31 January 2015

Dear Sir / Madam,

Parliamentary Inquiry into fracking - Natural Resources Committee of SA Parliament

As well as providing information in relation to the 4 particular topics outlined in your terms of reference, I have elaborated on a range of other impacts and risks created by fracking.

One particular problem I recommend you devote particular attention to in your inquiry is the impact of the **massive amounts of contaminated flowback water and salt drawn from the ground from the fracking process**.

1. *The risks of groundwater contamination;*

Groundwater (and surface water) contamination can come from:

- Flowback water (naturally occurring underground water that's been unearthed, which can be toxic and radioactive)
- Fracking fluid.

Flowback water
Dangerous BTEX (benzene, toulene, ethyl-benzene and xylene) chemicals have been banned from fracking fluid in NSW and Queensland. However, BTEX – which is renowned for being contaminants of air, soil and groundwater – are found naturally in the coal seam. They have a range of short terms and long term health effects – probably its most famous is benzene's link with leukemia. **In 2011 Arrow Energy admitted that 5 of its 14 monitoring holes at Dalby were contaminated with BTEX; with benzene detected 6-15 times the Drinking Water Standard.**[i]

Further information on flowback water is provided later in this submission.

Fracking fluid
Very large amounts of chemical additives are used per well. In one industry document, cited by Dr Lloyd-Smith from the National Toxics Network, **18,500kgs of chemical additives were used per well, of which 40% (7,500kg / 7.5 tonnes) was not recovered**. In other words, they stayed in the ground. These were chemicals such as surfactants, lubricants, acids, scale/corrosion inhibitors and biocides. Many of them had acute (short-term) toxicity or chronic (long-term) toxicity. But the industry papers had little, if any, data on the environmental fate or ecotoxicology. She said: "Basically, no one knew what happened when you released them into the environment."[ii]

According to the EPA study, studies conducted by the oil and gas industry, and interviews with industry and regulators, 20 to 85% of fracturing fluids may remain underground, which means the fluids could continue to be a source of groundwater contamination for years to come.[iii]

It is extremely difficult to find information about the exact chemicals used in CSG extraction and fracking. Regulation of the CSG industry in Australia does not require companies to list the chemicals used in fracking fluids.[iv] Frack fluid is regarded as a "proprietary mix," and as such, we aren't fully knowledgeable about all the chemicals that may be in this fluid.[v]

The National Toxics Network has consolidated various companies' lists and come up with 23 chemicals commonly used in fracking in Australia. Of those chemicals, only two have ever been assessed by a national regulator (despite being legal to use). The US Government Committee talks about 750 chemicals being used; APPEA (Australian Petroleum Production and Exploration Association) talks about only 46, but documentation shows many chemicals listed in companies' Environmental Impact Statements in Australia which are not on APPEA's list.[vi]

Many of the fracking additives are toxic, carcinogenic or mutagenic.[vii] Some of the chemicals (brominated biocides and nonylphenol) on the list are some of the world's most toxic chemicals.[viii] Many of the chemicals added to create fracking fluid are also known endocrine disruptors, chemicals that interfere with the body's natural signaling system.[ix]

Five of the chemicals widely used, including in exploratory wells, are dangerous at concentrations near or below chemical detection limits.[x] What this means is that the chemicals can do damage and we can't even test for them. According to Dr Lloyd-Smith, just because something may be a low level does not mean it is safe.[xi]

Improperly handled fracking fluids and 'produced water' can also contaminate surface water. Even a small spill of the highly toxic mixture can have large impacts on the surrounding livestock and wildlife.[xii] Spills of fracturing chemicals and wastes during transportation, fracturing operations and waste disposal have contaminated soil and surface waters.[xiii]

In Colorado alone, during an eight-month period in 2011, companies spilled 2 million gallons of fluids, which state officials say was just one-twentieth of one percent of the 10 billion gallons of fluids the industry handled during that time. **Officials acknowledge there are up to 400 oil and gas spills each year in Colorado, but they say only 20 percent contaminate groundwater.**[xiv]

Contamination when drilling through aquifers

The practice of fracking has the potential to induce connection and cross-contamination between aquifers, with impacts on groundwater quality. While oil and gas companies have data concerning the geology, they cannot identify every natural fault, fissure or other irregularity within hundreds of feet of the wellbore. A frack job may create new fractures that intersect natural geologic vertical faults that communicate with the surface or with upper zones.[xv] In such a scenario, the formation pressure would force the newly liberated gas, as well as the residual toxic fracking fluids, through these new fractures and into the natural fault. These fluids could then travel upwards along that fault

past the reservoir cap and into a freshwater aquifer or to the surface at distances over 1.5kms from the well.[xvi]

