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Inquiry into the management of the Murray-Darling Basin

APPEA Comments

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1. Introduction

The Australian Petroleum Production & Exploration Association (APPEA) is the peak national body representing the oil and gas exploration and production industry, including the coal seam gas (CSG) and liquefied natural gas (LNG) industries. Collectively our membership accounts for around 98 per cent of Australia's oil and gas production.

The opportunity presented by CSG for Australia is unmatched by any other commodity. Australia's CSG resource places the nation in a position to maintain long-term, clean energy security domestically and also internationally through LNG exports. CSG makes it possible for Australia to meet growing energy needs over the coming decades while incorporating a strategy to curb greenhouse emissions and address the risk of global climate change.

Like all societies around the world, Australia faces three major, interdependent challenges:

1. to maintain and expand energy supplies to meet growing consumer demand
2. to address the social and ecological risks posed by rising greenhouse gas emissions and the potential for human-induced climate change, and
3. to continue economic growth in line with community expectations.

The development of Australia's CSG resource should be central to government planning aimed at achieving these objectives. In doing so, Australia can reduce its emissions intensity by developing its CSG resource in a way that will drive economic growth in regional areas and reinvigorate regional towns.

2. What is coal seam gas, how it is produced, and the benefits of coal seam gas production

2.1. What is coal seam gas

CSG is naturally occurring methane contained in coal seams. As an end use product it is identical to natural gas and can be used for the same purposes including electricity generation and domestic heating. Methane is odourless, colourless, and non-toxic and other sources include cattle and other animals, garden compost, and decomposing organic matter in swamps and rivers.

In terms of potential resources, there may be in excess of 250 trillion cubic feet of CSG in Australia[1], equivalent in energy content to over 40 billion barrels of oil and enough to run a city of 10 million people for 500 years.

2.2. Where does it occur in the Murray Darling Basin

There are several large coal basins that outcrop and subcrop within the Murray Darling Basin in both Queensland and NSW. The oldest (and most consolidated coals) are Permian in age,

[1] *Australian Energy Resources Assessment*, Australian Government, http://www.abare.gov.au/publications_html/energy/energy_10/ga_aera.html

but there are also Triassic coals, Jurassic coals and Tertiary peats. The primary CSG targets are the Permian coal basins and the Jurassic coal basins. These are:

Permian Basins

- Western part of the Sydney Basin (NSW)
- Gunnedah Basin (NSW)
- Bowen Basin (QLD)
- Galilee Basin (QLD)
- Oaklands Basin (NSW)

Jurassic Basins

- Western part of Clarence Morton Basin (QLD)
- Northern part of the Oxley Basin (NSW)
- Great Artesian Basin (Surat Basin and Coonamble Embayment) (QLD and NSW)

2.3. CSG exploration and production

CSG exploration and production can be divided into four basic stages:

1. Core wells: These take physical samples of rocks which are analysed in the laboratory for properties such as gas content. Core wells may be drilled at a density of approximately one every 30 km^2.

2. Seismic: In some cases more information is required to understand the depth and geology of the resource under the ground and this is provided by seismic.

3. Pilot test wells: Also known as appraisal wells these are drilled to demonstrate that gas can flow to the surface in commercial volumes. Pilot test wells are normally drilled in groups of three to five with each well approximately 750m apart and each pilot test spaced several kilometres apart.

4. Production wells: These are drilled to supply gas to customers and vertical wells may be spaced some 750m apart. Horizontal wells (separate laterals within the coal seams) are clustered on pads and more widely spaced.

