

**From:** Joy Oddy [REDACTED]  
**Sent:** Thursday, 9 July 2015 10:51 AM  
**To:** EPC  
**Subject:** Submission to the Inquiry into Unconventional Gas in Victoria  
**Attachments:** Unconventional Gas - VIC submission 07-15.pdf

Dear Committee members,

Please find attached submission to the Inquiry into Unconventional Gas in Victoria from Doctors for the Environment Australia (DEA).

DEA requests the opportunity to be able to present our submission in person at a parliamentary hearing of the Inquiry into Unconventional Gas. Adj. Assoc. Prof. Marion Carey, Senior Researcher Public Health Monash University and myself would be please to present however Prof. Carey is likely to require teleconference facilities if possible as she is presently based interstate.

DEA has been active in its investigation of peer reviewed scientific literature of the health impacts of the gas industry since 2011. DEA has written submissions to the NSW, SA, NT, WA and Tasmanian governments and presented at several interstate inquiries including a federal inquiry in Canberra. DEA has also developed policy statements, discussion papers and information sheets on the gas and unconventional gas industries. We feel that we have gathered a comprehensive body of current knowledge in relation to the health implications of the industry in particular, and would welcome the opportunity to present to the Parliamentary Committee.

Could you also please notify us when we are permitted to upload our submission to our website [www.dea.org.au](http://www.dea.org.au)

Yours sincerely,

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# Submission to the Inquiry into Unconventional Gas in Victoria

July 2015



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Healthy planet, healthy people.

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## Introduction

Doctors for the Environment Australia (DEA) is an independent, self-funded, non-government organisation of medical doctors and students in all Australian States and Territories. Our members work across all specialties in community, hospital and private practices. We work to prevent and address the health risks - local, national and global - caused by damage to our natural environment. We are a public health voice in the sphere of environmental health with a primary focus on the health harms from pollution and climate change.

DEA welcomes the parliamentary enquiry into the onshore gas industry in Victoria, and the opportunity to comment on the health implications of the industry, including the risk of hydraulic fracturing or fracking.

In recent years, Australia has seen exponential growth in interest and development of exploration and drilling for unconventional gas reserves from coal seams, shale deposits and tight sands. These reserves require special techniques such as fracking, in-seam and horizontal drilling. DEA 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.

There is mounting evidence in the published scientific literature outlining threats posed to human health through unconventional gas development (UGD). If revenue generation from royalties and profits for developers is seen to be the imperative for unconventional gas drilling in Victoria, a full cost-benefit-analysis is required, including the external costs of adverse health outcomes, the costs of necessary extensive air and water monitoring and the negative economic effects of public health risks and psychosocial impacts.

The Australian Medical Association (AMA) has urged governments to ensure that all future proposals for UGD are subject to rigorous and independent health risk assessments, which take into account the potential for exposure to pollutants through air and groundwater and any likely associated health risks.

<https://ama.com.au/media/ama-calls-coal-seam-gas-health-checks>

This sentiment has been echoed by the United Kingdom's Chief Scientific Adviser, whose annual report drew a direct comparison between hydraulic fracturing technology and past health issues including exposure to asbestos and tobacco (Smith 2014). In July 2015, New York State officially banned fracking for natural gas by issuing its final environmental impact statement, concluding seven years of analysis by the state Department of Environmental Conservation (DEC). <http://rt.com/usa/270562-new-york-fracking-ban/>

Most importantly, any risk/benefit analysis of the industry needs to consider that the projected gas needs of Victoria are decreasing. Current supply is in line with both current and projected demands for at least the next 20 years, precluding any need for urgent approval of gas drilling licences.

<http://www.aemo.com.au/Gas/Planning/Gas-Statement-of-Opportunities>

This submission draws on the work of DEA in previous submissions to both federal and state governments and related authorities in Tasmania, Western Australia, New South Wales, the Northern Territory and South Australia, but also takes into account a growing body of peer-reviewed scientific research into the human health and environmental impacts of unconventional gas extraction.