Aquifers can be contaminated by water and chemicals when a hole is drilled through them (for example, when trying to reach a coal seam). The toxic materials contained in the coal seam can leak out when it's cracked.[xvii]

According to a 2011 report by Shenhua Watermark Coal: “Drill holes or fractures may intersect with one or multiple aquifers potentially mixing groundwater from different strata or altering the groundwater chemistry through exposure to the air, gas, fracking chemicals and drilling fluids or the release of natural compounds like BTEX”.[xviii]

As the fluids migrate upwards through the rock formations, they often become highly salinated and can be contaminated with naturally occurring carcinogens such as arsenic, hexavalent chromium and radium, along with other dangerous heavy metals, such as lead, selenium, mercury and antimony. Small amounts of these wastes can contaminate an entire aquifer.[xix]

b. A range of accidents
Contamination can also be caused by a range of accidents, such as:

- On-site spills and/or leaks[xx] (e.g. during the injection of the fracking fluids[xxi]; surface spills from storage facilities[xxii])
- Leaks from holding ponds and pipelines[xxiii]
- Spills of fracturing chemicals and wastes during transportation[xxiv]
- Accidental release of chemicals into groundwater (e.g. well malfunction)
- Leakage from on-site storage into drinking water sources
- Improper pit construction, maintenance and/or closure
- Accidents during the capture, transportation and disposal of the ‘produced water’[xxv]
- Faulty gas well casings
- Mechanical vibrations from natural gas drilling activity disturbing particles in neglected water well equipment[xxvi].

Homes near fracking sites with higher risk of contaminated water
A study by researchers at Duke University, suggests that people whose homes are located near fracking sites are exposed to a higher risk of having their drinking water contaminated. Researchers looked into samples from more than 140 private wells located in the vicinity of the actively exploited Marcellus shale in the northeastern part of Pennsylvania**. Results revealed that methane was present in concentrations higher than safe levels in 82 percent of water samples, with the average level detected reaching six times higher than normal if the well was situated within a kilometer of a drilling well.** The study also discovered the presence of high levels of ethane and propane in drinking water.[xxvii]

It was noted by Robert Jackson, a professor of environmental sciences at Duke's Nicholas School of the Environment and leader of the study that **there was no biological source of either gas in the area which could have**

affected samples of drinking water and that the results were conclusive that the contamination was linked to fracking.[xxviii]

2.*The impacts upon landscape;*

One of the differences between unconventional gas and conventional gas is that for unconventional gas many more wells need to be drilled for a given volume of gas production.

The result is that fracking often involves gasfields with hundreds and even thousands of wells.

The impact on landscape also includes pipelines, evaporation ponds, water storage tanks, well heads, roads and trucks; and the landscape will become littered with gas flares (gas flare or flare stacks are used in gas wells to 'dispose' of waste gas).

To see what a gasfield of just 73 wells looks like, visit: XXXXXXXX.

3.*The effectiveness of existing legislation and regulation;*

Neither fracking companies nor scientists understand the exact nature of the underground geology, aquifers or underground water pressures where they are drilling.

In addition, no two wells behave identically and the amount of flowback water can vary from a few thousand to hundreds of thousands of litres a day, depending on the underground water pressures and geology.

Moreover, there are so many elements involved in the fracking process that there is a lot of scope for accidents to happen and mistakes to be made.

Therefore, no matter what legislation and regulations you have in place, fracking will still create enormous problems and risks.

The Australian Petroleum Production and Exploration Association told a public meeting in Sydney in 2011 that: "Drilling will, to varying degrees, impact on adjoining aquifers," and that good management could minimise the risks of water contamination, but never eliminate them."[xxix]

Moreover, on ABC's 'Inside Business of 4 April 2013', investors admitted they were becoming "unnerved by it" and that it was "potentially quite tricky, dangerous stuff". To view, click here: XXXXX

Last year I was fortunate enough to listen to Wyoming farmer John Fenton (www.fentontour.com) speak about his experiences with fracking. John was told that Wyoming follows the world's *best practice* – but things went terribly wrong on his property – and things have gone wrong for many thousands of people.

The reality is that no matter how well legislated and regulated the fracking industry is, things will go wrong.

Last year the NSW Chief Scientist issued a report on best practice in relation to CSG. If you do happen to consider her report for the purposes of your inquiry, I respectfully request that you taken into account her Terms of Reference – which was restricted to “Best practice”. In other words, she was asked to advise on “how it could be done”, not “if it should be done in the first place”.

4.*The potential net economic outcomes to the region and the rest of the state.*

The cost of gas is about to increase significantly for those people living on the east coast of Australia. We’ll be paying more for other things too.

The reason? Because gas is now being exported overseas, and as a result, the price of gas is linked to international markets we’ll be paying international prices.

