



CCOF A COMMUNITY CLIMATE ACTION GROUP :: GLEN EIRA & MONASH, MELBOURNE

Submission to the Inquiry into Unconventional Gas in Victoria

**Climate Change Our Future
10 July 2015**

Contents

1	Introduction	1
2	Environmental impacts	1
2.1	Risks to agriculture.....	1
2.2	Water security and quality	1
2.3	Fire	2
2.4	Habitat	3
2.5	Greenhouse emissions	3
3	Human impacts	5
4	Economic impacts	6
4.1	Off-site property damage	6
4.2	Gas supplies.....	7
4.3	Remediation	8
5	Uncertainty	9

1 Introduction

Climate Change Our Future (CCOF) welcomes the opportunity to contribute to the Inquiry into Unconventional Gas in Victoria.

CCOF is a community-based group of residents from the Monash and Glen Eira municipalities who are concerned about climate change.

CCOF opposes the commencement of unconventional gas production in Victoria on environmental, social and economic grounds. Instead, we support the apparent bipartisan support for the development of renewable energy sources and energy efficiency measures.

2 Environmental impacts

2.1 Risks to agriculture

Victoria accounts for the largest share of Australia's food and fibre exports, and about half of Victoria's goods exports are derived from the sector. Agriculture underpins domestic food security, and is the foundation of rural and regional communities across Victoria.

Unconventional gas production poses a range of threats to Victoria's agriculture sector, most notably contamination of land and water, and fragmentation of land by well pads, pipes and roads¹. While the risks discussed below also have broader impacts, they are particularly relevant to rural communities and farm lands where unconventional gas production is proposed to take place.

2.2 Water security and quality

Australia is the driest inhabited continent on Earth, and climate change looks set to worsen water scarcity. Like many regions of the world, Australian aquifers are already under significant and unsustainable strain². This underlines the importance of protecting water resources from over-exploitation and contamination.

¹ A. Wasley, 'Fracking poses risk to UK farm animals and food safety, experts warn', *The Ecologist*, 17 September 2013, http://www.theecologist.org/News/news_analysis/2082668/fracking_poses_risk_to_uk_farm_animals_and_food_safety_experts_warn.html, (accessed 10 July 2015).

² D. Eamus, 'Declining groundwater is a big problem for Australia', *ABC The Drum* [website], 18 June 2015, <http://www.abc.net.au/news/2015-06-18/eamus-declining-groundwater-is-a-big-problem-for-australia/6556586>, (accessed 5 July 2015).

Some forms of unconventional gas production can consume large volumes of water and compete for scarce supplies with domestic, agricultural and other commercial uses³.

So-called 'beneficial use' of water produced from fracking has been proposed as a means of dealing with large volumes of water pumped from unconventional gas wells, particularly in the early stages of production. Produced water tends to be high in salinity and often contains heavy metals and chemicals used during the fracking process. This makes produced water highly unsuited to irrigation or release into natural water bodies. Even after treatment by reverse osmosis, produced water can remain high in salinity and metals⁴, and the removed solids present their own costly disposal challenges⁵.

Dangerous contaminants have been found in groundwater in proximity to onshore gas operations in other parts of Australia and overseas. Numerous examples of surface-level toxic chemical spillages exist where onshore gas production takes place. For example, a coal seam gas project in north western New South Wales contaminated nearby aquifers with heavy metals including uranium, arsenic and lead⁶. A recent study in Texas has revealed widespread contamination of groundwater by chemicals known to be used in unconventional gas operations⁷.

2.3 Fire

Victoria is one of the most fire-prone regions on earth, with the 2009 Black Saturday bushfires only one of the more recent examples of the state's vulnerability. This vulnerability is only likely to worsen with climate change⁸.

In such a fire-prone region, onshore gas operations present a particular risk that lacks parallel in most major unconventional gas producing regions. Gas leaks or flaring from onshore gas operations would raise additional fire risks that are currently not present in Victoria. Even if fires do not originate from gas operations, the gas facilities would represent dangerous contributors to fire intensity, and complicate fire management. These risks could potentially outlive the productive lifespan of the wells themselves.

