Submission for CSG Review

Nimna De Silva to: csg.review@chiefscientist.nsw.gov.au 25/04/2013 09:30 PM

Please respond to Nimna De Silva

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Dear Sir/Madam,

I've attached my submission for review by the NSW Chief Scientist & Engineer.

Could you kindly acknowledge your office has received it?

Thank you,

Nimna De Silva

Submission to NSW Cheif Scientist for CSG Review.docx

25/04/2013

Public Submission to the NSW Chief Scientist and Engineer

Re: The impact of coal seam gas activities on human health and the environment

I'm a final year medical student who lives in Sydney. My concerns about the coal seam gas development in Sydney and its potential impact on residents' health and wellbeing also extends to regional and rural NSW and Queensland. Australia's health expenditure was 9.3% of the Gross Domestic Product in 2010-11 and is predicted to rise significantly in years to come.[1] Therefore, any economic development that would affect the health of Australians should be assessed for sustainable health and environmental risks and gains in the future. In this submission I shall address the evidence base behind contemporary risks of coal seam gas development on fresh water management, air pollution, paediatric populations, and related specific health impact. The overall impact of fossil fuel-based industries on Australian economy and population health will not be discussed, although it is well within the scope of the Chief Scientist's review.

1. Impact on water

- Osborn et al analysed groundwater from 68 water wells in Pennsylvania and New York and found systematic evidence for methane contamination of drinking water associated with the extraction of shale gas, as well as higher chain hydrocarbons such as ethane, propane, and butane.[2] However, there have been no studies done on the long term health impacts of such a finding.

- Upon preliminary sampling of the air and water in Tara, Queensland, the National Toxics Network found evidence of Volatile Organic Compounds (VOCs) within 24 hours of the well-heads in this region being fracced.[3] These initial samples included known carcinogens like benzene and bromodicholoromethane.[3] Residents in Tara have reported clusters of symptoms (neurological, gastrointestinal, upper respiratory, and ophthalmological) which are being investigated in communities who are affected by gas extraction overseas.4 Medical experts cannot rule out hydrocarbon exposure and have raised concern over the potentially serious yet unassessed risk of unconventional gas development citing that "protecting the health and wellbeing of all Australians should be the priority".[3]

- In October 2012, Earthworks' Oil & Gas Accountability Project made a strong statement after conducting community-based research into the impact of gas development on health: "To protect the public health, our primary recommendation is: Pennsylvania (and other states) should put public health first and refuse to permit new gas development until they can assure affected communities that they (a) fully understand the associated public health risks and (b) have taken all necessary steps to prevent those health risks."[4]

- The following salient findings on the impact of water backed their recommendation[4]: Symptoms reported by residents increased as their proximity to gas facilities increased. Symptoms ranged from throat irritation and severe headaches to joint pains, forgetfulness, nosebleeds, sinus irritation, eye burning, and skin rashes in young children. The results suggest an association between ill health and proximity to gas field. Non-smokers reported symptoms that are commonly thought to be the lot of smokers. Odours were experienced by 81%, and for 18% on a daily basis, and water well samples that were tested had elevated methane in more than half, as well as levels of iron, manganese, arsenic, and lead that were higher than the Maximum Contaminant Level. Elevated levels of these, as well as barium,

bromide, calcium, chloride, magnesium, potassium, sodium, sulphate, and strontium were consistently pointing to contamination of drinking water by gas activities.

- Dr. Marion Carey, a public health physician, Senior Research Fellow at Monash University, and past Senior Medical Adviser in Environmental Health to the Chief Health Officer of Victoria, in her 2012 peer-reviewed paper, made particular emphasis on the potential impact coal seam gas activity would have on water[5]:

"Chief amongst the potential threats to health is contamination of surface and ground waters, particularly drinking water sources. The chemical additives used in fracking, their degradation products, and compounds mobilised from sediments during the process can pose a risk to animal and human health by contaminating water used for drinking, washing, stock watering and food production. These can include toxic, allergenic, mutagenic and carcinogenic substances as well as methane. Waste water coming to the surface may contain volatile organic compounds, high concentrations of ions, heavy metals and radioactive substances.