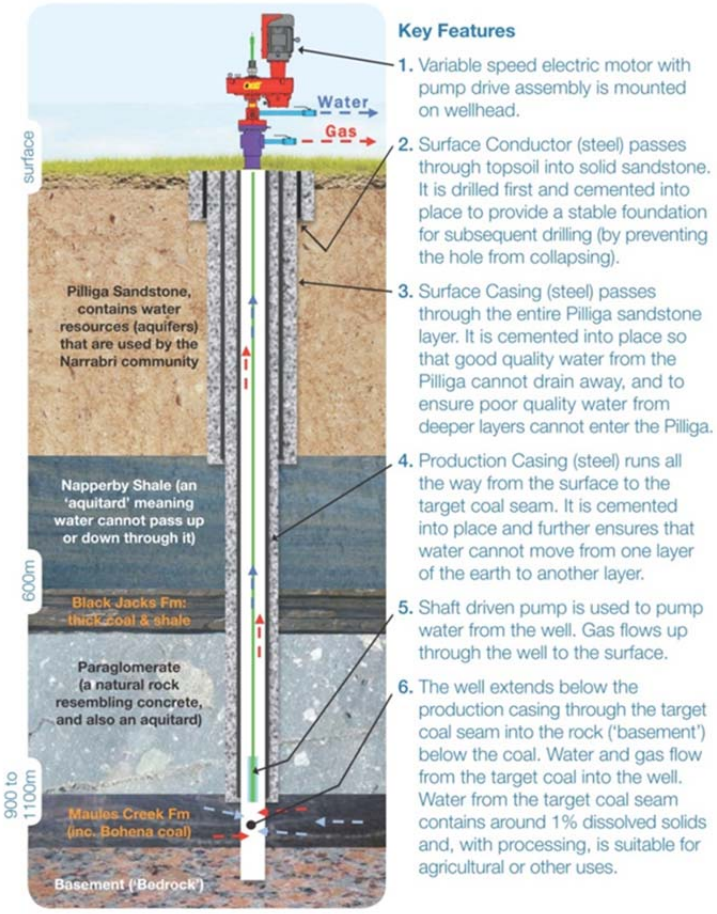
The above estimates are provided as a guide only as the nature of each CSG project is tailored to suit landholder and environmental requirements in addition to geology. For these reasons there is no one-size-fits-all solution for CSG development.

2.4. Well construction

CSG wells are the lifeblood of the CSG industry and represent a major investment by CSG companies. A great deal of effort goes into their construction to ensure that wells are isolated from overlying geological strata, including overlying aquifers. They are designed and constructed using proven procedures and equipment. An unsuccessful well that leaks water or gas will be unproductive and must be sealed and redrilled at great expense.

A basic schematic of a CSG well is shown in the figure below, however well design varies to account for the geology of the area.

Figure 1 – Basic schematic of a CSG well



2.5. Well completion methods

Coal seams typically consist of a matrix of natural fractures that allow gas and water to move through the rock to a wellbore. However, these may allow only a slow rate of flow. After a well is drilled down to the coal seams and isolated from the overlying strata, work may be undertaken to increase the flow of gas into the wellbore to commercial rates.

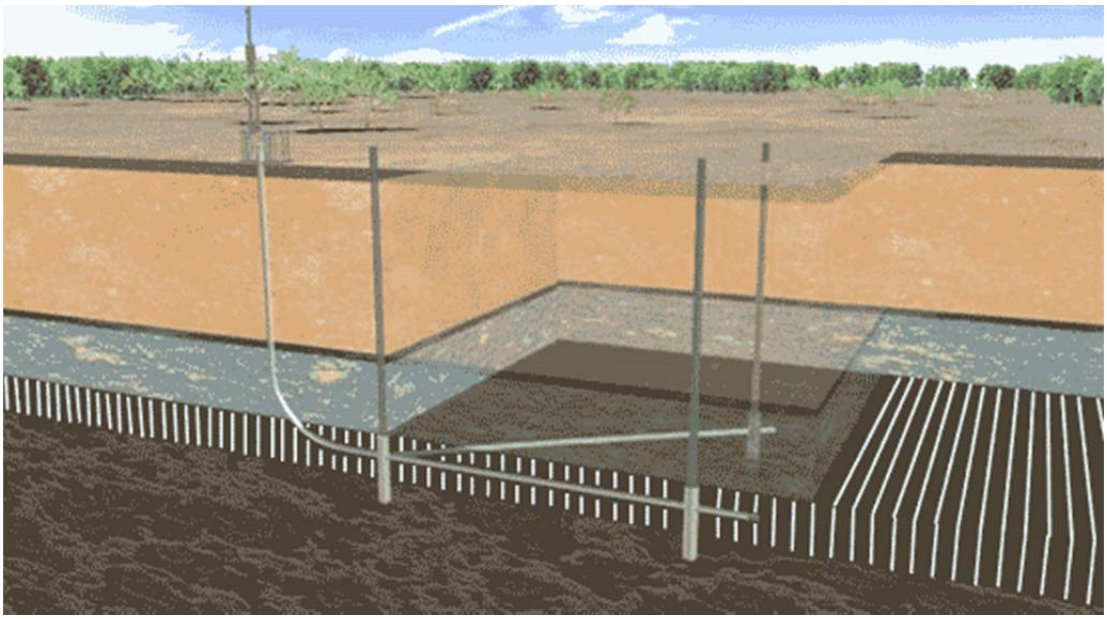
A number of methods have been developed to increase the flow with each one typically suited to different coal characteristics. Two common methods employed are:

- drilling long horizontal wells through the coal seam; or
- fracture stimulation of the coal seam to connect the wellbore to the existing natural fracture network

Horizontal well completions

The figure below shows a horizontal well completion. These are undertaken to increase the surface area of the coal seam that is exposed to the well, which increases the rate of gas flow.