³ K. Valentine, 'Despite Historic Drought, California Used 70 Million Gallons of Water For Fracking Last Year', *Climate Progress*, 6 April 2015, <http://thinkprogress.org/climate/2015/04/06/3643184/california-70-million-gallons-fracking/>, (accessed 5 July 2015).

⁴ R. Casson, 'AGL's irrigation trial ends in doubt', *Manning River Times*, 29 April 2015, <http://www.manningrivertimes.com.au/story/3044536/agls-irrigation-trial-ends-in-doubt/>, (accessed 5 July 2015).

⁵ P. Hannam, 'Santos CSG wastewater to top 1 million litres a day – with nowhere to go', *The Sydney Morning Herald*, 28 March 2015, <http://www.smh.com.au/environment/santos-csg-wastewater-to-top-1-million-litres-a-day-with-nowhere-to-go-20150328-1m91rz.html>, (accessed 5 July 2015).

⁶ C. Flint, 'Revealed: EPA investigation report shows extent of Pilliga contamination', *Lock The Gate Alliance*, 2014, http://www.lockthegate.org.au/revealed_epa_investigation_report_shows_extent_of_pilliga_contamination, (accessed 5 July 2015).

⁷ Z. Hildenbrand et al, 'A Comprehensive Analysis of Groundwater Quality in The Barnett Shale Region', *Environmental Science & Technology*, vol. 49, no. 13, 2015, pp. 8254-8262, doi: 10.1021/acs.est.5b01526, <http://dx.doi.org/10.1021/acs.est.5b01526>, (accessed 5 July 2015).

⁸ K. Hennessy et al, *Climate change impacts on fire-weather in south-east Australia*, 2005, CSIRO Marine and Atmospheric Research, http://www.cmar.csiro.au/e-print/open/hennessykj_2005b.pdf, (accessed 5 July 2015).

2.4 Habitat

Clearing of vegetation for gas operations and access may contribute to habitat destruction and fragmentation⁹. This would contribute to species vulnerability and harm the resilience of natural systems in the face of climate change, as well as impinge on the public's use and enjoyment of affected land. These impacts could be particularly pronounced where large areas are cleared around gas operations due to fire risk.

2.5 Greenhouse gas emissions

2.5.1 Practice fails to live up to theory

Gas combustion is claimed to have lower emissions intensity than burning coal. However, fugitive emissions across the gas supply chain add to the greenhouse intensity of gas and should be included in any comparison of energy sources. Methane, which is the major component of these fugitive emissions, is 56 times more potent than carbon dioxide on a 20 year time frame.

Once fugitive emissions are taken into account, gas may be more greenhouse intensive than coal, and certainly more greenhouse intensive than renewable energy¹⁰. At the very least, gas fails to offer emissions reductions of the magnitude offered by renewable sources, and would lead to higher emissions to the extent it displaces or crowds out renewable generation.

⁹ L. Straub, 'After the Frack: Habitat Fragmentation', *Earth Island Journal*, 2 July 2015, http://www.earthisland.org/journal/index.php/elist/eListRead/after_the_frack_habitat_fragmentation/, (accessed 5 July 2015).

¹⁰ R. Howarth and R. Santoro and A. Ingraffea, 'Methane and the greenhouse-gas footprint of natural gas from shale formations', *Climatic Change*, vol. 106, no. 4, June 2011, pp. 679-690, DOI 10.1007/s10584-011-0061-5, <http://www.acsf.cornell.edu/Assets/ACSF/docs/attachments/Howarth-EtAl-2011.pdf>, (accessed 5 July 2015).
D. Lyon et al, 'Constructing a Spatially Resolved Methane Emission Inventory for the Barnett Shale Region', *Environmental Science & Technology*, vol. 49, no. 13, 2015, pp. 8147-8157, DOI: 10.1021/es506359c, <http://pubs.acs.org/doi/abs/10.1021/es506359c>, (accessed 9 July 2015).
Beyond Zero Emissions, *Fugitive emissions: what is the real footprint of coal seam gas?*, <https://bze.org.au/media/newswire/fugitive-emissions-what-real-footprint-coal-seam-gas-110822>, (accessed 5 July 2015).

