Submission to the Standing Committee on Environment and Public Affairs for the Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas

Submission from:

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For the attention of
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Hon Minister O'Brien

I enclose my submission the to the 'Inquiry into the Implications for Western Australia of Hydraulic Fracturing for Unconventional Gas.'

Sincerely

Patricia McAuliffe

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Inquiry into the Implications for Western Australia of Hydraulic Fracturing For Unconventional Gas.

1 Introduction

This inquiry is welcomed, even though it is somewhat late given the huge area of Western Australia already under exploration for unconventional gas.

It allows concerned individuals and groups to express their grave concerns about this high risk, under researched unconventional gas industry by governments prior to giving the green light to go ahead in what appears to be a ' fracking frenzy', as observed elsewhere in Australia and overseas.

With apologies, this report to the enquiry has gone outside the limited terms of reference, and touched on wider concerns which I believe should be the brief of such an inquiry. This has been done with the recognition that it is unlikely that another such opportunity will be afforded the public before the industry gets into full production.

I have been unable to find local or other independent peer reviewed research approving this controversial practice, even though I have requested such research from the Department of Mines and Petroleum. Any existing research seems to be on the economic benefits or on the technicalities of gas extraction for the most efficient and cost effective results. There is however a great deal of independent peer reviewed research published in reputable scientific journals that contra-indicate the horizontal hydraulic slick-water practice. Given that unconventional shale and tight gas production is new to Australia; it must be to the experience overseas that I have turned.

Unconventional gas fracking has been progressing under the radar, in what appears to be a deliberate effort to avoid public debate, and so avoid the need for meaningful assessment of this industry. The few public talks on hydraulic fracturing for unconventional gas by Department of Mines have been so uncompromisingly supportive of this industry, that it begs the question of conflict of interest. Mis-information stated by senior spokespersons from the Department of Mines, is evidence of collusion with the industry. An example is a repeated statement that "Fracking has been occurring safely for more than 60 years." This is patently misleading. 'Horizontal hydraulic slick-water fracturing' is necessary for the extraction of unconventional gas and has only been in commercial operation since 1998. Other statements are that it is much cleaner than coal in terms of green house gas emissions, and that it is therefore a good transition fuel. Studies show clearly that when the whole process (upstream, midstream and downstream sections of the process) of unconventional gas mining is considered, not just the end point burning. The methane emissions over time contribute much more to global warming than CO_2, which is released when any hydrocarbon, like natural gas, is burned. (Howarth et al 2011; Stephensona et al 2012)

DMP should use independent sources of information, rather than repeating website information of industry bodies such as APPEA. They should also consider the broader federal government policy of the need to address climate change.

2 Choosing where to drill

It is my understanding that petroleum geologists/scientists seek out through seismic surveys, and core sampling, just where the most productive or 'sweet' target formations lie. From an economic viewpoint this is a natural industry practice. Additionally, they need to be close to adequate water resources (necessary in large amounts for the fracking process.) Decisions about where to locate the well sites are predicated on reasons other than conservation, ecological fragility, nature reserves and national parks, threatened species, agricultural farm land and livestock, essential aquifer systems, rivers and streams, iconic tourist attractions or even proximity to human habitation. These are Western Australia's other economic backbones that rely on healthy, uncontaminated soil, water and air, and indeed on which we all rely.

I will endeavour to show the serious risks posed by this industry to these 'other' essential needs of our populations and environment, and that it should not proceed as industry, government, and government departments so forcefully proclaim.

3 Land owners rights

Ease of access to land and the resources which lie beneath them are key considerations by the mining corporations. Land owners must have their rights clearly spelled out by these companies, councils and government; so that any bully tactics and threats regarding confidentiality contracts can be put in to perspective. Phrases such as 'minimal impact', or 'minor adverse effects' should be clearly defined and spelled out. Moreover, once written approval to an activity is given, those persons can no longer be considered as 'affected persons.' This undermines the rights, safety and compensation for potential affected parties. Although landowners and occupiers do not own the oil and gas under their land, they do have the right to deny access by not signing access arrangements proposed by companies. This needs to be made clear to land owners.

4 Establishing the well site

Consents for land use, water take and discharge may be granted elsewhere by regions or councils or government authorities. This can be without taking account of the cumulative effects of the different activities consented for, and the real impacts on the environment and nearby landowners and occupiers. Examples of these may be permissions to discharge emissions to air, including the combustion of returned frack fluids, and discharge of contaminants to water or land.

