

**Submission
No 280**

INQUIRY INTO COAL SEAM GAS

Organisation: Lock The Gate Alliance Inc

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LOCK THE GATE ALLIANCE INC

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Secretary:

Sarah Moles

The Director
General Purpose Standing Committee No. 5
Parliament House
Macquarie St
Sydney NSW 2000

7th September 2011.

The Lock The Gate Alliance (LTGA) welcomes the opportunity to comment on this important inquiry into coal seam gas (CSG) developments in NSW.

LTGA represents more than 100 community groups and more than 2500 individual supporters concerned by the rapid escalation of mining and coal seam gas developments and the impact these industries have on our land, water, environmentally sensitive areas and the health of people in nearby communities.

We have particular issues with the following introductory statements.
'Gas has a critical role to play in NSW moving to a low carbon economy. It is the only conventional energy source that can underpin this transition....'

The statement is based on several false or misleading assumptions:

1. Coal seam gas has a significantly lower carbon footprint than coal.

It is important that full life-cycle emissions are considered in our clean energy future. Recent research on the life cycle carbon cost of CSG which includes fugitive emissions of methane conservatively estimates that in a 20 year timeframe approximately 36 –60 grams of carbon are produced per MJ of energy produced, while coal estimates for the same timeframe range between 30 and 32 grams carbon per MJ. (Howarth, 2011). This is not fringe or discredited science but information used by the coal industry itself.

The CSG industry regularly states that gas is "up to 70% cleaner" than coal. The statement is true if combustion of CSG in combined cycle gas turbines is compared with combustion of brown coal in subcritical turbines. It is also true that the least efficient gas technology is 13% worse in terms of greenhouse emissions than the best quality coal burnt in a supercritical turbine.¹

2. The mining companies are interested in extracting gas primarily for the

¹Life-cycle Energy Balance and Greenhouse Emissions of Nuclear Energy in Australia. ISA, University of Sydney 2006

domestic /local market.

The NSW Government does not own the CSG companies and has no control over its end use. LTGA understands that the majority of the gas to be produced in Australia is destined for the export market. Current domestic gas consumption is about 1000 petajoules (PJ) annually and is estimated to increase to 1150PJ, while gas companies are looking to export over twice this amount (AIG, 2011). Linking domestic gas production to world export markets will dramatically increase the price of domestic gas (AIG, 2011). If the NSW Government is, as stated, looking to CSG as a transitional energy source to a low carbon economy, then export of CSG must be restricted.

3. CSG is 'conventional'.

CSG should not be confused with natural or "conventional" gas, traditionally associated with oil fields. CSG is "unconventional" gas and is a newer resource extracted from coal deposits that are too deep to mine economically. It has a different (significantly heavier) GHG footprint. While both are mostly methane, CSG contains very little of the heavier hydrocarbons (propane, butane), no natural gas condensate and no hydrogen sulphide which are found in natural gas.

CSG requires processing into LNG. Liquefying it consumes about 20% of its energy value and negates almost 30% of its 'clean' character.²

If the NSW Government is using the term 'conventional energy source' to mean 'traditional' then LTGA contends that the NSW government must take a wider and more enlightened view that acknowledges the global climate challenge and the benefits of a more diverse energy mix and broader based economy. Consideration must be given to the more innovative renewable energy sources now available that have been proven to provide base load power.

LTGA rejects arguments that renewable energy technologies are not economically competitive and advocates a level playing field (ie. the withdrawal of all subsidies currently provided to the fossil fuel sector).

1. The Environmental and health impact of CSG activities including the:

(a) Effect on ground and surface water systems.

Of critical importance to this inquiry is the absence of effective legislation and regulation of the CSG industry.

- The CSG industry is not subject to the *Commonwealth Water Act 2007*. This means that CSG water is not part of the MDB Plan until it is released (or escapes) into a surface water stream.
- The CSG industry is outside the National Water Initiative.
- No federal law or regulation specifically addresses the CSG mining industry.
- CSG is not subject to any formal federal review or environmental processes in the application phases, other than companies are required to address points in their submissions referencing their compliance to Federal environmental concerns.
- The CSG industry is not subject to State Water Acts.
- The CSG industry is not listed in the NSW Acts under which it is supposedly

² <http://www.peakoil.org.au/Heede.Ing.greenhouse-intensity.pdf>

regulated (e.g., NSW *On-Shore Petroleum Act 1991*).

- CSG exploration is not covered by the NSW *Protection of the Environment Operations Act* which defines the operations of the Department of Environment, Climate Change & Water.

Unlike all other users of water, CSG companies are allowed unlimited take. The National Water Commissioner raised concerns about the volume of water that would be extracted by CSG development in a position paper in December 2010 stating that

*"Current projections indicate the Australian CSG industry could extract in the order of 7,500 gigalitres of co-produced water from groundwater systems over the next 25 years, equivalent to ~300 gigalitres per year."*³

This volume is almost half of existing total extraction from the Great Artesian Basin.

In media statements in July 2011 the National Water Commissioner reaffirmed the concerns of the authority publically stating that the coal seam gas industry presents

*"significant potential risks to water and our water management as a result of the scale of the development of the sector."*⁴

Connectivity between coal seams and shallower groundwater sources and between coal seams and surface water streams are known to exist in some areas where CSG development is occurring (e.g. Queensland's Upper Condamine floodplain), and considered likely (and the subject of detailed study) in the Namoi valley. Groundwater experts are not prepared to categorically rule out the possibility of detrimental impacts. LTGA is deeply concerned that development in the Namoi catchment is proceeding in the absence of sound scientific information that is due within the current financial year.

LTGA understands that CSG production in NSW includes the area known as the Coonamble Embayment and north along the western slopes of the Great Dividing Range. These features form the Great Artesian Basin's southern recharge area. LTGA further understands that much about the GAB, including detail of its recharge processes are not well understood. The GAB is the only reliable source for water in many arid and semi arid areas. While the extraction of large volumes of water from the GAB is an obvious concern, the loss of the pressure resource is arguably a greater one. Water in coal seams is under pressure and maintains the pressure – and water levels - in adjoining aquifers. Not only does removal of CSG water detrimentally affect the water supplies of users tapping those aquifers, the loss of pressure undermines all the work, investment and achievements of the NSW Cap and Pipe the Bores program. Landholders considering undertaking capping and piping works are now questioning their involvement if the CSG industry will be allowed to squander the benefits.