The looming shortage is threatening NSW’s manufacturing industry, as the NSW government has refused to reserve any of the gas for Australia. Sue Morphet, the Chair of Manufacturing Australia, has claimed that **Australia is one of the only developed countries to permit unrestricted exporting of LNG**, and is seeking a “national interest test” similar to the United States and Canada, which weighs-up potential costs on domestic industries before granting approval to any new LNG export facilities.

With regards to CSG, the CSG industry blames anti-CSG activists for rises in gas prices. Ironically however, it is the industry itself which is to blame by virtue of exporting the gas overseas.[xxx]

The CSG industry also argues that producing more CSG will decrease gas prices. However, according to a study by The Australian Institute, the linking with the world price means that **if Australia develops lots of new CSG gas fields, we will still pay the world price. If we don't develop new CSG gas fields, we will still pay the world price. Put simply, it is predicted that more gas development is not going to have any real influence on the gas price we're going to pay.**[xxxi]

"This report suggests that even if the whole state of NSW were covered in gas wells it would have little impact on gas prices as it would just lead to more gas being exported.[xxxii]

The Australia Institute shows that the greatest threat to gas prices on the eastern seaboard is the CSG export industry itself.[xxxiii]

In addition, although the mining and unconventional gas industries claim the resources boom brings jobs, taxes and increased exports, **this growth comes at the direct expense of other industries such as agriculture,**

manufacturing, education and tourism.[xxxiv]

The projected economic gains from CSG development have been widely claimed by government and industry, but **a full cost-benefit analysis of the impacts on the wider economy of a massively expanded CSG production has not been done**. Financial benefits from employment, mining royalties and the export of coal seam gas must be offset against damage to agriculture, food exports, tourism, soil, water and air quality, as well as human health and well-being.[xxxv]

The resources boom has also resulted in a two-speed economy and a growing dependence on exporting our resources to China and India. This makes our economy vulnerable to global shocks.

Regular reports show that **Australians overestimate the extent to which the mining industry contributes to the workforce and the economy**.

We also need to take into account the subsidies we pay energy companies, the fact that a large number of fracking companies are foreign-owned, that it is the resources of the Australian people they are taking, and that they are putting our precious water and prime agricultural land at risk.

Moreover, creating LNG is energy expensive, consuming a considerable amount of natural gas and transportation fuel. Cooling natural gas to about −162°C (−260°F) and shipping it overseas for use in distant countries is costly and energy-intensive. The process to bring the gas to such low temperatures requires highly capital intensive infrastructure. Liquefaction plants, specially designed ships fitted with cryogenic cooling tanks, regasification terminals and domestic transmission infrastructure – plus all the infrastructure etc in relation to fracking – all make LNG relatively expensive in construction and operational cost.

Privatization of profits, socialization of costs

In Virginia in 2014, 300,000 had their water contaminated after a chemical spill by a company cleaning coal. They couldn't drink it. They couldn't even shower in it. Two months on, some people were still unable to drink their water.

A week after the spill, Freedom Industries, the company responsible for the widespread contaminated of West Virginia's water supplies, **filed for bankruptcy**.

The point is, while the profits from these companies mainly go to private individuals, if anything goes wrong the rest of us have to wear the burden.

Companies can file for bankruptcy; directors can flee overseas. But those people directly affected don't have that option. And the rest of us wear the costs through our taxes or by providing other forms of aid. No matter how

much compensation a company will be required to pay, and may pay, we will all also have to pay in one way or another.

Other impacts and risks of facking:

CSG produces massive amounts of contaminated wastewater (flowback)

One of the problems with CSG is what to do with the millions of litres of contaminated wastewater pumped out of the coal seams.

The wastewater – also known as 'flowback' or 'produced water' – is the water that is pumped out in order to release CSG.[xxxvi] **The wastewater is usually high in salt[xxxvii], as well as full of heavy metals, radioactive substances, fracking and drilling fluids**[xxxviii].

CSG water is classified as a waste under the QLD Environmental Protection Act 1994.[xxxix] **If it is released, it has the potential to alter the temperature, acidity and chemistry of local streams and lakes, wiping out plants and animals.**[xl] According to Matt Norrie, Vice Chair of Namoi Water, "Untreated coal seam gas water… pretty much sterilises the environment".[xli]

Seven months after the spill in the Pilliga Forest of produced water readings were still picking up high levels of lead, mercury, chromium, hydrocarbons and phenols.[xlii]

In addition, if the water dries out it can leave a hazardous sediment. For example, it can contain thorium, which in dust, is a cause of lung cancer.[xliii]

The CSIRO says that: "Produced water quality is highly variable from site to site, but it is generally not fit for human consumption." It also notes that: "the beneficial uses of CSG water are limited without treatment."[xliv]