The CSG industry uses enormous quantities of water, with predicted extractions of around 7,500 gigalitres from groundwater systems over the next 25 years. The National Water Commission is concerned that "CSG development represents a substantial risk to sustainable water management."

The Australian Senate interim report noted concern about the potential impact of the extraction of large volumes of water on the pressure within adjacent aquifers, and the possibility of contamination of water. A recent report by JP Morgan indicated a range of risks to water supplies from CSG operations.

'There has been no comprehensive hazard assessment of the chemical mixtures used and their impacts on the environment or human health. Only two of the twenty-three most commonly used fracking chemicals have been assessed by the national regulator (NICNAS), and neither of these has been specifically assessed for use in fracking. A report on one of the two fracking chemicals that have been assessed for use in other situations the persulfate salts used in hair bleaching preparations - state they are "hazardous chemicals and ...harmful if swallowed, irritant to the skin and eyes and able to cause allergic responses". The companies argue that only a very small percentage of fracking fluids consist of these chemicals, but because of the huge volumes of fluids used, cumulatively these chemicals may still constitute literally truckloads in volume. Additionally, some compounds such as benzene can present a risk to health even in minute quantities (as indicated by the Australian drinking water guidelines for benzene of 1ppb, the equivalent of a drop of water in a swimming pool)."[5]

2. Impact on air

- The 2012 Accountability Project also found that air in both rural and residential areas were contaminated with VOCs including known carcinogens, benzene, toluene, ethylbenzene, and xylene.[4] These levels were higher in some samples than those detected near oil refineries, as well as the national mean for urban areas. American state and federal agencies have already drawn known associations between the contaminants of water and air by gas activities and the health symptoms reported in the study. Sixty eight percent of residents had reported symptoms which were *known* to be associated with these contaminants from the gas industry.

- With regards to air quality, an assessment of human health risks from air emissions due to unconventional gas extraction (directional drilling, hydraulic fracturing) by McKenzie et al brought to light further health risks.[6] Results demonstrated that residents living less than 0.5

miles from wells were at greater risk for health effects than those living more than 0.5 miles from wells. The sub-chronic non-cancer hazard index (HI) of 5 for the former group was primarily driven by exposure to trimethylbenenes, xylenes, and aliphatic hydrocarbons.[6] Exposure to harmful air pollution was greatest during well completion (fracking and flowback). Cumulative risk for developing cancer was increased for residents living near wells due to the increased exposure, for the most part, from benzene. The known health effects from hydrocarbon exposure (headaches, throat and eye irritation) were also commonly reported by residents.[6]

- Recent studies by Colborn et al have had comparable findings for the health impacts from exposure to non-methane hydrocarbons, whose concentration in the air of residences where gas well co-existed were highest during the initial drilling phase.[7] Methylene chloride, a toxic solvent, was present 73% of the time when air quality over the year was monitored. It was present in extremely high concentrations (one reading of 1730 ppbv, and three others more than 563 ppbv) when the well was being developed but declined after the well began producing (highest level at 10.66 ppb). Since methylene chloride does not occur naturally in raw gas and is not a component of drilling or fracturing fluids (as far as the authors know), the source and exposure routes need to be better outlined; there are reports by residents and workers of the gas field that methylene chloride was stored on well pads for cleaning. This study highlights the unknown terrain that is familiar to residential natural gas extraction, and the known implications to people's health from exposure to hazardous substances associated with untested industrial processes.

- Literature reviews also revealed that non-methane hydrocarbons are linked to disruption of the endocrine system, even at low levels of exposure.[7,8] Furthermore, some polycyclic aromatic hydrocarbons (PAHs), like naphthalene, were detected at greater concentrations by Colborn et al than in past studies.[7] The impact of PAHs is clinically significant, even at low concentrations.[7,8] For instance, in 2006, Perera at al showed that children in New York City who received greater prenatal exposure to eight PAHs (summed concentration >4.16 ng/m^3 measured by the Columbia Center for Children's Environmental Health where pregnant women in urban areas wore personal air monitors) had lower intellectual developmental scores than others.[9] Follow-up in 2009 demonstrated lower IQ scores amongst five year-olds with prenatal exposures > 2.26 ng/m.[10]

