Greenhouse Gas Assessment for the Silver Springs Gas Processing Facility

Prepared for

RPS

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Prepared by

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Contents

Tables

Glossary

Term	Definition
CO	Carbon monoxide
CO_2	Carbon dioxide
GJ	Gigajoule
GWP	Global warming potential
CH_4	Methane
Mt	Million tonnes
N_2O	Nitrous oxide
t	Tonnes
tCO_2-e	Tonnes of CO_2 equivalent
NPI	National Pollution Inventory

1. Project description

Katestone Environmental has been commissioned by RPS, on behalf of AGL Energy Limited (AGL), to undertake a greenhouse gas assessment of the proposed Silver Springs Gas Storage Facility (the Project).

The Project is to construct and operate a coal seam gas (CSG) storage facility at the existing Silver Springs Processing Plant. The facility will allow for the storage of CSG in the depleted Silver Springs and Renlim gas reservoirs. Development of the Project is a key element in the AGL and Queensland Gas Company (QGC) strategy to capture ramp gas for preservation and use at a later date. Under a contractual arrangement with QGC, AGL will assist QGC to manage its ramp gas in the lead up to the commissioning of its Gladstone Queensland Curtis Liquefied Natural Gas (QCLNG) Processing Facility.

The main activity occurring at the Silver Springs site associated with the release of greenhouse gases is the consumption of fuel and oils.

This assessment has produced an inventory of projected worst-case total greenhouse gas emissions that are attributable to the Project, including both the existing Silver Springs Gas Plant infrastructure and the proposed storage facility infrastructure, expressed in terms of total mass of carbon dioxide equivalents (CO_2-e) and as a proportion of Australia's annual greenhouse gas emissions. Downstream transport and combustion emissions have not been included in the assessment.

2. Background to greenhouse gas issue

2.1 Greenhouse effect

The climate of the Earth is driven by a complex system of interactions between the atmosphere, land and ocean that constantly maintain the earth's energy balance. That is, the average energy received at the surface of the earth, in the form of solar radiation, approximately equals the average energy emitted back into space. To maintain the energy balance the surface of the earth continuously emits long-wave radiation (infrared) at approximately 240 W m^{-2} (Watts per square metre) (IPCC AR4, 2007). To emit 240 W m^{-2} a surface would have a temperature of around -19^{o}C, significantly lower than the global mean surface temperature of 14^{o}C (IPCC AR4, 2007).

The reason why the Earth's surface is warm is because absorption of infrared radiation by clouds and certain gases present in the atmosphere, commonly known as the greenhouse gases, warms the Earth's surface and lower atmosphere. This is known as the 'Natural Greenhouse Effect'. Increased anthropogenic activities, such as the combustion of fossil fuels, has led to an increase in the composition of greenhouse gases in the atmosphere and therefore an increase in absorption of outgoing infrared radiation, this is known as the Greenhouse Effect.

Greenhouse gases of particular importance are those that are found in the troposphere in substantial concentrations, and those that possess a strong radiative forcing. Important greenhouse gases include:

- Water vapour (H_2O)
- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

Indirect greenhouse gases such as carbon monoxide (CO), nitrogen oxides other than N_2O and non-methane volatile organic compounds (NMVOCs) do not have a strong radiative forcing effect in themselves, but influence atmospheric concentrations of the direct greenhouse gases.

Water vapour is the major contributor to the greenhouse effect but is not normally considered because fluxes are dominated by the day-to-day precipitation cycle. Carbon dioxide is the next most significant greenhouse gas and the major anthropogenic contributor. Since the beginning of the industrial era the amount of carbon dioxide in the atmosphere has increased by 35% (IPCC AR4, 2007).

The relative importance of a greenhouse gas is measured in terms of its global warming potential (GWP), usually related to a GWP of one for carbon dioxide. Nitrous oxide and carbon dioxide are greenhouse gases that are associated with combustion activities, such as the combustion of natural gas to generate electricity. Carbon dioxide tends to remain active for a lifetime of around 150 years and has a GWP of one on a 100-year timeframe. Nitrous oxide has a lifetime of 120 years and a GWP of 310 on a 100-year timeframe. Methane has a lifetime of 14.5 years and a GWP of 21 on a 100-year timeframe. Whilst nitrous oxide and methane have a greater potential to cause global warming, carbon dioxide is produced in far greater quantities by anthropogenic activities than these and consequently, carbon dioxide is the most important anthropogenic greenhouse gas.

2.2 Australian regulation

Greenhouse gas emissions are reported in terms of tonnes of CO_2 equivalent (tCO_2-e), which are calculated as the sum of the emission rate of each greenhouse gas multiplied by the global warming potential:

$$\text{tonnes } CO_2\text{-e} = \text{tonnes } CO_2 \times 1.0 + \text{tonnes } CH_4 \times 21 + \text{tonnes } N_2O \times 310.$$

In December 2007, the Australian government ratified the Kyoto Protocol, an international agreement designed to restrict the growth in the emission of greenhouse gases in developing countries to the quantity being emitted in 1990. This target was expected to be met over the five year period from 2008 to 2012. Australia committed to monitor and report greenhouse gas emissions and has set a target level for emissions of 108% of estimated emissions for 1990 or 598.076 Mt CO_2-e.

In December 2009, The Copenhagen Accord was agreed under the United Nations Framework Convention on Climate Change (UNFCC). The nations of the world attending the Copenhagen Conference strongly supported the accord which provides agreement to;

- Hold the increase in global temperature below 2.0°C
- Provide financial support to developing countries for emissions reductions and adaption schemes
- Implement a framework for national and international monitoring programs for mitigation measures
- Set specific emission targets for developed countries and actions to reduce emissions in developing countries

There is a tiered system of emission reductions and if emissions are not reduced sufficiently by a certain deadline, then the residual emissions are accounted for in evaluating progress to meeting future targets. Australia regularly reports to the UNFCCC detailing the Government's views on arising issues and ongoing negotiations globally to achieve emissions reductions.