LTGA is concerned that there is no mention at all of stygofauna in the Terms of Reference to this inquiry. Stygofauna are members of the rich biota found in underground water including potentially important chemo-synthetic microbes and distinctive and specialised (and often geographically specialised) fauna. Stygofauna are recognised in the Ramsar Convention on Wetlands of International Importance; and at a federal level by the National Groundwater Committee. There is an increasing awareness of these communities and of

³ http://www.nwc.gov.au/resources/documents/Coal_Seam_Gas.pdf

⁴ <http://www.theaustralian.com.au/national-affairs/plea-to-watch-water-quality-national-water-commission/story-fn59niix-1226115575097>

their importance to ecosystems in Western Australia (DEC, WA) but stygofaunal communities in the eastern States are rarely acknowledged. The task of describing stygofaunal species has barely begun and the importance of their role and function in groundwater ecosystems is very poorly understood.

Recently the NSW Land and Environment Court in [2010] NSWLEC 104 and [2010] NSWLEC 48 recognised the likely occurrence of stygofauna in ground water and required continual sampling and monitoring of the project on the basis of the Precautionary Principle. LTGA supports precautionary approaches and rejects Queensland's current emphasis on adaptive management.

LTGA regards governments' cavalier attitude to protection and sustainable management of our essential and irreplaceable water resources as short sighted, grossly irresponsible and tantamount to wilful vandalism.

Water Impacts: Quality

With approximately 25% of NSW currently covered by coal seam gas exploration licences⁵ including major population centres such as Sydney, Wollongong, Newcastle, Kangaroo Valley, Gunnedah, Taree and Casino, there is intense community interest in the protection of water quality

CSG associated water is generally saline and may contain as much as 5-8tonnes per megalitres of salt.⁶ It also often contains naturally occurring chemicals such as BTEX, heavy metals and radionuclides from within the coal seam. Their presence is more likely if hydraulic fracturing has occurred as the process can allow them to disperse into the groundwater aquifers or to volatilise into air.⁷

The National Water Commission's December 2010 position paper warned 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."*⁸

The chemical characteristics or fingerprint of any such releases and the implications for human health and in-stream aquatic fauna are unknown. In Queensland, the latter is the subject of DERM's Healthy Headwaters study.

CSG companies may be authorised to release treated associated water to rivers and streams, or to inject it into another aquifer. Treatment by reverse osmosis removes salts and membranes remove some other contaminants but not all. In Qld, where the CSG industry is more developed than in NSW, discharge limits for each contaminant are set by the regulator, DERM.

Environmental Approval PEN 100067807 granted to Australia Pacific LNG Pty Ltd (Origin) includes a table of chemical compounds to be released in treated water from its Talinga facility into the Condamine River and the water quality limits and monitoring requirements for each (weekly). Many of these substances are known to bio-accumulate. A few of these

⁵ Taken from a snap shot of petroleum titles as shown on the NSW Government's Minview site as at 1 August 2011.

⁶ http://www.arrowenergy.com.au/icms_docs/73090_Water_and_salt_management_brochure.pdf

⁷ <http://ntn.org.au/wp-content/uploads/2011/07/NTN-CSG-Report-July-2011.pdf>

⁸ http://www.nwc.gov.au/resources/documents/Coal_Seam_Gas.pdf

are covered in the table below.⁹ A detailed analysis of all the contaminants authorised for discharge to the Condamine River, including the extent to which some are above safe limits can be found at

http://www.nwc.gov.au/resources/documents/KH_complete_submission.pdf

The National Toxics Network (NTN) notes that some of these chemicals are dangerous at very low levels – approaching the detection limit.

In total, at a release rate of 20ML per day, Origin is authorised to release the following into the Condamine River over an 18 month (547.5 days) period.

| Chemical compound | Release rate/day | Total (release rate x 20ML x 547.5 days) |
|--------------------------|-------------------------|---|
| Uranium | 20g/ML | 219KG |
| Toluene | 800g/ML | 8760KG (8.76 tonnes) |
| Xylene | 600g/ML | 6570KG (6.57 tonnes) |
| Ethylbenzene | 300g/ML | 3285KG (3.285 tonnes) |
| Benzene | 1g/ML | 10.95KG |
| Cyanide | 80g/ML | 876KG |
| Lead | 10g/ML | 109.5KG |

Note that this is for one site and one company only.

For LTGA this highlights a significant flaw in the assessment and approval process, namely consideration of cumulative impacts.

Release limits were included in the Environmental Authority but most are not based on the ANZECC water guidelines, either because they were not listed in the guidelines, or were marked as having insufficient data to set a water quality guideline.¹⁰

NTN is concerned that there is no discussion of the persistence of the chemicals listed, nor their breakdown products or even how much of the contamination is expected to be absorbed to sediment, let alone their final fate. NTN believes the extent of permissible contaminants and the tonnage of BTEX is totally inappropriate for release to a natural water course, particularly given governments' much-publicised banning of BTEX in fracking chemicals (Dr Mariann Lloyd-Smith, pers comm).

Many NSW communities and a much larger number of individual users rely on groundwater sources.

With evaporation no longer a preferred disposal method due to the risks of dam wall-failure and spills after intense rainfall events, concern is increasing in Queensland that re-injected water could contaminate adjacent aquifers bearing higher quality water that is allocated to other users. While 'make good' provisions exist in Queensland, it appears the onus will be on landholders to prove CSG development as the cause. Further, LTGA questions how long it is feasible for a CSG company to make good a water source or supply that is permanently affected.

LTGA has little confidence in the CSG industry's ability to meet its license conditions. On 4 August 2011 the NSW Environment Minister issued a formal warning to AGL in relation to

⁹ Full document at http://anti-mining.com/environmental_authorities/ea-index.html

¹⁰ Lloyd-Smith, M., and Senjen, R. *Hydraulic Fracturing in Coal Seam Gas Mining: The Risks to Our Health, Communities, Environment and Climate* National Toxics Network briefing paper, April 2011

an uncontrolled gas and water release at a CSG well near Campbelltown. AGL was found to have been in breach of its environmental protection licence.¹¹ More recently, Arrow Energy reported BTEX at 15 times the ANZECC guideline level in groundwater near Dalby, Qld.¹²

(b) Effects related to the use of chemicals

LTGA believes this ToR should be widened to include consideration of chemicals mobilised and released into the wider environment as part of the gas extraction process.