There is an apparent paucity of research and risk assessment of the cumulative or synergistic effects of so many gas activities in a small area over the short to long term.

5 Drilling and constructing the well

5.1 Well integrity

The current engineering capacity cannot guarantee well integrity in the short or long term. Studies have shown that about 5% of all oil and gas wells leak immediately because of integrity issues, with increasing rates of leakage over time. In a period of 20 years, over half the wells will leak. (Ingraffea 2012) With the proposed huge number of wells expected, this problem is neither negligible nor preventable with current technology. Pressures under the earth, temperature changes, ground movement from the drilling of nearby wells and shrinkage crack and damage to the thin layer of brittle cement that is supposed to seal the wells. Ensuring the cement perfect as the drilling goes horizontally into shale is extremely challenging. Once the cement is damaged, repairing it many metres underground is expensive and often unsuccessful.

Regarding well integrity Lustgarten 2012 noted (in the US) a review of well records, case histories, and government summaries from "more than 220,000 well inspections…found that structural failures inside injection wells are routine" and that "from late 2007-2010" there was "one integrity violation...issued for every six deep injection wells examined- more than 17,000 violations nationally... more than 7,000 wells showed that their walls were leaking." There is nothing either to ensure that old wells that are being re-drilled have the required strength and integrity to withstand a 'second life' of production, possibly several years later.

6 Fracking the well

6.1 Environmental and health impacts of fracking chemicals

There are now many peer-reviewed studies that have demonstrated the serious risks involved in fracking, and the many pathways for water contamination to occur. Air pollution associated with flaring, venting, and evaporation ponds are also implicated. (Coborn 2011; Bamberger 2012; McKenzie 2012) Many of these studies have pointed for the need for more detailed research, baseline studies, and public disclosure especially in the area of health impacts from exposure to fracking chemicals.

At present, not enough is known about many of the chemicals, and the cumulative and synergistic effects they may have on humans, animals and soil or water quality. Many of the chemicals have not even been assessed, and some have undisclosed constituents, making it impossible to assess or monitor. Many of the chemicals are known to be toxic at concentrations near or below detection limits. e.g. Glutaraldehyde, Ethylene glycol monobutyle ether, 2,2-dibromo-3-nitrilopropionamide. Many of the chemicals are self-assessed by companies and approved under groupings as additives, process chemicals, and raw materials. It is questionable that the regulatory agencies have the technical capacity and resources to assess this.

6.2 Seismic risks and monitoring

Fracking is known to induce micro earthquakes, though in the USA, seismic monitoring capabilities in many areas are not capable of detecting small earthquake activity and quakes of $M<3$ are not always documented. Yet small earthquakes have the potential to cause damage to well casings and associated infrastructure and create linkages between previously unconnected sub-surface ground layers, such as fractured zones and aquifers (Ellsworth 2013; Keranen 2013) Fracture lines and faults are not all known or documented in the vast state of WA.

7 Flowback and transitioning into production

7.1 Fugitive emissions

These are well documented at all stages of the process (Howarth 2011; Finkel 2013). ***Well completion*** methane escapes during the initial drilling process; ***well head*** problems including corrosion are a source of methane leakage; ***flaring*** of returned frack fluids/waste is frequently permitted despite the fact that many fracking chemicals are known to be hazardous, carcinogenic, and when heated may release toxic gases. (These flaring practices can take place close to human habitation without regard to health consequences); ***venting*** (non-captured methane) is forbidden in many jurisdictions and is estimated to occur more frequently than flaring; (Howarth et al 2012) ***compressor stations*** are a big source of fugitive emissions and consequent air pollution and have exploded at times; ***gas pipes*** also are subject to aging, corrosion, leaks and explosions.

7.2 Groundwater contamination

This can occur via a number of routes, including pre-existing fractures and faults, as well as those caused through the hydraulic fracturing process (Meyers 2012; Warner 2012; Gross 2013; Adams 2011; Osborn 2011).The fracturing of the target formation releases not only the sought after methane gas, but many other organic compounds that have been safely locked in the rocks for aeons. Whilst in WA, the highly toxic and carcinogenic b-tex chemicals have reportedly been banned from the chemical injection fluids, they never the less are naturally occurring within the rock.

