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Chair's foreword

On behalf of the Environment and Planning Committee, I present the Final Report on the Inquiry into onshore unconventional gas in Victoria.

This Inquiry likely received more submissions than any other Inquiry in recent Victorian Parliamentary history.

The Government, through the Legislative Council, referred this Inquiry to the Committee at the end of May 2015. Over the following six months we amassed a significant amount of evidence from submissions, hearings, site visits, correspondence and Reports. We heard perspectives from farmers and other landholders, environment and community groups, the gas industry, gas market analysts, hydrogeologists, manufacturers, tourism operators, local governments and the general public. We tabled an interim Report in September outlining the work done to that point.

From the evidence presented it appears likely that shale and tight gas is present in the Otway and Gippsland Basins. In part, the moratorium on unconventional gas has prevented exploration which would prove or disprove this. Exploration companies are adamant that the resource is there. Industrial gas users have signed contracts. In relation to coal seam gas, while it has captured the public's attention, it is unlikely to be present in large commercial and extractable quantities in Victoria's brown coal fields.

The Committee also considered the question of whether unconventional gas could be extracted safely – that is, in a manner that does not damage the environment, water resources or human health. Many in the community are alarmed at perceived risks. Of particular concern to many is the scenario of surface water and aquifers becoming contaminated. Farmers are also concerned about competition for scarce water resources and the potential for Victoria's reputation as a 'clean green' producer to be compromised.

However, calls to completely avoid an industry or activity unless it is 100 percent safe are unrealistic. All human activities carry risk – the role of government, working with industry and the community is to design a regulatory framework to manage risk and mitigate it to an acceptable level. Inquiries and investigations in New South Wales, Western Australia and elsewhere have found that the risk is manageable with the right governance. Victoria's current regulatory framework may or may not be suitable, however improvements can certainly be made to the regulatory framework. The Report discusses what work would need to be done to implement this, noting our inability to examine best practice in other jurisdictions with established unconventional gas production activities. We also found that gaps in the scientific knowledge base remain, particularly in regard to water.

An important associated question on which the Committee received considerable evidence was: what contribution might this potential resource make to the supply and cost of gas available to Victorian industry and consumers? Manufacturers who rely on gas as a feedstock need new and lower cost sources to ensure that they can remain competitive. From their standpoint, the uncertainty over the Government's position on unconventional gas is frustrating. Equally, we received evidence of forecasting falling demand for gas in the eastern states gas market and the possibilities for some users to switch to other fuels or implement energy efficiency measures. More broadly, it is also clear that the gas market is highly complex with many players along the production and supply chain. It is pretty clear there will be a price challenge for gas in coming decades.

The Australian Competition and Consumer Commission (ACCC) is currently looking into the competitiveness of wholesale gas prices and the structure of the different segments of the gas industry. It is probable that the resolution of consumer and industry concerns through this ACCC process will be of far more import than any decision on unconventional gas in Victoria, especially noting that such an industry would take years to develop and have any impact on the market.

We received a considerable amount of evidence on the issue of land access. Currently, companies are required to negotiate access agreements and pay compensation where justified. There are many examples of mining companies successfully doing this. The Committee has taken the view that community concern on land access is best solved through a strengthening of the regulations around negotiating land access and compensation, rather than, as suggested by some, giving landholders a right of veto. Allowing landholders a right of veto is incompatible with the long established principle in Australia that the Crown owns the rights to minerals under the soil. To overturn this principle, while perhaps superficially attractive, would not be in the best interests of the Victorian community.

The community will wish to understand the Committee's overall view on the current moratorium on onshore gas. The Report and the Extracts of proceedings show that the Committee considered two positions in relation to this: either extending it for another five years or banning the unconventional gas industry altogether. The Committee was unable to reach a majority decision. However, our Terms of Reference require us to Report back to the House on a whole range of issues and we have done so with 15 agreed recommendations.

There is far more that the Committee could have seen to develop our understanding of this industry. The Committee could have travelled to Queensland, New South Wales and overseas jurisdictions where the industry is not merely theoretical. However, as stated in this Report, it is disappointing that the Government, through the Parliament, chose not to release the necessary funding and resources to allow this to occur and this has meant we were unable to do more than a cursory assessment of regulatory approaches elsewhere.

It is hard to believe the Government was serious about the Inquiry when they conspicuously failed to facilitate the support that was necessary to deliver an authoritative and complete Report.

The Committee sought additional scientific and administrative support, however what was provided in terms of a scientist was too late and too little. Additional administrative support was not forthcoming. Further, departmental precursor submissions have not been provided to the Inquiry, but in the Committee's view should be made public.

In my view, the decision of the Government to effectively block the appearance of the Minister for Energy and Resources, the Hon. Lily D'Ambrosio, at the Inquiry points to their lack of seriousness and lack of genuine support. This was a government-initiated reference after all and there is precedent for the appearance of Lower House Ministers at Upper House inquiries (eg. Minister Tony Robinson, 2007).

An initial request for additional support for the Committee Inquiry in the form of (1) scientific expertise, (2) researchers and (3) additional administrative help was sent to the Premier on 20 July 2015. A reply was received from the Premier on 27 August 2015 offering departmental support. A further letter from the Minister for Energy and Resources in late October again sent the Committee on a merry-go-round for additional resources. Any resources that may ultimately have been provided would have come too late to make

a material difference. Given the Committee was required to table an Interim Report on 1 September 2015 and a Final Report by 1 December 2015, it is hard to believe these letters were sincere.

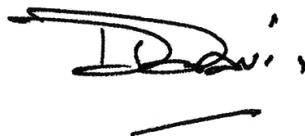
The Committee was not in a position to point to satisfactory or otherwise regimes of regulation in other Australian jurisdictions, particularly Queensland and New South Wales. By contrast is the Inquiry of two years duration by the Western Australian Standing Committee on Environment and Public Affairs into Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas.

The Committee's Terms of Reference were to inquire into and consider a range of matters including the Victorian Auditor-General Office's Report *Unconventional Gas: Managing Risks and Impacts* which was released during the period of the Inquiry. As a long-standing supporter of the Auditor-General's Office and previous Auditors-General, it pains me to indicate that the then Auditor-General appeared to me to have a pre-determined outcome. It is my humble view that this particular Auditor's Report cannot be relied upon in isolation.

A number of submitters pointed to the need for the Committee to look at best practice regulatory frameworks in Canada, the USA, Queensland and New South Wales. The inability of the Committee to collect evidence of the frameworks within these jurisdictions meant a recommendation of some cautious forward process on gas exploration and production within a world's best practice framework was not open to the Committee. Victorians would surely want their Parliamentarians to propose the best and most rigorous regulatory framework available. This was not possible.

I thank all those 1942 people who provided evidence to the Committee either through written submissions or by appearing at the Committee's public hearings. Thank you also to those who have assisted the Committee by hosting the regional hearings and site visits.

I would also like to thank my colleagues on the Committee. I would additionally like to thank the Committee staff for their work on this Inquiry and the production of this Report: from the Secretariat, Mr Keir Delaney, Secretary; Dr Catriona Ross, Inquiry Officer; Ms Annemarie Burt, Research Assistant; additional staff for this Inquiry Mr Ben Hall, School of Civil, Environmental and Chemical Engineering, RMIT University (Hydrogeology); and from the Council Committees office Ms Kim Martinow de Navarrete, Research Assistant; Ms Esma Poskovic, Research Assistant; and Mr Anthony Walsh, Research and Legislation Officer.



Hon David Davis MLC
Chair

Recommendations

The Committee considered two proposed recommendations: a ban on the unconventional gas industry in Victoria or a five year extension of the current moratorium. The Committee could not reach a majority decision. Notwithstanding this, and the content of any minority reports, the Committee must respond to its Terms of Reference and therefore makes the following recommendations relating to any future unconventional gas industry, were it to occur in Victoria.

RECOMMENDATION 1: That the precursor internal submissions from Victorian departments and agencies that informed the whole-of-government inter-departmental submission to this Inquiry into unconventional gas be made public to inform the community of the different positions of departments and agencies. 6

RECOMMENDATION 2: That the Chief Health Officer commissions a full review and report to the Victorian Government on the possible human health impacts of an unconventional gas industry. 70

RECOMMENDATION 3: That the Victorian Government undertake a significant program to collect baseline data prior to any unconventional gas industry going ahead, including:

- (a) further sampling of groundwater monitoring bores
- (b) locating groundwater monitoring bores in areas of potential gas extraction. 107

RECOMMENDATION 4: That the Victorian Government establishes an independent water science committee chaired by an eminent scientist to oversee a water science and monitoring program, and provide independent advice on water quality and other environmental issues. 107

RECOMMENDATION 5: That the Victorian Government:

- (a) increase the resources available to monitor the integrity and condition of wells, and identify and decommission these where necessary
- (b) clarify the roles and responsibilities of the Department of Environment, Land, Water and Planning, the Environment Protection Authority, water authorities and other agencies in regard to the decommissioning of wells. 107

RECOMMENDATION 6: That the Victorian Government provide easier online access to information about exploration licences targeting coal seam gas and petroleum exploration permits targeting tight and shale gas, and in particular:

- (a) update and improve the relevant sections of the Department of Economic Development, Jobs, Transport and Resources website to reflect machinery of government changes to departments
- (b) provide a simplified, more user-friendly interface and more effective search tools
- (c) display the 'Mining Licences Near Me Tool' more prominently on the website. 130

RECOMMENDATION 7: That, noting that the Committee is not in a position to determine whether a single Act or improvements to the *Mineral Resources (Sustainable Development) Act 1990* and the *Petroleum Act 1998* would result in better regulation, the Victorian Government should look to individual improvements in both Acts and should ensure that:

- (a) community consultation and effective dispute resolution processes are improved
- (b) landholder rights are strengthened and an equitable balance and process between the rights of landholders and mining companies in relation to land access, compensation, and the rehabilitation of land is achieved, noting the Crown owns all mineral resources.

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RECOMMENDATION 8: That mandatory environmental impact assessments be required for any coal seam gas, shale and tight gas projects.

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RECOMMENDATION 9: That the Victorian Government examine improved consultation with relevant water authorities to enable a more comprehensive assessment of risk to water sources.

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RECOMMENDATION 10: That the Victorian Government amend section 32 of the *Sale of Land Act 1962* to ensure that when a person buys land they are made aware of any exploration licences or petroleum exploration permits or retention leases that the land is subject to, by having the licences, permits or leases listed in the section 32 document. Disclosure of any such licences, permits or leases should be accompanied by a plain English explanation.

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RECOMMENDATION 11: That the Victorian Government, in consultation with stakeholders, develop an industry-wide code of practice for the exploration, production, and impact management of unconventional gas activities that specifically includes requirements for best practice in:

- (a) well integrity
- (b) hydraulic fracturing activities
- (c) produced water
- (d) fugitive emissions
- (e) well decommissioning and rehabilitation obligations
- (f) baseline and ongoing monitoring.

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RECOMMENDATION 12: That in relation to chemicals and additives used in hydraulic fracturing, the Victorian Government should:

- (a) commission research and advice on chemicals, including research to assess the impacts of chemical mixtures used in hydraulic fracturing
- (b) require companies to seek approval for all chemicals proposed to be used
- (c) require full, public disclosure of chemicals approved for use.

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RECOMMENDATION 13: That the Victorian Government examine the Queensland GasFields Commission model and other independent bodies in other jurisdictions, to consider establishing a wholly independent, appropriately resourced statutory body that may facilitate information sharing and stronger relationships between landholders, local communities and industry.

131

RECOMMENDATION 14: That the Minister for Energy and Resources meet with Victorian manufacturers to understand their concerns regarding the supply and increasing cost of gas, and the impact on their businesses. 144

RECOMMENDATION 15: That the Victorian Government take note and consider the findings of the Australian Competition and Consumer Commission Inquiry into the East Coast Gas Market, which are due to be reported in April 2016. 144

Introduction and conduct of the Inquiry

1.1 Structure of the Report

This is the Final Report of the Environment and Planning Committee's Inquiry into matters surrounding a potential onshore unconventional gas industry in Victoria. The Report consists of eight chapters. The first two chapters provide introductory and background information, and chapters three to eight are structured to correspond to the Terms of Reference for the Inquiry.

Chapter One

Chapter One provides a summary of the conduct of the Inquiry. It lists the Terms of Reference for the Inquiry and discusses the scope of the Report, the number of submissions received, and the hearings and site visits undertaken by the Committee. It also includes Committee comment on the resourcing of this Inquiry.

Chapter Two

Chapter Two presents background information on unconventional gas. It explains the difference between conventional and unconventional natural gas, and describes the geological characteristics of coal seam, shale and tight gas. It also provides a brief explanation of the identified potential risks posed by unconventional gas extraction, and how the industry is regulated. Chapter Two then provides a short summary of the history of unconventional gas activity in Victoria, and lists the key events in the regulation of unconventional gas at the Victorian state and Commonwealth levels.

Chapter Three

Chapter Three considers Victoria's prospectivity for commercial sources of unconventional gas. It begins by providing some context to the discussion of prospectivity, by explaining how gas resources and reserves are classified and measured. It looks at Victoria's conventional gas reserves, and unconventional gas reserves in other Australian jurisdictions.

Chapter Three then examines the geology of the two parts of Victoria that have been identified as the most prospective for unconventional gas: the Gippsland and Otway Basins. It provides a short history of exploration for unconventional gas in the Gippsland and Otway Basins and includes maps that show the historical and current exploration licences and permits over the regions. Chapter

Three concludes with an overview of the evidence provided to the Committee by explorer companies that believe that there are commercially viable quantities of unconventional resources.

Chapter Four

Chapter Four examines the commonly identified risks posed by the extraction of unconventional gas, and outlines community and industry views on those potential risks. It begins by collating the identified risks, and provides information on: the importance of well integrity and potential impacts on water resources; the practice of hydraulic fracturing or ‘fracking’; chemical use in drilling and fracking fluids and the mobilisation of naturally occurring hazardous materials; issues to do with ‘produced’ and ‘flow back’ water; and fugitive methane emissions. It also looks at the potential impacts the industry’s surface level infrastructure can have on native vegetation and biodiversity. Chapter Four additionally examines the evidence presented to the Committee about potential impacts of unconventional gas extraction on human health.

Chapter Four then outlines the significant community concern expressed to the Committee regarding the potential risks posed by an unconventional gas industry, which raises the issue that the industry may not have ‘a social licence to operate’ in Victoria. Chapter Four concludes with an outline of the industry views expressed to the Committee, which state that the risks posed by unconventional gas extraction can be successfully mitigated by industry adherence to ‘best-practice’ regulations, and that the benefits the industry will bring to Victoria will outweigh the risks.

Chapter Five

Chapter Five examines issues relating to the potential co-existence of an unconventional gas industry in Victoria with other land uses such as agriculture and tourism, and with the rights of Traditional Owner groups.

Chapter Five firstly looks at agriculture. It outlines evidence received by the Committee in regards to potential impacts of the industry on farming operations; biosecurity; water resources; domestic and export markets including reputational risk; as well as land access laws, compensation agreements and property prices.

Chapter Five then considers potential issues relating to the co-existence of the tourism industry with unconventional gas development, and with the rights of Traditional Owner groups in areas under Native Title, or subject to agreements under Victoria’s *Traditional Owners Settlement Act 2010*. The Chapter concludes with a consideration of the potential implications of an unconventional gas industry for local and regional development, investment and jobs.

Chapter Six

Chapter Six considers the scientific knowledge requirements that would be necessary to enable the effective regulation of an unconventional gas industry in Victoria. It builds on the information provided in Chapter Four about identified risks potentially posed by an unconventional gas industry and discusses them in more technical detail in the specifically Victorian context.

Chapter Six focuses on the importance of understanding the hydrogeology of an area prior to unconventional gas development. It firstly explains why understanding hydrogeology is important in regards to risk management. It then provides an overview of the current knowledge of groundwater resources in the Gippsland and Otway Basins, including the Victorian Government's recently completed water science studies, and the Bioregional Assessment of the Gippsland Basin which is expected to be completed in 2016.

In conclusion, Chapter Six identifies knowledge gaps that remain in the State's understanding of the water resources in the two Basins, and the further work that needs to be done more broadly to inform the effective regulation of an unconventional gas industry.

Chapter Seven

Chapter Seven examines issues and evidence provided to the Committee surrounding the regulation of a potential unconventional gas industry in Victoria. It considers the evidence provided on the policy and regulatory safeguards that would be necessary to enable the exploration and development of unconventional gas, if it is determined that the industry should proceed in this State.

Chapter Seven firstly provides a summary of the State's existing regulatory framework that applies to unconventional gas. It focuses on the two key pieces of legislation governing the industry: the *Mineral Resources (Sustainable Development) Act 1990* (which regulates coal seam gas exploration and production) and the *Petroleum Act 1998* (which regulates shale and tight gas exploration and production).

Secondly, it looks at ways the regulatory framework could be made more effective, and presents evidence submitted to the Committee, and findings from the Victorian Auditor-General's report: *Unconventional Gas: Managing Risks and Impacts*. The evidence the Committee received suggested ways to increase the capacity of the regulatory framework to address risks associated with unconventional gas. The Chapter puts forward recommendations regarding the regulation of environmental protection; community consultation; health and safety; land owner rights; approval processes; and administration. The recommendations are not exhaustive but focus on key regulatory measures drawn from the evidence.

Chapter Seven concludes with a brief overview of how unconventional gas activities are regulated in the other Australian jurisdictions of Queensland, New South Wales, South Australia and Western Australia.

Chapter Eight

Chapter Eight, the final chapter of this Report, looks at unconventional gas and the domestic and international gas markets. It explores the evidence the Committee received about the impact developing unconventional gas could have on the domestic gas market, particularly in regards to the price and supply of gas in this State.

Chapter Eight begins with a short overview of the eastern Australian gas market, which includes Victoria, and current market dynamics. It explains that the eastern Australian gas market is in a state of transition since liquefied natural gas exports began from Queensland to Asia in January 2015, and that the Committee was informed that the price of gas has been rising and is impacting negatively on Victorian manufacturing businesses that rely on gas.

Chapter Eight considers the evidence the Committee received concerning supply and demand for gas, and the ability of unconventional gas to provide a competitive source of energy and non-energy inputs for manufacturing industries. Chapter Eight then looks at whether unconventional gas has the ability to provide an affordable source of energy for domestic consumers, and briefly presents evidence submitted to the Committee regarding the appropriateness of Victoria adopting a gas reservation policy.

1.2 Terms of Reference for the Inquiry

On 26 May 2015, the Leader of the Government in the Legislative Council, the Hon. Gavin Jennings, moved that the Environment and Planning Committee inquire into matters relating to a potential unconventional gas industry in Victoria. The Legislative Council agreed to the motion and adopted the following Terms of Reference for the Inquiry:

That pursuant to Sessional Order 6 this House requires the Environment and Planning Committee to inquire into and consider matters relating to the exploration, extraction, production and rehabilitation for onshore unconventional gas and present an interim report no later than 1 September 2015 and a final report no later than 1 December 2015 and, in particular, the inquiry should include, but not be limited to, the following —

- (1) the prospectivity of Victoria's geology for commercial sources of onshore unconventional gas;
- (2) the environmental, land productivity and public health risks, risk mitigations and residual risks of onshore unconventional gas activities;
- (3) the coexistence of onshore unconventional gas activities with existing land and water uses, including —
 - (a) agricultural production and domestic and export market requirements;
 - (b) the legal rights of property owners and the impact on property values; and
 - (c) any implications for local and regional development, investment and jobs;

- (4) the ability of potential onshore unconventional gas resources contributing to the State's overall energy sources including —
 - (a) an ability to provide a competitive source of energy and non-energy inputs for Victorian industries;
 - (b) an affordable energy source for domestic consumers; and
 - (c) carbon dioxide emissions from these sources;
- (5) the resource knowledge requirements and policy and regulatory safeguards that would be necessary to enable exploration and development of onshore unconventional gas resources, including —
 - (a) further scientific work to inform the effective regulation of an onshore unconventional gas industry, including the role of industry and government, particularly in relation to rigorous monitoring and enforcement, and the effectiveness of impact mitigation responses; and
 - (b) performance standards for managing environmental and health risks, including water quality, air quality, chemical use, waste disposal, land contamination and geotechnical stability;
- (6) relevant domestic and international reviews and inquiries covering the management of risks for similar industries including, but not limited to, the Victorian Auditor-General Office's report *Unconventional Gas: Managing Risks and Impacts* (contingent upon this report being presented to Parliament) and other reports generated by the Victorian community and stakeholder engagement programs.

1.3 Scope of the Report

The Report investigates all aspects of the extensive Terms of Reference. In submissions and at public hearings the Committee also received evidence on matters concerning the exploration, extraction, production and rehabilitation for conventional gas. Conventional onshore gas is also subject to the current Victorian moratorium under which the unconventional gas industry has been halted. This Report makes mention of the conventional gas industry, however, the Committee has determined that this topic falls largely outside the Terms of Reference.

The Committee has also been able to make only passing examination of regulatory approaches overseas and interstate, for reasons explained in section 1.8 (below).

1.4 Submissions

The Environment and Planning Committee invited submissions by placing an advertisement in the *Herald Sun* and *The Age* on 12 June 2015, and in *The Weekly Times* on 17 June 2015. The Committee's call for submissions was also placed on

the Parliament of Victoria's website and announced through the Parliament's Twitter account. The Committee wrote to 172 stakeholders advising them of the Inquiry and seeking input.

The closing date for submissions was 10 July 2015. The Committee acknowledges the relatively short time frame of less than four weeks during which submissions could be received. The Committee considered and granted requests for extensions on a case by case basis.

The Committee has received and published 1862 submissions. This is likely to be the largest number of submissions ever received by a Victorian Parliamentary committee. The submissions came from a range of stakeholders including farmers, environmental and community groups, the gas industry, manufacturers, academics, small business owners, scientists, state and local governments, and the general public. The vast majority of the submissions expressed concerns that an unconventional gas industry in Victoria could pose risks to prime agricultural land and water supplies.

The Committee thanks each person or organisation that made a submission or provided evidence to the Inquiry. The submissions and evidence have been considered in their entirety, however, with such a large number of submissions and evidence received, it has not been possible to quote from each one. Lists of submitters and witnesses are provided in Appendices 1 and 2.

The Committee received a Victorian Government inter-departmental submission on 3 August 2015. Subsequent to a question taken on notice at a public hearing on 18 August 2015, the Acting Secretary of the Department of Economic Development, Jobs, Transport and Resources confirmed that the submission had been prepared pursuant to the Premier's 2002 Guidelines for making such submissions. The Committee believes that as a rule, Government contributions to Parliamentary Inquiries should reflect the diversity of views across Government that have input into an inter-departmental submission.

RECOMMENDATION 1: That the precursor internal submissions from Victorian departments and agencies that informed the whole-of-government inter-departmental submission to this Inquiry into unconventional gas be made public to inform the community of the different positions of departments and agencies.

1.5 Pro forma submissions

The Committee received 13 different pro forma submissions. The largest of these, facilitated by the Australian Greens website, was sent in by 679 individuals. In 549 cases the submission was identical. The Committee has ascertained that individual contact details were provided for every pro forma submission received.

1.6 Hearings and briefings

On 23 June 2015, the Committee received an initial briefing from the Department of Economic Development, Jobs, Transport and Resources.

The Committee held public hearings in Sale in Gippsland on 30 June and 1 July 2015, in Melbourne at Parliament House on 22 July, 5 August, 18 August, and 6 October 2015, in Torquay on the Surf Coast on 12 and 13 August 2015, and in Hamilton in Western Victoria on 23 September 2015.

The Committee heard valuable evidence from 125 individuals at public hearings and would like to thank all the witnesses who gave up their time to present to the Committee. A list of witnesses is provided in Appendix 2.

The Committee is of the view that it would have been beneficial to conduct further public hearings throughout regional Victoria had time and funding permitted.

1.7 Site visits

On 1 July 2015, following the conclusion of the public hearings in Sale, the Committee visited the Wombat Gasfield at Seaspray with Lakes Oil and then visited the neighbouring farm of Mr and Mrs Flint.

On 30 October 2015, the Committee toured Qenos, a polyethylene manufacturing facility in Altona that uses natural gas in its production processes.

1.8 Committee resources

As stated in the Interim Report, the Committee believes that the resources provided for this Inquiry were inadequate, given that the topic is highly contested, scientifically complex and the Terms of Reference are the most extensive of any parliamentary inquiry on this topic in Australia.

The Inquiry generated a huge level of public interest and the secretariat processed and considered an unprecedented volume of submissions, documents, reports and correspondence. The Committee made a number of requests to the Government for administrative and research assistance; these were not met. However, on 17 August 2015, the Committee received approval to engage a hydrogeologist to assist with understanding some of the scientific evidence received relating to water.

It is unfortunate and in fact a significant shortcoming of the Inquiry that funding was not released to enable the Committee to travel. In submissions and at public hearings, the Committee heard various claims and reports about the actual experience of unconventional gas mining in other parts of Australia and overseas. On both sides of the debate, Inquiry participants referenced these other jurisdictions to illustrate points about co-existence between mining and

agriculture, the potential health and environmental impacts and the effects of the mining industry on local economies. For example, Councillor Brian Crook of the Colac Otway Shire Council informed the Committee that:

...since this form of mining has been in place in Queensland and New South Wales we are seeing problems through lack of regulation whereby we have our agriculture and water basins, aquifers et cetera put at risk. In Queensland it seems that it was almost a free-for-all and now we are witnessing what happens when things go wrong.¹

Similarly, in relation to Queensland, Mr Paul Fennelly from the Australian Petroleum Production and Exploration Association stated at a public hearing:

...if the budget permits, I strongly recommend that the inquiry visit Queensland and talk to farmers. Talk to farmers, talk to the agricultural groups — AgForce. They indicated to me the other day they have more members in support of gas than those who are neutral or not interested. Gas is accepted by the farming communities up there. It is not war; it is a cooperation; it is a negotiation. They have provided legal advice, technical advice and water baseline studies. I encourage the committee to get into Queensland and talk to these people.²

Both the Victorian Auditor-General's Office and Professor Peter Cook of the Australian Council of Learned Academies drew the Committee's attention to the regulatory system in Canada. Professor Cook stated that:

I think there are lessons to be learnt there from their approach to onshore gas, particularly in Alberta. It is a very mature sort of area in terms of the industry, and I think there are lessons to be learned there.³

The Committee would have benefited from visiting operating unconventional gas fields in these other jurisdictions to see matters first hand and to hear directly from communities and industry.

1 B. Crook (2015) *Transcript of Evidence*, 12 August, p. 9.

2 P. Fennelly (2015) *Transcript of Evidence*, 22 July, p. 9.

3 P. Cook (2015) *Transcript of Evidence*, 22 July, p. 6; Victorian Auditor-General's Office (2015) *Transcript of Evidence*, 6 October, p. 4.

2.1 Chapter overview

Chapter Two presents background information on unconventional gas. It explains the difference between conventional and unconventional natural gas, and describes the geological characteristics of coal seam, shale and tight gas. It also provides a brief explanation of the identified potential risks posed by unconventional gas extraction and how the industry is regulated. It then provides a short summary of the history of unconventional gas activity in Victoria and lists key events in the regulation of unconventional gas both at the federal and the Victorian state levels.

2.2 The difference between conventional and unconventional gas

Coal seam gas, shale gas and tight gas are forms of unconventional natural gas. Natural gas is a fossil fuel that consists mostly of methane and can be found in a variety of geological settings. Natural gas is a major source of energy in Victoria and is used for home heating and cooking, manufacturing, and generating electricity. The term ‘unconventional gas’ refers to natural gas that is found in different geological settings from conventional gas, and is harder to extract from the ground than conventional natural gas.⁴

It is important to emphasise that it is the type of rock and the degree of difficulty involved in extracting the gas which define whether the gas is conventional or unconventional, and not the composition of the gas itself. All natural gas is composed predominantly of methane.⁵ As the Australian Petroleum Production & Exploration Association (APPEA) explains in their submission to the Committee, the key difference between conventional and unconventional natural gas is the ‘manner, ease and cost’ involved in extracting the gas.⁶

⁴ P. Cook (2015) *Transcript of Evidence*, 22 July, p. 2; P. Cook et al. (2013) *Engineering Energy: Unconventional Gas Production*, Report for the Australian Council of Learned Academies, p. 32; C. Ross & P. Darby (2013) *Unconventional Gas: Coal Seam Gas, Shale Gas and Tight Gas*, Victorian Parliamentary Library Research Service, p. 2.

⁵ *ibid.*

⁶ Australian Petroleum Production and Exploration Association (2015) Submission 364, p. 6.

2.3 Conventional gas

Conventional gas is natural gas that is easier to access and extract. Typically, conventional gas reservoirs are found in sandstones and limestones with high porosity and high permeability. The term ‘porosity’ refers to the spaces or ‘pores’ in the rock in which water or gas can be found. The higher the porosity, the greater the amount of water or gas that may be contained in the rock. The term ‘permeability’ refers to the level of interconnectivity between the pores in a rock (a characteristic that allows gas to flow through rock).⁷ Conventional gas found in these porous and permeable sedimentary rocks is trapped in place by layers of impermeable ‘seal’ rocks. When a well is drilled through the impermeable rock to reach the conventional gas reservoir, the gas is able to flow into the well relatively easily.⁸

Victoria’s conventional natural gas is sourced from the offshore parts of the Gippsland and Otway Basins, and to a lesser extent from the Bass Basin which is located entirely offshore.⁹ Conventional gas was also sourced onshore in the Port Campbell Embayment (part of the Otway basin) from 1986 until 2006 when the discovered commercially viable natural gas was depleted.¹⁰ The history of conventional natural gas in Victoria is discussed in Chapter Three.

2.4 Unconventional gas

It is expected that reserves of conventional natural gas will run out in coming decades and this is in part driving the exploration for the more difficult to access, and costly to produce, ‘unconventional’ natural gas.¹¹ The Commonwealth Scientific and Industrial Research Organisation (CSIRO) explains that unconventional gas is ‘generally produced from complex geological systems that prevent or significantly limit the migration of gas and require innovative technological solutions for extraction’.¹²

Advances in mining technology have aided the commercial viability of extracting unconventional gas. Horizontal drilling techniques developed in the United States since the mid-1980s have made it easier to reach unconventional deposits. The practice of hydraulic fracturing or ‘fracking’ (sometimes also called ‘fracking’) has increased the productivity of unconventional wells. Fracking involves injecting fluid made of water, sand and chemicals down a well at high pressure to ‘fracture’ the rocks and allow the gas to flow more easily.¹³

7 Cook et al. (2013) *Engineering Energy*, op. cit., p. 32; APPEA (2015) Submission 364, p. 6.

8 Government of Victoria (2015) Submission 658, pp. 5-6.

9 Ross & Darby (2013) op. cit., p. 6; Government of Victoria (2015) Submission 658, p. 11.

10 Government of Victoria (2015) Submission 658, pp. 11-12, 92.

11 Ross & Darby (2013) op. cit., p. 2; Gas Market Taskforce (2013) *Gas Market Taskforce: Final Report and Recommendations*, State Government of Victoria, p. 1.

12 CSIRO (2012) ‘What is Coal Seam Gas?’, Factsheet, CSIRO website; Ross & Darby (2013) op. cit., p. 2. See section 3.2 of this Report for a definition of gas ‘reserves’.

13 Ross & Darby (2013) op. cit., pp. 2, 18.

Identified potential risks of the fracking process include increased connectivity between different geological layers, the contamination of water resources, and the risk of spills when fracking fluids flow back to the surface.¹⁴ Stakeholder groups have different views on whether these risks can be adequately managed. A significant amount of evidence received by the Committee focussed on the potential risks of fracking – this is discussed in more detail in Chapter Four. It is important to emphasise that coal seam gas wells do not always require fracking. Shale gas and tight gas wells do often require fracking.¹⁵

A summary of the different characteristics of coal seam gas, shale gas and tight gas is provided below, and a more technical description of the difference between conventional and unconventional gas and the use of hydraulic fracturing is provided in Appendix 3.

2.4.1 Coal seam gas

Coal seam gas (CSG) is natural gas found in coal seams at depths of approximately 300 to 1000 metres underground. The CSG is trapped underground by water pressure. To extract the CSG, a well is drilled into the coal seam and the water is pumped out to release the gas. This water – known as ‘produced water’ or ‘formation water’ – is then separated from the gas at the surface.¹⁶

The produced water can be saline and contain chemicals from fracking fluids or naturally occurring hazardous materials mobilised by the extraction process (known as geogenic materials). The produced water generally requires treatment and extracted salt and/or chemicals and geogenic materials need to be disposed of. It is also important to note that the quantities of produced water can be very large.¹⁷

Coal seams are less permeable than conventional gas systems and the gas does not flow as easily, which means that more wells are required to develop a CSG field than a conventional gas field.¹⁸ It is also often necessary to drill horizontal wells and, as stated above, in some instances to fracture the well to increase the flow of gas.¹⁹

Coal seam gas is commercially produced in Queensland and New South Wales and is the most established kind of unconventional gas production in Australia. Significantly, Queensland and New South Wales have black coal deposits whereas Victoria has predominantly brown coal deposits. This matter is discussed in more detail in Chapter Three of this Report

14 M. Currell (2015) Submission 11; Standing Council on Energy and Resources (2013) *The National Harmonised Regulatory Framework for Natural Gas from Coal Seams*, Council of Australian Governments, p. 54; NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Fracture Stimulation Activities*, NSW Government, p. 12.

15 Ross & Darby (2013) op. cit., p. 18; Government of Victoria (2015) Submission 658, pp. 7-8; Cook et al. (2013) *Engineering Energy*, op. cit., pp. 32, 34.

16 CSIRO (2015) ‘What is Unconventional Gas?’, CSIRO website.

17 CSIRO (2015) ‘What is Unconventional Gas?’, op. cit.; M. Currell (2015) Submission 11, pp. 5-7. This is further discussed in Chapter Four.

18 Ross & Darby (2013) op. cit., p. 3; P. Cook (2015) *Transcript of Evidence*, 22 July, p. 2

19 Cook et al. (2013) *Engineering Energy*, op. cit., p. 33.

Additionally, it is also important to note that because coal seam gas is the most established kind of unconventional gas production in Australia and hence the most well-known, it is common for people to talk just about ‘coal seam gas’. In Victoria, however, there is also potential for shale and tight gas.

2.4.2 Shale gas

Shale gas is found in shale rock layers at depths of about 1000 to 3000 metres. Shale rock has very low porosity and permeability. It is much harder and deeper underground than coal seams. Fracking is often used in shale gas wells to facilitate the flow of gas.²⁰ Shale gas producers also usually employ horizontal drilling to gain maximum exposure to the deposit.²¹

Notably, shale gas extraction requires larger quantities of water for fracking than CSG extraction does, but it does not create the large quantities of ‘produced water’.²² More wells are required to develop a shale gas resource than a conventional gas resource.²³

The United States has an established shale gas industry which has grown rapidly since the early 2000s. In Australia, the shale gas industry is in its infancy with the first shale gas well successfully producing gas in the Cooper Basin in South Australia in 2012. An Australian Council of Learned Academies study, chaired by Professor Peter Cook, who appeared as a witness for the Committee, suggests that shale gas may be present in large quantities in the Otway Basin but that it is not yet known if it will be commercially viable to extract it.²⁴

2.4.3 Tight gas

Tight gas is natural gas that is trapped in compacted sandstones or limestones that are relatively impermeable and non-porous (also known as ‘tight sand’). Tight gas occurs at depths greater than 1000 metres. It is called tight gas because it is tightly constrained within very hard rock formations.²⁵

The CSIRO explains that the pores in the rock that contain the tight gas are ‘miniscule’ and that ‘the interconnections between them are so limited that the gas can only migrate through it with great difficulty’.²⁶ All methods to increase the productivity of tight gas deposits are usually employed, including fracking and horizontal drilling. Tight gas, like shale gas, requires relatively large amounts of

20 P. Cook (2015) *Transcript of Evidence*, 22 July, p. 9.

21 CSIRO (2015) ‘What is Unconventional Gas?’, op. cit.; NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, NSW Government, p. 40.

22 Cook et al. (2013) *Engineering Energy*, op. cit., pp. 24, 119; Ross & Darby (2013) op. cit., p. 4.

23 Government of Victoria (2015) Submission 658, p. 7.

24 Cook et al. (2013) *Engineering Energy*, op. cit., p. 49; P. Cook (2015) *Transcript of Evidence*, 22 July, pp. 2-3; See also P. Cook (2013) ‘Unconventional Gas in Victoria: Proceed with Care’, *The Conversation*, 18 November.

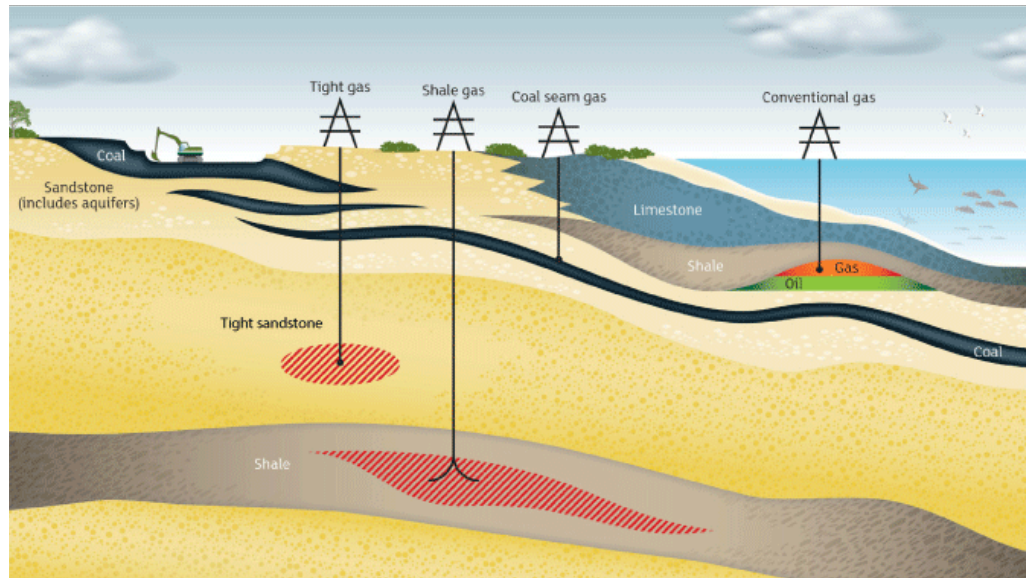
25 Government of Victoria (2015) Submission 658, pp. 6-7; Rigzone (2015) ‘What is Tight Gas and How is it Produced?’, Rigzone website.

26 CSIRO (2012) ‘What is Coal Seam Gas?’, Factsheet, CSIRO website; Ross & Darby (2013) op. cit., p. 4.

hydraulic horsepower and quantities of water for fracking.²⁷ More wells are also required to collect tight gas than are needed for conventional gas.²⁸ Tight gas exploration in Australia is still in its infancy. Notably, the exploration company Lakes Oil discovered tight gas in the Seaspray area of Gippsland in 2004.²⁹ This is further discussed in Chapter Three.

Figure 2.1 provides a diagram that illustrates the different geological settings of conventional and unconventional gas deposits:

Figure 2.1 Examples of conventional and unconventional gas deposits



Source: Government of Victoria (2015) Submission 658, p. 6.

2.5 Potential environmental impacts of unconventional gas extraction

The body of available literature on unconventional gas, government reviews, and evidence received by the Committee identify a number of potential risks posed by unconventional gas extraction. These risks centre on potential impacts on water resources which could affect agriculture and the environment more broadly, and potentially human health.³⁰ Identified potential risks also include impacts to the surface environment from the industrial infrastructure associated with

²⁷ NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., p. 40; Ross & Darby (2013) op. cit., p. 4.

²⁸ Government of Victoria (2015) Submission 658, p. 7.

²⁹ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, State Government of Victoria, p. 19.

³⁰ See: NSW Legislative Council, General Purpose Standing Committee No. 5 (2012) *Inquiry into Coal Seam Gas*, Parliament of NSW; NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit.; SCER (2013) *The National Harmonised Regulatory Framework*; Cook et al. (2013) *Engineering Energy*, op. cit.; M. Currell (2015) Submission 11; Government of Victoria (2015). Submission 658, p. 21; Doctors for the Environment (2015) Submission 416.

unconventional gas extraction such as clearing of bushland, fragmentation of native habitat, spread of weeds and increased risk of bushfires.³¹ Chapter Four of the report focuses on the risks potentially posed by the industry.

Government initiated reviews from some jurisdictions, and the report of the Gas Market Taskforce in Victoria, have concluded that these risks can be managed if regulatory frameworks for industry are improved, monitored and enforced.³² Two of these documents – the *National Harmonised Regulatory Framework for Natural Gas from Coal Seams* and the Gas Market Taskforce report – are briefly discussed in the next sections of this Report, which provide a short overview of the regulation of unconventional gas extraction, the history of unconventional gas activity in Victoria, and the evolution of government policy.

2.6 Regulating unconventional gas extraction

In Australia, it is the state and territory governments that have responsibility for the regulation of onshore mineral and petroleum resources, including unconventional gas. State and territory responsibilities include licensing mineral and petroleum exploration and development, setting conditions on licences, assessing environmental impacts and monitoring and enforcing industry adherence to regulation. The states and territories also collect royalties from mineral and petroleum production.³³

In Victoria, the licensing for exploration and production of CSG is regulated under the *Mineral Resources Sustainable Development Act 1990* (the Minerals Act). Licensing for the exploration and production of shale and tight gas is regulated under the *Petroleum Act 1998* (the Petroleum Act). Victoria is different to other states in that it regulates unconventional gas through two Acts. In other states CSG is regulated under petroleum legislation.³⁴

The Minister for Energy and Resources, through the Earth Resources Regulation Branch of the Department of Economic Development, Jobs, Transport and Resources (DEDJTR) administers these Acts and their regulations. The regulation of unconventional gas in Victoria is discussed in detail in Chapter Seven of this Report.

31 J. Williams, T. Stubbs & A. Milligan (2012) *An Analysis of Coal Seam Gas Production and Natural Resource Management in Australia: Issues and Ways Forward*, Australian Council of Environmental Deans and Directors, pp. 30-37, 105-106; Australian Academy of Technological Sciences and Engineering (2015) Submission 451, p. 2; Cook et al. (2013) *Engineering Energy*, op. cit., p. 24.

32 See for example: NSW Chief Scientist & Engineer (2014) *Final Report of the Independent Review of Coal Seam Gas Activities in New South Wales*, NSW Government; Gas Market Taskforce (2013) *Gas Market Taskforce: Final Report and Recommendations*, op. cit.; SCER (2013) *The National Harmonised Regulatory Framework*, op. cit.

33 Ross & Darby (2013) op. cit., p. 27; SCER (2013) *The National Harmonised Regulatory Framework* op. cit., p. 76; B. McCormick, A. St John & J. Tomaras (2013) 'Environment Protection and Biodiversity Conservation Amendment Bill 2013', Bills Digest, no.108 2012-13, Australian Parliamentary Library, p. 13.

34 M. Davison (2012) 'Coal Seam Gas Exploration in Victoria', Minerals Council of Australia-Victoria Division, *Media Release*, 24 August.

2.7 History of unconventional gas activity in Victoria and Government policy

As will be discussed in more detail in Chapter Three, activity relating to a potential unconventional gas industry in Victoria is at an early stage. It is not yet known whether there is unconventional gas in this state that would be commercially viable to produce. The highest potential for unconventional gas lies in the Gippsland and Otway Basins. From 2000 to the early 2010s, Victorian Governments issued companies with exploration licences to search for unconventional gas. Exploratory drilling and some hydraulic fracturing were undertaken.³⁵

2.7.1 The National Harmonised Regulatory Framework

In late 2011, community concerns over the development of the CSG industry in Queensland and New South Wales – regarding potential environmental, health and social impacts – led to the then COAG Standing Council on Energy and Resources (SCER) determining to develop a regulatory framework for the industry.³⁶

‘The National Harmonised Regulatory Framework for Natural Gas from Coal Seams’ was completed in May 2013.³⁷ It identified 18 ‘leading practices’ that can be adopted by regulators to best manage the CSG industry, with particular focus on the ‘core areas’ of ‘well integrity, water management and monitoring, hydraulic fracturing and chemical use.’³⁸ In regard to other forms of unconventional gas, the SCER stated that ‘some of the approaches to leading practice advocated in the Framework may have applicability to other oil and gas activities like shale and tight gas.’³⁹ The Framework is of ongoing relevance because the 18 leading practices continue to be used to represent regulatory ‘best practice’ for the CSG industry and are referred to in reviews and reports.

However, two further points are worth noting. Firstly, as noted by the SCER, the practices relate to coal seam gas, so further work would be necessary to consider their applicability in the Victorian context, in which coal seam gas is unlikely to generate an industry in the short term. Secondly, the Committee believes that Victoria should strive for international best practice, rather than settling for practices determined at the COAG level.

³⁵ Gas Market Taskforce (2013) *Gas Market Taskforce: Final Report and Recommendations*, op. cit., p. 20; Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 120.

³⁶ SCER (2012) *The Draft National Harmonised Regulatory Framework: Coal Seam Gas*, Council of Australian Governments, p. 1. Note: the Victorian Government’s submission states that the Standing Council on Energy and Resources is now called the COAG Energy Council.

³⁷ See: Standing Council on Energy and Resources (2013) *The National Harmonised Regulatory Framework for Natural Gas from Coal Seams*, Council of Australian Governments.

³⁸ *ibid.*, pp. 7-8.

³⁹ *ibid.*, p. 9.

2.7.2 The National Partnership Agreement

The COAG ‘National Partnership Agreement on Coal Seam Gas and Large Coal Mining Development’ was made between the Commonwealth, New South Wales, Victorian, Queensland, South Australian and Northern Territory governments in 2012.⁴⁰ The stated purpose of the National Partnership Agreement was to ‘strengthen the regulation of CSG and large coal mining development by ensuring that future decisions are informed by substantially improved science and independent expert advice’.⁴¹

As part of the Agreement, the Commonwealth established the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Developments (the IESC) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth). The role of the IESC is to improve the science base and provide advice on the impact of coal seam gas and coal mining on water resources.⁴²

One of the tasks of the IESC is to facilitate ‘Bioregional Assessments’ of the groundwater and ecology in regions with potential for CSG or coal mining.⁴³ Victoria, as a signatory to the Agreement, received funding to undertake a Bioregional Assessment of the Gippsland Basin (which is currently being conducted).⁴⁴

The funding received from the Commonwealth Government totalled \$10.13 million. The Victorian Department of Economic Development, Jobs, Transport and Resources informed the Committee that as at 31 August 2015, \$3.86 million remained taking account of actual and committed expenditure on projects.⁴⁵ It is not clear to the Committee how the remaining funding is intended to be spent.

2.7.3 The Victorian moratorium

In August 2012, the Victorian Coalition Government announced a hold on approvals to undertake fracking as part of onshore gas exploration and on the issuing of new exploration licences for CSG, until the National Harmonised Regulatory Framework had been completed and considered.⁴⁶ A ban on the use of BTEX compounds in hydraulic fracturing was also announced at this time, (discussed further in section 2.7.6) In the media release announcing the reforms, the then Minister for Energy and Resources, the Hon. Michael O’Brien, also stated

⁴⁰ See: Council of Australian Governments (2012) *National Partnership Agreement on Coal Seam Gas and Large Coal Mining Development*.

⁴¹ COAG (2012) *National Partnership Agreement*, op. cit., p. 1.

⁴² *ibid.*, pp. 13-15.

⁴³ *ibid.*, pp. 8, 13-14.

⁴⁴ Victorian Auditor-General’s Office (2015) *Unconventional Gas: Managing Risks and Impacts*, VAGO, p. 21. VAGO further states that: ‘This assessment is limited to the groundwater systems close to the surface not the deeper groundwater systems potentially impacted by tight and shale gas exploration.’ See also: Government of Victoria (2015) Submission 658, p. 10.

⁴⁵ A. Harris, Acting Secretary, Department of Economic Development, Jobs, Transport and Resources, Answer to question taken on notice 18 August 2015, received 23 September 2015.

⁴⁶ M. O’Brien, Minister for Energy and Resources (2012) ‘Reforms to Strengthen Victoria’s Coal Seam Gas Regulation and Protect Communities’, Media Release, 24 August.

that work was underway to determine the Victorian based scientific studies to be funded by the National Partnership Agreement, in addition to the IESC's Gippsland regional scale study.⁴⁷ The continuation of the moratorium is detailed in sections 2.7.5 and 2.7.8.

2.7.4 The Gas Market Taskforce Report

In December 2012, the Victorian Government established the Gas Market Taskforce which was chaired by the former Federal Government Minister, the Hon. Peter Reith, and consisted of industry representatives. The Taskforce was asked 'to provide policy options to the Victorian Government on improving the operation and efficiency of the eastern Australian gas market, suggesting ways of facilitating market transparency and transmission capability, and increasing gas supply to meet rising demand at competitive prices'.⁴⁸

In November 2013, the Taskforce presented its final report and recommendations – sometimes called the 'Reith Report' – and recommended that the Government proactively support the development of an onshore gas industry in Victoria and lift the holds on fracking and the approval of new CSG exploration licences. The report further recommended that the regulations underpinning onshore gas exploration and development be strengthened, particularly by the full implementation of the 18 leading practices outlined in the National Harmonised Regulatory Framework.⁴⁹

2.7.5 Continuation of moratorium, announcement of community consultation and water science studies

The then Premier of Victoria, the Hon. Denis Naphthine, announced in late November 2013 that the Government would seek public feedback on the Gas Market Taskforce report, and conduct a formal community consultation process on issues surrounding onshore gas from April 2014 to July 2015, during which time the moratorium on hydraulic fracturing would remain in place.⁵⁰

The then Deputy Premier, the Hon. Peter Ryan, further explained that the moratorium would also extend to the issuing of new coal seam, shale and tight gas exploration licences until at least July 2015.⁵¹ Water science studies of both the Gippsland and Otway Basins were also announced at that time.⁵²

⁴⁷ *ibid.*

⁴⁸ Gas Market Taskforce (2013) *Gas Market Taskforce: Final Report and Recommendations*, op. cit., p. 9.

⁴⁹ *ibid.*, pp. 1, 4-8.

⁵⁰ D. Naphthine, Premier (2013) 'Gas Market Taskforce Paper Open for Public Consultation', Media Release, 21 November, p. 1.

⁵¹ See: Victoria, Legislative Assembly (2013) *Debates*, Book 16, 27 November, pp. 4188-4190.

⁵² P. Walsh, Minister for Water & G. Hunt, Minister for Environment (Cth) (2013) 'Major Victorian Water Study Launched', Joint Media Release, 22 November.

In April 2014, the former Department of State Development, Business and Innovation engaged consulting firm ‘The Primary Agency’ to conduct the 12 month community and stakeholder engagement program.⁵³

2.7.6 Statutory ban of the use of BTEX compounds in hydraulic fracturing

In September 2014, the Victorian Parliament passed the *Resource Legislation Amendment (BTEX Prohibition and Other Matters) Act 2014*, which imposed a restriction on the use of BTEX compounds in hydraulic fracturing in Victoria. The acronym ‘BTEX’ refers to ‘benzene, toluene, ethylbenzene, and xylene’, which are compounds found in petroleum products that are known to be harmful to human health.⁵⁴ The Victorian Government inter-departmental submission to the Inquiry notes that BTEX compounds can also ‘occur naturally within the vicinity of natural gas and petroleum deposits.’⁵⁵ BTEX compounds are further discussed in section 4.2.3.

2.7.7 Publication of community consultation report

In April 2015, The Primary Agency published its *Report on Community and Stakeholder Attitudes to Onshore Natural Gas in Victoria*.⁵⁶ The Primary Agency stated in the report that it had sought to capture the views of Victorians on issues surrounding an onshore natural gas industry in Victoria, and had engaged ‘with some 2000 community attendees at open days, key stakeholder meetings, discussion groups and community panels’, as well as undertaking a quantitative phone survey of a sample of 960 people from different parts of the state.⁵⁷ The report divided the views of community members and stakeholders into three cohorts: those who do not support the industry, those who do, and those that are undecided, and outlined the typical reasoning behind each of the viewpoints.⁵⁸

2.7.8 Committee Inquiry and extension of moratorium

The Victorian Labor Party went to the November 2014 state election with a policy to hold a Parliamentary Committee inquiry into unconventional gas.⁵⁹ The Government also stated that the moratorium ‘will remain for all onshore gas activities including exploration, drilling and hydraulic fracturing’ until the Committee reports to Parliament in December 2015.⁶⁰

⁵³ Government of Victoria (2015) Submission 658, p. 11; The Primary Agency (2015) The Primary Agency website.

⁵⁴ C. Ross (2014) *Research Note on the Resources Legislation Amendment (BTEX Prohibition and Other Matters Bill) 2014*, Victorian Parliamentary Library and Information Service, p. 1.

⁵⁵ Government of Victoria (2015) Submission 658, p. 5.

⁵⁶ See: The Primary Agency (2015) *Report on Community and Stakeholder Attitudes to Onshore Natural Gas in Victoria*, Melbourne.

⁵⁷ *ibid.*, p. 1.

⁵⁸ *ibid.*

⁵⁹ L. D'Ambrosio, Minister for Energy & Resources (2015) ‘Inquiry to Give Regional Communities a Voice on Coal Seam Gas’, Media Release, 27 May.

⁶⁰ *ibid.*

2.7.9 Publication of water science studies

In early August 2015, the Government released the completed water science studies of the Otway and Gippsland Basins, which are intended to ‘help provide a better understanding of the potential impacts of any onshore gas development on Victoria’s water resources’.⁶¹

The water science studies were undertaken by the Department of Environment, Land, Water and Planning (DELWP) and the Geological Survey of Victoria (part of DEDJTR). They are distinct from the bioregional assessment of the Gippsland Basin that is being undertaken as part of the National Partnership Agreement by the IESC, which is due for completion in June 2016.⁶² However, the Victorian Government’s inter-departmental submission to the Committee states that the groundwater data from the Gippsland Basin bioregional assessment was used in the water science studies.⁶³

The Victorian Government’s inter-departmental submission also states that the water science studies provide an ‘initial screening analysis’ of potential impacts of unconventional gas extraction on water resources, and that ‘there are known gaps in the geological and hydrogeological data sets’.⁶⁴ The water science studies and further knowledge requirements are discussed in detail in Chapter Six of this Report.

The Government additionally states that it is also undertaking geophysical studies of the Gippsland region to provide more information about underground rock layers. The results of seismic studies were not available to the Committee and are forthcoming in early 2016.⁶⁵ A report on the Gippsland gravity survey was released with the water science studies in August 2015.⁶⁶

2.7.10 VAGO Report – *Unconventional Gas: Managing Risks and Impacts*

The Victorian Auditor-General’s Office (VAGO) report titled *Unconventional Gas: Managing Risks and Impacts* was tabled on 19 August 2015. The self-initiated report examines the State’s preparedness to effectively respond to potential impacts if an unconventional gas industry proceeds in Victoria.⁶⁷

⁶¹ Government of Victoria (2015) Submission 658, p. 10. Also see: Government of Victoria (2015) ‘About the Water Studies’, Onshore Gas Community Information website.

⁶² Government of Victoria (2015) Submission 658, p. 13.

⁶³ *ibid.*

⁶⁴ *ibid.*, p. 93.

⁶⁵ See Government of Victoria (2015) ‘Geophysical Studies’, Onshore Gas Community Information website; Government of Victoria (2015) Submission 658, p. 13.

⁶⁶ See: L. Matthews & M. McLean (2015) *Gippsland Basin Gravity Survey*, Onshore Gas Community Information website.

⁶⁷ See: Victorian Auditor-General’s Office (2015) *Unconventional Gas: Managing Risks and Impacts*. Note: references to the VAGO report on unconventional gas are stated as ‘VAGO (2015) op. cit.’ and the page number provided. References to the VAGO *Transcript of Evidence* provided to the Committee are identified as such.

VAGO reviewed the approaches of the relevant government departments – DEDJTR and DELWP – since 2000 to understand and manage unconventional gas. VAGO found that Victoria’s current regulatory system is ill-equipped to respond effectively to the specific risks arising from unconventional gas activities. The report states that other jurisdictions have amended their regulatory systems to address unconventional gas activities, but that this has not occurred in Victoria.⁶⁸

The VAGO report makes a number of recommendations on how to improve the regulatory system to better address the specific risks posed by unconventional gas activities, if the industry is to proceed in this State. The recommendations include the full implementation of the previously mentioned 18 leading practices of the National Harmonised Regulatory Framework.⁶⁹ The VAGO report and its recommendations are discussed in more detail in Chapter Seven of this Report.

The VAGO report is the most recent development in the timeline of events surrounding unconventional gas in Victoria, and concludes this short overview of the history of unconventional gas activity in the State and the evolution of government policy. The next chapter of this Report considers Victoria’s prospectivity for commercial sources of unconventional gas.

⁶⁸ VAGO (2015) *op. cit.*, p. xiii.

⁶⁹ *ibid.*, pp. xvi – xviii.

Victoria's prospectivity for commercial sources of unconventional gas

3.1 Chapter overview

Chapter Three considers matters relating to the prospectivity of Victoria's geology for commercial sources of onshore unconventional gas. At present, exploration for unconventional gas in Victoria is at a very early stage. It is clear that there are deposits of unconventional gas, but it is not known whether the gas is commercially viable to extract.

The areas of Victoria where unconventional gas is most likely to be located are the Gippsland and Otway Basins. Most of the Gippsland and Otway Basins are located offshore in Bass Strait, with a smaller portion located onshore. It may be that unconventional gas could be located under the seabed, but at this point in time the technology does not exist that would make it commercially viable to locate and extract unconventional gas offshore.

From 2000 to 2014, prior to the extension of the moratorium, gas exploration companies (often called 'explorer companies') looked for unconventional gas onshore in the Gippsland and Otway Basins. The most significant outcome of this activity was the explorer company Lakes Oil's discovery of tight gas in Gippsland in 2004. It is not known, however, whether the tight gas found by Lakes Oil can be commercially produced.

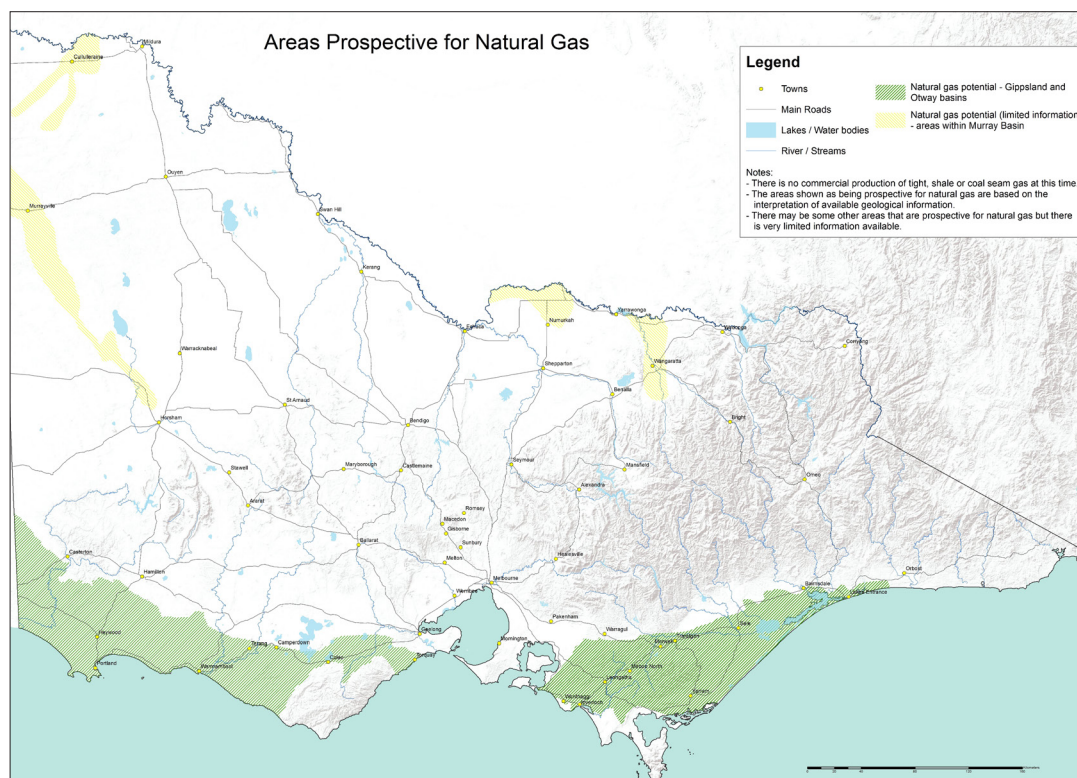
Chapter Three starts by providing some context to the discussion of prospectivity. It explains how gas resources and reserves are classified and measured. It looks at Victoria's conventional gas reserves, and unconventional gas reserves in other Australian jurisdictions.

