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Fracking the future

Busting industry myths about coal seam gas

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Summary

The purpose of this paper is to bust the gas industry's myths about coal seam gas (CSG). The gas industry has been prolific in putting out exaggerated claims about CSG's economic benefits while at the same time staying almost completely silent on the health and environmental risks. This paper will look at both the economic claims and the health and environmental risks and will show that, while the economic benefits are likely to be relatively small, a lot more work needs to be done to assess the health and environmental risks. There is little for Australia to gain by rushing into an expansion of CSG operations.

The gas industry in Australia is keen to produce more gas. Worldwide gas demand has grown in recent years as the world searches for less carbon-intensive forms of energy in an attempt to fight climate change. This growth in demand has led to a boom in world gas prices. With gas prices high, the industry is keen to tap and sell new sources of gas. This includes CSG – a new form of unconventional gas found on the east coast of Australia.

There is heightened public concern about the environmental and health impacts of CSG extraction and the industry has met fierce opposition from a range of different groups. It has also met resistance from policy makers, with several governments enacting restrictions aimed at CSG projects.

These restrictions include the federal government's introduction of a new water trigger, which requires further study to be done on the impact of resource projects that will use a large quantity of water. This will capture CSG projects as well as some large coal mining projects.

The Victorian government was sufficiently worried about the effects of CSG that in 2012 it introduced a moratorium on hydraulic fracturing of rocks to release coal seam gas, a process also known as fracking. The NSW government introduced two-kilometre CSG exclusion zones around residential areas and banned CSG extraction in the Sydney water catchment area due to fears it might contaminate Sydney's drinking water.

Despite these new regulations, the federal government is pushing to devolve responsibility for approving resource projects, including CSG projects, to state governments. This is part of the government's push to reduce regulation, or so-called 'green tape', in the resources sector.

Results from The Australia Institute's November survey[1] found that the general public has a very different view from the government on how CSG should be regulated.

When asked about which level of government should regulate CSG, 71 per cent thought that the federal government should do it. When asked about the level of regulation of the CSG industry, 56 per cent wanted more regulation, with only seven per cent thinking there should be less regulation. This puts the general public's views at odds with the federal government's views.

An earlier survey in August 2013[2] looked at the general public's perceptions of CSG and found that people's concerns were mainly environmental while the perceived benefits were mainly economic. The industry has highlighted the alleged economic benefits while ignoring the environmental concerns.

This paper looks in detail at the perceived benefits and concerns raised in the surveys to find out which have merit and those that do not. Below is a summary of those findings.

More CSG does not mean lower gas prices

The gas industry has claimed that the east coast of Australia is facing a gas crisis and that the solution is to fast track the expansion of CSG development. It claims the increase in supply will hold gas prices down. But these claims show a complete lack of understanding of what is causing prices to rise.

At the moment Australia's eastern gas market, which includes Queensland, NSW, ACT, Victoria, Tasmania and South Australia, is not linked to the rest of the world. Eastern Australia has hitherto enjoyed low gas prices, since there was plenty of supply relative to domestic demand and no capacity to export gas from the east coast to international customers.

Recently, however, gas companies have begun construction on three large LNG facilities near Gladstone in Queensland. They will liquefy the CSG so that it can be shipped overseas. The overseas price of gas is far higher than the eastern Australian price and once the export facilities are completed, if customers in eastern Australia want to buy gas, they will have to match the overseas price minus the cost of liquefying and transporting the gas to Asia. This is also known as the export parity price. When the three export facilities are up and running this will triple the demand for gas.

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1 TAI (2013b) *Australia Institute Survey – November.* The survey questions can be found in Appendix 2.

2 TAI (2013a) *Australia Institute Survey – August.* The survey questions can be found in Appendix 1.

While it is often the case that increasing supply of a domestic product will cause the price to fall, this is only the case, as economists say, 'with all other things being equal'. In this particular case other things are not equal because eastern Australia is about to be connected to the much higher world price. The increase in supply will only reduce the price Australians pay if it lowers the world price, which is unlikely.

What's really causing the price to rise?

What is interesting about the argument from the gas industry – that restrictions in supply are the cause of the rise in price – is that it was actually the increase in supply from CSG that led to the LNG export facilities becoming viable. Before CSG was discovered, the eastern market did not produce enough gas to make export a profitable venture. It is anticipated that the LNG facilities will be supplied solely by extracted CSG. It is therefore because of the expansion in CSG mining that eastern Australia will be linked to the world market and will face dramatic increases in gas prices.

With gas becoming far more profitable, it is not surprising that gas producers are keen to expand their supply. Blaming restrictions on CSG for coming price rises is a clever tactic, designed to turn public support against those restrictions and increase pressure for them to be removed. But these claims are little more than posturing and bear no resemblance to what is actually happening in the market.

Gas industry spin

Some gas producers have undermined the industry argument that there will be a lack of gas in the eastern market. Those producers who do not have an interest in removing restrictions on CSG production in NSW and Victoria are telling customers that they have plenty of gas to sell at the export parity price – this includes Origin Energy and BG Group. By contrast, AGL Energy and Santos, who both have CSG interests in NSW, are warning of a 'gas crisis' and price increase that can only be prevented by removing restrictions on CSG.

The belief instilled in the general public that an increase in CSG supply will make gas cheaper is therefore false. The expansion of CSG has led to the construction of LNG export facilities and a corresponding rapid rise in the wholesale price of gas. Once Australia is linked to the world market, only factors that are capable of changing the world gas price will be sufficient to change the domestic gas price.

Evidence doesn't support CSG as a solution to climate change

The claim that CSG will help Australia respond to climate change was rated as one of the top four benefits of CSG by the August survey respondents.[3] The claim is that, when burnt, natural gas produces fewer greenhouse gas emissions than coal. While this is true, it overlooks concerns about greenhouse gas emissions associated with the extraction of CSG, chiefly fugitive emissions. There are also concerns about how methane, the main fugitive emission from CSG, is accounted for.

Fugitive emissions are underestimated in Australia because of the way they are measured. The current method of estimation involves using data on fugitive emissions that were collected from conventional natural gas extraction. Unconventional natural gas, including CSG, uses a very different method of extraction, which sees more methane escape into the atmosphere rather than being captured and used to generate energy. The gas that escapes from the ground during the extraction process is known as fugitive emissions. The reason that conventional gas data is being used is because of the lack of measurement of fugitive emissions from unconventional natural gas in Australia.

While there is no information that would allow fugitive emissions from CSG in Australia to be calculated, there are ongoing studies in the United States. Australia assumes that fugitive emissions from unconventional gas is 0.12 per cent of gas produced, whereas the US Environmental Protection Agency (EPA) recently increased its estimate to 2.4 per cent – 20 times higher than in Australia.

Other studies in the US have calculated different leakage rates. Some studies suggest fugitive emissions from unconventional gas are very similar to those of coal. Others show lower leakage rates. What is clear is that more work needs to be done before we have a complete understanding of fugitive emissions.

Another problem with the idea that CSG can be used as a way of reducing greenhouse gas emissions is that methane is a particularly potent greenhouse gas. In order to compare the warming effect of different greenhouse gases the gases are converted into what is known as carbon dioxide equivalent or CO_2e. This is done by measuring the global warming potential (GWP) of the gas over a certain time period. The most common time period used is 100 years.

The conversion rate that is commonly used for methane is 25 times carbon dioxide over a 100-year period. Put simply, each tonne of methane emitted is equivalent to 25 tonnes of carbon dioxide emissions. This is because methane is a particularly potent greenhouse gas, which creates more warming than carbon

[3] TAI (2013a) *Australia Institute Survey – August*

dioxide. The most recent Intergovernmental Panel on Climate Change (IPCC) has suggested that the GWP of methane should be increased to 34.

The claim that CSG can act as a bridging fuel cannot be substantiated. The level of fugitive emissions for unconventional gas is simply unknown and far more research needs to be done before the claims by the gas industry can be taken seriously. The impact of increasing the release of methane into the atmosphere is also problematic since it has the potential to cause substantial short term warming at a time when the world is moving too slowly to combat climate change.

The gas industry is a small employer

While the gas industry is relentless in its claims about job creation, the simple fact is that it is a relatively small employer. It commissions modelling, has dedicated websites and runs national multi-million dollar advertising campaigns that are designed to exaggerate its employment numbers, but the objective data does not reflect the industry's claims.

The industry has made some incredible claims about its capacity to employ – including that it created 100,000 jobs in 2012. To fully appreciate this claim we need to put an additional 100,000 jobs in context. In 2012, according to the Australian Bureau of Statistics (ABS), the Australian economy added an additional 173,537 jobs. If the Australian Petroleum Production and Exploration Association's (APPEA) claims are true, 58 per cent of all the additional jobs created in the economy last year were in the gas industry. According to the ABS, 9,372 additional jobs were created in the oil and gas industry. This is somewhat smaller than the 100,000 claimed by the industry.

The ABS publishes job numbers for Australia's main industries. Unfortunately, due to its relatively small size, the ABS does not publish separate numbers for CSG or even for the gas industry; it publishes figures for the combined oil and gas industry of which CSG is a part. In August 2013 the entire oil and gas industry employed 20,700 people – that is, 0.2 per cent of the workforce or one in 500 workers. To put this figure into context, hardware retail company Bunnings employs 33,000 people.

So where does the gas industry get its job figures?

The most common method used by the gas industry to exaggerate its job numbers is to commission economic modelling. Economic modelling can be used to show important and interesting aspects of the economy but it can also be misused to make a small industry appear far larger.

The gas industry has done this on many occasions. In one case Santos commissioned modelling on a CSG project in northwest New South Wales that

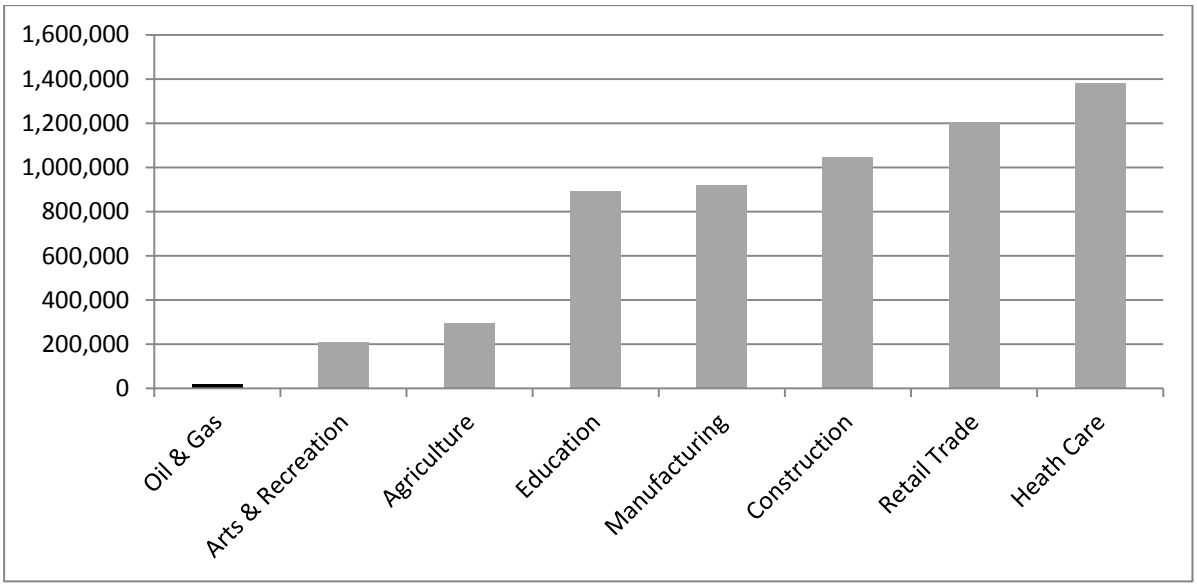
was expected to employ 30 people when it was operational. The modelling found that the project would create a large number of indirect jobs including 570 public sector jobs. How a project that employs only 30 people could possibly lead to the creation of 570 public sector jobs is left unsaid.

In another case, Arrow Energy commissioned modelling as part of its environmental impact statement (EIS) for its Gladstone LNG plant. The EIS referred extensively to the economic benefits of the project. While the EIS did provide a more complete report on the modelling outcomes than the Santos report, it did not mention the negative economic impacts in the main part of the report – rather they were buried in Appendix 21.

While the executive summary of the Arrow Energy report highlights the jobs created, it makes no mention of the 1,600 jobs across Queensland and Australia that its own modelling found would be destroyed, 1,000 of those in manufacturing.

The CSG industry clearly does create some jobs. But the number of people it employs is far lower than many of the industry's exaggerated claims suggest. As discussed above, the whole oil and gas industry employs only 20,700 people. Figure 1 puts this level of employment in context by comparing it to employment in other industries in Australia.

Figure 1: Employment in Australia by selected industry



Source: ABS (2013a) *6291.0.55.003 - Labour Force*.

CSG's impact on economic activity

Increased economic activity is a broad term but can encompass increases in goods and services that are bought and sold, higher profits, more tax paid, more employment or a general increase in economic prosperity.

Aside from the employment aspect, which we have already looked at, large resources projects that the gas industry is currently undertaking have the potential to have both positive and negative economic effects.

Skill shortage

The looming increase in gas prices means that the gas industry is currently investing heavily in new projects. The result has been described as a skills shortage during the construction of resource projects – but such a situation could as easily be described as excess demand. The outcome of this is that additional resource projects do not create jobs but rather poach jobs from other projects.

The poaching of key workers is not confined to other resource projects. The manufacturing industry has been particularly hard hit as the gas industry searches for workers with the skill set it requires.

The result of this poaching of workers trained by other industries will be either to drive up the wage costs of other industries or to force the shutdown of whole enterprises that cannot secure strategic staff; for example, tourism boat operators cannot function if they cannot secure diesel mechanics to maintain their fleet.

Interest and exchange rates

While Australia currently has historically low interest rates, they are high by world standards. Our higher interest rates are, in part, in place to manage the mining construction boom. While it is often assumed that the Reserve Bank of Australia is using high interest rates as a tool to slow down the mining boom, in fact it is using high interest rates to slow down other sectors of the economy in order to 'free up' additional resources for use in the mining construction boom.

Our high interest rates by world standards are also attracting money and capital from overseas, in turn putting upward pressure on our exchange rates. The large investment in oil and gas projects, which is at a record $205 billion, is also creating strong capital inflow that puts additional upward pressure on the Australian dollar.

The high exchange rate is hurting trade-exposed industries like manufacturing, agriculture and tourism. The pain that these sectors of the economy are experiencing in relation to the boom in mining has been dubbed the ‘two speed economy’.