Once fracked, the surface area of the rock is multiplied many times. This means that these chemicals and chemical compounds are much more readily available to contaminate whatever they come in contact with. About 50% of the injected water and fracking chemicals now mixed with the many other organic compounds are returned to the surface. The other 50% remains underground. There is growing evidence that despite the thick layers of rock above the target formation, toxic waste substances can make their way through not fully understood means, into overlying aquifers. (Lustgarten 2012

7.3 Water abstraction

From fracking to production, a substantial amount of water is required. Every fracked well may require up to 20 million litres of fresh water, 4,000 tons of proppants, and up to 200,000 litres of chemicals. (IEA 2012a:27: IEA 2012b:33)

This is of great concern in the driest state on the driest continent, at a time when inundation is decreasing, and temperatures are rising. The mining industry competes with the water needs of agriculture, of urban and regional populations, and of the sustainability of our natural environment.

Currently in Barnhart Texas, The Guardian (13.8.13) headline reads "***A Texan Tragedy: Ample Oil, No Water*** - Fracking sucks away precious water from beneath the ground, leaving cattle dead, farms bone-dry, and people thirsty." The local wells and main water supply to the town have dried up.

7.4 Potential for recycling produced water.

The vast amount of water used in hydraulic fracturing is a concern to many citizens who are aware of this problem. Because of lack of public debate in this state, most of the public are not aware. Serious questions must be posed and thoroughly researched before this goes ahead.

The frack fluid in the initial injection phase contains many hazardous chemicals, which are not yet known in the public domain. Added to this, in the return fluid, there are NORMs (naturally occurring radioactive material), sand and brine which is much saltier than sea water. Lutz (2013) in research into the waste water in the Marcellus shale region, said that waste water is overwhelming disposal options, and could have a range of environmental and health impacts if not properly managed. With unconventional gas the composition is difficult to deal with. Removing dissolved salts requires expensive distillation and reverse osmosis he says. Drillers found it more cost effective to invest in mobile waste water treatment for re-use in fracking rather than discharging it into the environment.

In addition, large amounts of produced water were trucked to deep wells for injection under high pressure. In some cases this had the effect of causing seismic events and was temporarily stopped, before tighter controls could be applied resulting in additional cost.

There remains major concerns about ground and surface water contamination and human exposures to this.

The re-use of fracking fluid in subsequent fracking operations is also fraught. It means that the injection fluid will be much more concentrated and will have the NORMs included. This intensifies the risk to aquifers and ground water in the case of leakages, migration and other forms of contamination.

Guy Pearse, in his book 'Big Coal' (P. 110, 2013) notes that " Rio Tinto is funding irrigation infrastructure for farmers", and in Chinchilla, Queensland, "The Queensland Gas Corporation has gifted pipelines and a treatment plant to supply un-potable water to supplement local agricultural water supplies". This is very concerning as using questionable industrial waste water for agriculture without much more research being done.

Adams (2011) reported on a stand of trees in West Virginia were damaged after fracking waste was sprayed on them.

7.5 Radio-nuclides and contamination risks

Christopher Busby, an expert on the health effects of ionizing radiation and is the Scientific Secretary of the European Committee on Radiation Risk, has written extensively on this topic. (Busby 2013) Among the most concerning of the released materials are part of the uranium chain; Naturally Occurring Radioactive Material (NORM). Human activities such as gas exploration can expose people to this ionising radiation. Notably Radium 226 is one of those released. When this reaches air, it becomes radon gas. This has been detected in greater quantities around gas fields and is highly carcinogenic. NORM's can also attach as scale to pipes and other mining equipment such as the trucks used for transporting waste. All of these materials then become hazardous radioactive waste which is very difficult to dispose of safely. The waste water can also be radioactive.

7.6 Health issues

There are many studies identifying the serious risks to public health through the life cycle of shale gas development. This can be through water, soil and air contamination. (Gross 2013; Lustgarten 2012; Litovitz 2013)

A health assessment of exposure to air emissions from shale gas development in Colorado found that residents who live within ½ mile from well pads are at greater risk of developing cancer and non-cancer health effects (McKenzie 2012).