- DEA Submission to the Inquiry into Unconventional Gas (Fracking) – South Australia. January 2015.  
[http://dea.org.au/images/uploads/submissions/Inquiry\\_into\\_Unconventional\\_Gas\\_SA\\_-\\_01-15.pdf](http://dea.org.au/images/uploads/submissions/Inquiry_into_Unconventional_Gas_SA_-_01-15.pdf)

- DEA Submission to the Review of Hydraulic Fracturing (Fracking) in Tasmania. December 2014.  
[http://dea.org.au/images/uploads/submissions/Review\\_of\\_Hydraulic\\_Fracturing\\_%28Fracking%29\\_in\\_Tasmania\\_12-14.pdf](http://dea.org.au/images/uploads/submissions/Review_of_Hydraulic_Fracturing_%28Fracking%29_in_Tasmania_12-14.pdf)
- DEA Submission to the Hydraulic Fracturing Inquiry Northern Territory. May 2014.  
[http://dea.org.au/images/uploads/submissions/DEA\\_Hydraulic\\_fracturing\\_in\\_NT\\_inquiry\\_final.pdf](http://dea.org.au/images/uploads/submissions/DEA_Hydraulic_fracturing_in_NT_inquiry_final.pdf)
- DEA Submission to the Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas. September 2013.  
[http://dea.org.au/images/uploads/submissions/WA\\_Inquiry\\_into\\_Hydraulic\\_Fracturing\\_-\\_UG\\_Submission\\_09-13.pdf](http://dea.org.au/images/uploads/submissions/WA_Inquiry_into_Hydraulic_Fracturing_-_UG_Submission_09-13.pdf)
- DEA Submission on the Coal Seam Gas Activities in NSW by the Chief Scientist and Engineer. May 2013.  
[http://dea.org.au/images/uploads/submissions/Review\\_of\\_CSG\\_in\\_NSW\\_-\\_Chief\\_Scientist\\_Submission\\_05-13.pdf](http://dea.org.au/images/uploads/submissions/Review_of_CSG_in_NSW_-_Chief_Scientist_Submission_05-13.pdf)
- Submission to the Parliament of NSW Coal Seam Gas Inquiry. September 2011.  
[http://www.parliament.nsw.gov.au/prod/parliament/committee.nsf/0/f96d076732225603ca25791b00102098/\\$FILE/Submission\\_0412.pdf](http://www.parliament.nsw.gov.au/prod/parliament/committee.nsf/0/f96d076732225603ca25791b00102098/$FILE/Submission_0412.pdf)
- Submission to the Federal Senate Inquiry into the management of the Murray Darling Basin impacts of CSG. June 2011.  
[http://dea.org.au/images/uploads/submissions/MDB\\_CSG\\_Senate\\_submission\\_June\\_2011.pdf](http://dea.org.au/images/uploads/submissions/MDB_CSG_Senate_submission_June_2011.pdf)

DEA's current position statement on Unconventional Gas Development can be found here: [http://dea.org.au/images/general/DEA\\_Position\\_Statement\\_-\\_Unconventional\\_Gas\\_Development\\_-\\_April\\_2015.pdf](http://dea.org.au/images/general/DEA_Position_Statement_-_Unconventional_Gas_Development_-_April_2015.pdf).

## Key recommendations

1. That the Victorian government applies a precautionary principle towards risk management of the health effects of any further development of the unconventional gas industry.
2. That the exploration and extraction of unconventional gas in Victoria, including the use of hydraulic fracturing, be subject to an indefinite moratorium until research can clearly demonstrate that key determinants of human health are not compromised.
3. A mandatory full public disclosure of all chemicals used in the gas industry, and assessment of all chemicals for safety by the national industrial chemical regulator.
4. If the moratorium is rejected, adequate environmental monitoring be undertaken for the lifetime the project, including:
  - independently audited water and air monitoring programs with publicly available results
  - effective independent monitoring and reporting of waste water produced and methods of disposal
  - sufficient capacity and resources to effectively oversee compliance
  - full life cycle analysis of greenhouse gas from UGD
5. If the moratorium is rejected, mandatory Health Impact Assessments for all UGD appropriate to the industry, including:
  - comprehensive epidemiological studies of population health both before and after gas extraction commences

- support for research on potential health effects of UGD independent of industry funding, including long term prospective health studies
- health surveillance of persons living and working near major UGD

## Responses to the terms of reference

### Risks to public health

#### Hydraulic Fracturing Fluids: Chemical Toxicology and Exposure Pathways

Hydraulic fracturing involves pumping large volumes of water with added sand and chemicals into coal seams or shale to open up cracks and allow gas to be driven towards extraction points. The risk of fracturing chemicals directly contaminating water used for drinking, livestock or soil irrigation has been one of the main causes of public concern (Coram et al). Contamination of adjacent beneficial aquifers has been documented in Australia and overseas. Although chemicals may be diluted, the toxicological effects of many of the chemicals has not been adequately assessed and even in diluted form may have unintended human health impacts. In particular chemicals affecting the endocrine system, such as ethoxylated 4-nonylphenol, can adversely affect the human endocrine systems at extremely low concentrations by binding to oestrogen receptors (Coram et al).