The Chapter then provides a short history of exploration for unconventional gas in the Gippsland and Otway Basins and includes maps that show the historical and current exploration licences and permits over the regions. The Chapter draws on the reports on the prospectivity for conventional and unconventional gas for both the Gippsland and Otway regions produced by DEDJTR and authored by geologist, Dr Louise Goldie Divko. These reports form part of the water science studies commissioned by the Victorian Government to better understand the potential impacts of an unconventional gas industry.⁷⁰

⁷⁰ See: L. Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, DEDJTR, Melbourne; L. Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, DEDJTR, Melbourne.

Chapter Three concludes with a presentation of the views of stakeholders on the prospectivity for commercial quantities of unconventional gas in Victoria. It focuses on the views of Lakes Oil, Ignite Energy and Mecrus Resources, as they are the three explorer companies who state that they may have found commercially viable sources of unconventional gas.⁷¹

Figure 3.1 Areas of Victoria where unconventional gas may prospectively be located



Source: Department of Economic Development, Jobs, Transport and Resources (2015) Onshore Gas Community Information website; Government of Victoria (2015) Submission 658, p. 15.

3.2 Gas classification system

Petroleum resources and reserves – which include conventional and unconventional natural gas – are classified according to a system created by the Society of Petroleum Engineers.⁷² The classification system works on a continuum from an untested estimate toward commercial production. The Australian Council of Learned Academies (ACOLA) study of shale gas, chaired by Professor Peter Cook (henceforth referred to as ‘the ACOLA report’), provides a simplified explanation of the difference between ‘resources’ and ‘reserves’:

⁷¹ Mecrus Resources is primarily targeting oil shale, but states that gas may also be present with the oil shale. See: Mecrus Resources (2015) *Transcript of Evidence*, 23 September, pp. 15-16.

⁷² See: Society of Petroleum Engineers (2007) *Petroleum Resources Management System*, SPE.

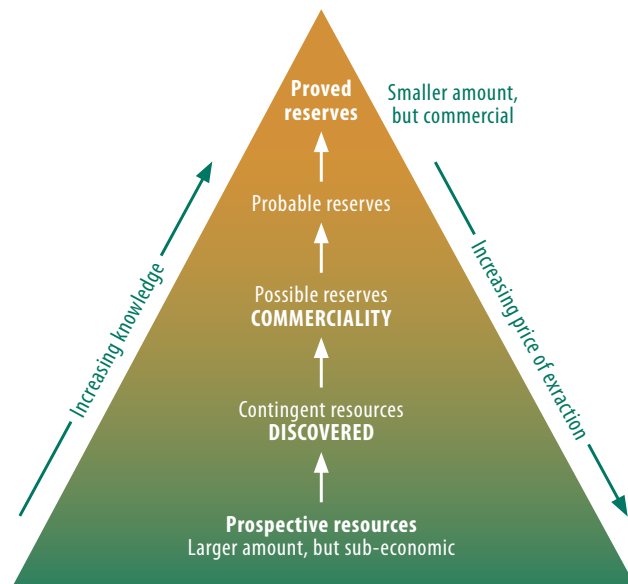
If the quantity of gas in the field is poorly known, perhaps only in a very speculative way, then it is likely to be classed as a resource. If it is known with great confidence because it has been extensively drilled and tested and it is very likely to be economic to extract the gas, then the quantity of gas in the field is referred to as a reserve.⁷³

Dr Goldie Divko, the author of DEDJTR's prospectivity reviews, explains that there are two categories of resources. The lowest category is called a 'prospective resource' which means an estimate based on geological data but not yet actually discovered.⁷⁴ The higher category is called a 'contingent resource' which is used when recoverable gas is actually discovered, and may be commercially viable to extract once certain contingences are satisfied (such as legal, logistical and technical issues).⁷⁵

The highest category is then the 'reserve' which is used when the gas is shown to be commercially recoverable. Dr Goldie Divko summarises: 'an undrilled prospect may be quantified with a prospective resource, if successful and whilst under evaluation it may contain a contingent resource, and once all the hurdles toward commercial production are cleared it may be considered a reserve.'⁷⁶

The system of resources and reserves is often depicted as a triangle, with the base of the triangle representing the large untested gas resource which may not be commercially viable, and the apex representing the usually much smaller, but commercially significant reserve.⁷⁷ Figure 3.2 provides an example of the triangle diagram showing the concept of resources and reserves:

Figure 3.2 System of resources and reserves



Source: P. Cook, Australian Council of Learned Academies (2013) *Engineering Energy: Unconventional Gas Production*, p. 42.

⁷³ Cook et al. (2013) *Engineering Energy*, op. cit., p. 40.

⁷⁴ Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., p. 10.

⁷⁵ *ibid.*

⁷⁶ *ibid.*

⁷⁷ Cook et al. (2013) *Engineering Energy*, op. cit., p. 41.

Dr Goldie Divko's prospectivity reviews of the Gippsland and Otway regions state that, at present, Victoria has no reserves of unconventional gas.⁷⁸ The Gas Market Taskforce report similarly communicated that:

Presently, all forms of unconventional natural gas (in shale, tight and coal seam formations) in Victoria are at an early stage of exploration and there is a lack of key information to estimate potential resource sizes. There is no production, commercial reserves or identified reserves of unconventional gas in Victoria.⁷⁹

Gas resources and reserves are measured in a number of ways including by energy (petajoules) and volume (cubic feet or metres). One petajoule equals 10¹⁵ joules. Cubic feet and metres of gas are measured in the billions ('bcf' and 'bcm') and trillions ('tcf' and 'tcm').⁸⁰

Additionally, the terms economic demonstrated resource or 'EDR' and sub-economic demonstrated resource or 'SDR' are also sometimes used. EDR means the quantity of resources that is judged to be economically extractable under current market conditions with current technology. SDR are similar to EDR in terms of certainty of occurrence but are considered to be potentially economic only in the foreseeable future.⁸¹

3.3 Victoria's conventional gas reserves

Victoria has large conventional gas reserves located in Bass Strait, which were first discovered in 1965 through a joint venture between BHP and ESSO. In 1969, the first gas from Bass Strait was piped to Melbourne, via the Longford processing plant near Sale.⁸² Ray Proudley writes in his history of the gas industry in Victoria that during the 1970s 'natural gas pipelines spread throughout the State, and town after town was incorporated into the transmission system supplied from the Bass Strait production platforms.'⁸³ Further gas fields in Bass Strait were discovered over the following decades, and today, Victoria is the second largest producer of conventional gas after Western Australia.⁸⁴ Australia's conventional gas basins are shown in Figure 3.3 below. These significant offshore reserves mean that Victoria is a large consumer of gas and has well developed gas infrastructure.⁸⁵

78 Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., p. 11; Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 10.

79 Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 18.

80 Ross & Darby (2013) op. cit., p. 9.

81 Bureau of Resources & Energy Economics (2013) *Energy in Australia*, p. xii; Australian Bureau of Statistics (2010) 'Mineral, Oil and Gas Resources', Year Book Australia, 2009-10.

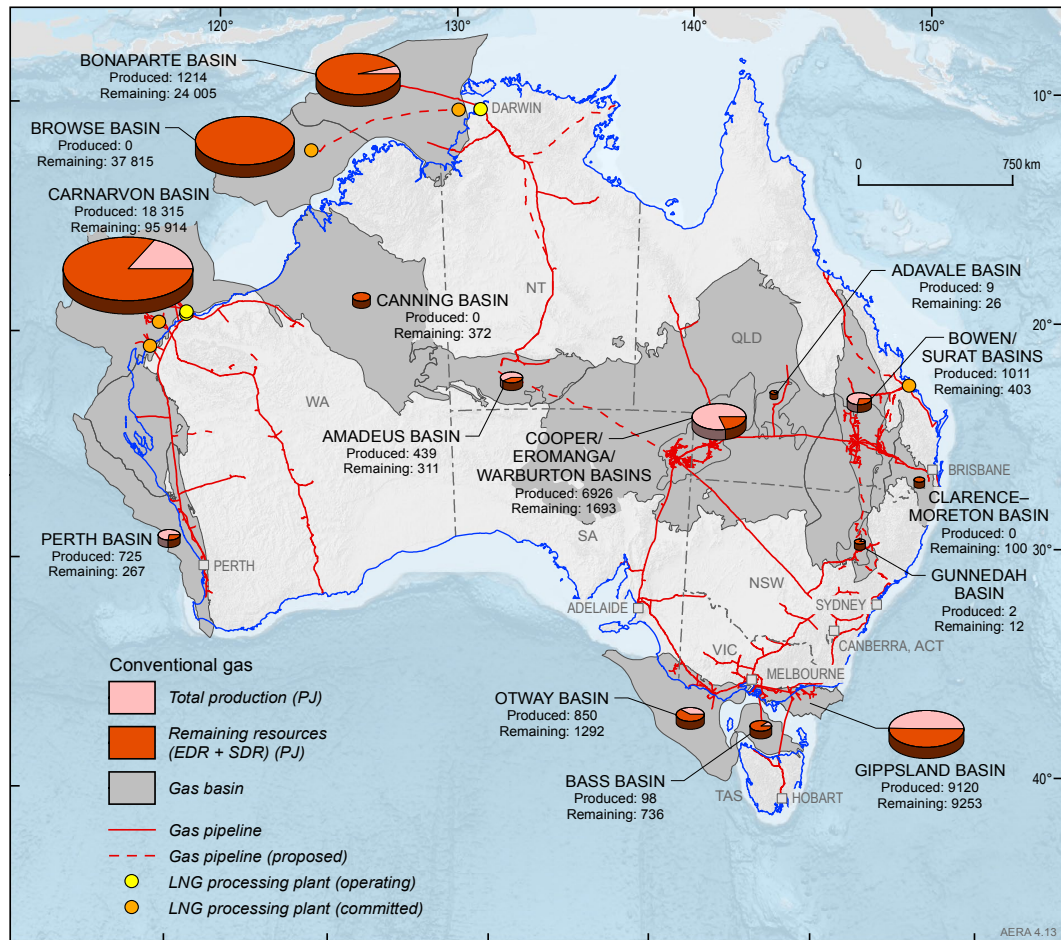
82 In the early 1960s, BHP secured acreage across much of the offshore Gippsland Basin and established a partnership with ESSO (later ExxonMobil) to search for oil and gas. In 1965, BHP and ESSO drilled the first well in Bass Strait and discovered the Barracouta gas field, further gas reservoirs were located in 1966 (and oil was discovered in 1967). In 1969, the first gas from Bass Strait was piped to Melbourne, via the Longford processing plant near Sale. See: BHP Billiton (2015) 'Our History: Petroleum in the Bass Strait', BHP Billiton website, p. 4; Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 6.

83 R. Proudley (1987) *Circle of Influence: A History of the Gas Industry in Victoria*, Melbourne, Hargreen, p. 8.

84 Ross & Darby (2013) op. cit., p. 6.

85 *ibid.*, Gas Market Taskforce (2013) *Gas Market Taskforce: Final Report*, op. cit. pp. 12-13.

Figure 3.3 Australia's conventional gas basins



Source: Geoscience Australia & Bureau of Resources and Energy Economics (2014) *Australian Energy Resource Assessment*, second edition, p. 94.

Most of Victoria's conventional gas comes from the offshore Gippsland Basin, with some coming from the offshore Otway Basin, and a minor amount coming from the Bass Basin (which is located entirely offshore in Bass Strait).⁸⁶ The gas is extracted by major energy companies including BHP Billiton, ExxonMobil, Origin and Santos. The VAGO report on unconventional gas states that DEDJTR 'has calculated that the production from offshore gas fields in Victoria is worth approximately \$1.5 billion annually.'⁸⁷

There has been significant exploration for onshore conventional gas reserves in Victoria since the 1950s.⁸⁸ No conventional gas has been found in the Gippsland region. In 1959, conventional gas was discovered near the Port Campbell township in the onshore Otway Basin. Dr Goldie Divko states that exploratory wells were then drilled across the onshore Otway Basin in the 1960s. From the late 1970s

⁸⁶ Ross & Darby (2013) op. cit., p. 6.

⁸⁷ VAGO (2015) op. cit., p. 5.

⁸⁸ *ibid.*, p. 3; Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., p. 22; Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 20.

until 2006 (particularly between 1986 and 2006) the Port Campbell Embayment was an active onshore gas producing region, until the discovered commercially viable gas was depleted.⁸⁹

Notably, in 2014, Origin Energy drilled an exploration well called 'Speculant-1' onshore in Nirranda South (about 30 kilometres south-east of Warrnambool) targeting conventional gas reservoirs in the offshore Otway Basin. The well is using extended-reach horizontal drilling technology to access gas fields located approximately five kilometres offshore and up to 2000 metres under the sea floor.⁹⁰ Stakeholders have differing views of whether the Minister's approval for the project was appropriate given the moratorium on onshore gas exploration.⁹¹

3.4 Unconventional gas in other Australian jurisdictions

In regard to unconventional gas in other Australian jurisdictions, coal seam gas is the only unconventional gas that is being commercially produced at this time. CSG has been commercially produced in Queensland since 1996 and in New South Wales since 2001. Exploration for CSG has occurred and continues in other states.

There is also exploration for shale and tight gas across Australia but no commercial production at the present time. There are no identified reserves of tight gas in Australia (Lakes Oil's discovery of tight gas in Gippsland is classed as a prospective resource). Santos announced in 2012 that it had successfully extracted shale gas from a well in the Cooper Basin in South Australia.⁹² Geoscience Australia states that Santos 'booked the first shale gas reserves' of two to three petajoules on the results of production from that well.⁹³

Coal seam gas in Queensland and New South Wales is extracted from black coal formations. Geoscience Australia states that the majority of identified CSG reserves are in Queensland in the Surat and Bowen Basins, with smaller amounts in the Clarence-Moreton Basin on the border of Queensland and New South Wales, and in the Gunnedah, Gloucester, and Sydney Basins in New South Wales. These basins and identified gas reserves are depicted in Figure 3.4 below:

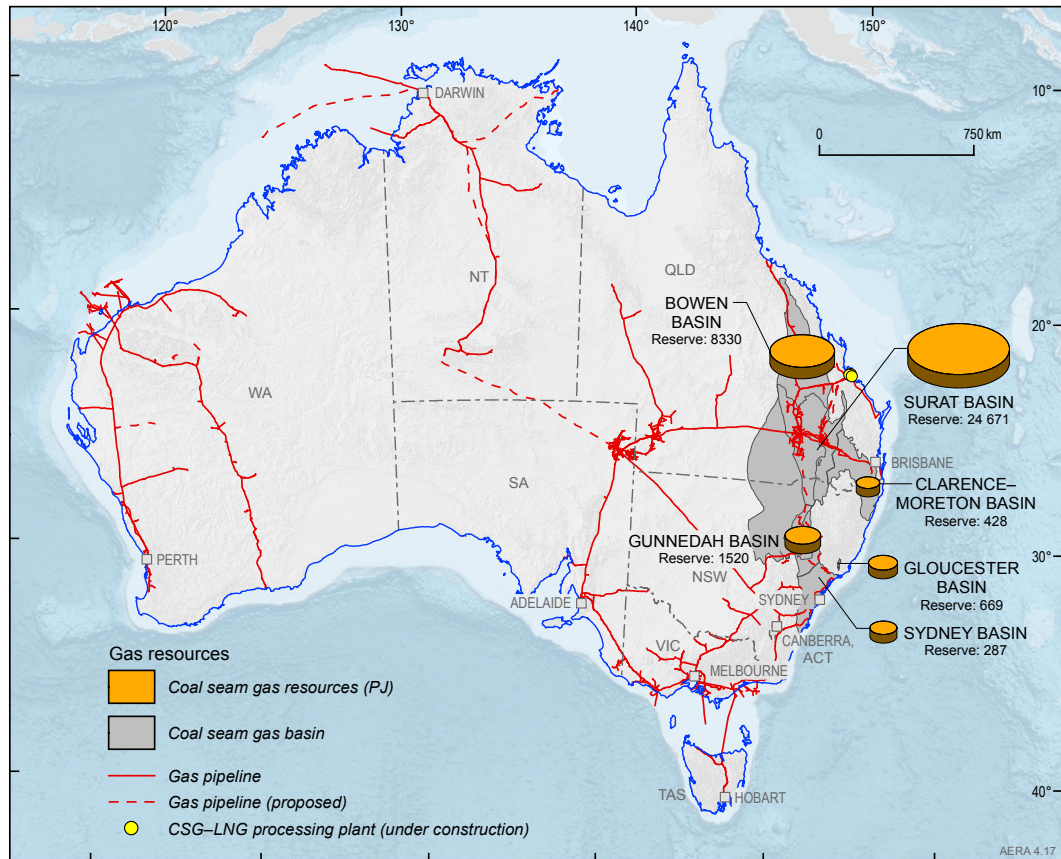
⁸⁹ Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., pp. 22-23.

⁹⁰ C. Hay (2014) 'Onshore well to test offshore gas field', Petroleum Exploration Society of Australia, 23 Septmeber.

⁹¹ See for example: Lakes Oil (2015) *Transcript of Evidence*, 6 October, p. 16. Mr O'Brien of Lakes Oil stated that: 'Origin was allowed to drill their directional horizontal well from onshore to offshore, 12 kilometres down the road, but we were not allowed to drill ours. This inconsistency is giving a lot of uncertainty for the area. We have recently had some large industry conferences in town where people just cannot understand why one has been allowed and not the other. There is just no scientific reasoning for it.'

⁹² Santos (2012) 'Santos Announces Start of Australia's First Commercial Shale Gas Production', Media Release, 19 October.

⁹³ Geoscience Australia & Bureau of Resources and Energy Economics (2014) *Australian Energy Resource Assessment*, second edition, p. 98.

Figure 3.4 Location of Australia's coal seam gas reserves

Source: Geoscience Australia & Bureau of Resources and Energy Economics (2014) *Australian Energy Resource Assessment*, second edition, p. 97.

The commercial production of CSG in Queensland has grown significantly in recent years as shown in Table 3.1 below. Energy companies extracting CSG in Queensland include Santos, Origin and QGC (previously Queensland Gas Company), which is part of the BG Group (formerly British Gas). Growth in the Queensland CSG industry has led to the development of export facilities at the Port of Gladstone on the mid-Queensland Coast, so that CSG can be exported to lucrative overseas markets in the form of liquefied natural gas or 'LNG'. This is an important development because it is affecting the operation of the eastern Australian gas market and is discussed in detail in Chapter Eight of this Report. Commercial production of CSG in New South Wales is on a smaller scale than in Queensland. Energy Companies involved in the CSG industry in New South Wales include AGL and Santos.⁹⁴

⁹⁴ Queensland Government (2015) 'Petroleum and coal seam gas', Business and Industry Portal website; Santos (2015) 'Coal seam gas', Santos website; Australia Pacific LNG (2015) 'About the project', Australia Pacific LNG website; QGC (2015) 'Who we are', QGC website; AGL (2015) 'Natural gas projects', AGL website.

Table 3.1 Australia's gas production by state in petajoules (2010–2014)

State		2010-11	2011-12	2012-13	2013-14
QLD	Total	322	336	312	342
	• Conventional	78	70	36	40
	• Coal Seam Gas	244	266	276	302
NSW	Coal Seam Gas	7	6	6	5
VIC	Conventional	421	401	441	412
SA	Conventional	54	59	76	66
WA	Conventional	1 380	1 283	1 558	1 604
NT	Conventional	24	27	26	27
Australia		2 208	2 112	2 419	2 456

Source: Department of Industry and Science (August 2015) Australian Energy Statistics, Table R, Canberra.

3.5 Unconventional gas in Victoria – Geology

In Victoria, the onshore portions of both the Gippsland and Otway Basins have been identified as regions where unconventional gas may prospectively be found. Notably, this does not guarantee that the unconventional gas is actually there, or if it is there, that it would be commercially viable to extract. Rather, it means that the geology of these areas is such that it is possible that unconventional gas may be there.

The different layers of rock in the onshore portions of the Gippsland and Otway Basins have geological names and the description of different geological layers is called 'stratigraphy'. In both basins there are particular stratigraphic groups which are most likely to hold deposits of unconventional gas.

The Gippsland Basin extends along the southeast coast and offshore of Victoria and contains a thick sequence of Cretaceous and Tertiary age rocks. The three main stratigraphic groups, from oldest to youngest, are the Strzelecki, Latrobe and Seaspray Groups as described by Dr Goldie Divko as follows:

...three broad stratigraphic successions across Gippsland (based on lithological variations) are generally recognised. These stratigraphic groups comprise (a) the Strzelecki Group, a thick sequence of non-marine volcanoclastic rich sediments; (b) the Latrobe Group, a sequence of marine and non-marine siliciclastics that host all the known hydrocarbon occurrences in the offshore Gippsland Basin; and (c) the Seaspray Group, a carbonate-dominated succession that is the regional seal to the top Latrobe Group oil and gas accumulations.⁹⁵

Of these groups, the Strzelecki and Latrobe Groups are considered the most comparatively prospective for gas.⁹⁶

⁹⁵ Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 16.

⁹⁶ *ibid.*, p. 5.

The Otway Basin extends for 500 kilometres along the south-west coast of Victoria, across into South Australia and offshore.⁹⁷ Within the Otway Basin, six main stratigraphic groups have been identified, which include the: Otway, Sherbrook, Wangerrip, Nirranda, Heytesbury and Bridgewater Bay Groups.⁹⁸ Dr Goldie Divko states that within this regional stratigraphic sequence the Cretaceous and Jurassic aged Waarre Formation, Pretty Hill Formation, Eumeralla Formation, Casterton Formation and Killara coal measures have the most potential for gas.⁹⁹

3.5.1 Coal seam gas and brown coal

Significantly, as was mentioned in Chapter Two, Victoria has predominantly brown coal deposits, as opposed to the substantial black coal deposits in Queensland and New South Wales, and this may impact on the prospectivity of coal seam gas in this State. As the Victorian Parliamentary Library research paper on unconventional gas explains:

In regard to Victoria's potential coal seam gas resources, it is important to note that the production of CSG in Queensland and New South Wales is from black coal deposits (bituminous and sub-bituminous coals). The kind, or rank, of coal is an integral factor in determining the gas properties of coal seams. It may be that Victoria's brown coal (lignite) deposits yield less coal seam gas than black coal deposits. It may also be the case that if there is coal seam gas in Victoria's brown coal deposits it may be harder to extract and hence more costly to produce than CSG from black coal deposits.¹⁰⁰

The VAGO report on unconventional gas states that there is no commercial production of CSG from brown coal anywhere in the world.¹⁰¹ It was submitted to the Committee that CSG is commercially produced from brown coal in the Powder River Basin in the United States and that this could provide a model for Victoria.¹⁰² The Committee found, however, that there is insufficient evidence to confirm this and that it is unlikely to be the case. Research undertaken by the Committee suggests that the coal in the Powder River Basin is sub-bituminous (black) not lignite (brown).¹⁰³ Mr Dane Stewart, a geologist from Ignite Energy Resources (the company targeting CSG in Gippsland's brown coal), similarly stated to the Committee that the coal in the Powder River Basin is 'sub-bituminous' coal.¹⁰⁴

⁹⁷ Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., p. 14.

⁹⁸ *ibid.*, p. 16.

⁹⁹ *ibid.*, p. 5.

¹⁰⁰ Ross & Darby (2013) op. cit., p. 12; T. Moore (2012) 'Coalbed Methane: A Review', *International Journal of Coal Geology*, iss. 101, pp. 50-52, 54, 58, 75.

¹⁰¹ VAGO (2015) op. cit., p. 2.

¹⁰² Latrobe City Council (2015) Submission 354: Appendix 1: MWH (October 2012) *Report: Briefing Paper on Coal Seam Gas in the Latrobe Valley*, Prepared for Latrobe City Council, p. 12. The report states that: 'In Australia, all CSG projects involve extraction of gas from black coal reserves and it has been assumed in this study that exploration in Latrobe City and vicinity is targeting CSG from brown coal reserves. It is less likely but possible that CSG could be extracted from brown coal, as there is at least one case where viable extraction of CSG from brown coal has been achieved on a large scale in the United States (Powder River Basin).'

¹⁰³ Briefing provided by the Energy and Environment Research Center, University of North Dakota.

¹⁰⁴ D. Stewart, Ignite (2015) *Transcript of Evidence*, 1 July, p. 7.

A number of submissions to the Committee state that there is unlikely to be commercial quantities of CSG in Victoria.¹⁰⁵ Mr Rob Annells, Chairman of Lakes Oil said that in his personal opinion he doubts whether there is any CSG in Victoria.¹⁰⁶ Mr Tim O'Brien, of Lakes Oil, has similarly stated to the Committee that: 'A lot of the focus has been on coal seam gas, which is probably the least likely resource to be produced in Victoria'.¹⁰⁷ The VAGO report on unconventional gas states that 'Greater possibilities appear to exist for tight and shale gas than CSG, which would make some of the risks and considerations, and even the footprint on the landscape, different from the experiences in Queensland and New South Wales'.¹⁰⁸

3.6 Unconventional gas in Victoria – History of exploration

Exploration for unconventional gas in Victoria was contemplated during the 1980s and 1990s but properly began around the year 2000.¹⁰⁹ As stated earlier in this Report, licensing for the exploration of CSG is regulated under the Minerals Act and licensing for the exploration of tight and shale gas is regulated under the Petroleum Act.¹¹⁰

The VAGO report states that between 2000 and 2014, at least 100 active licences allowed exploration for unconventional gas in Victoria, which often included multiple work plans under the one licence and a range of exploration activities including seismic surveys, drilling for rock cores and gas well drilling, testing, and some instances of fracking.¹¹¹ These licences were issued by the departments which administered the Minerals and Petroleum Acts prior to DEDJTR: the Department of Natural Resources and Environment (1996-2002); the Department of Primary Industries (2002-13); and the Department of State Development, Business and Innovation (2013-14).

A key function of the Department which administers the Minerals and Petroleum Acts is to actively promote the development of the State's earth resources by assigning rights to companies for exploration.¹¹² As the Victorian Government inter-departmental submission to the Committee explains 'The role of government has traditionally been to provide pre-competitive information and incentives for explorers to invest in a particular jurisdiction'.¹¹³

Prior to the moratorium, the Department allocated exploration rights for CSG under the Minerals Act when a company made a direct application (subject to an approvals process), and through a competitive tender (acreage release) process for

¹⁰⁵ For example see: G. Carman (2015) *Transcript of Evidence*, 13 August, p. 22; Friends of the Earth (2015) Submission 466, p. 2; C. Walker (2015) *Transcript of Evidence*, 13 August, p. 3; Mecrus Resources (2015) Submission 247, p. 1; Mecrus Resources (2015) *Transcript of Evidence*, 23 September, p. 15.

¹⁰⁶ R. Annells, Lakes Oil (2015) *Transcript of Evidence*, 1 July, p. 6.

¹⁰⁷ T. O'Brien, Lakes Oil (2015) *Transcript of Evidence*, 6 October, p. 14.

¹⁰⁸ VAGO (2015) op. cit., p. xii.

¹⁰⁹ *ibid.*, p. 3.

¹¹⁰ See section 2.6 of this Report.

¹¹¹ VAGO (2015) op. cit., pp. 43-45.

¹¹² *ibid.*, pp. 53, 55-56.

¹¹³ Government of Victoria (2015) Submission 658, p. 55.

exploration rights under the Petroleum Act, which included the rights to explore for shale and tight gas (see Appendix 4 for details). The Victorian Government inter-departmental submission explains that pre-competitive geological data is included in the acreage release packages. It states that the package would include 'A combination of regional data acquisition, such as geophysical surveys, new interpretations of geology and prospectivity, and open file company data collected in previous exploration attempts.'¹¹⁴

3.6.1 Explorer companies

The Report of the Parliament of Victoria's Economic Development and Infrastructure Committee's 2012 Inquiry into Greenfields Mineral Exploration explains that it has become common in recent decades for junior explorer companies to prospect for new resources, rather than the big mining companies.¹¹⁵ If the explorer company is successful it may then sell its find to a larger mining company to produce the resource. Evidence to the Greenfields Mineral Exploration Inquiry from Mr Richard Schodde of MinEx Consulting suggested that:

... the junior sector has got a much shorter time frame to work on than the majors. At any one time a junior company, on average, has got two years with cash in the bank, so they have got to deliver results in the next two years otherwise they will not get funding in the future. They are always on a very short fuse.¹¹⁶

The evidence of Mr Tim Goldsmith from PricewaterhouseCoopers to the Greenfields Mineral Exploration Inquiry, similarly stated that successful small companies 'do not have a huge amount of funds and do not necessarily have huge amounts of technology to utilise but do have an awful lot more hunger and want to make sure that every dollar is used to its full potential'.¹¹⁷

The companies with licences and permits which allow for the exploration of unconventional gas in Victoria are explorer companies, with the exception of Beach Energy Ltd, which is an explorer and a production company, but is presently focusing on South Australia.¹¹⁸

The following exchange between Committee Member the Hon. Richard Dalla-Riva and Mr Barry Richards, Managing Director of the explorer company Mecrus Resources, provides an example of the relationship between junior explorer companies and larger production companies:

Mr DALLA-RIVA — ... From my understanding Mecrus is an exploration company ... Can I just get some clarification? Once Mecrus finds a site at which it can demonstrate there is a resource, do you then undertake the removal of the gas or oil, or do you then onsell the licence?

¹¹⁴ *ibid.*, p. 8.

¹¹⁵ Parliament of Victoria, Economic Development & Infrastructure Committee (2012) *Inquiry into Greenfields Mineral Exploration and Project Development in Victoria*, EDIC, Melbourne, pp. 10-11.

¹¹⁶ *ibid.*, p. 11.

¹¹⁷ *ibid.*, pp. 11-12.

¹¹⁸ Beach Energy (2015) Submission 478, p. 1. Beach holds permits in the Otway Basin across both Victoria and South Australia, and states that it has been focusing its exploration in South Australia (in the Otway and Cooper Basins) since the moratorium was imposed in Victoria. Beach did not give evidence at a Committee hearing.

Mr RICHARDS — That will be an economic decision at the time. This area is expensive. We are a small private company. That is the reality. We will need support in developing this. How do we go about achieving that? We have talked to other organisations about supporting us, but our overriding objective is to maintain control and benefit for our state and our country as far as we are concerned as a business. We would want to maintain influence over that. But financially this could well get to a stage where we will only be a bit player; that is the reality. It would be nice if the state government contributed to help us out, but I do not know where the funding will come from. We are not about exploring and just dropping it; we will stay involved in one form or another. To what percentage? Yet to be seen.¹¹⁹

3.6.2 Details of unconventional gas exploration licences and permits

The tables in the following sections of this Report list the unconventional gas exploration licences and permits issued by the Department to explorer companies from 2000 to 2014. Maps showing the areas that the exploration licences cover or did cover are also provided. Exploration licences for CSG issued under the Minerals Act are called 'exploration licences' and are commonly abbreviated to 'EL', whereas the Petroleum Act provides for the issuing of 'exploration permits' and 'retention leases' which are commonly abbreviated to 'PEP' and 'PRL'. A petroleum retention lease or 'PRL' enables exploration permit holders to retain petroleum discoveries that are currently not commercially viable but may become so within 15 years.¹²⁰ Licences and permits issued under the Minerals and Petroleum Acts are discussed in Chapter 7 of this Report and further details are provided in Appendix 4.

Some of the ELs and PEPs that were issued have now expired or were cancelled or surrendered, and some are still active (but not currently being pursued because of the moratorium). The tables and maps below list licences and permits according to the basin they are looking in (Gippsland or Otway), their target (CSG or shale and tight gas), and whether the licence or permit is still active or not.

3.6.3 Onshore Gippsland Region: Historical coal seam gas exploration licences

The first exploration licences for CSG in the Gippsland region were granted in August 2001 under the Minerals Act. Between 2001 and May 2012, 35 separate exploration licences were granted. Dr Goldie Divko explains that some companies had specifically targeted CSG, whereas others may have undertaken multi-commodity exploration that could include CSG.¹²¹

Table A below lists the exploration licences for CSG in the Gippsland region that are no longer current because they expired or were cancelled or surrendered. Figure A then provides a map which depicts the areas where these licences were.

¹¹⁹ Mecrus Resources (2015) *Transcript of Evidence*, 23 September, p. 19.

¹²⁰ Ross & Darby (2013) op. cit., p. 9.

¹²¹ Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 24.

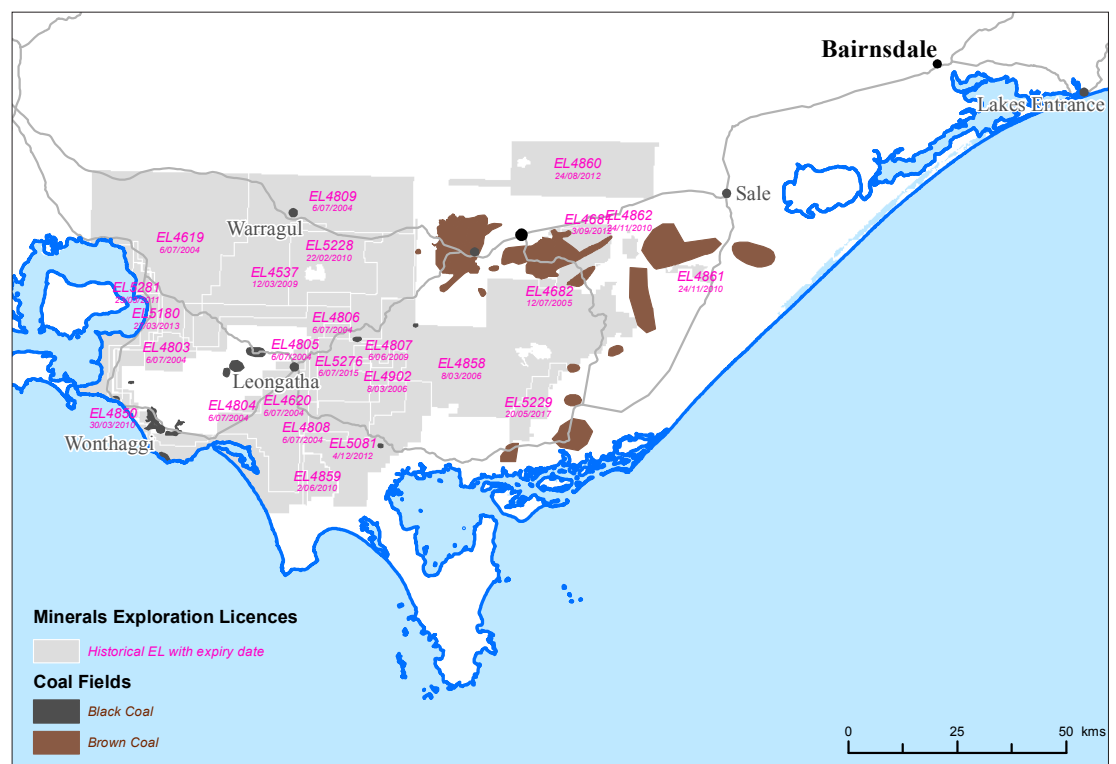
Cancelled, surrendered and expired exploration licences that included CSG in the Gippsland region

Table A

Company	Exploration Licence	Target/activities
Flatoak	4850	Cretaceous black coals in the Wonthaggi-Korumburra-Inverloch region; thin seams <3m. No record of on-ground activities.
Greenpower Natural Gas	4619, 4620, 4803, 4804, 4805, 4806, 4807, 4808, 4809, 5228	Company annual reports indicate a focus on lignite resources for conventional mining and coal to liquids technology.
Karoon Gas	4537	Tested Strzelecki Group for CSG and conventional gas potential (latter under a PEP). Drilled two wells (Megascolides-1 and -2) in 2004 and 2007, respectively.
Leichhardt Resources	5081	Coals near Fish Creek targeted for CSG, coal mining and conversion to Syngas – desktop reviews and modelling carried out. No on-ground activities reported.
Monash Energy Coal	4681, 4682	No report available.
Mr Stanislaw Wassylko	5229	No report available.
Sawells – Greenpower Energy	4858, 4860, 4861, 4862, 4859, 4902	Sub-bituminous to high volatile bituminous black coal seams of the Wonthaggi Formation, Strzelecki Group. Desktop studies and drill-hole location plans.
Seamair	5180	CSG in Strzelecki Group black coals near the Kongwak Monocline. Desktop studies only to plan drill holes. No on-ground activities.

Source: L. Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 23.

Figure A



Source: L. Goldie Divko (2015) *Geological Survey of Victoria*, Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria.

3.6.4 Onshore Gippsland Region: Current coal seam gas exploration licences

There are 16 exploration licences that include CSG as a target resource that are current over the Gippsland region. Ignite Energy Resources holds the current exploration licence for the 3800 km² EL 4416, which is the largest exploration licence in Gippsland (discussed further in section 3.7.2 of this Report). Table B below lists the current exploration licences that include CSG in the Gippsland region. Figure B then provides a map which depicts the areas the licences cover.

3.6.5 Onshore Gippsland Region: Current petroleum exploration permits and retention leases

There are two petroleum exploration permits (PEPs) and two Petroleum Retention Leases (PRLs) in the onshore Gippsland Basin. Companies are not required to state what resource they are targeting under a PEP. The permits are held by Lakes Oil and Icon Energy. Both companies have said that they are targeting tight gas.¹²² The permits and retention leases are listed in Table C and Figure C provides a map which shows the areas the PEPs and PRLs cover. In regards to exploration for shale gas in the Gippsland region, Dr Goldie Divko states that no petroleum exploration permit holder has indicated that they are searching for shale gas in the Gippsland region.¹²³ Lakes Oil has stated that it is interested in exploring and producing oil in PRL 3.¹²⁴

3.6.6 Onshore Otway Basin: Historical coal seam gas exploration licences

The first exploration licence for CSG in the Otway Basin was issued in 2000. Between the years 2000 and 2013, 22 exploration licences for CSG were granted or renewed. Most of these, however, had expired, been surrendered or cancelled by 2004.¹²⁵ Dr Goldie Divko states that results from drilling programs targeting CSG by Purus Energy and Easter Star Gas were ‘disappointing’ and that exploration for CSG in the Otway Basin to date has been unsuccessful.¹²⁶

Table D below lists the exploration licences for CSG in the Otway Basin that are no longer current because they expired or were cancelled or surrendered. Figure D then provides a map which depicts the areas where these licences were.

122 Lakes Oil (2015) Submission 510; Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 24.
123 Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 37.
124 *ibid.*, p. 24.
125 Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., p. 24.
126 *ibid.*, pp. 6, 47.

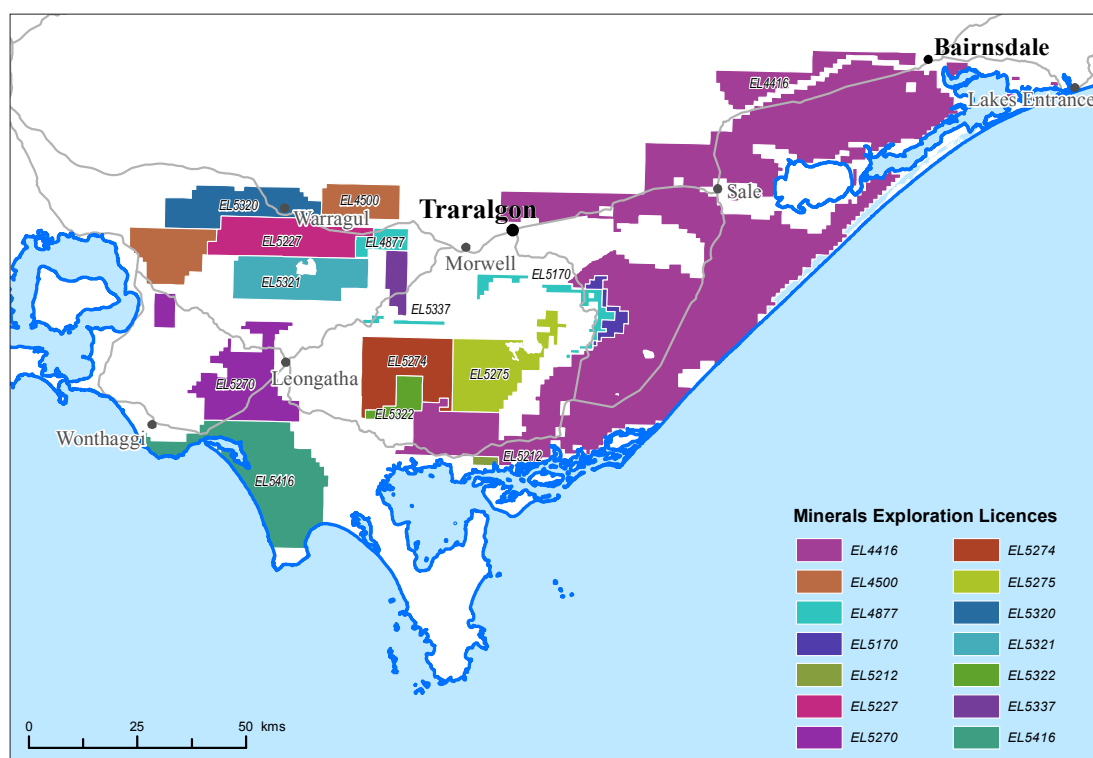
Current exploration licences that include CSG as a target in the Gippsland region

Table B

Tenement	District	Municipality	Primary Owner
EL4500	Gippsland	Cardinia Shire	Greenpower Natural Gas
EL4416	Gippsland	Wellington Shire	Ignite Energy Resources
EL4877	Gippsland	Baw Baw Shire	Sawells
EL5210	Gippsland	Baw Baw Shire	Resolve Geo
EL5212	Gippsland	South Gippsland Shire	Resolve Geo
EL5227	Gippsland	Baw Baw Shire	Greenpower Natural Gas
EL5270	Gippsland	South Gippsland Shire	Clean Global Energy
EL5276	Gippsland	South Gippsland Shire	ECI International
EL5320	Gippsland	Baw Baw Shire	ECI International
EL5321	Gippsland	Baw Baw Shire	ECI International
EL5337	Gippsland	Baw Baw Shire	Mantle Mining Corporation
EL5170	Gippsland	Wellington Shire	La Trobe Fuels
EL5274	Gippsland	South Gippsland Shire	ECI International
EL5275	Gippsland	Wellington Shire	ECI International
EL5322	Gippsland	South Gippsland Shire	ECI International
EL5416	Gippsland	South Gippsland Shire	Leichhardt Resources

Source: L. Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 27.

Figure B



Source: L. Goldie Divko (2015) *Geological Survey of Victoria*, Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria.

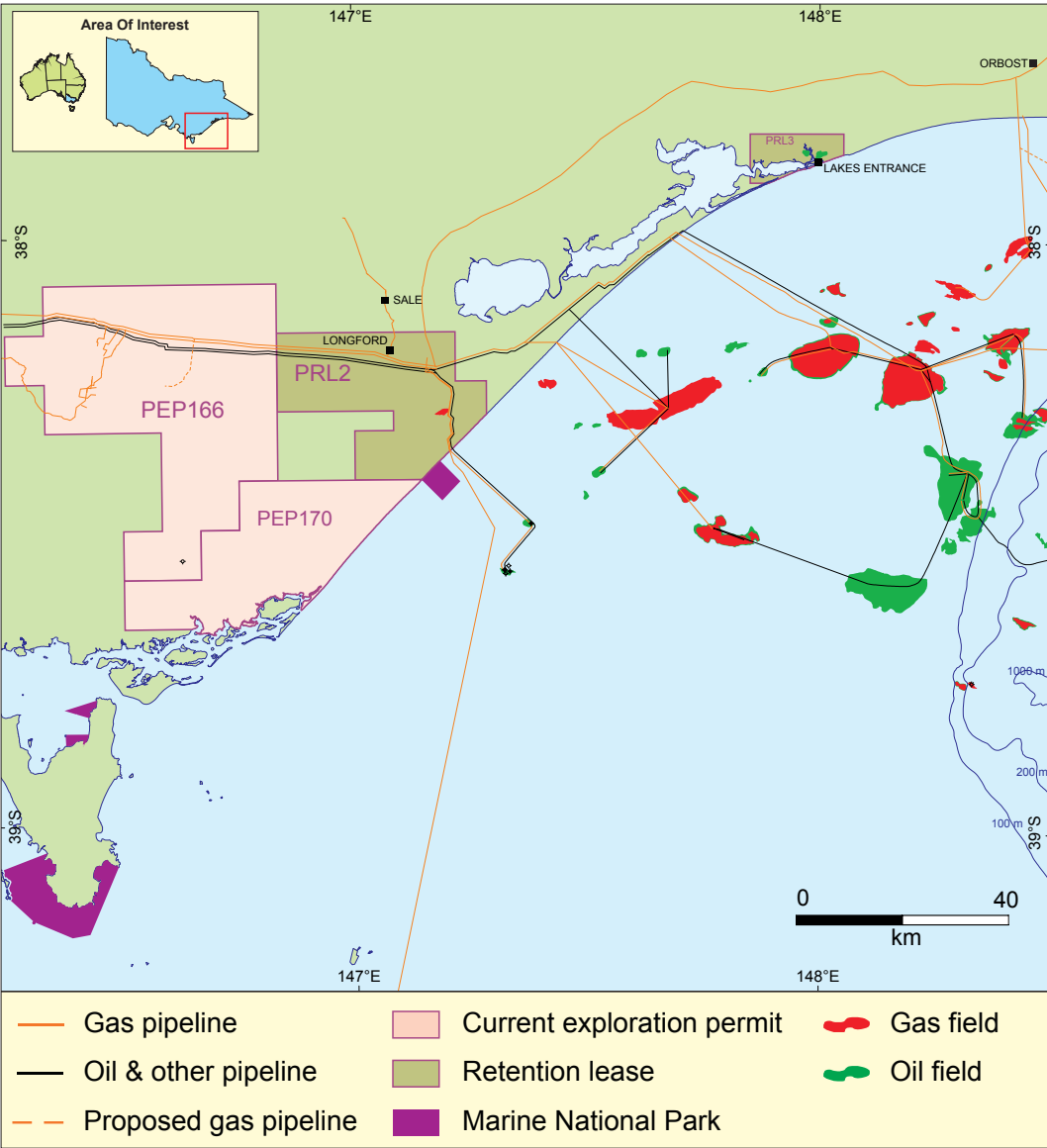
Current petroleum exploration permits and retention leases in the Gippsland region

Table C

Petroleum exploration permits (PEP) and Petroleum retention leases (PRL)	Primary Owner
PEP 166	Lakes Oil
PEP 170	Icon Energy
PRL 2	Lakes Oil
PRL 3	Lakes Oil

Source: L. Goldie Divko (2015). *A review of Gas Prospectivity: Gippsland Region*. Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 24.

Figure C



Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Gippsland Region*. Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 25.

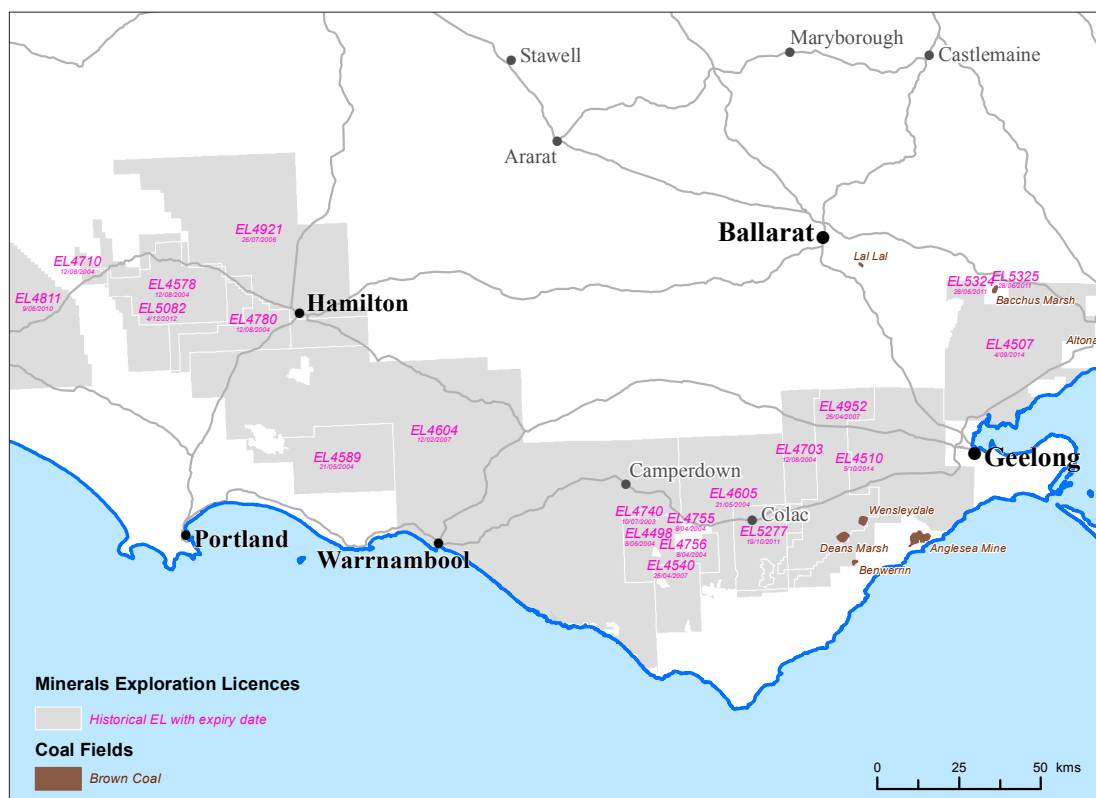
Cancelled, surrendered and expired exploration licences that included CSG in the Otway Basin

Table D

Primary owner	Exploration Licence	Target/activities
Eastern Star Gas	4507, 4510	Drilled four wells (one in the Bells Beach Syncline and three in the Parwan Trough); production testing at the 'Oak Park pilot' including high pressure water injection testing (fracturing).
ECI International	5277	Desktop reviews only
Greenpower Natural Gas	4811	Desktop reviews only
Ironbark Mineralsands	4540, 4498, 4755, 4756	A wholly owned subsidiary of Purus – formed in 2001 to explore for coal seam gas and mineral sands
Leichhardt Resources	5082	Desktop reviews only
Mantle Mining Corporation	5324, 5325	Desktop reviews; drilling to intersect the Maddingley coal seams in adjoining tenements
Purus Energy	4578, 4604, 4710, 4740, 4589, 4703, 4605, 4780, 4921, 4952	Targeted Early Cretaceous coals at the base of the Eumeralla Formation. Drilled seven wells over two project areas – Gordon and Hawkesdale – to test coal seam gas potential
Western Victoria Energy	4507	Took over lease from Eastern Star – not focused on CSG; potential for underground coal gasification and coal liquification investigated; water formation laboratory tests conducted.

Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Otway Region*. Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 26.

Figure D



Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Otway Region*. Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 25.

3.6.7 Onshore Otway Basin: Current exploration licences that include CSG as a target

In 2015, there are only two small exploration licences which include CSG in the Otway Basin remaining. Both licences are held by Mantle Mining who Dr Goldie Divko states is targeting the development of brown coal resources.¹²⁷ The licences are listed in Table E below. Figure E provides a map showing the location of these two licences.

Current exploration licences that include CSG as a target in the Otway Basin

Table E

Exploration Licence	Company
5294	Mantle Mining Corporation
5323	Mantle Mining Corporation

Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Otway Region*, Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 26.

Figure E



Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Otway Region*, Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 29.

127 Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, op. cit., p. 29.

3.6.8 Onshore Otway Basin: Current petroleum exploration permits

The Eumeralla Formation in the Otway Basin has been identified as prospective for tight gas.¹²⁸ The Casterton Formation may be prospective for shale gas. Dr Goldie Divko states that the Casterton Formation is known to occur in the Penola Trough in Western Victoria near the South Australian border, and that this area may be the most prospective for shale gas. She adds, however, that this may be because there is more data available for that area than for other areas.¹²⁹ Dr Goldie Divko states that most of the Otway Basin is covered by nine petroleum exploration permits held by four companies, which are listed in Table F below.¹³⁰ Figure F shows the location of the nine permits.

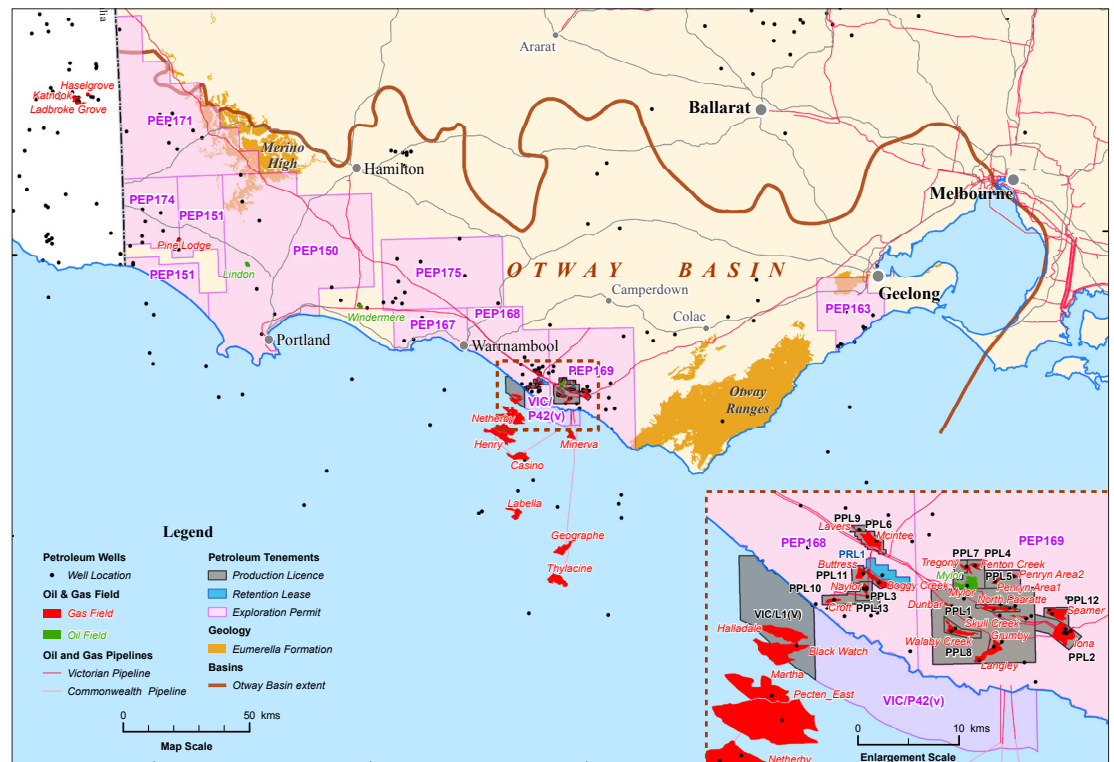
Petroleum exploration permit holders in the Otway Basin

Table F

Tenement	Operator	Tenement	Operator
PEP150	Mawson Petroleum [Beach Energy]	PEP169	Mirboo Ridge [Lakes Oil]
PEP151	Bridgeport Energy	PEP171	Beach Energy
PEP163	Mirboo Ridge [Lakes Oil]	PEP174	Mecrus Resources
PEP167	Mirboo Ridge [Lakes Oil]	PEP175	Mirboo Ridge [Lakes Oil]
PEP168	Beach Energy		

Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Otway Region*. Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 27.

Figure F



Source: L. Goldie Divko (2015). *A Review of Gas Prospectivity: Otway Region*. Department of Economic Development, Jobs, Transport and Resources, Melbourne, Victoria, p. 28.

128 *ibid.*, pp. 58, 62.

129 *ibid.*, pp. 59, 63.

130 *ibid.*, p. 27.

3.7 Lakes Oil, Ignite Energy Resources and Mecrus Resources

This section provides information about the three explorer companies who stated to the Committee that they may have found commercially viable sources of unconventional gas in Victoria: Lakes Oil, Ignite Energy Resources and Mecrus Resources. Lakes Oil and Ignite Energy have published their estimates of onshore unconventional gas.¹³¹ Mecrus Resources is an unlisted private company and has not published its estimates but has submitted them to the Committee.¹³²

3.7.1 Lakes Oil N.L.

Lakes Oil N.L. is an ASX listed oil and gas explorer company, formed in 1946 and named after Lakes Entrance in Gippsland.¹³³ Its website states that 'Lakes has also kept alive the pioneering spirit of a once larger band of optimistic junior explorers willing to tackle programs in which more cautious major companies have declined to take part.'¹³⁴ Lakes Oil states in its submission to the Committee that its primary focus for the last 20 years has been exploring the onshore potential of the Gippsland and Otway Basins, on which it has spent in excess of \$80 million over that time.¹³⁵ Lakes Oil has determined on the basis of studying the information provided by previous exploration and on its own exploration, that 'Victoria is very prospective for onshore unconventional and conventional gas of a significant enough volume to underpin Victoria's domestic and industrial needs on a cost effective basis for decades to come.'¹³⁶

Lakes Oil states that it is focusing relatively deep underground on the Early Cretaceous Strzelecki and Tyers Groups in the Gippsland Basin, and on the Early Cretaceous Otway and Crayfish Groups in the Otway Basin.¹³⁷ Lakes Oil states that the 'prospective in-place onshore gas resources within these deeper formations rival those from any basin around the world with just further work required to prove that these resources can be recovered at commercial rates'.¹³⁸

As stated previously in this Report, Lakes Oil discovered tight gas near Seapray in Gippsland in 2004. Dr Goldie Divko explains that the Strzelecki Group has been a primary target for tight gas exploration since the late 1990s, and Lakes Oil's discovery of tight gas there is, to date, Victoria's only unconventional gas discovery.¹³⁹

¹³¹ Lakes Oil (2015) Submission 510; Ignite (2015) *Transcript of Evidence*, 1 July.

¹³² Mecrus Resources (2015) Submission 247; Mecrus Resources (2015) *Transcript of Evidence*, 23 September.

¹³³ NL stands for 'no liability'; Lakes Oil (2015) Submission 510, p. i.

¹³⁴ Lakes Oil (2015) 'Welcome to Lakes Oil', Lakes Oil website.

¹³⁵ Lakes Oil (2015) Submission 510, p. 1.

¹³⁶ *ibid.*, p. 2.

¹³⁷ *ibid.*, p. 6.

¹³⁸ *ibid.*, p. 7.

¹³⁹ Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, *op. cit.*, pp. 5, 20, 35.

Lakes Oil has defined three gas accumulations known as the Wombat, Trifon and Gangell fields, which cover a combined area of 27 km² in the Seaspray Depression.¹⁴⁰ Lakes Oil has estimated that the fields host 1.7 trillion cubic feet of gas, but Dr Goldie Divko states that whether 'gas is distributed throughout the Strzelecki Group in quantities that may prove to be commercial is unknown.'¹⁴¹ Lakes Oil undertook hydraulic fracturing operations prior to the imposition of the moratorium in 2012.¹⁴²

Lakes Oil also submitted to the Committee its belief that – based on their studies of previous exploration in the Otway Basin – there are prospectively commercial amounts of tight gas in the Otway Basin.¹⁴³ Lakes Oil wrote to the Committee seeking permission to drill two 'proof of concept' wells to test the productivity of its sites in the Otway Basin and provide information to assist the Committee's understanding of Victoria's prospectivity.¹⁴⁴ The Committee determined that this is a matter for the Government to consider.