C. Dobney, 'SCU researchers trace methane emissions to CSG mines', *Echo Netdaily*, 19 November 2014, <http://www.echo.net.au/2014/11/scu-researchers-trace-methane-emissions-csg-mines/>, (accessed 5 July 2015).

2.5.2 Incremental emission reductions are a non-solution

There is widespread agreement among climate scientists that human activities are causing warming of the global climate¹¹. Furthermore, any uncertainty around the strength of impacts is actually grounds for more ambitious emission reduction measures, rather than delay¹².

International climate negotiations are often framed around restricting global warming to less than two degrees Celsius to prevent dangerous climate change. However, many now see 1.5 degrees as the only prudent threshold to avoid catastrophic outcomes¹³. It would be unwise to commit resources to a development path that was inconsistent with either of these thresholds since it would result in the allocation of scarce capital to ultimately stranded assets at the cost of activities with better long term economic prospects¹⁴. Expanding carbon-intensive activities would also make the inevitable transition away from them unnecessarily painful and uncertain for affected communities. This transition would be made more difficult where non-extractive industries have been undermined by fossil fuel developments due to effects including land use changes, soil and water contamination, and competition for labour¹⁵.

In modern society, most engineering standards are aimed at reducing risk of catastrophic failure to very low levels, typically in the order of fractions of one percent. For example, it would be unacceptable to specify that a bridge design should have a 10 per cent probability of collapse under typical loads.

The probability of exceeding two degrees of warming has already exceeded 10 per cent at current greenhouse gas concentrations¹⁶. In other words, there is a real and growing risk that we will fail to meet an inadequate target. The inevitable conclusion is that there is no room for new fossil fuel developments if we are to be confident about avoiding dangerous climate change. The window of opportunity for 'transition fuels' such as gas has closed, and zero-emissions energy sources are now the only defensible option.

¹¹ J. Cook et al, 'Quantifying the consensus on anthropogenic global warming in the scientific literature', *Environmental Research Letters*, vol. 8, no. 2, April-June 2013, <http://iopscience.iop.org/1748-9326/8/2/024024>, (accessed 5 July 2015).

¹² S. Lewandowsky et al, 'Scientific uncertainty and climate change: Part I. Uncertainty and unabated emissions', *Climatic Change*, vol. 124, no. 1-2, 2014, pp. 21-37, <http://link.springer.com/article/10.1007/s10584-014-1082-7>, (accessed 5 July 2015).

¹³ P. Trivedi, 'Why 2 Degrees Of Global Warming Is Still Too Much', *The Huffington Post*, 6 July 2015, http://www.huffingtonpost.in/pari-trivedi/limiting-global-warming-t_b_7686856.html, (accessed 5 July 2015).
D. Spratt, *Recount - It's time to "do the math" again*, 2015, Breakthrough Discussion Series, p.6, <http://www.nocarbonbudget.info/>, (accessed 5 July 2015).

¹⁴ C. Aldern, 'Fossil fuels are terrible investments, says top energy economist', *Grist* [website], 9 July 2015, <http://grist.org/news/fossil-fuels-are-terrible-investments-says-top-energy-economist/>, (accessed 10 July 2015).
C. McGlade and P. Ekins, 'The geographical distribution of fossil fuels unused when limiting global warming to 2 degrees C', *Nature*, vol. 517, no. 7533, 2015, pp.187-190, <http://dx.doi.org/10.1038/nature14016>, (accessed 5 July 2015).

¹⁵ T. Colebatch, 'Irish nightmare: Prepare', *The Age*, 27 March 2012, <http://www.theage.com.au/federal-politics/political-opinion/irish-nightmare-prepare-20120326-1vumc>, (accessed 5 July 2015).

¹⁶ D. Spratt, *Recount - It's time to "do the math" again*, 2015, Breakthrough Discussion Series, pp. 4-5, <http://www.nocarbonbudget.info/>, (accessed 5 July 2015).

Recommendation

Place a permanent prohibition on the development of new fossil fuel reserves in Victoria including unconventional gas.