Experience and investigations in USA & Australia in the vicinity of gas drilling including fracturing in coal, shale or other seams has revealed serious toxicity to communities by toxic volatile organic compounds (VOCs), poly-aromatic hydrocarbons (PAHs), heavy metals (eg uranium, lead, mercury) and other compounds naturally present in coal seams. They may be brought to the surface via leaks to the atmosphere or in "co-produced" (or "associated") water. These substances can and do contaminate air, surface water and underground water systems. Typical releases include BTEX (benzene, toluene, ethyl benzene and xylene). Of the compounds typically released:

- 25% are carcinogenic
- 37% affect the endocrine system
- 52% affect the nervous system
- 40% affect the immune system
- 100% affect the respiratory system.

(Note: many compounds affect several systems whether drunk in contaminated water or inhaled).

Chemicals used in the fracking process are considered under (c) below.

(c) Effects related to hydraulic fracturing

In areas where the controversial hydraulic fracturing (fracking) process is used, there is serious and unquantified risk of groundwater being contaminated, either by fracking fluids, by saline associated water contaminated with the chemicals naturally present in the coal seam entering a freshwater aquifer, and / or by the gas itself.

The chemicals used in the fracking process include carcinogens, mutagens, endocrine disruptors, substances linked to cardiovascular and blood disorders, kidney, liver and gastrointestinal damage, respiratory diseases, brain and nervous system conditions, reproductive, skin and eye disorders and developmental problems in children.¹³

The CSG industry frequently states that the chemicals in fracking fluids are found in everyday, household items on any supermarket shelf, *implying* but never actually stating that this therefore makes them safe. According to APPEA, 23 chemicals are used in the fracking process in Australia.¹⁴ NRN has called for a moratorium on the use of fracking chemicals on the grounds that only 2 of 23 chemicals used in the process have ever been tested by the national industrial chemicals regulator (NICNAS), making assertions about

¹¹ http://www.jeremybuckingham.org/wp-content/uploads/2011/08/4Aug_Warning-Letter-from-OEH.pdf

¹² <http://news.smh.com.au/breaking-news-national/carcinogens-found-in-csg-project-20110828-1jg77.html>

¹³ <http://www.endocrinedisruption.com/chemicals.fracturing.php>

¹⁴ http://www.appea.com.au/images/stories/mb_files/APPEA_fracking_chemicals.pdf

their safety extremely hard to justify.¹⁵

The compounds used in fracking processes are largely toxic. Ingredients include acetic and boric acids, bleach, caustic soda, detergents, polish, and hydrocarbon derivatives. They should not be inhaled, ingested or even handled by sensitive people. Any reflux is considered hazardous.

An estimated 30% to 70% of the fracking fluid resurfaces, bringing with it toxic substances naturally present in underground oil and gas deposits. This is pumped into storage dams. Sometimes, nothing is recovered – all the fluid stays underground.¹⁶

In the US, there are thousands of documented cases of drinking water supplies being contaminated by fracking fluids and gas even though they are separated by tens or even hundreds of metres of rock.¹⁷ Cases of contamination have also been reported in Australia.¹⁸

Recent reports from the US suggest that fracking may have contributed to earthquake activity, including a magnitude 5.8 event that shook the east coast and Washington DC on August 24th 2011.^{19 20}

(d) Effect on Crown Lands including travelling stock routes and State forests.

Even protected areas and public lands are not safe. CSG development leads to extensive clearing and fragmentation of native bushland and threatened species habitats. It transforms major vegetation remnants, refuges and corridors into industrial zones and represents a major threat to wetland systems, even distant ones that are hydrologically connected.

CSG extraction can occur in areas bordering National Parks, and is permitted in State Conservation Areas and State Forests. CSG development will clear at least 2,400 hectares and fragment 85,000 hectares of public lands in NSW, including State Forests and State Conservation Areas.

- At more than 500,000 hectares, the Pilliga is the largest intact temperate woodland in eastern Australia. It is home to threatened species such as the Regent Honeyeater and the Pilliga Mouse and helps recharge the Great Artesian Basin. Eastern Star Gas planned more than 550 wells in the Pilliga before selling their interests to Santos.
- At Putty, drilling is planned next to the World Heritage-listed Wollemi National Park.
- At Pogy, drilling is occurring on an in-holding in the Goulburn River National Park.
- In north-west NSW, Travelling Stock Routes, significant habitats for listed threatened species, are targeted for drilling and gas pipeline infrastructure. This

¹⁵ <http://ntn.org.au/2011/02/21/call-for-moratorium-as-report-finds-fracking-chemicals-have-never-been-tested-for-safety/>

¹⁶ The Endocrine Disruptor Exchange <http://www.endocrinedisruption.com/chemicals.introduction.php>

¹⁷ Scientific American, 17 Nov 2008

<http://www.scientificamerican.com/article.cfm?id=drill-for-natural-gas-pollute-water>

¹⁸ ABC-TV's Four Corners "The Gas Rush" broadcast February 2011.

¹⁹ <http://rt.com/usa/news/fracking-earthquake-virginia-dc-817-061/>

²⁰ <http://themoderatevoice.com/120738/fracking-the-dc-earthquake-and-unclean-water/>

infrastructure will interfere with the use of TSRs by local graziers.

- In the north-east, a pipeline is proposed through the World Heritage-listed Border Ranges National Park.

It should be noted that the presences of gas pipelines and other infrastructure increases the risk of catastrophic bushfires and will impeded or prevent the passage of rural fire brigade crews to affected areas to fight bushfires.

(e) Nature and effectiveness of remediation required under the Act.

Coal mines have a relatively compact footprint compared to the extensive spider- web network associated with gas-fields.