3.7.2 Ignite Energy Resources

Ignite Energy Resources, an unlisted company, holds the largest current exploration licence in Gippsland: EL 4416 which covers 3800 km².¹⁴⁵ Ignite is targeting CSG from the brown coal (lignite) in the area. Ignite states that the brown coals prospectively host 3.7 trillion cubic feet of gas.¹⁴⁶ The Victorian Government inter-departmental submission to the Committee states, however, that 'To date there have been no direct measurements of the gas content of the coals and whether the gas could be extracted' and that this prospective estimate, which is based on the assumed gas content, could be subject to change if it was found that the actual gas content or producibility was lower (or higher).¹⁴⁷

Ignite explained to the Committee that they are looking to exploit the biogenic gas in the deeper lignite seams in Gippsland.¹⁴⁸ Dr John White from Ignite emphasised the difference between the geological and physical circumstances of thermogenic gas from older black coals and the biogenic gas from the much younger brown coals that Ignite is interested in.¹⁴⁹ He stated that the water Ignite has 'sampled from lignite seams around Burong is of agricultural quality' and that it would be unlikely that the lignite would require fracking.¹⁵⁰

¹⁴⁰ Government of Victoria (2015) Submission 658, p. 20, Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., p. 35.

¹⁴¹ *ibid.*, pp. 5, 35.

¹⁴² *ibid.*, p. 36.

¹⁴³ Lakes Oil (2015) Submission 510, p. 4.

¹⁴⁴ Correspondence from Lakes Oil, Lakes Oil (2015) Submission 510, pp. i-ii.

¹⁴⁵ Ignite (2015) *Transcript of Evidence*, 1 July; Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, op. cit., pp. 27-28. Note: Goldie Divko provides further details here on the history of EL 4416.

¹⁴⁶ *ibid.*

¹⁴⁷ Government of Victoria (2015) Submission 658, p. 20.

¹⁴⁸ Ignite (2015) *Transcript of Evidence*, 1 July, p. 2.

¹⁴⁹ *ibid.*, p. 4.

¹⁵⁰ *ibid.*, pp. 2-3.

Dr White and Mr Dane Stewart from Ignite both emphasised that the project is at a very early stage and the commercial viability of producing gas from the brown coals is not yet known, and has not been done anywhere else in the world. Mr Stewart stated that 'There has not been a gas extraction operation that has used coal anywhere near as young as what we are proposing.'¹⁵¹ Mr Stewart further explained to the Committee that:

We are nowhere near the stage of an operation at the moment. We really are trying to figure out a ground truth this resource estimate that we have done and figure out the commerciality of the resource that is under there. We are a really long way away from understanding what an operation here might look like, so we will not know where any surface infrastructure would be or how many wells or even employees or anything like that. This is purely, as John said, research. There is potential for a commercial operation here, and we recognise that. That is why we are here. However, we are a long way away from being able to define exactly what this operation will look like. It is very much a preliminary assessment of our theory about the basin.¹⁵²

Notably, ExxonMobil formed a joint venture with Ignite in mid-2012 to explore for the CSG in the brown coals. However, in late 2014, ExxonMobil ended the joint venture with Ignite.¹⁵³ Dr George Carman, a petroleum geologist who supports lifting the moratorium, said in his presentation to the Committee that Victoria's brown coal does not present the same opportunities for gas as black coal, and that ExxonMobil may have withdrawn from the venture on that basis:

... the carbonaceous rocks in Victoria are more in the brown coal regime rather than black coal, and therefore we do not really have the same opportunities for a resource in that area. ExxonMobil had formed an alliance with Ignite petroleum, who thinks they have resources. They were allowed to speculate, and speculation does sometimes produce new results. But as I understand it, the ExxonMobil company has now withdrawn from that partnership, presumably on there not being a real resource there.¹⁵⁴

Dr Len Humphreys, the Chief Executive Officer of Ignite Energy, was reported as stating that ExxonMobil had provided limited information on why it had left the joint venture: 'We've just been told every year they review what's in their portfolio and based on what's in their basket they make a decision on whether they want to continue or not ... They have told us their view of the prospectivity of exploring for gas in onshore Victoria hasn't changed.'¹⁵⁵

3.7.3 Mecrus Resources

Mecrus Resources is an unlisted company which holds a number of exploration licences over the onshore Otway Basin in Western Victoria. Mecrus states that it 'has invested significant money to date in detailed exploration and investigation' and has identified 'significant resources of Oil Shale and hydrocarbons within

¹⁵¹ *ibid.*, p. 6.

¹⁵² *ibid.*, p. 4.

¹⁵³ M. Chambers (2014) 'Exxon pulls out of gas venture', *The Australian*, 17 December, p. 25.

¹⁵⁴ G. Carman (2015) *Transcript of Evidence*, 13 August, p. 18.

¹⁵⁵ M. Chambers (2014) 'Exxon pulls out of gas venture', *op. cit.*

the Oil Shale', particularly within its licences EL 5297 and EL 5298.¹⁵⁶ Mecrus states in regard to gas that: 'It should be noted that this oil contains gas in solution and accordingly any production of oil will result in production of gas as a by-product.'¹⁵⁷

It is important not to confuse 'oil shale' and 'shale oil' because they are two different things. The ACOLA report on shale gas explains that 'oil shale' – which is what Mecrus is targeting – is shallow shale rock containing oil which is mined and then retorted at high temperature at the surface to distil the oil. The oil shale can also be subjected to in situ thermal treatment, to release the oil.¹⁵⁸ The ACOLA report explains that 'shale oil' is 'the oil found at very deep levels underground in combination with shale gas.'¹⁵⁹

Mr Barry Richards from Mecrus stated to the Committee that Mecrus engaged consultancy firm RISC to undertake an independent review of the prospectivity of the oil shale.¹⁶⁰ Dr Rodney Halyburton from Mecrus said that the review confirmed that: 'potentially — I say potentially — there is a fairly large resource in Western Victoria, particularly in the two exploration licences, 5297 and 5298.'¹⁶¹

Dr Rodney Halyburton from Mecrus stated that the consultants did not consider gas in their report but that 'Gas will be produced along with the oils. RISC did not include the amount of gas or the value of the gas when they conducted all their studies. If oil is produced there, gas will also be produced and that will be the cream on top of the cake.'¹⁶² As stated earlier in this report, Mecrus has not published its estimates of prospective oil resources but has provided them to the Committee in confidence.¹⁶³

3.8 Findings

The onshore Gippsland and Otway Basins have geological formations which may be prospective for unconventional gas. This does not mean, however, that if the gas is there that it will be commercially viable to produce. Exploration for unconventional gas in Victoria started around the year 2000 and is at an early stage (and has been subject to the extended moratorium since November 2013).

Most of the exploration undertaken has focussed on searching for CSG. In the Otway Basin the exploration for CSG has been unsuccessful to date, and many of the exploration licences that nominated CSG as a target, expired, or were cancelled or surrendered prior to the imposition of the moratorium. In the Gippsland Region, of the 35 exploration licences issued which include CSG as

¹⁵⁶ Mecrus Resources (2015) Submission 247, pp. 1, 3.

¹⁵⁷ *ibid.*, p. 2.

¹⁵⁸ Cook et al. (2013) *Engineering Energy*, op. cit., pp. 32, 33, 189.

¹⁵⁹ *ibid.*, p. 33.

¹⁶⁰ Mecrus Resources (2015) *Transcript of Evidence*, 23 September, p. 15.

¹⁶¹ Mecrus Resources (2015) *Transcript of Evidence*, 23 September, p. 16.

¹⁶² *ibid.*

¹⁶³ Mecrus Resources (2015) Submission 247, p. 2.

a target, 16 remain current, the largest being held by Ignite Energy Resources. Ignite estimates that the brown coals within EL 4416 prospectively host 3.7 trillion cubic feet of gas. However, there has been no direct measurement of the gas, and it is not known whether the gas could be extracted, as CSG has not been produced from brown coal before and it would be a world first.

It appears that the geology of Victoria may be more prospective for tight and shale gas. Lakes Oil's discovery of tight gas near Seaspray in Gippsland in 2004 is the only discovery of unconventional gas in Victoria so far. Lakes Oil estimates that it has located 1.7 trillion cubic feet of gas, but whether the gas is actually distributed through the formation in those quantities and whether the gas can be commercially extracted is unknown. Lakes Oil states that it believes that there are prospectively commercial amounts of tight gas in the Otway Basin, but that this cannot be confirmed without drilling wells to provide the necessary data.

There is little information in regard to exploration for shale gas. Under the Petroleum Act, companies do not have to specify in their applications for petroleum exploration permits which resource they are targeting. It appears that the geology of the Gippsland region may not be prospective for shale gas. The geology of the Otway Basin may be more prospective for shale gas, but the companies who hold the petroleum exploration permits in the onshore Otway Basin have not made any statements in regard to shale gas. Mecrus Resources is targeting 'oil shale' which it states will produce gas as a by-product. It appears that this is different to 'shale gas' which is found in deep shale deposits.

4

Risks of unconventional gas extraction and community and industry views

4.1 Chapter overview

Chapter Four begins by collating the commonly identified risks posed by the extraction of unconventional gas. It provides information on the importance of well integrity and potential impacts on water resources; the practice of hydraulic fracturing or ‘fracking’; chemical use in drilling and fracking fluids and the mobilisation of naturally occurring hazardous materials; issues to do with ‘produced’ and ‘flow back’ water; and fugitive methane emissions. It also looks at the potential impacts the industry’s surface level infrastructure can have on native vegetation and biodiversity.

Chapter Four additionally examines the evidence presented to the Committee about potential impacts of unconventional gas extraction on human health. This evidence is inter-related with the identified environmental risks and centres on concerns regarding chemical use, and the mobilisation of harmful naturally occurring materials.

Chapter Four also outlines the significant community concern regarding the potential risks posed by the unconventional gas industry, and the prospect that the industry may not have ‘a social licence to operate’ in Victoria. It then concludes with an outline of the unconventional gas industry’s views that the risks posed by unconventional gas extraction can be mitigated by industry adherence to ‘best-practice’ regulations, and that the benefits the industry will bring to Victoria will outweigh the risks.

4.2 Identified potential risks of unconventional gas extraction

The body of available literature on unconventional gas extraction including scientific studies, government initiated reviews, and parliamentary inquiries commonly identify certain potential risks posed by the industry.¹⁶⁴ As stated above, the main potential risks involve leakage from wells and impacts on groundwater resources; the practice of hydraulic fracturing or ‘fracking’; chemical

¹⁶⁴ See for example: NSW Legislative Council, General Purpose Standing Committee No. 5 (2012) *Inquiry into Coal Seam Gas*, Parliament of NSW; NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit.; SCER (2013) *The National Harmonised Regulatory Framework*, op. cit.; P. Cook et al. (2013) *Engineering Energy*, op. cit.; M. Currell (2015) Submission 11; State Government of Victoria (2015) Submission 658, p. 21; Doctors for the Environment (2015) Submission 416.

use and the mobilisation of naturally occurring hazardous materials; issues to do with ‘produced’ and ‘flow back’ water which include induced seismicity and subsidence; fugitive methane emissions; and impacts on biodiversity.¹⁶⁵ Each of these potential risks is discussed below.

It is important to note, as stated in Chapter Two of this Report, that Government initiated reviews from some jurisdictions, and the report of the Gas Market Taskforce in Victoria, have concluded that these risks can be satisfactorily managed if regulatory frameworks for industry are improved, monitored and enforced.¹⁶⁶ Risk mitigation through regulation is discussed in Chapter Seven of this Report.

It is also important to note that potential impacts may differ across geographic areas due to differences in hydrogeology, geology, land use and other factors.

4.2.1 Wells and groundwater

To extract unconventional gas, wells are drilled deep underground through different geological layers including groundwater formations. Groundwater – water that is located under the ground – is stored in porous soils and rocks. The National Water Commission explains that these saturated soils and rocks are called aquifers and the top of the saturated portion of ground constitutes the water table.¹⁶⁷ Groundwater is a valuable source of water in Victoria, and is used primarily for irrigation, dairy and stock farming, as well as for domestic purposes.¹⁶⁸

RMIT Lecturer in Hydrogeology, Dr Matthew Currell, states in his submission to the Committee that in both the Gippsland and Otway Basins, target rocks for unconventional gas development are underneath aquifers that supply important sources of water for agriculture and domestic use.¹⁶⁹ The extraction of gas depressurises gas bearing geological formations and may cause groundwater levels to decline which can impact on water users. Groundwater level decline may also cause land subsidence. This is a greater potential risk with CSG development which requires groundwater extraction to depressurise the coal seam to allow the gas to flow.¹⁷⁰

The benefits of understanding Victorian groundwater formations prior to potentially proceeding with an unconventional gas industry are discussed further in Chapter Six. Figure 4.1 below provides a simplified diagram depicting unconventional gas wells passing through different geological layers including aquifers:

¹⁶⁵ *ibid.*

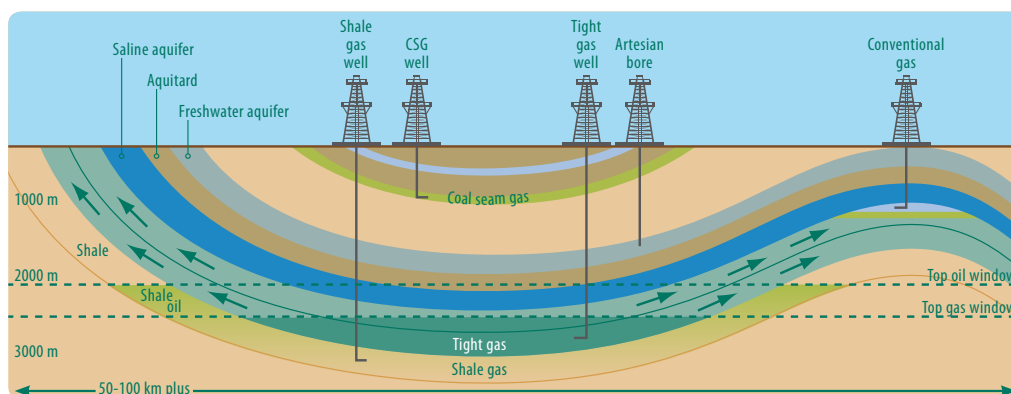
¹⁶⁶ See for example: NSW Chief Scientist & Engineer (2014) *Final Report of the Independent Review of Coal Seam Gas Activities in New South Wales*, op. cit.; Gas Market Taskforce (2013) *Gas Market Taskforce: Final Report and Recommendations*, op. cit.; SCER (2013) *The National Harmonised Regulatory Framework*, op. cit.

¹⁶⁷ National Centre for Groundwater Research and Training (2013) ‘What is Groundwater’, NCGRT website.

¹⁶⁸ Department of Environment, Land, Water and Planning (2015) ‘Understanding Groundwater’, DELWP website.

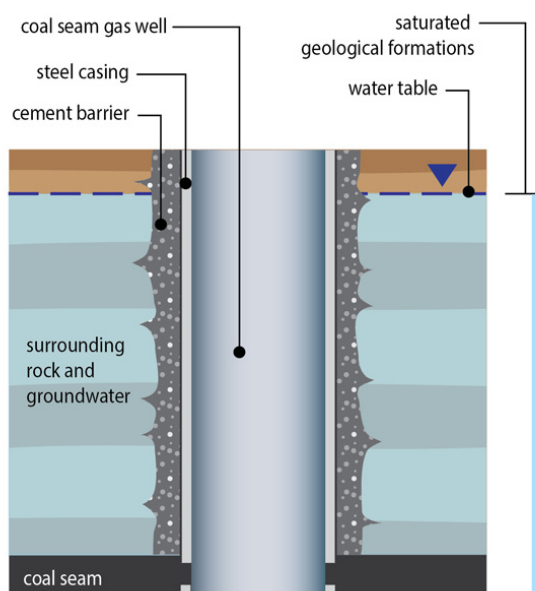
¹⁶⁹ M. Currell (2015) Submission 11, p. 8.

¹⁷⁰ Jacobs Pty Ltd (2015) *Gippsland Region Assessment of Potential Impacts on Water Resources*, Report prepared for DELWP and Geological Survey of Victoria (DEDJTR), Government of Victoria, p. 10.

Figure 4.1 Schematic diagram of unconventional gas wells and aquifers

Source: P. Cook et al. (2013) *Engineering Energy: Unconventional Gas Production*, Report for the Australian Council of Learned Academies, p. 33.

There is a risk when an unconventional gas well passes through different geological layers that gas or drilling and fracking fluids could leak out of the well and contaminate surrounding groundwater. The available literature emphasises that ‘well integrity’ which means making sure that wells are of high quality construction and do not leak is fundamentally important.¹⁷¹ Unconventional gas wells are, accordingly, constructed out of telescoping steel and cemented well casings to minimise the risk of leaks.¹⁷² Figure 4.2 shows a schematic diagram of a coal seam gas well passing through an aquifer.

Figure 4.2 Schematic diagram of a coal seam gas well

Source: NSW Office of Water (2013) ‘How Coal Seam Gas is Extracted in NSW’, Factsheet 2, Department of Primary Industries.

¹⁷¹ See for example: NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Abandoned Wells*, Government of NSW; SCER (2013) *The National Harmonised Regulatory Framework*, op. cit.; pp. 26-34; Cook et al. (2013) *Engineering Energy*, op. cit., p. 56.

¹⁷² J. Williams, T. Stubbs & A. Milligan (2012) *An Analysis of Coal Seam Gas Production and Natural Resource Management in Australia*, A report prepared for the Australian Council of Environmental Deans and Directors by John Williams Scientific Services, Canberra, ACEDD, pp. 21-28.

Risks of poor well integrity

The COAG Standing Council on Energy and Resources (SCER) emphasised that the design, construction, maintenance and decommissioning of a well needs to be done carefully at ‘best practice’ level.¹⁷³ It stated that poor well integrity – ‘caused by ineffective cementing, the use of inappropriate materials, failed well casings or other well construction, operational or decommissioning shortcomings’ – could lead to the following potential impacts:

- Hydraulic connectivity between otherwise isolated aquifers with different water qualities causing contamination and potentially unwanted alterations to water flows
- Contamination of water at the surface and subsurface by drilling and hydraulic fracturing fluids and geogenic (naturally occurring) compounds
- Migration of gas into surrounding aquifers, wells and water bores, and the surface.¹⁷⁴

The SCER also stated that ‘Over-pressurisation of the well head due to poor operational practices or through encountering over-pressurised formations in the subsurface’ could potentially lead to ‘A blowout at the surface or in the subsurface’ which ‘may cause injury to the drilling crew and contamination by allowing the escape of drilling and hydraulic fracturing fluids and gas into groundwater or the surface’.¹⁷⁵

Number of wells

Unconventional gas extraction requires more wells than conventional gas extraction because the gas does not flow as easily through the rock to the well.¹⁷⁶ The productive life of an unconventional gas well is also shorter than a conventional gas well which means that more wells need to be drilled to extract the resource. For example, a coal seam gas well is typically productive for 10 to 15 years, whereas a conventional gas well can be productive for up to 50 years.¹⁷⁷ In regard to shale gas, the ACOLA report explains that:

...unlike the situation for conventional gas, where a gas field can be exploited by a few wells involving a one-off, up-front capital investment, exploitation of a shale gas field can require thousands of wells drilled over a continuing timescale due to the nature of the gas production decline curve for a single shale gas well.¹⁷⁸

¹⁷³ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., pp. 26-27. The National Harmonised Regulatory Framework is initially discussed in section 2.7.1 of this Report.

¹⁷⁴ *ibid.*, p. 29; Ross & Darby (2013) op. cit., p. 18.

¹⁷⁵ *ibid.*

¹⁷⁶ State Government of Victoria (2015) Submission 658, p. 7.

¹⁷⁷ Ross & Darby (2013) op. cit., p. 3; B. McCormick, A. St John & J. Tomaris (2013) ‘Environment Protection and Biodiversity Conservation Bill 2013’, Bills Digest, no. 108 2012-13, Canberra, Australian Parliamentary Library, p. 7.

¹⁷⁸ P. Cook et al. (2013) *Engineering Energy*, op. cit., pp. 54-55.

Decommissioning of wells

When a well ceases producing economically viable amounts of gas it needs to be decommissioned because an abandoned well still has the potential to contaminate groundwater and leak gas into the air (fugitive emissions are discussed in section 4.2.5 of this Report). The decommissioning process generally entails that when a well ceases production, equipment is removed from the well, the well is plugged with cement, and cut and capped below the surface level. Surface equipment is then removed and the land should be rehabilitated.¹⁷⁹

Monitoring of decommissioned wells

The New South Wales Chief Scientist and Engineer, Professor Mary O’Kane (henceforth referred to as ‘the NSW Chief Scientist’), explains that active or temporarily suspended wells are typically subject to monitoring programs, ‘However, once a well is abandoned, monitoring generally ceases and the well must then stand the test of time.’¹⁸⁰ She further states that ‘Despite the abundance of information and research on petroleum well integrity (including design and cements), very little data exists about the long-term (100-1000 years) durability of abandoned petroleum wells.’¹⁸¹

The VAGO report on unconventional gas states that in Victoria, monitoring and integrity checks are required for up to three years after abandonment.¹⁸² Additionally, the VAGO report found that: ‘Rehabilitation and aftercare practices at unconventional gas well sites in Victoria – including the management of suspended and abandoned wells – has been poor. Better practice well approaches have not been required for these activities and DEDJTR has not effectively monitored them.’¹⁸³

4.2.2 Hydraulic fracturing

Hydraulic fracturing or ‘fracking’ (sometimes also called ‘fraccing’) is a method used by the oil and gas industry to increase the rate and amount of oil or gas extracted from wells. The fracking process involves injecting fluid made up of water, sand and chemicals down a well at high pressure to fracture the rock to help the gas flow out of the rock and up the well.

Identified potential risks of the fracking process include the fractures extending to connect with aquifers and contaminating water resources with methane, chemicals or geogenic compounds, and the risk of contaminating spills when

¹⁷⁹ NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Abandoned Wells*, op. cit., p. 1. Note: Wells have been dug by various industries in Australia over the decades, and historically may have been abandoned under less stringent conditions. These wells are called ‘legacy’ wells. See *ibid.*, pp. 2, 12.

¹⁸⁰ *ibid.*, p. 3.

¹⁸¹ *ibid.*, p. 5.

¹⁸² VAGO (2015) op. cit., p. 27.

¹⁸³ *ibid.*

fluids flow back to the surface.¹⁸⁴ Stakeholder groups have different views on whether these risks can be adequately managed. Submissions and evidence received by the Committee from industry groups and individuals who work in the oil and gas industry, state that the risks can be successfully minimised.¹⁸⁵ The broader community, however, has expressed concerns to the Committee about the potential risks the practice could pose to the State's groundwater resources.¹⁸⁶

The VAGO report on unconventional gas states that in Victoria, there were 11 fracking operations in tight gas wells between 2004 and 2009, and 12 fracking operations in coal seam gas wells between 2007 and 2008.¹⁸⁷ The Victorian Government inter-departmental submission to the Committee similarly states that 23 fracking operations occurred in Victoria in the Seaspray area between 2004 and 2009, with 12 operations approved under the Minerals Act and 11 operations approved under the Petroleum Act.¹⁸⁸

The hydraulic fracturing process

As stated earlier, the hydraulic fracturing process involves injecting 'fracking fluid' which is made up of water, sand (or ceramic beads) and chemicals down a well at high pressure to fracture the rock. The sand acts as a 'proppant' to hold the fractures open. Water and gas then flow up the well and are separated at the surface. It is stated in the available literature that around 15 to 50 per cent of the fracking fluid is recovered (during flowback and as produced waters). The recovered fracking fluid needs to be stored for reuse or appropriately disposed of at an approved site. The unrecovered fracking fluid remains underground and could act as a potential groundwater contaminant if contact with an aquifer is made.¹⁸⁹

The fracking process requires a range of equipment and materials and is usually undertaken by specialised service companies such as Halliburton.¹⁹⁰ The equipment includes fracking fluid storage tanks, sand storage units, chemical trucks, blending equipment and pumping equipment installed on a number of trucks, plus a data management van which controls the operation.¹⁹¹ Figure 4.3 below provides an image and list of hydraulic fracturing equipment from the

¹⁸⁴ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., pp. 54, 62, 65.

¹⁸⁵ See for example: M. Blackam, Coffey (2015) Submission 507; M. Blackam, Coffey (2015) *Transcript of Evidence*, 13 August; Minerals Council (2015) Submission 365, p. 6; APPEA (2015) Submission 364, pp. 8, 28; Lakes Oil (2015) Submission 510, p. 13.

¹⁸⁶ See for example: City of Greater Geelong (2015) Submission 601, pp. 1-2; Victorian Farmers Federation (2015) Submission 471, p. 6; Prof. M. Ackland, Acting Victorian Chief Health Officer (2015) *Transcript of Evidence*, 1 September, pp. 3-4; Friends of the Earth (2015) Submission 466, pp. 19-22 (provides list of places where hydraulic fracturing has been banned).

¹⁸⁷ VAGO (2015) op. cit., p. 6.

¹⁸⁸ Government of Victoria (2015) Submission 658, p. 12.

¹⁸⁹ Cook et al. (2013) *Engineering Energy*, op. cit. p. 57; NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit. p. 58; Ross & Darby (2013) op. cit. p. 19.

¹⁹⁰ NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit. p. 55; Halliburton (2015) Submission 647.

¹⁹¹ Cook et al. (2013) *Engineering Energy*, op. cit. p. 53-54; NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., p. 55.

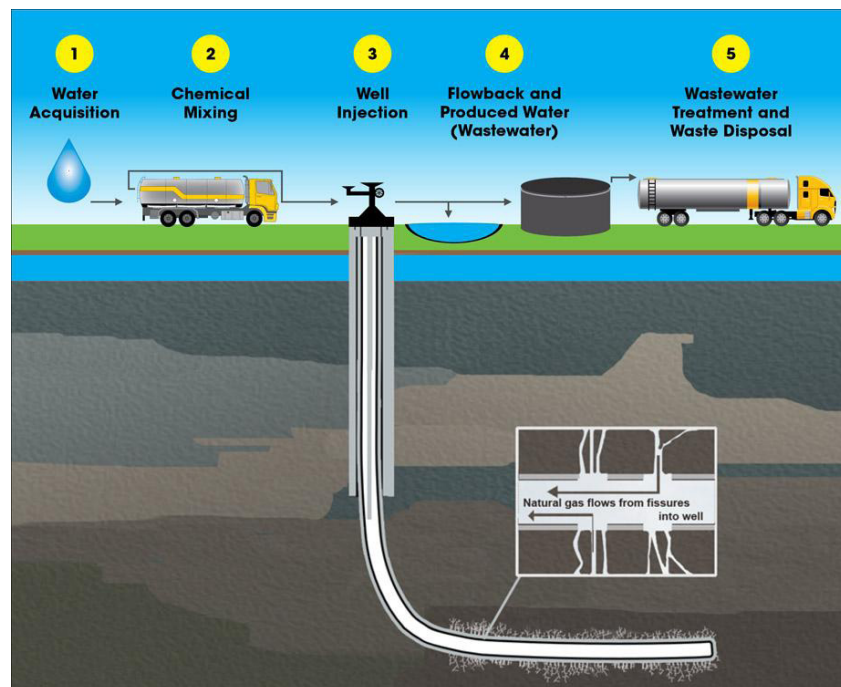
ACOLA shale gas report (sourced from Santos 2013). Figure 4.4 then provides a simplified diagram showing the underground view of a fracturing operation and water use.

Figure 4.3 Well stimulation by hydraulic fracturing in Australia



Source: P. Cook et al. (2013) *Engineering Energy: Unconventional Gas Production*, Report for the Australian Council of Learned Academies, p. 54.

Figure 4.4 Diagram of hydraulic fracturing



Source: United States Environmental Protection Agency (2015) 'The Hydraulic Fracturing Water Cycle', US EPA website.

It is important to emphasise that CSG wells do not always require fracking. Shale and tight gas wells do often require fracking (a summary of the different geological settings of coal seam, shale and tight gas is provided in sections 2.4.1 - 2.4.3 and Appendix 3 of this Report). The NSW Chief Scientist emphasises the greater scale of fracking that can be required for shale gas extraction in comparison to CSG extraction:

There is a major difference in the scale of operations in hydraulic fracturing between CSG and shale resources. Across the world, development of CSG resources have been in the depth range 200-1,000 metres (m) whereas shale resources are typically between 1,500 to 3,000m. The fracture stimulation pumping setup (frac spread) on the surface for CSG may run to 10,000 hydraulic horsepower with four to six high pressure pump units whereas for shale stimulation the power demand may be as high as 50,000 hydraulic horsepower and use 30 pump units.¹⁹²

The Committee also notes the evidence of Ignite Energy Resources which suggested that fracking the brown coal in the Gippsland region would likely be unfeasible because of the moisture content of the lignite. Dr White from Ignite stated that 'We do not think we can frack, because lignite is rather wet. It would be like fracking a peat bog.'¹⁹³

Water use in hydraulic fracturing

The hydraulic fracturing of shale and tight rock formations requires more water than is needed to fracture coal seams. The NSW Chief Scientist states that in the United States, the quantity of water used for fracture stimulation for CSG has been estimated as being between 0.2 – 1 ML per well (a megalitre or 'ML' is one million litres). The water required for fracture stimulation for shale has been estimated as being between 15 – 25 ML per well. She further states that 'stimulation of Cooper Basin shales (South Australia) has been as high as 45 ML per well (similar to parts of British Columbia), although the flowback water is good quality and can be recycled'.¹⁹⁴

However, Mr Tim O'Brien from Lakes Oil stated to the Committee that Lakes Oil has not used significant amounts of water in the fracking operations it has undertaken during exploration for tight gas in the Seaspray area, and suggests that less water would be required for a tight gas industry in Victoria than is required for agriculture:

The volumes that we would use, if we were to frack these rocks, is nothing near what is being portrayed out there as the 20 or 30 megalitres per frack. You would have to pump for three or four days to be able to do that, which we only pump for 60 minutes. The largest frack that has ever been done in Victoria was 0.2 of a megalitre, and that was in our Wombat-2 well. In the Trifon well, which has got five fracks in it, the largest we would have pumped I think is about 0.7 of a megalitre across five zones.

¹⁹² NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Fracture Stimulation Activities*, op. cit., p. 1.

¹⁹³ Ignite (2015) *Transcript of Evidence*, 1 July, p. 3.

¹⁹⁴ NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Fracture Stimulation Activities*, op. cit., p. 27.

The volumes are not significant. If you think that agriculture in Victoria uses 2.5 million megalitres, even if we were to frack these wells and were doing 100 wells a year, it might be using 5 megalitres per well for multistage ones. The entire industry would be 500 megalitres rather than 2.5 [million] megalitres.¹⁹⁵

There is also the identified risk of spills when fluids flow back to the surface (this is discussed in section 4.2.4 on flowback and produced water). It is also suggested that hydraulic fracturing may lead to an increase in seismic activity although, the reinjection of flowback or produced water into aquifers may be more likely to induce seismic events than fracking (this is also discussed in section 4.2.4).¹⁹⁶

4.2.3 Chemicals

Chemicals are added to well drilling fluids and to hydraulic fracturing fluids to enhance the drilling and fracturing processes during unconventional gas extraction. The available literature states that this chemical use needs to be carefully managed to minimise environmental impacts.¹⁹⁷

Drilling fluids

The SCER explained that drilling fluids, which are also known as ‘drilling muds’, are ‘used during the drilling of wells to reduce friction, stabilise formations, control pressures in the well bore and return drill cuttings to the surface.’¹⁹⁸ The drilling fluids are most often water-based with clays and chemical additives included to ‘control and minimise fluid loss, density and viscosity.’¹⁹⁹ The National Toxics Network states in its submission to the Committee that drilling fluid components include:

- Viscosifiers to increase viscosity of mud to suspend cuttings (eg bentonite, polyacrylamide);
- Weighting agent (eg barium sulphate);
- Bactericides/biocides to prevent biodegradation of organic additives (eg, glutaraldehyde);
- Corrosion inhibitors to prevent corrosion of drill string by acids and acid gases (eg zinc carbonate, sodium polyacrylate, ammonium bisulphate);
- Defoamers to reduce mud foaming (eg glycol blends, light aromatic and aliphatic oil, naptha);
- Emulsifiers and deemulsifiers to help the formation of stable dispersion of insoluble liquids in water phase of mud;
- Lubricants to reduce torque and drag on the drill string (eg. chlorinated paraffins);

¹⁹⁵ Lakes Oil (2015) *Transcript of Evidence*, 6 October, p. 20.

¹⁹⁶ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 54; NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., p. 86.

¹⁹⁷ See for example: SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 11.

¹⁹⁸ *ibid.*, p. 61.

¹⁹⁹ *ibid.*

- Polymer stabilisers to prevent degradation of polymers to maintain fluid properties (eg sodium sulphite);
- Breakers to reduce the viscosity of the drilling mud by breaking down long chain emulsifier molecules into shorter molecules (eg diammonium peroxydisulphate, hemicellulase enzyme);
- Salts (eg potassium chloride, sodium chloride, calcium chloride);

And in the case of drilling for shale gas:

- Shale control inhibitors to control hydration of shales that causes swelling and dispersion of shale, collapsing the wellbore wall (eg anionic polyacrylamide, acrylamide copolymer, petroleum distillates).²⁰⁰

The National Toxics Network also emphasises that drilling muds returned to the surface after the well has been drilled include contaminants that occur naturally underground but can be harmful to human health.²⁰¹ It also asserts that because many new wells are required to be drilled to keep unconventional gas fields commercially viable, the impact of large amounts of drilling fluid components needs to be considered in assessments of unconventional gas industry impacts.²⁰²

Hydraulic fracturing fluids

Chemical additives to hydraulic fracturing fluids vary depending on the geological setting, the operator, and in some cases the legislation and regulations of the area where the well is being fracked.²⁰³ The ACOLA report explains that a typical fracking fluid includes between three and twelve chemicals which, in general terms, are added to reduce fluid pumping friction, improve stimulation performance, and stop the formation of bacteria.²⁰⁴ The NSW Chief Scientist provides the following list of typical additives to CSG fracking fluids and the reasons why they are added:

Typical additives include acids and alkalis to control the pH balance of the fracture fluid (which affects the fluid viscosity); acids (to dissolve residual iron, cement, and rock particles from drilling operations and perforations, and calcium carbonate if present in the coals); bactericides to prevent bacterial growth (which could contaminate the formation and inhibit gas flow); gels including cross-linked gels to enhance proppant transport performance (addressing viscosity limits of water and improved functionality over less expensive linear gels); guar gum to create a gel (to transport the proppant); enzyme breakers to dissolve fracture gels (to aid fluid extraction and gas transmission); and friction reducers and surfactants such as emulsifiers and non-emulsifiers (to increase fluid recovery).²⁰⁵

²⁰⁰ National Toxics Network (2015) Submission 633, pp. 6-7.

²⁰¹ *ibid.*, p. 7.

²⁰² *ibid.*, p. 6.

²⁰³ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 61.

²⁰⁴ Cook et al. (2013) *Engineering Energy*, op. cit., pp. 57-58.

²⁰⁵ NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Fracture Stimulation Activities*, op. cit., p. 4.

The ACOLA report similarly provides the following list of chemicals, which it states are representative of the major compounds used in shale gas fracturing fluids:

Table 4.1 Hydraulic fracturing fluid additives

Additive Type	Main Compound(s)	Purpose
Diluted acid (15%)	Hydrochloric acid or muriatic acid	Help dissolve minerals and initiate cracks in the rock
Biocide	Glutaraldehyde	Eliminates bacteria in the water that produce corrosive byproducts
Breaker	Ammonium persulfate	Allows delayed breakdown of the gel polymer chains
Corrosion inhibitor	N, n-dimethyl formamide	Prevents the corrosion of the pipe
Crosslinker	Borate salts	Maintains fluid viscosity as temperature increases
Friction reducer	Polyacrylamide, Mineral oil	Minimises friction between fluid and the pipe
Gel	Guar gum or hydroxyethyl	Thickens the water in order to suspend the sand
Iron control	Citric acid	Prevents precipitation of metal oxides
KCl	Potassium chloride	Creates a brine carrier fluid
Oxygen scavenger	Ammonium bisulfite	Removes oxygen from the water to protect the pipe from corrosion
pH adjusting agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe
Surfactant	Isopropanol	Used to increase the viscosity of the fracture fluid

Note: The original table includes proppant in the list of additives and an additional column which lists common uses of main compounds.

Source: Adapted from P. Cook et al. (2013) *Engineering Energy: Unconventional Gas Production*, Report for the Australian Council of Learned Academies, p. 57.

Quantities of chemicals in hydraulic fracturing fluid

Estimates of the proportion of chemical additives in hydraulic fracturing fluid vary but are in general said to be between 0.1 – 2 per cent. The SCER states that in regard to CSG extraction, chemical additives typically make up 0.1 – 2 per cent of fracking fluid composition.²⁰⁶ The NSW Chief Scientist states that chemicals typically constitute about one per cent of CSG fracking fluids.²⁰⁷ The ACOLA report states that chemicals make up 0.1 – 0.5 per cent of fracking fluid for shale gas extraction.²⁰⁸

Industry submissions to the Committee emphasise the low concentration of chemicals in fracking fluids and that the chemicals used are also found in familiar household products. The APPEA submission states that:

²⁰⁶ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 61.

²⁰⁷ NSW Chief Scientist & Engineer (2014) *Independent Review of Coal Seam Gas Activities in NSW Information Paper: Fracture Stimulation Activities*, op. cit., p. 4.

²⁰⁸ Cook et al. (2013) *Engineering Energy*, op. cit., p. 57.

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 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.²⁰⁹

Lakes Oil's submission similarly said that: 'The fluids used in drilling and hydraulic stimulation activities are generally non-toxic. Most of the additives are used in everyday household products but at lower concentrations'.²¹⁰

The National Toxics Network states that while chemical additives make up less than two per cent of fracturing fluids, this nevertheless translates into large quantities of chemicals.²¹¹ The ACOLA report provides the following figures which it states provide a sense of scale of hydraulic fracturing, including chemical use:

... for a stimulation requiring ~15 million litres of water (roughly the average fresh water volume for fracturing per US shale well), the amount of chemicals required (using the high-end percentage of 0.5%) is ~75,000 litres (two road-tanker loads), and the amount of sand (proppant) required is of order 1 million kg (1000 tonne).²¹²

Hence, according to the ACOLA report, the amount of chemicals required for the fracturing of a typical shale gas well in the United States, if the chemicals constitute 0.5 per cent of the fracking fluid, will be about 75,000 litres or 'two road-tanker loads'.²¹³

Non-disclosure of exact chemicals in hydraulic fracturing fluids

The exact chemicals used in hydraulic fracturing fluids can be classed as 'commercial in confidence' and not disclosed.²¹⁴ The SCER stated that this is done to protect intellectual property rights and encourage growth in research, development and innovation.²¹⁵ However, a significant number of submissions to the Committee argued that, from a risk management perspective, it is difficult for regulators to assess the risks posed by chemical additives if it is not known what those chemicals are.²¹⁶ Professor Michael Ackland, Acting Chief Health Officer for the State of Victoria, said in his evidence to the Committee that in regard to hydraulic fracturing chemicals:

...perhaps one of the most alarming things for myself was that there are many, many chemicals that are proprietary chemicals and are essentially commercial-in-confidence and are therefore not able to be disclosed. Looking at the experience from the United States Environmental Protection Agency, there are

²⁰⁹ APPEA (2015) Submission 364, p. 35.

²¹⁰ Lakes Oil (2015) Submission 510, p. 15.

²¹¹ National Toxics Network (2015) Submission 633, p. 2.

²¹² Cook et al. (2013) *Engineering Energy*, op. cit., p. 58.

²¹³ *ibid.*

²¹⁴ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 63; M. Ackland, Acting Chief Health Officer (2015) Presentation, 1 September, p. 11.

²¹⁵ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 63.

²¹⁶ See for example: M. Ackland, Acting Chief Health Officer (2015) *Transcript of Evidence*, 1 September, p. 4; National Toxics Network (2015) Submission 633, p. 6.

around 1076 chemicals that have been compiled by the US EPA, and in only 42 per cent could the physicochemical properties of those chemicals be obtained, and in relation to levels that people could safely consume over a lifetime without health effects that information was only available in 90, or only 8 per cent, of that large list of chemicals. If that is not a large knowledge gap then I am not sure what is.²¹⁷

The VAGO report on unconventional gas states that in Victoria there is ‘no requirement to release information to the regulator or the community on the types, concentrations or toxicity of the chemicals used.’²¹⁸ Additionally, the National Toxics Network states that proprietary data means that the disclosure of full formulations is usually not possible by those who use the products because the company that makes them does not identify exact ingredients.²¹⁹

Lakes Oil provided the Committee with a list of drilling fluid components used in an unconventional gas well in Victoria.²²⁰ The submissions from industry groups to the Committee provided information on fracking fluids in general terms.²²¹

It is worth noting the similar experience of the New South Wales Legislative Council inquiry into coal seam gas in 2012 which observed that ‘The Committee did not receive evidence that addressed the exact composition of fracking fluids and the Committee received broad information only on the quantities and names of chemicals used.’²²²

The Committee also notes the introduction in New South Wales in 2012 of a ‘Code of practice for coal seam gas fracture stimulation activities.’²²³ The code includes a mandatory requirement for a ‘Fracture Stimulation Management Plan’ to be in place prior to the commencement of a hydraulic fracturing activity.²²⁴ The code states that the management plan ‘must identify all chemicals to be injected as part of the fracture stimulation process’.²²⁵ The code additionally provides that the Chemical Abstract Service (CAS) registry number for those chemicals must be identified.²²⁶

National assessment of chemicals associated with coal seam gas extraction in Australia

In 2012, the Commonwealth Government, on advice from the IESC, commissioned a project to assess chemicals used in CSG extraction by the National Industrial Chemicals Notification and Assessment Scheme (NICNAS), CSIRO, Department of Environment, and Geoscience Australia. NICNAS explains that ‘The National CSG Chemicals Assessment project examines

²¹⁷ M. Ackland, Acting Chief Health Officer (2015) *Transcript of Evidence*, 1 September, p. 3.

²¹⁸ VAGO (2015) *op. cit.*, p. 25.

²¹⁹ National Toxics Network (2015) Submission 633, p. 6.

²²⁰ Lakes Oil (2015) Response to question on notice, 6 October. Received by the Committee 22 October..

²²¹ See: Lakes Oil (2015) Submission 510, p. 15; APPEA (2015) Submission 364, p. 32, 35.

²²² New South Wales Legislative Council, General Purpose Standing Committee No. 5 (2012) *op. cit.*, p. 69.

²²³ NSW Government (2012) *Code of practice for coal seam gas fracture stimulation activities*.

²²⁴ *ibid.*, p. 2.

²²⁵ *ibid.*, p. 7.

²²⁶ *ibid.*

human health and environmental risks from chemicals used in drilling and hydraulic fracturing for CSG extraction in Australia. It will inform the Australian Government, the IESC, industry and the public about the use and potential risks of these chemicals.²²⁷

NICNAS further explains that it is 'conducting a voluntary industry survey of companies involved in CSG extraction in Australia. The main aim of the survey is to identify the chemicals (and their functions) used in CSG extraction in Australia.'²²⁸

NICNAS states that project examines surface and near surface water-related impacts of drilling and fracking chemicals, but does not examine impacts on deeper groundwater systems such as confined aquifers. It is also limited to consideration of CSG and states that shale and conventional oil and gas are outside its scope.²²⁹ NICNAS also states that the impact of mixtures of chemicals will not be considered.²³⁰ The project is expected to be completed in 2015-16.²³¹

BTEX chemicals

The acronym 'BTEX' stands for 'benzene, toluene, ethylbenzene and xylene'. These chemicals are found in petroleum and petroleum products and can occur naturally in the vicinity of gas deposits.²³² They are known to be harmful to human health and are highly volatile, which means that they can evaporate quickly into the air and dissolve in water.²³³ Benzene, the most toxic component of BTEX, is a well-established cause of cancer in humans.²³⁴

In other jurisdictions, BTEX containing petroleum products – such as diesel – have been used as additives to hydraulic fracturing fluids (to thicken the fluid and improve the efficiency of the fracking process). Additionally, the fracking process can cause a link between naturally occurring BTEX in a geological formation and nearby groundwater.²³⁵

227 NICNAS (2015) 'Information Sheet: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia', NICNAS website.

228 NICNAS (2015) 'Frequently Asked Questions: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia', NICNAS website.

229 NICNAS (2015) 'Information Sheet: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia', op. cit.

230 NICNAS (2015) 'Frequently Asked Questions: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia', op. cit.

231 NICNAS (2015) 'Information Sheet: National Assessment of Chemicals Associated with Coal Seam Gas Extraction in Australia', op. cit.

232 State Government of Victoria (2015) Submission 658, p. 5.

233 F. Leusch & M. Bartkow (2010) 'A short primer on benzene, toluene, ethylbenzene and xylenes (BTEX) in the environment and in hydraulic fracturing fluids', Griffith University Smart Water Research Centre, Queensland Government Department of Environment website, p. 1.

234 World Health Organisation (2010) 'Exposure to Benzene: A Major Public Health Concern', International Programme on Chemical Safety: Benzene, WHO website, p. 2.

235 Leusch & Bartkow, op. cit., p. 4.

In 2012, the Victorian Government announced a ban on the use of BTEX chemicals in hydraulic fracturing in Victoria. In late 2014, the Victorian Parliament passed the *Resources Legislation Amendment (BTEX Prohibition and Other Matters) Act 2014*, which implements a statutory condition restricting the use of BTEX chemicals in hydraulic fracturing in Victoria.²³⁶

4.2.4 Flowback and produced water

Issues to do with ‘flowback’ and ‘produced’ water are commonly identified potential impacts of unconventional gas extraction. The definitions of the terms ‘flowback water’ and ‘produced water’ are not fixed, but in general ‘flowback water’ refers to fluid that predominantly consists of hydraulic fracturing fluid that returns from a well to the surface following a fracking operation. The term ‘produced water’ (sometimes called ‘formation water’) refers to water that flows from gas wells, and is much greater in volume in the case of CSG than in regard to shale or tight gas extraction. This is because, as was explained in Chapter Two, the process of CSG extraction requires water to be pumped out of coal seams in order to release the gas. Produced water can contain flowback water if the well was fracked, and the term ‘waste water’ is sometimes used to refer to both flowback and produced water.

Produced water from coal seam gas extraction can be high in salt and organic and hydrocarbon chemicals that were naturally occurring in the coal seam. The NSW Chief Scientist states that these can potentially include trace elements such as mercury, arsenic and lead, organic acids and polycyclic aromatic hydrocarbons, BTEX chemicals, and naturally occurring radioactive materials (NORMS) such as radium, thorium and uranium.²³⁷

In regard to flowback and produced water from shale and tight gas extraction, Dr Currell states in his submission to the Committee that:

Contaminants typical in ‘flowback’ water produced by shale or tight gas hydraulic fracturing include salts, acids (hydrochloric and acetic acid) organic chemicals (biocides, gelling agents, surfactants and corrosion inhibitors), caustic soda and other additives used to control the density and viscosity of the fluid (e.g. Halliburton, 2015). Shale formations usually also contain saline formation water, which in some cases contains high levels of radionuclides such as radium and strontium...²³⁸

²³⁶ See C. Ross (2014) *Research Note: Resources Legislation Amendment (BTEX Prohibition and Other Matters) Bill 2014*, Victorian Parliamentary Library.

²³⁷ NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., pp. 63-64.

²³⁸ M. Currell (2015) Submission 11, p. 6.

Inappropriate use and disposal of flowback and produced water, including through accidents and spills, can contaminate the surrounding environment including surface water, shallow groundwater and land.²³⁹ There have been a number of documented pollution incidents involving produced water in New South Wales.²⁴⁰

Volume of produced water from CSG extraction, groundwater depletion and subsidence

The volume of produced water created by CSG extraction is large. The CSIRO states that the amount of water produced by CSG wells can vary but that in Queensland each well produces 20,000 litres on average per day.²⁴¹ Dr Currell states in his submission to the Committee that: 'Queensland Government statistics indicate that the total volume of produced water from CSG wells in the Bowen and Surat Basins in the 12 months from June 2013 to June 2014 was 26.7GL, a significant volume with major implications for wastewater treatment and disposal, and catchment salt balances'.²⁴²

There is concern that the removal of large quantities of water may deplete groundwater and draw down the water table, which could impact on other water users such as farmers and the environment in general. The life-span of a CSG well and the dewatering process is approximately 15 years depending on the geological formation.²⁴³ It is also identified that the dewatering of coal seams could potentially lead to subsidence of the ground surface, which can affect surface-water systems, ecosystems, irrigation and grazing lands.²⁴⁴

Notably, the extraction of shale and tight gas does not require the 'dewatering' process used to extract CSG. However, shale and tight gas extraction often requires fracking which can use significant amounts of water, whereas CSG extraction often does not require fracking. Mr Annells of Lakes Oil said to the Committee in regard to the dewatering of coal seams that:

That is one issue where the aim with coal seam gas and tight gas is that the two really should be dealt with as separate resources. With the coal you do have to dewater the coal and produce water. We do not produce any water. Obviously we use water if we are to frack, to pump into it and we recover that, but the volumes you use in that are obviously much smaller than is ever flowed back to try to dewater coal.²⁴⁵

²³⁹ SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 38.

²⁴⁰ See: M. Currell (2015) Submission 11, p. 6-7; S. Khan & G. Kordek (2014) *Coal Seam Gas: Produced Water and Solids*, Prepared for the Office of the NSW Chief Scientist and Engineer, University of NSW, Faculty of Engineering, pp. 53-55; National Toxics Network (2015) Submission 633, p. 16.

²⁴¹ CSIRO (2012) 'Coal Seam Gas – Produced Water and Site Management', Factsheet, CSIRO website.

²⁴² M. Currell (2015) Submission 11, p. 5.

²⁴³ L.D. Nghiem et al. (2011) 'Treatment of Coal Seam Gas Produced Water for Beneficial Use in Australia: A Review of Best Practices', *Desalination and Water Treatment*, 32: 1-3, p. 316.

²⁴⁴ Williams, J., T. Stubbs & A. Milligan (2012) op. cit., p. 53.

²⁴⁵ Lakes Oil (2015) *Transcript of Evidence*, 1 July, p. 5.

Treatment and disposal of produced water

Produced water generally requires treatment – such as reverse osmosis (desalination) – to purify it. The Queensland GasFields Commission states that CSG produced water that has been treated can be put to beneficial uses such as for irrigation, river discharge and the recharging of aquifers.²⁴⁶ The disposal of salt and associated chemicals from the treatment process, however, is an ongoing challenge. Dr Currell states in his submission that:

In Queensland and New South Wales there are some policy arrangements and infrastructure which have been developed in recent years in an attempt to manage the large volumes of produced water from CSG (e.g. Biggs, 2012), however there still exists a large gap between the ideal scenario –involving the safe storage and treatment of all production water to a high quality before selling water to nearby water users – and the reality of how this water is actually managed in practice, which often involves: - Extended periods of storage in dams, which can be subject to leaks, spills and overflows, that can contaminate groundwater (e.g. Khan and Kordek, 2014); and/or -Disposal into waterways or sewers, which occurs in contradiction to the wishes of environmental regulators such as EPAs (Hannam, 2015).²⁴⁷

One way of disposing of produced water is to reinject it into underground water systems. This reinjection can, however, potentially induce seismicity. It may be that the seismic activity is barely noticeable at surface level. The VAGO report on unconventional gas states that the reinjection of treated wastewater is routinely used in many areas in the United States and is gaining more popularity in Queensland and New South Wales, and that ‘This activity has been linked to increased seismic activity in a number of states in America.’ In regard to Victoria, the VAGO report explains that:

Reinjection is prohibited in Victoria under state environment protection policies unless the water is treated to a high standard prior to injection. There are many knowledge and cost barriers to the use of this method in Victoria because not enough is known about the short- and long-term impacts of reinjection on groundwater systems and their dependent ecosystems.²⁴⁸

4.2.5 Fugitive emissions

Natural gas is often presented as a transitional fuel in the move to a lower carbon economy because it produces less carbon dioxide than burning coal for comparable electricity generation.²⁴⁹ There is debate, however, over whether methane leaks during natural gas extraction – called ‘fugitive emissions’ – could mean that natural gas has a greater greenhouse gas impact than was previously thought.²⁵⁰ The NSW Chief Scientist states that methane has a global warming

²⁴⁶ Queensland GasFields Commission (2015) ‘Understanding Treated CSG Water Quality in Queensland’, Queensland GasFields Commission website; Queensland GasFields Commission (2014) *CSG Water Treatment and Beneficial Use*, Technical Communication no. 2.

²⁴⁷ M. Currell (2015) Submission 11, p. 6.

²⁴⁸ VAGO (2015) op. cit., p. 27.

²⁴⁹ NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., p. 91.

²⁵⁰ *ibid.*, pp. 91-92.

potential, defined by the Intergovernmental Panel on Climate Change, as 21 times that of carbon dioxide.²⁵¹ Fugitive emissions from unconventional gas extraction can also include other unintended gas or vapour emissions, but primarily refer to methane emissions.²⁵²

As stated earlier, the SCER identified that poor well integrity can potentially lead to the migration of gas into surrounding aquifers, wells, waterbores and the surface.²⁵³ Fugitive methane emissions can also occur during other stages of gas production such as storage, piping and treatment.²⁵⁴ The New South Wales Legislative Council inquiry into coal seam gas and the NSW Chief Scientist and Engineer found that there is a significant level of uncertainty over the amount of fugitive emissions across the lifecycle of production and the accuracy with which they are measured.²⁵⁵

The Victorian Government inter-departmental submission to the Committee provides an example of a gas leak incident in New South Wales from a CSG well, and states that ‘The NSW Environment Protection Authority has fined an energy company for a gas leak, which occurred from a gas well in Camden on 31 August 2014. The responsible entity acknowledged that 10,000 cubic feet of gas was released during the leakage.’²⁵⁶

The APPEA and Minerals Council submissions to the Committee point to a study conducted by the CSIRO in 2014 for the Commonwealth Department of the Environment, which measured emissions from 43 CSG wells in Queensland and New South Wales, and found the emissions to be very low.²⁵⁷

Industry groups also point out that methane leaks can occur naturally in the environment.²⁵⁸ The NSW Chief Scientist argues that this underlines the importance of obtaining baseline measurements prior to production, and conducting ongoing monitoring so as to be able to distinguish between natural sources of methane, methane being emitted through other bores, and fugitive emissions from industry.²⁵⁹

The VAGO report on unconventional gas states that there is currently ‘no licence or regulatory requirement to assess and monitor fugitive emissions across the area and life cycle of unconventional gas activities in Victoria.’²⁶⁰

251 *ibid.*, p. 91.

252 See *ibid.*; M. Currell (2015) Submission 11, p. 4.

253 SCER (2013) *The National Harmonised Regulatory Framework*, op. cit., p. 29; M. Currell (2015) Submission 11, pp. 2-4.

254 M. Roarty (2011) *The Development of Australia’s Coal Seam Gas Resources*, *Background Note*, Commonwealth Parliamentary Library, 28 July, p. 7.

255 NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., pp. 91-97; NSW Legislative Council (2012) op. cit., pp. 194-203.

256 Government of Victoria (2015) Submission 658, p. 28.

257 APPEA (2015) Submission 364, p. 20; Minerals Council (2015) Submission 365, p. 7. See: CSIRO (2015) ‘Fugitive Emissions for Coal Seam Gas: Australia’s first fugitive emissions measurement’, CSIRO website.

258 APPEA (2015) Submission 364, p. 36.

259 NSW Chief Scientist & Engineer (2013) *Initial Report on the Independent Review of Coal Seam Gas Activities in NSW*, op. cit., p. 93.

260 VAGO (2015) op. cit., p. 29.

4.2.6 Impacts on native vegetation, biodiversity and threatened species

It is also commonly identified that unconventional gas exploration and production can impact on native vegetation, biodiversity and threatened species.²⁶¹ Potential impacts of the infrastructure footprint of wells, roads, pipes and compressor stations, include the clearing of bushland, fragmentation of important remnant native vegetation, the spread of invasive species and the increased risk of bushfires.²⁶² The Victorian Government inter-departmental submission to the Committee states that:

Loss of biodiversity and habitat fragmentation may result from land clearance for roads and other infrastructure, thereby reducing habitat. This is particularly relevant due to the higher number of wells typically required for unconventional gas production as compared to conventional gas production. Impacts on biodiversity are difficult to quantify without adequate baseline data on prevalence and vulnerability.²⁶³

The Victorian Government inter-departmental submission also noted that loss of biodiversity may be caused indirectly through pollution or hydrological changes to ecosystems with a high dependence on groundwater, or through soil contamination caused by the increased mobility of water, gases and other chemicals through the strata.²⁶⁴ The submission states that there are 100 listed threatened species occurring in the parts of the Gippsland region prospective for unconventional gas, and 170 listed threatened species occurring in parts of the Otway region prospective for unconventional gas.²⁶⁵

4.3 Potential human health impacts

The risk of unconventional gas activities impacting on human health was also brought to the attention of the Committee. A number of submissions and evidence of witnesses at hearings focussed on potential health risks posed by the industry.²⁶⁶

The Acting Chief Health Officer, Professor Ackland, explained in his presentation to the Committee that public health risk assessment and management requires the identification of hazards of concern, and that there are a number of potential hazards associated with unconventional gas. He emphasised that the full range of hazards posed by the industry is currently unknown and that for the known

²⁶¹ Williams et al. (2012) op. cit., p. 32.

²⁶² *ibid.*, p. 105. For further information see *ibid.*, pp. 30-37, 105-106.

²⁶³ Government of Victoria (2015) Submission 658, p. 21.

²⁶⁴ *ibid.*, p. 27.

²⁶⁵ *ibid.* See: Wilderness Society Victoria (2015) Submission 1041; R. Reid (2015) Submission 1033 p. 1; T. Flint & D. Flint (2015) Submission 1034, pp. 2-3; Friends of the Earth (2015) Submission 466, pp. 13-14.

²⁶⁶ See for example: J. McCubbin (2015) *Transcript of Evidence*, 1 July; Environmental Justice Australia (2015) Submission 837, p. 7; Doctors for the Environment Australia (2015) Submission 416; Barwon Paediatricians (2015) Submission 864; Australian Medical Association – Victoria (2015) Submission 65.

hazards, the scientific data is limited. He emphasised that further research is required to fully assess the potential risks, and that strong and effective regulatory oversight is a prerequisite for protecting public health.²⁶⁷

Professor Ackland said that key hazards of the industry include the chemicals used to extract the gas and the chemicals produced by extracting the gas. He said that the available evidence indicates that these may include the chemicals listed below, but that many chemicals remain unknown:

- Acids (e.g. hydrochloric acid, peroxydisulfuric acid)
- Alcohols (e.g. methanol, isopropanol, ethanol)
- Hydrocarbons (e.g. petroleum distillates, methane)
- Metals (e.g. arsenic, mercury, cadmium)
- Naturally occurring radioactive materials (e.g. radon)
- Polycyclic aromatic hydrocarbons (e.g. naphthalene)
- Surfactants (e.g. 2-butoxyethanol)
- Volatile organic compounds (e.g. benzene, xylene, ethyl-benzene).²⁶⁸

Professor Ackland stated that the sort of health effects that can occur as a result of exposure to those chemicals, and importantly to mixtures of those chemicals, include ‘effects on the immune system, the nervous system, liver and kidney toxicity, reproductive issues, cancers, respiratory and cardiovascular illnesses and psychological effects’.²⁶⁹

He said that people may be exposed to these hazards through contaminated land (for example, from chemical spills or inappropriate disposal of wastes), through contaminated surface and groundwater supplies, or through pollutants in the air (for example, from fugitive emissions, dust from contaminated land and the operation of machinery).²⁷⁰

Professor Ackland stated that there are ‘a range of knowledge gaps’ regarding public health risks related to unconventional gas activities:²⁷¹

Knowledge is lacking regarding potential hazards and their physical and chemical properties, how they move in the environment, associated health effects and the dose-response relationships. In those points I am suggesting that while on the one hand we may not actually know what the chemicals are, even if we did know some of the names of those chemicals it may still be unknown as to what the actual effects those chemicals would have on people who are exposed to them, so that is a significant knowledge gap.²⁷²

²⁶⁷ M. Ackland, Acting Chief Health Officer (2015) *Transcript of Evidence*, 1 September, p. 4; M. Ackland, Acting Chief Health Officer (2015) Presentation, 1 September.