3 Human impacts

There is growing evidence of numerous negative health impacts from unconventional gas operations¹⁷. For example, higher incidences of skin and respiratory conditions are reported in the vicinity of unconventional gas operations. These impacts are consistent with the intentional and unintentional release of toxic gases and chemicals¹⁸ that are known to be

¹⁷ G. McCarron, *Symptomatology of a gas field - An independent health survey in the Tara rural residential estates and environs*, April 2013.

L. Reynard, 'Fracking Linked to Increased Infant Mortality in Alarming New Study', *AlterNet*, 25 June 2015, <http://www.alternet.org/environment/fracking-linked-increased-infant-mortality-alarming-new-study>, (accessed 5 July 2015).

Concerned Health Professionals of New York, *Compendium of scientific, medical, and media findings demonstrating risks and harms of fracking (unconventional gas and oil extraction) (2nd ed.)*, 11 December 2014, <http://concernedhealthny.org/compendium/>, (accessed 5 July 2015).

W. Hauter, 'Shocking Documents Reveal Fracking Health Complaints Swept Under the Rug in Pennsylvania', *EcoWatch*, 30 June 2015, <http://ecowatch.com/2015/06/30/fracking-health-complaints/>, (accessed 5 July 2015).

M. Carey, 'Air pollution from coal seam gas may put public health at risk', *The Conversation*, 20 November 2012, <https://theconversation.com/air-pollution-from-coal-seam-gas-may-put-public-health-at-risk-10819>, (accessed 5 July 2015).

L. Legere, 'Pennsylvania records shed light on shale-related health concerns', *Pittsburgh Post-Gazette*, 24 June 2015, <http://powersource.post-gazette.com/powersource/home-powersource/2015/06/24/Shale-related-health-concerns-spotlighted/stories/201506220025>, (accessed 5 July 2015).

E. Hill, *Three Essays On The Impacts Of Unconventional Drilling On Early Life Health*, PhD Thesis, Cornell University, 2014, <http://hdl.handle.net/1813/38804>

¹⁸ E. Esswein et al, 'Preliminary Field Studies on Worker Exposures to Volatile Chemicals during Oil and Gas Extraction Flowback and Production Testing Operations', *NIOSH Science Blog*, Centers for Disease Control and Prevention, 21 August 2014, <http://blogs.cdc.gov/niosh-science-blog/2014/08/21/flowback-2/>, (accessed 5 July 2015).

L. Barker, 'AGL's CSG blunders flare at Gloucester and expose EPA', *Independent Australia*, 15 April 2015, <https://independentaustralia.net/business/business-display/agls-csg-blunders-flare-at-gloucester-and-expose-epa,7587>, (accessed 5 July 2015).

associated with negative health impacts¹⁹. Heavy vehicle movements associated with gas operations even appear to have a negative impact on road safety²⁰.

While some of the health impacts are acute, unconventional gas operations appear to be related to higher incidence of chronic or longer-term conditions. For instance, substances used in gas operations are known carcinogens, and the impacts may not become apparent until long after exposure. Therefore, it seems likely that the full health impact of the recent expansion of unconventional gas production in Australia is yet to emerge.

Recommendation

Extend the moratorium on unconventional gas indefinitely while ever uncertainty over health impacts remains.

4 Economic impacts

4.1 Off-site property damage

4.1.1 Earthquakes

Unconventional gas operations have been linked to increased seismic activity and may contribute to larger seismic events²¹. This poses the risk of damage to property that is distant from gas operations. Southern Victoria is one of the most seismically active in Australia and

¹⁹ WHO, *Exposure to Benzene: A Major Public Health Concern*, World Health Organisation, 2010, Geneva, <http://www.who.int/ipcs/features/benzene.pdf>, (accessed 5 July 2015).

F. Ballester et al, 'Benzene Exposure and Respiratory Health in Children: A Systematic Review of Epidemiologic Evidences', *Journal of Pollution Effects and Control*, vol. 2, no. 2, 2014, doi: 10.4172/2375-4397.1000114, <http://www.esciencecentral.org/journals/benzene-exposure-and-respiratory-health-in-children-a-systematic-review-of-epidemiologic-evidences-2375-4397.1000114.php?aid=33894>, (accessed 5 July 2015).