Studies have shown that shale gas production is associated with raised atmospheric concentrations of tropospheric or ground level ozone, whereby nitrogen oxides, volatile organic compounds, and sunlight interact to produce hazardous respiratory irritants that increase s risks of morbidity and mortality.(Schnell 2009; Jerrett 2009; Olaguer 2012; Petron et al 2012)

Diesel trucks emit health damaging particulate air pollutants that contribute to cardiovascular and respiratory diseases, atherosclerosis, and premature death (Carb 2008; EPA 2011). Crystalline silica (frac sand) is a significant hazard for workers and other populations in close geographical proximity, silicosis, lung cancer, chronic obstructive pulmonary disease, chronic kidney diseases and a variety of auto immune diseases (NIOSH/CDC2012; NTP 2012)

7.7 Noise pollution

This is not an insignificant problem for local communities, many of whom are used to a slower paced and peaceful rural lifestyle. The noise is usually 24 hours per day, with a constant stream of trucks carrying chemicals, water, sand or silica, and toxic waste material. The diesel trucks are also a source of pollution, emitting diesel particulates. Then there is the onsite activity including infrastructure, transporting and building in the construction phase. Compressor stations are very noisy and operate 24 hours a day. Flaring is also noisy. Broomfield (2012) estimates that "for each well-pad (assuming 10 wells per pad) would require 800 to 2,500 days of noisy activity during pre-production, covering ground works and road construction as well as the hydraulic fracturing process"

7.8 Land footprint

Overhead pictures of gas fields are well known. Connecting roads and pipelines crisscross the landscape and transform previously productive, fertile and picturesque land, including nature reserves and national parks, into industrial wastelands. It disrupts the natural ecology, removing trees and vegetation that support life, changing the landscape to polluting entities destructive of life. Broomfield (2012) estimates that approximately 50 shale gas wells may be needed to give a similar yield as one North Sea gas well. He also compares the surface well installation area during the fracturing and completion periods as approximately 3.6 hectares per pad compared with conventional drilling which needs approximately 1.9 hectares.

8 Handling the waste

8.1 Air and soil contamination

Many particulates and chemicals are released into the atmosphere including sulphuric oxide, nitrogen, volatile organic compounds, benzene, toluene, diesel particulates, hydrogen sulphide, and radon gas. The drilling sludge, which is brought to the surface during the drilling process, contains fracking fluid, drilling mud, and radioactive material from the target formation, hydrocarbons, metals, and volatile organic compounds. The sludge is often left to dry out (evaporate) in surface waste pits. Alternatively it may be removed to waste disposal sites (not always hazardous waste sites) or may be tilled into the soil in 'land farms'. These practices raise the risk of contaminating soil, air, and surface water, as a result of the fine dust becoming air-born. (Finkel & Law2011)

8.2 Land farming

Land spreading (also known as land farming, land disposal and land treatment) is the process whereby drilling wastes are disposed of via application to land. The aim is to attempt to remediate the soil's naturally occurring microbial populations to degrade drilling waste constituents, particularly hydrocarbons and other organic compounds.

In terms of science, there is not enough information to ensure that this practice is safe over the long term. Fracking waste has been spread on land in Taranaki New Zealand, but no studies on the outcome were found. A Taranaki Land council technical report (Oct 2011)-after 3 years of drilling waste (not fracking waste) was reviewed after 3 years. The results did not reach any definitive conclusion. No New Zealand studies investigated the potential impacts on wildlife, livestock and food products.

In the USA, this practice has also had adverse effects. (Adams 2011)

Further research is needed into how this practice may affect the environment, soil health, animal health and food safety, especially the synergistic effects in the long term.

With fracking waste this caution is doubly important due to the toxic and known carcinogenic chemicals used. Should this be a proposal for West Australia, definitive research should be made into the long term outcomes in countries where this has occurred, prior to any consent to explore or drill.

Waste disposal is a major problem for energy companies engaged in fracking practices, and they grasp at any possibilities for disposing of the toxic waste. Once disposed of in unsafe ways, it then becomes the community's long term problem.

Given that the well pipes and underground structures will remain after well abandonment, a landscape extensively perforated by pipes going deep into the earth, often directly through aquifers remain in perpetuity. They have the potential to leak toxins into the water, ground and air. These structures make it unfeasible to return the land to productive use.

8.3 Deep well injection

Injecting waste water and materials into deep wells is often used by the industry. These might already exist, e.g. abandoned mining wells. The fluid must be injected at high pressure. This has been known to cause earthquakes. Whilst these quakes might be small, they have been suspected of triggering larger earthquakes over time. (Ellsworth 2013) Western Australia has in the past had significant earthquakes, and the fault systems, major and minor, have not been fully mapped.

Lustgarten (2013) writes that more than 30 trillion gallons have been estimated to have been dumped in thousands of wells across America in 'invisible dumping grounds'. Growing records are now showing that these wells repeatedly leaked, sending dangerous chemicals and waste gurgling to the surface, and at times seeping into shallow aquifers. It had previously been assumed that these wastes would be entombed beneath the deep layers of rock for ever.