²⁶⁸ M. Ackland (2015) Presentation, 1 September.

²⁶⁹ M. Ackland (2015) *Transcript of Evidence*, 1 September, p. 3.

²⁷⁰ M. Ackland (2015) Presentation, 1 September.

²⁷¹ M. Ackland (2015) *Transcript of Evidence*, 1 September, p. 3.

²⁷² *ibid.*

He further said that these knowledge gaps prevent the carrying out of comprehensive risk assessments, and that there is a limited understanding of the health impacts from exposure to chemical mixtures.²⁷³ He additionally highlighted that health guideline values are not available for all known hazards, including those relevant to different exposure routes such as oral intake, inhalation or topical contact; that there is limited evidence regarding the long-term and short-term effects in relation to those exposures; and that there is no evidence to rule out such health effects.²⁷⁴ He advised the Committee that ‘a precautionary approach’ should be taken where there is scientific uncertainty, and provided the following quotation from the *Public Health and Wellbeing Act 2008*: ‘If a public health risk poses a serious threat, lack of full scientific certainty should not be used as a reason for postponing measures to prevent or control the public health risk.’²⁷⁵

Other submissions to the Committee from medical professionals expressed similar concerns to the Acting Chief Health Officer. For example, the submission provided by Doctors for the Environment Australia (DEA) states that it ‘is concerned that the rush to exploit this resource has outpaced regulation to protect public health and to adequately assess the health impacts, including exposures to industrial chemicals.’²⁷⁶ The DEA further states that a cost-benefit-analysis of an unconventional gas industry in Victoria, should include the costs of air and water monitoring, health risk assessments, and potential adverse public health outcomes.²⁷⁷

The Australian Medical Association – Victoria similarly recommends in its submission to the Committee that governments ensure that all future proposals for unconventional gas development are subject to ‘rigorous and independent health risk assessments, and take into account the potential for exposure to pollutants through air and groundwater and any likely associated health risks.’²⁷⁸

The 13 paediatric doctors of the Barwon region said in their submission to the Committee that they ‘are unanimously opposed to any form of unconventional gas mining proceeding in the Geelong/Surfcoast/Bellarine areas given the concerning emerging data related to environmental and associated health impacts.’²⁷⁹ The Barwon paediatricians submission refers to research that is finding that the public health impacts of unconventional gas extraction remain undetermined and that more environmental and public health studies are needed.²⁸⁰

²⁷³ M. Ackland (2015) Presentation, 1 September.

²⁷⁴ M. Ackland (2015) *Transcript of Evidence*, 1 September, p. 3; M. Ackland (2015) Presentation, 1 September.

²⁷⁵ M. Ackland (2015) *Transcript of Evidence*, 1 September, p. 4; M. Ackland (2015) Presentation, 1 September.

²⁷⁶ Doctors for the Environment Australia (2015) Submission 416, p. 2.

²⁷⁷ *ibid.*

²⁷⁸ Australian Medical Association – Victoria (2015) Submission 65, p. 1.

²⁷⁹ Barwon Paediatricians (2015) Submission 864, p. 1.

²⁸⁰ For list of example studies see *ibid.*, pp. 1-2.

Dr Mike Forrester, who gave evidence on behalf of the Barwon paediatricians drew the Committee's attention to an editorial in the *British Medical Journal* which states that reports which find that problems with unconventional gas extraction are the result of poor regulation 'ignores many of the inherent risks of the industry that no amount of regulation can sufficiently remedy, such as well casing cement failures and accidental spillage of wastewater or produced water.'²⁸¹

4.4 Community concern about potential risks of unconventional gas extraction

The vast majority of submissions to the Committee express concerns about the potential risks an unconventional gas industry could pose to the Victorian environment. The concerns mainly centre on potential risks to Victoria's prime agricultural land and to the water resources that support agriculture, as well as to Victoria's tourism industry (agriculture and tourism are discussed in more detail in Chapter 5 of this Report on the co-existence of the unconventional gas industry with other land users).

These concerns are widespread, and shared by a broad cross-section of the community including farmers and other landholders, environmental groups, landcare groups, medical professionals, hydrogeologists, tourism operators, small business owners, and local councils.²⁸² The Committee has been informed that, while the designation does not have legal standing, since 2012 over 60 communities in Gippsland and Western Victoria have declared themselves 'gas field free' and formed local action groups.²⁸³

For example, the submission from 'Gas Field Free Seaspray' states that: 'Seaspray has two unconventional gas mining exploration licences covering the entire township and surrounds; Lakes Oil for tight gas and Ignite Energy for coal seam gas.'²⁸⁴ The submission explains that following a community survey in which 98 per cent of those surveyed confirmed that they did not want gas fields in Seaspray or surrounding areas, the community declared itself 'gas field free' on 28 July 2013. The occasion was marked with the formation of a human sign, made up of 650 people, spelling out the words 'No Gas Fields'.²⁸⁵ The Gas Field Free Seaspray submission also expresses the uncertainty the community feels about the development of an unconventional gas industry in their area:

²⁸¹ M. Forrester (2015) *Transcript of Evidence*, 12 August, p. 30.

²⁸² See: Environment and Planning Committee (2015) 'Inquiry into Unconventional Gas in Victoria: Submissions', Parliament of Victoria website.

²⁸³ C. Aldenhoven (2015) Submission 817, pp. 22-24; U. Alquier, Lock the Gate (2015) Submission 393, pp. 2-3.

²⁸⁴ Gas Field Free Seaspray (2015) Submission 426, p. 2.

²⁸⁵ *ibid.*, p. 3.

We have an overwhelming grief in our community as generational farmers face the uncertainty of a future in an industrialised environment, their properties devalued and unable to develop their business plans for future expansion. The prospect of leaving a long held family farm and life's work is heart wrenching and has led to extremes of depression and feelings of hopelessness.²⁸⁶

Similarly, 'Gas Field Free South West' describes itself as a group of farmers from the Byaduk, Byaduk North, Wallacedale and Branhholme area, south of Hamilton, which is covered by petroleum licence permit 150. Their submission states that: 'On Sunday 3 May 2015, our community came together in order to officially declare ourselves 'Gas Field Free'. Around 250 land holders took time out from their busy Autumn sowing season to bring their tractors to a help make a large sign saying 'Food Not Gas'.'²⁸⁷ The submission further states that:

Are we really prepared to risk a sustainable income from a product that all people need – food – and for which there is a growing demand for safe, clean and green food, for a short term (15-20 years) industry known to be damaging to human health and the environment...?²⁸⁸

Of the 17 local councils that have made submissions and/or presented at Committee hearings, most but not all were opposed to an unconventional gas industry proceeding in Victoria.²⁸⁹ As Councillor Neil Rankine from the Bass Coast Shire Council stated in his evidence to the Committee:

I would like to point out that Bass Coast Shire unanimously passed a motion — a number of motions in fact — of outright opposition to coal seam gas. Every councillor in our municipality has been told by our community that they do not want this industry. There is good reason for that. Our environment is our economy. Tourism is the industry in our municipality; agriculture and construction are the other two major industries.²⁹⁰

The submission from the Colac Otway Shire Council is similarly representative of local government opposition to the industry. Their submission emphasises potential risks to agriculture and environmental-based tourism, and suggests that resources would be better directed into the renewable energy sector:

The literal footprint of the industry, the amounts of water it requires, and the potential for the processes involved to contaminate groundwater present an unacceptable risk to the agriculture industry and the region's water catchments, especially in the face of climate change and dwindling water supplies. The potential impact on the unique environmental assets within our region, and subsequently the tourism industry, presents an unacceptable risk ... The resources and investment required to conduct appropriate research into these impacts, and to then develop and implement effective regulation of the industry, would be better directed to the renewable energy sector...²⁹¹

²⁸⁶ *ibid.*, p. 8.

²⁸⁷ Gas Field Free South West (2015) Submission 210, p. 1.

²⁸⁸ *ibid.*, p. 4.

²⁸⁹ See: Municipal Association of Victoria (2015) Submission 873, pp. 4-6.

²⁹⁰ N. Rankine (2015) *Transcript of Evidence*, 30 June, p. 2.

²⁹¹ Colac Otway Shire Council (2015) Submission 823, p. 4.

Significantly, the level of community concern that has been expressed to the Committee suggests that the industry has not been granted a ‘social licence to operate’ in Victoria.²⁹² The ACOLA report explains that the term ‘social licence to operate’ is widely used in resources industries and is based on the concept that ‘successful resource developments require not only the formal approval of government, but the broad acceptance of local communities and other key stakeholders’.²⁹³

Mr David Arnault, of Mirboo North, wrote in his submission to the Committee that the people in Victorian regions prospective for unconventional gas, such as South Gippsland and Portland, have:

...made it clear that they don’t see gas companies as anything but a threat to their lives, to the commercial fishery and sport fishing, to the tourism industry and to the health of themselves and their neighbours. There is no social licence for gas extraction (or coal mines), but there is a quiet determination to protect the land they live in...²⁹⁴

Gayle Margaret, Peter Ramon and Andrew and Linda Corcoran, residents and future residents of Mirboo North, similarly write in their submission to the Committee that ‘the government can be certain that there is no Social Licence for this industry to proceed in Victoria.’²⁹⁵

4.5 Unconventional gas industry response to community concern

Industry proponents have submitted to the Committee that the risks posed by unconventional gas extraction are similar to the risks posed by other extractive industries, and that the risks can be successfully mitigated by adhering to regulations. They point to government initiated reviews from other jurisdictions that are recommending that the industry proceed, subject to ‘best practice’ regulations. Industry proponents additionally emphasise that the benefits of an unconventional gas industry to Victoria will outweigh the risks.

The APPEA states that the potential environmental and health risks involved in unconventional gas production can be safely managed and that ‘there is no sound basis for continuing to delay an industry that can provide substantial economic and community benefits to the State.’²⁹⁶ The APPEA submission states that many of the risks found in the unconventional gas industry are also present in other industries, and that the CSG industry in Queensland provides an example how these risks can be successfully managed:

²⁹² See for example: B. Crook, Colac Otway Shire Council (2015) *Transcript of Evidence*, p. 4; U. Alquier, Lock the Gate (2015) Submission 393, pp. 2-4.

²⁹³ Cook et al. (2013) *Engineering Energy*, op. cit., p. 156.

²⁹⁴ D. Arnault (2015) Submission 588, p. 12.

²⁹⁵ G. Margaret, P. Ramon, A & L. Corcoran (2015) Submission 900, p. 2.

²⁹⁶ APPEA (2015) Submission 364, op. cit., p. 4.

Many of the activities – and associated risks – found in unconventional gas exploration and production are common in other industries. For example, drilling is undertaken in mining and agriculture. Hydraulic fracturing is used in geothermal energy production and to improve the flow of water bores. Pipelines are used to transport water and deliver gas to hundreds of thousands of households. The fact that these risks are manageable is clearly demonstrated by the Queensland coal seam gas industry, which coexists successfully with high-value agriculture and farming practices that are required to meet high standards, such as organic farming.²⁹⁷

The APPEA submission highlights the reviews which are concluding that risks involved in unconventional gas production can be effectively managed with strict regulatory frameworks: ‘The findings of multiple Australian and international reviews and inquiries by eminent individuals and institutions are clear – the risks associated with unconventional gas can be managed effectively through the creation of a robust regulatory regime, underpinned by effective monitoring and compliance.’²⁹⁸

The APPEA submission further states that: ‘Victoria is fortunate that there are a number of contemporary Australian examples of such regulatory regimes already in place’ and recommends the adoption of the SCER National Harmonised Regulatory Framework to underpin the regulation of unconventional gas in Victoria.²⁹⁹

The Minerals Council submission to the Committee emphasises the findings of recent reviews in New South Wales and the Northern Territory into unconventional gas:

In September 2014, the NSW Chief Scientist’s Independent Review of Coal Seam Gas Activities concluded that the technical challenges and risks posed by the CSG industry can, in general, be managed through a clear legislative framework, high engineering standards and professionalism from the extraction companies. Also Alan Hawke, the commissioner presiding over the Hydraulic Fracturing Inquiry in the Northern Territory, said in his November 2014 report that the environmental risks associated with hydraulic fracturing could be managed effectively with a robust regulatory regime. These findings are consistent with other Australian and international inquiries...³⁰⁰

Dr Halyburton from Mecrus Resources stated to the Committee that there are risks involved in his company’s plan to extract oil shale and gas but that those risks can be mitigated by following good practice and well design:

There are a few perceived risks with hydrocarbon exploration and production, whether it is conventional or unconventional. Tongue-in-cheek I like to say what is unconventional today will be conventional tomorrow. There have been many things that have changed along the way. When the Wright brothers first flew their plane somebody said, ‘If God had wanted us to fly, he’d have given us wings’. Now we fly without second thoughts. But there are risks, and they can be mitigated. Groundwater

²⁹⁷ *ibid.*, p. 11.

²⁹⁸ *ibid.*, p. 3.

²⁹⁹ *ibid.*, pp. 3-4.

³⁰⁰ Minerals Council (2015) Submission 365, p. 7.

and surface contamination: there are 2.5 kilometres of vertical separation between the aquifers near the surface and the oil. We will use good oilfield practice, including proper well design, to ensure that these risks are mitigated.³⁰¹

Lakes Oil's submission to the Committee emphasises that the benefits of an unconventional gas industry will outweigh the perceived risks, and that increasing the State's gas resources will aid the manufacturing sector:

Lakes has been supportive of all the inquiries that have looked into this issue as it believes that once the facts are out there the local and wider community will see that the benefits of an onshore unconventional/conventional gas industry far outweigh the perceived risks. Victoria has been blessed with very significant natural resources which in the past have been exploited to make Victoria the manufacturing heartland of Australia. We believe that by exploiting these deeper, cleaner onshore gas resources we will help rejuvenate industry across the state...³⁰²

4.6 Findings and recommendation

The body of scientific studies, government initiated reviews and parliamentary inquiries into unconventional gas commonly identify a number of potential risks posed by the industry to water resources, the environment and human health. It is important to identify and understand these potential risks so that informed decisions can be made, and the Government can weigh these risks against the expected benefits of an unconventional gas industry, such as the provision of a potential source of energy, royalties paid to the state and employment opportunities.

If it is decided that the industry should proceed in Victoria, it is important to identify the risks posed by unconventional gas extraction so that governmental agencies can develop corresponding risk-based strategies to address and minimise the risks and ensure the industry is effectively regulated. It is also important that a risk-based regulatory framework is in place prior to the industry going ahead.

The Committee notes the emphasis placed by the VAGO report on unconventional gas on the importance of the Department of Economic Development, Jobs, Training and Resources and the Department of Environment, Land, Water and Planning developing risk-based strategies if it is determined that the industry should proceed.

RECOMMENDATION 2: That the Chief Health Officer commissions a full review and report to the Victorian Government on the possible human health impacts of an unconventional gas industry.

³⁰¹ Mecrus Resources (2015) *Transcript of Evidence*, 23 September, p. 17.

³⁰² Lakes Oil (2015) Submission 510, pp. i - ii.

5

Co-existence – Can the unconventional gas industry co-exist with other land uses?

5.1 Chapter overview

Chapter Five examines issues relating to the potential co-existence of an unconventional gas industry in Victoria with other land uses such as agriculture and tourism, and with the rights of Traditional Owner groups. In regards to agriculture, it considers matters relating to potential impacts on water resources, domestic and export market requirements including reputational risk, as well as the legal rights of property owners and compensation agreements.

Chapter Five then considers potential issues relating to the co-existence of the Tourism Industry with unconventional gas development, and with the rights of traditional owner groups in areas under Native Title or subject to agreements under Victoria's *Traditional Owners Settlement Act 2010*. The Chapter concludes with a consideration of the potential implications of an unconventional gas industry for local and regional development, investment and jobs.

5.2 Agriculture

A key issue in the unconventional gas debate arises from the fact that gas deposits can be located under privately owned agricultural land. The following section provides a short overview of the evidence received by the Committee regarding the co-existence of the two industries, and then provides further details on evidence received by the Committee in regards to:

- the impact of gas industry infrastructure on farming
- biosecurity
- water resources and issues with chemicals and food safety accreditations
- reputational risk
- land access laws, compensation and property prices
- the multiple land use framework put forward by governments and industry to facilitate successful co-existence.

In very brief terms, under Victorian law, mining companies are required to negotiate access agreements with landholders and provide compensation for the disruption and impact on the property. In most cases, landholders and mining companies are able to reach an agreement. Ultimately, however, landholders

do not have the right to prevent the company from entering the property and exploring for and extracting the resource (land access laws and compensation is further discussed in section 5.2.5 of this Chapter and in Chapter 7 of this Report).

Farmers have expressed concerns to the Committee that unconventional gas extraction will pose risks to agricultural production. They emphasise the importance of agriculture to the Victorian economy and the state's food security. They also point to the long-term economic value of agriculture as opposed to the short-term nature of the unconventional gas industry. The Victorian Government inter-departmental submission to the Committee states that the Victorian agricultural sector generated a gross value of food and fibre production of \$12.68 billion in 2013-14 from approximately 12 million hectares of agricultural land across the whole State. This comprises approximately three per cent of Australia's agricultural land and includes many of the nation's most productive land areas.³⁰³ It is also notable, as the Inquiry into Greenfields Mineral Exploration pointed out, that Victoria is relatively densely populated in comparison to other Australian jurisdictions with 25 per cent of the national population occupying 2.6 per cent of the land mass.³⁰⁴

The Victorian Farmers Federation (VFF) similarly states that 'Despite farming on around three per cent of Australia's available agricultural land, Victorians produce close to 30 per cent of the nation's agricultural exports.' The VFF further states that 'The agricultural sector is a significant contributor to the Victorian economy, employing over 191,700 people, that is, one in six regional Victorians.'³⁰⁵

The VFF stated to the Committee that there are significant concerns among its membership that an unconventional gas industry will affect agricultural production, particularly in regard to impacts on the quality and quantity of available water and the potential for contamination from the use of chemicals in hydraulic fracturing.³⁰⁶ The VFF additionally said that there is a lack of scientific information on the risks posed by unconventional gas activities to the Victorian environment and that 'there are no guarantees from the Victorian Government or the gas industry that these risks can be managed.'³⁰⁷

Significantly, the VFF calls for the moratorium on the unconventional gas industry in Victoria to be extended for another five years: 'VFF members have responded to these uncertainties on the impacts of unconventional gas activities by calling for a moratorium on issuing licences for all types of unconventional gas exploration and mining until 2020.'³⁰⁸ The VFF states that it also supports the introduction of a farmer's 'right to veto' unconventional gas exploration and production on their property.³⁰⁹

³⁰³ Government of Victoria (2015) Submission 658, p. 33.

³⁰⁴ Parliament of Victoria, Economic Development and Infrastructure Committee (2012) op. cit., p. 58.

³⁰⁵ Victorian Farmers Federation (2015) Submission 471, p. 12.

³⁰⁶ *ibid.*, pp. 6, 8.

³⁰⁷ *ibid.*, p. 6.

³⁰⁸ *ibid.*, p. 6.

³⁰⁹ *ibid.*, pp. 2, 13.

The Committee also heard from farmers who called for an outright ban on the unconventional gas industry. For example, Mr Gary Everett, a lamb producer and fourth-generation farmer from Drumborg in Western Victoria, told the Committee that communities are overwhelmingly opposed to the industry and that: ‘We need a total ban on all unconventional gas exploration and extraction in Victoria so we can have closure and be more productive in our lives. We do not want law-abiding citizens, especially 70 and 80-year-olds, being arrested for protecting our farms and our environment for future generations.’³¹⁰

Conversely, Mr Alex Arbuthnot, a farmer from the Gippsland region who has been a member of VFF and mining committees and taskforces for many years, gave evidence to the Committee that it was his personal opinion that the two industries could successfully co-exist provided that the risks posed by unconventional gas extraction were managed by regulation.³¹¹ Mr Arbuthnot said that mining and agriculture already co-exist in Gippsland and that an unconventional gas industry could provide local businesses with better access to gas as an energy source and benefit the regional economy.³¹² Mr Arbuthnot also said, however, that he – like the VFF – supports the right of the farmer to say no to mining companies coming on to their land.³¹³

Industry bodies from the minerals and resources sector gave evidence to the Committee that the industry can successfully co-exist with agriculture, can be beneficial to farms, and have positive impacts on rural and regional communities. The submission from Lakes Oil to the Committee stated that: ‘Land is much more productive when gas activities and agriculture coexist and there is generally no drop in overall agricultural production.’³¹⁴ The APPEA stated to the Committee that:

Experience shows that petroleum companies have been able to successfully negotiate thousands of land access agreements and compensation arrangements with farmers. Over 4,700 landholder access agreements have been successfully negotiated in Queensland alone. Demonstrating that land access can be, and is being successfully managed. In many cases, the extra water and income provided to landholders has increased agricultural productivity. In Queensland the gas industry is also delivering infrastructure and investment to several rural and regional districts, providing new jobs and strengthening and diversifying regional economies.³¹⁵

The following sections of the Report discuss specific issues related to the co-existence of agriculture and the unconventional gas industry in more detail.

³¹⁰ G. Everett (2015) *Transcript of Evidence*, 23 September, p. 56.

³¹¹ A. Arbuthnot (2015) Submission 17, pp. i - ii, 7; A. Arbuthnot (2015) *Transcript of Evidence*, 30 June, p. 5.

³¹² A. Arbuthnot (2015) *Transcript of Evidence*, 30 June, p. 2.

³¹³ *ibid.*, p. 4.

³¹⁴ Lakes Oil (2015) Submission 510, p. 3.

³¹⁵ APPEA (2015) Submission 364, p. 14.

5.2.1 Impact of surface infrastructure

The Committee heard that landholders are concerned that companies accessing their land and building the surface infrastructure required to extract the gas, will negatively impact on the operation of the farm. As explained in Chapter Four, unconventional gas extraction typically requires more wells than conventional gas extraction, and these wells are connected by a network of roads, pipelines and compressor stations. The development phase when the wells are drilled can involve substantial intrusion on to a property (such as truck movements, light, erosion, noise and dust) and interruption to farming operations and domestic life.³¹⁶ The ACOLA report provides the following description of shale gas well site construction:

Site construction involves the levelling of the site, structures for erosion control, excavation of fenced pits with special impervious liners to hold drilling fluids and cuttings, and access roads for the transportation of equipment to the site. Once the well (or multiple wells from the pad) is drilled, the drilling rig is removed and site prepared for well stimulation, by hydraulic fracturing.³¹⁷

The ACOLA report further states that shale gas well drilling and completion typically takes several weeks but that (as stated in Chapter Four) wells need to be drilled over a ‘continuing timescale due to the nature of the gas production decline curve for a single shale gas well.’³¹⁸

Mr Malcolm Rowe, a prime lamb and premium beef farmer from North Byaduk in Western Victoria, expressed concerns in his evidence to the Committee that gas industry infrastructure and associated vehicle movements would negatively impact on the management of his farm. Mr Rowe emphasised that farms in south-west Victoria are smaller and more densely settled than other areas of the country with unconventional gas industries, such as the Chinchilla/Roma area in Queensland.³¹⁹ He said that in the Chinchilla/Roma area ‘farmers would be lucky to carry one sheep per hectare. We carry the equivalent of 15 to 20 sheep per hectare.’³²⁰ Mr Rowe further explained that farming those numbers of sheep on a relatively small farm requires careful management based on agricultural science, to ensure that the animals receive the energy intake they require:

In order to maximise production, we know that a sheep requires 12 megajoules of metabolisable energy. If she is pregnant, she needs 18; if she has twins, she needs 22. At 30 days of lactation, after she has had her lamb, it is in excess of 30 megajoules of metabolisable energy that she requires to get through that production system... For her to get 30 megajoules of metabolisable energy, she needs a paddock which has a minimum of 13 centimetres of grass, which might be the equivalent of 2500 kilograms of grass per hectare.

³¹⁶ Ross & Darby (2013) op. cit., pp. 25-26; D. Kerr (2012) ‘Property Rights, Agriculture and the Coal Seam Gas Industry’, *Australia’s Unconventional Energy Options*, Committee for the Economic Development of Australia, p. 47.

³¹⁷ Cook et al. (2013) *Engineering Energy*, op. cit., p. 53. See *ibid* and section 4.2.2 of this Report for a description of hydraulic fracturing equipment.

³¹⁸ Cook et al. (2013) *Engineering Energy*, op. cit., p. 53.

³¹⁹ M. Rowe (2015) *Transcript of Evidence*, 23 September, p. 57.

³²⁰ *ibid*.

What I am trying to establish here is that it is a science that we are involved in here; it does not happen by accident. To do that we have small paddocks, connected by laneways, and we shift animals around the farm regularly, sometimes every two days, in order to ensure that in front of those animals, whether they be sheep or cattle, there is sufficient grass for them to receive the energy intake they require...

When I talk about these livestock rotations, imagine a coal seam gas industry established on our farm, where we have small paddocks with laneways, cattle movements happening, sheep movements happening every day or two, and then the whole scene of the gas industry coming in on top of that with vehicles and movements – all that sort of stuff. It will not work. It will not work on our farm.³²¹

Ms Rebecca Reid, who lives on a wool farm in East Gippsland with her extended family, similarly expressed her opposition to unconventional mining on their property. She explained that one of the reasons is the potential impact of surface infrastructure and vehicle movements:

It would be a huge struggle to attempt to raise sheep with increased traffic and noise. Ewes can be quite skittish and can lose lambs when startled. It would be impossible to work around trucks, new roads, potentially polluted settling ponds, and noisy drills. Not only because of the pasture we would lose, but because of how disjointed our farm would become.³²²

Ms Claire Miller, from Dairy Australia who appeared before the Committee representing the Australian Dairy Industry Council, stated that dairy farms are ‘very intensive operations’ and ‘not like big broadacre farms where you could have wells out in the corner and you would never see them unless you flew over it. On a dairy farm the conduct of the contractors and the companies themselves has to be absolutely above reproach and very clearly set out beforehand.’³²³

From the unconventional gas industry perspective, the APPEA submission to the Committee stated that many of the impacts of site construction such as noise and movement of vehicles are of limited duration:

Many of the impacts such as noise are of short term duration while specific types of activities are being undertaken (such as drilling or hydraulic fracturing). Once a well enters production and is connected to an underground pipeline gas gathering network, many of the localised impacts such as noise and vehicular traffic are greatly reduced or eliminated entirely.³²⁴

The APPEA also said that mining companies will consult carefully with landholders in order to design their activities to minimise disruptions to farming:

Companies will design their activities to minimise the impact of their operations on land holders in areas such as biosecurity, use of roads, speed limits, impacts on stock, fencing, fire management, rubbish disposal, abandonment of water bores, gates, protection of trees and location of accommodation camps.³²⁵

³²¹ *ibid.*

³²² R. Reid (2015) Submission 1033, p. 1.

³²³ C. Miller, Australian Dairy Industry Council (2015) *Transcript of Evidence*, 1 July, p. 5.

³²⁴ APPEA (2015) Submission 364, p. 16.

³²⁵ *ibid.*

Lakes Oil similarly states in its submission to the Committee that: ‘All activities are scheduled to work in with the operations on the properties to minimise any disturbance’ and that farmers are provided with compensation and the benefits of upgraded access tracks, improved fencing and left over materials.³²⁶ Lakes Oil further states that:

The area around the wells is still available for general farming practices (e.g. grazing, cropping) and with the ability of directional drilling it is possible to position the wellsites so that the impact on the farmers day-to-day use of the land is minimised. Wellsites are usually positioned along fence lines and all access tracks run along the fence lines so as not to breakup the pastoral land. These access tracks are valuable assets for farmers as they provide all weather access to their properties. Petroleum and mining activities have co-existed with farming and other land uses across Victoria for well over one hundred years usually to the benefit of all parties concerned.³²⁷

5

5.2.2 Biosecurity

Concerns were expressed to the Committee that the movement of people and equipment associated with the unconventional gas industry on privately owned farmland could pose biosecurity risks, though the inadvertent introduction of animal and plant diseases and invasive species. The VFF submission to the Committee stated that: ‘As mining and exploration activities often involve the movement of visitors on private land, from contractors to protestors and government agencies, there are biosecurity risks that need to be managed appropriately.’³²⁸ Mr Rowe also addressed the issue of biosecurity risks in his evidence to the Committee:

...we make a significant effort to manage biosecurity on our farm. We have a closed shop in terms of livestock coming in and going out. Any animal that comes in goes through a rigorous induction program to ensure that we do not import any diseases. Diseases can come in in a whole range of boots or tyre treads – those sorts of things – so if we had an intensive unconventional gas industry operating here, coming from known infected places in the district, how do we manage that? How do we get compensated for stuff that has been brought onto our farms by others, which may not manifest itself in the first year or the second year, but it may manifest itself in the 5th or the 10th year? It is not going to work for us, and it is not going to work for a significant proportion of people in this area.³²⁹

5.2.3 Water resources, chemicals, and food safety accreditations

The Committee heard concerns from farmers that an unconventional gas industry could pose risks to Victorian water resources that are needed for agricultural production (water resources are further discussed in Chapter Six of this Report). The Committee also heard that the use of chemicals by the industry

³²⁶ Lakes Oil (2015) Submission 510, p. 18.

³²⁷ *ibid.*, p. 14.

³²⁸ VFF (2015) Submission 471, p. 10.

³²⁹ M. Rowe (2015) *Transcript of Evidence*, 23 September, pp. 57-58.

and the potential for industry activities to mobilise naturally occurring hazardous materials, were of concern to farmers (the potential risks of unconventional gas extraction are discussed in Chapter 4 of this Report). The risk of potential contamination interfering with food safety accreditations for agricultural produce was also brought to the Committee's attention.

A number of submissions from farmers emphasised the importance of groundwater to their farms. For example, a submission from a merino farmer in Goon Nure in East Gippsland states that farming in the district is totally dependent on continued access to good quality groundwater, and that contamination of the groundwater would mean the end of farming in the area.³³⁰ Mr Colin Frawley, from south-west Victoria, similarly stated to the Committee that 'We see that the unconventional gas industry puts our farming operation at risk. In our particular situation, for our livestock we must have underground water. If that were to be contaminated or compromised, that totally compromises our business.'³³¹ Ms Alice Irving, from Darriman in Gippsland said in her submission that:

Agriculture and an unconventional gas industry cannot co-exist safely. What Government in its right mind would risk the health and prosperity of such a productive area of Gippsland? The sustainability of beef, sheep, dairying and vegetable growing industries, as well as tourism, is so closely connected to the wellbeing of the Ramsar-listed Gippsland lakes, and directly threatened by the possible operation of an onshore gas industry.³³²

Mr Steven Ronaldson stated in his submission that: 'I live on 200ha of Certified Biodynamic land near the Ninety Mile Beach. I rely on the ground water to farm and any use of chemicals on or near the property would severely jeopardise my business, certification and lifestyle. The risk to the water table by fracking is just too great'.³³³

Mr Trevor Flint and Mrs Diana Flint, who run a mixed farm which produces prime lamb, premium pork and beef in the Seaspray/Longford area of Gippsland, which was visited by the Committee, emphasised that contamination risks posed by unconventional gas extraction could prevent farmers from gaining food safety accreditation for their produce.³³⁴

Mr and Mrs Flint drew the Committee's attention to accreditation systems that require farmers to adhere to regulations and auditing processes to verify that the produce is free from contaminants. Examples of these accreditation systems include HACCP Australia (Hazard Analysis Critical Control Point) and Livestock Production Assurance (LPA) National Vendor Declarations (NVD). DEDJTR explains that:

³³⁰ Name withheld (2015) Submission 945, p. 1.

³³¹ C. Frawley (2015) *Transcript of Evidence*, 23 September, p. 56.

³³² A. Irving (2015) Submission 1059, p. 1.

³³³ S. Ronaldson (2015) Submission 996, p. 1.

³³⁴ T. Flint & D. Flint (2015) Submission 1034, pp. 1-2.

The National Vendor Declaration (NVD) is the key tool underpinning Australia's food safety reputation for livestock. Producers use the NVD to declare necessary and valuable information about the food safety status of the livestock being sold. Buyers rely on the NVD for accurate information on the livestock purchased and processors rely on the information to ensure only the safest food enters our food chain.³³⁵

Mr and Mrs Flint's submission to the Committee states that more attention needs to be paid to the risks an unconventional gas industry could pose to a farmer's ability to gain these accreditations:

As ex dairy farmers, we are aware of regulated programs such as HACCAP which get routinely audited for chemical and animal medicine use on the farm. Being meat and livestock producers we have been audited and know only too well the seriousness of the 'LIVESTOCK PRODUCTION ASSURANCE NATIONAL VENDOR DECLARATION,' (LPA/NVD). This underpins Australia's meat and livestock FOOD SAFETY REPUTATION; (no contaminants get in the food chain).

As meat and livestock producers, our responsibility is to be accurate when answering all questions on the forms. Any false, misleading or UNVERIFIED statements may result in prosecution or civil action. These are legal documents we, as meat and livestock producers sign off on. The LPA/NVD is in place not only for traceability but to ensure all consumers; domestic and overseas, are guaranteed that no contaminants are in the food they consume. Agriculture and OUG [onshore unconventional gas] cannot co-exist due to the fact that whatever chemicals used or bought up to the surface, called 'naturally occurring' by the OUG [onshore unconventional gas] industry, cannot be guaranteed safe and has huge potential for entering the human food chain.

This is real, it is serious and it is underestimated. We ask you, what will the government do to protect all food producers and help them to continue to produce safe eating food for all? We cannot stress enough that this is extremely concerning for us. It is proven that some chemicals eg: arsenic, do accumulate over years in the soil. When livestock pick up some of that contaminated soil, the chemical hibernating in the soil becomes active again when it reacts with the animals stomach acid, therefore contaminating the food chain.³³⁶

Mr Rowe also gave evidence to the Committee that he subscribes to quality assurance programs to accredit his prime lamb and premium beef for export markets. Mr Rowe similarly expressed concern that unconventional gas extraction could put the certification of his produce at risk: 'If, for example, an unconventional gas industry come in and leaves stuff around and creates contamination in surface water supplies, we have to tick a box to say, "We think the cattle are contaminated". Who in his right mind is going to do that? Who in his right mind would want to do that?'³³⁷

³³⁵ DEDJTR (2015) 'Farm Management: National Vendor Declarations (NVD) and Tail (Transaction) Tags', DEDJTR Agriculture webpage.

³³⁶ T. Flint & D. Flint (2015) Submission 1034, p. 2.

³³⁷ M. Rowe (2015) *Transcript of Evidence*, 23 September, p. 57.

5.2.4 Reputational risk

Related concerns regarding the risks an unconventional gas industry may pose to the ‘reputation’ of Victorian agricultural produce as ‘clean and green’ were also articulated to the Committee. The Committee heard that one of Victoria’s competitive advantages in international, particularly in Asian, markets is its reputation based on strong environmental protection and food safety.³³⁸ For example, the East Gippsland Food Cluster – a collaborative network of regional food and wine producers – states that:

The East Gippsland Food Cluster is particularly concerned about the potential impacts of Unconventional Gas in Eastern Gippsland. These threats are considered as both perceived (i.e. detract from the clean and green image of our region amongst consumers) and real (i.e. threats to land, soil and water).³³⁹

Mr Frawley, who runs a farm between Hamilton and Bransholme, emphasised in his evidence to the Committee that agriculture is a long-term industry, whereas unconventional gas is a short-term industry that will put the clean, green image of the region at risk:

... we have the advantage at the moment of having a really clean, green image in our region, and we think that if industrial gas fields come to our region, that is immediately put at risk. We just think it is a marketing nightmare to promote your region if you have this overlay of a short-term unconventional gas industry.³⁴⁰

The evidence provided by the Australian Dairy Industry Council emphasises the importance of protecting the reputation of the Victorian dairy industry in international markets.³⁴¹ Mr Chris Griffin (a Gippsland dairy farmer and immediate past president of the Australian Dairy Farmers, who appeared before the Committee on behalf of the Australian Dairy Industry Council), highlights that Australia’s dairy industry is predominantly located in Victoria, and the importance of growing export markets to the industry:

We currently have around 6300 dairy farmers in Australia; 4268 of those are in Victoria. Some 9.2 billion litres of milk is produced in Australia annually; more than 6 billion litres of that is produced out of Victoria. Victorian dairy companies depend heavily on export markets for ongoing profitability and currently export around 60 per cent of the milk produced in Victoria. It goes out as milk powders, cheese, butter and other products. The dairy industry has potential to grow substantially over the next decade, and to meet growing domestic and international demand Victoria will certainly be a big part of this.³⁴²

Mr Griffin continued on to state that remaining internationally competitive is dependent on two things that unconventional gas extraction could put at risk:

³³⁸ VFF (2015) Submission 471, p. 13; A. McEwen (2015) Submission 261, pp. 1, 3.

³³⁹ East Gippsland Food Cluster (2015) Submission 654, p. 2.

³⁴⁰ C. Frawley (2015) *Transcript of Evidence*, 23 September, p. 56.

³⁴¹ C. Griffin, Australian Dairy Industry Council (2015) *Transcript of Evidence*, 1 July, p. 2.

³⁴² *ibid.*

But to achieve that growth and remain internationally competitive we need two things that unconventional gas mining could put at risk. Firstly, the natural resources upon which the dairy industry relies must continue to be available without any negative impact, and our primary focus here is water. Secondly, the dairy industry's reputation as a producer of high-quality, safe dairy products must be protected. Any possibility that unconventional gas mining could impact these two things, whether it is actual impact or the perception of our customers about impact, will need to be carefully managed to ensure all risks are addressed; for example, by having very robust legislative frameworks and limiting expansion of mining into new areas.³⁴³

Notably, Mr Griffin said that the co-existence of the dairy industry with unconventional gas in other jurisdictions was 'quite minimal' at this stage.³⁴⁴ Ms Miller said that: 'The coexistence at this stage is in Gloucester [NSW] near Barrington Tops. We have a couple of dairy farms up there that have trial wells on their properties with AGL, and we have one dairy farm there which has got trial fracking occurring as part of a more advanced exploration, and that is trial based.'³⁴⁵ Ms Miller further stated that they were not aware of any international examples of the co-existence of dairy farming with the unconventional gas industry.³⁴⁶

5.2.5 Land access laws, compensation and property prices

The following section discusses issues relating to land access laws, compensation determinations and potential impacts on property prices by an unconventional gas industry. Further details are provided on land access and compensation arrangements in section 7.3.4 of this Report (Chapter Seven addresses the regulation of a potential unconventional gas industry).

Land access

In Victoria, as in the rest of Australia, the Crown owns the mineral and petroleum resources – such as unconventional gas – that are located under privately owned land. The State Government, on behalf of the Crown, licences companies to explore for and extract the unconventional gas. According to Victorian law, as stated earlier in this Chapter, mining companies are required to negotiate access agreements with landholders and provide compensation for the disruption and impact on the property. If, however, the landholder does not give their consent for the company to access the land, the company can obtain a compensation determination from the Victorian Civil and Administrative Appeals Tribunal (VCAT) which allows the company to access the land even though the landholder has not consented.³⁴⁷ The Victorian Government inter-departmental submission to the Committee explains that VCAT's primary role is to determine the amount of compensation provided and does not have the right to determine that access

³⁴³ *ibid.*

³⁴⁴ *ibid.*, p. 3.

³⁴⁵ C. Miller, Australian Dairy Industry Council (2015) *Transcript of Evidence*, 1 July, p. 4.

³⁴⁶ *ibid.*

³⁴⁷ Ross & Darby (2013) *op. cit.*, pp. 25, 29; VAGO (2015) *op. cit.*, p. 61; Environmental Justice Australia (2015) Submission 837, Appendix: Environmental Defenders Office (2012) *Reforming Mining Law in Victoria*, p. 13.

should be refused.³⁴⁸ The VAGO report on unconventional gas states that in practice, however, land access disputes have historically been settled in Victoria through the Victorian Mining Warden, rather than VCAT.³⁴⁹

The Committee heard from industry proponents that thousands of land access agreements have been successfully negotiated between farmers and gas companies in Queensland.³⁵⁰ The Committee also received evidence and many submissions stating that the land access system in Victoria is unbalanced and favours the industry proponent over the landholder. The VFF submission to the Committee states that the ‘existing legislation does not provide a level playing field’ between landholders and companies ‘in negotiating access agreements for the use of agricultural land.’³⁵¹ It further states that:

VFF members often report that they feel compromised in the negotiation process for exploration and mining activities. That is, if a landholder disagrees with aspects of the activities proposed, they lose the power to negotiate on outcomes once a matter progresses to the dispute resolutions stage over compensation agreements.³⁵²

The VFF advocates that more support and certainty for landholders is built into the negotiation process so as to improve landholders’ legal rights and ‘create a more equal playing field’ with the mining companies.³⁵³ The VFF, as was mentioned earlier in this Chapter, proposes that landholders be given ‘a right of veto’ over mining activities on their land.³⁵⁴ The VFF states that:

We consider landholders have a right to determine what their land is used for, and this right should be enshrined in legislation. While the Crown undoubtedly owns the minerals, the land (including the top 15 metres of soil) is often privately owned. In most cases modern mining requires the removal of this soil to access the minerals, which landholders should have the power to stop.³⁵⁵

The Committee also heard evidence that the existing land access system is a source of significant anxiety for landholders whose properties are subject to unconventional gas exploration licences and permits. As the VAGO report on unconventional gas explains: ‘The existing system creates uncertainty for the landowner given their land may be subject to an exploration or development permit at any time.’³⁵⁶

Ms Aggie Stevenson, an agricultural scientist and farmer in south-west Victoria, gave evidence to the Committee about the stress and anxiety she and her community have experienced:

³⁴⁸ Government of Victoria (2015) Submission 658, p. 38.

³⁴⁹ VAGO (2015) op. cit., p. 61

³⁵⁰ APPEA (2015) Submission 364, p. 14.

³⁵¹ VFF (2015) Submission 471, p. 2.

³⁵² *ibid.*, p. 13.

³⁵³ *ibid.*

³⁵⁴ *ibid.*, p. 16.

³⁵⁵ *ibid.*

³⁵⁶ VAGO (2015) op. cit., p. 61

My family has cared for this land for decades, and the thought that a faceless corporation could destroy that is devastating for me and my family. The anxiety I have experienced over the last 18 months has been like nothing I have ever been through before. To think that that land that made my parents so proud could be taken away from us is unbearable.

I have spent the last 18 months trying to work out how anyone can possibly think that they can walk onto someone else's land and say, 'There's gas here, we're going to drill for it. You need to sign this access agreement'.

The feeling of landholders and citizens of being powerless to prevent the imposition of this industry is a telling psychological burden. People in agriculture have enough trouble coping with the usual pressures they face, and the added stress and anxiety caused by fighting this industry is taking its toll on the entire community.³⁵⁷

Mr and Mrs Flint similarly emphasised to the Committee the impacts, including health impacts, of 'the enormous stress' and 'anxiety' that the industry is causing to individuals, families and communities.³⁵⁸ Mr Rowe emphasised that the time that he and others have spent on the issue of unconventional gas, has taken time away from farm work and family life:

Running the operation as I do does not leave you much time at the end of the day to do other things. Gas has been night-time work. I have youngish children, and they say, 'What are you doing today, Dad?' I say, 'It's another gas meeting'. 'Ah', they say. If there is one thing I would like from this — it has been hugely distracting for me in my work; I have a couple of young dogs that need training and I have not been able to spend time on them — I think all of us would like from this, I speak collectively, would be for this distraction to stop. One thing we do not want to be is back here in five years time going through it all again. It is just so exhausting.³⁵⁹

Compensation

The Committee heard different views on the adequacy of compensation provided to landholders whose properties are accessed by unconventional gas companies. The issue of compensation requirements under Victorian law, and stakeholder suggestions for ways it could be improved, are discussed in detail in Chapter Seven of this Report.

The VAGO report on unconventional gas states that the 'current access and compensation arrangements for landowners are often criticised for not being fair or just. There is an imbalance between the bargaining positions of the landowners and industry, and the legislation unfairly limits possible compensation to those directly affected.'³⁶⁰ The VFF submission to the Committee states that: 'VFF members often feel that compensation will not provide a reasonable return to a farmer for use of their land and their time. The VFF believes that there are opportunities to provide commercial payment arrangements to account for the

³⁵⁷ A. Stevenson (2015) *Transcript of Evidence*, 23 September, p. 59.

³⁵⁸ T. Flint & D. Flint (2015) Submission 1034, p. 1.

³⁵⁹ M. Rowe (2015) *Transcript of Evidence*, 23 September, p. 60.

³⁶⁰ VAGO (2015) op. cit., p. xv.

full impact of a mining activity on a farming enterprise.³⁶¹ The VFF further states that when ‘land is rehabilitated following a mining development, there can be on-going issues that need to be addressed’ and proposes that the time period in which landholders can make claims, which is currently three years, should be extended to five years.³⁶²

Conversely, Lakes Oil gave evidence to the Committee that the current system of compensation works well and that their relationship with landholders is very positive.³⁶³ Lakes Oil’s submission to the Committee stated that:

Petroleum and mining activities have co-existed with farming and other land uses across Victoria for well over one hundred years usually to the benefit of all parties concerned. The compensation paid to the landowner for the use of the surface to access the resources below is far in excess of what the landowner would earn from their normal use of the land. If the wells are unsuccessful then they are totally rehabilitated to the landowner’s satisfaction and returned to normal farming practices.³⁶⁴

Mr Tim O’Brien of Lakes Oil, further stated to the Committee that: ‘Yesterday the landowner at North Seaspray, when I caught up with him, had great pleasure in showing me his new workshop that has been done and has been helped in some way by the compensation he has been receiving from us. He generates more income from that part of his land than any other part. It is a win-win for both of us.’³⁶⁵

Lakes Oil also provided the Committee with a copy of a letter written by a farmer, on whose property Lakes Oil had conducted exploration work in 2012 using conventional drilling methods, that was published in *The Weekly Times* newspaper in July 2015.³⁶⁶ The farmer, Mr Simon Gleeson from Brucknell in south-west Victoria, stated that it was a positive experience: ‘Our farm hasn’t shown any effects. In fact, we ended up with better access points, improved tracks and fencing. The trees next to the site are still alive, my adjacent pasture still produces its tonnage.’³⁶⁷

Property values

The Committee also heard differing evidence on the issue of whether unconventional gas exploration and development would negatively impact on property prices. The VFF submission to the Committee states that the survey it undertook of members views on unconventional gas found that: ‘There is the perception amongst the VFF membership that unconventional gas activities would undermine the value of a farm. VFF members feel that land values would

³⁶¹ VFF (2015) Submission 471, p. 17.

³⁶² *ibid.*

³⁶³ T. O’Brien, Lakes Oil (2015) *Transcript of Evidence*, 6 October, p. 14.

³⁶⁴ Lakes Oil (2015) Submission 510, p. 14.

³⁶⁵ T. O’Brien, Lakes Oil (2015) *Transcript of Evidence*, 6 October, p. 19.

³⁶⁶ S. Gleeson (2015) ‘Drilling company was perfect guest’, *Weekly Times*, 15 July; K. Sullivan (2015) ‘Farmer shares experience on test gas exploration’, *Weekly Times*, 22 July.

³⁶⁷ S. Gleeson (2015) *op. cit.*

be impacted because of the unknown risks.³⁶⁸ In contrast, Lakes Oil states that property prices in areas of Queensland where gas activities are occurring have not been adversely affected, and that the income earned from gas activities adds value to properties:

The myth of the negative impact on property values is exaggerated. This is highlighted by properties in Queensland, on which gas activities are occurring, advertising the off-farm income achieved from these activities as a selling point when marketing their properties for sale. The income earned from these gas activities is significant and, as mentioned above, far exceeds the usual income that would be earned by farming the affected land. The income earned from these activities is also secured and is not affected by the normal natural and market forces which affect primary producers so has been described as “drought proofing” farms and providing them some protection from the usual fluctuations which occur across the industry.³⁶⁹

The New South Wales Valuer General’s 2014 *Study on the Impact of the Coal Seam Gas Industry on Land Values in NSW* found that there has been little research to date on the impact of the CSG industry on land values and there was little guidance available overseas. The report further noted that other Australian jurisdictions, including Queensland where the industry is much further advanced, also did not provide definitive evidence about the impact of CSG operations on land values. In regards to New South Wales, the report concluded that:

The limited market evidence available for this study indicated no clear impact of the CSG industry on land values in NSW. However, a major limitation of these findings is the low number of sales that are available to analyse. The co-existence and impact of mining activity also limited the ability of the study to investigate some locations with CSG developments... Anecdotal evidence indicated that the presence of the CSG industry in an area may potentially cause a reduction to the number of potential purchasers and an increase to the time taken to sell a property...

Some of the features that are likely to be factors in the CSG industry’s impact on land values include the positioning of wells, well design, compensation provided to landholders, surrounding land uses, effect on the environment and community perceptions.³⁷⁰

5.2.6 Multiple land use framework

The SCER (now the COAG Energy Council) which produced the National Harmonised Regulatory Framework (see section 2.7.1 of this Report) was also tasked with producing a ‘Multiple Land Use Framework’ or ‘MLUF’. The MLUF was completed in 2013 and is intended to provide a nationally consistent methodology to enable states to improve the management of potential land use conflicts with regard to the minerals and petroleum sector.³⁷¹

³⁶⁸ VFF (2015) Submission 471, p. 18.

³⁶⁹ Lakes Oil (2015) Submission 510, p. 19. See also: APPEA (2015) Submission 364, p. 15.

³⁷⁰ NSW Valuer General (2014) *Study on the impact of the coal seam gas industry on land values in NSW*, Land & Property Information, pp. 40-41.

³⁷¹ See: Government of Victoria (2015) Submission 658, p. 39; VAGO (2015) op. cit., p. 55; COAG Energy Council (2013) Multiple Land Use Framework.

The submission from the APPEA states that it strongly supports the adoption of the guiding principles set out in the MLUF as way to foster successful co-existence.³⁷² The APPEA said that: ‘working together to establish a framework that supports ongoing development in both the agriculture and resources sectors, and of education and mutual understanding of the needs of all parties, has proven successful and will continue to be the most effective way to manage land access in Australia.’³⁷³ The APPEA advocates that the MLUF ‘should be pursued across government to deliver shared benefits to all stakeholders’ and ‘integrated into planning documents and strategic frameworks relating to the further development of the onshore gas industry in Victoria.’³⁷⁴

The Minerals Councils submission to the Committee similarly emphasises that ‘land can be used for different purposes at the same time (multiple) and for different purposes after a land use has finished (sequential).’³⁷⁵ The Minerals Council states that ‘Exploration for and development of unconventional gas fields are activities that complement multiple land use as the physical footprint of a production well is relatively small. It allows the existing land users to continue to utilise the land.’³⁷⁶ Land use planning is further discussed in section 7.3.4 of this Report.

5.3 Tourism

The Committee received evidence about the potential impact an unconventional gas industry may have on Victoria’s tourism industry. The Committee heard that tourism in areas of the state prospective for unconventional gas contributes a significant amount to both local and state economies. Councillor Brian Crook from Colac Otway Shire advised the Committee that tourism was worth \$133 million, and agriculture a further \$160 million per year in that shire alone.³⁷⁷ Councillor Margot Smith from the Surf Coast Shire advised that there are around two million visitors to the shire annually, accounting for over half a billion dollars of spending, and providing full-time employment for approximately 1100 people.³⁷⁸

Mr Michael Greenham, a farmer from Dartmoor in Western Victoria which is an area in which Mecrus Resources is permitted to explore, suggested to the Committee that the tourism and agriculture industries provide more money to the economy than a potential unconventional gas industry would:

³⁷² APPEA (2015) Submission 364, pp. 14-15; Minerals Council (2015) Submission 365, p. 9.

³⁷³ APPEA (2015) Submission 364, pp. 14.

³⁷⁴ *ibid.*, pp. 15-16.

³⁷⁵ Minerals Council (2015) Submission 365, p. 9.

³⁷⁶ *ibid.*

³⁷⁷ B. Crook (2015) *Transcript of Evidence*, 12 August, p. 8.

³⁷⁸ M. Smith (2015) *Transcript of Evidence*, 12 August, pp. 2, 9.

Mecrus, which own the exploration licence over our farms at Dartmoor, said they have about a \$6 billion goldmine they are sitting on there. I have figures from Tourism Victoria and the Department of Agriculture that say that in one year, tourism in this south-west area would match that, and that farming would match it over four years. Yet they have \$6 billion that they want to spread out over 40 years.³⁷⁹

A significant number of witnesses opposed the creation of an unconventional gas industry on the basis that it would damage the environment and pose a risk to the tourism industry.³⁸⁰ Councillor Crook emphasised the growth of ecotourism in the Otways following the cessation of hardwood logging in 2008, and the successful co-existence of new small tourism businesses with agriculture.³⁸¹

Councillor Neil Rankine from the Bass Coast Shire Council stated that tourism is a major industry in that municipality, and that: ‘The tourists who come to our municipality want to see cows in the paddock; they do not want to see an industrialised landscape. So it is absolutely essential to our economy that we maintain the viability of that industry without something that is going to industrialise that landscape.’³⁸² Mr Damien Marchant, of Frack Free Moriac, stated to the Committee that:

People have declared they do not want this industry in Victoria. What is at stake? Why did so many wish to be gas field free? The Surf Coast area, as you have heard today, is not only a top Victorian tourist area but boasts the best fertile agricultural land. In the heart of PEP 163, we have wineries, dairy farms, cattle studs, farmers cropping, horse studs, ecotourism accommodation and award-winning restaurants, all at the entrance of the Great Ocean Road.³⁸³

However, it was also suggested to the Committee that an unconventional gas industry may boost employment and tourism in these areas rather than reduce tourist numbers. Ms Megan Davison from the Minerals Council suggested that:

I think the assumption of a negative impact discounts the positive impacts also. Impact can be positive or negative. One of the benefits of any mineral development to any community in any region is that a company becomes an anchor tenant for upgrades of infrastructure and increased capacity in utilities, because it is an anchor contractor. It contracts a certain amount, and therefore the communities can benefit, so there is that benefit with regard to tourism. You might be surprised to know that mining tourism occurs as well. Certainly the Pilbara sees a very high proportion of travellers going on mining tourism.³⁸⁴

³⁷⁹ M. Greenham (2015) *Transcript of Evidence*, 23 September, p. 58. Note: Mecrus states in its submission to the Committee that, based on an independent assessment, royalties to the State would ‘exceed \$600 million’ over the 40 year period. See Mecrus (2015) Submission 247, p. 3.

³⁸⁰ See for example: T. Dennis (2015) *Transcript of Evidence*, 12 August, p. 34; K. Kline (2015) *Transcript of Evidence*, 12 August, p. 35; U. Alquier, Lock the Gate (2015) Submission 353, p. 22; M. Smith (2015) *Transcript of Evidence*, 12 August, p. 2.

³⁸¹ B. Crook (2015) *Transcript of Evidence*, 12 August, p. 3.

³⁸² N. Rankine (2015) *Transcript of Evidence*, 30 June, p. 2.

³⁸³ D. Marchant, Frack Free Moriac (2015) *Transcript of Evidence*, 12 August, p. 19.

³⁸⁴ M. Davison, Minerals Council (2015) *Transcript of Evidence*, 22 July, p. 8.

Dr George Carman, a petroleum geologist, suggested to the Committee that the two industries could co-exist, and gave the example of the Isle of Purbeck and the Solent in the United Kingdom. He said that: ‘Over 100 wells have been drilled horizontally out underneath this very prestigious sailing area, from a national park... All of these wells are drilling out up to 12 kilometres reach from the pads, and they are barely detectable to tourists’.³⁸⁵ Closer to home, the Committee notes that Corangamite Shire has both a tourist industry and a conventional gas industry operating in close proximity to each other:

[Corangamite Shire] has an important tourism industry with 2.5 odd million visitors annually to the Twelve Apostles, with Port Campbell as a key tourism hub. Corangamite Shire also has an important gas industry within the shire located in close proximity to Port Campbell. There are three large gas processing facilities within the shire that receive and process gas extracted from offshore fields in Bass Strait. The gas plants provide important direct employment opportunities for members of the community. They also contribute to the broader economy of the shire...³⁸⁶

5.4 Traditional Owner groups

The Committee recognises the significance of country to Victoria’s Traditional Owners, and the importance of considering issues relating to unconventional gas activity on land subject to native title or agreements under Victoria’s *Traditional Owner Settlement Act 2010*. The Victorian Government inter-departmental submission to the Committee explains that ‘Traditional owners have a responsibility under their traditional law and custom to care for their country, which they see as inextricably linked to their identity, culture and wellbeing’.³⁸⁷ The Victorian Government inter-departmental submission further explains that the Commonwealth *Native Title Act 1993* provides ‘a process through which Aboriginal people can make a claim for a Federal Court determination that recognises their native title rights and interests in their land and waters’.³⁸⁸

The Native Title Act provides that native title is deemed to be extinguished if the land is under freehold title but can be claimed over vacant Crown land, other public land such as forests, lakes and reserves, and over some types of leases (such as pastoral leases).³⁸⁹ The Victorian Government inter-departmental submission states that there have been four positive native title determinations in Victoria to date.³⁹⁰

³⁸⁵ G. Carman (2015) *Transcript of Evidence*, 13 August, p 16

³⁸⁶ D. Rae, Corangamite Shire Council (2015) *Transcript of Evidence*, 23 September, p. 3.

³⁸⁷ Government of Victoria (2015) Submission 658, p. 35.

³⁸⁸ *ibid.*

³⁸⁹ Cook et al. (2013) *Engineering Energy*, op. cit., p. 162.

³⁹⁰ Government of Victoria (2015) Submission 658, p. 35. It states that these determinations include: *Clarke on behalf of the Wotjobaluk, Jaadwa, Jadawadjali, Wergaia and Jupagulk Peoples v Victoria* [2005] FCA 1795; *Lovett on behalf of the Gunditjmarra People v State of Victoria* [2007] FCA 474; *Mullett on behalf of the Gunai/Kurnai People v State of Victoria* [2010] FCA 1144; *Lovett on behalf of the Gunditjmarra People v State of Victoria (No 5)* [2011] FCA 932.

The ACOLA report explains that native title does not provide Traditional Owners with the right to veto exploration or development activities on the land, but it does provide the right to negotiate over future uses of that land (termed ‘future acts’ in the legislation):

Native title gives only limited rights to traditional owners. In particular, native title holders do not own the subsurface rights, do not have a right of exclusive use and have no right of veto over development. They do, however, have a legally recognised right to negotiate over future uses of that land. If the parties cannot reach agreement, the matter can be referred to a court for final resolution, but in practice the great majority of claims involving resource projects are settled by negotiation. The main reason for this is that the alternative – seeking a court determination – is slow, costly and uncertain for all parties.³⁹¹

Mr Damein Bell, a Gunditjmara person, and the Chief Executive Officer of the Gunditj Mirring Traditional Owners Aboriginal Corporation, presented evidence to the Committee explaining that:

Under the Native Title Act 1993 and through the consent determinations by the Federal Court of Australia in 2007 and 2011 the state of Victoria and the commonwealth of Australia recognised a set of native title rights and interests in relation to Gunditjmara people. They include the right of access to lands and waters, the right to camp, the right to use and enjoy lands and waters, the right to take resources of the lands and waters, the right to protect places and areas of importance on the lands and waters, and the right to take water from the waterways, which is limited to domestic and ordinary use. The native title rights and interests are recognised over 143 000 hectares of vacant Crown land.³⁹²

Mr Bell further explained to the Committee that petroleum exploration permits which allow for exploration for unconventional gas have been granted over Gunditjmara country. He said that the Gunditjmara people, through Gunditj Mirring, have responded through the Native Title Act future acts notification process that triggers the right to negotiate. He said that ‘the Gunditjmara had successfully negotiated several Indigenous Land Use Agreements (ILUAs) with several companies, which allowed them to progress their exploration activities as prescribed in their respective exploration licences.’ Mr Bell further said that:

In early 2014 Gunditj Mirring became aware that one of the companies we had signed an ILUA with was including the practice of fracturing to extract unconventional gas if they were granted a production licence. Through several full-group meetings in 2014 our members discussed the previous negotiations with the company and whether the process of fracturing had been raised as a potential production method. At the same time Gunditj Mirring and our legal representatives, Native Title Services Victoria, reviewed our documents and the documents provided by the company for any reference to the fracturing method. We had found that while the earlier documents, the Indigenous land use agreement documents, that we had signed did not contain any mention of the fracturing method, we did find the term fracturing mentioned once in the actual exploration licence.³⁹³

³⁹¹ Cook et al. (2013) *Engineering Energy*, op. cit., p. 162.