The most likely of threats from a CSG field is water and soil contamination: by heavy metals, neurotoxins, radioactive isotopes and salinity from associated or produced water. A produced water spill would result in a hard surface crust that neither water nor plant roots can penetrate, effectively leaving the surrounding land unusable for agriculture.

LTGA understands that remediation of groundwater contaminated by a single chemical is possible. However, it is not possible to deal with a combination of many chemicals such as those found in fracking fluids. Contamination of the Great Artesian Basin is considered a serious and potentially irreversible risk given lengthy recharge times. In view of the contamination, leaks and falling bore levels already seen in Queensland and NSW gas-fields, expansion of the CSG industry is inviting a serious accident to occur.

(f) Effect on greenhouse gas and other emissions

As the prolonged drought and catastrophic floods of 2011 have demonstrated, southeastern Australia is vulnerable to the impacts of climate change and urgent action is needed to mitigate both the effects and costs of climate-related damage.

Estimates of the cost of the 2011 Queensland floods range from \$11 billion²¹ to \$30 billion.²² The costs of flooding in Victoria in 2011 range from \$676 million²³ to over \$2 billion.²⁴ Media reports put the NSW flood costs at \$850 million for crop losses,²⁵ \$1 billion for damage to roads and bridges;²⁶ and \$35 million to the mid-north coast local economy.²⁷ There are also undoubtedly significant costs to the health system arising from the stress-related conditions that accompany prolonged drought and follow the trauma of serious flooding.

The CSG industry repeatedly claims that gas-fired power stations emit up to 70 per cent less greenhouse gases than existing coal-burning plants. Since most of the CSG produced in Australia is for export markets, these benefits will not show up on our own greenhouse accounts. The '70% less' figure is not only cherry picking the best possible combination of

²¹ <http://www.theaustralian.com.au/news/nation/financial-cost-of-queensland-floods-put-at-6bn-and-rising/story-e6frg6nf-1225985224605>

²² <http://www.news.com.au/business/counting-cost-of-queensland-floods/story-e6frfm1i-1225988393452>

²³ <http://news.ninemsn.com.au/national/floods/8244392/victorias-floods-cost-676m>

²⁴ <http://www.theage.com.au/victoria/victorian-damage-bill-to-hit-2bn-20110125-1a4cf.html>

²⁵ <http://www.abc.net.au/news/2011-01-27/floods-cost-nsw-crops-850-million/1919484>

²⁶ <http://www.smh.com.au/nsw/nsw-councils-braced-to-fork-out-1b-to-fix-local-roads-20110110-19183.html>

²⁷ <http://www.insurancenews.com.au/local/nsw-floods-cost-local-economy-around-35-million>

gas-fired power plants and the most polluting brown coal and least efficient coal fired power stations; but also fails to include the emissions involved in producing the gas – the drilling, fracking, compressing, pumping, liquefying and transporting the gas; nor the loss of carbon-storing forests and woodlands cleared to make way for wells and pipes.

To export CSG, liquefaction is required. Full life cycle analyses show that the ultimate benefit is far less and in some cases results in higher CO₂ emissions than coal fired power generation.²⁸

The total domestic emissions per year from the first three LNG projects approved in Queensland amount to 24.14 million tonnes of CO₂ equivalent (Mtpa CO₂-e).^{29 30 31} Over the next three years, the CSG industry alone will increase Queensland's emissions by 21%. The emissions from combustion of the exported LNG from just these three projects will emit 136 Mtpa CO₂-e which will not show up in Australia's GHG accounts. This represents a 2-3% increase in total global emissions.

Research from Cornell University now indicates that the emissions footprint for unconventional gas is significantly higher than previously thought. The GHG footprint of coal seam gas consists of the direct emissions of CO₂ from end-use consumption, indirect emissions of CO₂ from fossil fuels used to extract, develop, and transport the gas, and methane fugitive emissions and venting. The GHG footprint is dominated by the direct CO₂ emissions and fugitive methane emissions.

A significant amount of the water used in fracking returns to the surface as flow-back within the first few days to weeks after injection and is accompanied by far more methane than could be dissolved in the flow-back fluids, reflecting a mixture of fracture-return fluids and methane gas. Between 0.6% and 3.2% of the life-time production of gas from a well is emitted as methane during the flow-back period.

More methane is emitted during "drill-out," the stage in developing unconventional gas in which the plugs (set to separate fracturing stages) are drilled out to release gas for production. Between 0.33 and 0.62% of the lifetime production of wells is emitted as methane during the drill-out stage.

After completion, some fugitive emissions continue at the well site over its lifetime. A typical well has 55 to 150 connections to equipment such as heaters, meters, dehydrators, compressors, and vapour-recovery apparatus. Many of these potentially leak, and many pressure relief valves are designed to purposefully vent gas. Emissions from pneumatic pumps and dehydrators are a major part of the leakage. Between 0.3% to 1.9% of the life-time production of a well is lost due to routine venting and equipment leaks.

Additional venting occurs during "liquid unloading." Empirical data from 4 gas basins indicated that 0.02 – 0.26% of the total life-time production of the well is vented as methane during liquid unloading. It is conservatively estimated that up to 0.19% of gas

²⁸ Comparative Life Cycle Air Emissions of Coal, Domestic Natural Gas, LNG, and SNG for Electricity Generation
<http://www.lcacenter.org/InLCA2006/Jaramillo-presentation.pdf>

²⁹ Santos Petronask GLNG project 7.2 million tonnes per annum
[http://www.glng.com.au/library/EIS/0c Executive Summary \(Section ES\) FINAL PUBLIC.pdf](http://www.glng.com.au/library/EIS/0c%20Executive%20Summary%20(Section%20ES)%20FINAL%20PUBLIC.pdf) ;

³⁰ Australia Pacific LNG Project Environmental Impact Statement Executive Summary
<http://www.dip.qld.gov.au/resources/project/aplng/eis-executive-summary.pdf>

³¹ Queensland Curtis LNG Project (BG/QGC)
http://qclng.com.au/uploads/docs/Queensland_Curtis_LNG_Project_IAS.pdf

produced is emitted during processing.

