Chapter 24

Greenhouse gas

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24. Greenhouse gas

The assessment of greenhouse gas emissions was undertaken in accordance with the Secretary's Environmental Assessment Requirements for the Narrabri Gas Project. This chapter presents a summary of the assessment, which is described in more detail in a greenhouse gas technical report (Appendix R).

The key findings of the impact assessment in relation to greenhouse gas were:

- The annual direct emissions from the project are equivalent to less than 0.2 per cent of Australia's current annual emissions which is less than 0.002 per cent of global greenhouse gas emissions.
- Lifecycle emissions for energy produced from the combustion of the natural gas delivered by the project will be nearly 50 per cent less than for electricity that is currently supplied to the NSW grid.
- Given the environmental benefits of low-carbon energy sources, the project is consistent with the principles of ecologically sustainable development.
- As a general principle, all reasonable and feasible measures to minimise greenhouse gas emissions will be considered in the development of the project.

The most material emissions from the project are associated with carbon dioxide venting and combustion of fuel during gas processing or for electricity generation for the project.

24.1 Methodology

The assessment of greenhouse gas emissions involved the following steps:

- identification of sources of greenhouse gas emissions
- quantification of greenhouse gas emissions, per source
- assessment of the impacts of greenhouse gas emissions
- development of mitigation and management measures to control emissions.

Sources of emissions were identified with reference to the description of the project (refer to Chapter 6 – Project description).

As defined under the Kyoto Protocol, greenhouse gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. As these gases vary in their global warming potential, their impacts are reported in equivalent quantities as tonnes or millions of tonnes of carbon dioxide (or t CO_2-e or Mt CO_2-e respectively).

Greenhouse gas emissions for the project were calculated by application of the Commonwealth Government's *National Greenhouse and Energy Reporting (Measurement) Determination 2008* and *National Greenhouse Accounts Factors* (Commonwealth Department of Environment and Energy 2016a).

This assessment is based on the assumption that peak gas delivery to market (being 200 terajoules) would be maintained for the entire 25-year assessment period of the project. In practice, the production of gas would start at a much lower volume, ramping up as the project progresses. The volume of greenhouse gas emissions associated with the project, particularly carbon dioxide vented during gas processing, is therefore likely to be overestimated.

Two electricity options for the project were considered in the greenhouse gas assessment:

- Option 1: an on-site gas-fired electricity plant consisting of gas engines with an operating capacity of 100 megawatts.
- Option 2: electricity sourced from the NSW grid.

24.2 Existing environment

The Commonwealth Department of the Environment and Energy reports Australia's greenhouse gas emissions in accordance with the requirements of the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.

Table 24-1 shows that national annual greenhouse gas emissions totalled 523.3 Mt CO_2-e in 2014. Global annual greenhouse gas emissions are currently estimated to be in the order of 49,000 Mt CO_2-e (IPCC 2014).

Table 24-1 National annual greenhouse gas emissions 2014

Sector	Australia (Mt CO_2-e)	Percentage of total
Electricity	180.8	34.5
Agriculture and land	73.3	14.0
Stationary energy other than electricity	93.8	17.9
Transport	92.9	17.8
Industrial processes	32.4	6.2
Coal mining	25.15	4.8
Oil and gas	12.94	2.5
Waste	12.0	2.3
Total	**523.3**	**100**

24.3 Potential impacts

24.3.1 Sources of greenhouse gas emissions

The greenhouse gas emissions quantified in this assessment can be categorised as direct emissions and indirect emissions.

Direct emissions are greenhouse gas emissions generated by the project from sources that are owned or controlled by the proponent. They are also known as Scope 1 emissions. Direct emissions include those that are generated by the combustion of fuel in vehicles and equipment on site, by the clearance of vegetation and by gas processing operations that involve flaring or venting.

If the on-site power plant option is progressed, direct emissions associated with the project will also include the emissions from the combustion of gas in the power plant.

Indirect emissions are generated at sources that are not owned or controlled by the proponent. These include emissions produced by the generation of electricity by a third party where the proponent is the end-user, also known as Scope 2 emissions. If the project is powered by electricity purchased from the grid, the emissions associated with the generation of that electricity will be reported by the controlling corporation of the proponent as Scope 2 emissions and will be reported by the electricity generator as the generator's Scope 1 emissions.

Indirect emissions also include downstream emissions that are generated as a result of an activity (also known as Scope 3 emissions). The downstream emissions associated with the project are the emissions that are likely to be generated as a result of the combustion of the gas produced by the project by the ultimate end users of the gas.