Figure 2 – Horizontal well completion



Fracture stimulation

Fracture stimulation is a process that uses pressure to create an artificial fracture network to allow gas to flow to a well to improve the gas production rate from the well.

Fraccing has been done safely for over 60 years in the United States, where more than one million wells have been fracced, and in Australia since 1968. Scientific government studies regularly conclude that it is a safe practice

For example, the United Kingdom House of Commons released a report on shale gas and fraccing in May 2011[2] which found:

"…no evidence that the hydraulic fracturing process involved in shale gas extraction – known as 'fracking' - poses a direct risk to underground water aquifers provided the drilling well is constructed properly."

Though shale gas is not exactly the same as CSG there are similarities, and the findings of the House of Common report are consistent with those of the 2004 United States Environmental Protection Agency study[3] which was specific to CSG and concluded that "that the injection of

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[2] *Energy and Climate Change Committee - Fifth Report Shale Gas*, http://www.parliament.uk/business/committees/committees-a-z/commons-select/energy-and-climate-change-committee/news/new-report-shale-gas/

[3] *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs Study* (2004), http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_coalbedmethanestudy.cfm

hydraulic fracturing fluids into [coal seam gas] wells poses little or no threat to [underground sources of drinking water]". The EPA is currently undertaking a second study in this area at the direction of the US Congress.

Contents of fluids used in fracture stimulation are not secret and can be found on the APPEA website www.appea.com.au/images/stories/mb_files/APPEA_fraccing_chemicals.pdf.

2.6. Water production

CSG production involves the coproduction of water as the gas is held in coal seams by water pressure and this must be reduced for gas to flow. Water production for each well peaks in the early stages of well life before falling off. The water produced is generally of marginal or poor quality and is generally not tapped by other water users for these reasons. Extracting water from coal seams can also cause gas to flow into farm bores tapping those seams – a fact known by farmers in the Surat Basin for many decades.

CSG companies are not consumptive users of water in the traditional sense as the water produced is treated and beneficially reused either by the company or another water user, and can also be reinjected underground.

Through the treatment and beneficial use of water extracted from coal seams, the CSG industry is providing the economic impetus to transform a poor quality source of water into clean water source that can be used for agriculture or town water supply.

Water is covered in more detail in sections below.

3. Economic benefits

The development of Australia's CSG resource offers an unrivalled source of new economic growth for Australia. A clear example of this is provided by the effects of the industry's growth on Queensland's economy.

Modelling by the Queensland Government shows that a CSG-LNG industry with a capacity of 28 million tonnes per annum (a mid-range estimate) would create more than 18,000 jobs, generate $850 million in annual royalties, and result in capital investment of $40 billion. Most jobs and economic activity associated with the industry will be in regional areas.

The 2011-12 Queensland State Budget also clearly showed the effects of the industry on the State's economy. Growth in investment is forecast to increase by 27.75% in 2011-12 and remain above 21% in 2012-13, with economic growth forecast at 5% and 5.25% in 2011-12 and 2012-13 respectively. This will make Queensland the fastest growing State in Australia with growth driven in large part by the expanding CSG industry.

NSW also has significant potential but the industry in NSW is at an early stage of development.

4. Greenhouse benefits

Australia's natural gas reserves have the unique potential to significantly reduce greenhouse gas emissions at low cost.