Tax

The gas industry, in an attempt to gain a social licence, often claims that it pays substantial amounts of tax. According to Australian Bureau of Statistics and Australian Taxation Office (ATO) figures the oil and gas industry paid an effective

corporate tax rate of six per cent. The statutory corporate tax rate in Australia is 30 per cent.

The oil and gas industry also paid the petroleum resource rent tax (PRRT) which amounted to an additional eight per cent. However it is important to remember that the PRRT is a tax on the "super profits" of the oil and gas industry, and is not intended to reduce the amount of corporate tax paid by the industry.

The industry often argues that the royalties it pays to state governments make it a highly taxed industry. It is important to remember that royalties are a payment for raw materials, in the same way that builders pay for bricks, and bakers buy wheat. We don't consider these as a tax, but the gas industry is treated differently in this regard because they buy their raw materials from the people of Queensland and NSW.

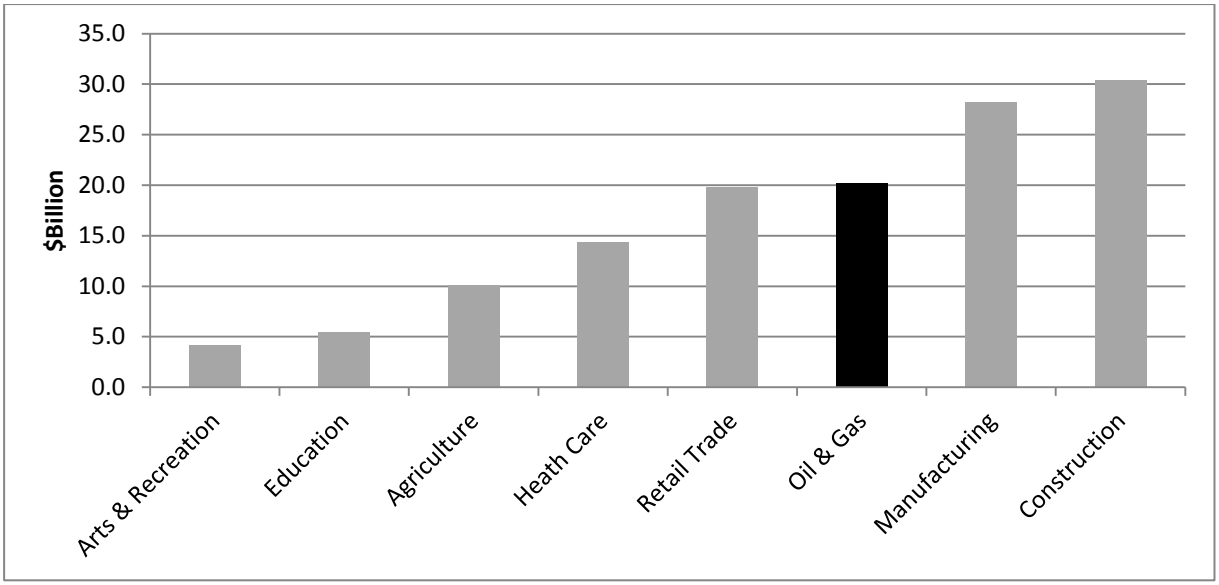
Other countries treat their non-renewable resources in a different way. Norway for example taxes their oil and gas industry at an effective rate of 90 per cent. As a result Norway has an AU$930 billion sovereign wealth fund[4] from the proceeds of the exploitation of their oil and gas resources that will benefit the nation for generations to come.

Profit

The one place that the gas industry does make a substantial economic impact is profit. In 2010-11 the oil and gas industry made $20.2 billion in profit. That represents approximately six per cent of all Australian profit in that year. This compares to 0.2 per cent of employment. Figure 2 uses the same industries from Figure 1 above, but this time looks at profit for the same selection of industries.

[4] Reuters (2014). *Norwegians become crown millionaires as sovereign wealth fund hits benchmark*.

Figure 2: Profit by selected industry



Source: ABS (2013b) *8155.0 - Australian Industry*.

While the gas industry is going through a boom because of high international gas prices, the economic benefits of this boom are being overstated by the industry. It is happy to highlight the benefits the boom is creating, but fails to account for the costs it creates.

Health and environmental effects of CSG

The chemicals used in fracking are of public concern, especially given the quantities used. A CSG well in Australia will use about 18.5 tonnes of chemicals. These chemicals can have dangerous consequences, as was shown when an emergency room nurse nearly died in the US after treating a patient who had been splashed with fracking fluid.

The evidence shows that there are environmental and health risks from fracking fluids, but because of the current lack of research they are difficult to quantify.

There is significant public concern about the contamination of aquifers by fracking chemicals. The evidence suggests that while gas is actively being extracted from the well the chances of contamination are low, so long as it is managed properly. But there is concern, and a lack of information, about stranded fracking fluids, which are fluids left in the ground after the well has been abandoned.

Contamination of aquifers is a real possibility and, like much of the research into the environmental and health impacts of unconventional natural gas, there are still many unknowns. Aquifers are a vital source of water and are important for the production of food. Risks of contamination need to be taken seriously and more research needs to be done.

A lack of research has meant that contamination of aquifers by fracking fluids is difficult to confirm. There is no Australian evidence to date, but there is a confirmed case in the US. There are also many unconfirmed cases, including wells containing high levels of hexavalent chromium, arsenic, lead, chromium, butanone, acetone, carbon disulphide and strontium. While best practice might limit the number of cases where aquifers are contaminated by fracking chemicals, it remains a potential outcome of the fracking process and a justifiable public concern.

While the public is most concerned about fracking chemicals and contamination of aquifers, the biggest risk to human health is likely to be from wastewater from the fracking process. Wastewater is fluid that has returned to the surface, as well as produced water, which is water that is extracted from the coal seam. Wastewater contains fracking and drilling chemicals as well as other materials that come from the fracture formation. Wastewater can be stored in ponds, and leaks and spills can occur, particularly during flooding events.

Wastewater poses a risk to the environment and health through leaks and spills. These happen with frightening regularity – they do not just pose a threat to people's health and the environment but also present a serious risk to farmland and livestock.

CSG extraction has the potential to cause harm to the environment, farming land, water resources and human health. August survey respondents raised all these concerns and the available evidence suggests they have good reason to be worried.

The lack of research that has been done into the environmental and health impacts of CSG is alarming. If the gas industry is keen to expand and the government wants it to, then it should commit far more funding to quality research in this area.

1 Introduction

The gas industry in Australia is keen to produce more gas. Worldwide demand for gas has grown in recent years as nations search for less carbon intensive forms of energy in an attempt to fight climate change. This growth in demand has led to a boom in world gas prices. While Australia has large reserves of conventional natural gas, it has even larger reserves of unconventional natural gas. According to the Bureau of Resource and Energy Economics (BREE)[5] there are 184,000 petajoules (PJ) of identified conventional natural gas in Australia – placed in context, this is enough gas to supply all of Australia at current levels for more than 130 years.[6] By comparison there is, potentially, far more unconventional gas, with 101,434 PJ of identified gas and a further 569,672 PJ of inferred and assumed unconventional gas resources.

With gas prices currently high, the industry is keen to tap and sell these resources, particularly the unconventional gas resources. Unconventional natural gas includes coal seam gas, tight gas and shale gas. The biggest problem the industry faces is widespread concern about the environmental effects of extracting unconventional natural gas, including its effects on water, land and human health.

The gas industry is keen to access CSG in the eastern parts of Australia and has proposed large numbers of CSG projects, but heightened concern about the environmental impacts of CSG extraction has created fierce opposition from a range of different groups. The industry has also met with resistance from policy makers, with several governments enacting restrictions aimed at CSG projects.

To overcome this resistance the industry has launched a campaign to convince governments, policy makers and local communities that CSG extraction is safe and in everyone's economic best interests. The industry faces a significant challenge – most Australians believe there should be more restrictions on CSG, not less.[7]

The gas industry, led by its lobby group the Australian Petroleum Production and Exploration Association (APPEA), has made many claims in an effort to make CSG more palatable to the Australian people. As is the case with most public relations exercises, the industry has chosen to highlight the positive aspects of what it does, including the potential economic advantages of CSG as well as the potential of natural gas to reduce global greenhouse gas emissions. This paper will look at those claims and in doing so examine the effect that CSG production is having on the Australian environment and economy.

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5 BREE (2012a) *Australian Gas Resource Assessment.*

6 Australian gas consumption from BREE (2013a) *Gas market report: October 2013.*

7 Vote Compass (2013) *Australians back restrictions on foreign ownership, CSG*.

Despite the expensive public relations campaign, the public still has major concerns about CSG. These include the potential environmental, health and water impacts that CSG extraction, particularly hydraulic fracturing, also known as fracking, is having on people, water and land. This paper will also examine some of these concerns, which the industry has mostly chosen to ignore.

What is CSG?

Most of the world's current gas supply consists of what is known as conventional natural gas. Natural gas is mostly methane, formed by organic material decomposing underground in a low-oxygen environment. Over very long periods of time gas migrates towards the surface, except where it is stopped by a large impermeable layer, usually rock. Under such layers, large gas reservoirs are formed deep underground. Conventional natural gas is extracted from such reservoirs by drilling through the rock layer. Conventional gas reservoirs have generally built up great pressure under their rock layer, which makes their extraction easy, at least in early phases of exploitation.[8]

Unconventional natural gas is formed in the same way, with organic material decomposing underground. But rather than forming a large reservoir under an impermeable layer, the gas is trapped in much smaller pockets in geological formations such as coal seams or shale layers. Unconventional gas takes a number of different names, depending on what formation it is held within: shale gas, tight gas or coal seam gas. In particular, CSG is held within the coal seam by pressure from water in the seam.[9]

Rather than being released under its own pressure like conventional gas, unconventional gas is more difficult to extract. Extraction methods vary depending on the type of unconventional gas. Extraction of shale gas requires fracking. This process involves pumping in large volumes of fluid at high pressure to fracture the rock so the gas can escape and come to the surface. The fluid is mainly water, but also contains sand and chemicals.

CSG needs to be depressurised by first removing water from the coal seams. Often the gas can then be extracted but, if not, the seam may also need fracking. Estimates of the number of CSG wells that require fracking in Australia vary, but it is likely to be between 25 and 40 per cent.[10] [11]

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8 Rutovitz et al. (2011) *Drilling down. Coal Seam Gas: A background paper*, p.3.

9 Rutovitz et al. (2011), p.3.

10 Rutovitz et al. (2011), p.4.

11 Senate Rural Affairs and Transport Reference Committee (2011) *Management of the Murray Darling Basin interim report: the impact of mining coal seam gas on the management of the Murray Darling Basin*, p.5.

In recent years there has been an increase in extraction of unconventional natural gas in many areas of the world, particularly the US. In Australia, CSG is extracted in New South Wales and Queensland. There are also known reserves of CSG in Victoria. There is currently a small amount of shale gas production in South Australia although there are large reserves there, as well as in Western Australia and the Northern Territory.

There is a fundamental lack of research and information available on the broader effects of unconventional gas extraction – scant measurement has been conducted in this area. The government has recognised the lack of research around these problems, and, to help address this has put aside $200 million from the Minerals Resource Rent Tax for scientific research on the effects of CSG extraction.[12]

Despite commitments to future research, the lack of current data has resulted in widespread concerns about the environmental impacts of unconventional gas, including the process of fracking. Confronting images of gas bubbles in rivers in Queensland[13] and tap water being set on fire in the US[14] have fanned these concerns. In Australia most of the concerns centre on water. They include contamination of ground water, disposal of produced water, reduced availability of water for other consumers and the creation of hazardous waste resulting from either treatment of produced water or drilling mud.[15] There is also concern about the chemicals that can be used in the fracking process.

A social licence

There is a strong sense among the general public and in the political sphere that large resource projects need a clear social licence to operate before they can be carried out.[16] That is, a large resource project should enjoy support from the general public, or at least should not be actively opposed by large sections of the local and wider community.

It could be argued that the gas industry has failed to obtain a social licence in Australia. An important part of this failure has been the industry's inability or unwillingness to engage with and allay the general public's fears about the potential environmental costs of CSG extraction. Indeed, the industry has displayed more than just an unwillingness to allay fears – it seems to have

12 Australian Broadcasting Corporation (2011) *CSG concessions win independents' support on mining tax.*

13 Carney et al. (2013) *GAS LEAK!*

14 Fox (2010) *GasLand.*

15 Rutovitz et al. (2011), p. 25.

16 Haigh (2013) *Building a social licence to operate in the natural resources sector* and KPMG (2013) *The Community Investment Dividend: Measuring the value of community investment to support your social licence to operate.*

followed a deliberate strategy of attempting to keep people uninformed and unaware of the issues surrounding CSG.

The gas industry has recently faced a growing number of restrictions from federal and state governments because of mounting public concern about the environmental impacts of CSG. The then NSW Minister for Resources and Energy, Chris Hartcher, in justifying new restrictions on CSG made the link between a social licence and CSG when he told industry: "You cannot build up corporate support until you build up community support."[17]

The failure of the gas industry to build a social licence has two main causes. The first is a growing concern about the environmental impacts of CSG, particularly concern about its impacts on water and farming land. The second is the gas industry's strategy to provide as little meaningful information about CSG as possible, including a failure to make any real attempts to address the growing concerns people have about CSG. The industry appears to be hoping that by staying quiet the problem will simply go away.

Environmental costs versus economic benefits

The public tends to see resource projects in terms of economic benefits versus environmental costs. It is accepted that these projects will cause environmental damage but that this will be offset, either partly or fully, by economic benefits. So for the general public the debate is often around the extent of the environmental costs versus the economic benefits. Potentially large environmental costs coupled with small perceived economic benefits would see little public support for a project – whereas potentially small environmental costs with large perceived economic benefits would usually mean the project could enjoy strong public support.

The debate is complicated because environmental costs are far more difficult to quantify than economic benefits, so weighing the environmental costs against the economic benefits is subjective. While large resource projects that are likely to have a substantial impact on the environment are subject to regulatory processes that attempt to evaluate all the costs and benefits, even these processes find comparing the costs and benefits difficult. For the general public it is far harder to assess.

The tendency for the general public to judge resource projects on the environmental cost versus the economic benefit helps explain why those opposed to a project emphasise the potential environmental costs while those in favour of a project focus on possible economic benefits. If the economic benefits can be highlighted, this increases the chances that the project will gain general public

17 Macdonald-Smith et al. (2013) *Hartcher defends stricter CSG rules.*

support. Alternatively, if the negative environmental effects can be highlighted, this will increase the chance the general public will reject the project.

The lack of information on CSG extraction and its effects on water, land and human health has created confusion and concern in the Australian general public. To better understand how informed the general public is about CSG and what benefits and costs the public see in CSG, The Australia Institute commissioned a survey that was conducted online in August 2013. Respondents were sourced from a reputable independent online panel. There were 1,436 respondents to the survey and the results were post-weighted by age and gender based on the profile of the adult Australian population.