24.3.2 Greenhouse gas emissions

Direct greenhouse gas emissions over the 25-year assessment period are quantified in Table 24-2 in respect of the two project options involving an on-site power generation facility and electricity sourced from the national grid respectively.

As shown in the table, total direct greenhouse gas emissions associated with the project would equal about 26.3 Mt CO_2-e with the power generation facility, or 15.5 Mt CO_2-e with electricity sourced from the national grid.

Table 24-2 Total direct greenhouse gas emissions over 25 year assessment period

Phase	Option 1: Self-generated electricity (Mt CO_2-e)	Option 2: Grid-sourced electricity (Mt CO_2-e)
Construction	2.2	2.2
Operation	24.1	13.3
Decommissioning	0.0	0.0
Total	**26.3**	**15.5**

Table 24-3 shows the direct greenhouse gas emissions that would be emitted in a typical operating year (i.e. peak operations, post principal construction and prior to decommissioning). Direct greenhouse gas emissions in a typical operating year would be about 0.96 Mt CO_2-e with the power generation facility, or 0.53 Mt CO_2-e with electricity sourced from the national grid. This is less than 0.2 per cent of Australia's current annual emissions (of 523.3 Mt CO_2-e).

Table 24-3 Direct greenhouse gas emissions for a typical operating year

Phase	Option 1 Self-generated electricity (Mt CO_2-e)	Option 2 Grid-sourced electricity (Mt CO_2-e)
Operation	0.96	0.53
Total	**0.96**	**0.53**

24.3.3 Purchased electricity

If Option 2 is the preferred development scenario, electricity that is used to power project equipment will be purchased from the national electricity grid. Although the emissions associated with the electricity generation will be the direct emissions of the third party generator, for completeness the controlling corporation of the proponent reports these emissions as Scope 2 emissions for the project.

For Option 2, the Scope 2 emissions for the project will be approximately 18 Mt CO_2-e over the 25-year assessment period and will be 0.72 Mt CO_2-e in a typical operating year.

There will be no Scope 2 emissions if the project incorporates an on-site power generation facility (Option 1). The emissions generated by the on-site power generation facility will form a portion of the direct emissions of the project.

24.3.4 Downstream emissions

Product use emissions by consumers of natural gas will generate additional greenhouse gas emissions that are beyond the control of the proponent.

To forecast a reasonable basis for emissions from product use, it was assumed that 100 per cent of the gas delivered to end users from the project would be combusted for energy generation. This could include electricity generation, large end-user energy requirements (e.g. manufacturing, mining), or combustion for heating and cooking. This provides a conservative basis for calculation of these emissions, as if for example a portion of the gas is used for industrial processing (e.g. conversion into plastics) rather than combustion; the associated downstream emissions will be less.

Based on the conservative assumption that the project will deliver 200 terajoules of gas per day for the 25-year assessment period (refer to Section 24.1), annual product-use emissions, assuming combustion of the gas by the end-user, would be in the order of 3.77 Mt CO_2-e. Such downstream emissions are a result of consumer demand for energy.

24.3.5 Impacts of greenhouse gas emissions

The challenge for the international community is to reduce anthropogenic greenhouse gas emissions while continuing to provide reliable and affordable energy and meet rapidly growing energy demands. By 2040, global energy demand is expected to have increased by 37 per cent from the present (IEA 2014).

Current global annual greenhouse gas emissions are estimated to be approximately 49,000 Mt CO2-e. Australia's emissions of 523.3 Mt CO2-e equate to approximately one per cent of global emissions.

As shown in Table 24-4, the annual direct emissions from the project are equivalent to less than 0.2 per cent of Australia's current annual emissions. This contribution is less than 0.002 per cent of global greenhouse gas emissions.

Table 24-4 Average annual direct emissions as a percentage of Australia's 2014 emissions

Sector	2014 emissions (Mt CO_2-e)	Option 1 (Self-generated electricity)	Option 2 (Grid-sourced electricity)
Australian energy sector	405.6	0.24%	0.13%
Total Australia	**523.3**	**0.18%**	**0.1%**

Note: Percentages based on average annual direct greenhouse gas emissions for a typical operating year i.e. 0.96 Mt CO_2-e for Option 1, and 0.53 Mt CO_2-e for Option 2 (Table 24-3). Australia's emissions as reported in the most recently published National Inventory Report (Department of Environment and Energy 2016b).