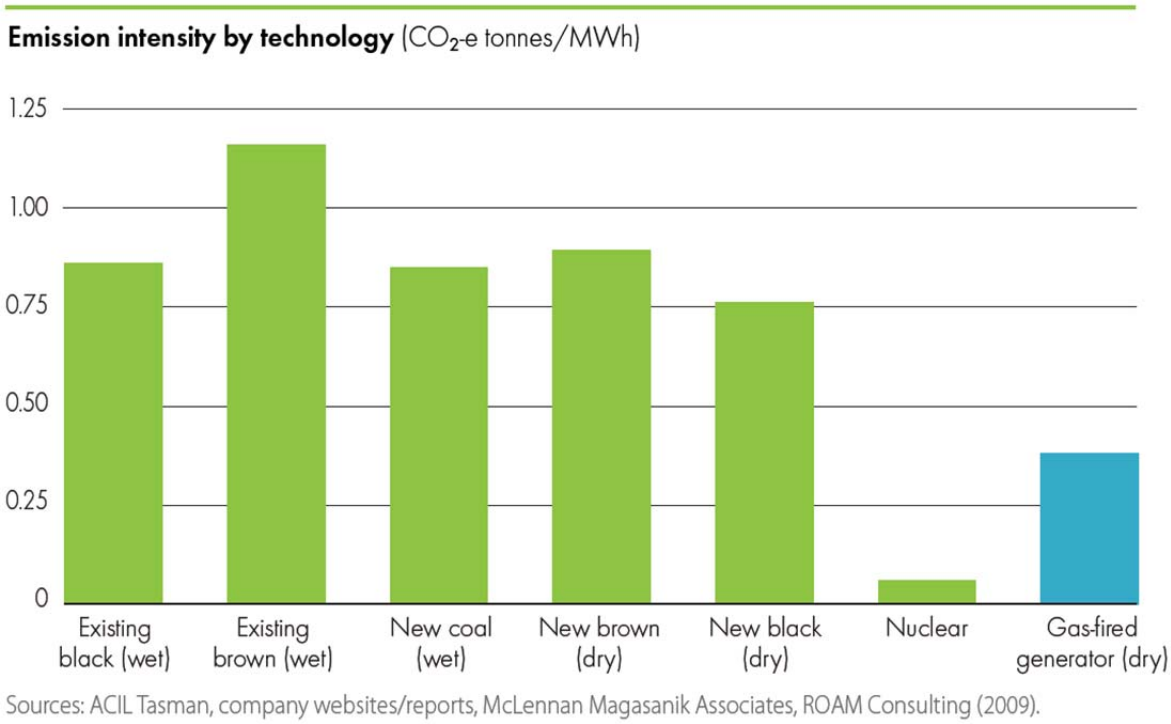
This could occur both within Australia through the greater use of natural gas (particularly for electricity generation), and throughout the Asia Pacific region by LNG exports.

Natural gas offers the cleanest viable source of large-scale baseload and peaking power. When combined with other low or no-emissions fuels it can contribute enormously to reducing the growth in Australia's greenhouse gas emissions. Electricity produced from gas produces 50-70 per cent less greenhouse gas emissions than current coal-fired power generation facilities.

As LNG, gas can also cut emissions in overseas export markets. For every tones of greenhouse gas emissions generated by LNG production in Australia, between 4.5 and 9 tonnes are avoided in Asia when this gas is substituted for coal in electricity generation.

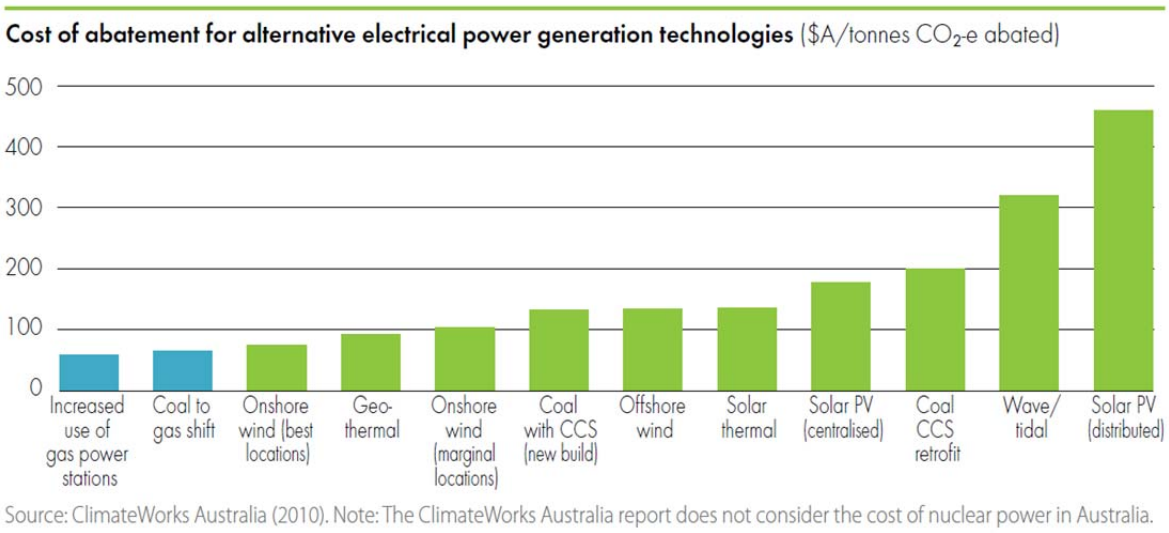
These facts are illustrated in the figures below which show that natural gas offers the cleanest viable source of large-scale baseload and peaking power for Australia. Gas-fired power is much cheaper than solar and wind power, and is not limited by weather conditions or the time of day.

