Chapter 5

Coal Seam Gas and Greenhouse Gasses

5.1 The merits or otherwise of CSG as a means of reducing greenhouse gas emissions, while not directly relevant to this committee's terms of reference, have been canvassed in a number of submissions. On the one hand its environmental benefits as a low green house gas fuel are used to justify the rapid expansion of the industry and 'offset' other potentially harmful environmental impacts of the industry; on the other claims that it is a worse source of greenhouse gas than coal are used to suggest the industry should not be allowed to proceed.

5.2 In the context of global warming, natural gas is considered to be an attractive 'transitional' energy source, being much lower in carbon dioxide (CO_2) emissions than coal or petroleum when burnt.[1]

Table 2: Average carbon emission intensity of selected fossil fuels. Fuel	**Emissions of carbon dioxide per GJ of produced energy**
Brown coal	93.3 kg
Black coal	90.7 kg
Petroleum	68.2 kg
Gas	50.9 kg

5.3 While natural gas is relatively 'cleaner' than coal when burnt, there is debate about the advantage of natural gas over coal when the total production process is considered. As the table above shows, CO_2 emissions from the combustion of natural gas are significantly lower than those from other hydrocarbon energy sources. However the release of methane, 'fugitive emissions', during the production and subsequent processing and transport of the gas may negate this advantage.

5.4 Methane is a much more potent greenhouse gas than CO_2; it is more than 20 times more effective at trapping heat in the atmosphere than carbon dioxide.[2] Methane is much less persistent in the atmosphere than CO_2, dispersing after little more than a decade, compared with CO_2 which can persist for much longer periods of time.[3] Thus methane's impact is of particular importance in the short term.[4]

1 Commonwealth Parliamentary Library, Mike Roarty, Research Paper no. 25, 2007-08, Australia's Natural Gas, issues & trends, p. 16 http://www.aph.gov.au/library/pubs/rp/2007-08/08rp25.pdf Accessed 22 August 2011.

2 Approximately 21 times more efficient at trapping heat in the atmosphere than CO_2, by weight over a 100 year period. http://www.epa.gov/methane/scientific.html Accessed 22 August 2011.

3 Solomon et al, *Persistence of climate changes due to a range of greenhouse gases*, Proceedings of the National Academy of Sciences of the United States of America (PNAS), 2010, October 26, 2010 vol. 107 no. 43 18354-18359 http://www.pnas.org/content/107/43/18354.full Accessed 29 November 2011

4 *Nova: Science in the News*, the Australian Academy of Science, http://www.science.org.au/nova/118/118key.html Accessed 25 October 2011.

5.5 Much of the adverse comment has relied on references to an article published in April 2011 by researchers at Cornell University, *Methane and the greenhouse-gas footprint of natural gas from shale formations.*[5]

5.6 This article does conclude that:

> The footprint for shale gas is greater than for conventional gas or oil when viewed on any time horizon, but particularly over 20 years. Compared to coal, the footprint of shale gas is at least 20% greater and perhaps more than twice as great on the 20-year horizon and is comparable when compared over 100 years.[6]

5.7 The authors also comment that:

> Our analysis does not consider the efficiency of final use. If fuels are used to generate electricity, natural gas gains some advantage over coal because of greater efficiencies of generation. However, this does not greatly affect our overall conclusion: the GHG footprint of shale gas approaches or exceeds coal even when used to generate electricity.[7]

5.8 It is necessary to note a number of qualifications which suggest that this conclusion cannot be directly applied to CSG production in Australia. The article is not looking at coal seams, nor does it include the efficiency of end use in its considerations. It evaluates "... the greenhouse gas footprint of natural gas obtained by high-volume hydraulic fracturing from shale formations" and comments that "the higher emissions from shale gas occur at the time wells are hydraulically fractured – as methane escapes from flow-back return fluids – and during drill out following the fracturing".[8]

5.9 As table 2 of the paper shows, the fugitive emissions profile for shale gas is exactly the same as for conventional gas with the exception of those two stages of production. Thus the requirement for fraccing in any given gas field is critical to analysis of the greenhouse gas footprint of the gas.[9]

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5 Climatic Change, DOI 10.1007/s10584-011-0061-5, *Methane and the greenhouse-gas footprint of natural gas from shale formation,* A letter, Robert W. Howarth, Renee Santoro, Anthony Ingraffea http://www.sustainablefuture.cornell.edu/news/attachments/Howarth-EtAl-2011.pdf Accessed 25 October 2011.

6 *Methane and the greenhouse-gas footprint of natural gas from shale formation,*, Abstract, p. 679.

7 *Methane and the greenhouse-gas footprint of natural gas from shale formation,*, section 6

8 *Methane and the greenhouse-gas footprint of natural gas from shale formation,*, p. 679. 'Flow back' is when fraccing fluids are withdrawn from a well, and 'drill-out', is the removal of concrete plugs used in the fraccing process. p. 681. Table 2 of the paper, p. 683, illustrates the sources of fugitive emissions clearly.

9 *Methane and the greenhouse-gas footprint of natural gas from shale formation,* Table 2, p. 683

5.10 Coal seams generally are less likely to require fraccing than shale. For example AP LNG states that:

> ... during the first 5 years of the current Australia Pacific LNG Project Implementation Plan, it is not expected that any development wells in the Walloons areas will need to be fracture stimulated as wells will be located in areas of high permeability coals.[10]

5.11 Eastern Star Gas has stated that its Narrabri project will not involve fraccing and Dart Energy representatives advised the committee that, depending on the structure of the coal seam, horizontal drilling was a preferred alternative to fraccing.