No two wells or coal seams behave identically and the amount of water produced can vary from a few thousand to hundreds of thousands of litres a day, depending on the underground water pressures and geology.[xlv] **In Queensland, the average well has produced around 20,000 litres of water each day[xlvi], and tens of millions of litres of water each year[xlvii].**

The CSG industry suggests it will pull out somewhere between 126 gigalitres and 280 gigalitres a year, while the National Water Commission puts the figure above 300 gigalitres a year. Others, including the **Water Group advising the Federal Government, suggest it is higher still,[xlviii] at 5400GL of water each year – almost three times the 1872GL used by all the households in Australia each year combined.[xlix]**

Much of the CSG wastewater was previously disposed of via evaporation ponds. However, because of the many risks and problems evaporation ponds have now been prohibited by the NSW Government.[l]

Nevertheless, once the water has been extracted from the coal seam the produced water is still stored in tanks or holding ponds while awaiting its intended future use.[li] There is consequently still the risk that the ponds will leak into underlying aquifers, or will escape into the surface water during floods,[lii] and there is the problem of air pollution caused by volatile chemicals gassing off.[liii]

In the Pilliga approval has recently been given for two storage ponds to hold brine and waste water with have a total capacity of 600 megalitres[liv] (the equivalent to about 240 Olympic swimming pools[lv]).

According to the CSIRO, the potential uses for produced water include:

(a) Water as a supply for local farmers and communities

(b) Irrigation of agricultural crops or plantation forestry

(c) Discharge of interim or occasional surpluses of treated water into local river or weir/dam systems (if the water is treated and conditioned to equal standards for discharge into rivers, it can contribute favourably to environmental outcomes for river systems already exposed to heavy irrigation demand)

(d) Reinjection into suitable underground aquifers or discharge as surface water

(e) Dust suppression

(f) Industrial purposes (e.g. drilling, coal washing for coal mining, cooling in power stations).

Most of these options can however create serious issues. Below is an outline of issues relating to some of these options.

Options (a), (b) and (c)

With respect to (a), (b) and (c) above, Origin and Australia Pacific LNG have begun using new CSG water purification technology which includes reverse osmosis to treat CSG water in Chinchilla, Queensland.[lvi]

After being treated, the water will be pumped into the Condamine River[lvii], which is an essential resource to local communities and landowners in the region and the principal drinking water supply for the Condamine Township[lviii]. Water taken by the Western Downs Regional Council will be further treated before being used in households. **From as early as October this year Chinchilla residents could be drinking the treated CSG water.** In addition, three customers have **been using the treated CSG water for agricultural purposes since December last year.[lix]**

It appears that this was the first time in the world that the produced water is being treated and then reintroduced for farming and as drinking

water, and there is debate regarding how safe the treated water will actually be.

Dr Lloyd-Smith from the Australian National Toxics Network says that the industry's own documents, the Water Commission, and documents of the Reverse Osmosis Industry all state that it is not possible to remove many of the CSG chemicals (e.g. naphthalene, nonylphenol, methanol, trichloroethylene, ethylene glycol).[lx] Standard reverse osmosis does not remove low-molecular-weight chemicals, many of which are present in coal seam water, and which are also toxic and bio-accumulative (build up in the body over time).

CSG water that was treated at another plant has previously been pumped into the Chinchilla. That water contained high levels of methane, ammonia, boron and bromine and in order to discharge the water, the Queensland Release Permit 2010 permitted 20 megalitres per day for 18 months of water contaminated with 80 chemicals plus radionuclides. The chemicals are persistent, bio-accumulative and toxic. Over the 18 month period, amongst other things, the company was permitted to pump nearly 5,500 tonnes of nitrate into the Condamine Tiver.

In addition, the National Water Commission has raised the concern that the **"production of large volumes of treated waste water, if released to surface water systems, could alter natural flow patterns and have significant impacts on water quality, and river and wetland health"**.

The National Water Commission has also noted that there "is an associated risk that, **if the water is overly treated, 'clean water' pollution of naturally turbid systems may occur"**.[lxi]

Another potential issue is **radiation in the water**. Analysis by the Environmental Assessor in the UK of Cuadrilla Resources' Preese Hall exploratory well found significant levels of radium-226, which has a half-life of 1,620 years, above legal limits. Although the concentration of radioactivity was low, the total volume of return fluids was large; large enough to require an environmental permit for disposal at its intended destination. Nearly a year on from the EA's visits, however, Cuadrilla was still yet to attain a permit, which requires a full radiological impact assessment, and the flowback water remains in steel tanks on the fracking site.[lxii]

Questions that must be asked include, **who is monitoring the quality and impact on the environment of the CSG treated water being released?** And, **are they independent?** Are they testing for all possible contaminants that may be in water such as contained in the fracking fluids (which aren't disclosed), are they testing for radiation and other contaminants that might be found in underground water, are they taking into account large low volumes (which can be just as significant and damaging and small amounts of high concentrations)? What about the chemicals that can't be tested?

