissions.

ACOLA notes that development would require great skill, persistence, capital and careful management of any impact on ecosystems and related natural resources. It will also need an informed and supportive community, transparent and effective regulations and companion codes of practice.



### **Case Study: IEA Golden Rules for a Golden Age of Gas**

In 2012 the International Energy Agency released a set of 'Golden Rules' to guide government and industry in relation to shale gas extraction. These rules were established to manage the social and environmental concerns that have emerged alongside the industry. In particular, the IEA noted:

*The technologies and know-how exist for unconventional gas to be produced in a way that satisfactorily meets these challenges, but a continuous drive from governments and industry to improve performance is required if public confidence is to be maintained or earned.<sup>54</sup>*

The full detail of the Golden Rules can be accessed through the IEA website, but points of note include:

- Measure, disclose and engage: Engage with stakeholders (local communities and residents etc.), establish baseline data for key environmental indicators, gather and disclose baseline data on water use and minimise disruptions during operations.
- Watch where you drill: Choose well sites that minimise impacts (including on local community and heritage etc.), properly survey sites (including for seismicity) and monitor to ensure propagation of fractures does not leave the target reservoir.
- Isolate wells and prevent leaks: Establish robust rules to ensure well integrity (e.g. proper cementing and integrity testing), consider minimum depth limitations on hydraulic fracturing, take action to prevent and contain surface spills and leaks from wells and

<sup>54</sup> IEA Golden Rules



ensure any waste fluids and solids are disposed properly.

- Treat water responsibly: Reduce freshwater use, store and dispose of produced and waste water safely, and minimise use of chemical additives and promote the use of environmentally benign alternatives.
- Be ready to think big: seek opportunities for realising economies of scale and coordinated development of local infrastructure that can reduce environmental impacts. Take into account the cumulative and regional impacts of multiple drilling, production and delivery activities.
- Ensure a consistently high level of environmental performance: ensure the level of activity is matched by resources and political backing for robust regulatory regimes, sufficient permitting and compliance staff, and reliable public information. Balance prescriptive and objective based regulation, pursue continuous improvement of regulation and operating practices and recognise the case for independent evaluation and verification of environmental performance.

APPEA views these rules as important considerations for industry and government in building community confidence.

The industry in WA is currently at a very early stage with small companies at the forefront of exploration efforts. However, the development of the industry in Western Australia will have a strong foundation as a result of:

- The petroleum sector's ability to bring to bear decades of experience;
- The State's tried and tested regulation having been assessed and endorsed for its ability to manage current shale and tight gas activities; and
- Significant efforts by government and industry to engage with communities, including through initiatives with independent third party groups such as CSIRO.

Strategic planning will be an important way of combining the State's advantages to capitalise on the industry's potential. The Committee has an opportunity to use the Inquiry to facilitate the delivery of fact-based information to the public so that the community can have a constructive conversation about the future of the industry.

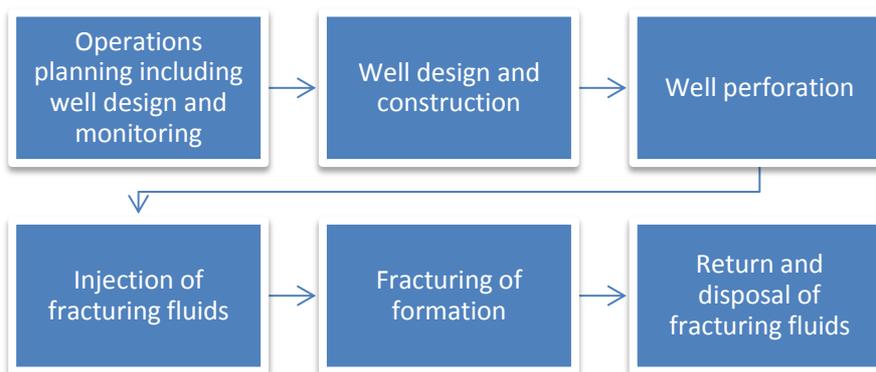
However, even building from this base, the industry's success is not guaranteed. Cost pressures for natural gas projects in Australia are very high and there are a number of projects worldwide, and within Australia, that are seeking to export into the global gas market. In this environment of high costs and competition, the continuation of Australia's resources boom and energy supply cannot be taken for granted. Successful development of a shale and tight gas industry will rely on targeted, coordinated and transparent regulation. For example, monitoring of water supplies needs to have an environmental benefit – the risk of contamination is highest at the surface and expensive monitoring of deep water saline aquifers does not represent the best allocation of resources to protect the environment.