When asked whether they had any concerns about CSG, 34 per cent of respondents said they did. Only 13 per cent said they had no concerns, and the majority, 52 per cent, were unsure. This highlights that people are still very uncertain and uninformed about CSG.

Those who did respond that they had concerns about CSG were asked to nominate what their two main concerns were. The top four were:

- Damage to the local environment
- Negative impact on farming land
- Damage to people's health
- Water contamination

These are all environmental impacts. Those concerns that were raised the least by respondents were the economic impacts, with just four per cent saying CSG damaged the local economy and one per cent saying it damaged the national economy. The August survey showed the stark divide about the negative impacts of CSG – people's concerns were environmental, not economic.

When people were asked if they thought there were any benefits from CSG, 26 per cent felt there were. Only 11 per cent thought there were no benefits, while 63 per cent were not sure. This again highlights how unsure and uninformed people are about CSG. More people were uncertain about potential benefits of CSG than were unsure about negative impacts of CSG.

When people nominated benefits of CSG they overwhelmingly chose economic benefits. The top four were:

- Increased gas supply will make gas cheaper
- Increased gas production that will act as a bridging fuel on the transition to renewables
- More jobs

- Increased economic activity

The only environmental benefit that ranked highly was gas acting as a bridging fuel to renewables. While this is an environmental benefit, it also has an economic element since gas is seen by some as a cheap alternative to renewable energy in combating climate change.

The August survey shows that when it comes to CSG the public has environmental concerns but believes there are some economic benefits. But what also emerges is that there is a majority of people who are unsure about both costs and benefits.

The August survey also highlights how important economic benefits and environmental costs are to the debate about resource projects and in particular the debate about CSG. If economic benefits have been exaggerated, as this paper will show, then the low level of community support for CSG may in fact be underestimated. If environmental concerns are being exaggerated, which this paper will reject, then CSG might be more readily accepted by the community.

It is also important to note that when it comes to assessing CSG projects the general public believes that environmental and health concerns are more important than economic benefits. In deciding whether to allow fracking or not, survey respondents thought that the most important factors to consider were the impact on human health (79 per cent), the impact on water supply (72 per cent) and the impact on farming land (67 per cent). The impact on the economy was considered important by just 44 per cent of respondents.

The paper will now look at the environmental costs and economic benefits of CSG that were identified in the August survey.

Table 1: Summary of polling results

Question	Response	% of respondents
Have you heard about Coal Seam Gas (CSG)?	Yes	65
	No	36
If a CSG project was proposed in your local area would you?	Want more information	86
	Have enough information	14
Do you think that CSG extraction occurs in?	Rural areas	32
	Urban areas	2
	Both rural and urban areas	30
	Not sure	37
Do you know what the difference is between CSG and LNG?	Yes	19
	No	81
Do you have any concerns about CSG?	Yes	34
	No	13
	Not sure	52
Do you think there are any benefits from CSG?	Yes	26
	No	11
	Not sure	63

Source: TAI (2013a) *Australia Institute Survey – August*. (see appendix 1 for questions). Number may not add to 100 due to rounding.

CSG extraction has increasingly been in the national spotlight. A high profile grassroots movement called the Lock the Gate Alliance has sought to bring greater attention to community concerns about CSG. The August survey found that two thirds of people had heard about CSG. The state break down showed that, in NSW and Queensland, where CSG is an issue, there were far higher levels of awareness. In Queensland, 82 per cent of people had heard of CSG. The figure was 75 per cent in NSW.

Table 2: People who had heard of CSG by state

	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
Those that had heard of CSG?	75%	50%	82%	44%	50%	50%	73%	70%

Source: TAI (2013a). (see appendix 1 for questions)

The lack of information from the gas industry has helped create a situation where the general public feel uninformed and concerned about CSG. When asked how they would feel if a CSG project were proposed in their local area, 86 per cent said they would want more information about CSG extraction methods and potential impacts.

A major controversy has arisen around CSG proposals in semi-urban areas of Sydney.[18] Yet when people were asked where CSG extraction took place, only 30 per cent correctly identified that it took place in both rural and urban areas – more than a third of people were not sure where it took place. When asked if they knew the difference between CSG and liquefied natural gas, or LNG, 81 per cent said they didn't know the difference.

When people were asked if they had any concerns about CSG, 52 per cent were unsure. When people were asked if there were any benefits from CSG, 63 per cent were unsure. This highlights that people feel uninformed about CSG and that it is currently impossible for communities to provide 'informed consent' for such projects.

While CSG is still an emerging issue in Australia, those who have some understanding of it predominantly have concerns. When the ABC's Vote Compass asked if restrictions on CSG should be reduced, almost two thirds of participants disagreed.[19]

The August survey results show that people are unsure and uninformed about CSG. People are aware that CSG is a controversial issue and graphic images of what can go wrong lead them to be uneasy. The general public seems to want to wait for more information on the effects of CSG before it is comfortable with its expansion.

Regulation of the industry

The Abbott government is pushing to devolve responsibility for approving resource projects, including CSG projects, to state governments. This is part of the government's push to reduce regulation in the resources sector – which is also

18 Heber (2013) *AGL temporarily backs down from Sydney fracking plans.*

19 Vote Compass (2013).

known as reducing so-called 'green tape'. Results from The Australia Institute's November survey[20] have found that the general public have a very different view from the government about how CSG should be regulated.

When asked about which level of government should regulate CSG, 71 per cent thought that the federal government should do it. When asked about the level of regulation of the CSG industry, 56 per cent wanted more regulation with only seven per cent thinking there should be less regulation.

This puts the general public's views at odds with the federal government's views. While the public is generally in favour of more regulation of CSG, with the federal government taking a lead role, the government has announced that it is keen to reduce regulation and transfer it to the states.

A paper by the Australian Network of Environmental Defender's Offices[21] looked at the powers that the federal government has to regulate CSG and found the federal government has a lot of scope to regulate in this area. As well as strong public support for federal government regulation of CSG there is also no legal impediment to such regulation.

CSG benefits: Perceptions versus reality

The August survey asked respondents to list two main benefits of CSG. The top four benefits are listed in Table 3.

Table 3: Perceived benefits of CSG

Perceived benefits	Per cent of respondents
Increased gas supply will make gas cheaper	44
Increased gas production that will act as a bridging fuel on the transition to renewables	44
More jobs	39
Increased economic activity	37

Source: TAI (2013a). (see appendix 1 for questions)

20 TAI (2013b) *Australia Institute Survey – November.*

21 ANEDO (2013) *Coal and gas mining in Australia: Opportunities for national law reform.*

These are the benefits that the general public believes will occur if CSG is allowed to expand. The gas industry echoes and reinforces these perceptions in their communications. Their claims are, however, often exaggerated or unproven. In the rest of this paper, we examine the following questions:

- Will increasing gas supply from CSG make gas cheaper in Australia?
- Will increasing gas production act as a bridging fuel between fossil fuels and renewables?
- Will increasing gas production bring more jobs?
- Will increasing gas production bring more economic activity?

2 Will increasing supply of CSG make gas cheaper in Australia?

CSG's effect on gas prices

The recent growth in gas supply to the eastern gas market has come from CSG. The CSG industry is keen to further expand production and claims that more CSG will mean lower gas prices. Further, the gas industry argues that anything that stands in the way of expanding CSG will mean higher prices. The chief technical officer of the Australian Petroleum Production and Exploration Association (APPEA) Australia, Rick Wilkinson, has claimed:

> *Rising gas prices are something the people of NSW may have to get used to unless the industry can get on with developing NSW gas resources … For this, they have local anti-CSG activists to thank.*[22]

The industry is arguing that an expansion of CSG will increase gas supply and push the price down. Other things being equal, this would be correct – an increase in supply would usually put downward pressure on prices. But a number of other factors are influencing both supply and demand in the gas market.

Australia's eastern gas market, which consists of New South Wales, the Australian Capital Territory, Victoria, Queensland, Tasmania and South Australia, is about to be linked to the world market. The world price is considerably higher than the current eastern market price paid by Australian consumers and companies, so when the Australian and world markets merge the eastern market price will rise to the world export parity price. This is the world LNG price minus the cost of transporting the gas from Australia to foreign markets.

The price in the eastern market was recently around $3 to $4 per gigajoule, while the Asian market price, which is the price the new export facilities are planning to adopt, is around $15 per gigajoule. With the cost of liquefaction and transportation at around $5 to $6 per gigajoule, the world parity price (the price eastern market producers will get) is around $9 to $10 per gigajoule. Once the eastern market and the world market are linked, only changes in the world price can change the eastern market price.

The eastern market has had ample access to conventional gas supplies to meet its own demand for many years. These conventional sources have supplied the eastern market, but economically and logistically it has not been viable to export this gas to the global market.

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22 Clennell (2013) *Pain as price of gas set to jump.*

The emergence of unconventional gas, particularly the rapid expansion of CSG in Queensland, has led to a far greater supply of gas in the eastern gas market. This bigger supply has made it economically viable to export gas to international buyers and large LNG export facilities are now being constructed near Gladstone in Queensland. Since it is uneconomic to build gas pipelines from Australia to customers in Asia, natural gas needs to be liquefied so it can be loaded on to ships and transported.

The prospect of higher prices has made the gas industry eager to increase its supply; gas is about to become far more profitable. In particular the industry is attempting to expand CSG exploration. Public concern about extracting CSG has meant that restrictions have been placed upon its development, particularly in NSW and Victoria.

These restrictions have upset the gas industry, as they restrict the profits it will make selling to world markets at the new higher prices. The industry has claimed that restrictions on CSG production are the cause of price increases in the eastern market. These claims are not correct. Increases or decreases in domestic gas supply will have almost no impact on the world price of gas. Once the eastern Australian gas market is linked with the world market, domestic gas prices will be subject to movements in the world price and domestic production will have little influence on the world price.

Put simply – when the eastern market is linked to the world market the domestic price will only change when the world price changes. Increases in domestic supply would only affect domestic prices if they were large enough to affect world prices. Despite the planned expansion of the CSG industry in Australia, the total amount of gas produced in Australia will only represent a small fraction of world supply.

World gas markets

The world gas trade is split into three reasonably distinct markets, North America, Europe and Asia, each with its own pricing structure.[23] At the moment the eastern Australian gas market has been insulated from the effect of other markets on local gas prices because the world gas markets and the eastern Australian gas market are not currently linked. This is set to change in 2014 as the three LNG facilities near Gladstone become operational.

The most important world market for Australia is the Asian market because of its proximity and high prices. Asian markets traditionally have the highest world price, currently about $15 per gigajoule for delivered LNG, which includes the cost of liquefying and transporting the gas. Prices are set in reference to Japanese crude oil prices.

[23] BREE (2012a), p.25.

North America's price is generally determined by the Henry Hub price. Prices in the United States have recently been low because of the rapid expansion of unconventional gas production and the United States, like Australia, has little capacity to export. While there are a large number of export facilities proposed, few have been approved so far. Should more export facilities be approved and completed this is likely to increase the Henry Hub gas price.

In Europe, prices are set against gas from inside Europe and pipeline imports from Russia. Prices are also set in relation to other fuel sources such as low-sulphur residual fuel oil and coal.

Australian gas markets

The Australian domestic gas market is split into three separate regions – eastern, western and northern.[24] All three are geographically isolated from one another, meaning all gas produced is either consumed within the market or exported to the Asian market. The isolation of the three Australian markets means that each has separate supply and demand conditions leading to different pricing structures.

The first region is the eastern market, which includes Queensland, New South Wales, the Australian Capital Territory, Victoria, Tasmania and South Australia. The eastern market produces about a third of Australia's natural gas and is the only market that produces CSG. Currently all gas produced in the eastern market is consumed domestically – there are no exports. This market is the largest producer of domestic natural gas.

Despite this the eastern market is the only market currently without an export capacity. This means that it is, at present, unaffected by world gas prices. Prices in the eastern market are determined by supply and demand within the market. This has historically resulted in relatively low gas prices when compared to world prices, wholesale prices for pipeline gas of around $3 to $4 per gigajoule.[25] But new LNG export facilities in Gladstone are scheduled to begin exporting gas in 2014. This will open the eastern market up to the world market and its associated higher prices.

The second market is the western market, which includes parts of Western Australia. The western market produces 59 per cent of Australia's natural gas, which makes it the largest producer of natural gas in Australia. It exports a significant quantity of natural gas in the form of LNG.

The third market is the northern market, which includes the Northern Territory as well as some gas produced in northern Western Australia and piped across to the

24 BREE (2012a), p.23.

25 Chambers (2013) *Gas price soars as Santos signs domestic deals.*

Northern Territory. The northern market is the smallest producer, only producing nine per cent of Australia's natural gas. The majority of this is exported as LNG.

Current price movements in the eastern market

Recently gas prices have begun to rise in the eastern market. Santos has reported that it is negotiating gas contracts at the higher end of the $6 to $9 per gigajoule range.[26] These contracts go beyond 2014 and 2015, when the new Gladstone gas plants will commence operations. This is very close to the export parity price and gives us a strong indication about what gas producers are assuming the price will be in the next couple of years.

From a commercial perspective this makes perfect sense. With the completion of the first LNG plant in mid-2014, gas producers in the eastern market will have a choice. They can supply to the world market and receive the export parity price, which is currently around $9 to $10 per gigajoule, or they can sell domestically. If domestic consumers want to negotiate a contract that includes 2014 or beyond they will need to pay the export parity price.

This of course represents a doubling or tripling of wholesale gas prices for domestic consumers. Increases of this magnitude are likely to put significant pressure on those businesses that are highly dependent on gas. There have already been some commentators, particularly in manufacturing, that have raised concern about the increasing gas price.[27]

Gas reserve policy

The western gas market is linked to the world gas price through large LNG gas facilities. To help mitigate higher domestic gas prices, the West Australian government introduced a policy that set aside a portion of gas for domestic use. With the imminent linking of the eastern market to the world market, the peak industry body 'Manufacturing Australia' has called on the government to introduce a similar gas reserve policy as has been implemented in Western Australia.[28]

The gas industry is strongly resisting these calls, claiming that such a policy will prevent investment in new gas supply. The industry is effectively arguing that a reserve policy would force it to sell some gas at a lower price and hence collect a reduced profit. This reduced profit and lower price, the industry claims, will discourage further expansion of gas supply.

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26 Chambers (2013).