L. McKenzie et al, 'Human health risk assessment of air emissions from development of unconventional natural gas resources', *Science of The Total Environment*, vol. 424, 1 May 2012, pp. 79-87, <http://dx.doi.org/10.1016/j.scitotenv.2012.02.018>, <http://www.sciencedirect.com/science/article/pii/S0048969712001933>, (accessed 5 July 2015).

A. Rowell, 'Fracking poses 'significant' risk to humans and should be temporarily banned across EU, says new report', *The Independent*, 20 June 2015, <http://www.independent.co.uk/environment/fracking-poses-significant-risk-to-humans-and-should-be-temporarily-banned-across-eu-says-new-report-10334080.html>, (accessed 5 July 2015).

²⁰ L. Olsen, 'Fatal truck accidents have spiked during Texas' ongoing fracking and drilling boom', *Houston Chronicle*, 15 September 2014, <http://www.chron.com/news/article/Fracking-and-hydraulic-drilling-have-brought-a-5747432.php>, (accessed 5 July 2015).

²¹ F.R. Walsh III and M. Zoback, 'Oklahoma's recent earthquakes and saltwater disposal', *Science Advances*, vol 1, no. 5, 5 June 2015, <http://advances.sciencemag.org/content/1/5/e1500195>, (accessed 5 July 2015).

M. Weingarten et al, 'High-rate injection is associated with the increase in U.S. mid-continent seismicity', *Science*, vol.348, no.6241, 2015, pp.1336-1340, DOI: 10.1126/science.aab1345, <http://www.sciencemag.org/content/348/6241/1336>, (accessed 5 July 2015).

M. Petersen et al, Incorporating induced seismicity in the 2014 United States National Seismic Hazard Model—Results of 2014 workshop and sensitivity studies: U.S. Geological Survey Open-File Report 2015–1070, 2015, 69 p., <http://dx.doi.org/10.3133/ofr20151070>, <http://pubs.usgs.gov/of/2015/1070/>, (accessed 5 July 2015).

holds the potential for a larger earthquake than those typically associated with the region in recent times²². Unconventional gas operations would appear to heighten these risks.

4.1.2 Road damage

Heavy vehicle movements associated with gas operations damage local roads²³. However, local government does not receive any funding under the heavy vehicle charging regime currently operating in Australia. Furthermore, unlike wind farms²⁴, it appears that current Victorian legislation would exempt unconventional gas operations from both local government rates²⁵ and land tax²⁶.

This appears to impose significant costs onto local ratepayers in the form of damaged roads and higher road construction and maintenance costs.

Recommendation

Remove extractive industry exemptions from local government rates and land tax.

4.2 Gas supplies

In the absence of a domestic reservation policy that supplies more gas to the domestic market than would otherwise occur, it is not plausible that gas producers would sell to Australian consumers at a price lower than they could obtain from the overseas market. Thus, domestic prices for gas will be driven more by global prices than local production, as noted by the NSW Independent Pricing and Regulatory Tribunal in their submission to the Inquiry into the supply and cost of gas and liquid fuels in New South Wales²⁷.

Noted economist Nicholas Stern has described suggestions that fracking in the United Kingdom would lower gas prices as “baseless economics”, and noted that:

“Gas is a commodity that can be traded on the international market, meaning that it will be sold to the highest bidder, whether inside or outside the UK.”²⁸

²² University of Melbourne, *The big earthquake still building SE Australia* [media release], 19 December 2002, <http://archive.uninews.unimelb.edu.au/view-31008.html>, (accessed 5 July 2015).

²³ S. Abramzon et al. 'Estimating the Consumptive Use Costs of Shale Natural Gas Extraction on Pennsylvania Roadways.' *Journal of Infrastructure Systems*, vol. 20, no. 3, September 2014, 06014001, <http://ascelibrary.org/doi/abs/10.1061/%28ASCE%29IS.1943-555X.0000203>, (accessed 5 July 2015).

²⁴ L. Ewbank, 'RET Road Trip #4 – Wind farms keep council budgets healthy', *Renew Economy*, 8 May 2014, <http://reneweconomy.com.au/2014/ret-road-trip-4-wind-farms-keep-council-budgets-healthy-50125>, (accessed 5 July 2015).

²⁵ *Local Government Act 1989 (Vic)* s 154(2)(e).