3. Impact on the special susceptibility of paediatric populations

- A 2010 study in Krakow, Poland by Edwards et al corroborated the above findings of Perera et al and reported similar detriment to children's cognitive development.[10,11] The acute exposure of relatively high concentrations of chemicals differs from the chronic, intermittent, low-level exposures that occur to residents near gas wells.[10] The health impact also varies depending on the individuals affected: pregnant women, developing embryos, children, and the elderly. Chemicals that disrupt the endocrine system are especially harmful when low-level exposure occurs in embryological development and childhood.[8-11]

- The American Academy of Paediatrics, Paediatric Environmental Health Specialty Units (PEHSU) Information on Natural Gas Extraction and Hydraulic Fracturing for Health Professionals released the following statement which is applicable to Australia's paediatric population[12]:

"Children are more vulnerable to environmental hazards. They eat, drink, and breathe more than adults on a pound for pound basis. Research has also shown that children are not able to metabolize some toxicants as well as adults due to immature detoxification processes. Moreover, the foetus and young child are in a critical period of development when toxic exposures can have profound negative effects.

Water Contamination
One of the potential routes of exposure to toxics from the NGE/HF process is the contamination of drinking water, including public water supplies and private wells. This can occur when geologic fractures extend into groundwater or from leaks from the natural gas well if it passes through the water table. In addition, drilling fluid, chemical spills, and disposal pit leaks may contaminate surface water supplies. A study conducted in New York and Pennsylvania found that methane contamination of private drinking water wells was associated with proximity to active natural gas drilling. (Osborne SG, et al., 2011). While many of the chemicals used in the drilling and fracking process are proprietary, the list includes benzene, toluene, ethyl benzene, xylene, ethylene glycol, glutaraldehyde and other biocides, hydrochloric acid, and hydrogen treated light petroleum distillates. These substances have a wide spectrum of potential toxic effects on humans ranging from cancer to adverse effects on the reproductive, neurological, and endocrine systems (ATSDR, Colborn T, et al, U.S. EPA 2009).

Air Pollution
Sources of air pollution around a drilling facility include diesel exhaust from the use of machinery and heavy trucks, and fugitive emissions from the drilling and NGE/HF processes. These air pollutants are associated with a spectrum of adverse health outcomes in humans. Increases in particulate matter air pollution, for example, have been linked to respiratory illnesses, wheezing in infants, cardiovascular events, and premature death (Laden F, et al, Lewtas J, Ryan PH, et al, Sacks JD, et al). Since each fracturing event at each well requires up to 2,400 industrial truck trips, residents near the site and along the truck routes may be exposed to increased levels of these air pollutants (New York State DECDMR, 2009). Volatile organic compounds can escape capture from the wells and combine with nitrogen oxides to produce ground-level ozone (CDPHE 2008, CDPHE 2010). Due to its inflammatory effects on the respiratory tract, ground-level ozone has been linked to asthma exacerbations and respiratory deaths. Elevated ozone levels have been found in rural areas of Wyoming, partially attributed to natural gas drilling in these locations. (Wyoming Department of Environmental Quality, 2010). In an air sampling study from 2005 to 2007 conducted in Colorado, researchers found that air benzene concentrations approached or exceeded health-based standards at sites associated with oil or gas drilling (Garfield County PHD, 2007). Benzene exposure during pregnancy has been associated with neural tube defects (Lupo PJ, et al), decreased birth parameters (Slama R, et al., 2009), and childhood leukaemia (Whitworth KW, et al., 2008).

Noise Pollution
Noise pollution from the drilling process and resulting truck traffic has not been optimally evaluated, but since drilling sites have been located in close proximity to housing in many locations, noise from these industrial sources might impact sleep, and that has been associated with negative effects on learning and other aspects of daily living (Stansfeld SA, et al., 2003, WHO 2011)."[12]

4. Specific health impacts

Given the widespread grassroots opposition to coal seam gas development in NSW, failure to address significant community concerns by undertaking exhaustive study into the above impacts, would escalate uncertainty and lack of confidence in the regulatory processes. Communities where opposition to such mining development is unanimous are at risk of breakdown of cohesive social structures, mental disorder and illness, and somatic manifestations of political disempowerment.