27 NIEIR (2012) *Large scale export of East Coast Australia natural gas: Unintended consequences.*

28 Robinson (2013) *Gas industry opposes call to reserve local supplies.*

The cost of extracting gas varies depending on the gas field. Some gas is easy to access and close to infrastructure and this makes its extraction and transportation cheaper. Other gas is in difficult-to-reach places far from existing infrastructure, making it more expensive to extract. Put simply, some gas is cheap to extract and some gas is more expensive. When the gas price is low, only the cheap gas is extracted – but as the price rises more expensive gas fields become viable.

A gas reserve policy will not lower the price of all gas supplies. Rather it will create two separate markets. One for the reserved gas sold domestically at a lower price and the other for LNG sold to the world market at a higher price. Since at the current relatively low price gas suppliers can supply the domestic Australian market, there must be sufficient gas that can be extracted and be profitable at a low price. Additional gas produced would therefore be sold at the higher export parity price. If additional gas supplies are attracting the export parity price, then a well-designed gas reserve policy would not act as a disincentive to further investment in new gas production.

Impact of expanding supply on gas prices

The industry's claim that expanding supply will lower the price is based on the flawed application of a simple principle of economics, namely that an increase in supply will usually lead to a reduction in price. There are problems with simply applying this principle of economics to the eastern gas market without taking into account the large changes that are occurring within the market. The lack of an ability to export to the world market has led to a situation where the domestic price is considerably lower than the world price. When the export facilities are complete and the domestic price merges with the export parity price, increases in supply can only lower the domestic price under two circumstances. The first circumstance is if domestic production is greater than the export capacity of the LNG plants plus domestic demand. The second is if an expansion of domestic supply reduced the world price.

For domestic production to expand to be greater than the export capacity of the LNG plants plus domestic demand would require a substantial increase in gas production. To put the size of this increase in perspective, we need to know how large current eastern market production is and the capacity of the new LNG facilities. According to the Australian Energy Market Operator (AEMO), domestic

gas demand in the eastern market in 2011 was 674 PJ.[29] The three Gladstone LNG facilities will have a combined capacity of 1,346 PJ per annum.[30]

It is planned that the new LNG facilities will be supplied through an expansion of CSG production in Queensland. It is the expansion of CSG production in Queensland that has made the Gladstone LNG facilities viable. Without CSG production it is unlikely that the eastern market could have produced a sufficient quantity of gas to make the construction of LNG facilities, as well as the other infrastructure required for its export, viable.

It is also worth noting that, should such a huge expansion in LNG production take place, it is highly likely that the LNG facilities would be expanded or new LNG facilities would be built. Indeed AEMO reports that currently proposed LNG export facilities would expand capacity by between 2,316 PJ and 6,612 PJ per annum.[31] Any proposed increase in gas production over and above that planned to supply the new LNG facilities could easily be exported. Put simply, once the Gladstone LNG facilities are up and running the eastern market will be linked to the world market and additional production will not break this link, regardless of the size of the increase in domestic production.

The second way that expanding production in the eastern market could reduce price is if the expansion increases Australia's LNG exports sufficiently to lower the world price of LNG. In 2011 the world trade in LNG was 13,283 PJ (241.5 Mt).[32] Looking at the list of CSG projects in New South Wales from BREE's major project listing, there were only four CSG projects in New South Wales.[33] Two of those projects have been suspended because of the changes put into place by the New South Wales government. If these projects were completed, this would amount to 30 PJ per year of lost production. If this gas had been exported it would have increased world exports by 0.2 per cent. This of course assumes that these were the only projects that would have gone ahead had the changes not been made, which is highly unlikely.

At the other extreme, the New South Wales government estimates that there is 19,000 PJ of "potentially recoverable CSG" in New South Wales.[34] If all of that were recovered over, say, 30 years, then this would increase production by, on

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29 This quantity comes from the *2012 GSOO figure data and tables* (figure A-3) that are used in AEMO (2012) *Gas Statement of Opportunities: For Eastern and South Eastern Australia*. It should be noted that this is gas demanded (consumed) and does not include gas used by the gas industry for distribution and processing which could be as much as 10 per cent of gas used by consumers.

30 Core Energy Group (2012) *Eastern & South-Eastern Australia: Projections of Gas Demand for LNG Export*, p.22.

31 Core Energy Group (2012), p.23.

32 IGU (2011) *World LNG Report.*

33 BREE (2013b) *Resources and energy major projects: April 2013 project listing.*

34 NSW Government (2013) *Coal seam methane in NSW.*

average, 633 PJ per year. If this amount of gas were then exported it would increase world LNG exports by less than five per cent. This assumes that all the gas can be extracted, which would include gas reserves over large parts of Sydney. This is equally unlikely.

The actual effect of the policy on world LNG exports will likely fall between these two unlikely extremes, but regardless of the final effect, the increase in exports is not likely to be large in comparison to the world trade in LNG, so its effect on the world price will be extremely small. This effectively means that increasing or decreasing domestic supply is going to have virtually no impact on the price of gas after the Gladstone LNG facilities are finished.

Gas prices are certainly going to rise substantially in the next few years, but the increase in price will have nothing to do with CSG production in New South Wales or Victoria. The increase is because the eastern gas market will now be linked to the world market and gas suppliers will be able to sell their gas at the export parity price. Domestic customers will have no choice but to pay this higher price unless the government sets aside a domestic reserve.

Price will ration gas

Another claim being made is that New South Wales needs to develop its CSG resources so that it will not have to import gas from other Australian states.[35] The claim goes on to say that, with a coming gas shortage, long-term supply will be harder to secure and having to import gas will make the state more vulnerable.

In order to assess this claim we need to consider a number of things:

- In 2012 New South Wales depended on interstate supply for 98 per cent of its gas[36]
- Demand for gas in New South Wales has been falling in recent years[37]
- This fall in demand is likely to continue when wholesale gas prices double or triple after the Gladstone LNG facilities become operational.

This tells us a number of things about the state of the gas market in New South Wales. The first is that New South Wales is already overwhelmingly reliant on gas from interstate. The second is that there is sufficient gas infrastructure in place to

35 AAP (2013) *NSW gas prices to swell 8.6 per cent.*

36 DomGas (2012) *Hall Shale Gas Fracturing: Review and Recommendations for Induced Seismic Mitigation.*

37 AEMO (2012), pA–32.

allow it to source gas easily from other states. With the state's demand for gas set to decrease in coming years, expanded infrastructure is unlikely to be necessary unless New South Wales sources its gas from new locations. If, over time, new infrastructure is required to enable gas supply to continue to flow to New South Wales, this can be built as it becomes necessary.

The idea that New South Wales will somehow be unable to continue to rely on other states to supply it with gas is false. The coming 'gas shortage' will not be caused by a drop in gas supply. It will, rather, be caused by an increase in demand for gas to be exported via the Gladstone LNG facilities. The 'shortage' in gas will be resolved in the market through increases in price. New South Wales consumers who are willing to pay the higher export parity price will have the same access to the gas supply as those consumers in Queensland, Victoria or any other state in the eastern gas market.

Finally, there are no trade restrictions for gas created by different state governments. The idea of 'importing' gas from another state is as meaningful as the idea of 'importing' gas from one region of New South Wales to another. Gas companies in Australia often operate in multiple states and are unconcerned which state the final consumer is in. Like most businesses in a market economy, they are going to sell to the consumers they believe will give them the most profit regardless of the state they live in and this includes international consumers, who will be able to buy Australian gas from the eastern market in 2014.

Can an increased gas supply make gas cheaper?

The coming gas price rises are not being driven by a lack of supply, but rather the linking of the eastern Australian gas market with the world LNG market. This link will occur with the completion of the Gladstone LNG facilities. Gas prices will then rise and gas production will become far more profitable. Because of this it is understandable that gas companies are keen to expand production.

Ironically it is not a lack of supply that is going to drive up gas prices but the introduction of CSG as a new form of supply. Without this additional supply it is unlikely that gas production would have been large enough in the eastern market to justify the construction of LNG facilities.

With gas becoming far more profitable, it is not surprising that gas producers are keen to expand their supply. Blaming restrictions on CSG for coming price rises is designed to turn public support against those restrictions and increase pressure on the New South Wales state government to remove them. But these claims are little more than posturing and bear no resemblance to what is actually happening in the market.

Some gas producers in the eastern market are undermining the industry line that there will be a lack of gas in the eastern market.[38] Those producers who do not have an interest in removing restrictions on CSG production in New South Wales and Victoria are telling customers that they have plenty of gas to sell at the export parity price – this includes Origin Energy and BG Group. By contrast, AGL Energy and Santos, which both have CSG interests in NSW, are warning of a gas shortage and price increases that can only be prevented by removing restrictions on CSG.

The belief instilled in the general public that an increase in gas supply through CSG operations will make gas cheaper is therefore false. The expansion of CSG extraction has led to the construction of LNG export facilities and a correspondingly rapid rise in the wholesale price of gas. Once linked to the world market, only factors that can change the world gas price will be able to change the domestic gas price.

Impact on Gladstone of the rise in gas prices

The new LNG export facilities are being constructed in Gladstone Queensland. It could therefore be assumed that Gladstone would be one of the biggest beneficiaries of the new gas export industry. In a surprising outcome, Gladstone is set to face a large increase in costs because of the new export facilities. Gladstone is a large industrial area and a big consumer of natural gas. With the new export facilities set to triple the wholesale price of gas, Gladstone is likely to pay $2.9 billion more for gas over the next 10 years.[39]

This means that Gladstone businesses will face large increases in costs and are likely to be put under financial pressure. It highlights that the real winners of the new LNG export industry are going to be the mostly foreign owners of the eastern Australian gas producers. Even the businesses in Gladstone that are at the centre of the new industry are going to face increased costs.

38 Macdonald-Smith (2013) *Heated clash fuels gas debate.*

39 Ogge (2013) *$2.9 billion CSG surcharge.*

3 Can CSG act as a bridging fuel?

Natural gas, oil and coal are all fossil fuels and they all produce greenhouse gases when they are consumed. Natural gas produces less greenhouse gas emissions per unit of energy when it is consumed, compared to coal or oil. The argument is that a transition to natural gas from coal would therefore reduce greenhouse gas emissions. This argument fails to consider the life cycle emissions of natural gas. Life cycle emissions include the emissions from extracting, transporting and consuming the gas. The lack of information on fugitive emissions (that is, emissions that escape during extraction of the gas) means that gas has the potential to have substantially higher emissions than has been previously claimed.

Ultimately the world needs to transition to zero carbon forms of energy if it is to avoid dangerous climate change. While the technical and economic feasibility of a zero carbon stationary energy for Australia has been demonstrated,[40] many still see it as impossible at the moment. Natural gas is therefore championed by some as a way to reduce emissions while renewable energy is developed. The key to the claim that natural gas can act as a bridging fuel lies in its ability to produce substantially less carbon emissions than coal.

Natural gas can be used in a very similar way to coal. It can therefore be rolled out relatively quickly with minimal change. It is claimed that natural gas can be used for a period of time to give the planet time to transition to renewable forms of energy. How long natural gas is needed will depend on how quickly renewable forms of energy can become cost competitive and gain acceptance as a replacement energy.

The gas industry has been keen to claim gas as a transition fuel as a benefit. The APPEA has said, "Australia's natural gas reserves have the unique potential to significantly reduce greenhouse gas emissions at low cost."[41] When burnt to generate electricity, natural gas can produce up to 70 per cent less greenhouse gas emissions than burning brown coal, the most emissions-intensive form of coal. The gas industry in Australia continually claims that it is a significantly cleaner fuel source and these claims have persuaded 44 per cent of the general public to rate this as a major benefit of CSG.[42]

This claim is correct if you only include greenhouse gas emissions from burning the gas in the most efficient power plants and compare this to emissions from the least efficient brown coal generators. Brown coal is the most emission-intensive form of coal, so the 70 per cent reduction should be considered to be the

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40 Wright et al. (2010) *Australian Sustainable Energy: Zero Carbon Australia Stationary Energy Plan* and AEMO (2013) *100 per cent renewables study: executive briefing.*

41 APPEA (2013c) *How natural gas can minimise greenhouse emissions.*

42 TAI (2013a) *Australia Institute Survey – August*

maximum reduction rather than an expected or average reduction. When compared to black coal the emissions reduction is 40 to 50 per cent but this reduction does not consider other emissions associated with the extraction of the natural gas. In the case of conventional natural gas this is not problematic but in the case of unconventional natural gas such as CSG, this could underestimate emissions substantially.

As demand for gas rises worldwide there has been an expansion beyond conventional natural gas to unconventional natural gas. In Australia this has meant an increase in the extraction of CSG. There are still many questions being asked about all the consequences of CSG extraction, along with calls for more research and measurement of its full effect on the environment.

There are two major concerns with the idea that CSG can be used as a bridging fuel. The first is that the way CSG fugitive emissions are measured is likely to significantly underestimate the size of the emissions. To date there has been very little actual measurement of fugitive emissions that occur when CSG is being extracted. The current methods of estimation, using fugitive emissions estimates for conventional natural gas, are inappropriate and are likely to underestimate CSG fugitive emissions.

The second major concern is that the way we measure methane, the main fugitive emission from CSG extraction, may also be inadvertently making it harder for the world to limit the warming effect of climate change to below the environmental tipping point of two degrees.

Fugitive emissions for the purpose of this paper are all leakage emissions from the extraction, processing and transportation of gas. This includes both accidental leakage as well as deliberate releases from, for example, venting or flaring. This is the definition that is used in the Intergovernmental Panel on Climate Change (IPCC) Guidelines for the reporting of national greenhouse gas inventories.

CSG fugitive emissions

The extraction process for coal seam gas produces emissions from a number of sources. A major source of fugitive emissions from CSG is leaks at the wellhead. This is when emissions, in the form of methane, leak out as the gas is being extracted. Fugitive emissions from the wellhead occur for both conventional gas and CSG; however the wellheads for conventional gas and CSG are very different. Conventional natural gas, particularly in offshore production, comes from large reservoirs and so only a relatively small number of wellheads are needed for a given quantity of gas. These wellheads are very large and are closely monitored.

CSG is extracted from many small reservoirs. This means that for any given quantity of gas there are many small wellheads, rather than a few large ones. It

also means that each of the wellheads is monitored less closely. This means that for every tonne of natural gas produced from CSG, there is potential for more leakage to occur from the wellhead when compared with each tonne of gas produced from a conventional natural gas well.

The amount of emissions that leak from the wellhead increases when fracking is used.[43] This means that fugitive emissions from shale gas are far larger than those from conventional gas, since unlike conventional gas, shale gas extraction always uses fracking.

CSG extraction also uses fracking at some, but not all of its wells. So the combination of a higher number of wellheads per tonne of gas produced, and increased fugitive emissions – because some CSG wells use fracking – suggests that fugitive emissions from CSG are likely to be higher than those from conventional gas but lower than those for the extraction of shale gas.