Figure 3 – Emissions intensity by technology



Further, as shown in in Figure 4 below, moving to gas fired generation is the lowest cost abatement technology for power generation.

Figure 4 – Cost of abatement for alternative electrical power generation technologies



5. Inquiry terms of reference

With specific regard to the Inquiry's terms of reference, we note that the Committee is examining the economic, social and environmental impacts of mining CSG on:

- the sustainability of water aquifers and future water licensing arrangements;
- the property rights and values of landholders;
- the sustainability of prime agricultural land and Australia's food task;
- the social and economic benefits or otherwise for regional towns and the effective management of relationships between mining and other interests; and
- other related matters including health impacts.

Each of these are addressed in the following section.

5.1. The sustainability of water aquifers and future water licensing arrangements

Queensland

In Queensland, the focus of industry activity to date has been the Surat Basin which is a sub basin of the Great Artesian Basin (GAB). The target coal measures within the GAB are Jurassic in age and have sandstone aquifers above and below these coal seams. The GAB itself has been studied for many years and there is a considerable body of knowledge about its geological formation - the rock layers, the quality of water in various aquifers and how water moves through them.

The GAB is also vast, with an estimated 64,900,000,000 million litres of water in storage and total recharge of some 910,000 million litres per year. Water does move between geological formations if a pressure gradient exists, but under natural conditions gradients are low, so movement is quite small. If gradients are increased (i.e. the pressure heads lowered in one formation), movement will increase, but will still be very slow as vertical permeability is very low. The volume of water in storage the GAB is so great that the impact on the storage component of the resource will be small.

In Queensland, proponents are permitted to extract groundwater in conjunction with petroleum. Should petroleum activities impact on other water bores, proponents are required to make good for the impact. This regulatory approach recognises a fundamental difference between petroleum activities and most other groundwater extractions, being that petroleum activity is temporary in nature whereas other extractors of groundwater are given a licence to take water over the long term. Other groundwater users are also not subject to make good arrangements.

The management of any impacts on underground water caused by CSG activities is comprehensively dealt with in the *Water Act 2000*. This includes arrangements for the management of cumulative impacts, the preparation of underground water impact reports to establish obligations to manage any impacts, and requirements to assess and make good any impact on authorised water bores. The implementation of the make good provisions is administered by the Queensland Water Commission.

All CSG-LNG proponents are funding and undertaking scientific assessments of a range of water issues, including the Queensland Water Commission's development of a regional groundwater model, and this information is being made public. Further, CSG companies have environmental conditions requiring ongoing monitoring and assessment which is adding to the scientific body of knowledge. The work undertaken as a result of the CSG industry's activities will mean that the Surat Basin will be one of the most comprehensively studied basins in the world with respect to groundwater. While the Surat Basin is the main focus of water production and water management, there is also substantial geological and hydrogeological information being collected for the other coal basins in Queensland that occur within the Murray-Darling Basin.

To obtain an Environmental Authority (EA) for a development area, CSG proponents are also required to prepare and submit for approval a comprehensive CSG Water Management Plan. A CSG Water Management Plan contains details of quantity, quality, treatment and impact and risk assessments. These plans are required under both State and Federal project approval conditions.

In their project Environmental Impact Statements for CSG-LNG projects, proponents relied on the existing body of science as well as their own research and modelling to best determine the likely effect on aquifers and landholders of CSG water extraction. In turn, the State and Federal Governments examined every aspect of proposed CSG-LNG project applications, with particular attention to the GAB and regional groundwater impacts. Both levels of Government have granted project approval – with many conditions – to further safeguard the aquifers, landholders and the environment. As part of the Federal Government review process for each CSG to LNG project, Geoscience Australia provided independent technical advice which indicated that there were no unacceptable risks which would prevent the projects from proceeding as long as they were appropriately conditioned.