Further fugitive emissions occur during transport, storage, and distribution of natural gas. Direct measurements of leakage from transmission are limited, but two studies give similar leakage rates in both the U.S. and in Russia. Direct estimates of distribution losses are even more limited. The more conservative of 2 studies indicated a 1.4% leakage rate as the likely lower limit but noted that "government scientists and industry officials caution that the real figure is almost certainly higher."

Summing all estimated losses, during the life cycle of an average coal seam gas well, 3.6 to 7.9% of the total production of the well is emitted to the atmosphere as methane. This is at least 30% more and perhaps more than twice as great as the life-cycle methane emissions estimated for conventional (natural) gas of 1.7% to 6%.

Methane dominates the GHG footprint for coal seam gas on a 20-year time horizon, the one we should be most concerned about given the urgent need to reduce emissions. At this time scale, the GHG footprint for coal seam gas is 22% to 43% greater than that for conventional gas. This is at least 20% greater than and perhaps more than twice as great as for coal when expressed per quantity of energy available during combustion.

In 2010, the US Council of Scientific Society Presidents wrote to President Obama, warning that some potential energy bridges such as coal seam gas have received insufficient analysis and may aggravate rather than mitigate global warming³²

Air Quality and Pollution

This summary information is from the July 2011 report *Citizen Investigation of Toxic Air Pollution from Natural Gas Development* by the community-based organisation, the Global Community Monitor. More details are available at <http://ntn.org.au/wp-content/uploads/2011/07/Toxic-Air-Pollution-from-Natural-Gas-Development.pdf>

Air samples were collected from neighbours of natural gas operations as well as targeted sampling sites including the well pad, compressor station, gas separation plant, dehydrator and waste disposal site. Analysis detected 22 toxic air contaminants associated with natural gas development, resulting in significant air pollution.

The report identified the following priority sources:

- **Air emissions from fracking compounds**

Air pollution caused by fracking compounds during their use, storage, or waste disposal.

- **Pits**

Waste from drilling, fracking, or production, which may be stored or disposed of in open-air pits to allow some of the toxic material to evaporate into the air.

- **Land application (including land farming)**

Waste from drilling, fracking, or production may be spread on the ground or otherwise applied to the land (eg sprayed as dust suppression on roads).

- **Flaring**

Unwanted gases in the exploration and production processes are burned off in the open air using flares. These produce toxic gases as a result.

- **Venting**

During various stages of gas exploration, production and maintenance, gases are vented directly into the air rather than contained or flared. Venting can release large volumes of

³² Howarth, R.W., Santoro, R., Ingraffea, A. *Methane and the greenhouse-gas footprint of natural gas from shale formations*. 2010. This article is published with open access at Springerlink.com

toxic gases.

- **Fugitive emissions**

Leaks in pumps, valves, compressors, pipes and tanks can result in significant air pollution releases because of the large number of components in gas processing.

- **Compressors**

Where the gas from the wells is collected and then compressed into smaller volumes, the compressors may release a range of toxic gases.

- **Condensate tanks**

Some wells produce semi-liquid gases along with natural gas that are stored in tanks, which can leak various toxic gases.

- **Dehydrators**

These systems are needed to remove water from natural gas and can release toxic gases in the process.

- **Gas processing plant**

The last stage of gas production involves the refining of the raw gas into the final product. This occurs at large gas processing plants, which have many sources of air emissions.

- **Additional waste disposal sites**

Wastes from various stages of gas production and processing may be sent to treatment sources including landfills, injection sites and wastewater treatment sites, which can also release air pollution.

2 The economic and social implications of CSG activities including those which affect

(a) the legal rights of property owners and property values.

Under NSW law the Government owns and controls mineral and gas resources under the ground. There are laws pertaining to the granting of rights to explore for and exploit those resources that give mining companies the right to force access to private land. These rights are creating tremendous anxiety and frustration in many communities, particularly in agricultural land. The issues include:

- Creating division within communities with individual landholders being able to grant access without reference to the neighbors or communities wishes. This has created some conflict between members of communities.
- Impacting on land and property values. Real estate agents in Queensland's Surat Basin report there are very few buyers interested in gas field property, or a property near one.³³ Property values do fall, in many cases reducing landholders' equity. Banks are refusing loans to landholders close to gas developments.
- Creating uncertainty where land is covered by exploration licenses which can remain dormant for years. Landholders have no idea of the plans or timelines for exploration or development.

LTGA understands that the only stage of the process where NSW landholders have the legal right to negotiate the terms of access to their property is before any exploration begins.

There is no obligation for gas or mining companies to inform landholders specifically before an exploration licence is granted over their land. Landholders do not have a right to veto a licence holder's access to their property. The Act states that Land Access Agreements can cover a wide variety of issues. The terms of the landholder's permission

³³ <http://qcl.farmonline.com.au/news/state/agribusiness-and-general/general/csg-ripples-felt-in-rural-property/2085883.aspx?storypage=0>

are detailed in this Agreement.

That negotiating access arrangements with mining companies has become extremely complex is evidenced by NSW Farmers Association advising its members that standard form documents are no longer appropriate given the scale of developments, the technology used and their potential impacts. The organisation states that factors for careful consideration and inclusion in any access agreement include the technology being used, the intensity and duration of exploration, and the degree of risk (i.e. the vulnerability of the farming system, and land and water resources to disturbance).³⁴

If the exploration and/or mining company and the landholder cannot reach an agreement on the terms of access after 28 days of the initial notice either party may request that an arbitrator be appointed. The parties may agree to the appointment of any person as an arbitrator. If, after a further 28 days, the parties cannot agree on the appointment of an arbitrator, either party may apply to the Director General to appoint one.

Under the Mining Act, the arbitrator must initially conciliate the claim by encouraging the parties to reach a settlement acceptable to all of them. If the parties are still unable to agree the arbitrator may impose a land access arrangement. The arbitrator will initially issue an interim decision which will be subject to further arguments by either party for a period of 14 days. If no objections are received then the interim decision will be finalised. If either party makes any objections, then the arbitrator will take these into account and make a final decision accordingly. The final decision can be appealed to the Land and Environment Court if the parties are not satisfied with the arbitrator's decision.

The history of Queensland coal seam gas companies' insistence on confidentiality clauses in access and compensation agreements speaks volumes about their commitment to transparency, equality and community good will. The general reluctance to meet with groups of neighbouring landholders reflects the industry's arrogant 'divide and conquer' mentality that many landholders find distasteful.