Another source of fugitive emissions comes from the transportation of gas. Fugitive emissions are unintended emissions that leak out, usually from gas under pressure. Fugitive emissions escape during the transportation of CSG through pipelines because the gas is under pressure and some of it inevitably leaks out. The more kilometres of pipeline that the gas runs through, the higher the fugitive emissions will be.

Transport fugitive emissions from unconventional gas are essentially identical to transport fugitive emissions from conventional gas. National Greenhouse and Energy Reporting (NGER) uses the same emissions factors for measuring emissions from transportation of CSG as those used for transporting conventional gas.

Another source of emissions is in the processing of the gas. While conventional gas sometimes contains significant quantities of other hydrocarbons including ethane, propane and butane, it may also have to be processed to remove excessive levels of CO_2. These processing activities can be emissions intensive. CSG differs from conventional gas in that it does not contain higher levels of hydrocarbons that need removing and rarely contains high levels of CO_2. Because of this difference, CSG requires very little processing.

Measurement of fugitive emissions

It is likely that the current approach to measuring fugitive emissions significantly overstates the ability of CSG to act as a bridging fuel. The industry has chosen to

[43] Howarth et al. (2011) *Methane and the greenhouse-gas footprint of natural gas from shale formations: A letter.*

use a measurement method that is not based on unconventional gas production and further study of their preferred method is required.

Emissions in Australia are recorded under NGER, governed by the *National Greenhouse and Energy Reporting Act 2007*. All firms that produce more than 25,000 tonnes of carbon dioxide emissions per annum are required to report annually under NGER. Since greenhouse gas emissions can come from many sources, the relevant regulation (the *National Greenhouse and Energy Reporting (Measurement) Determination 2008*) explains how to measure emissions. One of the ways to do this, known as 'method 1', provides a set of default factors for calculating the amount of emissions that might be created when doing something that produces greenhouse gas emissions. So for example, if your business uses black coal to heat something, you simply take the quantity of coal you burn in a year and apply the method 1 factor, and that determines your emissions from burning coal.

CSG method 1 factor

The NGER method 1 factor for fugitive wellhead emissions for CSG is 0.0012 tonnes of carbon dioxide emissions per tonne of natural gas, or 0.12 per cent of gas production.[44] This is the same as the method 1 factor used for conventional gas. If the method 1 factor is used, this means that for every tonne of natural gas produced, 1.2 kilogram of carbon dioxide equivalent of fugitive emissions is produced. This means that no account is made for the fact that CSG extraction uses far more wellheads, and wellheads of a very different size. Also no account is made for the fact that fracking is used when extracting some of the CSG.

Conventional and unconventional natural gas have the same fugitive emission factors in significant part because there has been very little research done on emissions associated with unconventional natural gas, whereas a lot of research has been done on conventional natural gas. So the method 1 factor is not an average of conventional and unconventional natural gas fugitive emissions, but, rather, is just the emissions factor for conventional gas.

The research that does exist on unconventional gas is mostly on shale gas. This is in part because shale gas production has increased rapidly in the United States and now accounts for about 15 per cent of US gas consumption.[45] In 2011 the United States Environmental Protection Agency (EPA) revised its estimates for fugitive emissions from natural gas operations, more than doubling it to 2.4 per cent of gas production, primarily because of emissions associated with

44 *National Greenhouse and Energy Reporting (Measurement) Determination (2008).*

45 Rutovitz et al (2011), p.3.

unconventional gas.[46] Note that the United States EPA thinks that emissions from unconventional natural gas are 20 times higher than the Australian method 1 factor, which means that Australia estimates fugitive emissions at 0.12 per cent while the US estimates them at 2.4 per cent.

A recent US study by the National Oceanic and Atmospheric Administration suggested that fugitive emissions from unconventional gas were four per cent.[47] Some US studies have even suggested that when the full emissions from shale gas are measured they might be higher than those for coal, which they are supposed to be replacing.[48] While CSG fugitive emissions are not expected to be as high as those associated with shale gas, they are very likely to be higher than those of conventional gas.

Very little study of CSG fugitive emissions has been done in Australia. There has been an unpublished study from the Southern Cross University where scientists drove around the public roads at the Tara gas fields to measure greenhouse gas levels up to three times higher than nearby districts.[49] The CSIRO is also conducting a large research project into the impact of CSG on fugitive emissions.[50] To date, if the industry has done anything to measure fugitive emissions it has not publically released any of that information.

Methane as a greenhouse gas

While it is likely that Australia is significantly underestimating fugitive emissions from CSG extraction and this is likely to reduce CSG's ability to act as a bridging fuel, there is another major concern with this theory. The way methane's global warming potential (GWP) is calculated could also mean more rapid short term warming at a time when the world is struggling to limit global warming to two degrees Celsius.

There are a number of different gases that cause warming of the atmosphere. The Global Warming Potential (GWP) of a gas is the average amount of warming it causes over 100 years. By converting these gases into carbon dioxide emissions, we can compare their GWP to that of a tonne of carbon dioxide over 100 years.

The main fugitive gas produced in extracting CSG is methane. The conversion rate that is commonly used for methane is 25 times carbon dioxide over a 100-year period. Put simply, each tonne of methane emitted creates the equivalent of

46 United States Environmental Protection Agency (2011) *Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2009.*

47 Tollesfson (2012) *Air sampling reveals high emissions from gas field.*

48 Howarth et al. (2011).

49 Cubby (2012) *Methane leaking from coal seam gas field, testing shows.*

50 CSIRO (2013) *Fugitive emissions from coal seam gas.*

25 tonnes of carbon dioxide emissions. This is because methane is a particularly potent greenhouse gas, which creates more warming than carbon dioxide. Methane is also a relatively short-lived gas in the atmosphere when compared to carbon dioxide. Methane only lasts about 12 years, whereas carbon dioxide could last more than 1,000 years. In the case of methane, it has broken down long before the 100 years are up, which drags down its average GWP. If methane is compared to carbon dioxide over 20 years instead of 100 years, then the conversion rate goes up almost threefold to 72 times the warming potential of carbon dioxide.

Since global warming is a long-term issue, using a time frame of 100 years might seem sensible, but there are a number of reasons why this is not the case for methane emissions. The first is that we are rapidly using up our budget of emissions in order to prevent more than two degrees of warming. Preventing two degrees of warming is important, because climate science is telling us that important tipping points are likely to be triggered if the globe warms more than two degrees. Tipping points cause feedback effects that in turn cause more warming, which once begun cannot be stopped. Once we pass two degrees of warming we may be unable to stop a further three or four degrees from occurring, even if we dramatically reduce our emissions.

The most recent estimates from the IPCC,[51] the GWP of methane increased by more than a third – from 25 to 34 over 100 years. The 20-year conversion rate has increased from 72 to 86. The increase in the GWP is to take account of the feedback effects that methane will have on the climate.

Tipping points mean that preventing warming in the short term is very important, particularly as countries are slow to act. Countries have a greater capacity to change their behaviour in the longer term than in the short term. Because of the way we measure GWP, the larger short-term warming effect created by an increase in methane emissions may not have been properly considered.

The other major problem with using a GWP for methane over 100 years is that gas is being held up as a bridging fuel to be used over a shorter period of time while we transfer to zero emission forms of energy. If gas is expected to be a bridging fuel, then we expect to use it in the short to medium term, and not over a 100-year period. This also means that we expect to ramp up our use of gas, which in turn will exacerbate the short-term effects of the fugitive methane emissions.

CSG is still a fossil fuel

The answer to the question of whether CSG produces fewer emissions than coal is still unknown – but it is important to remember that CSG is still a fossil fuel and

[51] IPCC (2013) *Working Group 1: The physical science basis*, pp8-58.

so still produces greenhouse gases. In the year to March 2013, Australia's greenhouse gas emissions were flat. This was despite significant falls in emissions from the production of electricity. These falls were offset by increases in greenhouse emissions from coal mining and gas production, which rose 13 per cent.[52]

Fugitive emissions have become more significant over time, rising by 41 per cent since 1990 to become eight per cent of total emissions. Even under the most optimistic of gas industry scenarios, switching from coal to gas – particularly CSG – will still create significant greenhouse gas emissions.

Can CSG act as a bridging fuel?

The claim that CSG produces substantially less greenhouse gas emissions cannot yet be substantiated since the level of fugitive emissions is currently unknown. With the industry unable or unwilling to measure fugitive emissions, the government has been forced to act and measure them. Before we adopt a policy of using CSG as a way of combating climate change, it is essential that we have a good understanding of the effect that switching from coal to gas will have on our emissions. We cannot do this until we can measure the fugitive emissions that occur in the CSG extraction process.

Before the government approves more CSG production, we need to better understand the quantity of fugitive emissions. We need to be sure that we are actually reducing our emissions by switching from coal to coal seam gas. We need to make sure that we are not jumping from the frying pan into the fire.

Fugitive emissions from CSG have the potential to significantly increase greenhouse gas emissions, particularly if the short term warming effect of methane is considered. These short-term warming effects need careful consideration. With global action on climate change slow, a significant increase in short term warming could push the world towards dangerous tipping points.

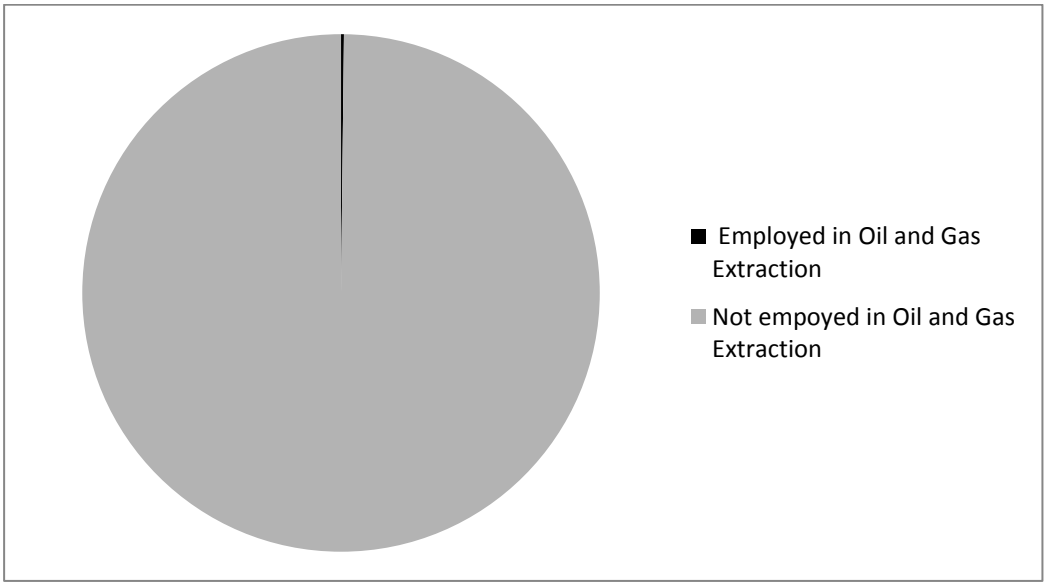
[52] Department of Environment (2013) *Australian National Greenhouse Accounts: March Quarter 2013.*

4 Will increasing gas production bring more jobs?

The gas industry is relentless in its claims about job creation. It commissions modelling,[53] creates dedicated websites[54] and runs national multi-million dollar advertising campaigns that focus on the potential for the industry to create huge numbers of jobs. It is not surprising then that 39 per cent of the August survey respondents nominated more jobs as a benefit of CSG.

While the industry is busy claiming it creates many jobs, the reality is that the gas industry is a relatively small employer. While figures for the CSG industry are not published by the ABS, job numbers for the oil and gas industry are, and the CSG industry is a part of this sector. In August 2013 the entire oil and gas industry employed 20,700 people,[55] which is 0.2 per cent of the workforce. To put this figure into context, the hardware retail company Bunnings employs 33,000 people.[56]

Figure 3: Employment in Oil and Gas extraction



Source: ABS (2013a).

Claimed employment benefits

The economic benefits that the industry has claimed in its most recent advertising campaign, 'our natural advantage', are quite extraordinary. On the campaign

53 CIE (2013) *Benefits of natural gas for NSW.*

54 APPEA (2013d) *Our natural advantage.*

55 ABS (2013a), Table 06.

56 Bunnings (2013) *About Us: Who we are.*

website it claims: "The natural gas industry was responsible for an estimated 100,000 Australian jobs last year."[57]

To fully appreciate this claim we need to put an additional 100,000 jobs in context. Last year, according to the ABS, the Australian economy added an additional 173,537 jobs.[58] If the APPEA's claims are true, 58 per cent of all the additional jobs created in the economy last year were in the gas industry. This would be an amazing achievement if it were true and at the same time it would probably show that growth in the Australian economy was extremely narrow, being focused almost entirely in the gas industry.

Fortunately we can check such a claim. The ABS does not publish employment statistics just for the gas industry as it is too small, but it does collect statistics for the oil and gas industry. From the available data it can be calculated how many additional jobs were created in the oil and gas industry, but this number is likely to overestimate additional gas jobs since it will also include additional oil jobs. According to the ABS, 9,372 additional jobs were created in the oil and gas industry.[59] This is somewhat smaller than the 100,000 claimed by the industry.

This is not the only time that the gas industry has made incredible claims about jobs creation. In September 2013, at the same time that the gas peak body was making the 100,000 additional jobs claim, James Baulderstone, Santos vice-president for Eastern Australia, wrote about job dependence on gas in NSW:

> *[CSG mining] can secure the more than 15,000 industrial jobs which are dependent on gas supply as a feedstock, and the further of 2.5 million people who are employed by those companies who use natural gas for power. However, it will require putting in place solutions today and not waiting for tomorrow.*[60]

Data from the Bureau of Resources and Energy Economics[61] show that 91 per cent of gas consumed by businesses in Australia is used by the mining and manufacturing industries. Census data from the ABS show that these industries employ around 300,000 workers in NSW.[62] The businesses employing the other 2.2 million workers account for less than nine per cent of gas consumption.

So, of the 2.5 million jobs the gas industry is claiming to support, 2.2 million are employed in businesses that use gas only in a very minor way – for example for the heating of work spaces. The idea that these businesses would no longer employ people if gas prices rose dramatically is highly unlikely. It is far more likely

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57 APPEA (2013b) *Did you know natural gas is a leading player in Australia's economic story?*

58 ABS (2013a).

59 ABS (2013a).

60 Baulderstone (2013) *NSW must secure its energy future and restore investor confidence.*

61 BREE (2012b) *Energy in Australia 2012.*

62 ABS (2011) *2011 Census Community Profiles.*

that these businesses would substitute gas with other forms of energy such as electricity.

Even the 300,000 jobs in manufacturing and mining would not all be lost if those industries were forced to pay more for gas. Some businesses, particularly in manufacturing, may struggle and lay off workers. But in the very profitable mining industry it is unlikely to have a large impact on employment. Many businesses in manufacturing and mining may also have the option of substituting different energy sources for gas.