While there are challenges ahead, the considered pace and manner in which the industry is approaching exploration and potentially development provides sufficient time to face these challenges head on.

## 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.

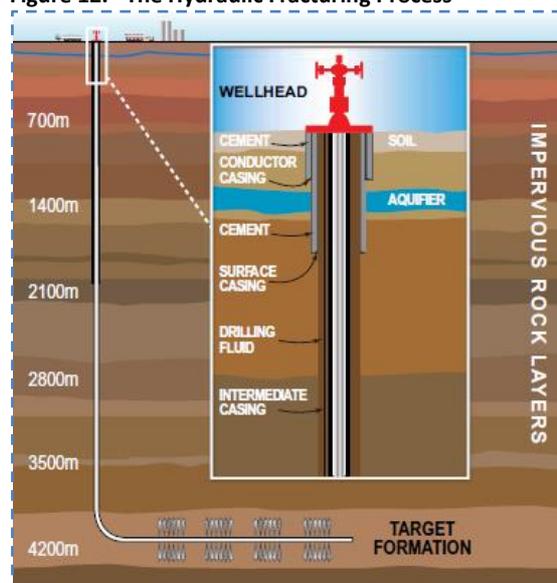
The hydraulic fracturing process is outlined below:



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 12.– The Hydraulic Fracturing Process

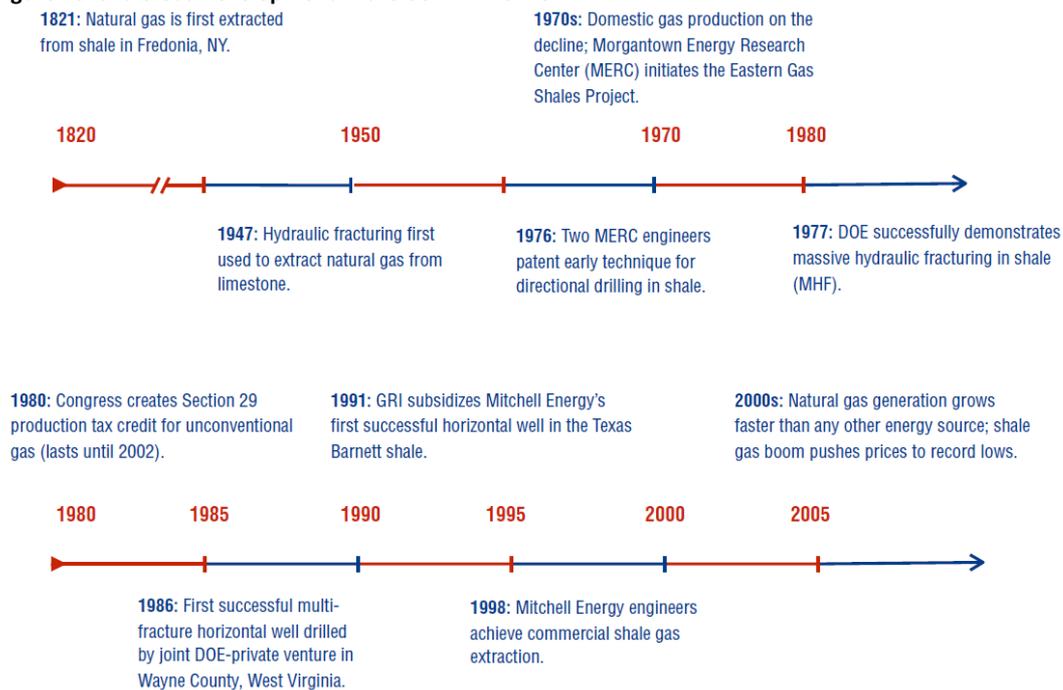


Source: International Gas Union



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 14, 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>55</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 13. Shale Gas Development in the US: A Timeline**