³⁹² D. Bell, Gunditj Mirring Traditional Owners Aboriginal Corporation (2015) *Transcript of Evidence*, 23 September, p. 32.

³⁹³ *ibid.*, p. 33.

Mr Bell stated that the Gunditj Mirring determined that the prospect of the hydraulic fracturing had not been brought to their attention and that now that they are aware of it, further information gathering and negotiation with the company will be required.³⁹⁴

In Victoria, the rights of Traditional Owners can also be recognised under the Traditional Owners Settlement Act. This Act is intended to provide a state-based means of settling native title claims and act as an alternative to the litigious processes provided by the Native Title Act. It allows for Victorian Traditional Owner groups to enter into ‘recognition and settlement agreements directly with the state government’.³⁹⁵

The Victorian Government inter-departmental submission to the Committee states that agreements under the Traditional Owners Settlement Act provide a right to negotiate for mining licences, and a fast-tracked approval process for exploration licences.³⁹⁶ The Victorian Government inter-departmental submission further states that some Traditional Owners have expressed concerns about not having the right to negotiate approvals for exploration licences in the context of a heightened awareness of the risks of hydraulic fracturing:

Due to concerns about hydraulic fracturing, some traditional owners have expressed dissatisfaction with the standard conditions component of Victoria’s alternative settlement framework, requesting that all exploration or prospecting licence grants be subject to a right to negotiate.

A number of traditional owners perceive the right to negotiate under the Native Title Act provides them with a better means of carrying out their duty to care for country. Traditional owner groups may consider that the only way to oppose hydraulic fracturing under an exploration licence is to reject a settlement under the Traditional Owner Settlement Act. Groups may instead seek native title determinations through the Federal Court.³⁹⁷

5.5 Local and regional development, investment and jobs

The Committee heard a range of evidence on the potential effects of an unconventional gas industry on local and regional development, investment and jobs. The submission to the Committee from the Minerals Council states that:

The development of an onshore gas industry has the potential to bring a great deal of wealth to the state and to the people of Victoria. It also has the potential to support regional economies and provide high-paying jobs to people who want to live in the regions.³⁹⁸

³⁹⁴ *ibid.*, p. 35. Mr Bell stated that Gunditj Mirring ‘determined to raise the issue of fracturing with the company through the dispute clause in the ILUA’, p. 33.

³⁹⁵ C. Ross & B. Merner (2010) *Research Brief: Traditional Owner Settlement Bill 2010*, Victorian Parliamentary Library Research Service, p. 1.

³⁹⁶ Government of Victoria (2015) Submission 658, p. 37.

³⁹⁷ *ibid.*

³⁹⁸ Minerals Councils (2015) Submission 365, p. 1.

Lakes Oil's submission to the Committee similarly emphasised that new energy sources such as unconventional gas will 'provide the ability for new industry to be developed to use them' and that:

As the developments associated with the new energy sources are generally located in regional areas they can provide huge benefits to the local and wider regional areas. Youth unemployment in regional Victoria is one of the biggest issues facing the State and it is getting more and more difficult to attract significant industrial investment into regional areas to help combat this problem as the energy sources and infrastructure are not present. As Australia is a safe place to do business large multinational companies are prepared to invest into regional Victoria and can accept the high labour costs as long as their energy costs are manageable. Victoria's onshore gas resources can offer them this energy cost security.³⁹⁹

Additionally, APPEA cited a 2013 study by KPMG of 'Australia's nine main resources regions' which found that, in the five years to 2011, the number of people employed in the resources sector across the sampled regions grew by 13,810 or 50 per cent, whereas the number employed in all industries – including resources – grew by just 14 per cent.⁴⁰⁰

Research by the Gas Industry Social & Environmental Research Alliance in Queensland has found that for each gas industry job created there were two additional jobs created in related construction and professional services. Conversely, for each new gas job there was a reduction of 1.7 jobs from the agricultural sector.⁴⁰¹

However, submissions from the Australia Institute and others have queried the long-term sustainability of the employment that might be provided by an unconventional gas industry in Victoria. The Australia Institute states that workers are likely to be sourced from interstate on a 'fly in fly out' basis, with minimal impact on local unemployment rates.⁴⁰²

Ms Ursula Alquier, of Lock the Gate Victoria, highlighted the potentially short-term nature of jobs provided by an unconventional gas industry in contrast to the ongoing employment provided by existing industries. She stated that: 'these jobs are short-lived. A boost in employment may last two or three years during the construction phase of a gas project, but many communities are beginning to find out that after the boom, there is a bust.'⁴⁰³ Ms Alquier further stated that:

Even during the construction boom, an increase in the number of gas-industry related jobs does not paint the whole picture. Increases in rent, the price of labour and increases in the demand on contractors can drive up prices for agriculture, manufacturing, tourism and other parts of the economy that could be devastating for farmers and small business.⁴⁰⁴

³⁹⁹ Lakes Oil (2015) Submission 510, p. 20.

⁴⁰⁰ APPEA (2015) Submission 364, p. 15.

⁴⁰¹ State Government of Victoria (2015) Submission 658, p. 42.

⁴⁰² Australia Institute (2015) Submission 831, pp. 6-7.

⁴⁰³ U. Alquier, Lock the Gate (2015) Submission 353, p 9.

⁴⁰⁴ *ibid.*

It is clear from media reports that the development of coal seam gas in south-east Queensland has resulted in considerable social and economic change in rural agricultural areas.⁴⁰⁵ The Committee notes the importance of Victoria taking account of the experiences of other jurisdictions in which the unconventional gas industry is more established.

5.6 Findings

The Committee notes that Victoria is a relatively small and densely populated state of Australia with agriculture forming a key component of the economy. The Committee also notes the economic importance of tourism to the State. The smaller size and more intensive land use in Victoria, in comparison to other Australian jurisdictions, is an important factor in the consideration of whether an unconventional gas industry should proceed in this State, and if so, how multiple land uses will be managed. The density of settlement and importance of agriculture in Victoria mean that there is potential for challenges in regard to co-existence with an unconventional gas industry.

The Committee also acknowledges the importance of country to Traditional Owner groups. It notes the importance of increasing awareness around the implications of unconventional gas exploration and development for Traditional Owners, and potential issues surrounding native title and agreements under the Traditional Owners Settlement Act.

The Committee also notes the evidence it received that the co-existence of the dairy industry with the unconventional gas industry in other jurisdictions is at a very early stage, with only one example of trial situations in New South Wales being provided to the Committee. Given the particular importance of the dairy industry to Victoria, it will be important to monitor the outcomes of the co-existence of dairy farming with unconventional gas production in other jurisdictions.

The Committee notes the findings of a number of reviews predating this current Inquiry which have found that there is an imbalance in the Victorian land access and compensation arrangements under the Minerals and Petroleum Acts, which favours the industry proponent over the landholder. The Committee concurs with the findings of those previous reports that the system needs to be reviewed.

The Committee acknowledges the VFF's call for landholders to be given the right to veto mining activities on their land, however it notes the difficulty of this proposition given that the resources below the ground belong to the Crown, and a granting of a right to veto effectively transfers ownership of these resources to the landholder.

⁴⁰⁵ J. Grewal (2015) 'Riches' Relics in Gas Towns the Boom Forgot', *Weekend Australian*, 15 August, pp. 1, 10.

6 Science knowledge requirements – Hydrogeology

6.1 Chapter overview

Chapter Six considers the science knowledge requirements that would be necessary to enable a potential unconventional gas industry, including the further scientific work required to inform the effective regulation of the industry. The compilation of scientific data is important because it enables a more informed understanding of the potential risks and impacts posed by the exploration and development of unconventional gas. This knowledge can then be used to formulate targeted risk-mitigation strategies, appropriate regulation, and to help determine areas where it would or would not be appropriate for an unconventional gas industry to proceed.

At present, there is an incomplete understanding of the prospectivity for unconventional gas in the geological formations of the Gippsland and Otway Basins, which was discussed in Chapter Three of this Report. Chapter Four outlined the commonly identified risks posed by the unconventional gas industry and highlighted potential impact on water resources as a major concern. Unconventional gas developments have the potential to impact water resources, and groundwater in particular, through a range of activities, such as drilling through aquifers, the use of various chemicals in drilling and hydraulic fracturing and by depressurisation of coal seams or reservoirs.

Chapter Six accordingly focuses on the importance of understanding the hydrogeology of an area prior to unconventional gas development. It firstly explains why understanding hydrogeology is important in regards to risk management. It then provides an overview of the current knowledge of groundwater resources in the Gippsland and Otway Basins, including the Victorian Government's recently completed water science studies, and the IESC's Bioregional Assessment of the Gippsland Basin which is expected to be completed in 2016. Finally, the Chapter identifies knowledge gaps that remain in the State's understanding of the water resources in the two Basins, and the further work that needs to be done more broadly to inform the effective regulation of an unconventional gas industry, if it is determined that it should proceed.

6.2 Why understanding hydrogeology is important to risk management

Hydrogeology is the study of groundwater, the rock layers in which the groundwater is contained and the interaction of groundwater with surface water. There is an extensive body of literature emphasising the need to understand the

hydrogeology of areas earmarked for unconventional gas development in order to identify and assess risks.⁴⁰⁶ The key hydrogeological information required includes geological structure, hydrogeological properties (hydraulic conductivity, storativity and porosity), baseline groundwater levels and groundwater quality (including natural variability in these), and connectivity between groundwater in different aquifers and surface water bodies.

This information is necessary for several reasons. Firstly, it is needed to identify the groundwater and surface water assets that are present and require protection, including their function and value to the community or environment. It is important to have a benchmark of existing groundwater levels and quality so that any changes or adverse impacts that might be caused by unconventional gas developments can be identified. Box 6.1 below provides an example of a baseline study for the CSG industry in New South Wales.

BOX 6.1: Baseline water study

In October 2015, researchers from Southern Cross University completed baseline studies of the Richmond River catchment in New South Wales, an area with the potential for CSG development. The studies looked for the presence of methane within the aquifers. The researchers found that there was no evidence of methane moving from coal seams into the underground water. The studies therefore provide a baseline of what is 'normal' for the catchment and will allow the impact of any future CSG operations to be assessed in terms of the movement of methane into aquifers.

Note: this example is provided as an illustrative case study of a baseline study.

Secondly, hydrogeological information is required to predict the type, scale and likelihood of impacts that may occur from unconventional gas development. A knowledge of aquifer extent, structure, interconnectedness, water balance (inflows and outflows), hydraulic properties and water chemistry are all required. This allows a decision to be made on where and how these risks can be mitigated.

For example, this information will allow decisions to be made on the amount and quality of water required to be extracted (for CSG), likely water requirements for hydraulic fracturing (for shale and tight gas), the potential fracture propagation distances if hydraulic fracturing is used, the extent of depressurisation likely to occur in response to water extraction, and the extent to which any spills of wastewater or other contaminants would be able to migrate into groundwater and surface water if they were to occur at the surface.

⁴⁰⁶ A. Vengosh, R.B. Jackson, N. Warner, T.H. Darrah & A.J. Knodash (2014) 'A Critical Review of the Risks to Water Resources from Unconventional Shale Gas Development and Hydraulic Fracturing in the United States', *Environmental Science & Technology*, 48, pp. 8334-8348; Ross & Darby (2013) op. cit.; Cook et. al. (2013) *Engineering Energy*, op. cit.; M. Currell (2015) Submission 11; US EPA (June 2015) *Draft - Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources*.

Finally, key hydrogeological information allows the establishment of appropriate safeguards and monitoring criteria during unconventional gas development in an area. For example, hydrogeological knowledge is required to decide if enough groundwater monitoring bores exist and are in the right locations in a particular area and what parameters are monitored.

6.3 Current knowledge of groundwater resources

Overall, the understanding of the hydrogeology of the Gippsland and Otway Basins is reasonably strong. However, more is known about shallow parts of the basin (<500 m) and areas which have already undergone groundwater development, that is, within the Quaternary and Tertiary geological units where most accessible groundwater resources reside. Data gaps still exist in such areas of knowledge as surface water-groundwater interaction, consolidation and subsidence, aquifer and aquitard properties (particularly at greater depths), groundwater chemistry and spatial coverage (good data exists for some but not all of these areas).

There is a long history of geological investigations carried out in both basins associated for geological mapping and hydrocarbon exploration.⁴⁰⁷ The Geological Survey of Victoria/Department of Mines produced geological maps and survey reports based on drilling and hydrogeological investigations in the both basins, mostly conducted between the 1970s and 1990s.⁴⁰⁸

At a statewide level, the Victorian Aquifer Framework divides and names aquifers (water bearing geological units) and aquitards (water restricting geological units) in a consistent manner across the State.⁴⁰⁹ Each particular aquifer or aquitard in turn consists of a geological unit specific to various locations across the State. These layers have then been mapped in three-dimensions,⁴¹⁰ with the degree of certainty or accuracy largely dependent on the amount of drilling that has occurred in any particular area.

Several numerical models of groundwater resources have been developed in the past decade, particularly in the Gippsland region. In 2010 ecoMarkets (a branch of DELWP) commissioned groundwater models for each of Victoria's ten catchment management areas including the Glenelg-Hopkins and Corangamite Catchments

⁴⁰⁷ See for example: E. A. Webb (1961) 'The geology and petroleum potentialities of the Gippsland area of Victoria', APEA Conference Papers, pp. 101-110; E. A. James & P. R. Evans (1971) 'The stratigraphy of the offshore Gippsland Basin', *APEA Journal*, vol. 11, iss. 2, pp. 71-74. Note: for a full list of published papers on geology and petroleum prospectivity of the Gippsland and Otway Basins, refer to the Victorian Government's 'Earth Resources Online' system (which compiled over 100 papers and reports on the two basins).

⁴⁰⁸ See for example: H. Wopfner & J. G. Douglas (1971) 'The Otway Basin of Southeastern Australia', Special Bulletin of the Geological Surveys of South Australia and Victoria; M. A. Reynolds (1971) *A Review of the Otway Basin*, Commonwealth Bureau of Mineral Resources, Geology and Geophysics, Report No. 134; J. B. Hocking (1976) *Definition and revision of the Tertiary stratigraphic units, onshore Gippsland Basin*, Department of Minerals and Energy, Geological Survey Report 1976/1; G. Y. Nahm (1977) *Groundwater resources in Gippsland*, Department of Mines, Geological Survey Report 1977/1; G. Walker & F. Mollica (1990) *Review of the groundwater resources in the South East Region*, Department of Water Resources, Report No. 54.

⁴⁰⁹ Department of Sustainability and Environment (2012) *Victorian Aquifer Framework: Updates for Seamless Mapping of Aquifer Surfaces*, Report produced by GHD for DSE.

⁴¹⁰ *ibid.*

(Otway) and West and East Gippsland Catchments (Gippsland).⁴¹¹ Additional large scale numerical models exist for managing groundwater depressurisation around the Latrobe Valley coal mines.⁴¹² These models help to understand the relative causes of groundwater level declines in South Gippsland from groundwater extraction by irrigators, coal mines and the offshore oil and gas industry.⁴¹³ See Box 6.2 below for more information.⁴¹⁴

Groundwater resource appraisals (which assess how much water could reasonably be extracted from a particular groundwater area) have been completed in recent years for the Hawkesdale Water Supply Protection Area,⁴¹⁵ Lower Tertiary Aquifer in the Otway region,⁴¹⁶ and the Moe Groundwater Catchment in the Gippsland region.⁴¹⁷ Other appraisals were completed over much of the Gippsland and Otway regions in the late 1990s but were preliminary in nature and require improvement.⁴¹⁸

Research in the Gippsland and Otway regions is ongoing. More recent research has focused on specific issues such as surface water–groundwater interaction,⁴¹⁹ or the potential storage of carbon dioxide.⁴²⁰

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- ⁴¹¹ See for example: C. Nicol and P. Bolger (2010) *West Gippsland CMA Groundwater Model: Transient Model Development Report*, Produced by GDH for Department of Environment and Primary Industries.
- ⁴¹² See for example: J. Schaeffer (2008) *Scaling point based aquifer data for developing regional groundwater models: Application to the Gippsland groundwater system*, PhD Thesis, University of Melbourne.
- ⁴¹³ T. J. Hatton, O. J. Claus, J. R. Undershultz (2004) 'Falling water levels in the Latrobe Aquifer, Gippsland Basin: determination of cause and recommendations for future work', CSIRO Wealth from Oceans Flagship Program, p. 37.
- ⁴¹⁴ International Association of Hydrogeologists (2015) Submission 973; C. Beverly, M. Hocking, X. Cheng, C. O'Neil, R. Schroers & S. Baker (2015) *The Gippsland groundwater model*, DEDJTR, p. 101; Hatton, Claus & Undershultz (2004) op. cit.; Department of Environment (Cth) (2009) 'Latrobe Aquifer Financial Assistance Package' Department of Environment website; C. Gloe (1977) 'Land subsidence related to brown coal open cut operations, Latrobe Valley, Victoria, Australia', Second International Symposium on Land Subsidence, Proc. Anaheim Symp., 1976, IASH-Unesco, pp. 399-407.
- ⁴¹⁵ SKM (2008) *Groundwater Resource Appraisal for the Hawkesdale Management Area*, December 2007, Report for Southern Rural Water.
- ⁴¹⁶ SKM (2010) *Lower Tertiary Aquifer Groundwater Resource Appraisal*, September 2010, Report for Southern Rural Water; A. L. (Bush) (2009) *Physical and chemical hydrogeology of the Otway Basin*, southeast Australia, PhD Thesis, School of Earth Sciences, Faculty of Science, University of Melbourne.
- ⁴¹⁷ Jacobs SKM (2014) *Groundwater Resource Appraisal - Moe Groundwater Catchment*, Report produced for Department of Environment and Primary Industries.
- ⁴¹⁸ M. Reid (2004) *Audit of permissible annual volumes for 35 Victorian groundwater management areas*, Department of Primary Industries.
- ⁴¹⁹ H. Hofmann (2011) *Understanding connectivity within groundwater systems and between groundwater and rivers*, PhD Thesis, Monash University.
- ⁴²⁰ See for example: C. R. Jenkins, P. J. Cook, J. Ennis-King, J. Undershultz, C. Boreham, T. Dance, P. de Caritat, D. M. Etheridge, B. M. Freifeld, A. Horte, D. Kirste, L. Paterson, R. Pevzner, U. Schacht, S. Sharma, L. Stalker, M. Urosevic (2012) *Safe storage and effective monitoring of CO₂ in depleted gas fields*, Proceedings of the National Academy of Sciences 109(2), E35-E41; G. O'Brien, P. Tingate, L. Goldie Divko, J. Miranda, M. Campi, K. Liu (2013) *Basin-scale fluid flow in the Gippsland Basin: Implications for geological carbon storage*.

BOX 6.2: Existing impacts on groundwater from coal mining and oil and gas extraction in the Gippsland Basin

Development of coal (onshore) and oil and gas (offshore) resources in the Gippsland Basin has had significant impacts on groundwater levels across the region. Approximately 180,000 ML of groundwater is extracted each year in the Gippsland Basin of which approximately 100,000 ML is by oil and gas operations and approximately 25,000 ML extracted by the Latrobe Valley coal mines.

Groundwater levels have declined by around 40 m in the Yarram region since the 1980s and continue fall by around 1 m per year. This has largely been attributed to the oil and gas extraction from Bass Strait. This has resulted in the need for drilling replacement bores, lowering pumps or additional water pumping costs for which the Victorian and Commonwealth Governments have previously provided financial assistance.

In the Latrobe Valley, the large volumes of groundwater extracted for dewatering and production water purposes from brown coal mines have resulted in large groundwater level declines in the surrounding aquifers and extensive land subsidence of up to 2 m near the mines themselves. Settlement to date has been relatively even such that structural damage has been minimal, but stability issues near the mines remain ongoing.

Little is known about the impacts of groundwater quality from existing developments. Further research is required to understand groundwater geochemistry and water-rock interactions, sources of solutes that may be used as signatures of water sources, and effective monitoring technologies.

Note: this is an illustrative example of the potential impacts of mining on groundwater.

6.4 Recently completed work

The following sections provide information on the Victorian Government's water science studies and the Bioregional Assessment of the Gippsland Basin.

6.4.1 Water science studies

In June 2015, during the course of this Inquiry, the Victorian Government completed water science studies, which it described as 'an initial screening analysis of the potential impacts of possible onshore gas exploration and development on water users and ecosystems.'⁴²¹ The water science studies were produced by DELWP in collaboration with the Geological Survey of Victoria (part of DEDJTR). The key reports were reviewed by independent experts including Professor Rae Mackay, Professor Dayanthi Nugegoda and Professor Craig Simmons.

⁴²¹ Jacobs Pty Ltd (2015) *Gippsland Region Synthesis Report: Overview of the assessment of potential impacts on water resources*, Report prepared for DELWP and Geological Survey of Victoria (DEDJTR), p. 3.

The water science studies are outlined in summary reports for both the Gippsland and Otway areas supported by eight technical reports.⁴²² The technical reports cover impact assessments, gas prospectivity and groundwater sampling for both areas,⁴²³ with two additional reports covering groundwater modelling and gravity survey results for the Gippsland area only.⁴²⁴

6.4.2 The relationship between the water science studies and bioregional assessments

The IESC has developed a comprehensive methodology for conducting bioregional assessments for regional sedimentary basins in Australia that are currently or potentially the subject of large scale coal seam gas development (see section 2.7.2 of this Report).⁴²⁵ The bioregional assessment program currently includes six areas in Australia with only one of those areas – Gippsland – located in Victoria.

Bioregional assessments are ‘a scientific analysis, providing a baseline level of information on the ecology, hydrology, geology and hydrogeology of a bioregion with explicit assessment of the potential direct, indirect and cumulative impacts of CSG and coal mining development on water resources.’⁴²⁶ While this system was set up specifically for CSG and coal mining developments, the risk assessment process is equally valid for unconventional gas developments more generally. The components of bioregional assessments include:

- Contextual information: context and background against which qualitative and quantitative assessments of impact and risk of are generated
- Model-data analysis evaluates and synthesises information from data and models to develop a quantitative description of the hydrologic relationship between depressurisation and dewatering and associated impacts on receptors
- Impact analysis reports and records the direct, indirect and cumulative impacts and associated uncertainties of impacts of development on specified receptors
- Risk analysis provides a scientific assessment of the likelihood of impacts on receptors
- Outcome synthesis is a synthesis of outcomes used by the IESC to support scientific advice on impacts and risk of development on water resources.⁴²⁷

⁴²² *ibid*; Jacobs Pty Ltd (2015) *Otway Region Synthesis Report: Overview of the assessment of potential impacts on water resources*, Report prepared for DELWP and Geological Survey of Victoria (DEDJTR).

⁴²³ See: DEDJTR (2015) ‘Onshore gas science studies: about the water studies’, DEDJTR website.

⁴²⁴ C. Beverly, M. Hocking, X. Cheng, C. O’Neil, R. Schroers & S. Baker (2015) *The Gippsland groundwater model*, DEDJTR; L. Mathews, & M. McLean (2015) *Gippsland Basin Gravity Survey*, Geological Survey of Victoria Technical Record 2015/1.

⁴²⁵ D. Barrett, C. Couch, D. Metcalfe, L. Lytton, D. Adhikary & R. Schmidt (2013) *Methodology for Bioregional Assessments of the Impacts of Coal Seam Gas and Coal Mining Development on Water Resources*, Report prepared for the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development through the Department of the Environment (Cth).

⁴²⁶ *ibid.*, p. ii.

⁴²⁷ *ibid.*

The Victorian Government's water science studies constituted a subset of studies that will ultimately form the suite of studies required for the bioregional assessment of Gippsland. While a full bioregional assessment is required for the Gippsland area only at this stage, the water science studies completed for the Otway area are consistent with bioregional assessment requirements. The water science studies have been completed in collaboration with the IESC and the water science reports were peer reviewed by Professor Craig Simmons, a member of the IESC.

However, not all of the work completed for the bioregional assessments is currently available, such as the water asset registry (a key part of the 'Contextual Information'). Furthermore, the impact and risk analysis completed were based on hypothetical development scenarios which may or may not be the same as actual future development of unconventional gas. The expected completion date for the Gippsland bioregional assessment is the first half of 2016.

6.4.3 Impact assessment reports

The water science studies impact assessments estimated the potential impacts to aquifers, rivers and water bodies from theoretical development scenarios of unconventional gas resources. The impact assessments considered four hazards: aquifer depressurisation, chemical contamination of groundwater from hydraulic fracturing fluids, induced seismicity and land subsidence. A 'causal pathway approach, describing where natural gas might be, where water resources are, and the physical connections between the gas and water resources' was used to complete qualitative risk assessments for each hazard as insufficient data was available for quantitative risk assessments.⁴²⁸

The key findings of the impact assessment reports are:

- In Gippsland the risk posed by tight and shale gas development is low while the risk posed by CSG development is medium (for land subsidence) to high (for impact to groundwater users and the environment from depressurisation)
- In the Otway region the risks posed by tight, shale and CSG development are low
- The difference in risk profile between the two regions is the vertical separation of potential zones of gas development from overlying aquifers in all scenarios considered for the Otway region while the development of gas from within the Latrobe Group, which is also an aquifer, was considered in the Gippsland Region.⁴²⁹

These findings were qualified in the report by noting some limitations of the studies (discussed further below).

⁴²⁸ Jacobs Pty Ltd (2015) *Gippsland Region Synthesis Report*, op. cit., p. 3.

⁴²⁹ Jacobs Pty Ltd (2015) *Gippsland Region Assessment of Potential Impacts on Water Resources*, op. cit., p. 12.

6.4.4 Groundwater sampling reports

Groundwater sampling was conducted in the Gippsland and Otway regions to characterise the groundwater chemistry (particularly to confirm the presence or absence of hydrocarbons including methane) and provide baseline data. Groundwater samples were collected and analysed from 29 existing monitoring bores in the Gippsland region and 30 existing monitoring bores in the Otway region. Bores were selected on the basis that they were:

known or suspected of having hydrocarbon concentrations...and/or within or near high value groundwater or surface water assets. Priority was given to nested sites which provide vertical information on variations in groundwater chemistry and sites with known construction details.⁴³⁰

Three rounds of sampling on different dates were conducted in the Gippsland region and one in the Otway region, although only the results from the first sampling round have been published to date.

The key findings of the groundwater sampling reports are:

- In Gippsland, major ion analysis indicated that groundwater is sodium chloride type and that lateral, not vertical, groundwater flow dominates
- Dissolved methane concentrations tend to be highest in the coal bearing units of the Lower Tertiary Aquifer and Upper-Mid Tertiary Aquifers. Methane was low or absent in shallow groundwater
- Ethene, Butane, Butene, Propane and Propene were not found in any samples
- Total Petroleum Hydrocarbons (TPH) and naturally occurring Benzene, Toluene, Ethylbenzene and Xylene (BTEX) compounds were only found in the coal bearing units of the Lower Tertiary Aquifer or Upper-mid Tertiary Aquifers
- The results are consistent with the idea that the Upper Mid-Tertiary Aquitard (Lakes Entrance Formation) acts as a seal on top of the Lower Tertiary Aquifer, although the presence of low concentrations of methane in shallow groundwater suggests that upwards seepage is possible and that the seal is imperfect
- In the Otway region, dissolved methane was typically found in low concentrations
- Only minor amounts of Total Petroleum Hydrocarbons were found while BTEX compounds were typically absent
- In the Otway region, it was tentatively concluded that there is limited upward migration of hydrocarbons from deep to shallow formations.⁴³¹

⁴³⁰ Jacobs Pty Ltd (2015) *Gippsland Region Groundwater Sampling and Characterisation for Hydrocarbons*, Report prepared for DELWP and DEDJTR, p. 5.

⁴³¹ Jacobs Pty Ltd (2015) *Otway Region Groundwater Sampling and Characterisation for Hydrocarbons*, Report prepared for DELWP and DEDJTR, p. 69.

6.4.5 Additional reports

A groundwater modelling technical report for the Gippsland Basin was also produced. It describes how existing models of the hydrogeology of Gippsland were assessed, reviewed, adapted and used in impact assessment modelling under future potential gas development scenarios.⁴³² As no numerical groundwater model currently exists for the Otway Basin, this was only conducted for Gippsland. The Gippsland model predicted the most substantial impacts on the shallow watertable are associated with CSG development (a water table decline of 10 m over a 193,000 hectare area), whereas tight and shale gas developments were predicted to have a negligible impact.

A gravity survey was conducted in Gippsland to improve understanding of the regional geological structure, particularly of the Cretaceous Strzelecki Group and the underlying Palaeozoic basement. The report outlines the data collection and processing and presents the final data but does not provide geological interpretation.

In addition to these reports, a GIS-based (geographical information system) database of water ‘assets’ in the two areas was also developed – for example, high value surface water and groundwater dependent ecosystems; high value water supply aquifers. As yet this database is not available to view by the general public. The database for Gippsland will form part of the Bioregional Assessments program outputs for the Gippsland Region.⁴³³

The gaps and limitations of the water science studies are outlined in the next section.

6.5 Current knowledge gaps and uncertainties

While the water science reports provide a comprehensive ‘initial screening analysis’ there were a number of limitations in the scope of the projects, some data gaps and/or degrees of uncertainty identified by the reports. These would need to be addressed to inform the effective regulation of an unconventional gas industry.

Matters outside of scope of the water science reports include:

- Produced water management including reinjection
- Use of water for hydraulic fracturing
- Hazards associated with bore integrity (closure, decommissioning and well abandonment)
- Handling and storage of chemical additives

⁴³² Beverly et al. (2015) *Gippsland Groundwater Model*, op. cit., p. 15.

⁴³³ Australian Government Bioregional Assessments (2015) ‘Gippsland Basin bioregion > Gippsland Basin subregion > product 1.3’, Bioregional Assessments website.

- Environmental issues not related to water resources such as amenity, air quality, fugitive gas emissions.⁴³⁴

The water sciences reports acknowledge a number of data gaps and uncertainty including:

- Permeability of seal rocks
- Compaction and consolidation parameters
- Definition of potential gas sources
- Connection of ecosystems to groundwater
- Drawdown estimates
- Relationship between drawdown and river flows.⁴³⁵

Additional gaps in the water science reports to date include:

- The lack of a numerical model to assess drawdown impacts in the Otway region
- The number of bores used in baseline assessment (and the number of bores currently available to adequately monitor potential gas developments)
- Ongoing maintenance of gas wells (that is, post installation and abandonment)
- The risk posed by existing or abandoned bores/wells that have not been sealed or decommissioned adequately.

It is noted that based on a review of international literature, and submissions to this Inquiry, these gaps relate to some of the most significant potential risks associated with unconventional gas activity (Chapter Four of this Report provides an overview of potential risks posed by the industry).⁴³⁶ The issues above can to some degree be informed by experiences in other jurisdictions, and in most cases are issues which are addressed to a degree in Victorian and Australian environmental policies and guidelines. Some of these key issues are discussed below.

⁴³⁴ Jacobs Pty Ltd (2015) *Gippsland Region Assessment of Potential Impacts on Water Resources*, op. cit., p. 10.

⁴³⁵ *ibid.*, p. 111

⁴³⁶ US EPA (2015) op. cit.; Cook et al. (2013) op. cit.; M. Currell (2015) Submission 11; IAH (2015) Submission 973; Khan & Kordek (2014) op. cit.; NSW Chief Scientist & Engineer (2014) *Final Report of the Independent Review of Coal Seam Gas Activities in New South Wales*, op. cit.; Vengosh et al. (2014) op. cit.

6.5.1 Production, treatment and disposal of produced water

Produced water management was the subject of a report completed for the NSW Chief Scientist by Professor Stuart Khan.⁴³⁷ It has also been studied extensively as part of the 'Healthy Headwaters' program of scientific studies in Queensland, associated with the recent expansion of the CSG industry there.⁴³⁸

This issue is one which would largely fall within the jurisdiction of the Victorian Environment Protection Authority (EPA), who regulate the management, disposal and (if necessary) clean-up of any wastes and/or pollution. The New South Wales EPA has established a dedicated team working on issues associated with management, monitoring and compliance of CSG activity in the state, and a significant part of their work involves assessing and managing current and future impacts of produced water. The team has undergone significant training in the area of monitoring and mitigation strategies for CSG produced water and, as pointed out in the Victorian EPA's submission, CSG exploration and production activities require an EPA licence.⁴³⁹

If an unconventional gas industry were to proceed in Victoria, site-specific information would be required to allow effective monitoring and regulation. This would firstly include information on the volumes of water likely to be extracted, either to allow gas flow from CSG wells, or to conduct successful hydraulic fracturing for shale and tight gas deposits in Victoria's geology. Secondly this would include information on the chemistry and quality of produced water or 'flow back' water associated with the particular conditions encountered with Victoria's gas deposits. These will both vary depending on local geology and industry practices adopted (e.g. choice of fluids used for hydraulic fracturing). Hence a program of water sampling and detailed chemical analysis of any such fluids would be required for the specific setting in question.

6.5.2 On site/surface management of chemicals

The issue of risks associated with on-site chemical management was one focus area in the United States EPA's forthcoming five-year study on impacts of hydraulic fracturing on drinking water.⁴⁴⁰ Their draft report, which has been released for public comment, identifies this issue as being one of the four major regulatory challenges associated with unconventional gas in the United States. The draft report provides data from Colorado, which shows that surface spills of hydraulic fracturing chemicals during preparation at the well-site and/or 'flow

⁴³⁷ Khan & Kordek (2014) op. cit.

⁴³⁸ See for example: A. Biggs, S. Witheyman, K. Williams, N. Cupples, C. de Voil, R. Power, B. Stone (2012) *Assessing the salinity impacts of coal seam gas water on landscapes and surface streams*, Final Report of Activity 3 of the Healthy Head Waters Coal Seam Gas Water Feasibility Study, Queensland Department of Natural Resources and Mines; Kohn Crippen Berger (2012) *Forecasting coal seam gas water production in Queensland's Surat and southern Bowen basins*, Report prepared for Queensland Department of Natural Resources and Mines; Worley Parsons (2013) *Groundwater risks associated with coal seam gas development in the Surat and southern Bowen basins*, Report prepared for Queensland Department of Natural Resources and Mines.

⁴³⁹ EPA (2015) Submission 841, p.7.

⁴⁴⁰ US EPA (2015) op. cit.

back' from the well have occurred in between one and ten percent of wells. Hence a strict set of guidelines and monitoring and compliance regimes covering this impact is a priority area.

As with produced water, this issue could be largely regulated by Victorian EPA, who oversee the assessment, management and regulation of wastes and pollution under the *Environment Protection Act 1970*. It is noted that unconventional gas prospects in Victoria are predominantly shale and tight gas, which in contrast to CSG (more common in Queensland) nearly always requires hydraulic fracturing.⁴⁴¹

6.5.3 Bore integrity

There is a consensus within the international research literature that the major pathway by which cross-aquifer contamination of groundwater, due to unconventional gas, occurs is through problems with gas and/or water bore integrity.⁴⁴² This is particularly the case for cross-contamination of aquifers with fugitive methane, but can also apply to other components (for example, abandoned or poorly sealed wells providing a conduit for downward leakage of surface contaminants).

Most documented cases of contamination of groundwater with fugitive methane in the United States are attributed to either abandoned or poorly sealed active wells.⁴⁴³ This is therefore a critical issue that requires effective regulation and oversight if an unconventional gas industry is to have minimal impacts on groundwater.

Victoria currently has a water bore construction and licencing system administered by Rural Water Corporations with standards set by the Minimum Construction Standards for Water Bores in Australia.⁴⁴⁴ The task of keeping accurate records of every bore and ensuring their long-term integrity, is a time and resource intensive task. For example, records show that between 500,000 and one million bores of some kind (for example, water supply, monitoring, oil and gas, geotechnical) have been drilled in Victoria since the 1970s.⁴⁴⁵ In cases where the bores are ageing and/or abandoned, decommissioning by way of cementing the bore is typically the recommended action, so that the bore cannot provide a contamination pathway in the future. A significant increase in the resources available to monitor the integrity and condition of wells, and identify and decommission these where necessary, would likely be required to ensure this pathway is minimised if an unconventional gas industry were to proceed.

⁴⁴¹ Cook et al. (2013) op. cit. p. 65.

⁴⁴² ibid.; Darrah et al. (2014) op. cit.; Vengosh et al. (2014) op. cit.; IESC (2014) *Bore Integrity, Background Review*, Commonwealth of Australia.

⁴⁴³ Darrah et al. (2014) op. cit.; Vengosh et al. (2014) op. cit.

⁴⁴⁴ National Uniform Drillers Licensing Committee (2012) *Minimum Construction Standards for Water Bores in Australia*, Australian Government National Water Commission.

⁴⁴⁵ DELWP (2015) 'Water Measurement Information System: Water Monitoring', DELWP website.

6.5.4 Groundwater monitoring bore locations and baseline sampling

Only a limited number of groundwater monitoring bores were considered appropriate (in terms of location, depth and condition) for sampling in the baseline groundwater sampling program. The Gippsland groundwater sampling report shows a map with regions of gas prospectivity, and locations of the monitoring bores sampled in the program. There are areas near gas deposits where no monitoring bores were available for sampling.⁴⁴⁶

The Gippsland groundwater sampling report also shows where groundwater monitoring bores would be desirable but do not exist at present. These areas include the Strzelecki group within the Seaspray depression, near the Lake Bunga 1 historic oil production bore near Lakes Entrance, near the interpreted hydrocarbon seeps to the north and southeast of Sale, within the Balook Formation near Rosedale, covering the Cretaceous and Lower Tertiary aquifers in all prospective areas near the Wombat, Trifon, Gangell, Echidna, Steele and Carrs Creek gas exploration fields.

A number of bores which have previously showed occurrences of hydrocarbons were also not sampled due to issues with poor bore condition. Only four sites in Gippsland were available where nested monitoring bores occurred, allowing assessment of the vertical connection between the aquifers.

Similarly, the groundwater sampling report for the Otway Basin stated: 'It should be noted that whilst the primary prospective formations for potential oil and gas deposits reside in the deep Eumeralla Formation, Waarre Formation and Casterton Formation, only one groundwater bore was available for sampling these units and it was located away from likely prospective areas and was quite shallow'.⁴⁴⁷

In both the Gippsland and Otway regions there is a lack of groundwater monitoring bores in the deeper Cretaceous geological layers (which are potential gas development targets). This means that as well as a lack of baseline water quality data, there is insufficient data to assess the vertical connectivity between the upper Cretaceous rocks (targets for gas) and overlying water supply aquifers in the lower tertiary (lower Tertiary aquifer) in both basins. Pumping tests are generally conducted in order to assess hydraulic parameters such as transmissivity, storativity and to determine if water extractions in one layer have a noticeable effect on water levels in overlying or underlying geological layers. Such data is also required to properly calibrate groundwater models, which require the user to estimate properties such as the vertical hydraulic conductivity of the various hydrogeological layers.⁴⁴⁸ In Gippsland, areas highlighted as potentially important regions to target with additional monitoring wells are the upper portion (for example, upper ~100m) of the Cretaceous Strzelecki Group,

⁴⁴⁶ Jacobs Pty Ltd (2015) *Gippsland Region Groundwater Sampling and Characterisation for Hydrocarbons*, op. cit., p. 5.

⁴⁴⁷ Jacobs Pty Ltd (2015) *Otway Region Groundwater Sampling and Characterisation for Hydrocarbons*, op. cit., p. 28.

⁴⁴⁸ IESC (2014) *Coal seam gas extraction: modelling groundwater impacts*, Report prepared by Coffey Geotechnics for the Department of the Environment, Commonwealth of Australia, p. 53.

where tight and shale gas occurs, and the Lower Tertiary Aquifer in which CSG occurs, largely in the Seaspray area.⁴⁴⁹ In the Otway Basin, this would include the Eumeralla formation/Killara Coals, and other Cretaceous aged shales and sandstones in the Portland/Glenelg area.

The baseline groundwater sampling in the water science studies were conducted over a relatively short time period. In Gippsland, three rounds of sampling were completed over approximately six months (December 2014 to June 2015), and at the time this Report was prepared, the results from rounds two and three have not been published. Regardless of the number of sampling rounds, a period of six months is generally not considered adequate to determine a full baseline of the degree of variability of groundwater methane and other quality indicators (a period of approximately two years is often used as a baseline monitoring period in resources/mining projects). In the Otway Basin, only one round of baseline sampling was completed, providing a single snapshot in time of the water quality in this Basin.

The water science groundwater sampling programs characterised groundwater quality largely from the point of view of hydrocarbons (including methane), as well as major ion compositions. It is likely that these constituents are the most important aspects of water quality that may be impacted by unconventional gas development. However, additional analytes and/or chemical data could also be included in order to have a more complete baseline assessment, in particular, an analysis of compounds commonly used in hydraulic fracturing fluids. Some common compounds not covered in the water science studies sampling include a range of ammonium based compounds, scale inhibitors (ethylene glycol), borate salts, biocides, gels (for example, hydroxyethyl) and other organic compounds not covered in standard assessments of hydrocarbons.

More detailed characterisation of the dissolved gas compositions in groundwater could also be conducted. The water science studies looked at the concentrations of methane and other hydrocarbon gases in groundwater at current (baseline) conditions. In Gippsland, significant existing concentrations of methane were discovered in groundwater from many areas. Isotopic characterisation of the methane in groundwater, as well as in the prospective gas deposits, has proved effective in the United States for identifying gas present in groundwater resulting from unconventional gas activity (as opposed to naturally occurring hydrocarbon gases).⁴⁵⁰ Data on the carbon and hydrogen isotope composition of gases produced in gas wells in current areas of production (e.g. offshore in Gippsland or in the exploration wells drilled in the Wombat and other onshore gas bores) would be of value in this sense, allowing fingerprinting of these sources of gas as distinct from naturally occurring methane. The Committee notes that DELWP has commissioned a PhD study at RMIT to look at concentrations and isotope compositions of methane in groundwater from the Gippsland and Otway Basins, however this does not include sampling of gas production wells, and DELWP are yet to release the data publicly.⁴⁵¹

⁴⁴⁹ Jacobs Pty Ltd (2015) *Gippsland Region Synthesis Report*, op. cit., p. 29.

⁴⁵⁰ Darrah et al. (2014) op. cit.

⁴⁵¹ D. Banfield & M. Currell (2015) 'Using isotopes to better understand dissolved gas hydrogeochemistry and the risk of unconventional gas development in the Gippsland and Otway basins', 13th Australian Environmental Isotope Conference, 8-10 July, Sydney, (poster presentation).

6.5.5 Delineation of gas deposits

A more precise knowledge of the locations and depths of prospective gas deposits is required to inform a proper understanding of the risks to water resources. While prospective locations have been mapped as part of the water science studies, it is acknowledged that there is uncertainty as to the precise depths and areas where prospective gas deposits may exist. A more precise knowledge of the extent and distribution of the gas deposits would allow targeted groundwater monitoring wells to be installed at appropriate depths and spacings around these areas. At least one monitoring bore in the gas bearing unit and each shallow aquifer above a prospective gas deposit at any potential drilling location would be needed in order to assess impacts of drilling, hydraulic fracturing and gas production at a given location. Ideally, sets of monitoring bores at regular spacings would be installed above prospective gas deposits.

6.6 Findings and recommendations

The Committee finds that gaps remain in terms of the geological and hydrogeological science which should underpin a possible unconventional gas industry in Victoria. Further scientific work would be necessary to enable informed decisions on risk mitigation, regulation and whether and where the industry should proceed in this State.

The Committee notes the substantial amount of work undertaken by the New South Wales Chief Scientist and Engineer on coal seam gas in New South Wales. To date there is no comparable suite of scientific (and social) research papers for Victoria, noting that Victorian prospectivity, geology and land use context are quite different. In light of this, the Victorian Government should assess Victoria's capacity to undertake a similar project.

RECOMMENDATION 3: That the Victorian Government undertake a significant program to collect baseline data prior to any unconventional gas industry going ahead, including:

- (a) further sampling of groundwater monitoring bores
- (b) locating groundwater monitoring bores in areas of potential gas extraction.

RECOMMENDATION 4: That the Victorian Government establishes an independent water science committee chaired by an eminent scientist to oversee a water science and monitoring program, and provide independent advice on water quality and other environmental issues.

RECOMMENDATION 5: That the Victorian Government:

- (a) increase the resources available to monitor the integrity and condition of wells, and identify and decommission these where necessary
- (b) clarify the roles and responsibilities of the Department of Environment, Land, Water and Planning, the Environment Protection Authority, water authorities and other agencies in regard to the decommissioning of wells.

7 Regulation of an unconventional gas industry

7.1 Chapter overview

Chapter Seven examines issues surrounding the regulation of a potential unconventional gas industry in Victoria. It examines the policy and regulatory safeguards that would be necessary to enable the exploration and development of unconventional gas, if it is determined that the industry should proceed in this State.

Chapter Seven firstly provides a brief summary of the State's existing regulatory framework that applies to unconventional gas with further details provided in Appendix 4. Secondly, it looks at ways the regulatory framework could be made more effective, and presents recommendations made by stakeholders and the Victorian Auditor-General's August 2015 report, *Unconventional Gas: Managing Risks and Impacts*. Thirdly, the Chapter provides a brief overview of how unconventional gas activities are regulated in Queensland, New South Wales, South Australia and Western Australia. The Chapter provides a number of recommendations, which are not intended to be exhaustive, but to suggest key directions for regulatory reform.

7.2 Current regulatory framework

This section provides a short summary of Victoria's existing regulatory framework for unconventional gas. Further details are provided in Appendix 4.

The Minister for Energy and Resources, through DEDJTR, administers and manages the legislation that regulates unconventional gas in Victoria. Victoria differs from other Australian states in that it regulates unconventional gas through two separate Acts, in conjunction with associated regulations and guidelines. These are the:

- *Mineral Resources (Sustainable Development) Act 1990* (Minerals Act) for CSG
- *Petroleum Act 1998* (Petroleum Act) for shale and tight gas.

A number of other Acts and related legislation also contribute to the regulation of unconventional gas in Victoria. The most significant of these are listed in Appendix 4.

7.2.1 *Mineral Resources (Sustainable Development) Act 1990*

The Minerals Act provides a legislative framework for development and regulation of CSG. The Act and associated regulations cover licensing and approval requirements, as well as issues surrounding landowner compensation, mine site rehabilitation and royalties payable to the state.

The four types of licences granted under the Minerals Act are:

- **Exploration licences** which authorise low impact exploration activities for minerals in the area to determine whether the resource is commercially viable
- **Mining licences** which allow the holder to carry out mining, exploration, construction and any other activities incidental to mining on the land
- **Prospecting licences** which enable the holder to prospect or explore for minerals
- **Retention licences** which allow the holder to retain the rights to a mineral resource in the land covered by the licence that is not currently economically viable to mine, but may be in the future.⁴⁵²

Exploration requires an approved work plan, consent or a compensation agreement with the owner of any private land affected and payment of a rehabilitation bond.⁴⁵³ Mining requires a work plan which contains additional details than those required for exploration, an approved planning permit or environment effects statement (EES), a compensation agreement, a rehabilitation plan, including payment of a rehabilitation bond and an approved work authority.⁴⁵⁴ Details of the requirements for exploration and mining licences are contained in Appendix 4.

7.2.2 *Petroleum Act 1998*

The Petroleum Act provides a legislative framework for the development and regulation of shale and tight gas, including licensing and approvals and other matters such as consultation, compensation, rehabilitation and royalties. The Petroleum Act provides for the issuing of:

- **Exploration permits** which enable the holder to explore for petroleum within the permitted area
- **Retention leases** which enable the holder of an exploration permit to retain certain rights to a petroleum discovery that is not currently commercially viable, but might become viable to develop within 15 years
- **Production licences** which allow for the production and exploration of petroleum.⁴⁵⁵

⁴⁵² *Mineral Resources (Sustainable Development) Act 1990* ss 13, 14, 14B and 14C.

⁴⁵³ *ibid.*, ss 40, 43(e), 78 & 80.

⁴⁵⁴ *ibid.*, ss 40, 42(6)-(7) & 78-80.

⁴⁵⁵ *Petroleum Act 1998* ss 18, 36 & 46.

Petroleum tenements are released by the Minister under acreage releases and companies are invited to tender.⁴⁵⁶ Tenders are assessed on their proposed work program and their technical and financial capability.⁴⁵⁷ Work under an exploration permit requires an approved operation plan, consent or a compensation agreement, where the affected land is private land, and a rehabilitation bond.⁴⁵⁸ Work under a production licence requires an approved operation plan and consent, compensation and rehabilitation commitments, as well as a production development plan and planning approval.⁴⁵⁹ Details of the requirements for exploration permits and production licences are contained in Appendix 4.

7.3 Review of regulatory framework

The current Victorian regulatory framework was established to primarily manage conventional oil and offshore petroleum resources.⁴⁶⁰ It is clear to the Committee from the evidence received that if an unconventional gas industry is to proceed, changes to the framework may be required to specifically address the risks associated with the industry. Parts of the regulatory framework that need to be considered include: environmental protection, community consultation, health and safety, land owners compensation rights and technical regulation. In their evidence to the Committee, Victoria's Environment Protection Authority (EPA) suggested key areas to be addressed in Victoria's regulatory framework:

...some aspects that would be relevant from the EPA's perspective include clear roles and responsibilities, so integration across the different life cycles stages, environment and community; a risk-based, industry-wide and cumulative impacts approach; design for post-closure, so setting clear standards at the beginning; operations as a first step of site rehabilitation, so clear and transparent compliance and enforcement; and finally, independent verification and increased governance.⁴⁶¹

The recent VAGO report, *Unconventional Gas: Managing Risks and Impacts*, made a number of regulatory framework recommendations for an unconventional gas industry in Victoria. The Committee received evidence from other key stakeholders including Professor Samantha Hepburn, from the School of Law at Deakin University; Environmental Justice Australia (EJA), an independent, not-for-profit, community legal service, specialising in public interest environmental law; and the Victorian EPA.⁴⁶² The Victorian Government inter-departmental submission also addresses regulation. The Committee also notes that the Gas Market Taskforce report made a number of recommendations

⁴⁵⁶ *ibid.*, Part 3, Division 2.

⁴⁵⁷ *ibid.*, ss 20-1.

⁴⁵⁸ *ibid.*, ss 161, 128 & 173.

⁴⁵⁹ *ibid.*, ss 161, 63 & 119-120.

⁴⁶⁰ VAGO (2015) *Unconventional Gas: Managing Risks and Impacts*, op. cit., p. 33. Note: references to the VAGO report on unconventional gas are stated as 'VAGO (2015) op. cit.' and the page number provided. References to the VAGO *Transcript of Evidence* provided to the Committee are identified as such.

⁴⁶¹ EPA (2015) *Transcript of Evidence*, 15 September, p. 11.

⁴⁶² The EPA sits under DELWP and reports to the Minister for Environment, Climate Change and Water.

regarding the regulation of an unconventional gas industry. Recommendations made by these stakeholders for changes to the regulatory framework are outlined in this section.

7.3.1 A single Act?

The Committee heard evidence criticising Victorian legislation for having two different Acts that essentially regulate the same activity.⁴⁶³ The VAGO report states that there are over 50 Acts, plus associated regulations, policies and administrative arrangements relating to unconventional gas operations, and suggests that there is a large degree of overlap and inconsistency between the Minerals and Petroleum Acts.⁴⁶⁴ In their evidence to the Committee, VAGO stated that: ‘Our current framework is complex and fragmented, does not address all unconventional gas risks and the roles and responsibilities of regulators overlap and duplicate.’⁴⁶⁵

The Victorian Government inter-departmental submission concedes improvements in consistency of regulation across unconventional gas types are necessary.⁴⁶⁶ Similarly, in 2012, the Victorian Parliament’s Economic Development and Infrastructure Committee recommended the amalgamation of the six earth resources Acts into one Act.⁴⁶⁷ VAGO also recommend consolidating legislative provisions for the regulation of CSG and shale and tight gas into one resource management Act to reduce the complexity and overlap of the roles and responsibilities of regulators and improve transparency.⁴⁶⁸ In their submission to the Committee, the Victorian EPA recommend the introduction of a new environmental framework which consolidates all environmental regulatory functions into a single regulator.⁴⁶⁹

7.3.2 Environmental assessment

Chapter Four discussed the risks of unconventional gas industries, highlighting concerns relating to environmental impacts, including issues surrounding hydraulic fracturing, water management and groundwater and land contamination. The Committee has found that the current requirements for environmental assessment are inadequate for ensuring that environmental impacts and risks are considered at all stages of the approval

⁴⁶³ It was stated that this can create confusion surrounding which Act applies to proposed activities – see Environmental Justice Australia (2015) Submission 837, p. 2.

⁴⁶⁴ VAGO (2015) op. cit., pp. 33 & 34.

⁴⁶⁵ VAGO (2015) *Transcript of Evidence*, 6 October, p. 3.

⁴⁶⁶ Government of Victoria (2015) Submission 658, p. 59.

⁴⁶⁷ Parliament of Victoria, Economic Development and Infrastructure Committee (2012) op. cit. The six earth resources Acts are the *Petroleum Act 1998*; *Mineral Resources (Sustainable Development) Act 1990*; *Greenhouse Gas Geological Sequestration Act 2008*; *Geothermal Energy Resources Act 2005*; *Pipelines Act 2005*; and *Offshore Petroleum and Greenhouse Gas Storage Act 2010*.

⁴⁶⁸ VAGO (2015) op. cit., pp. 34-5; EPA (2015) Submission 841, p. 4.

⁴⁶⁹ EPA (2015) Submission 841, p. 4.

process. The Committee received evidence that unlike in other jurisdictions, there is no distinct approval stage that requires definitive consideration of the environment.⁴⁷⁰

The Petroleum Act requires an environmental management plan, but does not identify the specifics that the plan must include.⁴⁷¹ Exploration can involve drilling of wells and hydraulic fracturing, however, the Minerals Act does not require an approved environmental management plan for this work.⁴⁷²

The Committee received evidence from Professor Hepburn and EJA which recommend a robust and detailed environmental assessment regime that gives regard to the impact that unconventional gas activities may have on the ecosystem, agriculture, climate change and water resources.⁴⁷³ The submission provided by the Victorian EPA recommends an integrated framework that consolidates the assessment of risks, including cumulative impacts to air, surface water and groundwater into a single approval at every stage of project development.⁴⁷⁴

Environmental impact assessment

The Committee received a large number of submissions that highlighted the widespread community concern surrounding the environmental impact of an unconventional gas industry. Currently, assessment of the environmental impact of unconventional gas is covered under the *Environment Effects Act 1978*.⁴⁷⁵ This legislation requires an EES be prepared, only if requested by the Minister. In relation to the Environment Effects Act, Professor Hepburn argues that: 'It is discretionary, non-binding, has an infrequent application to petroleum projects, and the approval process can often contain little more than bare environmental evaluation.'⁴⁷⁶

An environmental impact assessment (EIA) can influence the approval decision in a project, and therefore is a stronger protector of the environment than an environmental management plan.⁴⁷⁷ There is currently no regulatory mandate for a comprehensive EIA.⁴⁷⁸ The Minister may require an EIA be prepared under the Minerals Act, however no comparable requirement exists under the Petroleum Act.⁴⁷⁹ VAGO contends there are no transparent criteria or guidelines for when the Minister should apply this discretionary power and to date this provision has not been invoked.⁴⁸⁰

⁴⁷⁰ Environmental Justice Australia (2015) Submission 837, p. 26.

⁴⁷¹ VAGO (2015) op. cit., p. 39.

⁴⁷² *ibid.*

⁴⁷³ S. Hepburn (2015) *Mining and Energy Law*, Cambridge University Press, p. 177; Environmental Justice Australia (2015) Submission 837, p. 6.

⁴⁷⁴ EPA (2015) Submission 841, p. 4.

⁴⁷⁵ VAGO (2015) op. cit., p. 38.

⁴⁷⁶ S. Hepburn (2015) *Transcript of Evidence*, 13 August, p. 27.

⁴⁷⁷ S. Hepburn (2015) Submission 1072, p. 57; VAGO (2015) op. cit., p. 38.

⁴⁷⁸ S. Hepburn (2015) Submission 1072, p. 49.

⁴⁷⁹ *Mineral Resources (Sustainable Development) Act 1990* s 41A.

⁴⁸⁰ VAGO (2015) op. cit., p. 38.

Professor Hepburn and other stakeholders recommended to the Committee that a detailed, scientifically driven EIA process that focusses on the key risks associated with unconventional gas activities and is proportionate to the scale and dimension of the proposed project be introduced for all stages of work.⁴⁸¹ Professor Hepburn provided evidence to the Committee that: 'It is very important to implement mandatory environment impact assessment for all CSG, shale and tight gas projects, which takes account of principles of ecologically sustainable development.'⁴⁸²

In their submission EJA stipulates that the EIA process should be triggered by consistently applied, clear legislative criteria and should result in a legally binding decision to refuse, approve or conditionally approve the proposal, based on whether or not it is ecologically sustainable.⁴⁸³ The Committee received further advice from EJA that the EIA framework should incorporate community involvement, including the opportunity for the public to make submissions and review and dispute decisions made.⁴⁸⁴ EJA recommends these environmental controls should be introduced during the application process for an exploration licence to ensure work does not commence where the proposals are clearly unacceptable.⁴⁸⁵

In EJA's submission to the Committee they state that they support the recommendations of the Environment and Natural Resources Committee in their *Inquiry into the Environment Effects Statement Process in Victoria*, September 2011, which proposed:

- any project which is likely to have a significant impact on the environment must undergo some degree of environmental impact assessment
- there are three tiers of assessment that a project can go through, depending on the likely severity of the projected environmental impacts
- the Minister makes a legally binding decision to approve/reject the proposal on conditions, based on whether or not those environmental impacts are ecologically sustainable.⁴⁸⁶

Water management and monitoring

The Committee received extensive evidence relating to CSG and produced water.⁴⁸⁷ VAGO contends that the impacts and challenges to groundwater and surface water supplies that an unconventional gas industry would raise are inadequately regulated under the *Water Act 1989*.⁴⁸⁸ The current framework

⁴⁸¹ S. Hepburn (2015) Submission 1072, p. 49; VAGO (2015) op. cit., p. 38; Environmental Justice Australia (2015) Submission 837, p. 24.

⁴⁸² S. Hepburn (2015) *Transcript of Evidence*, 13 August, p. 27.

⁴⁸³ Environmental Justice Australia (2015) Submission 837, p. 24.

⁴⁸⁴ *ibid.*, p. 24.

⁴⁸⁵ *ibid.*, p. 28.

⁴⁸⁶ *ibid.*, p. 29; Parliament of Victoria, Environment and Natural Resources Committee (2011) *Inquiry into the Environment Effects Statement Process in Victoria*.

⁴⁸⁷ Produced and flowback water are discussed in Chapter Four of this Report.