The relatively small incremental increase (less than 0.2 per cent) in Australia's annual greenhouse gas emissions associated with the project, and its contribution to global emissions, should be considered in terms of the net environmental benefit of the natural gas generated by the project.

In the transition to a low-carbon economy, natural gas offers an opportunity for Australia by providing a low-carbon alternative to existing fossil fuel energy sources.

Fuel switching to natural gas for electricity generation can deliver an improvement in emissions intensity of the electricity grid. This has occurred in the United States of America, where it is reported that fuel switching to natural gas from the shale gas boom has resulted in an emissions reduction of 200 Mt CO_2-e per year (IEA 2014a).

In comparison on a lifecycle basis, where both upstream and downstream emissions are taken into account, energy (such as heat or electricity) produced by the combustion of natural gas has significantly lower greenhouse gas emissions than the emissions intensity of the NSW electricity grid (refer to Figure 24-1). Note that:

- upstream emissions for fossil fuel supplies are those emitted in the extraction, processing and transportation of the fuel product (i.e. coal or gas)
- downstream emissions are those emitted from the combustion of the fuel by the end-user.

Upstream emissions form only a small proportion of the total lifecycle emissions for energy generation. Consequently, it is the downstream emissions that have by far the greatest bearing on the emissions intensity of the energy.

To illustrate this comparison, Figure 24-1 shows that the lifecycle emissions for electricity produced by combustion of the gas delivered by the project would be approximately 50 per cent less than for the production of the electricity that is currently supplied to the NSW grid (Commonwealth Department of Environment and Energy 2016a).

In the context of these net environmental benefits, the project is consistent with the principles of ecologically sustainable development.

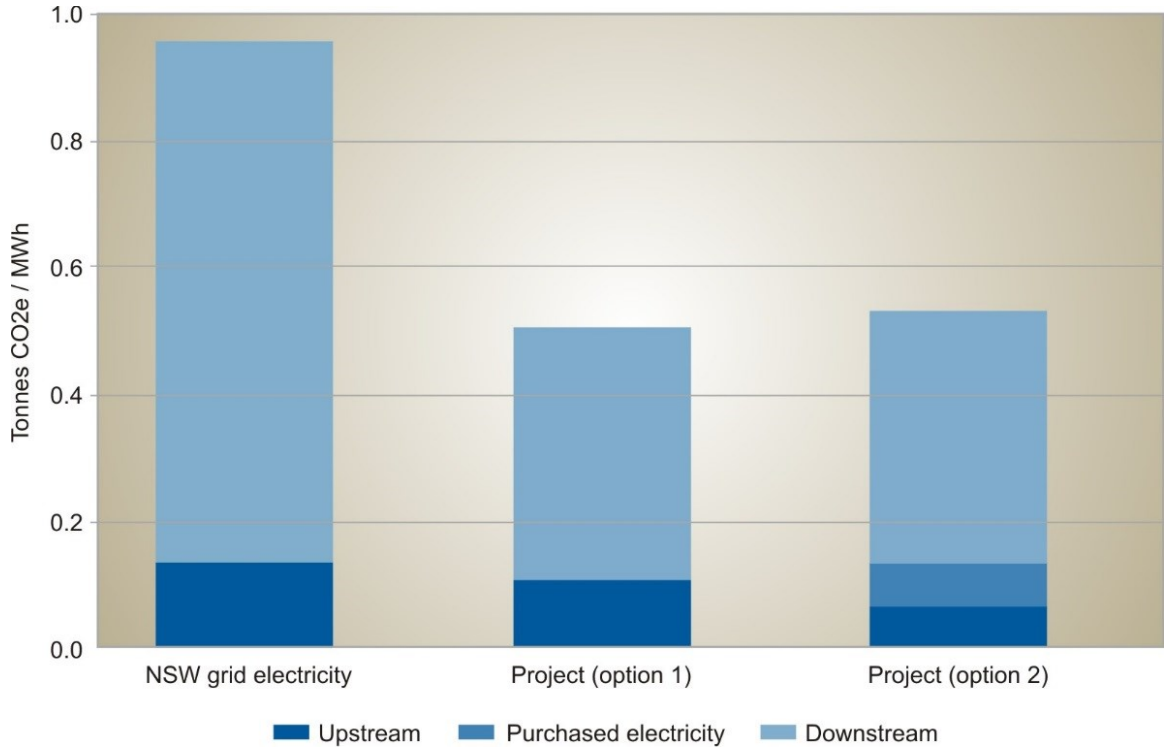

Figure 24-1 Comparative lifecycle greenhouse gas emissions intensity of electricity[1]

24.4 Mitigation and management measures

As a general principle, all reasonable and practicable measures will be considered to minimise greenhouse gas emissions from project emission sources within its control.