DOE = US Department of Energy; GRI = Gas Research Institute  
Source: Breakthrough Institute<sup>56</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

<sup>55</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>56</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].



alone.<sup>57</sup> In 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 14. The first commercial fracture treatments by Halliburton**



Source: Society of Petroleum Engineers<sup>58</sup>

---

<sup>57</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].

<sup>58</sup> *Ibid.*

## ATTACHMENT 2 – MULTIPLE LAND USE FRAMEWORK

APPEA supports and has engaged with the process by the Standing Council on Energy and Resources (SCER) to develop the Multiple Land Use Framework (MLUF). Achievement of the below outcomes would provide clear shared benefit for all stakeholders in the development of onshore gas industry:

- Shared commitment by government, industry and the community to multiple and sequential land use - Minimise incidences of land use conflict by improved ability to recognise differing needs and benefits to all stakeholders early, and acting upon this through a risk - based approach to mitigate adverse impacts and realise mutual benefits.
- Better informed public discourse - Increased transparency and consistency in land use decisions, provision of easy access for the public to relevant and factual information, improved understanding of land access regulations relevant to each activity, as well as recognising benefits of coexistence and collaboration through multiple land use approaches.
- Merit based land use decisions - Ensure land is not arbitrarily excluded from other uses without fully understanding the consequences. Providing certainty for industry and improved community confidence in land use decisions.
- Deliver acceptable outcomes for affected communities and landholders - Demonstrate and facilitate that multiple and sequential land use approaches can be accommodated in a manner that is beneficial to all stakeholders and engender greater confidence in, and positive engagement by, communities and land holders impacted by industry developments

### **ATTACHMENT 3 – CODE OF PRACTICE FOR HYDRAULIC FRACTURING**

At the end of 2011, APPEA and its onshore gas members released a Code of Practice for Hydraulic Fracturing to demonstrate what the gas industry is doing to successfully and responsibly develop significant onshore gas reservoirs in Western Australia.

The Code was developed by a working group of industry operators based on established operating principles and leading practices in other jurisdictions that are relevant to local conditions. The document can be viewed in full at [www.wa-onshoregas.info](http://www.wa-onshoregas.info) and includes a number of points relevant to the Inquiry, in particular:

- Guideline 1 – Community, landholder and stakeholder interaction. The aim of this guideline is to ensure operators communicate openly and as early as practicable with landholders, local communities and other stakeholders. This communication includes explaining how risks are being managed to minimise any potential unwanted or adverse impacts.
- Guideline 3 – Sourcing and use of water. The aim of this guideline is to protect and, where required, effectively and responsibly use groundwater resources. For example, all water used in hydraulic fracturing operations will be captured and reused where possible and a company needs to demonstrate that the taking of water will not have unacceptable impacts on aquifers.
- Guideline 4 – Use of chemicals in hydraulic fracturing. The aim of this guideline is to minimise the use of chemicals in hydraulic fracturing operations, provide clear and accurate information on any chemicals that may be used, and promote the safe and responsible use of chemicals. This includes by supporting the public release of information and using chemicals with the lowest toxicity to facilitate operations.
- Guideline 5 – Fluid flowback and produced fluids containment. The aim of this guideline is to ensure that post-fracture stimulation clean-up flowback or produced fluids cannot come into contact with Production Aquifers or pollute soil or soil substrate. This includes sealed storage and recycling where possible of all recovered hydraulic fracturing fluids.
- Guideline 7 – Continuous improvement. The aim of this guideline is to ensure continuous performance improvement and the sharing of information with regulators and other stakeholders to reduce potential risks of hydraulic fracturing.