5.12 In addition, at section 7 of the paper by Howarth et al, the authors consider whether fugitive emissions can be reduced and conclude that there is a range of measures and technologies which, if adopted, can significantly reduce emissions. However they also note that "... Industry has shown little interest in making the investments needed to reduce these emission sources ..." and that "Better regulation can help push industry towards reduced emissions".[11]

5.13 In evidence to this committee, a representative of Dart energy noted his company aimed at "zero fugitive emissions" and that:

> On an operational basis, coal seam gas wells are hooked up before they start producing gas. They are online to produce water first before they produce the gas. Fugitive emissions compared to those industries [shale gas] are very, very low.[12]

5.14 The gas industry in Australia has commissioned a study of this subject from consultants, Worley Parsons, who made:

> ... a life cycle comparison of the greenhouse gas (GHG) emissions of Australian liquefied natural gas (LNG) derived from coal seam gas (CSG) and Australian black coal, from extraction and processing in Australia to combustion in China for power generation.[13]

5.15 The report states that adopting the scenario comparing of CSG/LNG and black coal produced for export is reasonable.

> To achieve a like-for-like comparison (since the CSG/LNG industry examined is export driven) this L[ife] C[ycle] A[ssessment] only considers

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10 AP LNG, *Submission 366*, p. 42.

11 Climatic Change, *Methane and the greenhouse-gas footprint of natural gas from shale formation*, op cit, section 7.

12 Mr J Needham, Explorations Operations Manager, Dart Energy, *Committee Hansard*, 9 September 2011, p. 20.

13 Worley Parsons, Resources & Energy, *Greenhouse Gas Emissions, Study of Australian CSG to LNG*, April 2011, p. 3. http://www.appea.com.au/images/stories/Policy_CSG/appea%20worley%20csg%20greenhouse%20emissions%20study%20final%20110411.pdf

> export streams of CSG and black coal for combustion in power plant in China. This simplifying assumption is realistic since most LNG and a large proportion of black coal is likely to follow this route ...[14]

5.16 The report produced a range of results showing that, when used in electric power generation CSG has an advantage over most forms of coal.

> The results are sufficiently clear and robust to confirm that on a life cycle basis CSG/LNG produced for combustion in a Chinese power plant is less GHG intensive than coal, based on the stated assumptions and scenarios, including the application of best practice in GHG and environmental management.
>
> Depending on the end combustion technology, switching from coal to CSG/LNG for electricity generation avoids up to 0.87 tonnes CO_2-e for every life cycle tonne CO_2-e from CSG/LNG, and up to 4.5 tonnes CO_2-e for every tonne CO_2-e emitted from CSG/LNG in Australia.[15]

5.17 CSG/LNG's advantage diminishes where lower efficiency open cycle gas turbines are compared with higher efficiency coal plants and, at the margin, a worst case gas scenario may produce more greenhouse gasses than a best case coal scenario.[16] It has also been suggested that the 'best case' scenarios for CSG compare its use with "... the dirtier subcritical coal technology that the Chinese no longer build".[17]

5.18 There are significant differences in the profile of emissions over the production and combustion cycle for the two products. For coal the overwhelming majority of emissions are produced as a result of combustion, while for CSG the emissions during production are a much higher proportion of total emissions.

> The two products have different emissions profiles. For the export situation considered, most GHG emissions from coal (94%) will result from combustion in China, whereas extraction and processing in Australia accounts for only 2.7%. For CSG the respective figures are 74% and 22%.[18]

5.19 The Howarth paper concludes that:

> ...the uncertainty in the magnitude of fugitive emissions is large. Given the importance of methane in global warming, these emissions deserve far greater study than has occurred in the past. We urge both more direct

14 Worley Parsons, p. 7.

15 Worley Parsons, p. 29.

16 Worley Parsons, table 1.2, p. 5.

17 Beyond Zero Emissions, http://beyondzeroemissions.org/media/newswire/green-deals-csg-cleaner-coal-111108, accessed 14 November 2011.

18 Worley Parsons, p. 3.

measurements and refined accounting to better quantify lost and unaccounted for gas.[19]

5.20 One of the authors of the Howarth et al paper has made the comment that:

> We do not intend for you to accept what we've reported on today as the definitive scientific study in regards to this question. It's clearly not ... What we're hoping to do with this study is to stimulate the science that should have been done before.[20]

Committee view

5.21 This is a serious issue and it does merit continued study. Because methane is such a potent greenhouse gas, fugitive emissions do have the capacity to alter any net reduction in greenhouse gases quite significantly and, as the Worley Parsons paper shows, efficiency of end use is also critical. Because of the sensitivity of modelling to the data fed into it, it is vitally important to have accurate data collected from the actual gas facilities rather than relying on extrapolation from a small sample or another region.

5.22 Any assessment of fugitive emissions must be specific to the gas field, whether it is coal or shale (or any other source of natural gas), to the technologies used in extracting transporting, processing and burning the gas, and the regulatory framework under which the industry operates.

5.23 The most important message to emerge from this debate is that governments must have in place rigorous monitoring and regulatory regimes. These must have the necessary technical capacity to monitor all gas wells and other potential sources of fugitive emissions. They must also require the adoption of the most efficient technologies to minimise fugitive emissions in natural gas production and consumption. The regulatory regimes must be backed up by a qualified inspectorate that can ensure compliance.

Senator the Hon. Bill Heffernan
Chair

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19 Climatic Change, , *Methane and the greenhouse-gas footprint of natural gas from shale formation*, section 8

20 Anthony Ingraffea, quoted, *Cornell Chronicle*, 11April 2011, http://www.news.cornell.edu/stories/April11/GasDrillingDirtier.html.