"The cumulative impacts of water and air pollution, degradation of agricultural land and loss of amenity and landscape, all have mental health consequences for communities living in a gas field. The CSG process can divide previously close-knit rural communities, and it seems

the traditional Australian “fair go” doesn’t apply. Farmers do not have the right to veto a CSG operation on their land which may have been nurtured by their family for generations. This can lead to anger, anxiety and powerlessness. Miners can legally force their way onto farmers’ land with a court order if they don’t comply. One CSG company recently served a court order on a blind Hunter Valley farmer who refused access because he was concerned about damage to his water supply, and needed to preserve the physical integrity of his land to be able to farm without normal vision” [5]

A study of toxicology on ‘Environmental pathways of potential impacts to human health from oil and gas development in northeast British Columbia, Canada’ drew the following conclusions.[13]

“In order for the health impacts of oil and gas to be understood, cause and effect relationships need to be drawn. Confounding variables and a lack of data are some of the obstacles to this endeavour. However, we know that northeast British Columbia (NEBC) experiences some health problems at a higher frequency than the rest of the province. We know that contaminants and other upstream oil and gas (UOG) related stressors can cause those health problems. We know that NEBC is the only part of the province with such UOG activity. We also know from previous model predictions and field observations that some contaminants can reach levels high enough to have health consequences. Accordingly, there seems to be a correlation in British Columbia between UOG activity and increased rates of lung cancer, morbidity, and respiratory diseases.

Monitoring should be statistically rigorous and spatially representative accounting for topography, pollutant chemistry, meteorology, source density or distance, and the precision required to determine human health response. Considering the potentially high level of toxicity and carcinogenicity of some toxic substances (e.g., BTEX), it is recommended that even small releases be highly regulated, reported, and avoided. Background and environmental levels of these compounds may be increasing. For some less volatile compounds, measurements in water and soil may be an appropriate metric of total cumulative load/exposure. Widespread air monitoring of H2S is desirable to protect human health, and due to the different toxicological limits of H2S and various mercaptans, speciation of TRS is required. Similarly, due to varying toxicities of VOC, their grouping is considered arbitrary from a human health perspective and the measurement or reporting of these compounds should be speciated whenever possible.

Due to the commonality of radiation sources associated with UOG in NEBC, isotopes of uranium, radon, radium, and lead need to be measured along statistically defined transects to determine whether radiation may cause a human health risk based on usual outdoor habits and traditions. If measured levels warrant concern, ingestion and inhalation exposure pathways deserve immediate attention.

There are a myriad of potential health impacts from UOG development in NEBC. Contaminants from UOG activity can reach human receptors through the air, water,soil, and food pathways. Some contaminants such as PAH or radioactivity may be inhaled, absorbed, and ingested reaching people through all pathways. Many of these contaminants including air pollutants, radiation (such as radon), and volatile hydrocarbons in air or soil, are associated with lung cancer, respiratory ailments, and related mortalities — health indicators for which NEBC shows disparity. Modelling results and observations to date have found that levels of some contaminants are high enough to cause negative human health impacts; however, to determine whether or not UOG related contaminants are the cause of health disparities requires further research. That research must include long-term spatially representative monitoring of contaminants in the environment as well as spatial epidemiological analyses of potentially related health symptoms and any confounding lifestyle factors.

We also know little about the combined impacts of multiple stressors and contaminants on human health. Most upstream oil and gas activities are associated with multiple stressors. For instance, a new well being drilled will emit noise, vent pollutants and dispose of waste to the surface. Essentially anyone or anything within the range of influence of this new well will experience some sort of impact. That impact will be cumulative and may be equal to or greater than the sum of all individual impacts (e.g., Mauderly and Samet 2009). Human health is considered one of many potential indicators of cumulative impacts from UOG. Therefore, by protecting human health, environmental health may also be preserved (or vice versa). The combined risk or cumulative impact of UOG on human health, must to be determined in order for appropriate management and policy decisions to be made."[13]