Pro Publica (2012) quoted interviews with several key experts who acknowledged that the idea that injection is safe rests on science that has not kept pace with reality It quotes Mario Salazar, an engineer who worked 25 years as a technical expert with the EPA's underground injection program in Washington who said, "In 10-100 years we are going to find that most of our groundwater is polluted. A lot of people are going to get sick, and a lot of people may die.

9 The reclamation of land that has been hydraulically fractured

9.1 Reclamation planning prior to drilling

This involves numerous steps that should begin with initial site selection. It is necessary to choose an optimal site says Bloomfield (2012) in order "to minimise adverse impacts on sensitive receptors." Assessment of baseline information regarding the site contours, vegetation, wildlife habitat and land function prior too being given a licence to drill are essential. It should be the regulators that assess these details rather than the drilling companies, so that successful environmental restoration can be determined after the event (Parkland Institute). Where mature native trees, necessary for bird habitation among other things, are removed, it is difficult to see how these can be replaced in the short term.

Developer liability for water and soil contamination as well as inadequate land restoration should be determined before any leases or agreements are signed, as well as what steps will be taken to return the land to its original state. (Skausen 2011)

Broomfield (2012) notes that" The evidence suggests that it may not be possible fully to restore sites in sensitive areas following well completions or abandonment, particularly in areas of high agricultural, natural or cultural value. Over a wider area with multiple installations, this could result in a significant loss or fragmentation of amenities or recreational facilities, valuable farmland or natural habitats."

9.2 Soil compaction and topsoil removal

Soil compaction because of heavy machinery on the drill site and access roads needs to be addressed by tillage to at least 80 centimetre depth prior to top soil re-application, to optimise water filtration and revegetation. Even so there has been shown to be a decline in filtration on the land after a 3 year period (Chong 1997).

Careful topsoil removal and storage for later land restoration must be a requirement by the drilling companies. Skausen (2011) says that at least 2 feet and preferably 4 feet of topsoil should be salvaged for later restoration. It should be seeded with a vegetation cover if the stockpile is to remain for more than 6 months. It should be stored safely away from potentially contamination operations and substances. Pipeline disturbances need the same attention.

9.3 Removal of mining equipment and well abandonment

Removal of mining equipment is another area of concern. The waste ponds must be safely emptied without contamination of the site or surrounding land or water. It must be safely removed to hazardous waste facilities. The lining should also accompany this and not be buried on site, or on convenient nearby land.

Well abandonment is an under researched area of concern. Lustgarten (2011 and 2013) wrote of EPA's initial serious concerns about contamination from abandoned wells, and again reported about the back flip of the EPA. This had initially promised a peer reviewed research as a follow up. Eventually the EPA handed over the responsibility of the research to the likely offender in the industry, Encana, thus, "effectively disengaging from any research that could be perceived as questioning the safety of fracking or oil drilling."

In WA, wells are supposed to be monitored after abandonment for 2 years. After this time, the company is no longer responsible for their integrity. This will leave the government departments responsible both for ongoing monitoring and potential contamination costs into the future. The alternative to ongoing monitoring of abandoned wells is to leave and ignore them. Thus when contamination occurs down the track, possibly away from the original well site, traceability of the source of contamination, and any remediation will be either seriously hampered, too expensive or impossible to remediate.

Whilst wells are supposed to be plugged with concrete at the end of their active life, their integrity and permeability are unknown. Cement deteriorates over time, and the pipes which go deep into the ground and through aquifer systems, can corrode. This would both connect below levels of strata with the aquifers, and pose serious risks of contamination, both of the aquifers and the surface level soil and structures. Given that approximately 50% of waste water remains under the ground, this should be a major concern.

Old wells have been known to cave in, again connecting differing geologic layers with the surface. In a New York study (Bishop 2012) found that in the last 25 years, the oil and gas industry consistently neglected to plug most (89%) of its depleted wells, and the rate has increased since the year 2000. This indicates a culture of neglect and avoidance of responsibility. Whether or not plugged with cement (which itself deteriorates and cracks with time) the leakage of methane and other toxicities continue to occur without due oversight.

9.4 Feasibility of land restoration

Broomfield (2012) questions that full restoration of sensitive ecological sites and archaeological sites is possible for hydraulic fracturing shale gas well projects.