On the issue of equitable participation in assessment and approval processes, LTGA notes that several submissions to the Senate Regional Affairs and Transport Committee inquiry into CSG in the Murray Darling Basin commented on the resources (including time) available to large gas companies compared to individual (or groups of) landholders. In Queensland, CGS companies have several months for many highly paid staff to prepare e.g. Environmental Impact Statements, applications for environmental authorities, environment approvals, environmental management plans, appeals to amend conditions etc. By contrast, landholders and other interested parties who are eligible to respond have only a few days in which to research and prepare their submissions. This often means valuable time is taken away from regular work or business commitments.

2(b) Food security and agricultural activity

Australia is a significant producer and exporter of agricultural commodities that feed tens of millions of people and our farmers are among the worlds' most efficient. This is remarkable when one considers most of our soils are old, eroded and nutrient deficient and our weather patterns and hydrology extremely variable. Nevertheless, there are a few areas in Australia where soils are regarded as among the world's best. These include the Liverpool Plains and north western plains in the Moree area – areas targeted by CSG projects.

³⁴ http://www.nswfarmers.org.au/_data/assets/pdf_file/0006/53979/Overview_of_Mining_Exploration_Access_v1.2.pdf

The global population is growing rapidly and it is predicted that we will face food shortages in the near future. In this context, the loss of good quality agricultural land has serious implications for food security and even global security if food shortages become more frequent.

Farmers with CSG infrastructure on their land lose control of their businesses and day-to-day property management. Parts of their farms will be put out of production for 20-30 years. With each gas well pad occupying 1 hectare plus all-weather access roads, 'flow-back water' storage ponds, gas and water pipelines, compressor stations, CSG water storage dams, brine ponds, workers camps and office buildings, the interference, disruption and total loss of farming land will be very significant. Hundreds of extra vehicle movements mean properties will be at increased risk from the introduction and spread of new weeds, adding to business costs.

Farmers' most important asset –their soil – is at risk from CSG developments. The storage of large volumes of associated water awaiting treatment or reuse, potentially contaminated with many toxic substances, is a serious risk. This water may contain 5-8 tonnes of salt/ML.³⁵ If untreated CSG water comes into contact with high clay content soils, such as those on the Liverpool Plains and in Moree Plains Shire, the soil becomes impervious to water. Plant roots cannot penetrate and the soil becomes useless for agriculture.³⁶

2(c) Regional development, investment and employment, and State competitiveness.

There has been much discussion about Australia's 2-speed economy and there is no doubt that mining and energy developments are injecting massive amounts of money into regional Australia.

Financial analysts generally agree that the resources boom contributes to the high Australia dollar and have noted the negative impact this has for other export oriented industries including agriculture.

The independent research of QUT Professor Kerry Carrington *et al* is informative reading. Many mining and energy developments operate with a largely non-resident 'fly-in, fly-out' (FIFO) workforce meaning many of the economic benefits of the project do not flow into the local economy. Only 11% of respondents to a recent survey of Queensland mining towns felt the industry has a positive effect on their lives. Significantly, even some FIFO workers reported dissatisfaction. Unaffordable housing can make it impossible for the whole family to relocate meaning enforced separations from loved ones. Some FIFO workers find themselves unable to participate in or contribute to either the community they work in, or the one in which they live.³⁷

FIFO work forces have a number of social impacts on the towns close to these mining or gas developments. They are subject to rapid community and economic growth due to the

³⁵ Arrow Energy: Water and Salt Management, June 2010.

http://www.arrowenergy.com.au/icms_docs/73090_Water_and_salt_management_brochure.pdf

³⁶ Water For Profit: Effect of water quality on micro-irrigation maintenance.

http://www.growcom.com.au/uploads/21514water_quality_micro-irrigation.pdf#System_maintenance

³⁷ <http://www.couriermail.com.au/news/queensland/survey-shows-mining-booms-negative-impact-in-queensland/story-e6freoof-1226079369316>

expansion of the resources sector, leading to demographic changes. Local housing markets are dramatically affected with shortages of accommodation, a reduction in housing affordability and increases in (town) property values and rents. High rates of pay for those in the mining and energy sector create a new social hierarchy in which local residents, especially blue-collar workers, may feel inferior. Local businesses and farmers cannot compete and find it difficult to attract and retain local staff. Local businesses have few opportunities to participate in the so-called 'boom' because CSG companies source most of their requirements from capital cities.

The overwhelmingly male FIFO work forces are mostly housed in work camps. Alcohol-fuelled male-on-male violence is often associated with this form of accommodation and has been studied in detail.³⁸ The study found these communities were more than twice as violent as the state average and are under-resourced. They lack enough police, medical facilities and other emergency and human services to cope.

FIFO workers' contracts usually stipulate 12 hour shifts that inhibit workers' participation in local community activities and service clubs. The culture is an extremely masculine one in which excessive drinking and displays of aggression are considered normal and even 'cool'. In some regions, many locals feel invaded or threatened by up to a thousand men living nearby and some deem visiting local clubs and pubs unsafe due to alcohol-fuelled violence. More young local women than young men leave such towns, further entrenching the masculine culture.

A study (Petkova 2009 cited by Carrington *et al*) of the social impact of the mining boom on six towns in the Bowen Basin (primarily serviced by a non-resident workforce living in temporary accommodation and work camps), found that while economic benefits for the companies were substantial, 'the multiplier effects in remote towns were much smaller than anticipated as most mine-related jobs were created off site in major urban centres and regions.' The study also reported socio-demographic impacts associated with commute mining operations, such as an increase in single men, increased rates of drug and alcohol abuse, motor vehicle accidents and crime rates and a decline in community organizations. Sexual and domestic violence is another problem acknowledged as related to resource boom communities.

LTGA understands that resources companies begin to lose their social licence to operate when FIFO workers comprise more than 25% of their staff. We reject the often repeated assertion that regions and regional communities benefit from CSG projects. Social and economic impact assessments must examine benefits and costs of proposed CSG projects.

2(d) Royalties payable to the State.

In Queensland, CSG royalties are a flat 10% of well-head production.