²⁶ *Land Tax Act 2005 (Vic)* s 86.

²⁷ IPART, 2014, *Submission to the Inquiry into The supply and cost of gas and liquid fuels in New South Wales*, Independent Pricing and Regulatory Tribunal, Sydney, <https://www.parliament.nsw.gov.au/prod/parliament/committee.nsf/0/EFB3F0C1908F7B21CA257DC70005B1B2>, (accessed 5 July 2015).

²⁸ T. Bawden, 'Baseless economics': Lord Stern on David Cameron's claims that a UK fracking boom can bring down price of gas, *The Independent*, 3 September 2013,

Meanwhile, the ability of conventional sources in Bass Strait to supply east coast markets “indefinitely” has been noted within the industry²⁹, and analysts expect global gas prices to remain weak well into next decade as a result of oversupply³⁰. This oversupply, along with the need for global emissions reductions³¹, also cast doubt on the viability of new gas production within Victoria.

Recommendation

The Committee note that unconventional gas production in Victoria would not result in significantly lower prices for industrial or residential consumers, especially while Australian producers continue to pursue export markets.

4.3 Remediation

The oil and gas sector has traditionally experienced cyclical booms and busts. However, the need to decarbonise the economy is expected to bring about a secular decline in the industry. Many analysts see little prospect for significant recovery from the current low prices for coal, oil and gas³².

US states such as Wyoming have been left with large unfunded remediation costs as drilling companies fall victim to plunging gas prices³³. Closer to home, the refusal by GDF Suez to contribute to the costs of fighting the 2014 Hazelwood fire also raises doubts about the adequacy of the rehabilitation bond regime in Victoria³⁴.

As noted above, fugitive emissions at even relatively low leakage rates can make the gas supply chain more greenhouse intensive than coal. By their nature, gas wells are more susceptible to leakage than mines where solid materials were extracted. Abandoned wells may also connect aquifers and gas reservoirs long after production has ceased. Studies of

<http://www.independent.co.uk/news/uk/politics/baseless-economics-lord-stern-on-david-camerons-claims-that-a-uk-fracking-boom-can-bring-down-price-of-gas-8796758.html>, (accessed 5 July 2015).

²⁹ P. Manning, 'Even gas execs admit that we don't need more gas drilling in NSW', *Crikey*, 16 February 2015, <http://www.crikey.com.au/2015/02/16/even-gas-execs-admit-that-we-dont-need-more-gas-drilling-in-nsw/>, (accessed 5 July 2015).

³⁰ A. Macdonald-Smith, Citigroup sees LNG project delays as 'buyer's market' prevails until 2022-23, *Australian Financial Review*, 30 June 2015, <http://www.afr.com/business/energy/gas/citigroup-sees-lng-project-delays-as-buyers-market-prevails-until-202223-20150630-gi13v7>, (accessed 5 July 2015).

³¹ D. Carrington, 'Billions in gas projects stranded by climate change action, says thinktank', *The Guardian*, 7 July 2015, <http://www.theguardian.com/environment/2015/jul/07/gas-projects-climate-change-billions-thinktank>, (accessed 5 July 2015).

³² 'The End of Coal?', *4 Corners* [TV program], ABC1, 15 June 2015, <http://www.abc.net.au/4corners/stories/2015/06/15/4253096.htm>

³³ D. Frosch, 'Wyoming May Act to Plug Abandoned Wells as Natural Gas Boom Ends', *The New York Times*, 24 December 2013, <http://www.nytimes.com/2013/12/25/us/state-may-act-to-plug-abandoned-wyoming-wells-as-natural-gas-boom-ends.html>, (accessed 5 July 2015).

³⁴ T. Arup, 'Hazelwood owners GDF Suez refusing to pay \$18 million mine fire bill', *The Age*, 6 July 2015, <http://www.theage.com.au/victoria/hazelwood-owners-gdf-suez-refusing-to-pay-18-million-mine-fire-bill-20150706-gi6e6y.html>, (accessed 5 July 2015).