5. Consensus groups' recommendations on CSG impact

A) The New Brunswick College of Family Physicians called for a moratorium on hydraulic fracturing, citing apprehension over the protection of 'valuable resources and the public's health by putting a moratorium on hydraulic fracturing development in New Brunswick until further research can prove that the benefits clearly outweigh the risks'. They go on to state: "We are particularly concerned about potential contamination of public water supplies, air pollution resulting from fracking operations, disposal of radioactive wastewater, possible spills of toxic chemicals, the health of children and pregnant women, only enumerating a few. …" The letter concludes, "For all of the reasons above, we believe hydraulic fracturing is not the right choice for New Brunswick and we urge you to use the power of your legislation to suspend the development of this industry in our Province until further research is done."[14a,b]

B) Locally, Doctors for Environment Australia and the National Toxics Network, highlighted the 2012 study in Tara: "A recent independent university study of the atmosphere of a coal seam gas field near Tara, Queensland has shown evidence of widespread releases of methane and carbon dioxide concentrations. Hotspot concentrations of methane were detected within the gas field that were more than 3 times higher than background levels found outside the gas fields. Activities such as drilling and hydraulic fracturing can release contaminants into sediments and aquifers, which escape into the air. "Other air contaminants, such as volatile organic compounds (VOCs), were not measured as part of this study, but are known from studies overseas to be released from gas fields which are fracked" said Dr Mariann Lloyd-Smith, Senior Advisor to National Toxics Network. A recent study looking at the human health risk assessment of air emissions from unconventional gas extraction published in the journal, Science of the Total Environment, found that residents living closest to gas wells had higher risks for neurological, respiratory and other health effects and higher cancer risks than those living further away."[3]

C) Professor David Shearman, Emeritus Professor of Medicine at University of Adelaide, who does not work for, consult to, own shares in, or receive funding from any company or organisation that benefits from his work, has written extensively on the caution Australia should exercise with CSG[15,16]:

"Public health experience indicates that in a range of environmental contamination issues prevention is the mainstay to protection. Think of lead or asbestos for example; adequate assessment and regulation are key measures.

The debate has failed to focus on these important issues because industry has placed the onus of proof of contamination on exposed communities. It has refused on many occasions to disclose what chemicals are actually used in fracking, and has circulated information inaccurately suggesting the procedure uses only benign substances.

In Australia, baseline studies on aquifer water and air quality have not been done before CSG mining development. This is a failure of regulation in states.

Hydraulic fracturing (fracking) involves pumping a mixture of water, sand and chemicals deep underground to shatter rock strata and force coal seam gas to the surface. It is then refined into natural gas for fuel. The emerging problems of water contamination from fracking are being reported from many sources. They raise the entire question of government responsibilities to the community in the sphere of public health." [15]

"In Queensland, ground water and bores used for stock were contaminated recently with benzene and toluene near to the Cougar Energy project at Kingaroy. Queensland's Department of Environment and Resource Management (DERM) ordered Cougar to stop its underground coal gasification trial.

In Pavilion, Wyoming, 11 of 39 private water wells were found to be contaminated in regions where fracking was occurring. Some were contaminated with the solvent 2-butoxyethanol a chemical used in the process which can cause kidney disease and liver cancer. Traces of benzene, a carcinogen, were also found. Many medical symptoms reported in the community were compatible with exposure to these chemicals and are being investigated by the US Environmental Protection Agency. Problems have been reported in many other States in the USA and in August in New York State the Senate issued a moratorium on fracking until there is a comprehensive review of health and environmental concerns.

These adverse findings are at variance with the statements by industry that the process is safe and there are no cases of human health are being affected. Such statements often hide the fact that contamination and health have not been monitored.

The science and distribution of aquifers and other groundwater systems is rudimentary. Yet the coal seam gas sector and indeed the mining industry are currently exempt from the National Water Initiative which is responsible for water reform and water security. The water management rules which apply to every other industry, do not apply to the one sector that needs more regulation than any other. (There is potential for long term contamination and damage to aquifers)The National Water Initiative was signed in 2004, and although it was agreed that the mineral and petroleum sectors needed specific management arrangements there has been little progress to define these. Urgent reform needs to be instituted by the federal government which can accrue a body of expertise with recommendations that have to be followed by states. The prime consideration should be human health and the sustainability of land, particularly prime farming areas, and water resources. The precautionary principle should be paramount when there is potential for long term contamination and damage to aquifers with impacts on human health."[16]

D) The National Toxics Network has asked for a moratorium on drilling and the fracking process until the chemicals used in the process have been assessed for safety of residents above ground[17]:

'The real environmental and social costs of CSG extraction have not been thoroughly assessed. According to a recent Cornell University assessment, "Natural gas obtained by the controversial technique of hydraulic fracturing may contribute significantly to greenhouse gas emissions and so should not be considered as a cleaner alternative to coal or oil."