When one looks at the extent of shale gas mining activities and the very large land footprint, covering highly sensitive areas of sensitive ecosystems; unique flora; endangered species; habitat loss (especially mature trees); the arid and drought prone nature of much of the Western Australia, already threatened with significant global warming; the huge amount of water used for the process; the well documented and serious contamination risks to diminishing water supplies; the complex, expensive, and in some cases impossible task of achieving appropriate restoration; serious doubt about the viability of hydraulic fracturing for shale gas in this state is posited.

10 Regulation

10.1 Industry self-regulation; external monitoring; penalties for non-compliance; financial responsibility for accidents and clean-ups.

There is a continuing complaint from the oil and gas mining companies that their industries are over regulated and that self regulation would minimise costs and speed up processes.

The Commonwealth Government 'Task Force on Industry Self Regulation' (2000) outlined a checklist whereby self regulation by industry should be considered where:

- there is no strong public interest concern, in particular, no major public health and safety concern;
- the problem is a low risk event, of low impact/significance, in other words the consequences of self-regulation failing to resolve a specific problem are small; and
- the problem can be fixed by the market itself, in other words there is an incentive for individuals and groups to develop and comply with self-regulatory arrangements (e.g. for industry survival, or to gain a market advantage).

Given the above guidelines, it is clear that there is strong public concern.

The public health and safety concerns are that serious incidents have occurred where horizontal hydraulic slick-water practices in shale gas projects. (Bishop 2012; Drajen 2013). Self-Regulation for this industry is strongly counter indicated according to these sensible guidelines. The unconventional gas industry has a serious problem of methane leakages, and fugitive emissions, well failure, explosions, soil and air contamination. It is irresponsible for any government or government department not to be advocating for the most stringent of regulations on behalf of the populations they serve. To claim the industry cannot make adequate profits by observing such safety measures is not a reason to bend to their wishes. Political decisions are ultimately responsible to the will and rights of the people who elect the politicians.

What is needed is a much tighter regulatory system, with meaningful penalties for remediation and clean-up. As many of the companies are multi-national and are continually selling or taking over parts of their operations, it can be a huge and expensive task to pursue compensation after the event. These events may be catastrophic and irreversible given the volatile nature of the products they are responsible for producing. Well known examples of catastrophic events in offshore drilling, where the companies claimed best practice was occurring are BP's Deep Water Horizon in the Gulf of Mexico in 2006 and PTTEP's Montara oil spill off the north coast of Australia in 2009. Just like the on shore shale gas drilling they claimed that they had 'best practice.' Blow outs have also occurred in shale gas operations, though these have largely been locally confined, but deaths, injuries and ecological damage certainly occurs. These are known as 'fraccidents'. They are scattered across the USA. Some of these are mapped regularly by 'Frack Alert'.

In West Australia, as in other countries where the powerful oil and gas sector appear to dictate the parameters under which they will operate, there is a culture of secrecy, cost cutting, lack of transparency, avoidance of responsibility to other than to their shareholders. It is totally out of balance with the need sand rights of the populations which are potentially adversely affected by their operations.

Companies must be liable for compensation for environmental damage. Questions of how this could be assessed or calculated must be predetermined and not left to chance. As many of these companies are global in their reach, international legal solutions must be understood by our governments. An example of this is the asbestos mining industry which fled once the financial implications of their responsibility was known. The cigarette industry is another example of the cost afforded to our health system, and their consistent cries of foul play when limits are attempted on their promotional rights.

Extensive risk assessments should be done before the green light is given for unconventional gas production to commence in this state. The fact that exploration licences cover extensive parts of Western Australia, should not be a reason to allow the sector to proceed before appropriate risk assessments are carried out. The overseas experience must seriously be taken into account when doing these risk assessments.

Several countries and some US states have placed moratoriums on the industry. These should be serious red lights to those contemplating exposing our fragile ecosystem to such aggressive assault.

Should the industry proceed further in West Australia, it must only be with serious oversight. Government regulatory bodies must be fully resourced with enough scientifically trained personnel to fully monitor operations at all stages of the mining process.

Baseline studies are vital for the health of surrounding populations, land, air, soil health and particularly water quality, toxicity and aquifer depletion rates. The cost of all of this should be taken into account prior to decisions being made to proceed.

10.2 Conflict of interest

In WA, though we have the Environmental Protection Authority (EPA) which has the task of assessing potentially environmentally damaging projects, this has been underused, if used at all.

- Section 5 of the Environmental Protection Act 1986 (West Australia) provides that it has primacy over other laws, including the Department of Mines legislation:
- Section 5. Inconsistent laws:
  Whenever a provision of this Act or of an approved policy is inconsistent with a provision contained in, or ratified or approved by, any other written law, the provision of this Act or the approved policy, as the case requires, prevails.