⁴⁸⁸ VAGO (2015) op. cit., p. 40.

is unclear regarding licencing of activities that extract water from coal seams and there is uncertainty surrounding future water use requirements.⁴⁸⁹ Given the concerns and uncertainty surrounding unconventional gas and water management, the Committee acknowledge the framework regulating and monitoring water must be strengthened.

VAGO recommends the implementation of baseline studies and ongoing monitoring for vulnerable water resources, as well as the development of guidelines to develop a water management strategy for the life cycle of an unconventional gas operation.⁴⁹⁰ The Gas Market Taskforce report recommends the establishment of an independent water science committee which would oversee the water science and monitoring program and provide independent advice to the Minister on water issues relevant to the gas industry.⁴⁹¹ The Taskforce proposed that where aquifers are connected, all users must hold a water licence and be subject to coordinated management under the Water Act.⁴⁹²

In her submission to the Committee, Professor Hepburn asserts that shale and tight gas projects are not evaluated under the *Environment Protection and Biodiversity Conservation Act 1999 (Cth)* (EPBC Act) as it only regulates water resources impacted by CSG development.⁴⁹³ Professor Hepburn advocates for the expansion of the EPBC Act to cover both CSG and shale gas impacts on water resources.⁴⁹⁴

VAGO states that Victoria's water resources are currently managed in an allocation framework, with allocations capped for sustainable management.⁴⁹⁵ Under this framework existing users have a licence to take and use water and any proposal for new uses requires a licence and may be subject to the predetermined cap of the resource.⁴⁹⁶ VAGO recommends a new system for water allocation rights which is transparent and evidence-based and assesses water licences based on the region's economic, environmental and social priorities.⁴⁹⁷

Well integrity

Chapters Four and Six identified the integrity of gas wells as critical in the protection of water resources. Victoria currently has no code of practice or guidelines for well integrity and there are no explicit requirements surrounding

⁴⁸⁹ *ibid.*

⁴⁹⁰ *ibid.*, p. 71.

⁴⁹¹ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 56; S. Hepburn (2015) Submission 1072, p. 58.

⁴⁹² *ibid.*

⁴⁹³ *Environmental Protection Biodiversity Conservation Act 1999 (Cth)*, s 24D; S. Hepburn (2015) Submission 1072, p.55.

⁴⁹⁴ S. Hepburn (2015) Submission 1072, pp. 54-5.

⁴⁹⁵ VAGO (2015) op. cit., p. 40.

⁴⁹⁶ *ibid.*

⁴⁹⁷ *ibid.*

supervision of well construction.⁴⁹⁸ DEDJTR gave evidence to the Committee that: ‘Well integrity and aquifer protection is quite critical to the safeguards that need to be put in place to extract gas out of the ground.’⁴⁹⁹

VAGO recommends the introduction of a Code of Practice, similar to those in Queensland and New South Wales, that details the design, construction, operation, maintenance and decommissioning of wells and includes the requirement for independent supervision of well construction.⁵⁰⁰ The Gas Market Taskforce report highlighted the need to ensure a high level of competency in the workers performing any drilling, thus recommends the imposition of accreditation, qualification and experience standards.⁵⁰¹

Independent oversight

The Committee notes that there is no requirement for independent oversight of any unconventional gas activities under the existing framework.⁵⁰² VAGO states that requiring licensees to seek third party oversight and auditing for key elements of their environmental performance would strengthen environmental regulation, thus increasing transparency and improving public perception and confidence in the process.⁵⁰³ The Gas Market Taskforce report recommends the introduction of an independent gas commissioner, similar to that established in Queensland, to provide third party oversight (see Box 7.1 in Section 7.4).⁵⁰⁴ The Taskforce reasoned that an independent commissioner would improve community engagement.⁵⁰⁵ VAGO agrees the introduction of a gas commissioner or, alternatively, the expansion of the existing role of the Mining Warden would be of benefit to the regulatory framework.⁵⁰⁶

7.3.3 Health and safety

The Committee received a number of submissions and evidence from witnesses at Committee hearings that raised concerns about the health impacts of an unconventional gas industry (which were discussed in Chapter Four).

The Committee heard evidence that under the existing framework there is no explicit requirement to consider the health and safety of individuals impacted by an unconventional gas industry. EJA’s submission recommends strong protection, by way of robust risk management strategies that are enforceable through law and include recognition of the potential for unconventional gas activities to contaminate drinking water and food supplies.⁵⁰⁷ EJA proposes a

⁴⁹⁸ *ibid.*, pp. 41, 71.

⁴⁹⁹ DELWP and DEDJTR (2015) *Transcript of Evidence*, 18 August, p. 3.

⁵⁰⁰ VAGO (2015) *op. cit.*, pp. 41 & 71.

⁵⁰¹ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, *op. cit.*, p. 132.

⁵⁰² VAGO (2015) *op. cit.*, p. 39.

⁵⁰³ *ibid.*, pp. 39 & 49.

⁵⁰⁴ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, *op. cit.*, p. 53.

⁵⁰⁵ *ibid.*

⁵⁰⁶ VAGO (2015) *op. cit.*, pp. 39-40.

⁵⁰⁷ Environmental Justice Australia (2015) Submission 837, pp. 7-8.

framework to the Committee, similar to that in New South Wales, which includes a buffer zone prohibiting unconventional gas within two kilometres of existing residential zones and future residential growth areas in parts of Sydney.⁵⁰⁸

The Victorian Government inter-departmental submission recommends appropriate health guidelines that would support effective oversight of an unconventional gas industry.⁵⁰⁹ Their submission outlined additional safeguards for human health that could include:

- full disclosure of chemicals used in natural gas production to support comprehensive health risk assessments
- mechanisms to ensure that funds are available for necessary remediation, health risk assessment and management works that might be required to address public health risks during and beyond the life of a project
- revised community consultation requirements that licensees be responsive in considering mitigation options raised by residents.⁵¹⁰

7.3.4 Community involvement and land owner consent and compensation rights

As discussed in Chapter Five, the Committee received a very strong response from the community regarding community involvement and land owner rights. The Committee received evidence that currently there is no compulsory legislative pre-requisite for payment of compensation to landowners to be agreed upon prior to a licence being granted under legislation.⁵¹¹ The Committee recognises the importance of improving community engagement, including informing, involving and compensating individual land owners and communities and rectifying land use conflicts. These issues and recommendations for improvements are explored below.

Land access and compensation

Chapter Five highlighted issues surrounding land access and compensation rights of landowners. These were consistently raised in submissions and in Committee hearings. At the current time these issues are also being debated federally.

In their submission, EJA outline that a licence holder is required to seek the consent of the owner or occupier of private land, however, there is no requirement that they must actually obtain that consent, as VCAT allows applicants to circumvent any opposition with a compensation determination.⁵¹² VAGO contends that giving such power to VCAT dramatically reduces the bargaining power of landowners.⁵¹³

⁵⁰⁸ *ibid.*, p. 8.

⁵⁰⁹ Government of Victoria (2015) Submission 658, p. 63.

⁵¹⁰ *ibid.*, p. 62.

⁵¹¹ S. Hepburn (2015) Submission 1072, p. 38.

⁵¹² Environmental Justice Australia (2015) Submission 837, p. 13.

⁵¹³ VAGO (2015) *op. cit.*, p. 61.

Queensland regulates land access through its *Land Access Policy Framework* and a Land Access Code of practice, which mandates access and compensation agreements.⁵¹⁴ The policy framework includes compliance and enforcement provisions for breaches of the Code.⁵¹⁵ VAGO and Professor Hepburn both recommend Victoria consider a model similar to Queensland's Land Access Code.⁵¹⁶ The Code provides a simple structure which provides 'best practice' guidelines to establish a good relationship between parties and imposes mandatory conditions on the conduct of authorised activities on private land.⁵¹⁷ The Code includes:

- notice requirements
- induction training requirements for any person working on the land under the licence
- guidelines for access points, roads and tracks
- livestock and property considerations
- obligations to prevent the spread of declared pests
- guidelines for items which may be brought onto the land and conditions of use for gates, grids and fences.⁵¹⁸

VAGO's review of the current framework for compensation in Victoria found it was inadequate and limited in a number of respects, including:

- compensation may be claimed for damages or loss suffered as a 'direct, natural and reasonable consequence' of the approval of a work plan, thus compensation is only available for above ground impacts and underground impacts are not applicable
- compensation is restricted to private land owners only, thus local communities are ineligible for any compensation
- a compensation agreement is an implied form of consent by the landowner to access their land
- time limits apply for requesting compensation, however the impacts from unconventional gas activities may not be evident for a number of years.⁵¹⁹

Professor Hepburn's submission argues that compensation frameworks which require parties to agree to a conduct and compensation agreement prior to work commencing do help in reducing conflict and ensuring satisfaction of landowners.⁵²⁰ She recommends this change to the Committee because: 'You

⁵¹⁴ *ibid.*

⁵¹⁵ S. Hepburn (2015) Submission 1072, pp. 30-1.

⁵¹⁶ VAGO (2015) *op. cit.*, p. 61; S. Hepburn (2015) Submission 1072, p. 33.

⁵¹⁷ S. Hepburn (2015) Submission 1072, pp. 32-3.

⁵¹⁸ Queensland Department of Employment, Economic Development and Innovation (2010) *Land Access Code* pp. 7-10.

⁵¹⁹ VAGO (2015) *op. cit.*, p. 61.

⁵²⁰ S. Hepburn (2015) Submission 1072, p. 43.

are not saying that one party has a greater right than the other, because you are actually trying to achieve a reconciliation between those two effectively conflicting ownership rights.’⁵²¹

Professor Hepburn recommends that a compensation agreement should be a mandatory component prior to the issuance of a production licence.⁵²² She recommends existing compensation provisions should be broadened to include:

- loss of amenity incurred as a result of a disturbance to a landholder’s quiet enjoyment
- loss suffered to a surface activity, including depletion of groundwater aquifers and future losses connected with these environmental impacts
- legal and financial costs reasonably incurred by landowners in negotiating a compensation agreement.⁵²³

In her evidence to the Committee, Professor Hepburn argues that the current three-year time limit for compensation claims must be revised.⁵²⁴ She advocates for flexibility to ensure the amount and type of compensation recoverable by landholders is not limited in all cases to loss or damages contained within a compensation agreement.⁵²⁵ In her submission, Professor Hepburn states that: ‘Damage to the subsurface from unconventional gas extraction may not be evident until many years following the commencement of mining activities. This is particularly relevant for adjoining landholders who are not directly affected by the mining activities.’⁵²⁶ Therefore, it is essential that options for recovering compensation for future, unpredictable damages is accessible.

Finally, VAGO highlights that Victoria has no regulatory mechanism to compensate local communities who may be indirectly impacted by unconventional gas activities.⁵²⁷ Professor Hepburn also raised this issue in her evidence to the Committee, stating: ‘it is very important to distinguish between private compensation, which is based legally upon the impact a project will have on the ownership entitlement, and community.’⁵²⁸ Both VAGO and Professor Hepburn recommend the establishment of a transparent royalty program, similar to those in Western Australia and Queensland, which promote the redistribution of profits back into the community.⁵²⁹

⁵²¹ S. Hepburn (2015) *Transcript of Evidence*, 13 August, p. 26.

⁵²² S. Hepburn (2015) Submission 1072, p. 44.

⁵²³ *ibid.*, pp. 47-8.

⁵²⁴ *ibid.*, p. 48

⁵²⁵ *ibid.*

⁵²⁶ *ibid.*

⁵²⁷ VAGO (2015) *op. cit.*, p. 62.

⁵²⁸ S. Hepburn (2015) *Transcript of Evidence*, 13 August, p. 31.

⁵²⁹ VAGO (2015) *op. cit.*, p. 62; S. Hepburn (2015) *Transcript of Evidence*, 13 August, p. 31.

Community engagement

The Minerals Act requires consultation with the community prior to a mining licence being granted, however, the Petroleum Act does not have comparable provisions.⁵³⁰ The Petroleum Act contains no provisions for objections, while the Minerals Act contains the right to object but does not set out grounds on which an objection may be made or the significance the Minister must place on the consideration of these objections.⁵³¹

EJA, along with other stakeholders, made a number of recommendations to the Committee relating to community engagement, including:

- stronger laws relating to disclosure and community consultation
- public input on work plans and development plans
- amendments to current laws to enable greater weight to be given to community concerns in decisions about whether to grant licences
- the requirement that all licence applications should be required to notify the local council, and owners and occupiers of land within two kilometres of the licence area, in writing
- the provision that any person should have the right to apply to VCAT to enforce a breach of the Minerals and Petroleum Acts.⁵³²

VAGO outlines that community consultation should occur prior to decisions relating to mining being made to allow for individuals to comment and influence the decision, and once a project has commenced community engagement should be undertaken.⁵³³ VAGO provided evidence to the Committee that: ‘Community consultation should provide the opportunity to comment on and influence decisions across the life cycle of a project and, if a project goes ahead, should enable those affected to understand the issues and risks and how these are to be managed.’⁵³⁴

VAGO recommends the community engagement process should be separated from the staged licencing and approval process.⁵³⁵ Furthermore, VAGO recommends an effective dispute resolution process be initiated to complement the community engagement element of mining projects.⁵³⁶

State-wide planning

Chapter Five discusses the co-existence of an unconventional gas industry with other land users, which is an area the Committee recognises must be regulated. VAGO, in their evidence given to the Committee state: ‘There is currently no

⁵³⁰ VAGO (2015) op. cit., pp. 59 & 60.

⁵³¹ Environmental Justice Australia (2015) Submission 837, p. 9.

⁵³² *ibid.*, p. 10.

⁵³³ VAGO (2015) op. cit., p. 60.

⁵³⁴ VAGO (2015) *Transcript of Evidence*, 6 October, p. 3.

⁵³⁵ VAGO (2015) op. cit., p. 60.

⁵³⁶ *ibid.*, p. 40.

land use planning to determine whether extracting gas in a particular location will sustainably meet community needs and safeguard the priority economic, environmental and social values.⁵³⁷

VAGO recommends the introduction of a strategic resource assessment in Victoria to identify areas that offer the highest potential for the occurrence of unconventional gas.⁵³⁸ They suggest this assessment should consider issues relating to land use and land values, water resources, landscape values and regionally significant environment, social and economic values that require protection.⁵³⁹ VAGO recommends that a land-use plan should be required for any region identified through a resource assessment as a potential unconventional gas resource, prior to production approval.⁵⁴⁰ They propose that any land-use planning exercise should incorporate the guiding principles including best use of resources, co-existence, strategic planning, tailored participation of communities and landowners and accessible relevant information.⁵⁴¹

7.3.5 Hydraulic fracturing and chemical bans

Chapter Four discussed the potential environmental implications of hydraulic fracturing, including the concerns surrounding chemical use. The Committee notes that there are currently no specific requirements or guidance relating to hydraulic fracturing in the Victorian framework.⁵⁴² In New South Wales and Queensland operators must submit a list of all fracking chemicals, including their volumes, concentrations and potential toxicity, to state regulators prior to approval for hydraulic fracturing.⁵⁴³

EPA's submission to the Committee recommends the development of a code of practice for hydraulic fracturing, chemical use and water re-injection.⁵⁴⁴ The Gas Market Taskforce report recommends that the National Harmonised Regulatory Framework, produced by the former Standing Council on Energy and Resources (see section 2.7.1 of this report), be introduced as a minimum standard in relation to hydraulic fracturing operations, which includes:

- Developing new legislation, regulations and supporting guidelines that clearly set out the requirements for hydraulic fracturing operations
- Requiring public disclosure of all chemicals used in hydraulic fracturing operations
- Requiring demonstration of the effects of proposed chemical mixes, prior to those chemicals being approved for use in operations

⁵³⁷ VAGO (2015) *Transcript of Evidence*, 6 October, p. 3.

⁵³⁸ VAGO (2015) op. cit., p. 53.

⁵³⁹ *ibid.*

⁵⁴⁰ *ibid.*, p. 54.

⁵⁴¹ *ibid.*, p. 55; These principles were outlined in the COAG Energy Council's 2013 *Multiple Land Use Framework*.

⁵⁴² Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 133.

⁵⁴³ VAGO (2015) op. cit., p. 63.

⁵⁴⁴ EPA (2015) Submission 841, p. 4.

- Encouraging the use of environmentally benign chemicals in hydraulic fracturing operations
- Independent monitoring of impacts and seeking independent expert advice on best-practice hydraulic fracturing to inform legislative and regulatory amendments.⁵⁴⁵

7.3.6 Approval process

VAGO criticised the current regulatory system for containing a number of ministerial discretionary powers, including: exempting land from earth resources activities; determining the requirement for an EIA; granting, approving and imposing conditions on licences and work and operation plans; and determining the cost of rehabilitation bonds.⁵⁴⁶ In their evidence to the Committee, VAGO stated that: ‘the earth resources regulation group within the department had not effectively overseen the industry’s compliance with the regulatory requirements.’⁵⁴⁷

VAGO contends that the criteria for licences, permits, work plans, operation plans and other approval decisions are inadequate and insufficient.⁵⁴⁸ VAGO recommends clearer guidelines, with more definitive criteria for decisions, less ambiguous wording and firmer time lines.⁵⁴⁹ Furthermore, VAGO recommends decision-makers must be required to communicate their reasons for decisions, which should be made public and opportunities for review of these decisions should be implemented.⁵⁵⁰

7.3.7 Compliance and administration

Given the community concerns presented to the Committee and the identified potential risks of an unconventional gas industry (discussed in Chapter Four), the Committee acknowledge that if the industry were to proceed, Victoria must develop a strong compliance and administration framework. Currently, DEDJTR manages compliance with legislation by performing inspections and audits and applying sanctions where breaches have occurred via the issuance of notices or prohibitions.⁵⁵¹ VAGO is critical of this process and states that it is not effective or comprehensive, particularly in relation to unconventional gas risks.⁵⁵² VAGO recommends a strategic, risk-based approach to compliance, with a specific focus on unconventional gas activities.⁵⁵³

⁵⁴⁵ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 58.

⁵⁴⁶ VAGO (2015) op. cit., p. 63.

⁵⁴⁷ VAGO (2015) *Transcript of Evidence*, 6 October, p. 3.

⁵⁴⁸ VAGO (2015) op. cit., p. 45.

⁵⁴⁹ *ibid.*, p. 64.

⁵⁵⁰ *ibid.*

⁵⁵¹ *ibid.*, p. 45.

⁵⁵² *ibid.*

⁵⁵³ *ibid.*, p. 47.

To improve transparency, EJA, in their submission to the Committee cite an independent review of the efficacy of the Mining Warden conducted by the State Services Authority in 2009, which recommended that licence decisions should be made by the Secretary of the Department, rather than the Minister.⁵⁵⁴ They further recommended that these decisions should be open to review by the Department and by VCAT.⁵⁵⁵ In their submission, the EPA recommends that an agency that is equipped and resourced to effectively undertake a clear, transparent and risk-based assessment should be created to regulate compliance and enforcement.⁵⁵⁶ Furthermore, the EPA stipulates the agency responsible for overseeing compliance and enforcement must ensure the provision for long term liabilities from operators, as well as enforce post-closure management arrangements.⁵⁵⁷

With regard to administration of earth resources legislation and associated regulations, VAGO recommends improvements should be made to meet best practices in the areas of role clarity, accountability and transparency, risk-based strategies, and compliance assistance and advice.⁵⁵⁸ VAGO suggests a 'more reflective, adaptive and systematic approach' should be implemented by DEDJTR so it can respond to emerging issues in the unconventional gas industry effectively, and implement best practice regulation.⁵⁵⁹

7.3.8 New earth resources activities and emerging risks

VAGO asserts that as the current regulatory framework was developed when the industry's focus was on conventional gas activities, it is inadequate to handle the risks associated with unconventional gas.⁵⁶⁰ In their submission to the Committee, the EPA advocates that emerging risks must be considered in a regulatory framework: 'It is a developing area so the technologies, both the chemicals and the understanding of the chemicals, used in the drilling and the safeguards around the wells and failures, are all developing as time goes on.'⁵⁶¹

Professor Hepburn's submission recommends a monitoring system that is capable of responding to new technological advancements, such as hydraulic fracturing and horizontal drilling for the successful development of an unconventional gas industry.⁵⁶² Furthermore, VAGO suggests that the development of a code of practice that specifies mandatory technical and operational requirements for unconventional gas activities would provide greater clarity on the rights and responsibilities of industry personnel.⁵⁶³

⁵⁵⁴ Environmental Justice Australia (2015) Submission 837, p. 50; State Services Authority (2009) *Review of the Mining Warden: Objectives, functions and alternatives*.

⁵⁵⁵ Environmental Justice Australia (2015) Submission 837, p. 50; State Services Authority (2009) op. cit.

⁵⁵⁶ EPA (2015) Submission 841, p. 4.

⁵⁵⁷ *ibid.*

⁵⁵⁸ VAGO (2015) op. cit., p. 48.

⁵⁵⁹ *ibid.*, p. 49.

⁵⁶⁰ *ibid.*, p. 33.

⁵⁶¹ EPA (2015) *Transcript of Evidence*, 15 September, p. 18.

⁵⁶² S. Hepburn (2015) Submission 1072, p. 4.

⁵⁶³ VAGO (2015) op. cit., pp. 41-2.

7.4 Key features of regulatory frameworks in other jurisdictions

The Committee heard that the regulatory frameworks in the other jurisdictions are significantly more developed than the regulatory framework for unconventional gas in Victoria. In their evidence to the Committee, the EPA asserts that: ‘if the state government decides to permit these activities, then obviously the lessons learnt by other jurisdictions are very relevant in the context of Victoria.’⁵⁶⁴

Coal seam gas has been in commercial production in Queensland since 1996 and New South Wales since 2001; regulatory frameworks have developed in these states over time to manage their specific requirements.⁵⁶⁵ For example, New South Wales and Queensland have two separate agencies to deal with the two functions of promoting and developing earth resources and regulating the environmental, economic and social impacts of exploration and production activities.⁵⁶⁶ Whereas, in Victoria, DEDJTR has two separate divisions to perform these functions, but both are still within the one department.⁵⁶⁷

Queensland, New South Wales, South Australia and Western Australia have developed individual frameworks to manage unconventional gas and a summary of each is provided below. It is important to note, however, that due to resourcing constraints the Committee has not been able to fully explore the different elements and the pros and cons of these regulatory frameworks.

7.4.1 Queensland

The Department of Natural Resources and Mines (DNRM) manages compliance relating to CSG, with a focus on groundwater resources.⁵⁶⁸ The Department of Environment and Heritage Protection (DEHP) manages environmental impact assessments and issues Environmental Authorities and water permits.⁵⁶⁹ These two departments combine to manage compliance.⁵⁷⁰ The Victorian EPA presented to the Committee that the Queensland Competition Authority performed an independent CSG review in January 2014, with most findings involving simplifying and clarifying the roles and responsibilities of the departments.⁵⁷¹

⁵⁶⁴ EPA (2015) *Transcript of Evidence*, 15 September, p. 10.

⁵⁶⁵ VAGO (2015) *op. cit.*, p. 4.

⁵⁶⁶ *ibid.*, p. 35.

⁵⁶⁷ *ibid.*

⁵⁶⁸ EPA (2015) Presentation, 15 September; Queensland Department of Natural Resources and Mines (2015) Department of Natural Resources and Mines website.

⁵⁶⁹ EPA (2015) Presentation, 15 September; Queensland Department of Environment and Heritage Protection (2015) ‘Management: impact assessment’, DEHP website; Queensland Department of Environment and Heritage Protection (2015) ‘Management: non-mining water’, DEHP website.

⁵⁷⁰ EPA (2015) Presentation, 15 September.

⁵⁷¹ EPA (2015) *Transcript of Evidence*, 15 September, p. 12.

Queensland's regulatory framework contains comprehensive codes of practice for hydraulic fracturing and environmental risk assessment.⁵⁷² Legislation protects land with high agricultural value and manages impacts on natural systems, groundwater and the environment and mandates licence approvals throughout all stages of the work process.⁵⁷³

Queensland's former 'Royalties for Regions' scheme has been replaced with a 'Building our Regions' program, which compensates local communities who may be impacted by an unconventional gas industry by redistributing some profits back into the community.⁵⁷⁴ The program has provided support for infrastructure projects that addressed identified local needs.⁵⁷⁵

The Committee heard evidence that a GasFields Commission (see Box 7.1 for details), which manages the interface between rural landholders, regional communities and the CSG industry, similar to that established in Queensland in 2013, should be introduced in Victoria.⁵⁷⁶ In their submission to the Committee, APPEA stated:

In Queensland the establishment of a GasFields Commission has significantly improved the level of community engagement and the dialogue between government, industry, and landholders. The Commission also assists in de-politicising the regulation of the industry as it is independent of the Minister and relevant government departments.⁵⁷⁷

The Office of Groundwater Impact Assessment (OGIA) is responsible for assessing and managing the impacts of water extraction that occurs as part of the petroleum and gas industry.⁵⁷⁸ Queensland's *Land Access Code* establishes a code of practice guiding communication between operators and landholders in relation to land access and mandates negotiation of a conduct and compensation agreement prior to accessing private land.⁵⁷⁹

⁵⁷² EPA (2015) Presentation, 15 September; Queensland Department of Natural Resources and Mines (2015) *Code of Practice for constructing and abandoning coal seam gas wells and associated bores in Queensland*, DNRM website; Queensland Department of Natural Resources and Mines (2015) 'Mining, land and resources', DNRM website.

⁵⁷³ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 50; Petroleum and Gas (Production and Safety) Act 2004 (Qld); Water Act 2000 (Qld); Environment Protection Act 2014 (Qld).

⁵⁷⁴ VAGO (2015) op. cit., p. xv; Queensland Department of State Development (2015) 'Royalties for the Regions', DSD website.

⁵⁷⁵ *ibid.*

⁵⁷⁶ APPEA (2015) Submission 364, p. 5; Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 50; GasFields Commission Queensland (2015) GasFields Commission Queensland website.

⁵⁷⁷ APPEA (2015) Submission 364, p. 7.

⁵⁷⁸ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 50; Queensland Department of Natural Resources and Mines (2015) 'Office of Ground Water Impact Assessment', DNRM website.

⁵⁷⁹ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 50; Queensland Department of Employment, Economic Development and Innovation (2010) *Land Access Code*, DEEDI website.

BOX 7.1: GasFields Commission

The *Gasfields Commission Act 2013* (Qld) established the GasFields Commission in 2013. It is an independent statutory body comprised of seven Commissioners appointed for their skills and expertise in their respective fields. The Commission is designed to facilitate stronger relationships between landholders, regional communities and the onshore gas industry.

The powers and functions of the Gas Fields Commission include:

- reviewing the effectiveness of legislation and regulation
- obtaining and publishing factual information
- identifying and advising on coexistence issues
- convening parties for the purpose of resolving issues
- promoting scientific research to address knowledge gaps
- making recommendations to government and industry.

The Commission has the power to compel landholders and gas operators to provide relevant information or documents that they require to carry out their functions. This information goes towards creating Conduct and Compensation Agreements. The Commission produces publications to assist landowners and industry officials, manages enquiries and facilitates community engagement via site visits, meetings and workshops.

Source: GasFields Commission Queensland.

7.4.2 New South Wales

The Victorian EPA presented evidence to the Committee that the New South Wales regulatory framework was updated in July 2015 and is still evolving.⁵⁸⁰ The New South Wales EPA is the lead regulator of the health and environmental impacts of CSG. The NSW EPA issues licences and undertakes compliance and enforcement on all approvals.⁵⁸¹ The Department of Industry's Resources and Energy Division are responsible for administering petroleum titles and for granting approval for exploration and do this through the Office of Coal Seam Gas, which was established in 2013.⁵⁸² The Department of Planning and Environment assess and grant approval for production.⁵⁸³ All CSG operators must hold an environmental protection licence issued by the NSW EPA for exploration, assessment and production activities.⁵⁸⁴

⁵⁸⁰ EPA (2015) *Transcript of Evidence*, 15 September, p. 10.

⁵⁸¹ EPA (2015) Presentation, 15 September; New South Wales EPA (2015) NSW EPA website.

⁵⁸² EPA (2015) Presentation, 15 September; New South Wales Department of Industry Resources & Energy (2015) 'The Facts on CSG: Protections and Controls', DIRE website; New South Wales Department of Planning and Environment (2015) 'Coal Seam Gas: NSW Gas Plan', DPE website.

⁵⁸³ EPA (2015) Presentation, 15 September; New South Wales Department of Planning and Environment (2015) op. cit.

⁵⁸⁴ Ross & Darby (2013) op. cit., p. 47; New South Wales EPA (2014) 'Environment Protection Licences', New South Wales EPA website.

New South Wales has implemented a range of regulatory safeguards for the CSG industry, including:

- a Land and Water Commissioner who oversees mining and CSG activity and provides independent advice to landholders, resource companies, the community and government⁵⁸⁵
- an Aquifer Interference Policy which sets out the requirements for assessing the impacts of aquifer interference activities on water resources⁵⁸⁶
- a 'Gateway process' which requires that a proponent obtain a certificate for the project from a panel of independent experts prior to lodgement of their application⁵⁸⁷
- a Strategic Regional Land Use Policy, which requires the preparation of an Agricultural Impact Statement⁵⁸⁸
- mandatory Codes of Practice for well integrity and hydraulic fracturing.⁵⁸⁹

The New South Wales Gas Plan, released in November 2014, established a one-off buy-back of petroleum exploration licences (PELs) for titleholders which allowed holders of PELs to surrender their titles in exchange for limited compensation.⁵⁹⁰ On 11 December 2014, the buy-back program commenced, with an expiry date of 30 July 2015, which was extended to 30 September 2015.⁵⁹¹ To date 17 PELs have been bought back by the New South Wales Government.⁵⁹²

7.4.3 South Australia

In South Australia, the environmental elements of unconventional gas are regulated through the Department of State Development and management of water resources is regulated by the Department of Environment, Water and Natural Resources.⁵⁹³ The South Australian EPA is a mandatory referral agency and has a role in advising the Department of State Development in relation to environmental impacts.⁵⁹⁴ Public consultation to demonstrate potential risks and how they can be managed is required for any proposed hydraulic fracturing.⁵⁹⁵

⁵⁸⁵ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 51; New South Wales Department of Industry (2015) 'Land and Water Commissioner', Department of Industry website.

⁵⁸⁶ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 51; New South Wales Department of Primary Industries (2012) *NSW Aquifer Interference Policy*.

⁵⁸⁷ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 51; New South Wales Department of Industry Resources & Energy (2015) op. cit.

⁵⁸⁸ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 51; New South Wales Government (2012) *Strategic Regional Land Use Policy*.

⁵⁸⁹ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 51; New South Wales Department of Industry Resources & Energy (2015) op. cit.

⁵⁹⁰ New South Wales Government (2014) *NSW Gas Plan: Protecting what's valuable, securing our future*.

⁵⁹¹ *ibid.*; New South Wales Government (2015) 'NSW Gas Plan – Three More PEL Buy-Backs', Media Release, 6 July

⁵⁹² New South Wales Government (2014) op. cit.

⁵⁹³ EPA (2015) Presentation, 15 September; South Australia Department of State Development (2015) 'Petroleum', DSD website.

⁵⁹⁴ South Australia Department for Manufacturing, Innovation, Trade, Resources and Energy (2012) *Roadmap for Unconventional Gas Projects in South Australia*, p. 145.

⁵⁹⁵ EPA (2015) Presentation, 15 September; South Australia DMITRE (2012) op. cit., pp. 145-6.

The South Australian Government developed a 'Roadmap' in 2012 which considered how unconventional gas projects could best progress.⁵⁹⁶ The Roadmap provided information to people, communities and markets about the potential risks and rewards of an unconventional gas industry.⁵⁹⁷ From this, a Roundtable working group, consisting of companies, peak representative bodies for industries, the environment and indigenous people, universities, media, individuals and key government agencies, was established to develop plans to implement the 125 recommendations made in the Roadmap.⁵⁹⁸

The South Australian Legislative Council's Natural Resources Committee began an inquiry into unconventional gas with a focus on fracking on 19 November 2014. The Committee tabled its interim report on 17 November 2015, and will table its final report in 2016.⁵⁹⁹

7.4.4 Western Australia

Western Australia has a whole-of-government regulatory approach to unconventional gas, with an inter-agency working group established in 2011. This group includes the Departments of Mines and Petroleum, Agriculture and Food, Environment Regulation, Health, Parks and Wildlife, State Development, Water, and the Office of the Environmental Protection Authority.⁶⁰⁰

The Department of Mines and Petroleum is responsible for regulating petroleum which includes assessing environmental plans, works programs, well management plans, safety management systems, safety cases, native vegetation clearing and permit applications.⁶⁰¹ The Department of Environment Regulation is responsible for assessing emissions and discharges, issuing works approvals and licences and managing contaminated sites.⁶⁰² The Department of Water regulates the management of water resources, including the assessment of proposed water wells, taking water licence applications and managing the safe guarding of public drinking water sources.⁶⁰³ Western Australia's EPA performs environmental impact assessments for proposals that are likely to have significant environmental impacts.⁶⁰⁴

⁵⁹⁶ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 49; South Australia DMITRE (2012) op. cit.

⁵⁹⁷ South Australia DMITRE (2012) op. cit.

⁵⁹⁸ *ibid.*, p. 7.

⁵⁹⁹ Natural Resources Standing Committee (2015) *Inquiry into Unconventional Gas (Fracking) Interim Report*, Parliament of South Australia.

⁶⁰⁰ Western Australia Department of Mines and Petroleum (2014) *Natural Gas from Shale and Tight Rocks: An overview of Western Australia's regulatory framework*, p. 11.

⁶⁰¹ EPA (2015) Presentation, 15 September; Western Australia Department of Mines and Petroleum (2015) DMP website; Western Australia Department of Mines and Petroleum (2014) op. cit., p. 10.

⁶⁰² *ibid.*

⁶⁰³ *ibid.*

⁶⁰⁴ EPA (2015) Presentation, 15 September; Western Australia Department of Mines and Petroleum (2014) op. cit., p. 10.

The Western Australian Legislative Council's Environment and Public Affairs Committee began an inquiry on 7 August 2013 into hydraulic fracturing for unconventional gas. The Committee tabled its final report on 17 November 2015.⁶⁰⁵

7.5 Findings and recommendations

The Committee was unable to reach definitive conclusions about whether or not an industry could or should proceed at this time. A contributing factor was that the Committee was not provided with the full range of support that was necessary to fully examine every aspect of the Terms of Reference.

Given the large number of submissions, the complexity of the material, and the range of detailed scientific studies, the Committee sought additional support of an administrative and scientific nature. Late in the process some scientific support was provided, but this was not sufficient to examine and fully test all aspects of the evidence submitted. The Committee was also not able to travel nationally or internationally which particularly impacted on the ability to examine regulatory systems and take evidence from other jurisdictions. In the case of New South Wales and Queensland, it is clear that significant regulatory learnings are available of which the Committee was not able to avail itself fully. The Committee's key finding is that while there are clearly improvements that can be made in Victoria's regulatory system, the Committee is not in a position to point definitively to jurisdictions with better regulation. It is clear further work will have to be done by the Victorian Government.

The Committee finds that the Victorian regulatory system is not currently in a position to effectively manage the potential risks associated with an unconventional gas industry. The Committee supports the conclusions of recent reports, and the views of key stakeholders, that if an industry is to proceed, changes would need to be made to the regulatory framework, particularly with regard to environmental protection, community consultation, health and safety, land access, compensation and land rehabilitation.

To the extent that resources have permitted, the Committee has reviewed the regulatory frameworks in other Australian jurisdictions, specifically the codes of practice pertaining to the industry and suggests that Victoria also formulate codes specific to the industry, if it is determined that it proceed in this state. As stated at the beginning of this Chapter, the following recommendations are not intended to be exhaustive, but to suggest key directions for regulatory reform.

⁶⁰⁵ Standing Committee on Environment and Public Affairs (2015) *Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas*, Parliament of Western Australia; EPA (2015) *Transcript of Evidence*, 15 September, p. 10.

The Committee considered two proposed recommendations: a ban on the unconventional gas industry in Victoria or a five year extension of the current moratorium. The Committee could not reach a majority decision. Notwithstanding this, and the content of any minority reports, the Committee must respond to its terms of reference and therefore makes the following recommendations relating to any future unconventional gas industry, were it to occur in Victoria.

RECOMMENDATION 6: That the Victorian Government provide easier online access to information about exploration licences targeting coal seam gas and petroleum exploration permits targeting tight and shale gas, and in particular:

- (a) update and improve the relevant sections of the Department of Economic Development, Jobs, Transport and Resources website to reflect machinery of government changes to departments
- (b) provide a simplified, more user-friendly interface and more effective search tools
- (c) display the 'Mining Licences Near Me Tool' more prominently on the website.

RECOMMENDATION 7: That, noting that the Committee is not in a position to determine whether a single Act or improvements to the *Mineral Resources (Sustainable Development) Act 1990* and the *Petroleum Act 1998* would result in better regulation, the Victorian Government should look to individual improvements in both Acts and should ensure that:

- (a) community consultation and effective dispute resolution processes are improved
- (b) landholder rights are strengthened and an equitable balance and process between the rights of landholders and mining companies in relation to land access, compensation, and the rehabilitation of land is achieved, noting the Crown owns all mineral resources.

RECOMMENDATION 8: That mandatory environmental impact assessments be required for any coal seam gas, shale and tight gas projects.

RECOMMENDATION 9: That the Victorian Government examine improved consultation with relevant water authorities to enable a more comprehensive assessment of risk to water sources.

RECOMMENDATION 10: That the Victorian Government amend section 32 of the *Sale of Land Act 1962* to ensure that when a person buys land they are made aware of any exploration licences or petroleum exploration permits or retention leases that the land is subject to, by having the licences, permits or leases listed in the section 32 document. Disclosure of any such licences, permits or leases should be accompanied by a plain English explanation.

RECOMMENDATION 11: That the Victorian Government, in consultation with stakeholders, develop an industry-wide code of practice for the exploration, production, and impact management of unconventional gas activities that specifically includes requirements for best practice in:

- (a) well integrity
- (b) hydraulic fracturing activities
- (c) produced water
- (d) fugitive emissions
- (e) well decommissioning and rehabilitation obligations
- (f) baseline and ongoing monitoring.

RECOMMENDATION 12: That in relation to chemicals and additives used in hydraulic fracturing, the Victorian Government should:

- (a) commission research and advice on chemicals, including research to assess the impacts of chemical mixtures used in hydraulic fracturing
- (b) require companies to seek approval for all chemicals proposed to be used
- (c) require full, public disclosure of chemicals approved for use.

RECOMMENDATION 13: That the Victorian Government examine the Queensland GasFields Commission model and other independent bodies in other jurisdictions, to consider establishing a wholly independent, appropriately resourced statutory body that may facilitate information sharing and stronger relationships between landholders, local communities and industry.

8 Unconventional gas and the gas market

8.1 Chapter overview

Chapter Eight, briefly explores the evidence the Committee received about the potential development of an unconventional gas industry in Victoria and its possible impact on the gas market, particularly in relation to the price and supply of gas in this state.

The Chapter begins with a short overview of the eastern Australian gas market, of which Victoria is a part, and current market dynamics. It then considers the ability of unconventional gas to provide a competitive source of energy and non-energy inputs for Victorian industries, in particular for the manufacturing industry. Following the consideration of industry concerns, the Chapter looks at whether unconventional gas has the ability to provide an affordable energy source for domestic consumers.

8.2 Victoria and the eastern Australian gas market

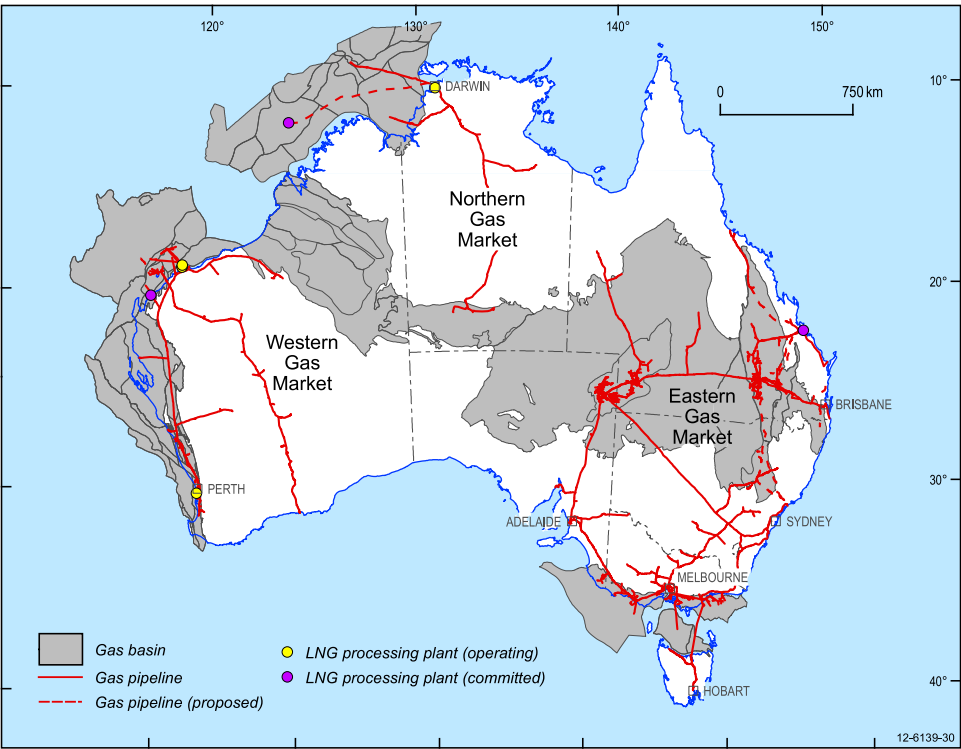
The development of Victoria's large offshore conventional gas reserves (as discussed in Chapter Three) has led to the state being a relatively large user of gas in comparison to other Australian jurisdictions. Gas in Victoria is primarily used for manufacturing and other industrial uses, for home heating and cooking, and for electricity generation in gas-fired power stations.⁶⁰⁶ Victoria also has a relatively well-developed network of gas transmission pipelines.⁶⁰⁷

Victoria is connected by gas pipelines to New South Wales, Queensland, South Australia and Tasmania, and together they form the eastern Australian gas market. In addition to the eastern gas market, there is also the western gas market and the northern gas market. At present, these markets are not connected and are geographically and economically isolated from one another. The three different Australian gas markets, major pipelines, and gas basins are depicted in Figure 8.1. An enlarged image of the eastern Australian gas market and pipelines is depicted in Figure 8.2.

⁶⁰⁶ DEDJTR (2014) 'Opportunities for Gas in Victoria', Energy and Earth Resources website. See also Gas Market Taskforce (2013) *Gas Market Taskforce Supplementary Report*, op. cit., p. 3.

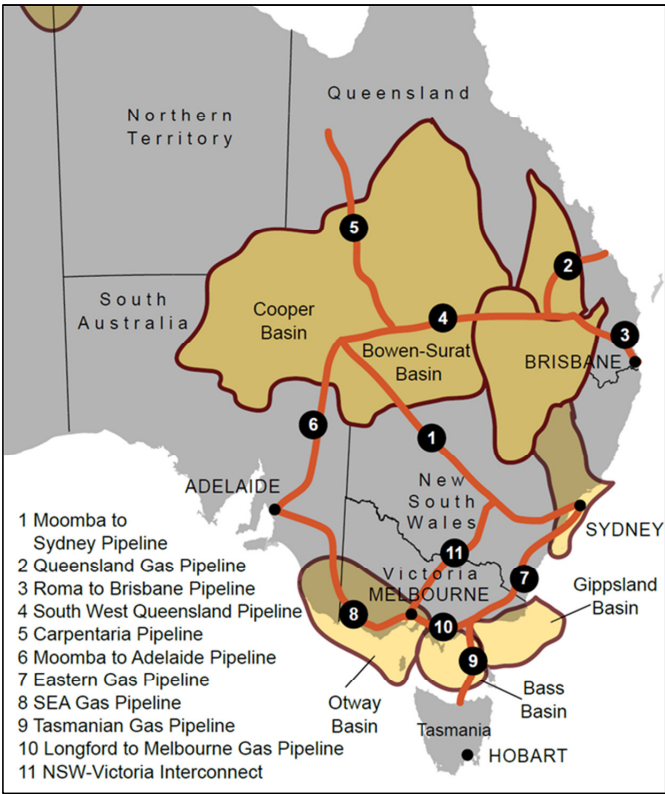
⁶⁰⁷ *ibid.*

Figure 8.1 Australia’s gas markets and key pipelines



Source: Gas Market Taskforce (2013) *Gas Market Taskforce Final Report and Recommendations*, p. 11

Figure 8.2 Major pipelines and gas fields in eastern Australia



Source: T. Wood & L. Carter (2013) *Getting Gas Right: Australia’s Energy Challenge*, Grattan Institute, p. 25.

Until recently, the eastern Australian gas market was purely a domestic market and did not export gas overseas. The price of gas in the eastern Australian market was insulated from international prices and has been comparatively low, and also comparatively stable because of the use of long-term contracts.⁶⁰⁸ As Mr Tony Wood, the Energy Program Director at the Grattan Institute, explained to the Committee:

The east coast of Australia has historically had a balanced gas market. The production of conventional gas from the Gippsland and Cooper Basins has been more than sufficient to meet domestic demand. It has been relatively low cost to develop these resources for a relatively small domestic market. This led to stable wholesale prices of between \$3 and \$4 per gigajoule over several decades.⁶⁰⁹

Eastern Australian gas prices have, however, been increasing over the past few years, which Geoscience Australia and the Bureau of Resources and Energy Economics state is because of a number of factors, including but not limited to the expiration of mature long-term contracts, and increasing network charges to 'reflect rising capital and operating costs of pipeline transmission and distribution.'⁶¹⁰ The most significant occurrence affecting the eastern Australian gas market is the recent commencement of exports from Queensland to Asia.

8.2.1 Liquefied natural gas exports from Queensland

The growth of the CSG industry in Queensland has enabled the export of gas overseas in the form of liquefied natural gas or 'LNG'. The APPEA explains that when natural gas is chilled to minus 161 degrees Celsius, it becomes a liquid which takes up much less space than methane in its gaseous form, and can be exported in purpose built tanker ships.⁶¹¹ The LNG is created by moving gas through a system called an 'LNG train' which cools and compresses the gas, and then loads it onto the ship for export.⁶¹² Gas companies have invested over \$63 billion in constructing the necessary infrastructure to export LNG from the Port of Gladstone in Queensland.⁶¹³ The first LNG tanker departed Gladstone Harbour for Asia in January 2015.⁶¹⁴

8.2.2 Gas price rise

The opening of the eastern Australian domestic market to the Asia-Pacific market is putting upward pressure on domestic prices.⁶¹⁵ The price paid for gas in the Asia-Pacific market is mainly linked (within contracts) to the oil price and is significantly higher than in the eastern Australian gas market. It

⁶⁰⁸ Geoscience Australia & Bureau of Resources and Energy Economics (2014) *Australian Energy Resource Assessment*, second edition, p. 106.

⁶⁰⁹ T. Wood, Grattan Institute (2015) Submission 984, p. 2.

⁶¹⁰ Geoscience Australia & BREE (2014) op. cit., p. 106.

⁶¹¹ APPEA (2014) 'What is liquefied natural gas?' APPEA website.

⁶¹² T. Wood & L. Carter (2013) *Getting Gas Right: Australia's Energy Challenge*, Grattan Institute, p. 5.

⁶¹³ Australian Competition and Consumer Commission (2015) *East Coast Gas Inquiry: Issues Paper*, p. 3.

⁶¹⁴ APPEA (2015) 'World first for Queensland as LNG tanker leaves Gladstone', Media Release, APPEA website.

⁶¹⁵ Geoscience Australia & BREE (2014) op. cit., p. 107.

is expected that domestic prices will continue to rise to meet the ‘netback’ or ‘parity’ price of LNG, which refers to the export price received for LNG without the transport and liquefaction costs.⁶¹⁶ The Productivity Commission states that the extraction of CSG and the linkage of the eastern Australian gas market to the Asia-Pacific market is driving significant and rapid change, with adjustments in prices occurring alongside growth in gas production.⁶¹⁷ Mr Wood informed the Committee that the price of gas in international markets has been as high as \$15-20 per gigajoule, and that:

Linking the Australian gas market to the international market means that domestic gas consumers must now compete with international buyers. If a gas supplier can get \$8-10 per gigajoule (before liquefaction and transport) from an international consumer, why would they choose to supply domestic consumers at \$4 per gigajoule?⁶¹⁸

The Committee notes the difficulty in obtaining clear information about price movements in the eastern Australian gas market. The Australian Energy Market Operator (AEMO) acknowledges that obtaining credible data is an issue in the changing east coast gas market, thus making forecast modelling difficult,⁶¹⁹ and the Australian Competition and Consumer Commission (ACCC) notes that the lack of price information adds to the level of risk and uncertainty felt by industrial gas users.⁶²⁰ AEMO have stated that they are committed to working with industry to improve data quality and transparency.⁶²¹

While acknowledging that forecasting future gas prices is difficult, Mr Wood cited Deloitte Access Economics figures forecasting that domestic wholesale gas prices will peak at around \$9 a gigajoule in 2016 and then fall back to about \$7.50 to \$8 from 2019.⁶²² He said that ‘there appears to be one thing on which all commentators agree: domestic prices will rise.’⁶²³

8.2.3 Impact of gas price rise

The Committee heard that the increase in the price of gas will impact significantly on Victorian businesses and households that rely on gas.⁶²⁴ The Committee received submissions and heard evidence from a number of manufacturing companies and representative bodies that expressed serious concerns about the implications of the gas price rise. These concerns are discussed below in

⁶¹⁶ *ibid.*

⁶¹⁷ Productivity Commission (2015) *Examining Barriers to More Efficient Gas Markets*, p. 43.

⁶¹⁸ T. Wood, Grattan Institute (2015) Submission 984, p. 2.

⁶¹⁹ Australian Energy Market Operator (2015) *Gas Statement of Opportunities for Eastern and South-Eastern Australia*, April, p. 3.

⁶²⁰ ACCC (2015) *East Coast Gas Inquiry: Issues Paper*, op. cit., p. 15.

⁶²¹ AEMO (2015) op. cit., p. 3.

⁶²² T. Wood (2015) Submission 984, p. 2.

⁶²³ *ibid.*

⁶²⁴ See for example: CSR Limited (2015) Submission 105; PACIA (2015) Submission 275; Energy Users Association of Australia (2015) Submission 827; Australian Workers' Union – Victoria Branch (2015) Submission 362; T. Wood (2015) Submission 984.

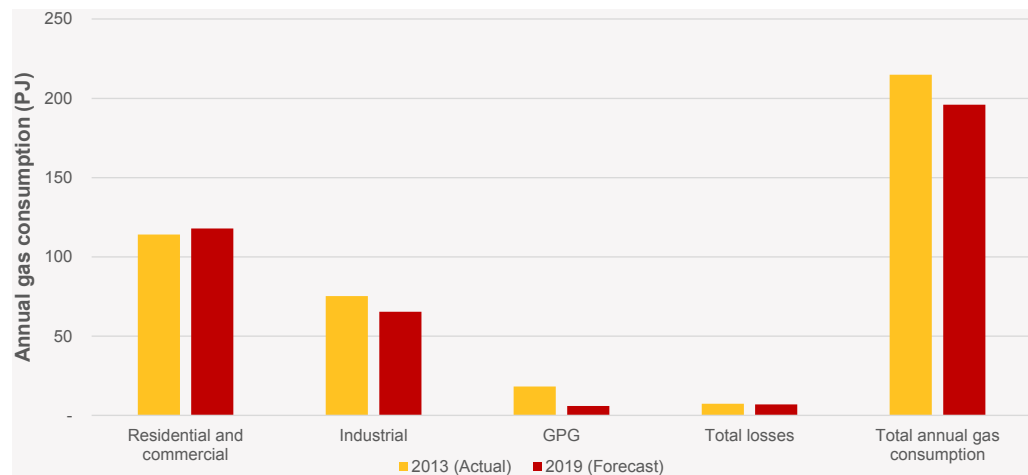
section 8.3. Victorian households use more gas than other Australian states and are particularly reliant on gas for heating. Household gas bills are expected to markedly increase and this is discussed in section 8.4 of this Report.

8.2.4 Supply and demand

The Committee acknowledges that there are different views as to whether there will be a shortage of gas in eastern Australia now that gas has started being exported to Asia. Mr Wood stated that there is no shortage of gas, as 'Australia has more than enough natural gas reserves to supply both the domestic and export markets for many years.'⁶²⁵ The manufacturing company CSR submitted to the Committee that gas prices for Australian businesses will more than double from 2015 and there may be critical gas shortages and outages of 10 or more days.⁶²⁶ Mr Mark Ogge, from the Australia Institute, submitted to the Committee that AEMO has never suggested that there is any risk of a gas shortfall in Victoria over their forecast period. He states that gas will be available but that it will be at the global linked prices.⁶²⁷

The Committee notes that AEMO reported that Victorian gas consumption declined from 217.8 petajoules to 214.9 petajoules between 2010 and 2013.⁶²⁸ AEMO predicted a decrease at an average annual rate of 1.7 per cent for total gas consumption in their short-term forecast (2014-19).⁶²⁹ This is depicted in Figure 8.3 below:

Figure 8.3 Comparison of 2013 (actual) and 2019 (forecast) annual gas consumption



Source: Australian Energy Market Operator (December 2014) *National Gas Forecasting Report for the Eastern and South-Eastern Australian Gas Region*, p. 40.

⁶²⁵ T. Wood (2014) *Gas at the Crossroads: Australia's Hard Choice*, Grattan Institute, p. 5. See also Wood & Carter (2013) op. cit., p. 5.

⁶²⁶ CSR Limited (2015) Submission 105, p. 2.

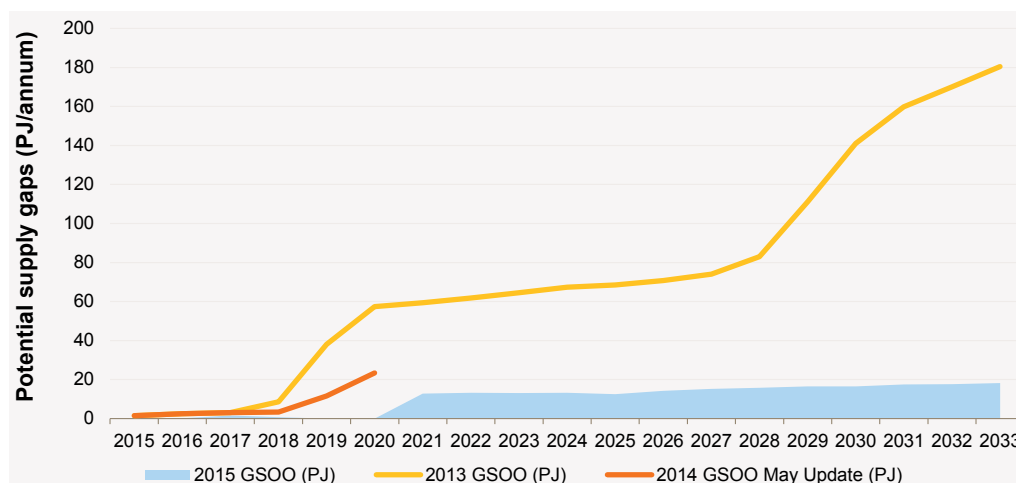
⁶²⁷ M. Ogge, The Australia Institute (2015) Submission 831, pp. 4-6.

⁶²⁸ Australian Energy Market Operator (2014) *National Gas Forecasting Report for the Eastern and South-Eastern Australian Gas Region*, December, p. 40.

⁶²⁹ *ibid.*

The AEMO *Gas Statement of Opportunities for Eastern and South-Eastern Australia* (April 2015) provides forecasts of gas supply gaps over a 20-year period and includes a comparison to gaps forecast in the 2013 and 2014 Gas Statement of Opportunity Reports.⁶³⁰ This is depicted in Figure 8.4 below. AEMO forecast a short, medium and possible long-term supply gap in Queensland, but no other supply gaps in eastern and south-eastern gas markets by the end of 2019.⁶³¹ AEMO concludes that there are sufficient commercially viable reserves and resources available to provide supply for the projected gas demand in the next 20 years.⁶³²

Figure 8.4 Total forecast supply gaps



Source: Australian Energy Market Operator (April 2015) *Gas Statement of Opportunities for Eastern and South-Eastern Australia*, p. 5.

8.2.5 Will developing unconventional gas influence prices?

The Committee heard differing evidence on whether the development of an unconventional gas industry in Victoria would be able to positively impact on the price of gas now that the state is linked to international markets. CSR stated in its submission to the Committee that: 'The development of further gas resources in Victoria will have a highly material and favourable impact on the availability and price of gas, and therefore on the viability of many of our businesses.'⁶³³ The APPEA submission cited the Gas Market Taskforce report's conclusion that:

Victorians should be under no illusions. Rising gas prices will have a negative impact on Victoria's manufacturing base. Jobs and investment are at risk. Costs of living will rise... the only sensible course of action is for the Victorian Government and other eastern states to promote production of additional gas supply.⁶³⁴

⁶³⁰ AEMO (2015) *Gas Statement of Opportunities for Eastern and South-Eastern Australia*, op. cit., p. 5.

⁶³¹ *ibid.*, p. 6.

⁶³² *ibid.*, p. 7.

⁶³³ CSR Limited (2015) Submission 105, p. 3.

⁶³⁴ APPEA (2015) Submission 364, p. 1.

The APPEA submission argued that the link between more Victorian gas and cheaper prices was a straightforward one: ‘Simple economics dictates that the best way to address these pressures is to bring more gas to market.’⁶³⁵ Mr Annells, of Lakes Oil, similarly stated to the Committee that ‘There is talk about more gas making things more expensive, but that is economics 101: you increase supply and the price comes down.’⁶³⁶

However, the Victorian Government inter-departmental submission to the Committee stated that the linkage to international markets means that if Victoria increases the supply of gas it may not lower prices, because it would not be of a sufficient quantity to impact on the international market:

As a general economic principle, increasing supply of a good into a market is expected to create downward pressure on its price. With the start of LNG exports from Queensland, Victorian gas is now part of an international market and increases in Victorian supply would not be expected to have much impact on world supply; the price of gas in Victoria is instead being driven by the international LNG price.⁶³⁷

Mr Mark Feather, the Executive Director of the Energy Sector Development Branch of DEDJTR, gave evidence to the Committee that: ‘For a Victorian gas find to have an impact on those LNG prices, you would have to find a lot of gas, because Victoria is only a very small component in what is an international market.’⁶³⁸ Mr Feather also pointed out, however, that there is work going on more broadly through the COAG Energy Council, within the Government, and the ACCC, in understanding barriers to competition in the eastern gas market.⁶³⁹

The Committee notes that the ACCC is currently conducting an inquiry into the competitiveness and structure of the eastern Australian gas market, and suggests in its issues paper that there may be a number of possible factors influencing the price of gas.⁶⁴⁰ The ACCC states that these factors could include exposure of domestic gas users to international prices; insufficient competition in the supply of gas in eastern Australia; rising costs of exploration, development and production; as well as uncertainty about LNG export volumes and long-term prices.⁶⁴¹ The ACCC also states that ‘Some market participants consider that a move to spot price indexation in long-term gas supply agreements is desirable to ensure a competitive and efficient market for supply of gas.’⁶⁴²

The ACCC further suggests that the historic reliance on long-term, confidential bilateral gas supply agreements in the eastern Australian gas market, has contributed to a lack of transparency in the market and made it difficult to access information.⁶⁴³ The Productivity Commission, in its recent research paper on

⁶³⁵ *ibid.*, p. 18.

⁶³⁶ Lakes Oil (2015) *Transcript of Evidence*, 1 July, p. 5.

⁶³⁷ Government of Victoria (2015) Submission 658, p. 49.

⁶³⁸ DEDJTR & DELWP (2015) *Transcript of Evidence*, 18 August, p. 16.