The NSW coal seam gas industry currently enjoys a 5 year royalty holiday. In 2010 royalties from NSW coal seam gas amounted to \$462,000³⁹

The royalty arrangements in NSW are:

³⁸ Carrington, K., McIntosh, A., and Scott, J. *Globalization, Frontier Masculinities and Violence: Booze, Blokes and Brawls*, British Journal of Criminology, 2010

³⁹ <http://www.parliament.nsw.gov.au/prod/lc/qalc.nsf/18101dc36b638302ca257146007ee41a/38aa3b44b953655eca25788700233402?OpenDocument>

- 0% for the first five years,
- 6% in year 6,
- 7% in year 7,
- 8% in year 8,
- 9% in year 9 and
- 10% in year 10 and for remaining years.

Industry experience in NSW has shown that peak production of wells often occurs in the first few years of the life of a well with production dropping off significantly after that.

This means that under the current arrangements, NSW will miss out on the bulk of royalties that would be payable if a fixed 10% rate was in place.

LTGA regards this as evidence that our governments are selling off our land and non-renewable resources for a song, leaving us or future generations without soil and water to feed ourselves, and a massive clean up bill.

2(e) Local Government including provision of local/regional infrastructure and local planning control mechanisms.

LTGA again points to the Queensland experience. Local Government and local communities are currently largely excluded from the planning process and public participation and legal standing is inadequate. LTGA fears that NSW will follow the same path and make the same mistakes.

The resource rich regions that generate wealth for Queensland are not sharing in the returns. Local government grants have not increased to deal with significantly increased volumes of heavy traffic using council roads.

Water supplies and water treatment plants are in many cases inadequate to deal with an additional 1,000+ individuals. LTGA is aware of contractors in B-double trucks making round trips of 300 - 600kms several times a week to dispose of sewage waste from worker accommodation camps at large CSG project camps.⁴⁰

3 The role of CSG in meeting the future energy needs of NSW.

LTGA believes that insufficient attention has been given to energy demand management strategies. Many confuse the concept of 'doing more with less' with 'doing less' or 'doing without.' The significance of energy saving is overlooked because it does not come in large, obvious pieces but in many thousands of small ones.

Using energy more efficiently offers an economic bonanza because saving fossil fuel is a lot cheaper than buying it. US research has found that preventable energy waste costs Americans hundreds of billions of dollars and the global economy more than \$1 trillion a year. Furthermore, of 100 units of energy generated about 9.5 units are actually used. The majority is lost in transmission and other inefficiencies that are mostly avoided by distributed generation.⁴¹

On the supply side, there are a number of future energy options for NSW including existing

⁴⁰ Dean Hartog, Absolute Waste, pers comm

⁴¹ <http://www.scientificamerican.com/media/pdf/Lovinsforweb.pdf>

coal fired, potential future gas, a range of renewable energy options and any mix of these.

The lack of discussion by the CSG industry about retiring coal-fired power stations and replacing them with gas turbines suggests that the industry does not take a domestic gas-fired electricity supply seriously.

3(a) Nature and extent of CSG demand and supply.

Some of the projects flagged at the moment will provide gas for domestic power generation such as at Wellington Power Station (660 MW not yet under construction and able to be supplied by existing conventional gas⁴²), Wilga Park Power Station (16MW currently in operation)⁴³ and a new power station planned at Casino (Metgasco – 30MW not yet under construction⁴⁴). These are relatively small power plants compared to current NSW electricity supply.

While 6% of Sydney's domestic gas is supplied by coal seam gas from AGL's Camden gas field,⁴⁵ the bulk of projects currently being developed in Australia and NSW are targeted to the export market. Options include export from a Liquefied Natural Gas plant at Newcastle as proposed by Eastern Star Gas⁴⁶. Metgasco are proposing an offshore processing and export facility off the coast of Ballina⁴⁷ and a pipeline to Queensland would see the major deposits currently under exploration in the Gunnedah Basin and north to the Queensland border transported to Gladstone in Queensland where four major export terminals are planned⁴⁸.

Mention has already been made of the industry's positive greenhouse claims and overseas research that calls the stated benefits into question. Also previously mentioned is advice from eminent scientists to US President Obama warning of unconventional gas' suitability as a transitional fuel with greenhouse advantages.

It must be noted that there is growing evidence that renewable technologies have matured to the point that there is no need for a transition fuel to fill any gap in energy demands. NSW currently has over 2,200 MW of wind energy installed, approved or proposed.⁴⁹ Recently Spain commissioned a solar thermal power station with molten salt storage to demonstrate the feasibility of 24hour electricity - i.e. baseload supply- from solar power.⁵⁰

Beyond Zero Emission have provided a roadmap for Australia to move rapidly to zero emissions energy generation within a decade with a focus on solar thermal, wind and biomass power generation.⁵¹ This could be done within a time frame as to not require a gas transition fuel.

Furthermore, a vibrant mix of renewable would mean a more diverse (and therefore less vulnerable) regional economy with a wider range of job opportunities. Renewable energy projects would not come at the cost of our soil and water resources, would have far less impact on nearby residents and offer new income streams to landholders on whose properties elements of such projects are established.

⁴² <http://www.ermpower.com.au/power/wellington>

⁴³ <http://www.easternstar.com.au/powergeneration.html>

⁴⁴ http://www.metgasco.com.au/page/richmond_valley_power_station.html

⁴⁵ <http://www.agl.com.au/about/EnergySources/indevelopment/Pages/Camden-Gas-Project.aspx>

⁴⁶ http://www.easternstar.com.au/pdf/factsheets/04_LNG.pdf

⁴⁷ <http://www.northernstar.com.au/story/2011/05/03/plenty-pipeline-for-metgasco-chief-peter-henderson/>

⁴⁸ http://pipeliner.com.au/news/all_pipelines_lead_to_gladstone_queenslands_burgeoning_lng_industry/041805/

⁴⁹ http://en.wikipedia.org/wiki/List_of_wind_farms_in_New_South_Wales

⁵⁰ http://en.wikipedia.org/wiki/Solar_Tres_Power_Tower

⁵¹ <http://beyondzeroemissions.org/>

3(b) Relative whole-of-lifecycle demand and supply.