24.4.1 Governance approach

Climate change is a long-term issue, requiring urgent but informed action to stabilise atmospheric greenhouse gas concentrations. As a global stakeholder in the energy business the proponent recognises that one of its key social and environmental responsibilities is to pursue strategies that address the issue of climate change.

In accordance with its Climate Change Policy, the proponent will make procurement decisions based on the corporate policy and tangible commitments as detailed in Section 24.4.2. The policies and commitments underpin the proponent's approach to greenhouse gas emissions management, which is governed through a suite of corporate standards, guidelines and manuals, that, among other things:

- describes the proponent's approach to climate change and greenhouse gas emissions, building on the Climate Change Policy commitments and setting out requirements for identifying, measuring and reporting greenhouse gas emissions, and systematically assessing energy efficiency opportunities
- describe the proponent's approach to driving energy efficiency improvements, covering both energy use (fuel and electricity) and energy loss (flare, vent and fugitives)

[1] NSW grid electricity emissions - Project emissions: Project analysis reported in Table 24-3, Section 24.3.3 and Section 24.3.4; and Option 1 and Option 2 downstream emissions intensity: Based on new combined cycle gas turbine manufacturer specifications.

- detail how energy efficiency assessments are conducted and require energy efficiency opportunities to be assessed during the design process for new projects
- set out how greenhouse gas emissions management should be applied to each stage of development, including in respect of the measurement and reporting of emissions and energy consumption, energy efficiency and greenhouse gas abatement.

The proponent has a dedicated Carbon and Sustainability team with oversight of its greenhouse gas emissions management approach. The team maintains a set of detailed compliance manuals that describe the processes and methodologies that are required to be used for data collection, emissions calculation and reporting.

Each year, the proponent's greenhouse gas emission reports are assured by an independent third party auditor and reported publicly via its sustainability reports and to the National Greenhouse and Energy Reporting authority.

Progress against the proponent's Climate Change Policy is reported quarterly to the Environment, Health, Safety and Sustainability Committee of the Board.

24.4.2 Measures

The proponent's standard practice is to consider, and where practicable implement, a range of energy efficiency and greenhouse gas management measures in relation to its activities. These measures are described in Table 24-5.

Table 24-5 Mitigation and management measures for the project

Mitigation / management measure
The design of infrastructure and selection of plant, vehicles, equipment and fuels will be reviewed for energy efficiency.
Measurement systems will be incorporated into the design to comply with *National Greenhouse and Energy Reporting Act 2007* requirements.
Transport logistics will be planned to minimise energy use, and the most fuel-efficient vehicles and equipment will be used where economically viable.
Energy use will be considered when procuring plant, vehicles and equipment.
Plant, vehicles and equipment will be maintained in good operating condition to maintain fuel use efficiency.
Energy efficiency opportunities will be monitored and periodically reviewed.
Greenhouse gas emissions will be reported and independently assured on an annual basis in accordance with the *National Greenhouse and Energy Reporting Act 2007*.
A leak detection and repair program approved by the NSW Environment Protection Authority will be implemented to identify and minimise fugitive emissions.

24.5 Conclusion

Natural gas can underpin the transition to a low carbon economy.

Low-carbon energy sources such as natural gas can help to meet growing global energy demand while reducing relative global greenhouse gas emissions. For example, lifecycle emissions for energy produced from the combustion of the natural gas delivered by the project will be nearly 50 per cent less than for electricity that is currently supplied to the NSW grid (refer to Figure 24-1).

Annual direct greenhouse gas emissions for the project in a typical operating year would be about 0.96 Mt CO_2-e with the on-site power generation facility, or 0.53 Mt CO_2-e with electricity sourced from the national grid. This is the equivalent of less than 0.2 per cent of current annual emissions in Australia and less than 0.002 per cent of current global emissions.

Given the environmental benefits of low-carbon energy sources, the project is consistent with the principles of ecologically sustainable development.

The proponent has a strong track record of working cooperatively with government, industry and the community to address greenhouse gas emissions with specific focus on addressing energy efficiency, the transition to low emission technologies and reporting transparency. The proponent is committed to implementing reasonable and practicable measures to reduce, monitor and disclose its greenhouse gas emissions throughout the life of the project.

As such, the residual environmental risk presented by the project with regard to greenhouse gas emissions is low.