⁶³⁹ *ibid.*

⁶⁴⁰ ACCC (2015) *East Coast Gas Inquiry: Issues Paper*, op .cit.

⁶⁴¹ *ibid.*, p. 13.

⁶⁴² *ibid.*

⁶⁴³ *ibid.*, p. 15.

the efficiency of the eastern Australian gas market, similarly states that these long-term bilateral contracts between gas producers and gas users are often subject to commercial confidentiality clauses, which makes pricing opaque to third parties.⁶⁴⁴ The ACCC suggests that market reforms could provide for greater information transparency and trading liquidity in the eastern gas market.⁶⁴⁵

8.3 Victorian industries and the gas market

The Committee received evidence from Victorian manufacturing businesses that changes in the eastern gas market, such as rising prices and the difficulties experienced by gas users in securing contracts, are of major concern. Australian Paper (AP), which employs approximately 1200 people at its manufacturing facilities in the Latrobe Valley and Preston, and head office in Mount Waverley, stated to the Committee that:

All of AP's investment and contribution to Victoria is currently at risk due to the failure of the gas markets to provide long-term competitively priced gas to manufacturers and industry. Historically, AP has, along with other major industrial customers, been able to rely upon competitive long-term gas supply contracts to underpin its business and business investment. Such supply contracts are no longer available in the current gas market. Competition to supply AP's gas does not exist and a one-year or two-year supply contract is the best outcome if you can get an offer at all.⁶⁴⁶

CSR, which states that it has seven large manufacturing facilities in Victoria and employs over 1000 people and an additional 200 contractors, explained to the Committee that their manufacturing processes are dependent on gas.⁶⁴⁷ CSR stated that 'ensuring adequate gas supplies are available' will 'be critical to the ongoing competitiveness of manufacturing in the state.'⁶⁴⁸ CSR said to the Committee that issues with gas may affect the continued operation of its Dandenong glass factory:

The CSR Board will need to make a decision in the next two years to invest \$80 million to re-furbish the Dandenong glass factory. The Board is following the issue of gas supply and demand closely and the outcome of this inquiry and the ACCC investigation together with action by Government will be a key input to their considerations. The alternative is to co-invest overseas in new manufacturing capacity or to develop long term supply agreements with overseas suppliers.⁶⁴⁹

The packaging company Orora stated in its submission to the Committee that it had experienced recent increases in the cost of gas which had placed significant upward pressure on their costs. Orora stated that in order to 'ameliorate rising gas prices' it has entered into an agreement with an explorer company to supply

⁶⁴⁴ Productivity Commission (2015) *Examining Barriers to More Efficient Gas Markets*, op. cit., pp. 47-48.

⁶⁴⁵ ACCC (2015) op. cit., p. 15.

⁶⁴⁶ Australian Paper (2015) Submission 648, pp. 1- 2.

⁶⁴⁷ CSR Limited (2015) Submission 105, p. 1.

⁶⁴⁸ *ibid.*, p. 2.

⁶⁴⁹ *ibid.*, p. 3.

gas from a prospective CSG field in the southern Cooper Basin, and that the moratorium in Victoria had discouraged Orora from considering prospective gas suppliers in this State.⁶⁵⁰

The Committee notes that Lakes Oil stated that it has signed provisional agreements with two manufacturing companies – Simplot and Dow Chemical – to supply gas at below market prices. Mr O’Brien of Lakes Oil gave evidence to the Committee that:

...we have signed provisional gas sales agreements with Simplot and Dow to supply gas at less than the market price, because we know we can do it cheaper than everyone else can... They are provisional gas sales agreements, on the provision that we can drill the wells and get the gas to the surface. We have said, ‘As long as we can show that we will sell what we have got to you cheaper than what the market price is’, because they cannot secure those contracts through Esso or other traditional suppliers at the moment. We want to be given the opportunity to prove it. That is what we ask for.⁶⁵¹

8.3.1 Gas as feedstock for manufacturing

The Committee was also informed of the importance to some businesses of using gas as a feedstock in manufacturing. The Committee heard evidence that gas is used as feedstock in the manufacturing of a range of products, such as plastics and polymers, textiles, pharmaceuticals, paints, dyes, cosmetics, pesticides, fertilisers and explosives, and in mineral and metals processing.⁶⁵² The Plastics & Chemicals Industries Association (PACIA) stated in their submission to the Committee that 37 per cent of Victorian industrial gas is consumed for chemical feedstock purposes.⁶⁵³ In their evidence to the Committee, PACIA outlined the diverse variety of uses of gas as a feedstock, including for the production of:

‘fertilisers to increase our agricultural yields; treatments to make our water safe to drink; pipes to transport water and gas and for other reticulation purposes used in agriculture and mining and for residential use; and... advanced packaging products that protect and preserve our food.’⁶⁵⁴

During the Inquiry, the Committee was pleased to have the opportunity to visit Qenos polyethylene plant in Altona to discuss the use of gas as a feedstock first hand.

The Committee heard evidence that for some such manufacturers, there are no alternatives to gas.⁶⁵⁵ PACIA stated to the Committee that ethane and methane are essential feedstock molecules found in natural gas that allow the advanced

⁶⁵⁰ Orora (2015) Submission 646, pp. 1-2.

⁶⁵¹ Lakes Oil (2015) *Transcript of Evidence*, 1 July, pp. 5-6.

⁶⁵² State Government of Victoria (2015) Submission 658, p. 45; PACIA (2015) Submission 275, pp. 3-5.

⁶⁵³ PACIA (2015) Submission 275, p. 4.

⁶⁵⁴ PACIA (2015) *Transcript of Evidence*, 2 September, p. 2.

⁶⁵⁵ *ibid.*, pp. 4-5.

chemistry to occur that is required for the production of a variety of materials and products.⁶⁵⁶ They further stated that these feedstock molecules cannot be substituted in the manufacturing process.⁶⁵⁷

8.4 Victorian domestic consumers and the gas market

The Victorian Government inter-departmental submission to the Committee emphasised the importance of gas to Victorian households. It explains that: 'Victoria has the largest residential gas demand of any Australian state, equivalent to two-thirds of all residential gas consumption in Australia.'⁶⁵⁸ The Victorian Government inter-departmental submission also provides data from the Essential Services Commission, which states that:

... 77 per cent of Victorian households receive gas via the pipeline distribution network and many other households use bottled gas where mains gas is unavailable, or to supplement the mains gas supply. The main household uses of gas are in cooking appliances (ovens, cooktops and barbeques), gas heaters, ducted heating units and hot water systems.⁶⁵⁹

However, Mr Tim Forcey, Energy Adviser at the University of Melbourne Energy Institute, stated to the Committee that research undertaken by the Institute has found that domestic gas use in eastern Australia peaked in 2012 and is now declining. He emphasised that the economics of gas have changed and that it is now cheaper for Victorian households to disconnect from gas and use electricity instead (which is termed 'fuel switching'). Mr Forcey stated that:

The Australian Energy Market Operator is only starting to study gas to electric fuel switching in homes and businesses. Fuel switching has the potential to be a significant phenomenon. Some people can save hundreds of dollars per year by heating their homes with their electric reverse cycle air conditioner instead of using gas. Reverse cycle air conditioners, hot water heat pumps and the induction cooktop are the big three that lead to the all-electric Australian home.

With the wide availability of these efficient electric appliances, there is no longer any economic reason to connect gas to new Australian homes and suburbs. As consumers economically disconnect from the gas grid, those that remain must pay the cost of operating that grid. This leads to what is known as the gas grid death spiral, where fixed charges go up, then some people leave the gas grid, and fixed charges go up again to cover that and so forth.⁶⁶⁰

The submission to the Committee from the Australian Workers' Union (AWU) emphasises the hardship experienced by some Victorian households as a result of increasing gas prices. The AWU stated that: 'Already there have been

⁶⁵⁶ *ibid.*, p. 2.

⁶⁵⁷ *ibid.*

⁶⁵⁸ Government of Victoria (2015) Submission 658, p. 45.

⁶⁵⁹ *ibid.*

⁶⁶⁰ T. Forcey, Melbourne University Energy Institute (2015) *Transcript of Evidence*, 22 July, p. 2.

anecdotal reports of so called ‘energy poverty’ emerging in the state, with lower socio-economic households and pensioners unable to heat their homes during the winter due to escalating and prohibitive gas prices.’⁶⁶¹

8.5 A gas reservation policy?

Some submissions to the Committee suggested that Victoria should introduce a gas reservation policy to ensure that it retains a cost-effective and sufficient supply of gas.⁶⁶² The submission by the AWU stated that increasing gas supply will not lower the price of gas now that eastern Australia is linked with the international market, and advocates that: ‘the Government adopt a regulatory approach that ensures Australia’s gas prices are not completely exposed to a distorted global price. This would be in the form of a gas reservation – or reservation like – policy.’⁶⁶³

The AWU propose that ‘gas exporters would still be permitted to sell Australian gas to foreign nationals at the high global price – but on the condition that a percentage of the gas extracted would have to be reserved for sale at an affordable domestic price.’⁶⁶⁴

The opposing perspective was put to the Committee by Mr Wood who, while expressing sympathy for businesses affected by the rising cost of gas, stated that domestic reservation policies do not prove to be effective in the long term:

... there are a lot of small businesses and small manufacturers in Melbourne and regional Victoria that are seriously being affected by gas price increases. I have enormous sympathy for their situation, but I fail to see that providing a subsidy to domestic gas consumers is necessarily by any means in the interests of the Australian economy. Fundamentally it is just another form of protectionism, and our history suggests that most of the time protectionism does not work. All it does, eventually, as domestic gas reservation policies tend to do, is put up prices and reduce supply in the long term.⁶⁶⁵

8.6 Findings and recommendations

At present, gas is an important energy source for Victorian businesses and households. The eastern Australian gas market, which includes Victoria, is in a state of transition now that exports of LNG have begun to overseas markets. The domestic price of gas is increasing and is impacting on Victorian manufacturers. It is unclear if the development of unconventional gas in Victoria could influence the price of gas in this state, given that there are no identified reserves of

⁶⁶¹ Australian Workers’ Union – Victoria Branch (2015) Submission 362, p. 8.

⁶⁶² For example see: Australian Workers’ Union – Victoria Branch (2015) Submission 362; Moyne Shire Council (2015) Submission 505, p. 3. Also see: PACIA (2015) *Transcript of Evidence*, 2 September, p. 4.

⁶⁶³ Australian Workers’ Union – Victoria Branch (2015) Submission 362, p. 22.

⁶⁶⁴ *ibid.*, p. 24.

⁶⁶⁵ T. Wood, Grattan Institute (2015) *Transcript of Evidence*, 5 August, p. 14.

unconventional gas, the long lead-in time required to develop reserves once they have been identified, and the possibility that the amount of gas would be too low to influence the international price.

The Committee notes that there may be other factors involved in the current challenges facing the gas market. The Committee acknowledges the current ACCC inquiry into the competitiveness of wholesale gas prices and the structure of the gas industry in eastern Australia, and finds that it may have the potential to address some of the concerns expressed by Victorian manufacturers.

RECOMMENDATION 14: That the Minister for Energy and Resources meet with Victorian manufacturers to understand their concerns regarding the supply and increasing cost of gas, and the impact on their businesses.

RECOMMENDATION 15: That the Victorian Government take note and consider the findings of the Australian Competition and Consumer Commission Inquiry into the East Coast Gas Market, which are due to be reported in April 2016.

Committee Room, 26 November 2015.

Appendix 1

List of submitters

- | | | | |
|-----|---|-----|---|
| 1. | Kristin Bitmead | 45. | Jonathan McCarthy |
| 2. | Diane Morris | 46. | Philip Baker |
| 3. | Lynnette Alderson | 47. | Peter Gardner |
| 4. | Pam White | 48. | Wendy Evans |
| 5. | Lee Gladwell | 49. | Peter Roche |
| 6. | Ray Gladwell | 50. | Monica Petterson |
| 7. | Rajeshkumar Patel | 51. | Brad Kijlstra-Shone |
| 8. | Alan Coleman | 52. | John Bowman |
| 9. | Stuart Dalgleish | 53. | Stephen Issell |
| 10. | Neville Larson | 54. | Jeremy Schroder |
| 11. | Dr Matthew Currell | 55. | Elizabeth Ellen |
| 12. | Vanessa Mullin | 56. | Julie Francis |
| 13. | Lois Doeven | 57. | Gippsland Environment Group |
| 14. | Daryl Hook | 58. | Marg Desira |
| 15. | John King | 59. | Graeme Stockton |
| 16. | Andrew Beale | 60. | Jane Gorman |
| 17. | Alexander Arbuthnot | 61. | Martha Hills |
| 18. | Paul Calvert | 62. | Barbara Young |
| 19. | Nikki Thompson and Rob Hann | 63. | Brian Steadman |
| 20. | Kenneth Reid | 64. | Jo Southern |
| 21. | Wayne Somerville | 65. | Australian Medical Association Victoria |
| 22. | Jenny Jeal | 66. | Dr Janeen Samuel |
| 23. | Robert McLean | 67. | Wendy Davis |
| 24. | Brian O'Sullivan | 68. | Dr Fred de Munk |
| 25. | Michael McGarrigle | 69. | Dale Gibbs |
| 26. | Craig Farmer | 70. | Jackson Docherty |
| 27. | Wurdale Landcare | 71. | Patricia de Moulpied |
| 28. | Greg Oates | 72. | Robin Friday |
| 29. | Kim White | 73. | Lynley Manson |
| 30. | Robert Whitaker | 74. | Ann Wingad |
| 31. | Craig Lambie | 75. | Sheridan Guiney |
| 32. | Kylie Richter-Cools | 76. | Warren Sanders |
| 33. | Pro forma F (see Appendix 1.1 for list of names) | 77. | Ian and Marian Cooke |
| 34. | Paul Alexander | 78. | William Reid |
| 35. | Stewart Guthrie | 79. | Steve Winfield |
| 36. | Anne Mulvey | 80. | Pro forma C (see Appendix 1.3 for list of names) |
| 37. | Brian Bowtell | 81. | Danielle Haywood |
| 38. | Lorraine Bignoux | 82. | Raymond Martin |
| 39. | Sunny Wilson | 83. | Gail Barton |
| 40. | Alison Marchant | 84. | Kerry Woodward |
| 41. | Pro forma H (see Appendix 1.2 for list of names) | 85. | Stephen Koci |
| 42. | Robyn McLachlan | 86. | Cathy Cheadle |
| 43. | Tracey McGuinness | 87. | Angela Robinson |
| 44. | Clive and Pamela Newman | 88. | Mordialloc Beaumaris Conservation League Inc |

89. Mark Holman
90. Carolyn Gauci
91. David Holmes
92. Des Bryant
93. Elizabeth Pollock
94. Peter Martin
95. Maureen Verstedden
96. Corangamite Shire Council
97. Queensland Department of Natural Resources and Mines
98. Elizabeth Packett
99. Jeremy Rundell
100. Johanne Walker
101. Leendert van Donk
102. Dr John Bardsley and Wendy Radford
103. Peter Elson
104. Rick and Jenny Robertson
105. CSR Limited
106. Deni Collyer
107. Dr Marisa Schlichthorst
108. Rosemary Faris
109. Jane Marriott
110. Irene Yuill
111. Leonie Guion
112. Susan and Colin Wales
113. Louise McArthur
114. Hilary Brown
115. Don Stokes
116. Nicole Bignoux
117. Michael and Margaret Waddington
118. Michael Quigley
119. Margarita Kumnick
120. Andrew Kumnick
121. Martin Pritchard
122. Jacinta Smith
123. Darrell Morrison
124. James Brown
125. Michelle Hibberson
126. Graeme Biggins
127. Robert and Margaret Vernon
128. Chris Johnson
129. Catherine Vick
130. Robyn Langford
131. Chris O'Reilly
132. Noah Beecher Kelk
133. Kate Shone
134. Jan Morgan
135. Dr Debora Campbell
136. Agribusiness Gippsland
137. Ken Pearce
138. Dot Pearce
139. Bill Frisina
140. Terrie Hall and Ian Fox
141. Cooper Energy
142. Moira Shire Council
143. Tria Manley
144. Bob Weis
145. Graeme Wilson
146. Sustainable Boolarra Group
147. Margaret Byron
148. Peter and Carol McGregor
149. Danielle Anawati
150. Jacinta Hendriks
151. Lyn O'Brien
152. Elisabeth Jones
- 153. Pro forma J (see Appendix 1.4 for list of names)**
- 154. Pro forma G (see Appendix 1.5 for list of names)**
155. Bengworden Landcare Group
156. Owen Hendriks
157. Nicholas Hendriks
158. Keith Rayfield
159. Peter Morris
160. Stina Foster
161. Carl Foster
- 162. Pro forma I (see Appendix 1.6 for list of names)**
163. Melissa Corbertt
164. Queenscliffe Community Association
165. Lucia Rolls
166. Catheryn Thompson
167. Dr Geoffrey Coggins
168. Sylvia Ashcroft
169. Elizabeth Bashford
170. Brian Lawrence
171. Margaret Plowright
172. Jennifer O'Brien
173. Zianna Fuad
174. Laura Williams
175. Doug Phillips
176. Dianne Cascianelli
177. Jean Christie
178. Colin Smith
179. Peter Miller
180. Prue Tipping
181. Helen Phillips
182. Gary Milich
183. Margaret Milich
184. Stavroula Kostarakis
185. Rosalind Ellinger
186. Sally Baldwin
187. Dr Anthony Lunken
188. Jason Virgo
189. Robin B
190. Ramona Headifen
191. Ian Onley
192. John Coverdale
193. Mara Luglio
194. University of Melbourne Energy Institute

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|------|--|------|---|
| 195. | Kate Leslie | 248. | Andrew and Jill Milne |
| 196. | Patricia Fraser | 249. | Mary Rogers |
| 197. | Dr A Barrie Pittock | 250. | Jasmine Beschorner |
| 198. | Liana Beavis | 251. | Tony Hardy |
| 199. | Elizabeth Banks | 252. | Duncan Reilly |
| 200. | G. H Schorel-Hlavka | 253. | Dominic O'Dwyer |
| 201. | Julie Agar | 254. | Noel Will |
| 202. | Gabriel Brennan | 255. | David Metzenthien |
| 203. | Heinz de Chelard | 256. | Jack Doeven |
| 204. | Kate Wattchow | 257. | Connor Jolley |
| 205. | Ingrid de Neve and Mark Wallace | 258. | Maureen Cooper |
| 206. | Gasfield Free Dean Marsh and Bambra Community Group | 259. | Marc De Vecchi |
| 207. | Anunaki Holmes | 260. | Carol Wilmink |
| 208. | David Williams | 261. | Cr Andrew McEwen |
| 209. | Dr Angela Munro | 262. | Don McArthur |
| 210. | Gasfield Free Southwest | 263. | Diamond J Legend |
| 211. | Thomas Rees-Lightfoot | 264. | Dr Amanda Peyton |
| 212. | Georgette Courtenay | 265. | Roy and Elizabeth Stephens |
| 213. | Colin and Jill Frawley | 266. | Gillian Morpeth |
| 214. | Jan Molloy | 267. | Samuel Pottenger |
| 215. | David Tomkins | 268. | Pam Norton |
| 216. | Australian Landscape Trust | 269. | Denyse Menzies |
| 217. | Bruce Hedditch | 270. | Hannah Alquier |
| 218. | C and P Jones | 271. | SRK Consulting |
| 219. | CSG-Free Maffra and Districts | 272. | John Knox |
| 220. | Danniel Bennett | 273. | Pamela French |
| 221. | Diane Lawton | 274. | Harry Cossar-Gilbert |
| 222. | E McKinnon | 275. | Plastics and Chemicals Industries Association |
| 223. | Hadyn Cain | 276. | Anne Simons |
| 224. | Julie Hard | 277. | Lawrence Balshaw-Blake |
| 225. | Leigh Pettingill | 278. | Steven McGlashan |
| 226. | Lesley Briggs | 279. | Sally Stead |
| 227. | Marilyn Rossack | 280. | David Robinson |
| 228. | Paul Bennett | 281. | Eve Stocker |
| 229. | Russell Haslam | 282. | Christine Corbidge |
| 230. | S Galle | 283. | Vince de Simone |
| 231. | David Fenton and Caroline Coggins | 284. | Terry Nelson |
| 232. | Adam and Jennifer Boughton and family | 285. | Michael Rosenbrock |
| 233. | Tamara Taylor | 286. | Trevor Flinn |
| 234. | Dr Jeffrey Butler | 287. | Marc O'Carroll |
| 235. | Bass Coast Shire Council | 288. | Julia Ditterich |
| 236. | Mark Freeman | 289. | Brett Hedger |
| 237. | Robert Taylor | 290. | Ian Jeffries |
| 238. | Sharyn Munro | 291. | Elizabeth Owen |
| 239. | Michael Stanley | 292. | Marian Noga |
| 240. | Frack Free Grovedale | 293. | Maira Van Deur |
| 241. | Michael Scott | 294. | Birgitte Horn |
| 242. | Jill Smith | 295. | Helen Butcher |
| 243. | Brian William McLure | 296. | Josephine Richardson |
| 244. | Bairnsdale Gas Field Free Group - Meerlieu and District branch | 297. | Andrew Tune |
| 245. | Edward Stuckey | 298. | Clare Coney |
| 246. | Margaret Murphy | 299. | ClimActs |
| 247. | Mecrus Resources | 300. | Kurt Liffman |
| | | 301. | Hannah Reid |

302. Save the Planet
303. Fiona Kelly
304. Anna Sowards
305. Theresa Battaglia
306. Simone Dunstan
307. Christopher Everist
308. **Pro forma B (see Appendix 1.7 for list of names)**
309. Harry Barton
310. Meike Zielinski
311. Paul Wayper
312. Dereka Ogden
313. Gasfield Free Bairnsdale
314. Colin and Gwenda Barnes
315. Groundswell Bass Coast
316. Leanne Baker
317. Rainer Maier
318. Jarod Lazzard
319. Dr Russell Peel
320. Peter Flanagan
321. John Jacobs
322. David Archer
323. Mark Lapierre
324. Lois Rayan
325. Latrobe Valley Sustainability Group
326. Alan Distel
327. Lester Congram
328. Helen Pritchard
329. Dandenong Ranges Renewable Energy Association Inc
330. John O'Reilly
331. Coralie Coulson
332. Helen Pereira
333. Judith Goddard
334. Marian (Louise) Lee
335. Linnie Lambrechtsen
336. Jessica Stafford
337. Kongwak Community Group
338. Coal and CSG Free Mirboo North
339. Zachary Casper
340. Jennifer Bishop
341. Lolita Gunning
342. David Myer
343. Jocinda May
344. Thomas Mintsenikos
345. Dr Margaret Lynn
346. Suzanne Brown
347. Craig Walters
348. Alan Thomas
349. Kerri Darby
350. Lorraine Bull
351. Claire McFee
352. David Horner
353. Sarah Martinelli
354. Latrobe City Council
355. Lawrence Reddaway
356. Margaret Lorang
357. Susan Quinn
358. Vicky Shukuroglou
359. Linda Dal Castello
360. Rick Shulver
361. Ulla Taylor
362. The Australian Workers' Union (AWU), Victorian Branch
363. Hayley Rundell
364. APPEA
365. Minerals Council of Australia
366. Eeon Macaulay
367. Kerry Johnson
368. Aira Firdaus
369. Julie Corridon
370. Bruce Campbell
371. Phil Coyne
372. Tamara Kruger
373. Rachel Chiodo
374. Sue Ganz
375. Nic and Amy Paul
376. John Millane
377. Beyond Zero Emissions Inc.
378. Robert Nolan
379. Pauline Aw
380. Louise Shepherd
381. Gaye Cooper
382. Colin and Lorraine Brimblecombe
383. Richard Schurmann
384. Peter Millard
385. Peter Halcombe
386. Tegan Kop
387. Leah Wendt
388. Voices of the Valley
389. Wayne Saunders
390. Virginia Shering
391. Vincenzo De Simone
392. Vicki Jans
393. Lock the Gate Victoria
394. Una Allender
395. Trevor Caldwell
396. Heather Richardson
397. Michael Danne
398. No Gasfields for Birregurra
399. Laura Brackley
400. Environment Victoria
401. Simon Kennedy
402. CLIMARTE
403. Henry Leschen
404. Catharina Cook
405. Peter Grenfell
406. Gail Cartwright
407. Carmen Vido
408. Dr Murray Frazer

409. West Gippsland Catchment Management Authority
410. Bill Bennett
411. Julie Constable
412. Margaret Rolfe
413. Suzanne Giacometti-Kingston
414. CSG Free Bass Coast
415. Glenelg Shire Council
416. Doctors for the Environment Australia
417. Roosendaal Farm
418. Pamela Reeves
419. Absolution Ecology
420. Marie Gibson
421. Karen Fitzpatrick
422. Jane Brownrigg
423. Dr David Harding
424. Geraldine Bagwell
425. Victorian Trades Hall Council
426. Gasfield Free Seaspray
427. Daan Spijjer
- 428. Pro forma D (see Appendix 1.8 for list of names)**
429. Rod and Ann Ebbott
430. Thomas Clarke
431. Margaret Gaita
432. Julie and David Boulton
433. CSG Free Kongwak
434. Michael Howes
435. Anda Banikos
436. Jo Livermore
437. Gerry Dunlop
438. Louise Nicholas
439. Malcolm Hansford
440. Robert Packett
441. Paul Batey
442. Nick Brodribb
443. Daniel Smith and Susan Peel
444. Simon and Louise Manifold
445. Ute Mueller
446. Tim Frazer
447. Quoc An Bui
448. Janet Watson Kruse
449. B Phillips
450. Bessie Tyers
451. Australian Academy of Technological Sciences and Engineering
452. Debbie McIntyre
453. Dr Michelle Sherriff
454. Leon Furze
455. Linda O'Hara
456. Jan Cosser and Guy Gilbert
457. Robert Brown
458. Golden Plains Shire Council
459. Robin James
460. LIVE (Locals into Victoria's Environment)
461. Larissa Gardiner
462. Michael Gooch
463. Danielle Wilson
464. Andrew Laird
465. Surf Coast Air Action Inc.
466. Friends of the Earth
467. Naomi Halpern
468. Karen Large
469. Denise Schimana
470. Pamela Fyfe
471. Victorian Farmers Federation
472. Port Phillip City Council
473. Northern Alliance for Greenhouse Action (NAGA)
474. Elke Nicholson
475. Dorelle Davidson
476. David Lamb
477. Damian Thrum
478. Beach Energy
479. Peter Foot
480. Barbara and Alistair Hopkins
481. The Australian Living Earth Centre
482. Debra Fowler
483. Chris Wilson
484. Surf Coast Shire Council
485. Jane Donaldson
486. Clara Davies
487. Elvyn Dear
488. Katharine Wheldrake
489. Lesley Goodge
490. Elaine Jones
491. George Laird
492. Sue Stevens
493. Shiona Berry
494. Helen Hilll
495. Baw Baw Sustainability Network
496. Dr Peter Laird
497. Janet Howie
498. Phil Langdon
499. Brendan Gray
500. Andrew Ellery
501. Petroleum Exploration Society of Australia Ltd (PESA)
502. Lynda Britten-Epworth
503. Andrew Harrison
504. Barwon Region Water Corporation
505. Moyne Shire Council
506. Angela Crunden
507. Michael Blackam
508. Debra King
509. Maggie Riddington
510. Lakes Oil N.L.
511. Neil Longmore
512. Regnan Governance Research and Engagement

- | | | | |
|-------------|---|-------------|--|
| 513. | Mornington Peninsula Shire Council | 566. | Brett Drayton |
| 514. | Meredith Luke | 567. | Ivor Graney |
| 515. | Pro forma E (see Appendix 1.9 for list of names) | 568. | David Cooper |
| 516. | Sara Vidal | 569. | Francine Bell |
| 517. | Anne Denham | 570. | Anna-Marie Callil |
| 518. | Kendall Lovett | 571. | Stephen and Lee Storti |
| 519. | Ed Sloane | 572. | Kerry Picard-Arnott |
| 520. | Warrnambool Unfrackabools | 573. | Norman and Susan De Silva and Family De Silva |
| 521. | Jane Hildebrandt | 574. | Nicole Merzliakov |
| 522. | Chris Solum | 575. | Marg Thomas |
| 523. | Peter Negus | 576. | Tony Peck |
| 524. | Emily Smith | 577. | Peter Collins |
| 525. | Anne Burley and Rupinder Singh | 578. | Dr Geralyn McCarron |
| 526. | Bronwyn Plarre | 579. | Bernadette Tapscott |
| 527. | Emma Bitmead | 580. | Jim Walker |
| 528. | Jocinda May | 581. | Sarah Fox |
| 529. | Jocelyn Meyer | 582. | Mamia Shukuroglonu |
| 530. | Leigh Coggins | 583. | Jeremy Klitzing |
| 531. | Haydn Barling | 584. | Michael Harris |
| 532. | Elsbeth Ferguson | 585. | Steven Marshall |
| 533. | Joel Gross | 586. | Nola Wilmot |
| 534. | Maxwell James Smith | 587. | Dian Bedggood |
| 535. | Elizabeth Fenton | 588. | David Keith Arnault |
| 536. | Amanda Hack | 589. | Barbara White |
| 537. | Ian Clarke | 590. | Geoff Ellis |
| 538. | Victor Nanut | 591. | Hannah Capon |
| 539. | Joanne Ford | 592. | Lisa Habermann |
| 540. | Trude Ellingsen | 593. | Carolyn Davey |
| 541. | Rev Jim Houston | 594. | Keith Field |
| 542. | John Turner | 595. | Janet Cameron |
| 543. | Sam Washington | 596. | Pro forma A (see Appendix 1.10 for list of names) |
| 544. | Dawn Kneen | 597. | Andrew Pettingill |
| 545. | Sue Andderson | 598. | Bayside Climate Change Action Group |
| 546. | Madeline Maitri | 599. | Beth Ripper |
| 547. | Mike Cleeland | 600. | Chris McGrath |
| 548. | Marguerite Marshall | 601. | Greater Geelong City Council |
| 549. | Diana and Sandra Svendsen | 602. | Doug Yuill |
| 550. | David Martin | 603. | Edwin Jones |
| 551. | Leah Sestokas, Amber Sestokas and Aidan Sestokas | 604. | Elaine Brogan |
| 552. | Nick Clarke | 605. | Gail Noble |
| 553. | Terry Swalwell | 606. | Government of Western Australia |
| 554. | Tasmin Kelly | 607. | Hilary Turner |
| 555. | Maggie and Gary Evison | 608. | Jan Ken |
| 556. | Elizabeth Horner | 609. | Rebecca Clarke |
| 557. | Bernice Davies | 610. | Vicki Cochrane |
| 558. | Peter Callender | 611. | Avril Lambert |
| 559. | Kelly McLean | 612. | Martin Demosthenous |
| 560. | Danial Murphy | 613. | Buloke Shire Council |
| 561. | Catherine Hearse | 614. | Andrew Snook |
| 562. | James and Fiona Whale | 615. | Emeritus Professor Malcolm Skilbeck AO |
| 563. | Josephine Lester | 616. | Yarragon and District Community Association |
| 564. | Neil Barraclough | 617. | Neville Chapman |
| 565. | South Gippsland Landcare Network | | |

618.	Allan Pratt	672.	Anna Murphy
619.	Dr Helen M Connell	673.	Anne Elvey
620.	Caroline Bitmead	674.	Annette Madden
621.	Suyin Anson	675.	Annie Toller
622.	Kate Soulsby	676.	Ann-Marie Ingeme
623.	John and Beryl Langer	677.	Anthea Mereweather
624.	Jan McCann	678.	Anthony Gleeson
625.	Dr Nancy McMurray	679.	Anthony Willacy
626.	Robert Messenger	680.	Athena Jeeson
627.	Janene Swalwell	681.	Bill Pemberton
628.	Dr Katrina Swalwell	682.	Bob Rich
629.	Ian and Gay Cornthwaite	683.	Bonnie Draeger
630.	Anne Young	684.	Britta Klingspohn
631.	Robyn Muller	685.	Bron Jones
632.	Ebony Yuill	686.	Bruce Hedge
633.	National Toxics Network Inc.	687.	Bruce Wyatt
634.	Peter Eynaud	688.	Cam Gould
635.	Peter Moir	689.	Carli Reeve
636.	Julie Tyrrell	690.	Caroline Cox
637.	Wattlebank Community Group	691.	Carolyn Hanna
638.	Eve Fisher	692.	Charles Sowerwine
639.	Gillian Laland	693.	Chris Trueman
640.	Dr George Carman	694.	Christine Banks
641.	Rob and Sharon Rentsch	695.	Christine Simpson
642.	Iain Donald	696.	Christine Hopper
643.	Susan Healy	697.	Christine Hamilton
644.	Julian Cook	698.	Colin Smith
645.	Jill Poulson	699.	Colin Long
646.	Orora Ltd	700.	Colleen Brown
647.	Halliburton	701.	Craig Webb
648.	Australian Paper	702.	Craig Mildwaters
649.	David Rothfield	703.	Cyndi Dawes
650.	Neil Phillips	704.	Daniel Diesendorf
651.	Jane Touzeau	705.	Daniel Monaghan
652.	Shire of Campaspe	706.	Danielle Smelter
653.	Amanda Smith	707.	Darrell Morrison
654.	Verity Tuck	708.	David Hollis
655.	Vicki Perrett	709.	David Dawson
656.	Craig Carpenter	710.	David Doe
657.	Goulburn-Murray Water	711.	David Dawson
658.	Interdepartmental Submission, Government of Victoria	712.	David Capon
659.	Sarah Myhill	713.	David Vernon
660.	Alastair Leith	714.	David Feith
661.	Alex Schlotzer	715.	Deearne Nicholson
662.	Alice Bleby	716.	Denise Murray
663.	Alice Woodruff	717.	Don Tylee
664.	Dr Alison Ashburner	718.	Dorothy Howes
665.	Andrea Brown	719.	Douglas Pretsell
666.	Andrea White	720.	Dr Martin Playne
667.	Andrea Buckley	721.	Elizabeth Chivell
668.	Andrew Conley	722.	Erika Kotsiakos
669.	Andrew Creek	723.	Frederick Tropp-Asher
670.	Andy Hook	724.	Freya Headlam
671.	Ann Shenfield	725.	Gabriel Fuller

726.	Gary Rundell	780.	Maureen Campbell
727.	Glenn Michael	781.	Maureen Corbett
728.	Graham Parton	782.	Max Sargent
729.	Hannah Dickinson	783.	Megan Fallon
730.	Helen Henry	784.	Meredith Newman Debens
731.	Helen Downie	785.	Michael Wauchope
732.	Ian Robinson	786.	Mik Weir
733.	Jackie White	787.	Mike Redfern
734.	Jacquie Kelly	788.	Monica Winston
735.	James Fahy	789.	Murray and Alison Clarke
736.	Jamie Crickmay	790.	Nickee Freeman
737.	Jan Wild	791.	Noel Wyndom
738.	Jane Leitinger	792.	Pat Yodo
739.	Jane Ormonde	793.	Patricia Simmons
740.	Jane Moulin	794.	Patricia Fraser
741.	Janet Hall	795.	Patrick Pheasant
742.	Jason Watt	796.	Patrick Bird
743.	Jeffrey Booth	797.	Paul Leitinger
744.	Jennifer Forest	798.	Peter McDonald
745.	Jenny Tame	799.	Peter Mewett
746.	Jenny Barrett	800.	Phil Baulch
747.	Jenny Gardner	801.	Raymond McNeil
748.	Jerome Winston	802.	Rebecca Rosario
749.	Jesseka Chadderton	803.	Julie Dingle
750.	Jessie Arnold	804.	Dr Richard Petheram
751.	Jill Redwood	805.	Nalin Arileo
752.	JJ Miller	806.	Mark De-La-Warr
753.	Jo Elvins	807.	Gill Fox
754.	John Graham	808.	Tanya Laird
755.	John Chadderton	809.	Kirra Boulton
756.	John Nihill	810.	Victor Aeberli
757.	Judy Cameron	811.	The Norwood Resource
758.	Julie Bain	812.	Elizabeth Balderstone
759.	Justin Teague	813.	Lorraine Halabarec
760.	Justin Wiseman	814.	Kirsty Irving
761.	Karen Thomas	815.	Deborah Bunce
762.	Karina Hogan	816.	Moreland City Council
763.	Kate Ormonde	817.	Chloe Aldenhoven
764.	Katherine Copsey	818.	Adele van Rosmalen
765.	Ken Savage	819.	Frac Free East Gippsland
766.	Kimberley Nightingale	820.	Friends of the Gippsland Lakes Parks and Reserves
767.	Kym Monaghan	821.	Commonwealth Department of Industry and Science
768.	Leanne Holmes	822.	Manufacturing Australia
769.	Lesley Walker	823.	Colac Otway Shire
770.	Linley Walker	824.	Alternative Technology Association
771.	Louise Simmons	825.	Moynes Shire Council
772.	Louise Avery	826.	Joan Kinnon
773.	Louise Sharp	827.	Energy Users Association of Australia
774.	Maggie Morgan	828.	Australian Water Association
775.	Margaret Young	829.	Energy Supply Association of Australia
776.	Margaret Ryan	830.	Jan van de Graaff
777.	Marian Smedley	831.	The Australian Institute
778.	Marie-Anne Cooper	832.	Malcolm Rowe
779.	Mark Lapierre		

833.	Joan Lindros	887.	Kate Dumas
834.	Wendy Saphin	888.	Sweet View Farm
835.	Australian Pipelines and Gas Association	889.	Sally Mathrick
836.	Australian Food and Grocery Council	890.	Ben Cram
837.	Environmental Justice Australia	891.	Anne Daw
838.	Sally Newell	892.	Ben Courtice
839.	SRK Consulting (Australasia) Pty Ltd	893.	Christine Price
840.	Indigo Shire Council	894.	Dr Catherine Pye, Dr Clive Carlyle and Ms Sharon Holmes
841.	Environment Protection Authority Victoria	895.	Roger Thorrowgood
842.	Not Available	896.	Frank O' Shanassy
843.	Australian Dairy Industry Council	897.	Chris Bitmead
844.	Jason Harris	898.	Victorian Water Industry Association
845.	Syd Whyte	899.	Paula Greenough
846.	K. McMahon	900.	Andrew and Linda Corcoran, Gayle Margaret, Peter Ramon
847.	Ken Blackman	901.	Elizabeth Haughton
848.	Lana Eichler	902.	Jacqui Walker
849.	Matthew Winkler	903.	The Portland Field Naturalists Club
850.	Nic and Amy Paul	904.	Gippsland Gas
851.	Nola Kelly	905.	Katherine Smyrk
852.	Origin Energy	906.	Ruth Glass
853.	Reginald and Olive Waltham	907.	Jo Livermore
854.	Rachel Wilson	908.	Armour Energy Limited
855.	Robert Hodgetts	909.	Kathryn Senko and Graham Talmage
856.	Rod Clark	910.	Apollo Bay Community Against Fracking
857.	Rural City of Wangaratta	911.	Avril Baxter
858.	Tony Woolford	912.	Energy Australia
859.	Tracey Tanner	913.	Kees Doggerand Michelle Lee-Dogger
860.	V.J. Reschke	914.	Rosemary Maher
861.	Wal Grahame	915.	Rick Molloy
862.	David and Sarah Minifie	916.	John Frayne
863.	Alison Leahy	917.	Chris Brand
864.	Barwon Paediatricians	918.	Nola Anderson
865.	Charles Morris	919.	Julie Wallace
866.	Name Withheld	920.	Lindy Brand
867.	Climate Change Our Future	921.	John and Leanne Hanrahan
868.	Hilary Da Costa	922.	Centre for Climate Safety
869.	Frack Free Geelong	923.	Catherine Money
870.	Geelong Sustainability Group	924.	Peter Smee
871.	Jillian Sokol	925.	The Global Foundation for Sustainable Communities
872.	Limestone Coast Protection Alliance Inc	926.	Ann McAlpin
873.	Municipal Association of Victoria	927.	John Gray
874.	Helena MacLaughlin	928.	Lana Kagan
875.	Otway Conservation Association Inc	929.	Dr Sam Long
876.	Priscilla Brady	930.	Jane Trengove
877.	Process Consultants Pty Ltd	931.	Janine Strachan
878.	Sebastian Richards	932.	Sean Marsh
879.	Debbie Carruthers	933.	Nigel Heywood
880.	Paul K. Smilich	934.	Lyn Worcester
881.	Naomi Grant	935.	Dean O'Callaghan
882.	Paul and Krysalis Wizard	936.	CSG-Free South Gippsland
883.	Marek Morgan	937.	Jessica Jones
884.	Deborah Murrell	938.	Sustainable Boolarra Group
885.	Harin De Soysa		
886.	Sue Behrent		

- | | | | |
|------|--|-------|---|
| 939. | Dr Alphonse Benoit | 992. | Simone Hill |
| 940. | Nelson Brand | 993. | Sophie Gebhardt |
| 941. | Sophie Brand | 994. | Spiridon Fragopoulos |
| 942. | Sandra Cutts | 995. | Stephanie Johnston |
| 943. | Phoebe Brand | 996. | Steven Ronaldson |
| 944. | Jillian Thio | 997. | Sunny Wild |
| 945. | Name Withheld | 998. | Susan Meyer |
| 946. | Nicki Jennings | 999. | Taffy Avarð |
| 947. | Name Withheld | 1000. | Dr Tass Holmes |
| 948. | Damien Shell | 1001. | Thomas Sounness |
| 949. | Name Withheld | 1002. | Tom Bolton |
| 950. | John Jenkyn | 1003. | Tony Ennis |
| 951. | Name Withheld | 1004. | Trevor Hoare |
| 952. | Mark Tethington | 1005. | Trish Jardine |
| 953. | Australian Nursing and Midwifery Federation | 1006. | Tristarnya Sheridan |
| 954. | Kongwak Hills Landcare Group | 1007. | Ulla Killury |
| 955. | Peter Couch | 1008. | Victoria Smith |
| 956. | Tony Goodfellow | 1009. | Wendy Radford |
| 957. | Claire McKinnon | 1010. | Name Withheld |
| 958. | Martin Boyer | 1011. | Zoe Glen-Norman |
| 959. | David Franklin | 1012. | Katherine Moore |
| 960. | Gabriella Hont | 1013. | Melinda Venticich and Simon Ransome |
| 961. | The Clean Food Garden | 1014. | Helen Boyer |
| 962. | Cheryl Mainard | 1015. | Dr Barbara Hoare |
| 963. | Stuart Jones | 1016. | Billy Greenham |
| 964. | Peter Campbell | 1017. | Bernie McComb |
| 965. | Brigit Skilbeck | 1018. | Katherine Cunningham |
| 966. | Suzie Gold | 1019. | Peter Wonfor |
| 967. | Helena Lewers | 1020. | Jennifer Carter |
| 968. | Jeanette and Rex Blennerhassett | 1021. | Sharon Wright |
| 969. | Robbie Frawley | 1022. | Sylvia Collett |
| 970. | Erin Callahan | 1023. | Kathleen Dangerfield |
| 971. | Sally North | 1024. | Anthony Walker |
| 972. | Jim Macgugan | 1025. | Lynn Hofmann |
| 973. | International Association of Hydrogeologists | 1026. | Sarah Linton |
| 974. | Rebecca Rosario | 1027. | SACA (Sustainable Agriculture and Communities Alliance) |
| 975. | Surf Coast Air Action | 1028. | Gary Goodwin |
| 976. | Rev Dr Richard Mallaby | 1029. | Daryl Simkin |
| 977. | Rhonda Attwood | 1030. | Mike Robinson-Koss |
| 978. | Richard Purdy | 1031. | Susan Holberton |
| 979. | Rob Skillern | 1032. | Irene Proebsting |
| 980. | Robert Dart | 1033. | Rebecca Reid |
| 981. | Roger Prowd | 1034. | Trevor and Dianna Flint |
| 982. | Roslyn Leary | 1035. | Chali Banney |
| 983. | Russell Edwards | 1036. | Miranda Hill |
| 984. | Grattan Institute | 1037. | John Poppins |
| 985. | Sally Warmington | 1038. | Gillian Vanyai |
| 986. | Sandie LaVaughn | 1039. | Chelsea Heights EarthCarers |
| 987. | Sandra Hawkins | 1040. | Naima Fine |
| 988. | Sarah Dowling | 1041. | The Wilderness Society Vic Inc |
| 989. | Sarah Charlton | 1042. | Lighter Footprints |
| 990. | Scott Campbell-Smith | 1043. | Brenton Rittberger |
| 991. | Simon Thornton | 1044. | Janyne Rees |
| | | 1045. | Bronwyn Mibus |

- 1046. Ruth Caluzzi
- 1047. Gary Price
- 1048. Robert and Gloria Foard
- 1049. Paul B. Kumnick
- 1050. Southern Otway Food Co-operative
- 1051. David Charleson
- 1052. Lucy Foley
- 1053. Graeme Webb
- 1054. Susan Moss
- 1055. Tracey Anton
- 1056. Peter Sublet
- 1057. Dr Pat Phair
- 1058. Margaret Young
- 1059. Alice Irving
- 1060. Roslyn Webb
- 1061. Wendy Leitmanis
- 1062. Damien Pitts
- 1063. Pat Purcell
- 1064. Prof. Andrew Garnett, University of
Queensland, Centre for Coal Seam Gas
- 1065. Jenny Stielow
- 1066. Kate Lidgerwood
- 1067. Jan Earthstar
- 1068. Charlie Davey
- 1069. T. Rawlings
- 1070. Prof. Paul O'Brien
- 1071. Johannes denToom
- 1072. Prof. Samantha Hepburn
- 1073. Garry Owers
- 1074. Lyn Hovey
- 1075. Annabelle Gumpold
- 1076. Pro forma K (see Appendix 1.11 for list
of names)**
- 1077. Elaine Furniss
- 1078. Condah Groundwater Users Committee
- 1079. Lorraine Watt
- 1080. Wendy Klason
- 1081. Chris McPherson
- 1082. Jenny Jeal
- 1083. John Graham
- 1084. Maree Goodwin and Lorraine Halabarec

Appendix 1.1 Pro forma F Submitters

1085.	Rhys Schulze	1088.	Peter Koster
1086.	Janna Everett	1089.	Andrew Fox
1087.	Jared Anskaitis		

Appendix 1.2 Pro forma H Submitters

1090.	Biranna Stock	1092.	Brendon Thomson
1091.	John and Cynthia Lyons	1093.	Julian Cook

Appendix 1.3 Pro forma C Submitters

1094.	J Robinson	1102.	Alan Broughton
1095.	Elizabeth Bates	1103.	Ann Patterson
1096.	Peta Fisher	1104.	Mark Blandford
1097.	J & P Fleming	1105.	Debbie Jackson
1098.	Angie Derham	1106.	Andrew McArthur
1099.	Geoffrey Bates	1107.	Louse McArthur
1100.	Chris Stubbs	1108.	Kaye and Robert Hoffman
1101.	David Bourke		

Appendix 1.4 Pro forma J Submitters

1109.	Geoffrey Pittaway	1115.	Pam Benjamin
1110.	Michael Smith	1116.	Peter Benjamin
1111.	Julia Smith	1117.	Suzanne Wightman
1112.	Owen Casson	1118.	Glenys Pentland
1113.	Diane Beyer	1119.	Tracey Fraser
1114.	Carina Beyer		

Appendix 1.5 Pro forma G Submitters

1120.	Suzanne Bitmead	1123.	Freya Morris
1121.	Lisa Kirwan	1124.	Verity Tuck
1122.	Jo Harrison		

Appendix 1.6 Pro forma I Submitters

1125.	David Yates	1127.	Lynnette Yates
1126.	CK Bond	1128.	Susan Deery

Appendix 1.7 Pro forma B Submitters

1129.	Claire Halliday	1142.	Caroline Clarke
1130.	Wendy Morris	1143.	Janina King
1131.	Paul Gadsby	1144.	Kevin Harbison
1132.	Philip Waters	1145.	Kate Ferguson
1133.	Andrew McKinnon	1146.	Helen Karpas
1134.	Sherridan McDonald	1147.	Julie Gelman
1135.	Julie Stephens	1148.	Kerry Bourke
1136.	Lisa Minchin	1149.	Maureen Pearl
1137.	Anita Hannaford	1150.	Owen Smith
1138.	Sian Bloom	1151.	Peter Margrie
1139.	Robin Massey	1152.	Rachel Diffey
1140.	Rick Shulver	1153.	Jacqueline Berry
1141.	James Lockwood	1154.	Darian Zan

1155. Janet Burchill
1156. Louise Harvey
1157. Karen Coffield
1158. Ellen Fox

1159. Helen McKinnon
1160. Carol Dyer
1161. Bryan Baldwin

Appendix 1.8 Pro forma D Submitters

1162. S & L Souther
1163. Lesley Briggs
1164. Steven and Fiona Collins
1165. Ellen Burton

1166. Pauline Fry
1167. Hamish Southerland
1168. Helen Newman

Appendix 1.9 Pro forma E Submitters

1169. A & M Lange
1170. B Hepburn
1171. Marissa Mahon
1172. Jim Cleary
1173. Will Wolseley
1174. Ken Stevenson

1175. Julian Knox
1176. Lorelle Sunderland
1177. Maureen Shivel
1178. Barry Schulze
1179. L & J Grossman

Appendix 1.10 Pro forma A Submitters

1180. Abdul Baig
1181. Adam Quennell
1182. Adam Watson
1183. Adrian Francis
1184. Adrian Rachele
1185. Aidan Macdougall
1186. Aidan Matuschka
1187. Ailsa Jean
1188. Akarsini Ashman
1189. Alan Leenaerts
1190. Alex Breskin
1191. Alex Byrne
1192. Alex Delaney
1193. Alex Lindeman
1194. Alexandra Bhathal
1195. Alia Swift
1196. Alice Burns
1197. Alisa World
1198. Alison MacGregor
1199. Allison Harvey
1200. Amy Lampugnani
1201. Ana Gioino
1202. Andrea Frisby
1203. Andreas Katsineris-Paine
1204. Andrew Godall
1205. Andrew Nielsen
1206. Andrew Pepløe
1207. Andrew Pollitt
1208. Andrew Steward
1209. Andy Shanahan
1210. Angela Smith
1211. Angela Watson

1212. Ann Abrahmsen
1213. Ann McGovern
1214. Anna Haines
1215. Annabel Davy
1216. Annaisse Novak
1217. Anne Boyd
1218. Anne Caughey
1219. Annette Brooker
1220. Annette Herschtal
1221. Annie Crane
1222. Annie Leschen
1223. Anthony Day
1224. Anthony Hamilton-Smith
1225. Anthony Reid
1226. Anthony Williams
1227. Arisja Oberholzer
1228. Arnold Greiner
1229. Ashley Voigt
1230. Bartolomeo Verduci
1231. Basil Eliades
1232. Ben Cronly
1233. Ben Leunig
1234. Bernard Abadie
1235. Bernard Rowley
1236. Bernard Silvey
1237. Bethann Taylor
1238. Bethany Ong
1239. Betty Breneizeris
1240. Bev Cowan
1241. Bev Isaac
1242. Bianca Mellor
1243. Bill Bradley

1244.	Billy Fox	1298.	Damian Thrum
1245.	Billy Price	1299.	Damien Moir
1246.	Bing Escalante	1300.	Damien Stevens
1247.	Bobbie French	1301.	Daniel Voronoff
1248.	Brett Ford	1302.	Danielle Charlery
1249.	Brian Earl	1303.	Danny Blay
1250.	Brian McGennicken	1304.	Dave Gregurke
1251.	Brian Reed	1305.	David Birrell
1252.	Brian Salter-Duke	1306.	David Brumley
1253.	Brooke Roberts	1307.	David Crouch
1254.	Bruce Howlett	1308.	David Graham
1255.	C Caleo	1309.	David Weinstein
1256.	Caitlin Pheasant	1310.	Dayalan Ramasamy
1257.	Callum Irving	1311.	Debra Millard
1258.	Calum Davies	1312.	Declan Jones
1259.	Can Okyar	1313.	Denise Smallwood
1260.	Candace O'Neill	1314.	Derek Wilson
1261.	Carmel Green	1315.	Diana Ward
1262.	Carole Nugent	1316.	Dianne Johnstone
1263.	Carolyn Haywood	1317.	Dianne Mark
1264.	Carrie Templeton	1318.	Dianne Stephens
1265.	Casandra Upton	1319.	Django van Tholen
1266.	Casey O'Brien	1320.	Domenico de Pieri
1267.	Catherine Lance	1321.	Dominique Plumanns
1268.	Catherine McMahon	1322.	Donna Samuel
1269.	Catherine Pendrey	1323.	Donna Swan
1270.	Catherine Tenni	1324.	Doug Hagan
1271.	Catherine Young	1325.	Douglas Levings
1272.	Cathryn Levett	1326.	Ebony Yuill
1273.	Cecilia Kwok	1327.	Ed Ghiocas
1274.	Charlotte Britton	1328.	Edmond Kennedy
1275.	Chay-Ya Clancy	1329.	Elise Armitage
1276.	Chloe Elmer	1330.	Elizabeth Raimondo
1277.	Chloe Erftemeyer	1331.	Elle Kirk
1278.	Chris Heine	1332.	Ellen Rijs
1279.	Chris King	1333.	Emily Reuter
1280.	Christian Pavez	1334.	Emma Fenty
1281.	Christine Demicoli	1335.	Emma French
1282.	Christine McArthur	1336.	Emma Jones
1283.	Christine Rea	1337.	Emre Durmaz
1284.	Christine Spoljar	1338.	Eric Mainard
1285.	Christine Walsh	1339.	Erica Vernon
1286.	Christopher Ottery	1340.	Evan Hopkins
1287.	Christopher Robertson	1341.	Evelyn Lee
1288.	Claire Carlow	1342.	Fabia Pryor
1289.	Claire Sandford	1343.	Ferne Millen
1290.	Claire van Herpen	1344.	Fiona Macaulay
1291.	Clare River	1345.	Fran Murrell
1292.	Colin Brokenshire	1346.	Frances Schulz
1293.	Colleen Murtha	1347.	Frances Sutherland
1294.	Colleen Wagner	1348.	Fraser Medhurst
1295.	Cristian Hanley	1349.	Gabrielle Demirdjian
1296.	Dale Cadd	1350.	Gabrielle Francis
1297.	Dale Smithyman	1351.	Gavin Brown

1352.	Gemma Garbutt	1406.	Jared Jenkins
1353.	Genevieve Owen	1407.	Jarrold Pan
1354.	Genevieve Smith	1408.	Jasmine Sesso
1355.	Geoff Hollis	1409.	Jason Van Rooyen
1356.	Geoffrey Falk	1410.	Jaunita Landeesse
1357.	Georgie Waddell	1411.	Jay Smith
1358.	Georgina Davis	1412.	Jean Lee
1359.	Georgina Linnell	1413.	Jeanne Harper
1360.	Georgina Neave	1414.	Jeff Parkes
1361.	Georgina Trimble	1415.	Jen Loader
1362.	Geraldine Archibald	1416.	Jenna Redknap
1363.	Gerard Lind	1417.	Jennifer Bensemann
1364.	Gero von Aderkas	1418.	Jennifer Clark
1365.	Gillian Clarke	1419.	Jenny Mathews
1366.	Gillian Trebilcock	1420.	Jenny O'Connor
1367.	Glenys Parslow	1421.	Jeremy Schroder
1368.	Goran Nilsson	1422.	Jess Dalrymple
1369.	Gordon Webb	1423.	Jess Longmuir
1370.	Greg Campbell	1424.	Jess Pendlebury
1371.	Greg James	1425.	Jessamin Kaye
1372.	Greg Mason	1426.	Jill Bunnell
1373.	Guislaine Allen	1427.	Jill Vincent
1374.	Hal Peck	1428.	JJ Miller
1375.	Hannah Bolt	1429.	Jo Hughson
1376.	Hans Foik	1430.	Joan Spittle
1377.	Harry Hook	1431.	Joan Staples
1378.	Hayley Walker	1432.	Joanne Barnes
1379.	Heather Oldfield	1433.	Joanne Sweeney
1380.	Heather Richardson	1434.	Jocelyn Gray
1381.	Helen Eastwood	1435.	Jodee Dewhurst
1382.	Helen Hoey	1436.	Jodi Cameron
1383.	Helen Keeley	1437.	Jodie Mitchell
1384.	Helen Rickards	1438.	Joe Rafalowicz
1385.	Helen Trueman	1439.	Joel Mather
1386.	Helen Wake	1440.	John and Shirley Gunson
1387.	Henrietta Camilleri	1441.	John Ashton
1388.	Hieu Huynh	1442.	John Begelhole
1389.	Iain Lygo	1443.	John Julian
1390.	Ilse Jamonts	1444.	John Oldfield
1391.	Isobel Monie	1445.	John Paterson
1392.	Jacki Straude	1446.	Jonathan Hicks
1393.	Jacob van Dort	1447.	Jonathon Colliver
1394.	Jacqueline Hannigan	1448.	Jules Banner
1395.	Jacqui Sterling	1449.	Julia Greenwood
1396.	Jacqui Sundbery	1450.	Julia Uren
1397.	Jamie Thompson	1451.	Julie Holmes
1398.	Jan Colliver	1452.	Julie Kidd
1399.	Jan Petersen	1453.	Julie Moore
1400.	Jane Carracher	1454.	Julie Stevens
1401.	Jane Glover	1455.	Justin L'Huillier
1402.	Jane Hughes	1456.	Karen Corbett
1403.	Jane Monk	1457.	Karen Large
1404.	Jane Storey	1458.	Karen Rees
1405.	Janet Pelly	1459.	Karyn Solomon

1460.	Kate Doyle	1514.	Mark Dowse
1461.	Kath Angus	1515.	Mark Glickman
1462.	Katharine Prata	1516.	Mark McKew
1463.	Katie Getson	1517.	Mark Schuliga
1464.	Katrina Sawyer	1518.	Mark Seels
1465.	Katryn and James Langford	1519.	Marnie Lee
1466.	Kellie Wakely	1520.	Marti Shield
1467.	Kelly Rattle	1521.	Martin Davis
1468.	Kenneth Lydall	1522.	Martin Rush
1469.	Kerri Russell	1523.	Martin Siegrist
1470.	Kerry O'Meara	1524.	Mary Edgerton
1471.	Khaseem Warren	1525.	Mary Grant
1472.	Kim Brennan	1526.	Mary-Jane Rosette
1473.	Kim Hamilton	1527.	Matthew Ellen
1474.	Kirsty Hannan	1528.	Matthew Harris
1475.	Kirsty McIntyre	1529.	Maurice Perry
1476.	Kriss Ellis	1530.	Meg Pillai
1477.	Kristy Welch	1531.	Megan Gladysz
1478.	Laurelle Jasper	1532.	Mel Audrey
1479.	Leah Oliver	1533.	Melanie Smith
1480.	Leah Pollard	1534.	Melanie Wiltshire
1481.	Lenka O'Connor Sraj	1535.	Merryn Hamilton
1482.	Leo Chen	1536.	Michael Grau-Veliz
1483.	Les Mallett	1537.	Michael Hamel-Green
1484.	Lesley Bowen	1538.	Michael Kelly
1485.	Lesley Goodge	1539.	Michael Lambkin
1486.	Lesley Ross	1540.	Michael Nugent
1487.	Liezl Schnookal	1541.	Michael Rayner
1488.	Lilja Radley	1542.	Michael Ruyg
1489.	Lindsay Quennell	1543.	Michael Zulicki
1490.	Lindy Price	1544.	Michaela Poncell
1491.	Lisa Hall	1545.	Michele McCrohan
1492.	Lisa Hilton-Cronin	1546.	Michelle Johnstone
1493.	Lisa Maza	1547.	Michelle Niznik
1494.	Lorraine Spalding	1548.	Mick Lucas
1495.	Lucas Jordan	1549.	Milla Vincent
1496.	Luke Stafford	1550.	Miquel Orpella-Comino
1497.	Lynda Crossley	1551.	Monique Decortis
1498.	Lynn Atkinson	1552.	Monique Keel
1499.	Lynne Hollis	1553.	Morgana Creely
1500.	Lynne Wishart	1554.	Mychelle Whitewood
1501.	Maree Darby	1555.	Nadia Collis
1502.	Marg Donald	1556.	Nadia Miller
1503.	Margaret Lynn	1557.	Nagaraj Nayak
1504.	Margot Hansen	1558.	Naomi Rose
1505.	Maria Fiotai	1559.	Narelle Graefe
1506.	Maria Pye	1560.	Narelle Young
1507.	Maria Triado	1561.	Natalie Abboud
1508.	Marie Bliss	1562.	Natalie Jozsa
1509.	Marie Gibbon	1563.	Natalie Petersen
1510.	Marigold Hayler	1564.	Natalie Segal
1511.	Marilyn Connor	1565.	Natalie Stecko
1512.	Marion East	1566.	Nerida Joss
1513.	Marion Weller	1567.	Nestor Evangelista