Many fracking chemicals are known to be associated with the potential for short and long-term health risks. Extrapolating from US research, we know that over 75% of these chemical can affect the skin, eyes and other sensory organs, and the respiratory and gastrointestinal systems; 40–50% affect the brain and nervous system, immune and cardiovascular systems, and the kidneys; 37% can affect the endocrine system; and 25% can cause cancer and mutations (Colborn et al). Cancer may develop many decades after exposure. 2-butoxyethanol, formamide and ethylene glycol are known to cause foetal abnormalities in animals (Vandenberg et al). In addition, naturally occurring contaminants mobilised by hydraulic fracturing, such as heavy metals and radioactive materials have well known adverse health effects (Coram et al). Chemicals added to fracking and drilling fluids may also cross react with chemicals naturally occurring in the gas formation.

Many chemicals used in the unconventional gas industry are not disclosed (Haswell and Shearman). This is of concern to doctors as it makes assessment of health risks or management of accidents where workers or others are exposed, extremely difficult. DEA believes protection of public health should be prioritised over industry requests to keep their chemicals 'commercial in confidence' where the potential for harm exists.

While DEA acknowledges that regulatory frameworks are in place to try to encourage best practice, no amount of legislation or voluntary industry codes can prevent accidents, casing failures or flooding and spillage of containment pools. Accidents have occurred and will continue to occur, however strict the safeguards. There are well documented cases of wastewater spills, failures of holding dams and planned release of contaminated waste water in Australia and the United States (Gross et al, Rozell and Reaven, Validakis, Miller, Shonkoff).

Though naturally occurring, both uranium and BTEX chemicals are mobilised and brought to the surface by the fracking process (Bank). In March 2014 a water leak from a storage pond at Santos' CSG project in NSW contaminated groundwater with uranium up to levels 20 times higher than safe drinking limits. The high salinity of the water

from the storage pond had mobilised uranium from the surrounding soils into the aquifer (Validakis). Operations at AGL Energy's Gloucester project were suspended in January 2015 after benzene, toluene, ethylbenzene and xylene (BTEX) were found in four pilot wells and a water storage tank (Miller). Some BTEX chemicals are carcinogenic and have been banned from use in the fracking process.

Research in Colorado has found "that surface spills are an important route of potential groundwater contamination from hydraulic fracturing activities and should be a focus of programs to protect groundwater" (Gross et al).

The failure rate of drilled wells is significant – estimated from recent international data at somewhere between 1 in every 50 to 1 in 16 wells drilled (Davies et al, Ingraffea et al, Jackson). Ingraffea et al noted a 6-7% failure rate in modern wells, that horizontal wells are more likely to fail, and inspection rates of older and decommissioned wells may underestimate the long-term failure rates. The most favourable published figure for well failure is 1.88% with modern 21st century fracturing technology (Ingraffea et al).

## Airborne emissions

It is increasingly being recognised that volatile chemicals used in the fracking process and the gases released from UGDs pose health risks to workers and people living nearby. Volatile organic compounds and hydrocarbons (including the carcinogen benzene) are released during unconventional gas operations, from venting, holding tanks, ponds, compressors and other infrastructure. Some of these mix with nitrous oxides from diesel-fuelled machinery, creating ground level ozone – a significant respiratory irritant.

Emissions measured near gas wells include the BTEX compounds -benzene, toluene, ethylbenzene, and xylene – of which benzene is a contributor to lifetime excess cancer risk (McKenzie et al, 2012). Emissions of formaldehyde, hydrogen sulfide, acrylonitrile, methylene chloride, sulfuric oxide, and volatile organic compounds (VOCs) are recorded near gas drilling, and all have potential adverse health effects. Trimethyl-benzenes, aliphatic hydrocarbons, and xylenes may cause neurological effects, and can irritate the respiratory system and mucous membranes (McKenzie et al 2012).

Even if concentrations of pollutants are low at any one well, given the expansion of many wells across large areas, cumulative air pollutants have health implications at a population level (Rabi and Spadaro).

Air pollution is potentially a health issue for gas field workers. Accidental exposures to chemicals, and airborne silica from proppants have the potential to cause serious health impacts.