The EPA then should be much more prominent in decisions and oversight relating to the environment, and not secondary to the DMP. The Department for Mines and Petroleum does practically all the assessing behind closed doors.

The EPA was recently discredited in its approval for the proposed James Price Point Gas Hub in the Kimberley. The conflict of interest of 3 of the 4 decision makers, who had gas mining shares in their personal portfolios, evidenced what might be a serious problem with many high ranking decision makers. Full disclosure of conflicts of interest should be mandatory before appointments are made, and not incidentally discovered later by the investigation of those with counter interests.

The DMP has a questionable role in its industry promotion. A DMP Executive Director was recently described by the chairperson from CSIRO at a public lecture, as being a fervent advocate of unconventional gas mining in Western Australia. Certainly the two public talks that I attended presented by him, upheld this pro industry bias. He was dismissive of any objective criticism of the industry. This is in itself a real conflict of interest, leading to poor and biased decision making within a department with a large influence on government policy. It excludes fair and open public debate on this matter.

10.3 Economic considerations

There are a growing number of experts questioning the ongoing viability of unconventional gas production. (Nafeez 2013; Economy Watch. 26August 13)

Once the most productive areas (sweet spots) have been exploited, the companies must forever expand. Energy expert Bill Powers (2013) describes this 'the drilling treadmill'. The companies are continually seeking more possibilities, much of which cover less productive sites which give weak and ever diminishing returns. At the same time this wreaks further havoc on the environment.

Once the money runs out, these leases may be on sold to unsuspecting buyers, or abandoned altogether. The extensive infrastructure, including roads and un-usable land will be left for the public purse to deal with, and shareholders left stunned as the gas bubble bursts.

11 Climate change and alternatives to fossil fuels

Howarth et al (2011) note in comparing CO2 emissions, methane's lifetime is shorter in the atmosphere, but the comparative impact on climate change is over 20 times greater than CO2 over a 100 year period. It is much more efficient at trapping heat. Given that climate change is now a given by most published scientists throughout the world, and our time line for reducing our hydrocarbon emissions has almost passed for avoiding catastrophic climate change, it is hard to comprehend why governments are not heeding these warnings.

Building new coal and natural gas power plants remains a counter productive lock-in of scarce resources needed elsewhere to avert catastrophic global warming.

Whilst as stated earlier, unconventional gas is being falsely proclaimed as a necessary transitional fuel, the great potential that Australia in particular has for renewable energy is being delayed to appease the hydrocarbon industries. Australian scientists and engineers involved in Beyond Zero Emissions have put together two substantial reports outlining how 100% renewable energy is achievable and affordable in a 10 year transformational period, (BZE 2010) and also how we could be world leaders technologically in this field. (BZE 2012)

12 Summary

Transparency and public debate is of utmost importance with regard to shale gas exploration in Western Australia. To date there has been a lack of research into the potentially devastating effects on our water, air quality, soil, ecosystems and biodiversity, water quality and depletion, health, agriculture, tourism, culture and amenity. Baseline studies are also missing from the equation, without which it will be more difficult to assess the potential negative impacts. The unconventional gas industry produces vast amounts of toxic waste, for which there is no proven safe way of disposal. Their practice lags considerable behind the available science. Add to this Industry's demand for more and more self regulation, to which economically strapped governments tend to readily comply. In the past, self-regulation has proved to be disastrous in risk fraught industries.

Monitoring costs, supervision costs and the number of qualified government personnel required to oversee this industry are seen as prohibitive. The public sector work force which is currently targeted for cuts, opens the potential for a lack of supervision in an industry which has the potential to threaten our water and food security. Such an important role should not be out-sourced to the private sector.

With a shale gas industry looming, Western Australian tax payers should be spared this industry entirely and at worst protected from potential disaster clean-ups if the companies either leave, on-sell, or have already left. Penalties for misdemeanours and accidents across the world have shown to be non-existent or totally inadequate. Should our aquifers be adversely affected, there is no known remedy. It is a risk we should not contemplate.

Short sighted economic gains, which may be very questionable, should not lead to a potential terrible economic burden, diminished lifestyle and amenity for this and future generations.

Whilst the general population is largely unaware of this industry, which is currently operating under the radar, fracking for unconventional gas's potential for all of the above will become more widely known. As the deleterious effects become real, greater opposition will be expressed as the industry progresses. This is clearly evident on the eastern seaboard.