## **ATTACHMENT 4 – LETTER CIRCULATED TO MEMBERS OF PARLIAMENT, ‘APPEA’s position on concerns raised by CCWA’**

### ***An Approach Based on Facts & Science, Not Fiction or Fear***

Shale and tight gas is natural gas – the fuel Western Australians have been using in homes and businesses for more than a generation. It’s clean and efficient, producing about half the greenhouse gas of coal in generating electricity.<sup>59</sup> The development of gas resources located offshore Western Australia has been overwhelmingly positive for the State. The further development of natural gas from shale and tight rocks in the Mid West and Canning Basin could be equally important in generating jobs, building infrastructure, providing income and energy security. The industry supports high operational and regulatory standards based on science, transparency, stakeholder involvement, predictability and consistency.

### ***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>60</sup> The International Energy Agency estimates that natural gas will account for 20 per cent of world total primary energy supply by 2035.<sup>61</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>62</sup>

### ***What is Happening in Western Australia?***

There is no significant shale or tight gas production in Western Australia at present. Most of the State’s existing supplies of natural gas come from offshore reserves. However, the State has extensive exploration areas showing potential for shale and tight gas production.

---

<sup>59</sup> US Environmental Protection Agency, ‘Natural Gas’, <http://www.epa.gov/cleanenergy/energy-and-you/affect/natural-gas.html>.

<sup>60</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>61</sup> IEA, <http://www.iea.org/publications/freepublications/publication/kwes.pdf>

<sup>62</sup> US Energy Information Administration, ‘International Energy Outlook 2011’, <http://www.eia.gov/forecasts/ieo/>

The most advanced exploration projects are in the Canning Basin in the State's North West and the North Perth basin around the Mid West region. Most of the exploration projects are in the early or proof-of-concept stages. Exploration is governed by a tested framework of regulation and operating practices which focus on reducing risks to the environment, ensuring safe operations and supporting open and transparent engagement with local residents.

If commercial development goes ahead, the gas would be used initially for domestic markets, delivering secure long term supplies of gas at competitive prices for homes and industry. The industry has the potential to underpin a new phase of Western Australia's strong economic performance and promote economic and social development in regional areas.

### ***What are the Facts About the Environmental Concerns?***

#### The process of hydraulic fracturing

The process of hydraulic fracturing – pumping fluid into deep geological zones to release the gas into production wells – is one feature of tight and shale gas production. It has been used in the oil and gas industry in WA since the 1950s with some 780 petroleum wells drilled and fractured with no adverse effects on the environment, water sources or public health according to the WA Department of Mines & Petroleum. It is a tightly controlled and highly regulated process.<sup>63</sup>

The regulations covering the industry are stringent and comprehensive. An explanation of the process can be found on the websites of the Department of Mines and Petroleum and APPEA.<sup>64</sup>

#### Protection of groundwater

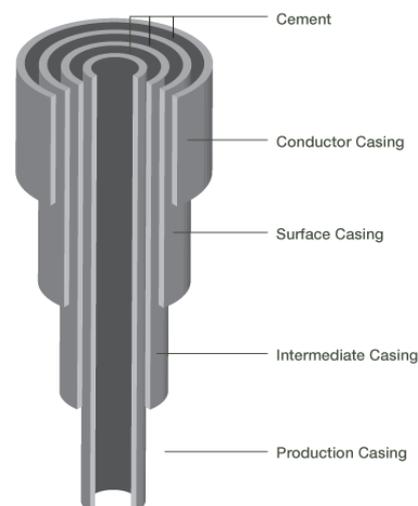
The industry recognises the conservation and protection of ground water is a top priority. Key factors which protect groundwater during natural gas production are:

- 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.