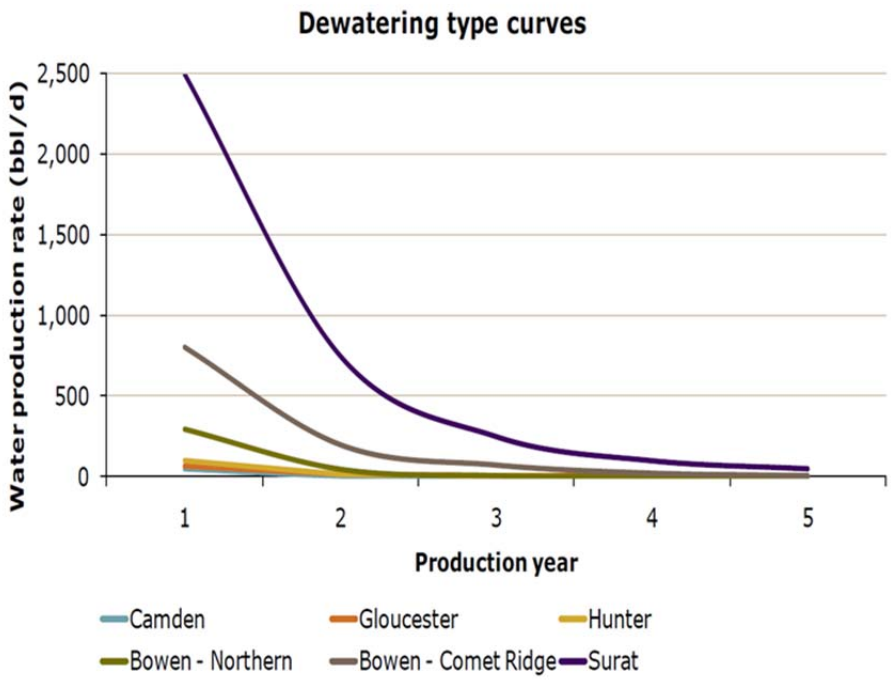
Further information on this topic is available in presentations given at the recent APPEA CSG Water Forum[4].

New South Wales

In general, NSW differs markedly from the Surat Basin in terms of water extraction associated with CSG as the volume of water produced varies considerably depending on geology and as such varies from location to location. Even though similar in age and type to the Permian Bowen Basin coals in Queensland, the produced water volumes are generally less and the water quality a little more saline than these basins in Queensland.

As shown in the figure below, the experience of the industry to date is that CSG wells in NSW produce much less water than those in the Surat Basin in Queensland. Water qualities are generally poorer because of the lower aquifer permeabilities, longer residence times, and lack of connectivity with shallow aquifers, steams and recharge areas.

Figure 3 – CSG dewatering curves by basin



Groundwater extractions and by extension, the quantity of water that may be available for beneficial uses such as irrigation and industry must therefore be assessed on a case by case basis.

Another key difference between NSW and Queensland is the regulation of associated water extraction. In NSW CSG water extraction is regulated by water sharing plans (WSPs). Water sharing plans establish rules for sharing water between the environmental needs of the river or aquifer and the consumptive needs of water users. Aquifer access licences and aquifer interference approvals apply (or will soon apply) to CSG dewatering activities, and there are

[4] Available at www.appeacsgwaterforum.com.au , username: waterforum, password: 2011

different works and use approvals to differentiate between different types of water use such as town supply, rural domestic supply, stock watering, industry and irrigation.

Therefore, in NSW there is no difference between the water extraction rights of an irrigator, for example, and a CSG company. Licences have equal validity and licensees have equal access to the water source (in this case the Murray Darling Basin Porous Rock Groundwater Sources WSP)

All new groundwater extractions in the Murray Darling Basin for new consumptive uses are currently embargoed so new developments require licences and allocation to be purchased on the water market. In regard to deep water bearing zones in porous rocks (where there has never been any groundwater development) there are proposals to allow small extractions from the storage component of the resource. This is possible as the Minister can make surplus water available at their discretion with any conditions they see fit, but in allocating water the Minister would consider the impact on other water users or the environment.

The statutory planning and approvals process in NSW aims to ensure there are no impacts on the environment, and on the ability of existing water users to access water from the issuance of new water rights. There are however fallback provisions (such as restricting water extraction) available to the Minister if there are impacts on other water users. Where there is a potential impact on an overlying aquifer from water extraction, then the extractor is required to purchase a water right in that overlying aquifer in addition to their own water right. There are also make good requirements similar to Queensland provisions in some water sharing plans, and these apply to all water users.