The transparency of information regarding water quality cannot be

guaranteed. The Queensland State Opposition is in fact currently considering whether to formally accuse Queensland Environment Minister Andrew Powell of misleading Parliament, after he described his department as "completely transparent" on water released from coal mines. On July 19, under questioning from Opposition environment spokeswoman Jackie Trad during Budget Estimates, Mr Powell defended his handling of mine water discharges in Central Queensland saying all necessary information for councils, residents and industry was available on government websites. APN has since learned **critical data on water quality was kept from the public, labelled** '**commercial-in-confidence**', a justification questioned by the Opposition and water experts.[lxiii]

AGL has recently been working out ways of dealing with the CSG produced water issue by trialing mixing it with normal water and spraying it onto crops.[lxiv] Again, the question arises how safe it those crops would be for human or animal consumption, given the other toxic and radioactive materials that may have also been brought up during the CSG mining process.

In addition, the question must be asked about **what happens to the residuals—the concentrated brines and solids containing the chemicals removed from the produced water—that will be created as a by-product of the water treatment.** Since chemicals in these residual wastes are present at higher concentrations than in the original produced waters, careful management and disposal is essential.[lxv]

Option (d)

Option (d), namely reinjection of coal seam gas, creates another set of problem. There's evidence that the deep disposal wells used to store drilling wastewater may help trigger earthquakes.[lxvi]

Into most of them goes wastewater from hydraulic fracking, while some, as those in Prague, are filled with leftover fluid from dewatering operations.[lxvii] Nobody really knows how all this water will impact faults, or just how big an earthquake it could spawn.[lxviii]

In fact, after a spate of quakes linked to injection-wells shook northern Arkansas, the state's oil and gas commission declared a moratorium on underground wastewater disposal activities within a 1,000-square-mile area and required seismic-risk studies.[lxix]

According to Dr Lloyd-Smith from the National Toxics Network, in addition to being environmentally very risky, it's often not possible to reinject the produced water; and it's nearly impossible to reinject back into the aquifer from where the water came.[lxx] According to the National Water Commission, the reinjection of treated waste water into other aquifers has the potential to change the beneficial use characteristics of those aquifers.[lxxi]

Option (e)

With respect to dust suppression as a means of disposing the wastewater, in

the Chinchilla/Tara gasfield areas in Queensland the contaminated water from CSG mining operations is sprayed with water trucks onto unsealed public roads and other areas.[lxxii] It appears that this is done under the premise of 'dust suppression', although local residence have reported seeing the spraying take place when it's raining. Moreover, spraying the roads poses a risk as rainfall washing salts and other chemicals off roadways can result in stream or groundwater contamination.[lxxiii]

The radiation problem

Waste from fracking can be radioactive – and in some cases, highly radioactive.[lxxiv] This is because **fracking brings naturally occurring radioactive materials to the surface**.[lxxv]

Wastewater from fracking can contain high levels of radioactivity. When wastewater is released into our streams and rivers without adequate radiation treatment, highly radioactive elements like uranium and radium, which had previously been safely trapped thousands of feet below the surface, can then enter the food chain and bioaccumulate in humans, plants, and animals just as heavy metals do.[lxxvi]

Radioactive waste creates the risk of potential contamination of water supplies.[lxxvii]

In Pennsylvania millions of litres of radioactive wastewater — sometimes with radium levels 3,000 times the safe level —have been sent through sewage treatment plants incapable of correcting radioactivity and then discharged into rivers.[lxxviii]

Radioactive waste also creates issues surrounding transportation, treatment and disposal of the waste.[lxxix] In 2013, a US truck carrying drill cuttings from a hydraulic fracturing pad was turned away due to its radiation warning.[lxxx] There are also recent reports of another truck driver who believes he's suffering from radiation sickness after transporting the waste.[lxxxi]

It has also been reported that radioactive waste unearthed by hydraulic fracturing is becoming a serious problem in Ohio, in the US.[lxxxii]

Lowering of aquifers

According to Santos in 2009, "Drawdown of groundwater heads within coal seam gas aquifers is an unavoidable impact". In other words, extraction of groundwater from coal seams will inevitably result in the drawdown (e.g. change in groundwater level) of freshwater aquifers in the same vicinity.

Lowering the water table in aquifers can also degrade water quality by allowing more particles to concentrate in what is left in the aquifer.

Sometimes there are requirements that if, for example, CSG mining causes groundwater levels to drop below specified 'trigger' points then companies must 'make good' to affected water users. It is however unclear how this would ever work in practice.