With the industry relying so heavily on these claimed benefits – and its propensity to exaggerate those benefits – it is important to examine more closely the industry's economic claims.

The gas industry in context

Before we look at the industry's claimed economic benefits it is important to put the CSG industry into context. The amount of political noise an industry makes is not necessarily a good indicator of its relative economic importance.

The gas industry is spending an unprecedented amount on investment projects. According to the Bureau of Resources and Energy Economics (BREE) major project listing there is $203 billion of gas projects at the committed stage.[63] The committed stage of the investment pipeline includes all projects that have passed all approvals and final investment decision and, in most cases, have already begun construction.[64] The vast majority of these projects are LNG export facilities. These facilities make up $189 billion of the $203 billion of new projects. With world LNG prices, and particularly the Asian price, having risen substantially in recent years it is not surprising that gas companies are keen to export Australian gas.

Large investment projects have the potential to generate jobs during the construction phase. These jobs are not ongoing, but are short term in nature. This can create the potential for the industry to exaggerate jobs created by claiming very temporary construction employment.

While investment in the gas industry is currently high, other measures of its economic importance show it to be relatively small. As shown above, the oil and gas industry is a relatively small employer. This does not stop the industry from claiming far larger employment figures. The APPEA claims on its website that the CSG industry employs 27,300 people in Queensland and NSW.[65] Curiously this

63 BREE (2013b).

64 BREE (2013b), piii.

65 APPEA (2013a) *Creating jobs.*

figure is higher than the ABS count of 20,700 for all of the oil and gas industries across the entire country.

Economic modelling

Economic modelling has, for many people involved in Australian policy debates, become synonymous with the process of serious policy development. Proponents of policy change that are armed with economic modelling are often taken more seriously than those with 20 years' experience working on the same problem. The modelling result that suggests tens of thousands of jobs will be lost or created often trumps logic or experience that suggests such claims are nonsensical. This is because model results are presented as objective outcomes of a scientific study. Experience, by contrast, is highly subjective.

This is not to suggest that modelling has no role to play in policy debates. It can and it does often make a useful contribution, but the fact that it sometimes can should not be confused with the conclusion that it always will.

An economic 'model' is not a physical thing, like a model car. Rather, it is a mathematical representation of the linkages between selected elements of the economy. For example, an economic model of the link between economic growth and commonwealth tax revenue would usually be based on the historic relationship between economic growth and the amount of tax collected. A simple model might distinguish between the impact of changes in economic growth on income tax, goods and services tax and the tax on company profits, whereas a more complex model might distinguish between different types of economic growth – for example, growth in exports, growth in consumer spending, growth in business investment – on a wider range of commonwealth taxes such as capital gains tax, mining taxes and fringe benefits tax.

The two most common types of economic modelling used in Australia are input-output modelling and Computable General Equilibrium (CGE). The gas industry has used both types of modelling in the past but tends to favour CGE modelling and has used it in a number of reports that show the alleged benefits of CSG projects in Australia. For more information about how input-output and CGE modelling are used, as well as their limitations, please refer to the box 'Input-Output and Computable General Equilibrium modelling'.

Input-Output and Computable General Equilibrium modelling

Input-output modelling looks at the relationships between different sectors in the economy. [66] These relationships are calculated by the ABS and published in its 'input-output' tables. These tables show how the output of one sector is used as an input into another sector. For example, the output of the steel industry is an input into the car industry. If the car industry were to expand the input-output tables it would show us how much extra steel would be required (as well as all the other inputs in the car industry).

The input-output tables are useful for those interested in understanding the impact of a change in one industry on other 'upstream' and 'downstream' industries. The input-output tables can also be used to calculate multipliers that show the flow-on effects that can occur if one sector of the economy expands or contracts. For example if the car industry were to expand by $1 million, multipliers can show how much upstream and downstream industries would benefit.

Multipliers can be used to reveal connections with the economy but they can also be misused. They are often used to exaggerate the importance of an industry and in doing so they ignore the limitations of the input-output tables. Because of the fixed nature of the links between industries, input-output tables work better when the change in one sector of the economy is not large enough to cause major change in other sectors of the economy. Put simply the larger the change being studied the more that input-output modelling will overestimate the change in a sector. This is a flaw in the modelling that some lobby groups find very appealing.

Another limitation of input-output modelling is that it overestimates increases in employment. As the ABS warns:

> *The implicit assumption is that those taken into employment were previously unemployed and were previously consuming nothing. In reality, however, not all 'new' employment would be drawn from the ranks of the unemployed; and to the extent that it was, those previously unemployed would presumably have consumed out of income support measures and personal savings. Employment, output and income responses are therefore overstated by the multipliers for these additional reasons.*[67]

So for example if input-output tables were used to determine the impact of a doubling of the size of mining output they would find that employment would double, regardless of the ability of the economy to provide twice as many suitably qualified employees at the wage rate that prevailed when the input-output tables were constructed.

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66 For a more detailed discussion of these modelling techniques see Denniss (2012) *The use and abuse of economic modelling in Australia.*

67 McLennan (1990) *Information Paper ANA Introduction to Input-Output Multipliers*, p.24.

Input-output tables are useful for conducting what economists call 'partial equilibrium analysis', that is, analysis of a change in one sector that is sufficiently small that it is considered safe to assume that 'all other things remain equal'. For that reason, when big changes that affect other industries are being considered it is necessary to rely on some form of macroeconomic model that explicitly considers the way that industries both respond to changes in relative prices and are competitors with each other for scarce resources.

The most commonly used models for evaluating major policy decisions are Computable General Equilibrium, or CGE models. These models are an extension of the input-output type models described above, with one of the most significant differences being that CGE models allow for prices to change the relative use of different factors of production in the production of a good or service. While input-output models are an attempt to explain how much wheat, energy, labour and capital is used to make bread, a CGE model might be used to estimate the impact of a wage rise on the amount of labour used in bread production.

CGE models are built on the input-output tables but combine these models with a wide range of equations designed to simulate the structural and behavioural relationships that shape economic activity. In addition to the data from the input-output tables on the linkages between different industries, CGE models need to include estimates of the 'elasticity', or sensitivity, of a wide range of variables.

These sensitivities include things like how much exports will change when the exchange rate changes; how much employment will change when wage rates change; and how much a change in tax rates will change people's desire to work.

It is important to remember that if a model assumes that a small increase in tax will lead to a large reduction in the willingness of people to work then the model will inevitably 'find' that a small increase in tax will lead to a large reduction in the willingness of people to work. It is, therefore, essential that those who are using macroeconomic modelling results are fully aware of what assumptions have been made by the modeller otherwise models can simply become a vehicle for converting assumptions into conclusions.

One of the most important, and least understood, features of CGE models is that they assume that, in the long run, the economy will be in full employment and that the path that the economy follows has no impact on its long-run destination. It is hard to overstate the significance of this assumption – put simply, it means that if the economy experiences a deep policy-induced recession, the model assumes that the recession will cause a sufficiently strong recovery that the final destination is no different from what it had been had no such recession occurred. In other words, CGE models are programmed to show that there was no long-run harm from the high interest rates that caused the 'recession we had to have'.

Modelling case study 1: Santos and the North West New South Wales CSG project

How economic modelling is presented is very important. A good report on economic modelling should contain the critical assumptions made and discuss any limitations that the modelling may have. Bad economic modelling hides the assumptions made and makes no mention of limitations of the modelling. A good example of this was modelling commissioned by Santos on the benefits of a CSG project it had proposed in North West NSW. The results of this modelling were quite curious.

Santos was planning to mine the coal seam gas reserves of North West New South Wales and, as elsewhere with coal seam gas projects, has encountered substantial local opposition. Action groups such as Save Liverpool Plains and the Lock The Gate Alliance have initiated lobbying and protest action. Santos released a report entitled 'The economic impacts of developing coal seam gas operations in North West NSW' undertaken by the Allen Consulting Group (the Allen Report). The Allen Report was commissioned and released by Santos and in an accompanying press release Santos' Vice President Eastern Australia, James Baulderstone, took the Allen Report to say that:

> *Allowing the natural gas industry to develop in NSW will deliver once-in-a-generation economic opportunities for the state, especially in regional areas.*[68]

But despite the claim that the development of CSG will create a 'once in a generation' economic opportunity, a careful reading of Santos' own economic modelling shows that, on the contrary, the benefits to the local economy of the planned development will be quite small and that the major beneficiaries will be the owners of Santos who predominantly reside outside of the development area.

The modelling showed that only 30 new gas jobs are expected to be created in the operational phase of the development and that 570 new public sector jobs would be created.

Due to the fact that the Allen Report does not provide a clear outline of the critical assumptions it made, readers are at a disadvantage in trying to understand how such a small increase in direct employment could create 570 new public sector jobs.

The Allen Report is a good example of how economic modelling can be used to create results that are nonsensical. Good economic modelling should present all the economic impacts so that a balanced view of the project can be reached. This means that even when economic modelling is done well, if the positive results are

68 Santos (2011) *Santos NSW CSG investment promises substantial benefits for state.*

highlighted and the negative results downplayed or ignored then the purpose of the modelling is wasted.

Modelling case study 2: Arrow Energy's Gladstone LNG plant

Another example of the misuse of economic modelling is presented by Arrow Energy on its Gladstone LNG plant. As part of its environmental impact statement (EIS), Arrow was required to conduct an economic impact statement that involved economic modelling of both the positive and negative impacts of the project.

While the economic benefits were regularly mentioned in the report, including on multiple occasions in the executive summary, the negative economic impacts were harder to find. They were finally spelt out, not in the main report but in Appendix 21. For those with the stamina to read that far, the appendix spells out both the positive and negative impacts.

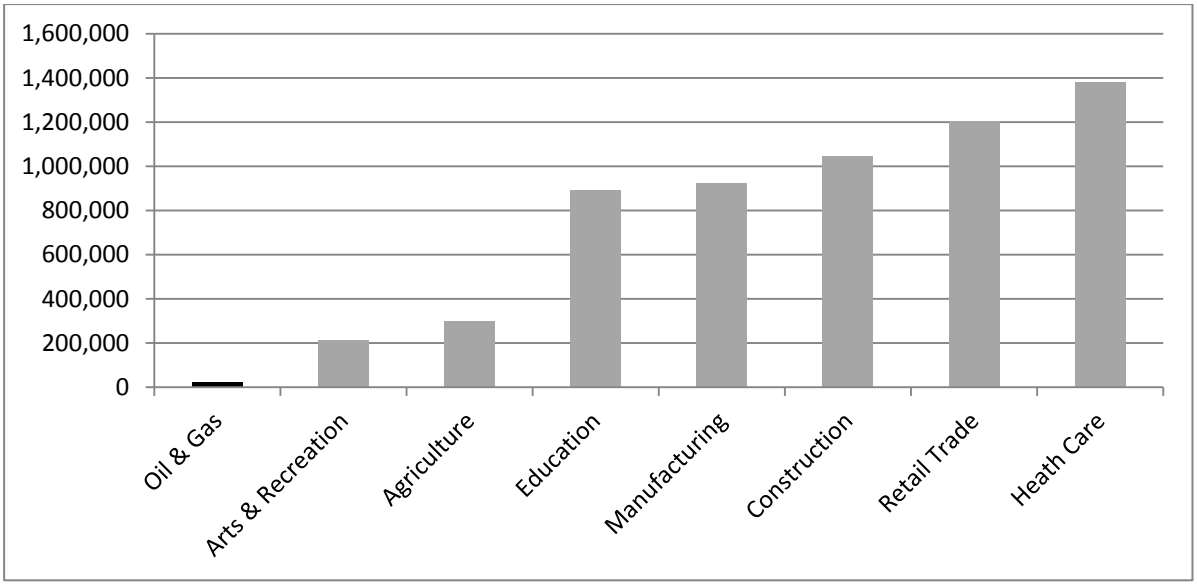
While the executive summary is keen to highlight the jobs created, it makes no mention of the 1,600 jobs across Queensland and Australia that will be destroyed, 1,000 of those in manufacturing.

The gas industry has in the past used economic modelling as a way of highlighting the benefits that its proposed resource projects may create while at the same time downplaying or ignoring the negative effects. This is a misuse of economic modelling. Good economic modelling shows all the benefits and costs as well as discussing critical assumptions and limitations. Bad economic modelling focuses attention only on a subset of outcomes and hides critical assumptions and limitations.

Does the CSG industry create lots of jobs?

The CSG industry clearly employs people but the number it employs is far lower than many of its exaggerated claims suggest, including those made by economic modelling it has commissioned. The whole oil and gas industry employs 20,700 people. Table 4 puts this level of employment in context by comparing it to other industry employment in Australia.

Figure 4: Employment by selected industry



Source: ABS (2013a).

The gas industry may be profitable and able to afford to pay consultants to exaggerate the size of employment within the industry, but the simple fact is that the arts and recreation industry employs more than 10 times as many people. Perhaps we would be as keen to see the arts and recreation industry expand if it could afford to spend as much on public relations as the gas industry does.

5 Will increasing gas production bring more economic activity?

Increased economic activity is a broad term but can encompass increases in goods and services that are bought and sold, higher profits, more tax paid, more jobs and a general increase in economic prosperity. We have looked at employment in the oil and gas industry, but what about other effects the industry has on the economy? The large resources projects that the gas industry is currently undertaking have the potential to have both positive and negative economic effects.

How can an economic project have negative economic effects?

It is slightly counterintuitive to think about a new resource project having negative economic impacts. People tend to think if you build a new business in town and that adds to the local economy, then if you build a really big business in town then that must add even more to the local economy. The reality is that large resource projects at the peak of a mining boom can have effects on the micro-economy and the macro-economy as well as creating or exacerbating bottlenecks that produce inflationary pressures.

Big projects have the ability to affect other sectors of the economy and these changes have the potential to offset economic gains. This can occur through skills shortages, higher interest rates and exchange rate volatility.

Skills shortages

In a 'perfectly competitive' labour market, individuals would move seamlessly from employment in one sector to employment in another sector when the returns, whether financial or personal, from taking a new job exceeded the benefits of remaining in an existing job.

In such a labour market employees would be unconstrained by their partner’s employment prospects, their children's schooling or the need to live near friends and family to either provide or receive care. Similarly they would face no financial or logistical barriers when switching housing, nor any difficulties finding alternative care for their children.

Furthermore, in a perfectly competitive labour market, firms could substitute between a range of skills when attempting to fill positions. If highly skilled workers were in short supply then firms could substitute a larger number of less skilled workers.

In reality, however, families are slow to abandon their 'home town', workers take time to be retrained and employers are typically unwilling to substitute larger numbers of unskilled workers for smaller numbers of skilled workers.