APPEA does not believe the different regulatory regime in NSW relative to Queensland will inhibit the growth of the CSG industry as the evidence is that there is surplus groundwater available in coal seams (which is not generally accessed by other due to its poor quality and the effect of gas flow on pumps).

5.2. The property rights and values of landholders

The resource industry in Australia is founded on the basis that the State owns subsurface resources (including groundwater resources) and issues the rights to explore and produce to third parties. A return to the community is then provided through secondary taxation arrangements such as royalties.

Under this arrangement, resource proponents are given access by the Government to land to explore for and produce resources, and both Queensland and NSW require proponents to enter into access arrangements with private landholders and pay compensation.

In Queensland, petroleum companies seeking to explore for or produce oil or gas on privately owned land have to finalise a conduct and compensation agreement with the landowner. If agreement cannot be reached, the case can be referred to the land court. At present in Queensland, more than 1,400 such agreements have been reached and there are no cases before the land court initiated by proponents.

In NSW, petroleum companies seeking to explore for or produce oil or gas on privately owned land must enter into a land access and compensation agreement. If agreement cannot

be reached then a Ministerial intervention can be sought, however such an action is rarely if ever requested.

Compensation requirements are comprehensive in both states. In Queensland "compensatable effects" includes all or any:

- deprivation of possession of the surface of land
- diminution of the land's value
- diminution of the use made or that may be made of the land or any improvement on it
- severance of a part of the land from other parts of the land
- cost, damage or loss arising from the carrying out of activities on the land
- accounting, legal or valuation costs necessarily and reasonably incurred to negotiate a CCA (other than facilitating an ADR).
- consequential damages suffered by the landowner because of any of the above.

In NSW, compensation includes:

- damage to the surface of land, to crops, trees, grasses, or other vegetation (including fruit and vegetables) or to buildings and improvements, being damaged, which has been caused by or which may arise from prospecting operations;
- deprivation of the possession or of the use of the surface of land or any part of the surface; or
- severance of land from other land of the landholder; or
- surface rights of way and easements; or
- destruction or loss of, or injury to, disturbance of or interference with stock; or
- damage consequential on any matter referred to in paragraph (a) - (e).

Access agreements negotiated with landholders are similarly comprehensive, and cover matters such as when access is permitted, the activities to be undertaken and their location, and conditions to be observed by proponents.

With over 1,400 access agreements in place in Queensland alone and no companies seeking compulsory access, APPEA considers that there is ample evidence that private landholders, agriculture, and the CSG industry can coexist. The presence of CSG activity in the Surat Basin in particular is drought proofing the region by virtue of the compensation paid to many which is not dependant on seasonal conditions. By providing a stable long-term income to landholders, and also potentially a new supply of water separate from existing water rights, the

CSG industry will also open up new opportunities to landholders in terms of their ability to secure finance for property improvement and other activities.

5.3. The sustainability of prime agricultural land and Australia's food task

Prime agricultural land is an important finite resource. CSG has a relatively small footprint on the land surface and therefore the evidence shows that the industry co-exists well with agriculture.

CSG does not destroy land in the same way that more invasive resource industries may and there is flexibility in the placement of CSG production facilities which do not permanently alienate the land. CSG producers also have strict rehabilitation requirements placed on them under environmental legislation and the conditions of environmental authorities that apply to development activities.

During the construction phase of CSG infrastructure on a property, there may be disruption to farming and livestock operations which would be subject to appropriate compensation. However, during the longer term operations phase of a CSG project, only limited impact on existing farming and livestock operations occur. There are already in existence CSG developments on properties that demonstrate CSG operations and normal farming and livestock operations can coexist.

There have been extensive assessments of the impact of CSG activity on the sustainability of agricultural land as part of the environmental approvals process. In Australia, these have primarily occurred in Queensland as most industry activity is in that State, and Queensland has also recently introduced a policy to protect prime agricultural land after extensive consultation with a broad range of stakeholders.