The Salt Problem

Massive amounts of salt are produced as a by-product of coal seam gas projects. Modelling suggests the industry could produce 31 million tonnes of waste salt over the next 30 years. This amount of salt would fill the Melbourne Cricket Ground to the brim 15 times.

NSW's coal seam gas industry has a "complete lack of solutions" to deal with large quantities of salt, with one pilot project alone producing five tonnes of salt a day, a report commissioned by the state's Chief Scientist says.

To give you an idea of the salt problem created by the industry, please see the picture at the following link:
http://www.smh.com.au/environment/coal-seam-gas-industry-faces-salt-overload-20131204-2yqx8.html

The Toxic Air Pollution Problem

Air pollution is another serious concern where CSG activity takes place. It has been found that exposure to contaminated air may contribute significantly to the health problems of both people and animals living near gas drilling operations.

Farm residents in Chinchilla QLD have reported noxious air emissions from a neighboring gas production, complaining of burning eyes and respiratory problems.

Air pollution can arise from various sources:

- Flaring – Little air monitoring is conducted in Australia yet over two hundred air pollutants can be released from gas flaring including carcinogens such as benzopyrene, arsenic and chromium.
- Venting from condensate tanks and when liquefying the gas.
- Leaking pipes and wells, and chemical spills.
- Methane contamination brought to the surface from local aquifers contributes to local air pollution.
- Exhaust from pumps and trucks.

CSG's Impact on physical health

While there are significant gaps in studies on health consequences, there is a considerable amount of evidence which indicates likely impacts on human health from CSG projects.

In fact, health professionals and organisations around Australia are concerned about the potential health impacts of CSG mining. At a recent health experts

meeting in Canberra, serious concerns were raised about the availability of data and support for health research in relation to coal and CSG: ‘A lack of monitoring and inadequate investment in research means there is grossly insufficient data available in Australia on health impacts to inform policy decisions.”

Similarly, in a joint statement, a coalition of Australian health organisations "noted that the risks to human health from energy and resources policy were not being well accounted for in current policy decisions... and called for a precautionary approach to policy, and for potential intergenerational consequences to be considered.”

A report launched in May 2013 by Doctors for the Environment Australia (DEA) revealed evidence of likely health impacts from Australian coal and coal seam gas projects. In April 2013 the Australian Medical Association (AMA) also voiced their concern about CSG.

CSG’s impact on mental health

The cumulative impacts of water and air pollution, degradation of land and loss of amenity and landscape, all have mental health consequences for communities living in a gas field.

A Hunter Valley psychiatrist has documented the mental health impacts of CSG extraction he has witnessed: “Exploration is when the psychological stresses are first noticed in the community. ... uncertainty starts to generate community anxiety.... The community starts to divide between the few who see it as an opportunity for an additional income and the larger number who hear the risks and see little in the way of benefits. .... Seismic surveys come and go with some damage to paddocks, heavy vehicle traffic ruining country roads, and noise. Drilling occurs with the same complications. The town takes on a different look...Lifetime plans are put on hold or cancelled. Property development in the area declines as a result of the general uncertainty. Rental property is more expensive... The gas company employs very few locals. Exploration wells are fracked to optimize the flow and the wells are flared for months. There is no explanation of the risks and precautions taken in these… operations. There is no publicity given to any air or water testing. There have been at least two separate unpredicted explosions locally due to gas migration known to the community from just a dozen exploration wells...This results in understandable anxiety about safety risks. In Gloucester this first phase has taken 5 years so far and production has yet to commence.

“The people are having their rights, their homes, their business, their health, their security, water, land taken away from them and threatened. Country roads all of a sudden have thousands of vehicle movements a day for each well being drilled, not to mention the truck loads of water, chemicals, equipment… compressor stations, gas plants, power plants, reverse osmosis water plants. Basically turning once peaceful lovely to live in places into overnight industrialised mini cities which is not what people live in the country

for.”

Fracking’s impact on food security

At a June 2013 panel discussion on *Food, Farms, and Fracking in California*, Kassie Siegel, director of the US-based Climate Law Institute at the Center for Biological Diversity, addressed this issue and stated that "**fracking pollution poses a real risk to our food sheds, organic farms, and all aspects of food production**."[lxxxiii]

Indeed, recent studies by Penn State and Cornell found that in Pennsylvania counties with at least 10,000 dairy cows, those that had at least 150 Marcellus Shale wells experienced a 16 percent average **decline in the number of dairy cows** between 2007 and 2010, compared with a 3 percent increase in counties without shale gas wells. **The counties with the wells saw an 18.5% decrease in milk production; counties without wells experienced an *increase* in milk production.**[lxxxiv]

Soil acidity increases in the vicinity of oil and gas pipelines where flaring occurs, reducing the amount of usable essential nutrients in the soil such as carbon, nitrogen, and phosphorus. Fracking also releases toxic heavy metals like arsenic, barium, cadmium, chromium, lead, and mercury into soils.