The sudden and massive spike in demand for gas, construction and plant operator positions is typically described as causing a skills shortage; however, such a situation can just as easily be described as excess demand. For example, each Christmas the demand for prawns surges, driving the price of prawns to annual highs but such a situation is rarely described as a 'prawn shortage'.

Australia does not currently have an idle workforce of tens of thousands of people with the skills required to construct the many large gas developments simultaneously and the gas industry is investing very little in training its future workforce. The proponents of Arrow Energy's Gladstone LNG plant make clear in their economic impact assessment that the developers of new gas projects expect that most of their workforce will have been trained by other industries and will depart from those industries to work in the gas construction boom.

> *The Arrow LNG Plant will compete with local business and industry for constrained labour resources. Due to the high incomes on offer from the project during both construction and operation, it is expected that the Arrow LNG Plant will attract labour away from other businesses both locally and further afield.*[69]

The result of this poaching of workers trained by other industries will be either to drive up the wage costs of some industries or to force the shutdown of whole enterprises that cannot secure strategic staff; for example, tourism boat operators cannot operate at all if they cannot secure diesel mechanics to maintain their fleet.

Higher interest rates

In order to maintain stable inflation, the Reserve Bank of Australia is using monetary policy to 'make room' in the economy for the unprecedented expansion of the mining industry, including the gas industry. That is, while it is often assumed that the RBA is using high interest rates as a tool to slow down the mining boom, in fact it is using high interest rates to slow down other sectors of the economy in order to 'free up' additional resources for use in the mining construction boom. Freeing up additional resources means closing or shrinking non-mining businesses so labour and capital can be moved into the mining industry.

The current construction boom is being driven primarily by gas projects. Of the $268 billion in committed projects currently in Australia, $205 billion are in oil and gas. The RBA explicitly cited the mining boom in explaining seven of its interest rate increases between May 2006 and March 2008.

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69 Arrow Energy (2012) *Arrow LNG Plant Environmental Impact Statement, Appendix 21: Economic Impact Assessment*, p.39.

In addition to the increased export revenues and the massive inflow of foreign capital that is funding the mining and gas construction boom, the high interest rates being used to slow the macro economy are also attracting passive foreign investment in the Australian bond market, creating even further pressure on the Australian exchange rate.

Exchange rate volatility

Most economists do not typically believe that there is a 'right' exchange rate for a country, preferring instead to let market forces determine its level. That said it is common practice for central banks to try to 'smooth' exchange rate volatility in order to reduce the adverse impacts of short term volatility on the broader economy.

The decision to approve $205 billion of oil and gas projects will require substantial capital inflow from the mainly foreign owners of these projects. The approvals, and the increased capital inflow, will create significant upward pressure on the exchange rate. While the exchange rate has recently fallen it still remains well above its post float average.[70]

The gas industry is quite open about the upward pressure its projects have on the exchange rate. The Economic Impact Assessment for Arrow's Gladstone LNG facility said:

> *The Arrow LNG Plant is expected to contribute to maintaining the strength of the Australian dollar, which may adversely impact the profitability and long term prospects of some sectors that are exposed to international competition. Key industries expected to be impacted by the exchange rate include manufacturing, some agricultural commodities and tourism-related sectors.*[71]

The impact of the exchange rate on industries exposed to international competition has been substantial. Manufacturing, agriculture and tourism have been hardest hit. It is important to note that if the exchange rate rises by 20 per cent then Australian companies get 20 per cent less in Australian dollar terms for their exports.

To put the lost earnings into perspective, since the beginning of the resources boom Australia's rural sector has lost $61.5 billion in export income.[72] This includes $18.9 billion in 2011-12 alone. The damage the resources boom is doing to other sectors has created what has been dubbed the 'two speed economy'.

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70 The Australian exchange rate was floated in 1983. Before this the interest rate was set by the government. The average exchange rate from the time in was floated until the beginning of the mining boom in 2004 is AU$1 = $US0.70. For full discussion see Grudnoff (2013a) *Still beating around the bush.*

71 Arrow Energy (2012), p.55.

72 Grudnoff (2013a).

The booming resources industry, which has been dominated by the gas industry, has pushed up the Australian exchange rate and in doing so has cut the export earnings of trade-exposed parts of the economy.

Most Australian exporters are price-takers. They do not set the world price but rather accept the current world price. So when the value of the exchange rate increases, the amount the exporter receives in Australian dollar terms falls.

The rural sector is heavily reliant on export earnings. In 2011-12 it exported almost $40 billion worth of produce, but in Australian dollar terms this has been reduced by $18.9 billion. This represents a decrease of 47 per cent in export income because of the high exchange rate attributable to the resources boom.

While in recent times the exchange rate has fallen back below parity it is still significantly higher than its post float long-term average. This means that agriculture, manufacturing, tourism and other trade exposed industries continue to face substantially lower Australian dollar prices for their exports.

While much has been written about the need for the Australian economy to adapt to the 'structural change', and associated higher exchange rates, being driven by the resources boom it is important to consider whether or not such a boom is best interpreted as a structural or cyclical change.

Of greater concern, however, is that the gas industry is only a large employer during its construction phase. That is, after the projects are built, the skilled labour currently being drawn from industries such as manufacturing will no longer be required in large quantities. But if the high exchange rate and pressure on employing skilled workers together or alone has driven manufacturing firms out of business or overseas then there may not be jobs available for that skilled labour.

While much of the analysis of the current mining boom is based on the assumption that the current record terms of trade will be maintained for decades to come history suggests that mining booms are cyclical – mining booms tend to follow a pattern where a boom is followed by a bust. If this were indeed the case then good macroeconomic policy would suggest that peaks should be dampened, rather than facilitated, by government policy.

Static versus dynamic efficiency

The gas industry employs relatively large numbers of workers during the construction phase and relatively few workers during the operation phase. As discussed above, Australia is experiencing an unprecedented resources construction boom with an unprecedented demand for construction and manufacturing workers. The vast majority of these jobs, however, will be relatively short term and will abate when the new projects are built.

While it may be 'efficient' in the short term for the gas industry to poach the workforce trained by other industries, the longer-term outcomes are likely to appear far less efficient. The manufacturing industries that are likely to shut down in response to the high exchange rates and high wage rates driven by the gas construction boom are unlikely to return quickly, or even within decades, when the construction boom ends and the workers that are currently in high demand are again 'freed up' for other purposes.

In ‘perfect competition’, labour and capital could be expected to flow freely both within and between industries and countries – but in the world of modern manufacturing, firms operate with very long investment cycles. For example, Toyota, Holden and Ford’s decision to close due to high wage and exchange rates, are very unlikely to reopen Australian operations when the gas industry no longer requires their key staff and the exchange rate falls as capital inflows for construction dry up while capital outflows in the form of profits begin. Similarly, if Qantas decides to locate its fleet maintenance in South East Asia, or a major bank decides to shift its ‘back office’ activities to India, these decisions would not be quickly reversed when the exchange rate falls again.

While it is theoretically possible that the individual decisions of the proponents of the $205 billion worth of energy developments are compatible with maximising the long-run returns on Australia's skilled manufacturing workforce, such a situation appears unlikely.

Does the gas industry pay a lot of tax?

The gas industry, in an attempt to gain a social licence, often claims that it pays substantial amounts of tax. According to ABS[73] and ATO[74] figures the oil and gas industry paid $1.3 billion in tax on profits of $20.2 billion. This means it paid an effective corporate tax rate of six per cent. The oil and gas industry also paid petroleum resource rent tax (PRRT), which added an additional eight per cent tax to oil and gas profits.[75] This takes tax paid by the industry to 14 per cent of their profit, still well below the theoretical corporate tax rate of 30 per cent.

While figures that show the economic size of the CSG industry are difficult to find, the larger oil and gas industry, of which CSG is a part, show that it is a small employer and pays comparatively low rates of tax. While the industry likes to promote the size and importance of the CSG industry by spinning and exaggerating, the reality is very different. The industry uses a number of methods to promote itself. Some of these have been dealt with in a previous section, including amazing claims of job creation and dependence.

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73 ABS (2013b).

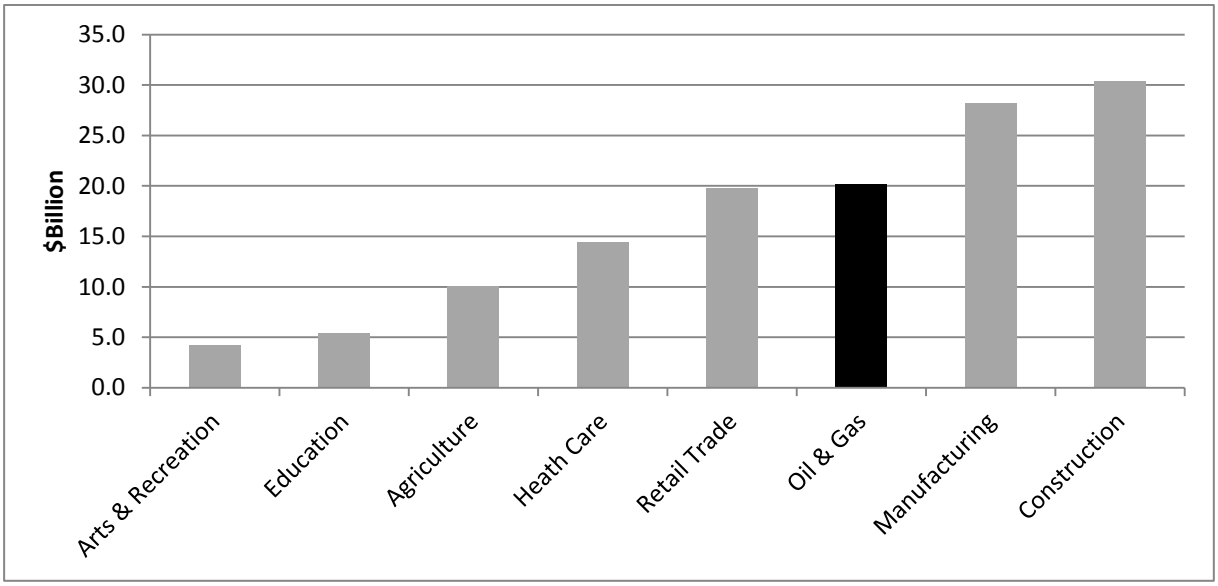
74 ATO (2013), Table 4 Part E.

75 The Treasury (2013) *Budget Paper No.1 2013-14, Budget statement 5: Revenue.*

Does the gas industry make a lot of profit?

As noted above the industry made a substantial profit of $20.2 billion in 2010-11. That represents approximately six per cent of all Australian profit in that year. This compares to 0.2 per cent of employment. Figure 5 uses the same industries from Figure 4 above, but this time looks at profit for the same selection of industries.

Figure 5: Profit by selected industry



Source: ABS (2013b).

The oil and gas industry is far better at making profits than employing workers. These profits do add to Gross Domestic Product (GDP), which is one measure of economic activity. Unfortunately this tends to overstate the benefit that derives to Australia. While profit can be good for the economic well-being of Australians, for example when a café owner makes a profit and then spends that in his local economy, the oil and gas industry is more than 80 per cent foreign owned. This means that the vast majority of the profits flow to the overseas owners and are not spent in the local economy – a fact that much of the industry's economic modelling typically ignores.

Does the CSG industry increase economic activity?

While the gas industry is going through a boom because of high international gas prices, the economic benefits of this boom are being overstated by the industry. While it is happy to highlight the benefits the boom is creating, it fails to account for the costs that are also created. In exaggerating a gas 'crisis' in NSW the industry has also made unbelievable job creation claims and warned of even larger job losses to come.

It is also important to note that much of the benefits are short-term peaks during the construction of large resource projects, while many of the negative effects have long term consequences for the economy. The oil and gas industry pays relatively low rates of tax and while it does earn high rates of profit, most of this profit flows overseas to foreign owners.

6 The public's perceived concerns about CSG

In the August survey, respondents listed concerns they had about CSG. We have scrutinised and rejected the main claimed benefits; the paper will now scrutinise the main concerns to see if they are justified.

The August survey asked respondents to list two main concerns they had about CSG. The top four concerns are listed in Table 4.

Table 4: Perceived concerns about CSG

Perceived concerns	Per cent of respondents
Damage to the local environment	39
Negative impact on farming land	37
Damage to people's health	28
Water contamination	22

Source: TAI (2013a). (see appendix 1 for questions)

The concerns people had about CSG are centred on its impact on health and the environment. Many of these concerns overlap. For example, water contamination could also damage people's health and have a negative impact on farming land. Damage to the local environment is very broad and could include negative impacts on farming land and water contamination.

Looking at the evidence shows that these concerns that the general public have are justified. A literature review of the effects of unconventional gas on health and the environment found that there are serious concerns and unknowns about the negative effects that unconventional gas can have.[76] Because of the overlapping nature of the concerns highlighted in the August survey, evidence does not fit neatly into just one category. This means that evidence on the impacts of CSG can be associated with multiple concerns.

There are still many gaps in our present knowledge of the effects of CSG on the environment and health. More research needs to be conducted in order to gain a better picture of the full impacts that CSG extraction is likely to have. Some of the research that has been conducted is on Australian circumstances and using this we are able to begin to build a picture of the likely effects of an expansion of CSG. More research has been done in the United States, where the industry is older and larger. Where appropriate this research will be included to help draw out the environmental and health effects of CSG.

[76] Grudnoff (2013b) *What Australians don't know about CSG: Public perceptions of coal seam gas.*

For this literature review the author has relied heavily on *Is fracking good for your health?* by Jeremy Moss, Alicia Coram and Grant Blashki. For a more detailed discussion of the health and environmental impacts of CSG please refer to that paper.[77] All references are from this source unless otherwise noted.

Fracking chemicals

Discussions of the health and environmental impacts of CSG usually lead to a discussion of fracking and the chemicals that are used in that process.