This US finding has direct relevance to the situation in Australia. The methods of extraction of unconventional gas both here and in the US are the same and both countries face the impacts of methane emissions, chemical contamination, water depletion and waste water management.

In neither country have the fracking chemicals been adequately assessed for their health and environmental effects and there is a growing concern that they may have significant negative impacts on the environment and surrounding communities. For instance, toxic spills can occur, and air, soil and water may also be polluted with fracking chemicals as a by-product of the CSG extraction process. Contamination of drinking and irrigation water and the destruction of productive farmland are also significant issues that concern the community.'

'Industry representatives claim that fracking chemicals are safe because they are similar to 'food additives' and are used in 'household products'. NTN believes these claims are misleading for several reasons. A number of the chemicals used in fracking fluids would never be permitted as food additives or household products due to their toxicity. As well, there has been no comprehensive hazard assessment of the chemical mixtures used in fracking fluids nor their impacts on the environment or human health.

A US analysis of chemicals used in fracking based on health data obtained from the MSDS as well as government toxicological reports, and the medical literature for the 362 chemicals with CAS numbers found:

• Over 78% of the chemicals are associated with skin, eye or sensory organ effects, respiratory effects and gastrointestinal or liver effects. The brain and nervous system can be harmed by 55% of the chemicals. Symptoms include burning eyes, rashes, coughs, sore throats, asthma-like effects, nausea, vomiting, headaches, dizziness, tremors, and convulsions.
• Between 22% and 47% of the chemicals were associated with possibly longer term health effects such as cancer, organ damage, and harm to the endocrine system.
• 210 chemicals (58%) are water-soluble while 131 chemicals (36%) are volatile; i.e., they can become airborne. Because they can be inhaled, swallowed, and also reach the skin, the potential for exposure to volatile chemicals is greater.
• Over 93% of the volatile chemicals can harm the eyes, skin, sensory organs, respiratory tract, gastrointestinal tract or liver, 86% can cause harm to the brain and nervous system, 72% can harm the cardiovascular system and blood, and 66% can harm the kidneys.'

In their release of a briefing paper on the chemicals used in the drilling and extraction of coal seam gas in Australia the NTN also noted[18]:

'Our investigation found that of 23 common fracking chemicals used in Australia, only 2 have ever been assessed by NICNAS, Australia's industrial chemicals regulator. The two that were assessed, have never been assessed for use as fracking chemicals," said lead author of the report, Dr Mariann Lloyd Smith.

"Constituents of fracking fluids are often considered 'trade secrets' and not revealed. Even regulators are left in the dark," she says. "Risk assessments for specific CSG projects in Queensland lacked basic information on the chemicals. The ones we were able to identify concerned us because of their significant potential to cause damage to the environment and human health. Some were linked with cancer and birth defects, while others damaged the hormone system of living things and affected aquatic species at very low levels."

"Fracking chemicals are complex mixtures of different chemicals which increases their risks. They are being used in very large volumes and unknown concentrations for purposes they were never intended for," Dr Lloyd –Smith says.

"Despite industry claims that fracking chemicals are 'only used in small quantities' and are all 'food grade chemicals used in household chemicals', NTN has discovered that hazardous

chemicals such as ethylene glycol, formamide, naphthalene, ethoxylated nonylphenol and sodium persulfate are commonly used in fracking mixtures

“To give you an idea of the quantities involved, in one QLD proposed coal seam gas operation it was reported that 18,500kg of additives were to be used in each well during the fracturing process and that up to 40% (i.e. 7,500kg or 7.5 tonnes) of the fracking fluids would remain in the formations,” Dr Lloyd-Smith says.

