8.9 Greenhouse Gas Emissions

8.9.1 Introduction

Introductory information pertaining to the GLNG Project Greenhouse Gas (GHG) assessment is presented in Section 6.9.1. Additionally, the GHG technical report for the GLNG Project includes estimates for two different LNG facility designs, the Optimized Cascade LNG Process (OCP) design and a Propane Pre-cooled Mixed Refrigerant (C3MR) process design. In December 2008 the OCP design was selected as the preferred design option. Estimates for both designs were retained in Appendix T in the interests of completeness but only the results for the OCP design will be presented in this section.

8.9.2 Methodology

Relevant information pertaining to methodology is presented in Section 6.9.2.

8.9.3 Regulatory Framework

Relevant information pertaining to the regulatory framework is presented in Section 6.9.3.

8.9.4 Existing Environmental Values

The majority of this section is identical to Section 6.9.4, with the exception of the sources and factors used for the LNG facility emissions.

8.9.4.1 Emissions Sources

The GHG Scope 1 emission sources from the LNG facility included in this inventory are:

- Fuel consumption in process equipment;
- On-site power generation via gas turbine power station;
- Diesel fuel consumption in vehicles during all stages of the project;
- Flaring and venting of gas; and
- Land clearing.

Scope 2 emissions were considered to be immaterial as there will be no significant purchases of electricity for any portion of the project. The LNG facility will generate its own electricity using gas-fired turbines, and power for worker accommodation during construction will be generated using on-site diesel generators.

The GHG emissions have been estimated for operation of the LNG facility on an annual basis and for a total lifespan of 25 years.

Construction emissions from the LNG facility have been estimated by the process design engineers for construction equipment. The base case for the LNG facility construction is the construction of a bridge to Curtis Island, which will require personnel and material to be transported to Curtis Island by barges/ferries for Train 1 construction until the bridge is operational. The option for no bridge has accounted for the use of the barges/ferries throughout the construction and operation of Trains 2 and 3.

Carbon sequestration due to rehabilitation of cleared areas has not been included in the inventory.

Fuel Consumption in Process Equipment

The primary process equipment at the LNG facility will be the compressors, which are powered by gas-fired turbines. The LNG facility design lists six GE LM2500+G4 compressor turbines for the 3 Mtpa case

and 18 LM2500+G4 compressor turbines for the 10 Mtpa case. The facility design also includes some process equipment such as heaters which consume a small portion of the product stream for process heat.

GHG emissions estimates were provided for the OCP designs on both an hourly basis and an annual basis that included a predicted facility availability rate. This availability rate is the predicted number of hours the facility will be operating in the course of a year, with stoppages assumed to come from scheduled maintenance, inspections, and estimates of downtime due to equipment faults or other unscheduled shutdowns.

All other facility process equipment is powered by electricity produced by the facility's on-site power generation station.

Power Generation

The LNG facility will be powered by 5.5 MW turbines fuelled by a portion of the product gas stream. The LNG facility design indicates the use of five Solar Taurus power generation turbines for the 3 Mtpa facility and 11 Solar Taurus power generation turbines for the 10 Mtpa facility. As for process equipment, GHG emissions estimates were provided on both an hourly basis and an annual basis that included a predicted facility availability rate.

Fuel Consumption in Vehicles

Diesel consumption by vehicles at the facility during operation was considered immaterial as no large vehicles will be operating on-site on a regular basis and light vehicle traffic will be minimal. However, emissions produced by employee commuter traffic and materials and equipment deliveries to the LNG facility have been calculated in order to enable comparison of the two options currently under consideration, specifically access to Curtis Island via a bridge (the base case) or barges and ferries (option). Vehicles included in the "bridge" option are medium and heavy trucks and passenger vehicles. All vehicle trips are assumed to originate in and return to Gladstone. Vehicles included in the "no bridge" option are barges and passenger ferries making return trips to Curtis Island from Auckland Point.

An indicative estimate of emissions from construction equipment has been provided by the LNG facility design team. In addition, emissions from ferries and barges used to transport workers, materials and equipment to the construction site has been calculated as above for the operational period. As no bridge will be available during construction of Train 1, only marine vessel emissions have been considered. On-site emissions during construction of Trains 2 and 3 are assumed to be 50 % of Train 1 each, based on workforce and traffic reports. Emissions from truck, bus and passenger vehicle movements during construction of Trains 2 and 3 have been calculated based on return trips from Gladstone via the bridge.

Flaring and Venting

Flaring rates have been provided for the LNG facility design based on flaring required for scheduled shutdowns for maintenance and inspection. Flaring for plant upset conditions have not been included as this is assumed to be a rare or non-occurring situation and unlikely to represent a significant contributor to total GHG emissions.

CO_2 will also be present in the gas stream in small quantities (approximately 0.3 % of the incoming gas stream). This CO_2 is considered a contaminant in the product LNG stream and will be removed at the facility and vented directly to the atmosphere.

Fugitive Emissions

Fugitive emissions include all those quantities of gas that are lost directly to the atmosphere through uncontrolled sources such as leaks or during well drilling. Leaks typically occur at pipe joints such as flanges, caps, plugs, valves, pump seals, and connections points. Estimates of fugitive emission rates from the facility design have been included.

Land Clearing

Trees and other vegetation metabolise carbon and store a portion of it as permanent, woody biomass as they grow. When this vegetation is cleared the stored carbon is typically lost to the atmosphere as CO_2 along with small amounts of CO and CH_4. Estimates of the area of cleared land has been combined with vegetation studies and used as input for a carbon loss model. The model used was FullCAM, from the Department of Climate Change's National Carbon Accounting Toolbox.

Land clearing emissions from the LNG facility occur only during construction of the site. These are included in the total emissions during construction as presented in Section 6.9.4.1. The GHG assessment has not accounted for revegetation of temporary construction areas or rehabilitation of the site once it is decommissioned.

8.9.4.2 Emission Factors

Emission factors used to calculate GHG emissions from the combustion of diesel and natural gas have been sourced from the Department of Climate Change NGA Factors Workbook, 2008 as indicated in Table 8.9.1 below.

Table 8.9.1 Emission factors used in the Formation of the Project GHG Inventory

Emission Source	Emission Factor	Units	Source
Scope 1 Emissions			
Combustion emission factor diesel	2.7	t CO_2-e/kL	NGA Factors. Table 4, (fuel combustion for transport)
Consumption of Natural Gas (or CSG) - Queensland	51.3	t CO_2-e/GJ	NGA Factors. Table 2 (consumption of natural gas)

Emission factors for the carbon loss associated with land clearing activities specific to locations in the project site were obtained using the FullCAM model, in combination with data on vegetation types and amounts in those locations provided by URS ecologists. For the LNG facility a factor of 54.88 tonnes carbon per hectare (t C/ha) (201 tonnes CO_2-e/ha) was used. Estimates of release rates for elemental carbon (C) were converted to CO_2-e by using the molecular weights of CO_2 and C (44 and 12, respectively).

8.9.4.3 Summary of Scope 1 and Scope 2 Emissions

Relevant information pertaining to Scope 1 and 2 emissions is presented in Section 6.9.4.3.

8.9.5 Potential Impacts and Mitigation Measures

Relevant information pertaining to potential impacts (including cumulative impacts) and mitigation measures is presented in Section 6.9.5.

8.9.6 Summary of Findings

Relevant information pertaining to the summary of findings is presented in Section 6.9.6.