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Greenhouse Gas Emissions Study of Australian CSG to LNG

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Section 1 Executive Summary

1. EXECUTIVE SUMMARY

This report presents 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. APPEA recognises the need for and importance of such a comparison in view of Australian and international commitments to reduce GHG emissions, the potential role of liquefied natural gas (LNG) as a less GHG intensive alternative to coal, an impending price on carbon in Australia, and conflicting public information regarding the relative GHG intensity of the two products. APPEA commissioned WorleyParsons to carry out an independent comparison.

A life cycle assessment (LCA) was conducted following internationally established standards and methods for LCA and GHG accounting. Export to China for power generation was chosen as a fair, like-for-like basis for comparison, with MWh of electricity produced selected as the functional unit. Using data from industry sources and public reports, the study compares life cycle GHG emissions from existing or projected normal operating conditions using commonly employed and proven technologies, including GHG mitigation. The base case comparison is for typical or representative GHG emissions scenarios for each product, while ranges are considered for variations in technology, operating or other conditions in extraction and processing and for efficiencies of power plant in final combustion. The analysis assumes that CSG/LNG projects apply best practice in GHG and environmental management, especially to the prevention of venting and leaks in upstream operations.

The general findings and conclusions were as follows:

- CSG/LNG is significantly less GHG intensive for most existing, commonly employed end-user combustion technologies and for most of the life cycle scenarios considered.
- 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%.

Specific findings included the following:

- When comparing life cycle GHG emissions per MWh of electricity sent out from a power plant, the results are highly sensitive to assumptions about the thermal efficiencies that apply to power generation.
- On average, coal combusted in a subcritical, supercritical or ultra-supercritical pulverised coal plant produces respectively 87%, 51% and 43% more life cycle GHG emissions per MWh than CSG/LNG combusted in a combined cycle gas turbine (CCGT) plant (Table 1.1 and Figure 1.1).
- The corresponding numbers for the respective coal technologies compared to combustion on an open cycle gas turbine plant (OCGT) are 37%, 11% and 5% more GHG emissions per MWh. However this comparison is less important since OCGT is seldom used for baseload generation, and rather in smaller plants for peak shaving, emergency generation or remote locations.
- Sensitivity bands for uncertainties and ranges of power plant efficiency generates various best/worst case comparisons (Figure 1.1 and Table 1.2). For these atypical scenarios, electricity from coal is only less GHG intensive when best case coal is compared to a few worst CSG/LNG cases, mainly low efficiency OCGT combustion.
- Although no relevant CSG/black coal life cycle comparisons were found, the results are consistent with comparable elements of various LNG /coal comparisons.

Potential savings from combusting CSG/LNG instead of coal in power generation in China for simple substitution scenarios are as follows:

- For every life cycle tonne CO_2-e from CSG/LNG up to 0.87 tonnes CO_2-e may be avoided compared to electricity from coal (Tables 1.1 and 1.2). This maximum figure will decrease over time since large numbers of supercritical and ultra – supercritical plant are being constructed, but subcritical is likely to remain the dominant coal combustion technology in China.
- Considering savings from a 30 year 10 Mtpa CSG/LNG project (as expected for the Gladstone LNG development), if CSG/LNG is combusted in a CCGT plant instead of a subcritical coal plant, the life cycle emissions are 42.7 million tonnes (Mt) CO_2-e per annum, the annual savings 37.2 Mt CO_2-e and the project life savings 1114 Mt CO_2-e. For CSG/LNG combustion in a CCGT plant instead of a supercritical coal plant the annual savings and project life savings are 21.7 and 652 Mt CO2-e respectively.
- Considering global GHG emissions savings from CSG/LNG GHG emissions in Australia, if electricity is generated in China from CSG/LNG in CCGT instead of subcritical coal, then for every tonne CO_2-e emitted in Australia, 4.3 tonnes are avoided globally. For CCGT instead of supercritical coal 2.5 tonnes CO_2-e are avoided.

In conclusion, 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 for the stated assumptions and scenarios.

Table 1.1 Electricity generation GHG intensities - base case (units: tonnes CO2-e/MWh)

OPERATION		COAL SEAM GAS		BLACK COAL		
		BASE CASE		BASE CASE		
		OCGT	CCGT	SUBCRITICAL	SUPER CRITICAL	ULTRA SUPER CRITICAL
Assumed average efficiency (%)		39	53	33	41	43
Extraction and processing		0.15	0.11	0.03	0.02	0.02
Transport		0.01	0.01	0.03	0.03	0.03
Processing and power generation in China		0.59	0.43	0.96	0.78	0.74
Totals		0.75	0.55	1.03	0.83	0.79
Ranges	Min	0.64	0.49	0.75	0.61	0.58
	Max	0.84	0.64	1.56	1.26	1.20

Figure 1.1. Base case GHG intensities and ranges

Note: Includes ranges from all life cycle emissions sources

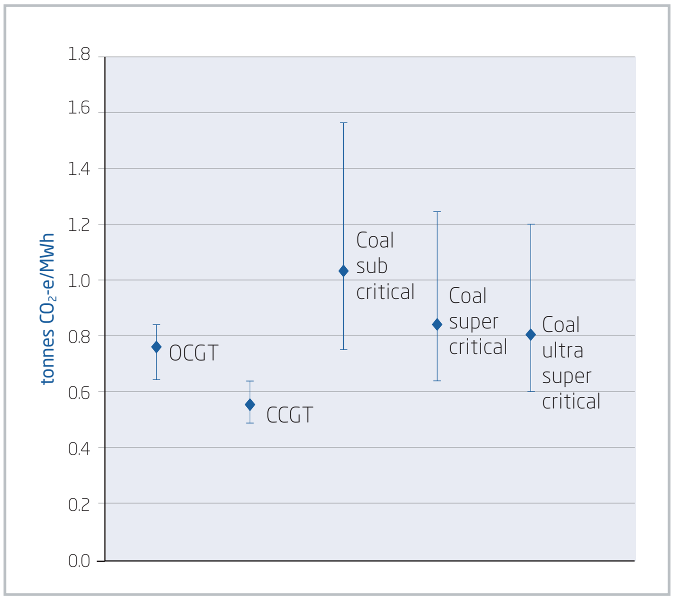

Table 1.2. Life cycle GHG savings from CSG/LNG instead of coal electricity generation

	INSTEAD OF	EMISSIONS AVOIDED (T CO_2-E/MWH) FOR EVERY LIFE CYCLE T CO2-E FROM CSG/LNG		
GAS TECHNOLOGY	**COAL TECHNOLOGY**	**BASE CASE**	**MAX**	**MIN**
CCGT	Subcritical	0.87	2.18	0.17
CCGT	Supercritical	0.51	1.57	-0.05
CCGT	Ultra supercritical	0.43	1.44	-0.10
OCGT	Subcritical	0.37	1.43	-0.11
OCGT	Supercritical	0.11	0.97	-0.27
OCGT	Ultra supercritical	0.05	0.88	-0.31

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