As fracking expands into areas that are home to some of the most productive farmland in the world, questions need to be raised regarding the long-term safety for the agricultural industry.[lxxxv] Humans and animals that eat these plants are exposed to these heavy metals, which can accumulate in body tissues and cause serious damage.[lxxxvi] Produced water is posing a highly underreported threat to our food supply and security and to our families' health.[lxxxvii]

When meat and produce are grown in toxic conditions, the toxic contamination doesn't stop at the farm field. Contaminated fruits, vegetables, and meats can be shipped all over the country, potentially poisoning people hundreds or thousands of miles away from the frack source. Unfortunately, most foods are not adequately inspected for chemical contamination and residue. Furthermore, since the gas companies are not required to disclose the chemicals within fracking fluid, government regulatory organisations may not even know what to test for.[lxxxviii]

There is also the issue of the perception of food grown in fracking and/or areas where CSG mining is prevalent. For example, in Pennsylvania some people are avoiding food from areas where fracking is prevalent.[lxxxix] Australia is therefore risking its position as a major food exporter, as well as risking the health of people who consume the food produced and water sourced from gaslands.

Other risks and problems of fracking

There are many other risks and problems created by fracking, some of which are briefly summarised below:

- Noise pollution – This is a major concern for families living near gas wells. Drilling can be a 24 hour-a-day operation, and many people have reported very high noise levels, even inside their homes. Compressor stations operate around the clock and can even be heard several kilometres away. In addition, the constant stream of trucks going into and out of the gas wells can create serious noise problems.

- The potential to lower the value of nearby properties. In Tara, Queensland, many residents want to be relocated away from the gasfields.

- Safety and road repair issues from the transportation of so much water and waste.

- Land subsidence over large areas, affecting surface water systems, ecosystems, irrigation and grazing lands.

- Damage to tourism.

- Rent increases from fracking workers, making locals unable to afford the rent.

- Lifetime plans are put on hold or cancelled.

- Property development declines in the area as a result of general uncertainty.

- It can divide previously close-knit communities between those who see it as an opportunity for an additional income and those who hear the risks and see little in the way of benefits.

- Coal seam gas is a fire hazard. It mainly comprises methane, which is highly flammable and can be easily ignited by sparks or an open flame. Methane leaks are common. Once an area is fracked, gas can leak from many places over an entire gas field. Should it be commercially exploited, pressurised methane gas flowing through gas pipelines from the processing plants could explode and cause devastation in this high value conservation area. Such blazes can, of course, also endanger residents in neighbouring towns.

- Explosions and injuries at sites, which pose not just a danger to the miners but also to firefighters, paramedics and other medical staff.

CSG and climate change

The overwhelming majority of the world's scientists are now as certain that humans are causing climate change, as they are that smoking causes lung cancer. This was one of the key take-outs of the most comprehensive assessment of the science of climate change ever undertaken: the IPCC Fifth Assessment Report, which was published on 27 September 2013.

In addition, according to a recent draft United Nations report, another 15 years of failure to limit carbon emissions could make the problem virtually impossible to solve with current technologies.

The fact of the matter is that we are now working within a very limited timeframe for dealing with these issues. We must act very quickly.

Natural gas has been described as a transitional fuel between gas and renewable energy. This is not however the case.

The 20-year Global Warming Potential (GWP20) of methane is currently understood to be about 105 times that of CO2. The next 20 years – the next 10, even – are crucial if we are to avoid climate change, so there are very good reasons to consider GWP20 rather than the more common GWP100. And with GWP 20, it only takes about 2.6% leakage to effectively double the net climate effect of gas. That is, the 2.6% that would be leaking as methane would have the same warming effect as the other 97.4% being burned, over the next 20 years. This doubling of emissions already makes fossil gas roughly equal in impact to black coal.[xc]

APPEA has consistently said coal seam gas is 70 per cent cleaner than coal. But in September 2012 the Government released a report which found that the absence of published information about fugitive emissions - greenhouse gases that leak into the atmosphere during the extraction process - was a matter of "public policy concern".[xci]

Longtime oil and gas engineer Anthony Ingraffea has said that because of leaks of methane, the main component of natural gas, the **gas is not a "bridge" to a renewable energy future — it's a gangplank to more warming and away from clean energy investments**.[xcii]

CSG extraction results in fugitive methane emissions from:

- Methane escaping through underground systems[xciii]
- Leaking pipelines, well heads and processing plants[xciv]
- Entrained methane in produced water
- Flaring[xcv]
- Gas and oil wells that lose their structural integrity also leak methane and other contaminants outside their casings and into the atmosphere and water wells[xcvi].