3(c) Dependence of industry on CSG for non energy needs (Chemical manufacture).

3(d) Installed and availability costs of CSG versus other stationary energy sources.

3(e) Proportion of NSW energy needs which should be base load or peaking supply and the extent to which CSG is needed for that purpose.

LTGA understands there are four kinds of electricity production – base-load, peak-load, load-matching and intermittent.

On the question of what level of penetration intermittent renewables can provide, we note that Denmark is looking at 50% wind penetration by 2025. A recent US DoE study has shown that by interconnecting wind farms and transmission grids in the eastern United States, 14-27% or more of wind capacity could be relied on as baseload generation.⁵²

Solar thermal technology has advanced significantly and can now operate (as at Gemsolar in Spain) as base load or peak load. Solar thermal currently costs more than gas but cost reductions are achieved through deployment. Modelling for the Garnaut commission by the University of Melbourne Energy Institute provides information on the costs and savings of multiple solar thermal plants commissioned in Australia. See <http://www.garnautreview.org.au/update-2011/commissioned-work/renewable-energy-technology-cost-review.pdf>

3(f) Contribution of CSG to energy security and as a transportation fuel.

Unconventional gas reserves in the US have been significantly overstated by gas companies. It is likely the same is true in Australia.⁵³ Exaggeration keeps share prices up and investors confident.

LTGA does not support coal to liquid (CTL) projects using either the Sasol (as used in South Africa) or the Fischer-Tropsch (developed in Germany during World War 2) technologies. On a full life cycle analysis, the Energy Returned on Energy Invested (EroEI) ratio of either technique is negative. In other words, when the energy value of the coal is factored in and not considered a 'free good', the technique is an energy sink, not an energy source.

In Queensland, Ambre Energy's proposed coal mine and CTL plant on the Darling Downs has been described as a plan to convert coal to CO₂ with petrol as a by-product.⁵⁴

4 The interaction of the Act with other legislation and regulations, including the Land Acquisition (Just Terms Compensation) Act 1991.

LTGA is deeply concerned that the mining and resources sector receive very favourable treatment under many pieces of legislation and even Inter Governmental Agreements. The entire sector is outside the National Water Initiative – a massive competitive advantage over other water users. The CSG industry is also outside the Commonwealth Water Act

⁵² <http://www.nrel.gov/wind/systemsintegration/ewits.html>, pp74-76, 202-203

⁵³ www.businessinsider.com/wow-us-slashes-marcellus-shale-gas-estimate-by-80-2011-8

⁵⁴ R. McCreath, pers. com

2007 and where relevant the forthcoming Murray Darling Basin Plan.

Interaction with Federal legislation at the exploration phase is poorly understood and not enforced, as evidenced by the extensive exploration by Eastern Star Gas without Federal approval in the Pilliga forest.

In NSW, the coal seam gas industry is exempt from a number of important pieces of legislation including the Native Vegetation Act 2003 and the Water Management Act 2000. Legislation controlling activities on public lands are inadequate to prevent coal seam gas development, which when approved, effectively privatises public lands.

The CSG industry is not even mentioned in the Act under which is supposedly regulated – viz. the *Onshore Petroleum Act 1991*. Further, CSG exploration is not covered by the *Protection of the Environment Operations Act* which defines the operations of the Department of Environment, Climate Change & Water.

The inclusion of a policy on surface and groundwater management is welcomed. LTGA considers this to be an important component of any triple bottom line assessment. However, policies must be developed to include consideration of the *Fisheries Management Act*, the *Threatened Species Conservation Act*, and *Environment Protection and Biodiversity Conservation Act*.

The impact similar industries have had in other jurisdictions

This submission has drawn heavily on the Queensland experience of the unconventional gas industry and to a lesser extent, overseas impacts. To this we briefly add our concerns about:

- significant problems with leaking wells;
- impacts on groundwater as evidenced by falling levels in nearby stock & domestic and irrigation bores as well as drawdown of the Condamine Alluvium;
- groundwater contamination incidents. The most recent of these involved BTEX at 15 times the ANZECC guideline level⁵⁵.
- growing social discord;
- an exploding well at Dalby⁵⁶;
- major impacts on the World heritage listed Great Barrier Reef lagoon near Gladstone. Since dredging for the Curtis Island LNG terminal commenced this year there have been 119 turtle, 8 dugong and 5 dolphin deaths. Locals reject government explanations that the deaths were flood-related;
- alienation of farmland; and
- clearing of bushland resulting in fragmentation of important wildlife habitats.

In the United States where unconventional gas extraction has been underway for decades:

- there have been regular fires associated with CSG wells, pipelines and facilities;⁵⁷
- chemicals used in all aspects of gas extraction have been shown to be toxic to humans;⁵⁹

⁵⁵ National Toxics Network Media release 29 August 2011 - Gas industry plays down BTEX levels in groundwater.

⁵⁶ <http://www.theaustralian.com.au/news/nation/queensland-coal-seam-gas-well-blows-its-top/story-e6frg6nf-1226061049085>

⁵⁷ <http://wellwatch.wordpress.com/2011/02/24/marcellusgasinfo-pa-natural-gas-well-fire/>

⁵⁸ <http://www.wpxi.com/news/23011139/detail.html>

⁵⁹ http://www.endocrinedisruption.com/chemicals_introduction.php

- there has been systematic contamination of groundwater with methane,⁶⁰; and
- increased incidence of earthquakes after fracking.^{61 62}

LTGA thanks the NSW Legislative Council for establishing this public inquiry. Should public hearings be held we would welcome an opportunity to make further comment in person.

Should you have any questions regarding this submission, please contact Ms Sarah Moles as above.

We look forward to the Committee's final report.

Yours sincerely,

Dew Hutton,
President,
Lock The Gate Alliance Inc.

Sarah Moles
Secretary,
Lock The Gate Alliance Inc.

⁶⁰ <http://www.scientificamerican.com/article.cfm?id=fracking-for-natural-gas-pollutes-water-wells>

⁶¹ <http://themoderatevoice.com/120738/fracking-the-dc-earthquake-and-unclean-water/>

⁶² <http://rt.com/usa/news/fracking-earthquake-virginia-dc-817-061/>