## Evidence of adverse health outcomes

Although specific research on the health impacts of the unconventional gas industry has been minimal in Australia and the long-term health impacts of UGD are still unclear. It is important to be mindful that the health effects from exposure to asbestos and tobacco were not conclusively evident for many years after the first concerns were raised (Finkel). As Sir Bradford Hill said in 1965 at a London keynote address, in relation to applying the Precautionary Principle to tobacco's association and causation of disease, "*... all scientific work is incomplete ... and is liable to be upset or modified by advancing knowledge. This does not confer upon us a freedom to ignore the knowledge we already have, or to postpone that action that it appears to demand at a given time.*"

Evidence is emerging of short-term adverse health impacts. In a 2014 study of 124,842 births in rural Colorado, an association between a higher prevalence of congenital heart defects and mothers living within a 10 mile radius of gas wells was found. There was a less prominent, but equally concerning association with defects of the spinal cord (McKenzie et al 2014). A further report shows an association between low birth weight and low APGAR scores of infants born to mothers living within 2.5 km of a shale gas well compared to mothers living near future wells. (Hill, Bamberger and Oswald).

In a Pennsylvanian study, the number of reported skin and respiratory symptoms was higher among residents living <1 km compared with >2 km from the nearest gas well (Rabinowitz et al).

Another survey of self-reported health symptoms included skin rash or irritation, nausea or vomiting, abdominal pain, breathing difficulties or cough, nosebleeds, anxiety/stress, headache, dizziness, eye irritation, and throat irritation, which were more frequent the nearer people live to gas wells (Colborn et al). These symptoms are echoed in an independent self-reported health survey conducted in a Queensland gas field (McCarron).

There is generally an even greater potential for higher exposures in wildlife and farm animals than humans. A US study reported multiple accounts of adverse health effects in herd and domestic animals that live in proximity to unconventional gas developments, such as birth abnormalities and infertility (Bamberger and Oswald) - an issue that is highly relevant to Victoria's agricultural economy.

The unconventional gas industry poses further risks related to transport, which is required in the development of the gas field, via air and noise pollution. Large numbers of heavy vehicle movements are required for hydraulic fracturing and the fracking of a well can be a 24 hour operation. Increased risks of road traffic accidents associated with development of a gas field will increase the economic and health burden of our road system (Connelly and Supangan). A 2015 study from Pennsylvania reported an increase of 15-65% in road traffic accidents in those counties with UG drilling, with a corresponding increase in fatalities and major injuries (Graham et al).

## Risks to soil and food

Shale gas extraction is associated with a measureable decrease in numbers of dairy cows and milk production in Pennsylvania according to published research (Adams, Finkel).

*"Data based on U.S. Department of Agriculture statistics show a greater decrease in milk production (in thousands of pounds) and number of milk cows in counties with the most drilling activity compared to neighbouring counties with fewer than 100 wells drilled.... Counties with the most wells drilled during 2007 through 2011 uniformly had declines in total milk production ranging from -16.8 percent in Tioga county to -28.9 percent in Washington county" (Finkel).*

## Social and psychological impacts

The migratory, boom and bust nature of UGD developments can carry significant social and psychological effects for those who live in communities near operations and on those who may travel to work at these developments. A study of impacts of mining and unconventional gas operations on landholders in Queensland found that these operations placed rural communities "under sustained stress", with study participants describing significant impacts on the health, social fabric and economy of local communities (Hossain et al).

There are significant social justice implications arising from the distribution of community impacts. For example, police in Queensland have forcibly removed people from their own land when attempting to prevent gas drilling activities.

Solastalgia, the phenomenon of psychological distress arising from loss of familiar and cherished landscape and sense of place, has also been described in the context of extractive industries such as unconventional gas (Albrecht et al), notably in Tara, Queensland (Darling Downs Public Health Unit).

Initial gas well drilling and hydraulic fracturing can result in light and noise exposure 24 hours a day 7 days a week for those living in proximity, creating the potential for increased stress and disturbed sleep patterns. Industrial noise is known to cause a variety of adverse physiological effects (Passchier-Vermeer).

## Greenhouse gas emissions

Compared with coal, gas combustion emits less carbon dioxide per unit of energy produced. This has led to the proposal by some that natural gas can and should be used whilst enabling societies to transition from coal to renewable energy sources.

However, it now appears that anticipated lower greenhouse gas emissions from gas obtained through hydraulic fracturing have been overstated. Hydrocarbons extracted through hydraulic fracturing have almost the equivalent greenhouse gas per unit energy produced as coal when the full life cycle is considered, including the energy used to build the gas field and apply the special techniques to extract it. In addition, fugitive emissions of methane escaping from gas wells contribute very significantly to the overall greenhouse gas emissions. Evidence is growing that only 2-4% of gas needs to be lost as fugitive emissions to wipe out the greenhouse emission advantage of gas over coal as an energy source (Wigley).