1568.	Nicola Carlile	1622.	Robyn Hoe
1569.	Nicola Coles	1623.	Robyn Smith
1570.	Nicole Alexander	1624.	Rod May
1571.	Nicole Merzliakov	1625.	Roderick Anderson
1572.	Nicole Robinson	1626.	Rodolfo Garcia-Flores
1573.	Nigel D'Souza	1627.	Roger Putnam
1574.	Nina Earl	1628.	Rosalind Jones
1575.	Nina Hagan	1629.	Rosemary Brooks
1576.	Olga Morris	1630.	Rosemary Haas
1577.	Olivia Hartigan	1631.	Rowena Smith
1578.	Pam Talbot	1632.	Rupert Steiner
1579.	Pat Allan	1633.	Ruth Carson
1580.	Patricia Hubbard	1634.	Sahar Naghashian
1581.	Patricia McGann	1635.	Sally Dawe
1582.	Patrick Alilovic	1636.	Sally Goulet
1583.	Patrick Hearps	1637.	Sally Walsh
1584.	Paul Bennet	1638.	Sam Shepherd
1585.	Paul Pocock	1639.	Samuel Dariol
1586.	Paul Riddle	1640.	Samuel Hill
1587.	Paul Williamson	1641.	Sanaya Khisty
1588.	Pauline McCracken	1642.	Sandra Betts
1589.	Peta Malins	1643.	Sandra Bland
1590.	Peter Carroll	1644.	Sandra Frost
1591.	Peter Hassold	1645.	Sarah Bartak
1592.	Peter Krause	1646.	Sarah Gardiner
1593.	Philip Cahn	1647.	Sarah Garry
1594.	Philip Horbury	1648.	Sarah Glass
1595.	Philip Riley	1649.	Sarah Griffiths
1596.	Phillip Payne	1650.	Sarah Jones-Hill
1597.	Pia Arrien	1651.	Scott Daniel
1598.	Rachel Laws	1652.	Scott Wilson
1599.	Ray Connor	1653.	Sean Flynn
1600.	Ray Heathcote	1654.	Sean Knight
1601.	Rebecca Cameron	1655.	Sean Weatherly
1602.	Rebecca Edwards	1656.	Sebastian Ramsay
1603.	Rebecca Lloyd	1657.	Sharon Hargreaves
1604.	Rebecca McGhee	1658.	Sharon Lee
1605.	Rebecca Rose	1659.	Sheryl Gay
1606.	Renea Johnson	1660.	Silvia Gonzalez
1607.	Renee Huish	1661.	Simon Conlon
1608.	Richard Lane	1662.	Simon Schulz
1609.	Riley AcAuliffe	1663.	Smith Colin
1610.	Robert Brown	1664.	Sonia Dioguardi
1611.	Robert Cameron	1665.	Sonia Holt
1612.	Robert Dunn	1666.	Sonja van Dort
1613.	Robert Fomiatti	1667.	Sophia Rutter
1614.	Robert Hoogenraad	1668.	Stanislaw Pelczynski
1615.	Robert Humphreys	1669.	Stephen Swan
1616.	Robert Krones	1670.	Steven and Honey Boyd
1617.	Robert Krones	1671.	Stuart Kelly
1618.	Robert McKelvey	1672.	Sue Davis
1619.	Robert Stephen	1673.	Sue Hertzog
1620.	Robin de Garis	1674.	Susan Ablitt
1621.	Robyn Aldrick	1675.	Susan Barnes

1676.	Susan Bryant	1701.	Tom Facey
1677.	Susan Hillman	1702.	Tom Nicholson
1678.	Susan Leamon	1703.	Tomas Robinson
1679.	Susan Springfield	1704.	Tomislav Nikolic
1680.	Susie Ross	1705.	Tony Canning
1681.	Suzanne Edge	1706.	Tony Gay
1682.	Tabitha Lowdon	1707.	Tony Henry
1683.	Talia Hoysted	1708.	Tracey Seach
1684.	Tamara Berquez	1709.	Tracy Roberts
1685.	Tamara Murphy	1710.	Travis White
1686.	Tami McVicar	1711.	Trevor Kingsbury
1687.	Tammie Thornton	1712.	Trish Clayton
1688.	Tanya Black	1713.	Valentine Franks
1689.	Tanya Smith	1714.	Vernon Terrill
1690.	Tayla Meerkin	1715.	Vicki Harriss
1691.	Ted Woolan	1716.	Vikki Patten
1692.	Tegan Beaton	1717.	Virginia Coghill
1693.	Tell Arstargazer	1718.	Virginia Lawrence
1694.	Tess Mancini-Fiske	1719.	Vonney Lancaster
1695.	Tijana Dabic	1720.	Warwick Sprawson
1696.	Tim Ambrose	1721.	Wendy Menzel
1697.	Tim O'Donnell	1722.	William Freeman
1698.	Tim Peck	1723.	Yasmin Kellner
1699.	Tim Snell	1724.	Ywonne Nilsson
1700.	Todd Levi	1725.	Zachary Ellis

Appendix 1.11 Pro forma K Submitters

1726.	Andrew and Gill Davies
1727.	Jenny Bradshaw
1728.	Alison Marchant
1729.	Mark Reeves

Appendix 2

Public hearings and site visits

A2

Public Hearing – Tuesday 30 June 2015 – Gippsland Regional Sports Complex, Sale, Victoria

Wellington Shire

John Websdale, General Manager, Development

South Gippsland Shire

Tim Tamlin, Chief Executive Officer

Cr Don Hill

Baw Baw Shire

Cr Murray Cook

Phil Cantillon, Director, Community Assets

Latrobe Shire

Sara Rhodes Ward, General Manager, Community Livability

Bass Coast Shire

Cr Neil Rankine

Deirdre Griepsma, Environment Manager, Sustainable Environment

Alex Arbuthnot

Lock the Gate Alliance

Chloe Aldenhoven, Community Campaigner, Friends of the Earth

Ursula Alquier, Victorian Coordinator, Lock the Gate Alliance

Ross Scott

Committee for Gippsland

Mary Aldred, Chief Executive Officer

Margaret Williamson

Rodger Davis

Ronald Wangman

Elizabeth Balderstone

Lorraine Halabarec

Andrew Harrison

Marg Thomas

Maureen Versteden

Glen Maher

Kerrin Schelfhout

Rosemary Maher

Public Hearing – Wednesday 1 July 2015 – Gippsland Regional Sports Complex, Sale, Victoria

Dr Jo McCubbin

Australian Dairy Industry Council

Claire Miller, Manager, Policy Strategy, Dairy Australia

Chris Griffin, Member, Natural Resources Management Policy Advisory Group

Irene Clarke, Senior Policy Manager, Australian Dairy Farmers

Lakes Oil NL

Robert Annells, Executive Chairman

Tim O'Brien, Operations Manager

Ignite Energy Resources

Dane Stewart, Manager, Resource Development

Dr John White, Government and Community Liaison

Public Hearing – Wednesday 22 July 2015 – Legislative Council Committee Room, Parliament House

Melbourne Energy Institute, University Of Melbourne

Timothy Forcey, Energy Adviser

Australian Academy of Technological Sciences and Engineering

Professor Peter Cook

Department of Environment, Land, Water and Planning

Dr Sharon Davis, Executive Director, Water Resources

Kate Houghton, Deputy Secretary, Water and Catchments

Chris Mcauley, Director, Water Entitlements and Markets

Victorian Farmers Federation

Gerald Leach, Chair, Land Management Committee

Melanie Brown, Policy Manager

Emily Waters, Policy Adviser, Land Management

Australian Petroleum Production and Exploration Association (APPEA)

Paul Fennelly, Chief Operating Officer, Eastern Australia

Damien Dwyer, Director, Economics

Matthew Paul, Policy Director, Queensland

Dr Matthew Currell, RMIT University, Hydrogeology And Environmental Engineering

Minerals Council of Australia

Megan Davison, Executive Director, Victorian Division

Public Hearing – Wednesday 5 August 2015 – Legislative Council Committee Room, Parliament House

Environment Victoria

Dr Nick Aberle, Safe Climate Campaign Manager

Anne Martinelli, One Million Homes Energy Efficiency Campaigner

Grattan Institute

Tony Wood, Energy Program Director

David Blowers, Energy Fellow

Public Hearing – Wednesday 12 August 2015 – Surf Coast Shire Council, Torquay

Surf Coast Shire Council

Keith Baillie, Chief Executive Officer

Cr Margot Smith, Mayor

Kate Sullivan, General Manager, Environment and Development

Rowan Mackenzie, Manager, Environment and Community Safety

Colac Otway Shire Council

Cr Brian Crook, Deputy Mayor

Stewart Anderson, Manager Environment and Community Safety

Barwon Water

Carl Bicknell, General Manager Strategy and Planning

Steven Reddington, Senior Environmental Planner

Frack Free Moriac

Alison Marchant

Damien Marchant

Dr Mike Forrester

G21 Agribusiness

Russell Coad

Otway Harvest Trail

Tom Dennis, President

Kit-E Kline, Vice-President

Ian Clarke

Wendy Klason

Darren Noyes-Brown

Alan Manson

Suzanne Yandle

Chris Johnson

Kristin Bitmead

Public Hearing – Thursday 13 August 2015 – Surf Coast Shire Council, Torquay

3228 Residents Association

Sid Pope, President

Friends of the Earth

Cam (Campbell John) Walker, Campaign Coordinator

Dr George Carman

Professor Samantha Hepburn, Research Director, Deakin University Law School

Michael Blackam, Coffey

Frack Free Geelong

Anthony Gleeson, Frack Free Geelong

Elizabeth Packett, Gasfield Free Torquay

Wurdale Landcare Group

Peter McGregor

Carole McGregor

Joan Lindros

Environmental Justice Australia

Ariane Wilkinson, lawyer

Public Hearing – Tuesday 18 August 2015 – Legislative Council Committee Room, Parliament House

Department of Environment, Land, Water and Planning

John Ginivan, Executive Director, Planning and Building Systems

Lee Miezis, Acting Executive Director, Environmental Policy

Dr Sharon Davis, Executive Director, Water Resources

Department of Economic Development, Jobs, Transport and Resources

Paul McDonald, Director, Geological Survey of Victoria,

Ross McGowan, Executive Director, Earth Resources Regulation Branch

Mark Feather, Executive Director, Energy Sector Development Branch

Anthony Hurst, Executive Director, Earth Resources Development Branch

Public Hearing – Tuesday 1 September 2015 – Legislative Council Committee Room, Parliament House

Department of Health and Human Services

Professor Michael Ackland, Acting Chief Health Officer

Doctors for the Environment Australia

Dr John Iser, Committee Member

Dr Liz Bashford, Committee Member

Public Hearing – Wednesday 2 September 2015 – Legislative Council Committee Room, Parliament House

Plastics and Chemicals Industries Association

Samantha Read, Chief Executive Officer

Peter Bury, Director, Strategy, Innovation and Research

CSR Limited

Martin Jones, General Manager, Government Relations

Public Hearing – Tuesday 15 September 2015 – Legislative Council Committee Room, Parliament House

Energy Users Association of Australia

Peter Dobney, Board Member

Environment Protection Authority Victoria

Tony Robinson, Manager, Major Projects

Dr Cathy Wilkinson, Executive Director Knowledge, Standards and Assessments

Public Hearing – Wednesday 23 September 2015 – Regional Hearing – Hamilton Performing Arts Centre, Hamilton

Glenelg Shire Council

Greg Burgoyne, Chief Executive Officer

Moyne Shire Council

David Madden, Chief Executive Officer

Corangamite Shire Council

David Rae, Acting Chief Executive Officer

Cr Chris O'Connor, Mayor

Southern Grampians Shire Council

Cr Peter Dark, Mayor

Mecrus

Barry Richards, Managing Director

Dr Rodney Halyburton, Senior Petroleum Consultant

Mr Darrell Morrison

Gunditj Mirring Traditional Owners Aboriginal Corporation

Damein Bell, Chief Executive Officer

Wannon Water

Peter Wilson, Branch Manager, Asset Planning

Protect the West Alliance

Bernadette Tapscott

Bob Hodgets

John Coverdale

Pat Nesbitt

Kevin Cotter

Branxholme, Byaduk and Wallacedale farmers

Malcolm Rowe
Colin Frawley
Michael Greenham
Aggie Stevenson
Gary Everett

John Graham

Hayley Rundell

Helen Henry

David Smith

Andrew Pettingill

**Public Hearing – Tuesday 6 October 2015 – Legislative Council
Committee Room, Parliament House**

Victorian Auditor General's Office

Steve Vlahos, Assistant Auditor-General
Dallas Mischkulnig, Sector Director, Performance Audit
Maree Bethel, Manager, Performance Audit

Lakes Oil

Robert Annells, Executive Chairman
Timothy O'Brien, Operations Manager

Site Visit – Wednesday 1 July 2015 – Seaspray, Victoria

Wombat Gasfields

Lakes Oil

Flints Farm

Trevor and Di Flint

Site Visit – Friday 30 October 2015 – Altona, Victoria

Qenos

Appendix 3

The difference between conventional and unconventional gas

A3

The following extract provides a detailed explanation of the difference between conventional and unconventional gas and the use of hydraulic fracturing. It is extracted from Dr Louise Goldie Divko's reviews of the gas prospectivity for the Otway and Gippsland regions, produced as part of water science studies undertaken by the Department of Economic Development, Jobs, Transport and Resources.⁶⁶⁶

Conventional gas reservoirs are commonly porous and permeable rocks such as sandstones or limestones. Impermeable rocks such as claystones lie directly above the reservoirs and are known as a seal or cap-rocks. The gas is trapped in the reservoir and under the seal in geological structures. Geological structures are like an inverted dish, with the gas held underneath. A gas well drilled into the geological structure will intersect the porous gas reservoir and, when present, gas will flow into the well.

Tight, shale and coal seam gas are termed unconventional gas types. These differ from conventional gas in that the gas is trapped at or near the source, which may also act as the gas reservoir. In the case of tight gas, the gas is produced from relatively low permeability and low porosity sedimentary reservoirs. The lack of permeability in the rock prevents gas from migrating, and so it is trapped in the tight rock formation. A similar principle applies to shale gas where the gas is sourced from and trapped in fine-grained sedimentary rocks that have low porosity and permeability, and are organic-rich. The gas is held on organic matter in the rock, in tiny pores between grains, and in any fractures present in the rock. In the case of coal seam gas (also known as coal bed methane), naturally occurring methane in the coal seams is held on the coal surfaces by water pressure and may also exist in the gaps and cracks in the coal seams.

Shale gas in the US has been produced since 1820 (e.g. Martin et al., 2010) and coal seam gas production in Queensland has grown from the first small scale commercial production 18 years ago at Moura (Slater & Baker, 2012). In the case of US shale gas, it is only in the last few years that decades of experience and knowledge gained from the development of individual shale gas plays, and advancements in well completion technologies, have led to the growth of the industry. The rising price of the commodity has also contributed to the commercial viability of gas development projects that would not have been possible in the past.

⁶⁶⁶ Goldie Divko (2015) *A Review of Gas Prospectivity: Otway Region*, DEDJTR, Melbourne, pp. 9-10; L. Goldie Divko (2015) *A Review of Gas Prospectivity: Gippsland Region*, DEDJTR, Melbourne, pp. 8-9.

The difference between conventional gas production and the unconventional gas types (tight, shale and coal seam gas) is that for most conventional wells, gas will flow from the reservoir into the well and to the surface infrastructure without assistance, whereas for the other gas types, additional technologies are required to release the gas. For instance, gas may not flow unless the rocks are fractured to create artificial permeability in the formation to release the trapped gas. For coal seam gas, water must be drawn away from the coal seam by depressurising the coal to release the gas into the well.

Not all unconventional gas types require fracturing or are suitable for fracturing, and some conventional gas reservoirs are artificially fractured to maintain or enhance production. For instance, more than 700 conventional wells have been fracture stimulated to enhance hydrocarbon recovery in South Australia since 1969 (Goldstein et al., 2012).

Appendix 4

Regulatory framework

Victoria predominately regulates onshore unconventional gas activities through two earth resources Acts, administered by the Minister for Energy and Resources through DEDJTR. These Acts are:

- the *Mineral Resources (Sustainable Development) Act 1990* (Minerals Act) for CSG
- the *Petroleum Act 1998* (Petroleum Act) for shale and tight gas.

The four other earth resources Acts in Victoria are:

- the *Greenhouse Gas Geological Sequestration Act 2008*
- the *Geothermal Energy Resources Act 2005*
- the *Pipelines Act 2005*
- the *Offshore Petroleum and Greenhouse Gas Storage Act 2010*.

A number of other Acts and related legislation also contribute to the regulation of unconventional gas, including:

- the *Native Title Act 1993* (Commonwealth)
- the *Planning and Environment Act 1987*
- the *Water Act 1989*.
- All petroleum exploration and recovery in Victoria is prohibited unless authorisation is granted.⁶⁶⁷ The Minister may grant rights for specified areas via a licence under both the Petroleum and Minerals Acts. The Minister may also exempt land from the application of the Acts.⁶⁶⁸

Mineral Resources (Sustainable Development) Act 1990

The Minerals Act provides a legislative framework for development and regulation of CSG. The Act and associated regulations cover licensing and approval requirements, as well as issues surrounding compensation, rehabilitation and royalties.

⁶⁶⁷ *Petroleum Act 1998* s 15; *Mineral Resources (Sustainable Development) Act 1990* s 8.

⁶⁶⁸ *Petroleum Act 1998* s 12; *Mineral Resources (Sustainable Development) Act 1990* s 7.

The Minerals Act applies to ‘minerals’ as defined as any substance which occurs naturally as part of the earth’s crust, excluding petroleum.⁶⁶⁹ This definition means CSG is defined as a ‘mineral’ rather than as ‘petroleum’ and therefore, is regulated by the Minerals Act.

The four types of licences granted under the Minerals Act are:

- **Exploration licences** which authorise low impact exploration activities for minerals in the area to determine whether the resource is commercially viable
- **Mining licences** which allow the holder to carry out mining, exploration, construction and any other activities incidental to mining on the land
- **Prospecting licences** which enable the holder to prospect or explore for minerals
- **Retention licences** which allow the holder to retain the rights to a mineral resource in the land covered by the licence that is not currently economically viable to mine, but may be in the future.⁶⁷⁰

Exploration and mining licences are the two most common and details of the application process for each are provided below.

Exploration

Minerals exploration requires an exploration licence granted under the Minerals Act. Exploration licences authorise low impact exploration activities for minerals in the area, to determine whether the resource is commercially viable.⁶⁷¹ To obtain an exploration licence, an applicant must advertise their application,⁶⁷² and satisfy the Minister that they:

- are a fit and proper person to hold the licence
- intend to comply with the Act
- genuinely intend to do work
- have an appropriate program of work
- are able to finance the proposed work and rehabilitation of the land.⁶⁷³
- All exploration applications are subject to an objection process and any objections must be considered.⁶⁷⁴

A licence holder must lodge and obtain approval of a work plan before any exploration activities may commence.⁶⁷⁵ It must:

⁶⁶⁹ *Mineral Resources (Sustainable Development) Act 1990* s 4.

⁶⁷⁰ *ibid.*, ss 13, 14, 14B & 14C.

⁶⁷¹ *ibid.*, s 13.

⁶⁷² *ibid.*, s 15(5).

⁶⁷³ *ibid.*, s 15(6).

⁶⁷⁴ *ibid.*, ss 24 & 25.

⁶⁷⁵ *ibid.*, s 40.

- describe the proposed work, including details of potential environmental impacts and the measures proposed for their control or mitigation, as well as the proposed methods of monitoring, auditing and reporting those impacts
- include a description of the proposed rehabilitation of areas subject to surface disturbance, maps depicting sites identified for drilling or other earthworks and the proposed arrangements for consultation with landowners
- be prepared in consultation with DEDJTR and other relevant agencies, and
- include an environment impact assessment, where required by the Minister.⁶⁷⁶

A cultural heritage management plan may also be required for ground disturbing works in areas of cultural heritage sensitivity and must be prepared prior to the approval of the work plan.⁶⁷⁷

As discussed in Chapter 5 of this Report, which looked at the co-existence of agriculture and unconventional gas mining, if the land affected is private land, compensation must be determined prior to a licensee commencing work under an exploration licence. The licensee must either:

- obtain the consent of the owners of the land affected
- make and register a compensation agreement with those owners and occupiers
- obtain a compensation determination from VCAT, or
- purchase the land.⁶⁷⁸

Further restrictions apply to land which is on restricted Crown land, water supply catchments or on land with a public highway, road or street on it.⁶⁷⁹

A licensee has a duty to consult with the community throughout the period of the licence, by sharing information about activities authorised by the licence, and giving them a reasonable opportunity to voice their concerns.⁶⁸⁰ The licence holder must give owners and occupiers of the affected land at least seven days notice prior to work commencing and is not permitted to do any work within 100 metres of a home without the owner's consent.⁶⁸¹

In accordance with the conditions of their licence, the licensee is obliged to rehabilitate the land they have worked on.⁶⁸² Before work commences, the licensee must pay a rehabilitation bond, which will only be repaid if the licensee rehabilitates the required land to the satisfaction of the Minister.⁶⁸³

⁶⁷⁶ *Mineral Resources Development Regulations 2002* r 25, Schedule 12 and *Mineral Resources (Sustainable Development) Act 1990* ss 77TE and 41A.

⁶⁷⁷ *Mineral Resources (Sustainable Development) Act 1990* s 41AD.

⁶⁷⁸ *ibid.*, s 43(1)(e).

⁶⁷⁹ *ibid.*, ss 44(1) & 44(2).

⁶⁸⁰ *ibid.*, s 39A.

⁶⁸¹ *ibid.*, ss 43(1)(d) & 45.

⁶⁸² *ibid.*, s 78(1).

⁶⁸³ *ibid.*, s 80.

Mining production and extraction

Before any mining, as defined in the Minerals Act as ‘extracting minerals for the purpose of producing them commercially’, can begin, a separate mining licence must be obtained. Mining licences allow the holder to carry out mining, exploration, construction and any other activities incidental to mining on the land.⁶⁸⁴ The applicant for a mining licence must satisfy the Minister that there is a reasonable prospect that the mineral resource will be economically viable.⁶⁸⁵

The application process covers a number of the same factors prescribed for in an exploration licence, with some additional requirements. For instance, the licensee must advertise their application in newspapers and must also directly notify the owners or occupiers of the land affected by the application.⁶⁸⁶ A mining licence requires an approved work plan which must include more detail than that required for exploration, including maps and plans of proposed work, a rehabilitation plan, an environmental management plan and a community engagement plan.⁶⁸⁷ A work plan, prepared in consultation with DEDJTR will be lodged in draft form where it then must receive a ‘statutory endorsement’ within the timeframe required by the licence.⁶⁸⁸ Once endorsed, the draft works plan will be submitted with the application for planning approval, unless an environmental effects statement (EES) has been required.

Unlike exploration work, which is exempt from the requirements of planning approval, mining requires either a planning permit or an EES.⁶⁸⁹ A mining application requires a planning permit from the responsible authority, under the *Planning and Environment Act 1987* (PE Act), as specified by the Victoria Planning Provisions (VPPs).⁶⁹⁰ However, if the Minister for Planning decides the project could have a significant effect on the environment, they may insist an EES is prepared under the *Environment Effects Act 1978* (EE Act), which overrules the planning permit requirement.

Similar to exploration licences, objections may be made to the grant of a mining licence which the Minister must consider.⁶⁹¹ The PE and EE Acts outline the process for objection and appeals against mining projects. Under the PE Act, an individual may object to an application for a planning permit, and any one of those objectors may appeal to VCAT if the permit is granted.⁶⁹² The EES process involves public submissions and hearings which act as an individual’s means to object to the mining proposal.

⁶⁸⁴ *ibid.*, s 14.

⁶⁸⁵ *ibid.*, s 15(6B).

⁶⁸⁶ *ibid.*, s 15(5); *Mineral Resources Development Regulations 2002* r 16(2).

⁶⁸⁷ *Mineral Resources (Sustainable Development) Act 1990* s 40; *Mineral Resources Development Regulations 2002* r 25, Schedule 13.

⁶⁸⁸ *Mineral Resources (Sustainable Development) Act 1990* Part 6B.

⁶⁸⁹ *ibid.*, s 43(3).

⁶⁹⁰ *Victoria Planning Provisions* cl 52.08.

⁶⁹¹ *Mineral Resources (Sustainable Development) Act 1990* s 25(2).

⁶⁹² *Planning and Environment Act 1987* ss 57 & 87.

A licensee must establish a rehabilitation plan and pay a rehabilitation bond, which is set in consultation with the owner of the land and the local council.⁶⁹³ Finally, an approved work authority must be obtained, which certifies that all other approvals and requirements have been met.⁶⁹⁴

The provisions and arrangements relating to compensation, duty to consult, notice of intention to commence work, the 100 metre buffer zone and consent requirements for specific land apply the same way to mining as they do for exploration work.

Petroleum Act 1998

The Petroleum Act provides a legislative framework for the development and regulation of shale and tight gas, including licensing, approvals and issues including consultation, compensation, rehabilitation and royalties. The Petroleum Act provides for the issuing of:

- **Exploration permits** which enable the holder to explore for petroleum within the permitted area
- **Retention leases** which enable the holder of an exploration permit to retain certain rights to a petroleum discovery that is not currently commercially viable, but might become viable to develop within 15 years, and
- **Production licences** which allow for the production and exploration of petroleum.⁶⁹⁵

Exploration permits and production licences are the focus of the description below.

Exploration

Petroleum exploration requires a petroleum exploration permit (PEP). Petroleum tenements are released by the Minister under acreage releases and companies are invited to tender.⁶⁹⁶ Tenders are assessed on their proposed work program and their technical and financial capability.⁶⁹⁷ When granting a permit, the Minister must ensure the area to which the permit applies is smaller than 12,500 square kilometres and forms a continuous parcel of land and that no part of the area is already the subject of an exploration permit.⁶⁹⁸

⁶⁹³ *Mineral Resources (Sustainable Development) Act 1990* ss 79 and 80(2).

⁶⁹⁴ *ibid.*, s 39(3).

⁶⁹⁵ *Petroleum Act 1998* ss 18, 36 & 46.

⁶⁹⁶ *ibid.*, Part 3, Division 2.

⁶⁹⁷ *ibid.*, ss 20 & 21.

⁶⁹⁸ *ibid.*, s 25.

Once the Minister has granted the PEP, the holder must prepare and have approved an operations plan prior to any exploration work commencing.⁶⁹⁹ This plan:

- must address the proposed activities, risk assessments and management commitments, well operations plans and environmental management plans that include consultation
- may be referred to other agencies for review
- may be subject to a cultural heritage management plan for any ground disturbing works in areas of cultural heritage sensitivity.⁷⁰⁰

No exploration (or production as described below) can be carried out on private land without.⁷⁰¹

- obtaining consent of the owner and occupier, or
- a compensation agreement being entered into with the owner and occupier of the land, or
- VCAT determining the compensation payable to the owners and occupiers of the land, and
- the written consent of the Minister.⁷⁰²
- Petroleum exploration does not require a planning permit.⁷⁰³ A licensee must hold insurance and provide a rehabilitation bond.⁷⁰⁴ A licensee must provide the landowner or occupier with 21 days written notice of any operations taking place.⁷⁰⁵

Production and extraction

Petroleum production requires a petroleum production licence, which may only be applied for in respect of an area on which the holder has discovered petroleum or a reservoir.⁷⁰⁶ Similar to the process described above for exploration, petroleum production also requires an approved operation plan and in addition requires a production development plan, which must include a reservoir management plan.⁷⁰⁷ These plans must address all the issues relating to the proposed operation and must cover all the aspects prescribed in the Petroleum Regulations.⁷⁰⁸

⁶⁹⁹ *ibid.*, s 161.

⁷⁰⁰ DEDJTR, Onshore Gas Community Information – Regulations, viewed 18 September 2015 <onshoregas.vic.gov.au/regulation/regulations>; *Petroleum Regulations 2011* regs 6 and 8-13; and Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 128.

⁷⁰¹ *Petroleum Act 1998* s 128.

⁷⁰² *ibid.*, ss 128 and 138.

⁷⁰³ Gas Market Taskforce (2013) *Gas Market Taskforce: Supplementary Report*, op. cit., p. 128.

⁷⁰⁴ *Petroleum Act 1998* ss 171 & 173.

⁷⁰⁵ *ibid.*, s 145.

⁷⁰⁶ *ibid.*, ss 46 & 47.

⁷⁰⁷ *ibid.*, ss 63 & 64.

⁷⁰⁸ *Petroleum Regulations 2011* r 16.

An applicant must obtain planning approval for petroleum production and development unless the project is assessed under the EE Act.⁷⁰⁹ The same requirements for exploration relating to consent, compensation, insurance and rehabilitation also apply to production.⁷¹⁰

The Crown owns all petroleum “on or below the surface of any land in Victoria that came to be on or below that surface without human assistance”.⁷¹¹ Therefore, no compensation is payable to landowners for petroleum that is extracted from their land.⁷¹² Compensation is payable for any loss or damage that has been, or will be, sustained in relation to the land as a direct, natural and reasonable consequence of the approval of any petroleum operation or the carrying out of any petroleum operation under the authority.⁷¹³

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⁷⁰⁹ *Petroleum Act 1998* ss 119 & 120.

⁷¹⁰ *ibid.*, s 145.

⁷¹¹ *ibid.*, s 13.

⁷¹² *ibid.*, s 131.

⁷¹³ *ibid.*, s 129.

Extracts of proceedings

Legislative Council Standing Order 23.27(5) requires the Committee to include in its report all divisions on a question relating to the adoption of the draft report. All Members have a deliberative vote. In the event of an equality of votes, the Chair also has a casting vote.

The Committee divided on the following questions during consideration of this report. Questions agreed to without division are not recorded in these extracts.

25 November 2015

Key Recommendation A

That, in recognition of the Committee not receiving a body of indisputable evidence that convinced it that the current moratorium on an unconventional gas industry operating in Victoria should be lifted, and in recognition of the need to provide certainty on this issue, within the Terms of Reference for this Inquiry, the Victorian Government introduce a permanent ban on the exploration and extraction of unconventional gas.

Mr Leane moved, That Key Recommendation A stand part of the Report.

The Committee divided.

Ayes 4

Ms Dunn

Mr Leane

Ms Shing

Mr Young

Noes 4

Ms Bath

Mr Dalla-Riva

Mr Davis

Mr Somyurek

There being an equality of votes, the Chair gave his casting vote for the Noes.

Question negatived.

Key Recommendation B

That in these circumstances, the Committee supports a further five year moratorium on onshore gas exploration and production in Victoria.

The Chair moved, That Key Recommendation B stand part of the Report.

The Committee divided.

Ayes 3

Ms Bath

Mr Dalla-Riva

Mr Davis

Noes 5

Ms Dunn

Mr Leane

Ms Shing

Mr Somyurek

Mr Young

Question negatived.

Recommendation 3

That, noting that the Committee is not in a position to determine whether a single Act or improvements to the *Mineral Resources (Sustainable Development) Act 1990* and the *Petroleum Act 1998* would result in better regulation, the Victorian Government should look to individual improvements in both Acts and should ensure that:

- community consultation and effective dispute resolution processes are improved
- landholder rights are strengthened and an equitable balance and process between the rights of landholders and mining companies in relation to land access, compensation, and the rehabilitation of land is achieved, noting the Crown owns all mineral resources.

The Chair moved, That Recommendation 3 stand part of the Report.

The Committee divided.

Ayes 7

Ms Bath

Mr Dalla-Riva

Mr Davis

Mr Leane

Ms Shing

Mr Somyurek

Mr Young

Noes 1

Ms Dunn

Question agreed to.

Minority reports

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Environment and Planning Standing Committee of the Legislative Council

Inquiry into Unconventional Gas in Victoria

Minority Report – Liberal and National Members

The Committee was not provided with the full range of support that was necessary to reach definitive conclusions given the large number (1987) of people who provided evidence to the Committee both through written submissions and by appearing at the Committee's public hearings, the complexity of the material and the range of detailed scientific studies.

As the complexity and scope of the task at hand became apparent, the Committee sought additional support of an administrative and scientific nature. Late in the process some scientific support was provided and we note the important contribution made, but this was not sufficient to examine and fully test all aspects of the evidence submitted.

Such was the Government's apparent disdain for the inquiry that in response to the Committee's request to the Premier for additional support made on 20 July, it received a letter from the Minister for Energy and Resources in late October, having tabled its interim report on 1 September and rapidly approaching the 1 December deadline for its final report, that stated: "The Committee's specific staffing requirements are yet to be determined".

This disdain for the inquiry was also evidenced by the Minister for Energy and Resources failing to appear before the Committee, not once, when requested by the Committee, but also when requested to appear to give evidence before the Committee by the Legislative Council as a whole.

The Leader of the Government in the Legislative Council made clear the Government's policy about the uses to which committee resources could be put when he said in the Parliament on 24 June 2015:

It certainly has not stopped your members of committees, who complain bitterly about the number of references and the amount of resources available to support the research activities, being very adventurous in using that precious resource to underpin overseas trips. Whilst at the same time you are pushing for a multiplicity of references simultaneously

and worrying about the amount of resources, you want to spend it on trips. I reckon as a matter of principle you might suggest that overseas trips in this climate are perhaps not a good idea.

The Committee was therefore not able to travel nationally or internationally with a particular impact on its inability to examine regulatory systems and take evidence from other jurisdictions. In the case of New South Wales, Queensland, Canada and the United States, which have established unconventional gas industries, it is clear that significant regulatory learnings are available of which the Committee was not able to avail itself fully.

The Committee repeatedly received evidence and direct advice that it should visit a series of other jurisdictions to view first-hand the strengths and weaknesses of the various regulatory approaches, for example the Gas Fields Commissioner model in Queensland. We were not permitted to do this and thereby test these regulatory approaches.

A key finding is that while there are clearly improvements that can be made in Victoria's regulatory system the Committee is not in a position to point definitively to jurisdictions with better regulation.

It is clear further work will have to be done by the Victorian Government.

In these circumstances the Coalition members of the Committee proposed a further five year moratorium on onshore gas exploration and production in Victoria – a proposition that was rejected by the ALP members of the Committee.

The real reason for the apparent disdain in which the Government held the inquiry became apparent in the ALP members of the Committee's counter proposal, which was to impose a complete ban on onshore gas exploration and production in Victoria.

It is also clear that to ensure the future of Victorian industry, including key manufacturers, issues of gas supply and price will have to be resolved. Long term more gas will have to be brought on stream to ensure reliable supply and reasonable pricing.

A further five year moratorium on onshore gas exploration and production would have permitted necessary further examination of other jurisdictions' regulatory frameworks and the development of a world's best practice regulatory environment for Victoria that might have permitted a timely resumption of onshore conventional gas exploration at the very least.

The Coalition members of the Committee recommend the Government extend the current moratorium for a further five years.

Signed

David Davis

Richard Dalla-Riva

Melina Bath

Simon Ramsay



Minority Report

Inquiry into Onshore Unconventional Gas in Victoria 2015

Introduction

This minority report reflects my views in relation to submissions received by a broad range of community members, individual industries, environment groups, peak bodies and industry groups as part of the Inquiry into Onshore Unconventional Gas in Victoria. As detailed in the final report, the committee received 1,862 published submissions and participated in multiple public hearings across the state.

It must be noted that the recommendations contained in the final report are made without prejudice as part the work of the Environment and Planning Committee members in responding to the Inquiry and in my view should no way be considered as a recommendation for this industry to proceed in Victoria.

The findings

It was disappointing that the committee could not reach a consensus, nor a majority decision, when considering either a permanent ban on unconventional gas exploration and extraction against a counter position of extending the current moratorium.

It is my view a permanent ban on unconventional gas exploration and extraction would ensure the protection of Victoria's environment, agriculture and water supply as well as public health.

Further it is my view that the only way to provide certainty across the range of stakeholders, including community, primary producers and industry, is to secure a permanent ban on the exploration and extraction of unconventional gas in Victoria.

It was unfortunate that the committee was not resourced to visit other states in Australia, it would have been useful to hear first hand the views of other communities who have already experienced the impact of unconventional gas activities.

The committee heard from concerned community members across the state, both at public hearings and via written submissions. At the time of writing this minority report, 69 towns across Victoria have declared themselves Gasfield Free. The public hearings revealed the enormous amount of stress communities were feeling at the prospect of an unconventional gas industry in their region. The depth of concern was profound and the amount of time community members have dedicated to the issue, being strong advocates for the protection of rural and regional Victoria, was immense.

The committee heard extensively from Victoria's primary producers, agri-tourism and tourism sectors, both at public hearings and through written submissions. A consistent theme of their submissions was the risk to productive farmland and water supply, the impact of industrialised landscapes and reputational risk of Victoria as a clean and green primary producer. The final report elaborates on these submissions.

The committee heard substantial evidence on the energy market and Victoria's energy future. Unconventional gas is not a renewable source of energy, it is polluting, contributes to climate change, and is not required as a fuel to transition between fossil fuels and renewables. Victoria doesn't need an unconventional gas industry in Victoria to provide employment. Supporting and growing our renewables industry would provide more jobs that are future-proofed and lead to greater long-term employment growth in Victoria. A permanent ban on unconventional gas activities would also ensure that fugitive emissions would not be a contributor to greenhouse gas emissions.

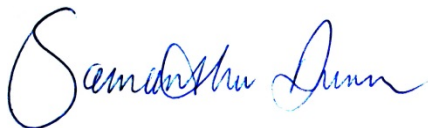
The lack of scientific knowledge around the full extent of risk was alarming as were the ongoing gaps revealed when examining current regulatory frameworks. The hearings and submissions highlighted the need for much further work to properly understand all the risks associated with unconventional gas activities, whether that be around public health, environment, air, aquifers, water supply, soil, subsidence, economic impact, climate change, biodiversity, land productivity, agricultural industries, traditional owners and our communities.

It is my view that the risks posed by unconventional gas exploration or extraction are far too great to be managed by regulation and that those risks are far outweighed by any perceived or real benefits.

Conclusion

In conclusion, given the evidence presented to the Committee by the wide range of stakeholders, from farmer, to township group, to industry and advocacy groups alike, I am of the opinion that unconventional gas, including coal seam gas, tight gas and shale gas, poses an unacceptable threat to Victoria's farmland and communities and that this threat cannot be mitigated through regulation.

I would like to thank the Chair and members of the committee for allowing me to be an active participant even if we weren't able to come to a consensus position on the key recommendation. I would also like to thank my colleague, Ms Colleen Hartland MLC for her contribution as a participating member when I was absent. I would also like to thank the Committee Secretariat for their tireless efforts in supporting the Committee Inquiry and in preparing the Final Report in what has been an enormous task with few resources.



Samantha Dunn MLC
Member for Eastern Metropolitan Region
30 November 2015

OVERVIEW

There was unanimous agreement among members of the committee concerning appropriate legislative and regulatory safeguards to put in place should an unconventional gas industry commence in Victoria.

The Committee was not, however, able to reach an agreement on the principal recommendation of the inquiry. The two competing principal propositions considered by the committee were as follows:

- An outright ban on the unconventional gas industry in Victoria based on bringing about greater certainty
- A five-year extension of the current moratorium.

While I acknowledge the evidence received by the Committee [The Environment and Planning Committee] concerning the risk of unconventional gas extraction to human health and the environment was powerful, I do not believe that an outright ban is the right action to take. An outright ban on unconventional gas does not make allowances for future technological advances that may make unconventional gas more palatable in the future, so it could result in missed opportunities for the competitiveness of our economy and the living standards of Victorians.

On the other hand, I believe that a moratorium on unconventional gas should only be applied for another three years and not five, given the speed at which technological advances may take place.

I also rejected the recommendation of extending the current moratorium since a mere extension of the current moratorium as proposed by Coalition members would incorporate conventional gas.

The refusal of the Coalition members of the committee to decouple conventional and unconventional gas from their recommendation to extend the moratorium on onshore drilling when the committee's terms of reference did not require the committee to investigate conventional gas is misleading because it creates the impression that the committee investigated the extraction of conventional gas.

I therefore believe the inclusion of conventional gas in the five-year moratorium as recommended by Coalition members is arbitrary –it is not based on any evidence received by this inquiry.

As a result of Coalition members recommending an extension to a moratorium on conventional gas as part of the moratorium on unconventional gas (and formulating a minority report on that basis), I will also incorporate recommendations concerning conventional gas into this report.

The committee heard significant evidence that pressure is mounting for domestic gas prices to rise to a level equivalent to the world price (before the cost of liquefaction and transport is added). This would result in a doubling of gas prices for the domestic market. Yet cheap gas is the backbone of much of Victoria's manufacturing industry and is used extensively in domestic and commercial premises as both a feedstock and an energy source. It also has the potential to be an interim form of baseload energy as the state transitions from brown coal to renewables.

While the committee did emphasise the importance of maintaining a cheap ongoing supply of gas to Victoria, it did not make recommendations on the importance of implementing policy instruments to put downward pressure on gas prices.

Manufacturing renaissance: United States

The importance of proceeding with onshore gas production in the medium term cannot be overemphasised. In the United States rising shale gas production had an enormous impact in terms of jobs, increased manufacturing competitiveness and boosting the economy.

This is because, as in Australia, gas is an important component in manufacturing and industrial processes. And with cheaper locally available gas supplies the chemical, plastics, aluminium, iron and steel, rubber, coated motor vehicle and glass industries have been revitalised.

The United States went from being an importer of energy, mainly from the Middle East, to now being a net exporter. Shale gas production is a major contributor to the turnaround in the US economy.

The Australian Petroleum Production & Exploration Association (APPEA) has reported that US shale gas production is expected to create some 1.5 million jobs and is expected to continue to drive US economic growth and is projected to contribute \$332 billion to US gross domestic product (GDP) by 2035.

Conventional gas: Moratorium

The proposed inclusion of conventional gas in the present moratorium on onshore gas exploration appears to be driven by political expediency rather than good public policy outcomes. The committee received very little evidence supporting the moratorium on conventional gas exploration.

A conventional non-fracking onshore gas industry should not be caught up in the net of maintaining a moratorium for whatever period on unconventional gas. A conventional gas industry is a critical element for the future industry because it will allow us to ascertain the size of the resource and potentially will provide significant new gas onshore without fracking.

A recommendation to continue the current moratorium without stating that it does not include conventional gas would capture conventional gas by default. This means that the committee is bound to express a view on onshore conventional non fracking gas exploration and extraction. As the committee has not expressed a view on this issue, this report will argue strongly to allow conventional non-fracking gas exploration and production to proceed.

This minority report will address the negative impacts on the Victorian economy of not proceeding with gas exploration and extraction onshore within appropriate safety and regulatory arrangements. In particular, allowing conventional non-fracking gas exploration and extraction alongside of a reservation policy is crucial to maintaining low prices and saving and increasing jobs in Victoria.

RIISING GAS PRICES – EFFECTS ON JOBS AND THE ECONOMY

There are two reasons for the projected increase in gas prices. First, the increased costs of production as new gas developments are no longer underpinned by oil production. This is highlighted by Esso/BHP's new Kipper/Turrum development requiring a gas price of approx. \$5.50/Gj to break even. Offshore developments are much more expensive than onshore (up to

ten times the cost) and therefore it is increasingly less likely that gas produced from offshore can be supplied at the traditionally low prices that the state has enjoyed for the past 50 years.

Second, there is increasing pressure to utilise existing gas resources for export LNG and to bring the price of domestic gas into line with international prices. Gas suppliers now have strong incentives to ‘reserve’ gas for the export market at the expense of domestic users.

In its submission to the enquiry the AWU emphasised the negative effects of rising gas prices:

“The AWU in 2014 commissioned BIS Shrapnel to consider the economic impacts of rising gas prices on the economy in general and the manufacturing sector in particular. The main conclusions from the study are:

- Economy-wide net losses of between \$26.6 billion to \$110 billion of the value of output, and associated job losses of between 56,500 and 235,800, once you add the net indirect flow on effects
- Negative impacts on households with annual gas bills rising \$260 (26 per cent) over the next four years
- Higher greenhouse gas emissions in Australia as there is a switch to coal fired electricity generation and away from domestic gas usage.”

This point was also emphasised in the Reith Report:

“Victorians should be under no illusions. Rising gas prices will have a negative impact on Victoria’s manufacturing base. Jobs and investment are at risk. Costs of living will rise and could rise for longer if not addressed.”

– Gas Market Taskforce Chair The Hon. Peter Reith AM, October 2013

In this context it is not appropriate simply to lock up the massive potential of onshore gas reserves and not even allow conventional exploration and extraction. While the volume of the resource is not known and will not be fully established until at least conventional gas exploration commences, estimates indicate that put the volume is very significant.

A recent study by the Department of Economic Development, Jobs, Transport and Resources, Oil and Gas, for example, estimated that “1.8 to 3.7 Tcf of gas remains undiscovered. In the Gippsland Basin, it is likely that 0.6 to 2.0 Tcf of gas remains undiscovered with up to 600 million barrels of liquids.”

Victoria cannot afford to leave this resource in the ground and not allow any exploration including conventional gas extraction to take place. We need to learn from the US experience and do it better but also recognise that we must maintain our competitive advantage in lower energy prices through onshore gas production as the United States has done.

A WAY FORWARD – CONVENTIONAL GAS AND A RESERVATION POLICY

It is clear from submissions to the committee that natural gas is the only energy source that can underpin Victoria’s economy while also serving as a transitional fuel to a low-carbon economy.

If a non-fracking onshore conventional gas industry is allowed to proceed and it finds considerable onshore gas that can be extracted using conventional means, there are potentially massive benefits for the Victorian economy. Proposals to build a petrochemical plant, gas-fired power station and fertiliser plant in the Otways alone have been floated if a long-term low gas price can be negotiated.

The need to maintain cheap guaranteed supplies is evident from recent comments by the largest single user of gas, Australian Paper, which employs some 1300 people directly, that an

increase of the gas price of the scale anticipated will render their business uncompetitive. Other significant local employers, such as Qenos plastics facility, Simplot and Dow Chemicals are approaching potential conventional onshore gas exploration companies to offer contracts to buy gas at affordable prices in order to maintain or expand their operations.

None of this will occur unless two things happen as a matter of urgency:

- First, that alternative sources of gas onshore are identified and exploited using conventional non-fracking means to increase competitive pressure and hold down prices.
- Second, that all new (and perhaps ultimately also existing) sources of gas include a reservation arrangement so that a certain percentage of the gas is tagged for the local market with long term pricing guarantees at or below current domestic prices.

In addressing the first of these issues this minority report specifically endorses conventional non-fracking onshore gas in Victoria on the strict condition that any production licence will exclude fracking and will be subject to reservation conditions.

SUPPORT FOR CONVENTIONAL GAS

In its report the committee differentiated between conventional and unconventional gas noting that onshore conventional gas involves those reservoirs where the gas is trapped under pressure and where the gas will flow easily without fracking when a well is drilled.

The committee also identified a number of potential risks from unconventional, fracking-related gas extraction including risks of contamination of ground water, depletion of groundwater, increased seismicity and pollution. Uncertainty over the technical and regulatory management of these risks has generated considerable community concern and this is a reason to continue with a moratorium pending further technical and regulatory enquiries.

The committee has included in its recommendations an approach that would ultimately lead to a safe unconventional gas industry. This is despite significant disagreements as to timing. However, the committee also heard much evidence in relation to a conventional gas industry onshore with the vast majority of those providing evidence at hearings or in submissions favouring the immediate commencement of onshore conventional non fracking gas activities. One example is the Corangamite Shire.

Corangamite Shire – formal submission to the inquiry

Conventional onshore gas. We understand that there are potentially reserves of gas located onshore, particularly in the Port Campbell area. It is likely that these gas reserves can be extracted without fracking. We believe this gas should be treated in a similar manner to the offshore gas reserves. The moratorium that prohibits exploratory drilling for conventional onshore gas should, therefore, be lifted as a matter of urgency. If exploratory works prove that the gas resource is available, extraction of these reserves is supported subject to the usual environmental approvals being obtained and that no fracking be used in the extraction processes.

Unconventional gas. We do not support the moratorium on exploration activities, including drilling, for unconventional gas. It is difficult to make informed decisions on the viability or potential economic significance of unconventional gas unless we actually know if the resource exists and the nature of that resource. Any exploration activities should be subject to high levels of environmental control and landowner consultation and compensation.

Corangamite Shire – transcripts of evidence

“Corangamite understands there are potential reserves of gas located onshore, particularly in the Port Campbell area, and it is likely that these gas reserves can be extracted without fracking. We believe this gas should be treated in a similar manner to offshore gas reserves, and the moratorium that currently prohibits exploratory drilling should therefore be lifted. If exploratory works prove that gas resources are available, extraction of these reserves is supported by Corangamite subject to the usual environmental approvals” and “We support the moratorium on fracking, but we would like to see the moratorium on exploration lifted to understand what reserves are actually in existence within the shire.”

– Mr David Rae, Acting Chief Executive Officer, Corangamite Shire Council.

Mr David Davis (Chair): Thank you for those submissions. I want to come to the Corangamite submission. Chris, there are a few points that Simon has partially fleshed out. I just want to get absolutely clear in my mind: you support conventional gas extraction from a capped well?

Cr Chris O’Connor, Mayor, Corangamite Shire Council: “Yes.

“Our actual conventional gas industry is being threatened to a degree by the current moratorium. We would like to see it taken out. That is our main concern: to have it taken out and allow further exploration for conventional gas, as we have always done.

“Conventional gas just does not happen under water; it is onshore as well. As I said before, conventional gas is also much cheaper to extract, so conventional onshore gas is much cheaper to extract than offshore.”

Moyne Shire Council – transcript of evidence

“Recently, even though there is a moratorium on drilling, we have had drilling at Nirranda, because it is actually offshore gas but it is drilled from onshore. That work has been really well accepted by the community. It has caused no fuss at all in the community”

– Mr David Madden, Chief Executive Officer, Moyne Shire Council.

Protect the West Alliance – transcript of evidence

Mr John Coverdale, who appeared with the Protect the West Alliance, seemed to have no difficulty with conventional gas.

Mr John Coverdale: I am not opposed to conventional gas whereby you drill straight down, find pockets of gas and extract it. It has been around in Timboon for quite a number of years. It is offshore in the Otway Basin.

Mr Daniel Young MP: Just as a last question then, you would support lifting the moratorium for conventional gas?

Mr Coverdale: Lifting for conventional gas? I personally would, yes. But they would have to guarantee themselves that it was going to be conventional gas, and be watched.

The Australian Workers Union – formal submission

“The AWU does not buy the argument which says that unfettered access to gas to supply LNG exports will assist to lower domestic gas prices. Nor does the AWU believe that gas should be locked away for all time simply because it raises (albeit) major challenges regarding its sustainable and responsible extraction on-shore.

The Government could consider ‘fast-tracking’ approvals for proponents contributing to the reserve for ‘best-practice’ projects.

The Australian Workers Union – media comments

AWU Secretary Ben Davis is also quoted in *The Weekly Times* of 30 September 2015 as saying: “A ban on any exploration for onshore gas and extraction of conventional onshore gas would be to the detriment of all Victorian households and businesses. There’s no reason we can’t have exploration for onshore gas that doesn’t have to include fracking.”

A RESERVATION POLICY

The AWU in its submission and in subsequent comments by its secretary Ben Davis called for a reservation policy that would reserve some gas for domestic use at an affordable price. It is important to stress the concept of an affordable price.

In Western Australia, the reservation policy of 15 per cent for local consumption resulted in the most expensive gas in the country for local consumption as there was no requirement to keep prices down. We don’t want this in Victoria.

Instead we should look at policies under which companies would agree to set aside a portion of the gas deposit (e.g. 20 per cent) to be sold on the domestic market at below the prevailing local price. In return their licence applications to operate may be fast-tracked. Of course they must also meet all applicable requirements under the *Mineral Resources (Sustainable Development) Act 1990* and the *Petroleum Act 1998* and operate under additional conditions aimed at maximising local content and jobs, and cooperation with the local community.

Companies would be expected to engage with local landowners and communities as legitimate stakeholders in the development and ongoing stewardship of the industry and explain to stakeholders and the broader community the reservation and pricing obligations they have agreed to for the benefit of Victorians.

Based on the analysis above, this Minority Report proposes the following recommendations:

RECOMMENDATION 1

Enact a moratorium on unconventional, fracking-related gas production for three years – and, in line with agreed recommendations of the committee, including:

- detailed scientific research be commissioned by the government on all health and environmental risks associated with onshore unconventional gas production and how they can be contained
- a parallel process of implementing best practice in regulation, and
- economic modelling to identify potential impact in terms of jobs, manufacturing and the economy of onshore gas production.

RECOMMENDATION 2

Immediately discontinue the moratorium on conventional gas wells on the basis that any proposal to drill a conventional well will include a number of commitments by the applicants including:

- that gas production will use only conventional non-fracking means
- full consultation with local communities and landowners
- a percentage of the resource will be reserved for local businesses or consumers at a price below the prevailing local price, and
- a commitment to abide by all best practices under the various Acts and Regulations.

Minority Report on the Inquiry Into Onshore Unconventional Gas in Victoria

By

**Harriet Shing MLC (Deputy Chair) and
Shaun Leane MLC**

“The question is not have we got gas, but, at what price?”

Tony Wood, Grattan Institute

Introduction

This Minority Report has been drafted by reference to the evidence presented to the Victorian Parliamentary Inquiry Into Onshore Unconventional Gas in Victoria (Inquiry) and to the oral and written submissions made to the Inquiry by individuals, organisations and peak body representatives referred to in the Inquiry’s Interim and Final Reports.

Between us, we attended every metropolitan and regional hearing, and we have each read and assessed every submission to the Inquiry, including those submissions made by way of oral evidence (which occurred at the end of witness evidence in a number of hearings).

To the extent of any inconsistency, the Recommendation made in this Minority Report is intended to override any recommendation made in the Main Report.

Scope

As the Terms of Reference for the Inquiry specifically relate to the exploration, extraction, production and rehabilitation for onshore *unconventional* gas, this Minority Report does not express a view on conventional gas.

Victoria’s unique regional profile and productivity

Evidence to the Inquiry clearly distinguished Victoria’s agricultural profile from other parts of Australia where onshore unconventional gas industries have proceeded. In this regard, we note that significant investment has been made over a long period of time to develop and maintain domestic and international market share in a highly competitive environment and to enhance the

reputation and desirability of our meat and livestock, dairy and horticultural products.

Community engagement, education and consultation

Evidence to the Inquiry indicated a lack of sustained investment and engagement by industry in community consultation, engagement or education in communities that might be affected by the development of an unconventional gas industry in Victoria.

This is despite evidence to the Inquiry from industry of the potentially lucrative returns that onshore unconventional gas might generate in Victoria if it were to go ahead, and the long history of commercial interest in developing and growing such an industry.

Social Licence

The Inquiry was presented with overwhelming evidence that Victoria's regional communities, particularly those in the Otway and Gippsland Basins, have refused to grant any substantive form of "social licence" that might enable onshore unconventional gas exploration or extraction to take place.

It is clear that community opposition to any (further) onshore unconventional industry growth or development in Victoria has grown exponentially over time.

In fact, the evidence indicated that the actual and/or perceived risks of an unconventional gas exploration or extraction are, for an overwhelming majority of communities in regional Victoria, too great to enable exploration or extraction of onshore unconventional gas in the terms proposed by industry.

In this regard, it seems to us that the absence of scientific consensus on appropriate risk identification and management, mitigation, reparation and "best practice" within the industry as it operates elsewhere, regulatory shortcomings, and a lack of engagement between industry and communities has placed this issue well beyond the point at which an onshore unconventional industry could operate with the blessing of regional Victorians whose land, water sources and communities would or might be directly affected.

Co-existence

The Inquiry received a large volume of submissions raising a range of concerns about the impact that an onshore unconventional gas industry would have on existing industries and markets, from primary production to regional tourism.

The majority of evidence provided to the Inquiry on this issue submitted that co-existence was not possible given the actual and perceived risks that any potential unconventional industry would present.

Uncertainty for communities and industry

It was clear from evidence to the Inquiry that there is a high level of community distress and anxiety at the prospect of an onshore unconventional gas industry in Victoria. It was also evident that the prospect of any future onshore unconventional gas industry for the state is an ongoing source of uncertainty and worry – for families, farmers, and business operators in regional Victoria.

This was clearly articulated in both written submissions and at the regional hearings and not only centred around the potential environmental damage such as risk to essential water supplies but also related to Victoria's ability to retain the current reputation as a clean food producing jurisdiction which has been a pivotal element to food safety accreditations and to maintaining and building success in agricultural export markets.

A number of industry and local government witnesses also indicated a clear preference for the Inquiry to determine the question of a potential onshore unconventional gas industry in Victoria as conclusively as possible.

Extension of the Moratorium

It is our view that to extend the current moratorium for onshore unconventional gas would simply delay the making of a further decision about the potential for an onshore unconventional gas industry, and enable these existing uncertainties to continue.

Alternative energy sources

Although an onshore unconventional gas industry in Victoria might provide improved supply and pricing for gas to meet domestic and industry demand, it

is our view that the risks (including perceived risks), costs (including as they relate to potentially diminished international market demand for Victoria's prestige meat, dairy and horticultural products) and uncertainties outweigh the benefits that any industry might bring.

In this regard, it is our view there are other energy sources available to put downward pressure on prices. Specifically, the Andrews Government's commitments to new energy technology as part of the *Future Industries Fund* and renewable energy targets are illustrative of the increased policy and community appetite for energy supply that minimises the environmental, health and social impacts on affected communities.

The Final Report contains a number of Recommendations that could possibly facilitate a framework for the development of an unconventional coal seam gas industry coexisting with Victoria's vital agricultural and tourism industries, however we note that evidence was also provided to the Inquiry that questioned whether this could occur even if these recommendations were accepted and the resources and funding were invested.

As the Final Report and accompanying (unanimous) Recommendations indicate, there is a significant volume of further work required, at significant cost, *before* any onshore unconventional gas industry could potentially commence in Victoria. The funding and resourcing requirements associated with properly completing this work would be the responsibility of government, and thus taxpayers to meet.

Even after the completion of such work and for reasons such as those detailed in this Minority Report and the Interim and Final Reports, there is nonetheless a significant chance that an onshore unconventional gas industry could or would not go ahead in any event.

On this basis, it is our view that funding and resources that might otherwise be allocated to undertaking this further work are more appropriately directed to investment in the certain, predictable and long-term benefits of renewable energy initiatives, a number of which are already the subject of investments by the Andrews Government.

Conclusion and Recommendation

For these reasons, we recommend that the Government consider the following Recommendation in responding to the Interim and Final Reports.

That, in light of the Committee not receiving a body of indisputable evidence that convinced it that the current moratorium on an unconventional gas industry operating in Victoria should be lifted, and in recognition of the need to provide certainty on this issue within the terms of reference for this Inquiry, the Victorian Government introduce a permanent ban on the exploration and extraction of unconventional gas.

Signed:



Harriet Shing MLC

Deputy Chair

Member for Eastern Victoria Region



Shaun Leane MLC

Member for Eastern Metropolitan Region