The impact of CSG activity on agricultural productivity was examined during the development of this policy and the final policy states the following:

> "Well-designed CSG operations may be able to be accommodated under this policy without permanently alienating the land. For example, gas wells and pipelines are usually considered to have a temporary impact as the land can be restored back to strategic cropping land when the development ends. This type of infrastructure carried out in an appropriate manner may be able to proceed on strategic cropping land.
>
> However, high-impact CSG infrastructure such as water storage ponds and gas compression stations may permanently impact on strategic cropping land and a proponent would not be able to undertake these activities in Strategic Cropping Protection Areas, except in limited 'exceptional circumstances'.
>
> In Strategic Cropping Management Areas, proponents would be assessed to ensure that they make all reasonable efforts to avoid and minimise any impacts on strategic cropping land. Any proponents of CSG infrastructure that is unable to avoid strategic cropping land and likely to cause its permanent alienation will be required to mitigate their impacts to ensure Queensland's agricultural cropping productive capacity is maintained.
>
> It is important to recognise that some CSG companies are already making efforts to structure their developments in a way which facilitates co-existence with strategic cropping land. For example, the Queensland Government is aware of CSG proponents who have committed to actions such as:

- increasing the spacing between wells and adopting a flexible approach to the placement of wells (for field development);

- undertaking a trial of constructing and restoring a transmission pipeline on intensively farmed land (for major pipeline development) using world-leading practices to demonstrate that soils can be removed and replaced in layers to maintain the existing soil profiles; and

- ensuring that the area can be rehabilitated with precision to minimise impacts on farming businesses.

These actions seek to facilitate CSG operations in a manner that allows them to co-exist with strategic cropping land, and are a positive response to the strategic cropping land policy."

APPEA therefore considers that the goals of food and energy security are not in conflict where the CSG industry is concerned as there is ample evidence that agriculture and CSG can coexist.

In NSW, the Department of Planning and Infrastructure (**DP&I**) has recently announced a range of Strategic Regional Land Use initiatives to address community concerns over potential land use conflicts. For example, the DPI has introduced the following arrangements pending the implementation of its Strategic Regional Land Use Policy:

- a requirement that all new coal seam gas, petroleum extraction and coal applications be accompanied by an Agricultural Impact Statement. Agricultural Impact Statements will require an assessment to identify what potential impacts a project may have on agricultural land;

- public notification of Guidelines which will inform the assessment of impacts on strategic agricultural land from proposed developments; and

- development of an Aquifer Interference Regulation which will introduce a suite of new measures to regulate activities that impact on aquifers.

5.4. The social and economic benefits or otherwise for regional towns and the effective management of relationships between mining and other interests

As noted above, there are substantial economic benefits already being generated in Queensland through the growth of the CSG-LNG industry, including regional labour market benefits and State, regional and local flow-on effects from royalties.

APPEA understands that with any growing economy issues may arise such as a higher cost of living in some towns, competition for skilled labour, stretched government services (e.g. health and local councils) and increased demand on infrastructure such as roads.

The Government and industry clearly recognise these challenges and Environmental Impact Statement commitments for CSG-LNG projects address cost of living, competition for skilled labour, impacts to government services and demand on infrastructure amongst other things. Proponents are also required to develop a Social Impact Management Plan which details how these commitments will be realised.

APPEA agrees that the impact of resource industry growth on regional towns should be properly managed by industry working with government, however these are impacts associated with a growing economy and they are far preferable to the impacts of economic contraction which must be managed by government alone.

5.5. Other related matters including health impacts.

The CSG industry is extremely serious about the health and safety of its workers and the public. CSG as extracted from the ground is 98-99% methane, which is a non-toxic gas used safely throughout the world for heating and cooking in homes. Methane is also lighter than air and therefore when exposed to the atmosphere does not collect at ground level.

While there are many claims about adverse health impacts associated with CSG extraction, there is very little if any scientific evidence provided in support of such claims. This is in marked contrast to the standards expected, rightly, of the industry itself which must justify and provide scientific evidence in support of everything it does.

6. Conclusion

The CSG industry is a game changer for Australia. It's development in Queensland is transforming the State's economy and will underpin economic growth for decades to come, and NSW could soon be on the same trajectory. At the same time, the industry is producing a low emissions energy source that will enable Australia and our trading partners to reduce greenhouse emissions at low cost.

The industry is highly scrutinised and regulated, with every aspect of the major LNG projects and the industry more generally scientifically examined and assessed. To obtain environmental approvals CSG-LNG projects have gone through an assessment process lasting several years and the Queensland Government has taken a cautious approach to environmental conditioning. The assessment process will be ongoing with ongoing monitoring and an adaptive conditioning process for the life of projects. This intensive process not only ensures the highest environmental standards but, in the context of water, will also greatly add to the already substantial body of knowledge of groundwater resources in the areas where the industry operates.

We urge the Committee to support the responsible and sustainable development of this important resource.