Methane is the second largest greenhouse gas contributor to climate change after CO<sub>2</sub>, with a global warming potential more than 20 times that of CO<sub>2</sub> over a 100-year period (Horwath). Methane is released by the gas industry through intentionally venting or flaring excess gas, or by fugitive emissions, which include unintentional leakage from wellheads, transportation, storage and distribution (Moser et al).

As climate change is widely considered the major global health threat of this century, hydrocarbons produced from the gas industry are an unacceptable health risk.

<http://www.thelancet.com/commissions/climate-change>

## Regulatory safeguards, monitoring and enforcement

What is particularly of concern to DEA, and what should be recognised by the Committee is that 'accidental' or 'unintended' consequences will occur, and these have implications for public health that the strictest regulation cannot adequately protect against.

When systems are functioning according to best practice, the industry may promote an acceptable safety record. Nonetheless exposure can occur through accidents, leaks, natural events such as flooding, or even through normal operations. There are many different possible sources of leakage or infiltration because of the complexity of the hydraulic fracturing process, and the on-going toxicity of the chemicals even after hydrocarbon extraction has ceased. The US\$ 3 million payout to a family suffering from

fracking-related contaminants, demonstrates legal recognition of this risk (Atkin).

Intensive and on-going regulation and monitoring are essential to minimise risks. Accidents and spills have occurred, so the risk in Victoria is a very real concern. It is paramount that there is appropriate staffing of departments to provide the additional monitoring and inspection capacity required.

Victoria is in a position to benefit from mistakes made in other states, including not undertaking appropriate HIA processes for prior to expansion of their UG industries. For example, failure to undertake baseline water monitoring is common, although this is vital for meaningful analysis if contaminants are found after production has commenced. DEA recommends Health Impact Assessments as well as Environmental Impact Assessments be conducted for all developments.

DEA reminds government that Health Impact Assessment is an integral part of the Environmental Impact Assessment (EIA) process. In Australia, the states operate the EIA process under Health Impact Assessment (HIA) Guidelines (September 2001). These guidelines specifically recommend a precautionary approach when the scientific basis for risk management is in the early stages of development in order to protect human health and well-being, as well as the environment.

[http://www.health.gov.au/internet/main/publishing.nsf/Content/9BA012184863E206CA257BF001C1B0E/\\$File/env\\_impact.pdf](http://www.health.gov.au/internet/main/publishing.nsf/Content/9BA012184863E206CA257BF001C1B0E/$File/env_impact.pdf)

## Relevant domestic and international reviews and inquiries

DEA's position statement on Unconventional Gas Development supports the moratorium on UGD until the health and environmental consequences are adequately understood, and appropriate monitoring and regulations are in place to protect human health.

[http://dea.org.au/images/general/DEA\\_Position\\_Statement\\_-\\_Unconventional\\_Gas\\_Development\\_-\\_April\\_2015.pdf](http://dea.org.au/images/general/DEA_Position_Statement_-_Unconventional_Gas_Development_-_April_2015.pdf)

The Australian Medical Association (AMA) similarly calls for the application of the precautionary principle in the absence of sufficient evidence to ensure safety, calling for a block to any coal seam gas development where there remains any doubt about their potential to cause serious harm to health (Flannery). Dr Moss from the Nossal Institute of Global Health wrote:

*"The main thing about this issue is that we don't know enough, and what we do know is that it places too much risk on the public - and not with the people who are doing the extracting, or who are benefiting from the extraction of the gas. I think that is frankly unacceptable".*

In 2013, the **AMA adopted** a policy resolution urging governments:

*"... to ensure that all future proposals for coal seam gas mining are subject to rigorous and independent health risk assessments, which take into account the potential for exposure to pollutants through air and groundwater and any likely associated health risks. In circumstances where there is insufficient evidence to ensure safety, the precautionary principle should apply" (Hambleton).*

Doctors for the Environment Australia and the National Toxics Network have provided assessment of the potential dangers of the unconventional gas industry and led in recommending a precautionary approach to this industry. A lead that has been followed by both the Public Health Association of Australia (PHAA) and the AMA.