An August 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 0.03

Typical Well Casing Diagram  
(Not to Scale)



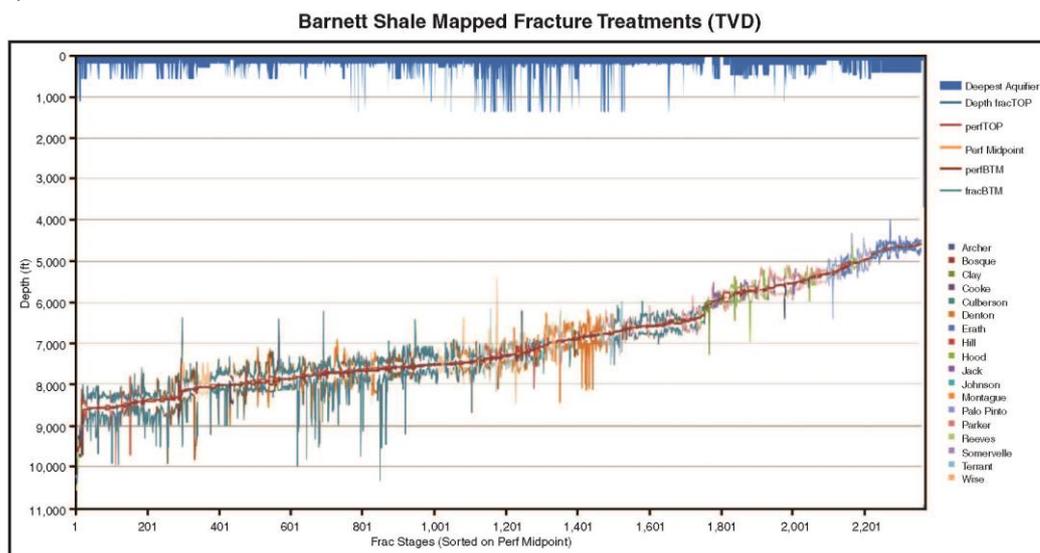
<sup>63</sup> More detail is available at [http://www.youtube.com/watch?feature=player\\_embedded&v=BEH4M7EuIsU](http://www.youtube.com/watch?feature=player_embedded&v=BEH4M7EuIsU)

<sup>64</sup> DMP: <http://www.dmp.wa.gov.au/15136.aspx> ; APPEA: <http://wa-onshoregas.info>

per cent had failures of casing or cement. Most of those incidents (more than 80 percent) occurred in the 1980s and 1990s before modern technology and regulations. A similar study of 187,000 wells in Texas found that 21 incidents (0.01 per cent) related to well integrity.

- The depth of the gas-bearing rock

Shale and tight gas resources are typically between two and four kilometres below the ground, separated from near-surface freshwater aquifers by a least a kilometre of impermeable 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 in WA. 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 following chart shows the depth of the process, the maximum extent of the induced fractures and the relation to the 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

The hydraulic fracturing process uses about 11 million litres water – equivalent to the contents of four Olympic swimming pools. Ongoing production involves a minimal water use – much less than most horticultural properties.

- Surface water management

Once the well begins to produce natural gas, about a third 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 if a WA. They have also used photographs of gas fields in the US which are very different in design and scale to the projects which might be developed in WA.

A WA shale and tight gas development 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 three 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, will be far less than the unfounded claims being made.

### ***The Gaslands Myth***

Gaslands, 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>65</sup> The household bore had intersected a natural 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>66</sup>

### ***Calls for a Moratorium***

WA Parliament has previously rejected requests for a moratorium on shale and tight gas exploration.

A halt to exploration would be counter-productive and unnecessary given the regulatory assessment and guidance offered by the Department of Mines & Petroleum 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 the State's shale and tight gas resources are developed in an environmentally responsible manner.

### ***A Partnership Approach***

APPEA has partnered with the State Government and CSIRO to provide public meetings and workshops in regional communities intended to provide access to information people can trust and to create a dialogue with regulators and exploration companies. The Western Australian industry believes that this partnership represents a proactive, innovative and responsible approach for delivering local background information to support national and international scientific studies.