Vast amounts of methane appear to be leaking undetected from Australia's biggest coal seam gas field, according to world-first research that undercuts claims by the gas industry. Testing inside the Tara gas field, near Condamine on Queensland's Western Downs, found some greenhouse gas levels over

three times higher than nearby districts, according to the study by researchers at Southern Cross University.[xcvii] **According to the Queensland Government, in the Tara gas field over 44 per cent of wells are leaking**.[xcviii]

Multiple industry studies show that about 5 percent of all oil and gas wells leak immediately because of integrity issues, with increasing rates of leakage over time. With hundreds of thousands of new wells expected, this problem is neither negligible nor preventable with current technology.[xcix]

In addition, there are the other emissions including carbon emissions during the full life cycle of CSG including production, pipeline transport, liquefaction, shipping, regasification, transportation and generation.[c] In fact, a recent report shows that **flaring from unconventional gas in North Dakota alone is the equivalent to one million cars per year**.[ci]

Severe pressure on fresh water in the future

In May 2013, 500 scientists from around the world warned that the majority of the 9 billion people on Earth will live with severe pressure on fresh water within the space of two generations as climate change, pollution and over-use of resources take their toll. "There is no citizen of the world who can be complacent about this," said Janos Bogardi, former director of the UN University's Institute for Environment and Human Security.[cii]

It seems insane to waste and take such risks with our water.

Bans and concerns

A United Nations report has raised deep concerns about unconventional gas sources including CSG, claiming it presents considerable environmental risks. The report from the United Nations Environmental Program, said the risks ranged from potential water and soil contamination and surface leaks of gas to increased competition for water and implications for climate change.[ciii]

Some countries, including France and Bulgaria, have banned fracking, while other E.U. nations have raised environmental bars high enough to discourage the practice.[civ]

Our environment in a state of emergency

As outlined above, fracking causes an enormous amount of environmental destruction. As outlined below, our environment is already in a state of emergency from burning fossil fuels and other destructive practices. We therefore need to be focusing on protecting and conserving the environment and engaging in forms of energy that have as little impact as possible:

- The overwhelming majority of the world’s scientists are now as certain

that humans are causing climate change, as they are that smoking causes lung cancer. This was one of the key take-outs of the most comprehensive assessment of the science of climate change ever undertaken: the IPCC Fifth Assessment Report, which was published on 27 September 2013.[cv]

- Moreover, an IPCC report published in March 2014 found that climate change will raise the risk of conflict, floods and hunger.[cvi]

- In addition, according to the draft of another United Nations report, **another 15 years of failure to limit carbon emissions could make the problem virtually impossible to solve with current technologies.[cvii]**

- According to the UN Environment Programme in August 2013, the Earth is in the midst of a mass extinction of life. Scientists estimate that 150-200 species of plant, insect, bird and mammal become extinct every 24 hours. This is nearly 1,000 times the 'natural' or 'background' rate and, say many biologists, is greater than anything the world has experienced since the vanishing of the dinosaurs nearly 65 million years ago.

  Notably, another major UN report was expected to say that saving biodiversity is remarkably cost-effective and the benefits from saving "natural goods and services", such as pollination, medicines, fertile soils, clean air and water, are between 10 and 100 times the cost of saving the habitats and species that provide them.[cviii]

- In October 2013 a study released earlier from the International Programme on the State of the Ocean (IPSO) showed that our oceans are in such a bad way that a mass extinction may already be under way.[cix]

- A United Nations report from November 2012 raised deep concerns about unconventional gas sources including CSG, claiming it presents considerable environmental risks. The report from the United Nations Environmental Program, said the risks ranged from potential water and soil contamination and surface leaks of gas to increased competition for water and implications for climate change.[cx]

The fact of the matter is that we are now working within a very limited timeframe for dealing with these issues. We must act very quickly.

Renewable energy

Despite what you may have heard, renewable energy offers enormous hope. It's viable, cheap, and ready to go. The more I learn about what can be achieved by combining renewable energy and energy efficiency the more excited I get about the future. Things get even more exciting when we also reduce our consumption and minimize our waste.

Add to that getting rid of *all* subsidies – including fossil fuel subsidies (which amount to an eye-popping $1.9 trillion worldwide[cxi]) – and renewables have it in the bag.

The way forward

The world currently has a quota of the amount of greenhouses gases that can be released to keep us within safe climate limits (known as an 'emissions quota'). Rather than investing in the fracking industry, which contaminates water and land and creates enormous problems, we should be putting all our energy into building renewable resources. It's also worth noting that renewable energy uses significantly less water than any other form of energy.

Yours sincerely,

[Name withheld]

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