In June 2015 New York State banned fracking after a seven year investigation by the Department of Environmental Conservation, which concluded that fracking posed risks to land, water, natural resources and public health. A New York State Department of Health report released earlier this year outlined evidence of adverse health outcomes and growing health concerns associated with the industry, citing over 100 pages of peer reviewed scientific papers and abstracts. <http://rt.com/usa/270562-new-york-fracking-ban/> and [http://www.health.ny.gov/press/reports/docs/high\\_volume\\_hydraulic\\_fracturing.pdf](http://www.health.ny.gov/press/reports/docs/high_volume_hydraulic_fracturing.pdf)

The European Commission, the executive body of the European Union, published a report on the results of a preliminary screening of potential public health and environmental risks related to fracking. The Commission determined that fracking in Europe will entail "high" cumulative risks of groundwater contamination, surface water contamination, depletion of water resources, releases to air, increased noise, and increased traffic. [http://ec.europa.eu/environment/integration/energy/pdf/fracking\\_study.pdf](http://ec.europa.eu/environment/integration/energy/pdf/fracking_study.pdf)

There are already a number of large scale epidemiological studies being undertaken in the US to assess the health impact of gas drilling. It would be prudent to await the outcomes.

1. The Geisinger Health System is studying 30,000 asthma patients and 22,000 pregnancies in Pennsylvania to assess how they are affected by the Marcellus shale development. <https://grantome.com/grant/NIH/R21-ES023675-02>
2. The University of Colorado Sustainability Research Network is undertaking a five-year cooperative agreement intended to address the conflict between natural gas extraction and water and air resources. Outreach and education efforts will focus on citizen science, public involvement, and awareness of the science and policy issues (Univ. Colorado, 2012; Shonkoff, 2014). Published research has already been produced from this program investigating associations between fracking activity and birth outcomes and potential for methane leakage from natural gas infrastructure. <http://www.colorado.edu/news/releases/2012/10/02/nsf-awards-cu-boulder-led-team-12-million-study-effects-natural-gas>
3. The US Environmental Protection Agency is undertaking a study on The Potential Impacts of Fracking for Oil and Gas on Drinking water. It's preliminary report, released in May 2015, identified many mechanisms by which water resources can be contaminated. Documented incidences of contamination were found, but the incidence was low in relation to the number of wells. However, the EPA concluded the low incidence could well be due to the absence of baseline data, the short duration of existing studies, and inaccessible data from fracking activities. The full study will be released in 2016. <http://www2.epa.gov/hfstudy>

## Conclusion

As with many complex human activities, absolute scientific certainty regarding impacts of unconventional gas development on public health may perhaps never be attained. However, toxicology and exposure pathways clearly describe mechanisms of harm, and potential risks to public health exist. There are already preliminary data which give cause for concern. Many of the reports published to date are limited or exploratory in nature, suggesting hypotheses about potential impacts that need further evaluation. Certainly the adverse social and psychological impacts of the industry on communities in Australia and abroad have been well documented.

The gas drilling industry correctly states that at present only a handful of scientific studies identify specific cases of adverse health effects from the industry. However, this is not surprising as the types of risks involved to populations are unlikely to be evident in small scale studies, especially in what is a relatively new industry on its current

scale. To identify population risks of long-term exposure to low doses of environmental toxins; large scale, costly, longitudinal epidemiological population studies are needed. Several such studies have been initiated in the US, and more will come. To not wait for the results of at least some of these studies is to subject Victorians to unnecessary risk.

Without rigorous scientific studies, unconventional gas development will remain an uncontrolled health experiment on an enormous scale (Bamberger and Oswald).

The recommendations of this submission are in keeping with those of other peak scientific and health bodies in Australia and around the world, in calling for the application of the precautionary principle with regards to gas drilling and hydraulic fracturing. In the view of medical organisations such as DEA and also expressed by the AMA, there is a lack of information on the chemicals used and wastes produced by this industry, and a lack of comprehensive environmental monitoring. The risks are potentially serious, many are difficult or impossible to manage, and could be very long-lived. This is the view taken by many other risk-averse governments in similar situations such as New York State (USA), New Brunswick (USA), Wales, Scotland, France and Italy.

Any economic benefits from this industry must be weighed against the long-term impacts on human health and the environment. If the Victorian government decides to proceed with unconventional gas development in the absence of evidence of safety; Victorians will hold it accountable for future adverse impacts; and to minimise harm, at a minimum, unconventional gas projects should not be permitted near communities, water sources or agricultural land. DEA urges the Inquiry and the Victorian Government to consider our recommendations in relation to the health implications of developing an unconventional gas industry.

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