---

<sup>65</sup> State of Colorado Oil & Gas Conservation Commission, <http://cogcc.state.co.us/library/GASLAND%20DOC.pdf>

<sup>66</sup> Energy in Depth, 'GasLand Debunked', <http://www.energyindepth.org/wp-content/uploads/2011/11/Debunking-Gasland.pdf>

## BIBLIOGRAPHY

Cook, P, Beck, V, Brereton, D, Clark, R, Fisher, B, Kentish, S, Toomey, J and Williams, J (2013). *'Engineering Energy: Unconventional Gas Production.'* Australian Council of Learned Academies (ACOLA), [www.acola.org.au](http://www.acola.org.au).

*'Golden Rules for a Golden Age of Gas'*, International Energy Agency (2012), [www.iea.org](http://www.iea.org)

*'EIA projects world energy consumption will increase 56% by 2040'*, US Energy Information Administration, (2013) <http://www.eia.gov/todayinenergy/detail.cfm?id=12251> [Accessed 17/09/13].

*'Energy in Australia 2012'*, Bureau of Resources and Energy Economics (2012), <http://www.bree.gov.au/documents/publications/energy-in-aust/energy-in-australia-2012.pdf> [Accessed 17/09/13];

WA Office of Energy, *'Strategic Energy Initiative Directions Paper'*, [http://www.finance.wa.gov.au/cms/uploadedFiles/Public\\_Uilities\\_Office/WAs\\_Energy\\_Future/Strategic+Energy+Initiative+Directions+Paper\\_web.pdf](http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Uilities_Office/WAs_Energy_Future/Strategic+Energy+Initiative+Directions+Paper_web.pdf) (2011), [Accessed 17/09/13].

*'Energy White Paper 2012'*, Department of Resources, Energy and Tourism (2012), [http://www.ret.gov.au/energy/Documents/ewp/2012/Energy\\_20White\\_Paper\\_2012.pdf](http://www.ret.gov.au/energy/Documents/ewp/2012/Energy_20White_Paper_2012.pdf), P. 160 [Accessed 17/09/13].

*'Gas Statement of Opportunities'*, Independent Market Operator (2013), <http://www.imowa.com.au/GSOO> [Accessed 17/09/13].

*'Strategic Energy Initiative: Energy 2031'*, Public Utilities Office (2012), [http://www.finance.wa.gov.au/cms/uploadedFiles/Public\\_Uilities\\_Office/WAs\\_Energy\\_Future/Strategic\\_Energy\\_Initiative\\_Energy2031\\_Final\\_Paper.pdf](http://www.finance.wa.gov.au/cms/uploadedFiles/Public_Uilities_Office/WAs_Energy_Future/Strategic_Energy_Initiative_Energy2031_Final_Paper.pdf) [Accessed 17/09/13].

*'Hydraulic Fracturing: Submission to the Parliamentary Commissioner for the Environment'*, Todd Energy (2012), <http://www.toddcorporation.com/system/files/FINAL%20HF%20SUBMISSION.pdf>, [Accessed 17/09/13], P. 35.

*'Technically recoverable shale oil and shale gas resources'*, US Energy Information Administration (2013), <http://www.eia.gov/analysis/studies/worldshalegas/> [Accessed 17/09/13].

*'EIA/ARI World Shale Gas and Shale Oil Resource Assessment'*, US Energy Information Administration (2013), [http://www.eia.gov/analysis/studies/worldshalegas/pdf/chaptersi\\_iii.pdf?zscb=395186](http://www.eia.gov/analysis/studies/worldshalegas/pdf/chaptersi_iii.pdf?zscb=395186), [Accessed 17/09/13], P. III-4.

*'Natural Gas from Shale and Tight Rocks Fact Sheet'*, Department of Mines and Petroleum (2013), [http://www.dmp.wa.gov.au/documents/Shale\\_and\\_tight\\_gas\\_and\\_WA\\_future\\_energy\\_security.pdf](http://www.dmp.wa.gov.au/documents/Shale_and_tight_gas_and_WA_future_energy_security.pdf) [Accessed 17/09/13].