Whilst I have detailed a long list of serious risk factors inherent in this industry, it is my belief that it would only take one incident to have calamitous repercussions. This is particularly pertinent with regard to our valuable water resource. As a mother, grandmother and concerned citizen I feel it is incumbent on all of us to consider future generations.

13 Recommendations

The first recommendation reflects a sensible approach and is my preferred choice. However, I also recognize that this industry has well-funded lobbying powers, which promotes a mythology unsustained in real science, and which appears to have the attentive ear of governments. I have therefore added constraints in the subsequent recommendations which may limit the industries unfettered approach to unconventional gas mining and the serious risks it poses.

1. **A moratorium** should be placed on the industry, until the science can catch up with the practice.

2. **Site selection** should be determined on the least interference with natural ecosystems, farming, tourist destinations, and should not occur over or through our aquifers. Noise levels, compressor stations and associated venting, flaring, storage tanks and pipelines should not be located near human habitation.

3. **Landowner rights** must be respected relating to refusal of access to their land, pre-determined contracts fully outlining risks, adequate compensation for use, and eventual appropriate restoration to former land function.

4. **Prompt violations or accident reporting** should occur for remediation, and with adequate pre-determined consequences applied.

5. **Fracking chemical testing** should be fully scientifically analysed to determine individual and synergistic effects on water, soil and air, as well as on human and animal life if ingested, or in case of bodily contact with them. This knowledge should be publically available.

6. **Fracking chemicals disclosure** should occur in each individual operation, with this knowledge available for public scrutiny if requested.

7. **Seismic mapping for faults and fractures** on all land should be pre-determined, and where they are located, drilling should not take place.

8. **Baseline studies** should be instigated for water aquifer levels and for water, soil and air quality prior to the commencement of drilling. Also baseline health data on workers and nearby populations should be done.

9. **External government monitoring** of *all* well sites, including well integrity, waste pond construction and operation, compressor stations, flaring and venting activities and outcomes, waste disposal and any other infrastructure.

10. **Water extraction** from aquifers and other natural water sources that replenish the aquifers must meet priority needs of resident populations, food production needs, and maintenance of the ecology including wildlife, trees and other natural vegetation.

11. **Toxic waste disposal** including produced water, sludge, with particular attention to radioactive waste, including waste pond liners, disused piping and other contaminated equipment, and contaminated soil must have safe pre-determined methods of safe disposal. Practices such as spraying toxic waste onto farmlands, roads, and into streams and rivers, or burying waste in non-disclosed sites so commonly documented elsewhere, must be totally prohibited. Even re-cycled water should not be sprayed on land as this method is in its infancy, with long term outcomes not known.

12. **Deep well injection** has been shown to be hazardous for earth precipitation and for waste migration into aquifers. Any such sites must be geologically surveyed and safety analysed prior to use.

13. **Abandoned wells** are not able to be secured in the long term and pose serious risks to water , soil and air over time. For those that do exist, they must be mapped and monitored, with companies being contractually responsible for them into the future.

14. **Regulation** of all the processes of the unconventional gas industries from exploration to completion must be monitored by independent government bodies, with those companies being seriously held to account for breaches and dangerous outcomes.

15. **EPA Act 1986** must allow the EPA to resume its primary role in assessment and monitoring in accordance with its purpose to protect the environment, and must be sanctioned to over-ride the DMP in its decision making processes where appropriate.

16. **Conflicts of interest** must be fully disclosed by all elected government representatives and employees of government departments responsible for policy decision making about this highly controversial and potentially dangerous industry. Transparency must be paramount, and open for public debate and challenge.

17. **Cost benefit analyses** should be done including social amenity, increased health costs, food production, air, water and soil quality and the remediation costs of all of these. Water usage must be a major component of this, and the costs for alternative sources such as desalination, expensive water recycling processes. Our limited and irreplaceable natural aquifer systems may be irremediable should serious contamination occur.

18. **Climate change and global warming** is irrefutably occurring according to an overwhelming majority of climate scientists. They all strongly affirm that the continuing use of fossil fuels contributes to this enormously. In particular unconventional gas is one of the worst offenders. Contrary to the spin put out by the industry, methane emissions have a greater impact on global warming than even CO2. Science must be heeded, and priority action pursued on increased renewable energy targets made by all governments. The temporary job losses in the fossil fuel industry would be more than offset by those provided by the renewable energy sector.

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