M. Seccombe, 'Mining's multi-billion-dollar black hole', *The Saturday Paper*, 24 May 2014, <https://www.thesaturdaypaper.com.au/news/politics/2014/05/24/minings-multi-billion-dollar-black-hole/1400853601>, (accessed 5 July 2015).

oil and gas wells show significant integrity failures in some areas, however ongoing monitoring is often limited or non-existent³⁵.

We are not confident that the ongoing integrity of unconventional gas wells could be guaranteed in Victoria, particularly given the potential for seismic activity in proposed production regions and the uncertain longer-term commercial prospects for gas producers. This imposes significant risk on Victorians for the remediation and ongoing management of abandoned gas well in perpetuity, as well as the costs of contamination that may emerge over time.

Recommendation

Strengthen the remediation bond regime to ensure Victorians are fully protected from remediation and site management costs resulting from the operations of extractive industries, including where operators enter liquidation or bankruptcy.

5 Uncertainty

Proper consideration of the risks of unconventional gas production is hampered by incomplete oversight and reporting in established production regions. For example, a draft assessment by the US EPA noted a lack of baseline water quality data near fracking operations, and confidentiality restrictions over reporting of chemical use³⁶. Governments also appear to be reluctant to acknowledge the negative impacts of unconventional gas production on local communities³⁷.

Some jurisdictions have even limited the ability of medical professionals to discuss possible contamination with their clients³⁸. This clearly impedes the ability of researchers to examine linkages between unconventional gas operations and health effects³⁹.

³⁵ R. Jackson, 'The integrity of oil and gas wells', *Proceedings of the National Academy of Sciences of the United States of America*, vol. 111, no. 30, 2014, pp. 10902–10903. doi:10.1073/pnas.1410786111, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4121783/>, (accessed 5 July 2015).

A. Ingraffea et al, 'Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012', *Proceedings of the National Academy of Sciences of the United States of America*, vol. 111, no. 30, 2014, pp. 10955–10960. doi:10.1073/pnas.1323422111, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4121786/>, (accessed 5 July 2015).

R. Davies et al, 'Oil and gas wells and their integrity: Implications for shale and unconventional resource exploitation', *Marine and Petroleum Geology*, vol. 56, September 2014, pp. 239–254, doi:10.1016/j.marpetgeo.2014.03.001, <http://www.sciencedirect.com/science/article/pii/S0264817214000609>, (accessed 5 July 2015).

³⁶ United States Environmental Protection Agency, Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources - Executive Summary, External Review Draft, June 2015, p. ES-22, http://www2.epa.gov/sites/production/files/2015-06/documents/hf_es_erd_jun2015.pdf, (accessed 5 July 2015).

³⁷ T. Bosworth, *Defra fracking report – the truths the Government tried to hide*, 2015, Friends of the Earth, London, <http://www.foe.co.uk/blog/defra-fracking-report-truths-government-tried-hide>, (accessed 5 July 2015).

³⁸ S. Weinberger et al, 'Legislative Interference with the Patient–Physician Relationship', *New England Journal of Medicine*, vol. 367, no. 16, 2012, pp. 1557–1559, DOI: 10.1056/NEJMSb1209858, <http://www.nejm.org/doi/full/10.1056/NEJMSb1209858>, (accessed 5 July 2015).

³⁹ M. Bamberger and R. Oswald, 'Impacts of gas drilling on human and animal health', *New Solutions*, vol. 22, no. 1, 2012, pp. 51–77, doi: <http://dx.doi.org/10.2190/NS.22.1.e>, http://www.psehealthyenergy.org/data/Bamberger_Oswald_NS22_in_press.pdf, (accessed 5 July 2015).

Furthermore, the relatively recent emergence of horizontal hydraulic fracturing is unlikely to have allowed sufficient time for all negative impacts to emerge. For example, leakages may not have yet leached through to groundwater, and health impacts that do not become symptomatic until some time after exposure may not have begun to emerge in exposed populations.

Given these constraints, the negative impacts that are apparent so far should be considered a lower bound on the possible range of harmful consequences of unconventional gas production. As with the lower bound of any range of uncertainty, the actual level of harm is likely to be somewhat higher than apparent so far, and potentially much higher. As a consequence, the precautionary approach should be adopted in considering whether an unconventional gas industry should be allowed to establish itself in Victoria.