*'America's New Energy Future – The Unconventional Oil and Gas Revolution and the US Economy'*, IHS Global Insight (2013), <http://www.ihs.com/info/ecc/a/americas-new-energy-future-report-vol-2.aspx>, [Accessed 17/09/13]

*'U.S. Unconventional Oil and Gas Revolution to Increase Disposable Income by more than \$2,700 per Household and Boost U.S. Trade Position by More than \$164 billion in 2020'*, IHS (2013), <http://press.ihs.com/press-release/economics/us-unconventional-oil-and-gas-revolution-increase-disposable-income-more-270>, [Accessed 17/09/13].

Duffy, A, 'Booming coal and coal seam gas industry creating thousands of jobs', Australian Mining, <http://www.miningaustralia.com.au/news/booming-coal-and-coal-seam-gas-industry-creating-t> (2012), [Accessed 17/09/13].

'The wider contribution to Australia of the Oil and Gas Industry', Australian Venture Consultants (2012), P. 15.

'Redrawing the energy-climate map', International Energy Agency (2013), <http://www.worldenergyoutlook.org/media/weowebiste/2013/energyclimatemap/RedrawingEnergyClimateMap.pdf>, [Accessed 17/09/13].

MacKay, D, Stone, T, 'Potential Greenhouse Gas Emissions Associated with Shale Gas Extraction and Use', Department of Energy and Climate Change (2013), [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/237330/MacKay\\_Stone\\_shale\\_study\\_report\\_09092013.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/237330/MacKay_Stone_shale_study_report_09092013.pdf), [Accessed 17/09/13].

'Climate Change and Fracking', Clean Water Health Land (2013), <http://cleanwaterhealthyland.org.au/content/climate-change>, [Accessed 17/09/13].

'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].

Xamon, A, 'Question on Notice No. 4510', Western Australian Parliament (2011), <http://www.parliament.wa.gov.au/parliament/pquest.nsf/a02db76382427ad84825718e0018e9c9/168b5dba6804dbd3482578ee002c46d9?OpenDocument>, [Accessed 17/09/13].

'Durham's Richard Davies speaks at Geological Society Briefing on fracking and hydraulic fractures', Durham University (2012), <https://www.dur.ac.uk/dei/news/?itemno=14865>, [Accessed 17/09/13].

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

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#.UjfgtEqQ-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].

'Shale Gas: The Facts About Environmental Concerns', International Gas Union (IGU) (2012), [http://www.igu.org/gas-knowhow/publications/igu-publications/UG20120064\\_IGU\\_ShaleBooklet\\_Final\\_forWeb1.pdf](http://www.igu.org/gas-knowhow/publications/igu-publications/UG20120064_IGU_ShaleBooklet_Final_forWeb1.pdf), [Accessed 17/09/13].

'Science Omega: Backing for Fracking', Cuadrilla Resources (2013), <http://www.cuadrillaresources.com/news/industry-news/article/science-omega-backing-for-fracking-an-article-from-professor-peter-styles/> [Accessed 17/09/13].

Potter, B, "Demand to sort out `ideological crusaders'", *Australian Financial Review*, 9 September 2013.

'Environmental Protection Bulletin No. 15: Hydraulic fracturing of gas reserves', Environmental Protection Authority (2011), <http://www.epa.wa.gov.au/EPADocLib/EPB%2015%20Fracking%20050911.pdf>, [Accessed 17/09/13]

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].

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].

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].

Vidic, R, Brantley, S, Vandenbossche, J, Yoxheimer, D, Abad, J, 'Impact of shale gas development on regional water quality', Science (2013), <https://n-1.cc/file/download/1708283> [Accessed 27/09/13].

'Statoil strengthens US shale gas position', Statoil (2010), <http://www.statoil.com/en/newsandmedia/news/2010/pages/26marmarcellus.aspx> [Accessed 27/09/13]

Taylor, B, Stone, P, 'Dongara Mid-West onshore gas community workshop – 24 October 2012', CSIRO Ecosystem Sciences (2012), [http://www.dmp.wa.gov.au/documents/Report\\_Onshore\\_gas\\_workshop.pdf](http://www.dmp.wa.gov.au/documents/Report_Onshore_gas_workshop.pdf) [Accessed 27/09/13].