3. Sources of greenhouse gas emissions

The Australian Government Department of Climate Change and Energy Efficiency (DCCEE) monitors and compiles databases on anthropogenic activities that produce greenhouse gas emissions. Emissions of greenhouse gases can be classed as either direct or indirect. Direct emissions are defined as occurring from sources within the boundary of an organisation as a direct result of that organisation's activities, such as combustion of fossil fuels in electricity generators (DCC, 2009). Indirect emissions are defined as occurring in the wider economy as a consequence of the organisations activity, but which are physically produced by the activities of another organisation, such as the consumption of electricity (DCC, 2009).

The major activity of the Project that produces greenhouse gas emissions is stationary fuel combustion of fossil fuels (direct emissions) in existing and proposed gas compressor engines.

Stationary fuel combustion includes the use of fuel in site plant and stationary equipment. Table 1 shows the annual stationary fuel combustion quantities for the existing compressor engines as reported for the 2009/2010 NPI (National Pollution Inventory) and calculated from fuel consumption rates of the proposed compressor, provided by RPS.

Table 1 Annual stationary fuel combustion for the Project

Source	Fuel	Annual quantity	Units
Existing Gas Compressors[1]	Diesel	551	kL/yr
	Fuel oil	8,175	kL/yr
	Natural gas	2,821,145	m^3/yr
Proposed Gas Compressor (CAT G3612)[2]	Natural gas	6,281,179	m^3/yr

Note:
[1] Annual consumption data provided by RPS
[2] Annual consumption data calculated from engine specifications assuming continuous use over a year

4. Method used to estimate greenhouse gas emissions

The DCCEE monitors and compiles databases on anthropogenic activities that produce greenhouse gases in Australia. DCCEE has published greenhouse gas emission factors for a range of anthropogenic activities. The DCCEE methodology for calculating greenhouse gas emissions is published in the National Greenhouse Accounts (NGA) Factors workbook (DCC, 2009) and is based on Australian data. This workbook is updated regularly to reflect current compositions in fuel mixes and evolving information on emission sources.

The greenhouse gas intensity of each activity has been calculated using the simplified equation as follows:

$$GHG = E \text{ x } EF \text{ x } CF$$

Where:

GHG: Annual greenhouse gas emissions in tonnes of carbon dioxide equivalent (tCO_2-e)
E: Annual fuel input energy (GJ/yr)
EF: Emission factors for CO_2, CH_4 and N_2O (kg CO_2-e /GJ)
CF: Capacity factor (%)

The total annual greenhouse gas emissions are the sum of the emissions for each of the three key greenhouse gases, namely: CO_2, CH_4 and N_2O.

The greenhouse gas emission factors for the combustion of various fuels relevant to the Project are presented in Table 2 (DCC, 2009). The energy content of each of the fuels is shown in Table 3.

Table 2 Greenhouse gas emission factors for site activities

Activity	Fuel	CO_2	CH_4	N_2O	Units
Stationary fuel combustion	Diesel oil	69.2	0.1	0.2	kg CO_2e/GJ
	Fuel Oil	72.9	0.03	0.2	kg CO_2e/GJ
	Natural gas	51.2	0.1	0.03	kg CO_2e/GJ

Table 3 Energy content factor of various fuels

Activity	Fuel	Energy content		Density[a]	
Stationary fuel combustion	Diesel oil	38.6	GJ/kL	0.836	kg/L
	Fuel Oil	39.7	GJ/kL	0.9	kg/L
	Natural gas	0.0393	GJ/m^3	0.0255	kg/MJ
				0.7170 [b]	kg/m^3

Note:
[a] as detailed in NPI Guide, Version 5.1 Feb 2010
[b] calculated using the ideal gas law and assuming the gas is entirely methane

5. Project greenhouse gas inventory

The greenhouse gas emissions estimated for the Project are presented in Table 4, based on the maximum annual fuel usage for each source and as a combined total to represent worst-case greenhouse gas emissions.

Table 4 Estimated annual greenhouse gas emissions for the Project (tonnes CO_2e)

Source	Greenhouse gas emissions (tonnes CO2e)	% of Australia's Kyoto target
Existing	30,904	0.005%
Proposed	12,671	0.002%
Combined emissions – existing & proposed	43,575	0.007%

The peak annual emission rate of greenhouse gases from the Project combined with existing emissions from Silver Springs was estimated to be 0.044 Mt CO_2-e or 0.007% of Australia's assigned amount under the Kyoto Protocol. The Project alone was estimated to emit 0.013 Mt CO_2-e per year.

6. Conclusions

A greenhouse gas assessment was undertaken to project future greenhouse gas emissions attributable to the Project with the following conclusions:

- The major activity of the Project associated with the release of greenhouse gases are fuel consumption in engines used for the compression of natural gas
- The maximum annual greenhouse gas emission rate due to the Project combined with existing emissions from Silver Springs was estimated to be 43,575 tonnes CO_2-e per year, which corresponds to 0.007% of Australia's Kyoto target.
- The Project alone was estimated to emit 12,671 tonnes CO_2-e per year, which corresponds to 0.002% of Australia's Kyoto target.

7. References

Department of Climate Change (DCC) June 2009, “National Greenhouse Accounts Factors”, Commonwealth of Australia, Barton ACT

Department of the Environment, Water, Heritage and the Arts, February 2010, National Pollution Inventory Guide Version 5.1, Commonwealth of Australia

Intergovernmental Panel on Climate Change (IPPC), 2007, Fourth Assessment Report, Cambridge University Press, UK