There is little evidence for harm caused directly by drilling and fracturing chemicals. This is not to say that they are safe, rather that there is not enough information to say if they are safe. The chemicals used in fracking are heavily diluted, making up between one and 10 per cent of the fracking fluid, but given the huge volume of fluids used this still means each CSG well in Australia uses about 18,500 kilograms of chemicals.[78] The national toxics network found that chemicals from fracking chemicals could cause cancer, skin and eye irritation, respiratory problems, nervous system damage, blood cell damage, endocrine disruption and reproductive problems.[79] Another study of fracking fluids in the US found that 93 per cent of the chemicals had some identifiable health effect with insufficient evidence on the remaining seven per cent.[80]

While exposure to fracking chemicals is likely to be in a highly diluted form, the US EPA found that some chemicals were at concentrations that still posed a threat to human health.[81] Some fracking chemicals were considered dangerous at levels near or below their detection limits[82] and the effects could potentially last for generations.[83]

A case in the US showed that direct exposure to fracking fluids can have catastrophic consequences. An emergency room nurse nearly died after treating a patient who had been splashed with fracking fluids from a gas rig.[84]

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77 Moss et al. (2013) *Is fracking good for your health?*

78 Lloyd-Smith et al. (2011) *Hydraulic Fracturing in Coal Seam Gas Mining: The Risks to Our Health, Communities.*

79 Lloyd-Smith et al. (2011).

80 Colborn et al. (2011) *Natural Gas Operations from a Public Health Perspective.*

81 Sumi (2005) *Our Drinking Water at Risk.*

82 Jackson et al. (2011) *Research and Policy Recommendations for Hydraulic Fracturing and Shale-Gas Extraction.*

83 Mall et al. (2007) *Drilling Down: Protecting Western Communities from the Health and Environmental Effects of Oil and Gas Production.*

84 Jackson et al. (2011) and Lustgarten A (2008). *Drill for Natural Gas, Pollute Water.* Please note this is a revised version of the original paper published on 18 March 2014 which incorrectly stated that the nurse died. It is reported that the nurse suffered multiple organ failure but did not die. References have been updated to reflect this.

The evidence shows that there are environmental and health risks from fracking fluids but because of the lack of research they are at the moment difficult to quantify.

Aquifer contamination

There is significant public concern about the contamination of aquifers from fracking chemicals. The evidence suggests that while gas is actively being extracted from the well, so long as it is managed properly, the chances of contamination are low. But there is concern, and a lack of information, about stranded fracking fluids, which are fluids left after the well has been abandoned.

A study in the US estimated that one in six abandoned wells was leaking.[85] Since around 20 to 40 per cent of fracking fluids remain underground;[86] they represent a risk of further contamination. In CSG extraction groundwater tends to rise after the well is abandoned – this rise in the water level may mobilise the stranded fluids.[87]

Contamination of aquifers by fracking fluids is difficult to confirm. There is no Australian evidence to date, but there is a confirmed case in the US where it has occurred.[88] There are also many unconfirmed cases including wells containing high levels of hexavalent chromium, arsenic, lead, chromium, butanone, acetone, carbon disulphide and strontium.[89] While best practice may be able to limit the number of cases where aquifers are contaminated by fracking chemicals, it remains a potential outcome of the fracking process and a justifiable public concern.

Risk assessments have noted that contamination of aquifers can occur through improperly constructed wells or corroded well casings.[90] The US EPA has found contaminants in drinking water in several states thought to be caused by nearby unconventional gas operations.[91] Fracking has also been linked to seismic activity.[92] Such activity is slight and is unlikely to be felt on the surface but given

85 Bishop (2011) *Chemical and Biological Risk Assessment for Natural Gas Extraction.*

86 CSIRO (2012) *Coal Seam Gas Developments - Predicting Impacts.*

87 Sumi (2005).

88 Urbina (2011) *A Tainted Water Well, and Concern There May Be More.*

89 Michaels et al (2010) *Fractured Communities: Case Studies of the Environmental Impacts of Industrial Gas Drilling.*

90 Jackson et al (2011).

91 DiGiulio et al (2011) *Investigation of Ground Water Contamination near Pavillion, Wyoming.*

92 King (2012) *Hydraulic Fracturing 101: What Every Representative, Environmentalist, Regulator, Reporter, Investor, University Researcher, Neighbour and Engineer Should Know About Estimating Frac Risk and Improving Frac Performance in Unconventional Gas and Oil Wells* and Green et al. (2012) *Hall Shale Gas Fracturing: Review and Recommendations for Induced Seismic Mitigation.*

that breakage or corrosion of well casings is a likely cause of aquifer contamination, seismic activity could increase the chances of this occurring.[93]

Contamination of aquifers is a real possibility and, like much of the research into the environmental and health impacts of unconventional natural gas, there are still many unknowns. Aquifers are a vital source of water and are important for the production of food. Risks of contamination need to be taken seriously and more study needs to be done.

Wastewater

While the public is most concerned about fracking chemicals and contamination of aquifers, the biggest risk to human health is likely to be from wastewater from the fracking process.[94] Wastewater is fluid that has returned to the surface as well as produced water, which is water that is extracted from the coal seam. Wastewater contains fracking and drilling chemicals as well as other materials that come from the fracture formation. Wastewater can be stored in ponds, and leaks and spills can occur particularly during flooding events.

Evaporation ponds have been banned in Australia for new CSG developments but there are no restrictions on the use of holding dams to store wastewater before treatment. These dams pose similar risks.[95] In NSW Santos is alleged to have breached its production licence by spilling untreated water into the Pillaga state forest. The NSW government is preparing to prosecute Santos over this breach.[96]

Wastewater accidents have also affected farming land. After a wastewater accident farmers have reported high numbers of calves dying in the following two seasons. In one case during the second season after exposure, 11 out of 17 calves were lost.[97] In another case half the cows were exposed while the other half were not. Of the exposed cows 21 died and 16 did not produce calves, while the half that was not exposed suffered no health problems.[98]

Further documented examples include a case where 17 cows died in one hour after fracking fluids were released into a field. Another found that goats exposed to fracking fluids suffered reproductive problems for two years. In yet another case

93 Harvey et al. (2013) *Fracking company Cuadrilla halts operations at Lancashire drilling site.*

94 Machol et al. (2013) *Economic Value of U.S. Fossil Fuel Electricity Health Impacts* and Rozell et al. (2012).

95 Carey (2011) *Coal Seam Gas: Future Bonanza or Toxic Legacy?*

96 Validakis (2013) *Santos to Be Prosecuted for Pillaga Pollution.*

97 Bamberger et al. (2012) *Impacts of gas drilling on human and animal health.*

98 Bamberger et al. (2012).

half the cows exposed to wastewater died, with many of the survivors suffering reproductive problems.[99]

Permits can be granted to release wastewater in Australia. There have been a number of cases where harmful chemicals have been found in the wastewater even after treatment. A permit was granted for the release of water into the Condamine River in NSW that contained 22 chemicals that exceeded the limits of environmental guidelines. These included boron, chlorine, cadmium, cyanide and zinc.[100]

Naturally occurring contaminants have been found in wastewater, including heavy metals and naturally occurring radioactive materials. Heavy metals are known to cause health problems including autoimmune disease, cancer, cardiovascular disease, cognitive function, dermatologic function, dermatologic toxicity, genotoxicity, hematology, metabolism, neurotoxicity, renal dysfunction, foetal health and development and respiratory disease.[101]

Naturally occurring radioactive materials such as uranium and radon are also found in wastewater. Wastewater samples in the US have been found to exceed radium-226 safety standards by as much as 267 times.[102] Treatment of sludge and waste has also caused problems – a truck in the US was refused entry to a landfill site after it set off the radioactivity alarms.[103]

There is evidence that wastewater spills and leaks happen fairly regularly. There have been many cases of spills and leaks in Australia, with 30 being recorded in the first six months of 2011.[104] A study of wastewater in New York State found that six per cent of gas projects encountered mishaps that posed serious pollution risks.[105]

Wastewater may also be harmful when it evaporates. Many of the chemicals found in wastewater have the potential to become airborne. While no studies have been done in Australia, in the US 37 per cent of chemicals used can become airborne. These have the potential to harm eyes, skin, sensory organs, respiratory

99 Bamberger et al. (2012).

100 Doctors for the Environment (2011) *Submission to the Rural Affairs and Transport References Committee Inquiry into Management of the Murray Darling Basin – Impact of Mining Coal Seam Gas.*

101 Witter et al. (2008) *Potential Exposure-Related Human Health Effects of Oil and Gas Development: A Literature Review (2003-2008).*

102 Kargbo et al. (2010) *Natural Gas Plays in the Marcellus Shale: Challenges and Potential Opportunities.*

103 McMahon (2013) *Fracking Truck Sets Off Radiation Alarm at Landfill.*

104 Doctors for the Environmental (2011).

105 Bishop (2011).

tract, gastrointestinal tract, liver, brain and nervous system, cardiovascular system and blood, or kidneys.[106]

Wastewater poses a risk to the environment and health through leaks and spills. These leaks and spills happen with frightening regularity – they do not just pose a threat to people's health and the environment but also present a serious risk to farmland and livestock.

Air

Unconventional gas extraction is associated with methane leaks, and methane can contribute to ground level ozone. While there are no studies in Australia identifying ground level ozone, there are several studies in the US connecting unconventional gas to ground level ozone. This includes a study of Wyoming that linked gas operations to increased doctor visits.[107] Ground level ozone has been known to cause respiratory irritation and lung damage.[108] It can also affect farming land by damaging trees and crops.[109]

Air quality studies done near and on residential areas close to gas production zones have found high concentrations of carcinogenic and neurotoxin compounds.[110] One study found that the risk of cancer was greater for those that lived within half a mile of unconventional gas wells than those that lived more than half a mile away.[111]

Airborne pollution from unconventional gas production has been shown to cause serious health effects, and more research in this area is needed in Australia to ascertain the full risks involved.

Are people's concerns about CSG justified?

CSG extraction has the potential to cause harm to the environment, farming land, water resources and human health. These concerns were all raised by the August survey respondents and the available evidence suggests they had good reason to be worried. The other alarming aspect is the lack of research that has been done into the environmental and health impacts of CSG. If the gas industry is keen to expand and the government wants it to, then it should commit far more funding to quality research in this area.

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106 Colborn et al. (2011).

107 Forslund (2013) *Associations of Short-Term Exposure to Ozone and Respiratory Outpatient Clinic Visits - Sublette County, Wyoming, 2008-2011.*

108 Colborn et al. (2012) *An Exploratory Study of Air Quality near Natural Gas Operations.*

109 Colborn et al. (2012).

110 Wolf Eagle Environmental (2009) *Town of Dish, Texas Ambient Air Monitoring Analysis.*

111 McKenzie et al. (2012) *Human health risk assessment of air emissions from development of unconventional natural gas resources.*

These concerns about CSG were important enough for the Australian Medical Association to pass a resolution saying:

> *… all future proposals for coal seam gas mining are subject to rigorous and independent health risk assessments, which take into account the potential for exposure to pollutants through air and groundwater and any likely associated health risks. In circumstances where there is insufficient evidence to ensure safety, the precautionary principle should apply.*[112]

112 AMA (2013) *AMA calls for coal seam gas health checks.*

Conclusion

CSG mining is a controversial way of extracting natural gas. The Asian LNG price is at record levels and Australian gas producers are keen to meet export demand. The high price and big profits explain why the gas companies are pushing hard to expand CSG production in NSW and Victoria.

In their campaign to get more gas out of the ground, the gas companies have made regular claims about the economic benefits of CSG. The truth of these claims is unverifiable, exaggerated or non-existent.

While the CSG industry will provide some economic benefit, that economic benefit will be far smaller than the industry has led the general public to believe. The industry is a relatively small employer, a significant portion of the economic benefit goes to the majority overseas owners and there are uncomfortable questions over whether CSG can act as a transition fuel. The industry has also been unwilling to discuss the negative economic consequences that will be created by an expansion of CSG.

The industry has failed to engage with the public's concerns about the environmental and health impacts of CSG. The impacts CSG could have on farming land, water and human health are serious and require further research. Before CSG can be considered safe, further research needs to be done into the impact of fracking fluids, aquifer contamination and wastewater. Until these areas have been addressed, CSG production should be approached with great caution.

At a time when the general public wants the federal government to take a key role in expanded regulation of the CSG industry, the Abbott government is planning to reduce regulation and to devolve much of it to the states. The expansion of CSG in Australia is an important issue and needs strong leadership to ensure industry claims are properly scrutinised. This is what the federal government needs to do.

The expansion of CSG in Australia is likely to bring limited economic benefits and to come with large environmental and health risks. Because of this the industry should be subject to further scrutiny by governments and policy makers before any expansion is considered. The benefits do not seem to justify the risks.

Appendix 1

Australia Institute survey questions August 2013

Below is a list of **issues** that many Australians feel passionate about. Thinking about these issues, which would you like to see politicians taking action on? (Please rank your top five issues.)

- Improving healthcare, disability and mental health services
- Closing the Gap and Indigenous reconciliation
- Gender equality and the rights of women
- Technology & innovation
- Marriage equality
- Climate change
- Infrastructure development & the NBN
- Government spending
- Animal welfare
- Immigration policy
- Defence spending
- Foreign aid
- Economic growth & development
- Development in regional and remote areas
- Coal seam gas
- Other

What type of **gas** goes in the gas cylinder for an outside BBQ?

- LPG
- CSG
- LNG
- PPG
- Not sure

Have you heard about Coal Seam Gas (CSG)?

- Yes
- No

Do you know what the **difference** is between CSG and LNG?

- Yes
- No

If a CSG project was proposed in **your local area** would you?

- Want more information about CSG
- Feel you had a sufficient understanding about CSG

Do you think that CSG extraction occurs in…

- Rural areas
- Urban areas
- Both rural and urban areas
- Not sure

Do you have any **concerns** about CSG?

- Yes
- No
- Not sure

What are your two **main** concerns?

- Water contamination
- Damage to the local environment
- Damage to the national economy
- Damage to the local economy
- Damage to people's health
- Negative impact on the landscape
- Negative impact on climate change
- Negative impact on farming land
- Negative impact on food security

Do you think there are **benefits** from CSG?

- Yes
- No
- Not sure

What are the two **main** benefits?

- More jobs
- Increased economic activity
- Revitalising rural economies
- Increased gas supply will make gas cheaper
- Extra tax revenue
- Increased gas production that will act as a bridging fuel on the transition to renewables
- Positive impact on local environment
- Positive impact on local water resources

If CSG extraction **reduces** the productivity of agricultural land would you…?

- Support CSG extraction
- Support CSG extraction if the farmer approved CSG extraction on their farmland
- Not support CSG extraction

Do you think that farmers should have the **right to say no** to CSG extraction on their own farmland?

- Yes
- No
- Not sure

Appendix 2

Australia Institute survey questions November 2013

Because of health and environmental concerns with the extraction of CSG there have been some additional regulations placed on it. Do you think that state and federal governments should?

- Increase regulation of CSG further
- Decrease regulation of CSG
- Keep the level of regulation of CSG the same

Who do you think should be responsible for regulating CSG companies? [select all that apply]

- Local government
- State government
- Federal government
- No one, they should be self regulated

In deciding whether or not to allow fracking in a particular area which factors do you think should be the most important? [select all that apply]

- Impact on water supply
- Impact on human health
- Impact on farmers
- Benefits to the economy
- Whether the gas is for domestic use or export
- Whether the profits flow to Australians or foreign owners

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