“That’s a very large quantity of chemicals and they have to go somewhere. Whether they stay underground or they are bought back to the surface and placed in evaporation ponds, there are significant risks of pollution to waterways, the atmosphere and surrounding communities,” she says.

“By allowing these chemicals to go unchecked, it effectively gives the CSG industry a green light to pollute. With such rapid expansion of the CSG industry expected, Governments must intervene to ensure the industry does not cause irreversible pollution” Dr Lloyd-Smith concluded.”’[18]

E) Dr. Marion Carey also advised on coal seam gas development and the biopsychosocial model of population health and wellbeing impact:

‘It would be at present difficult to undertake adequate health risk assessments of CSG operations as insufficient information has been gathered on the nature and doses of chemicals entering water and air and the exposures of people to these chemicals. However concerns about long-term effects of some chemicals used in or generated by CSG mining include hormonal system disruption, fertility and reproductive effects and development of cancer.’[5]

‘Overseas there have been bans or moratoriums on shale gas mining in France and parts of the USA and South Africa, with the European Parliament calling for comprehensive regulation.

The US EPA has begun a study to investigate the potential adverse impacts that hydraulic fracturing may have on water quality and public health. Our own governments’ reassurances appear less convincing once publicly available data start to emerge. The Queensland government reported that in only the first six months of 2011 there were forty-five CSG compliance related incidents, including twenty-three spills of CSG water during operations, four uncontrolled discharges of CSG water, three exceedances of discharge limits, three overflows of storage ponds, and other incidents relating to vegetation clearing and BTEX contamination.

Recently 10,000 litres of saline water leaked at the Narrabri CSG Project, now operated by Santos. The incident was not reported at the time despite an obligation to do so under the conditions of the petroleum exploration licence.

And yet people concerned about their water supplies and asking for testing of water before CSG operations begin may be forced to protest publicly and risk being arrested.

The NSW Ombudsman has raised serious issues about conflicts of interest in the assessment of CSG developments and under resourcing of compliance and enforcement activities. The same government department is responsible for both promoting investment in the CSG industry and regulating it. developments and under resourcing of compliance and enforcement activities. The same government department is responsible for both promoting investment in the CSG industry and regulating it.

A number of Australian health experts, including one of our Nobel Laureates, are sounding alarm bells. Some US public health experts say that claims of safety lack credibility in the face of a growing litany of accidents and contamination problems. They are advocating the need for the precautionary principle to be observed in the absence of health data. While the industry calls for definite proof of health effects, as with tobacco and asbestos, by the time evidence is iron-clad, damage may be well underway. We need to act to prevent serious impacts.

In the words of one analyst: " in the rush to supply CSG to China, Australia could forfeit its water security, and consequently its food security….It seems clear that every Australian has good reason to be concerned about whether Australian CSG mining will impair the Australian way of life."[5]

F) Some international leaders have adopted the precautionary principle on allowing further development of unconventional gas extraction:

The Natural Resources Minister for Quebec, a state which has banned hydraulic fracturing, recently asserted: "I cannot see the day when the extraction of natural gas by the fracking method can be done in a safe way..Our position is very clear: we want a complete moratorium, not only on exploitation but also on exploration of shale gas. We haven't changed our minds."[19]

Summary

In conclusion, this submission has highlighted the significant unknowns that surround the impact of coal seam gas mining on human health. For the risks these unknowns pose to be addressed adequately, independent and thorough review of the current evidence is needed. Given the disparate lack of evidence available, further research into the impact of coal seam gas activity on population health and environmental health is called for. The review should provide policymakers and communities alike with the confidence that such development is safe, evidence-based, and sustainable. Currently, there is a void of high quality studies into the impact of coal seam gas development on human health: the few peer-reviewed studies published to date have raised concern about significant risks to air, water, and human health from unconventional gas extraction. In contrast, there is a growing body of evidence which advocates for the synergistic development of renewable energy-based economies and the phasing out of the fossil-fuel based sector in Australia. Given the studies presented in this submission, and the expert opinions of those in the wider scientific community and health industry, I advise the precautionary principle be applied to the consideration of coal seam gas activity in NSW and Australia: "While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavours…When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically."[20]

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